THE COCONUT RHINOCEROS BEETLE IN SOLOMON ISLANDS

A Rapid Damage Assessment of Coconut Palms on Guadalcanal

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[1]Pacific Community, Land Resources Division and [2] Solomon Islands Ministry of Agriculture and Livestock

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EXECUTIVE SUMMARY

The coconut rhinoceros beetle Guam biotype (CRB-G) is not only an internal pest problem for the Solomon Islands, but a concern for the entire Pacific region. The magnitude of the problem on coconut palms in Honiara and the surrounding villages is alarming. If control methods are not applied soon, most if not all of the palms will die from CRB-G. The beetle is posing an impending quarantine threat within Solomon Islands and beyond. Rapid assessment is necessary to ensure countries can make informed decisions on how to deal with invasion. This report gives an updated assessment of damage on palms by CRB-G after the beetle was first detected in Honiara in January 2015.

INTRODUCTION

Similar to its neighbouring countries in the Pacific, Solomon Islands boasts a diversity of palm species, which include both native and exotic species (Dowe, 1989). Invariably, palms are important to many Pacific Island nations in terms of food and drink security, domestic and foreign earnings, and their cultural and ornamental value, which also support tourism industries (Johnson, 1994).

The coconut rhinoceros beetle (CRB) – *Oryctes rhinoceros* – is a major pest of palms, especially coconut palms. Palms are damaged when adult beetles bore into the crowns of palms to feed on sap. A classical visible damage symptom is the 'V' or diamond notch shape on the leaf fronds of the palm. The symptoms usually become visible four months after the palm has been attacked. Early detection of visual damage symptoms is a means of determining new invasion and occurrence of the coconut rhinoceros beetle. Tree mortality occurs when beetles destroy the growing tip (meristem) (Marshall et al. 2016).

Immature beetles (grubs) do no damage to palms; however they're able to proliferate by feeding on dead, decaying vegetation in breeding sites. Preferred breeding sites include dead, standing coconut stems, and piles of decaying vegetation, such as those left behind by tropical cyclones or after the replanting of oil palm plantations.

The CRB is native to tropical and subtropical Southeast Asia but made its way into the Pacific region in 1909. From its first introduction into Samoa, it spread to American Samoa in 1912, Tonga in 1921, Wallis and Futuna in 1931, Fiji in 1953, and to Tokelau (year unknown). Another introduction into the Pacific region occurred in 1942 when it landed in New Britain and then later (1952) spread to New Ireland and Manus Island in Papua New Guinea (PNG). Another introduction was recorded in Palau in 1942 (Gressitt, 1953). Recent determinations of DNA samples of CRB for most of the islands mentioned above possessed an identical *O. rhinoceros* haplotype (biotype), known as CRB Pacific biotype (CRB-P) (Marshall et al. 2016).

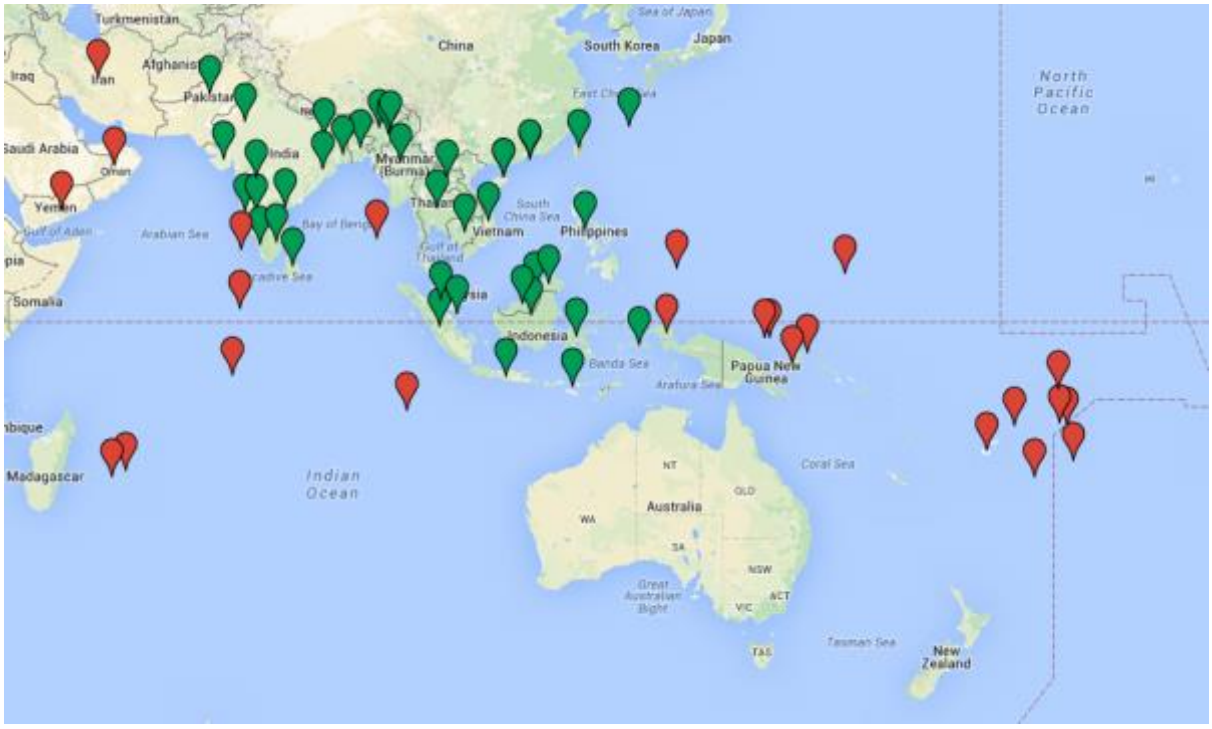


Figure 1. Map showing the native and escape range of the coconut rhinoceros beetle. The green coordinates are the native range while the red coordinates are the escape range. (Source: Sean Marshall, AgResearch, New Zealand)

The devastation that CRB-P caused to palms – especially coconut – when it invaded the islands was quite catastrophic, resulting in the widespread death of infested palms in cases where no control interventions were applied. Some of the control methods used to suppress field populations at outbreak locations included field sanitation, collection and destruction of all development stages of CRB, and use of biological control agents – mainly viruses and fungi.

Figure 2. Dead palms in Fiji before Oryctes Nudivirus (OrNV) was introduced.
(Source: Bedford. G.O., 2013 Annu Rev Entomol 58: 353–72)

The discovery of the virus, *Oryctes* Nudivirus (OrNV) in Malaysia in 1963 by Dr Huger and its subsequent release to all of the countries affected by CRB-P was a major breakthrough in the control of the pest in the region (Huger, 2005). The severity of damage on palms was reduced following the release of OrNV in many plantations, even without the application of other control interventions.

Figure 3. Image showing healthy palms free of CRB in Samoa in 2013. OrNV and effective plantation sanitation helped contribute to the eradication. (Source: Trevor Jackson, Principal Scientist, AgResearch, Lincoln, Christchurch, New Zealand)

The emergence of a new haplotype (biotype) of coconut rhinoceros beetle in the Pacific, known as the Guam biotype (CRB-G), was first detected through damage symptoms and later confirmed with beetle identification in Guam in 2007. The same biotype was later detected on the PNG mainland in 2009, in Hawaii in 2013, and in Solomon Islands in 2015. It is also present in Palau (CRB-P), but was not detected until DNA samples of the beetle were analysed in 2014 (Marshall et al. 2016).

The CRB-G is tolerant to the OrVN, the virus that is keeping CRB-P under control. Because CRB-G is tolerant to OrNV, it is healthy and strong and able to bore deep into the core of the growing shoot or meristem of the plant to cause tantamount damage, which is currently resulting in the death of palms in Guam, PNG and Solomon Islands.

The first confirmed detection of CRB-G in Solomon Islands occurred in January 2015 when adult beetles and larvae were collected by a resident of Panatina, a suburb of Honiara; however, a visiting Suva-based Plant Health and Biosecurity team from SPC had identified symptoms in December 2014. Usually the first sighting of CRB palm damage symptoms suggests a beetle invasion occurred approximately four months prior. The invasion of CRB-G in Honiara was estimated to have occurred more than a year before it was detected. As it was first detected in the vicinity of where the Festival of Pacific Arts was held in Honiara in 2013, it is possible that it was inadvertently introduced from the already infested countries (Guam, Palau or PNG) during the event.

When CRB-G adult specimens were first suspected, entomologists from Biosecurity Solomon Islands (BSI) morphologically identified them as CRB, and second opinions from entomologists abroad were sought to confirm the beetle's identity. Based on photographic images of the adult beetle, an entomologist from SPC reconfirmed it as CRB. The presence of strains and two haplotypes already detected in other Pacific Island countries and

territories made it important to determine the haplotype identity of the beetle. Under the SPC and AgResearch partnership on biological control activities in the Pacific for selected countries, the beetle was then sent to the AgResearch laboratory in Lincoln, Christchurch, New Zealand for DNA identification and was confirmed as CRB-G.

METHODS AND MATERIALS

The survey team that carried out the CRB-G coconut palm rapid damage assessment (RDA) on Guadalcanal consisted of personnel from BSI and Land Use and Planning, departments within the Solomon Islands Ministry of Agriculture and Livestock, and SPC's Land Resource Division. The RDA was used to determine the severity and spread of CRB-G on Guadalcanal over the two and a half year period from its first detection. This type of assessment is required to quickly determine the status of the pest in order to make informed decisions on response. The survey requires fewer people and was completed within two days. This particular survey was made possible by following a map of where coconut palms were present within and outside Honiara city boundaries. It was very helpful to have the BSI officers with the survey team as they were familiar with the site locations of CRB-G occurrences on Guadalcanal. The assistance rendered by MAL's GIS Officer was also invaluable in determining the coordinate locations of where the survey had been undertaken.

The RDA on palms involved driving around photographing coconut palm crowns. The images provided a good representation of the average level of palm damage in Guadalcanal, and were then analysed to determine damage category levels. The descriptions of the different locations that were surveyed were noted.

Five criteria were used to determine the level of palm damage in the assessments. Each pixel taken during the survey was assessed and assigned a grade according to the damage levels described here. These levels included: (1) no damage; (2) slight damage (with 1–10 percent of palm leaves removed); (3) moderate damage (between 10–50 percent of palm leaves removed; (4) severe damage (50–95 percent of palm leaves removed); and (5) unrecoverable and dead palms (95–100 of palm leaves removed). Refer to the pictures in Figure 4 for examples of damage categories.

Pictorial demonstration of damage scales:

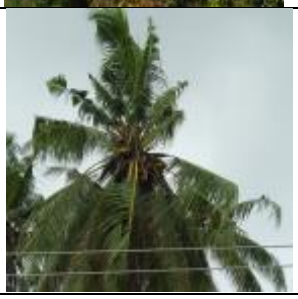
No damage	
Slight damage 1–10% damage	 
Moderate damage 11–50% damage	 
Severe damage 50–95% damage	 
Non-recoverable/dead palms 95–100 damage	 

Figure 4. Pictures of damage categories

RESULTS

The presence of CRB-G as determined by pheromone monitoring traps and palm damage symptoms indicated that the beetle covered about 100 km of the northern coast of Guadalcanal from Lambi Station on the west, and Mbarande on the east. The beetle dispersed, diverging from Honiara towards both the west and east coasts at a distance of 50 km within two and a half years; therefore it had spread at a rate of 1.6 km per month.

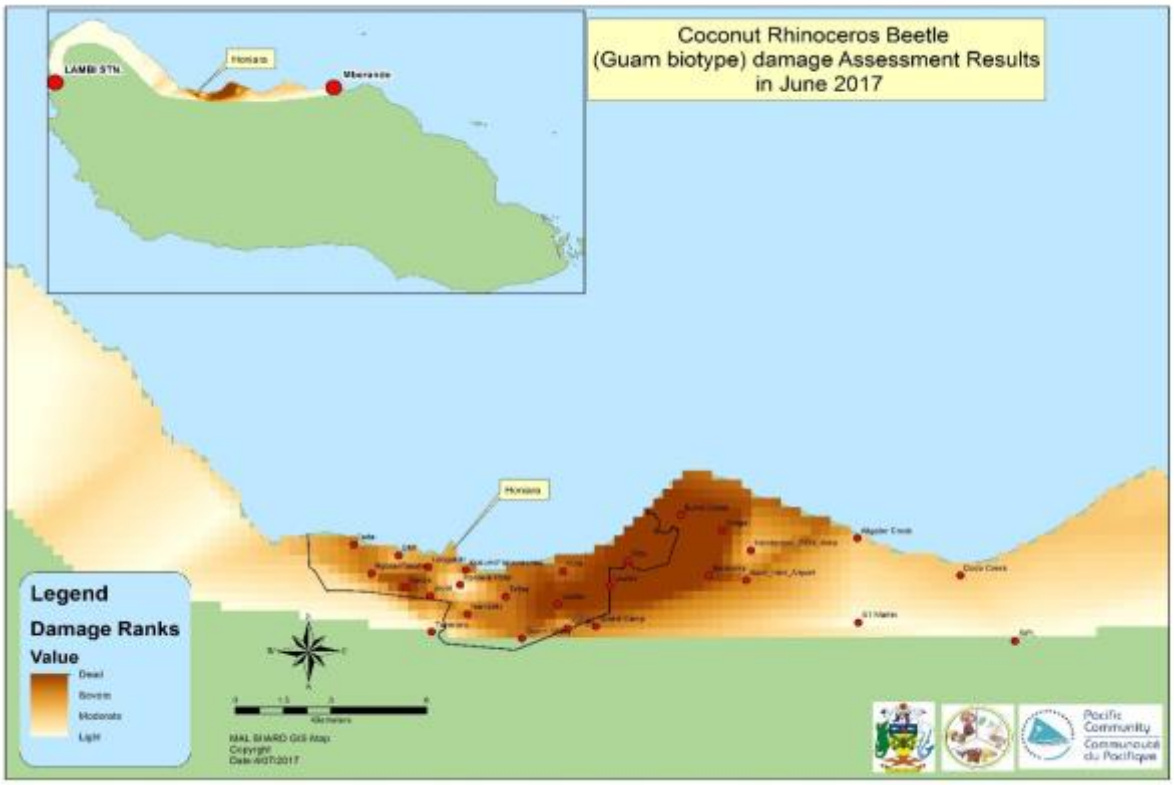


Figure 5. CRB-G damage symptom assessment map on Guadalcanal as of June 2017. Red dots on the map indicate the sites assessed. (Source: SPC and MAL Survey team)

A total of 585 palms were assessed during the RDA survey – a large number for a two-day period. The number of palms assessed in a given location depended on the number of palms that existed there. Most surveyed areas were urban residential and industrial areas, thus not many coconuts were grown there. In some areas, coconut palms had already been cut down due to CRB-G damage. Residents had to cut them down due to the hazard the dead trunks posed to the general public. Therefore a good number of dead coconut palms had already been cut down by the residents and could not be accounted for during the survey.

Coconut palm damage at the villages outside of Honiara was generally moderate to light.

Figure 6. Dead palms, Honiara, Solomon Islands, June 2017 (photo taken during the time of the survey)

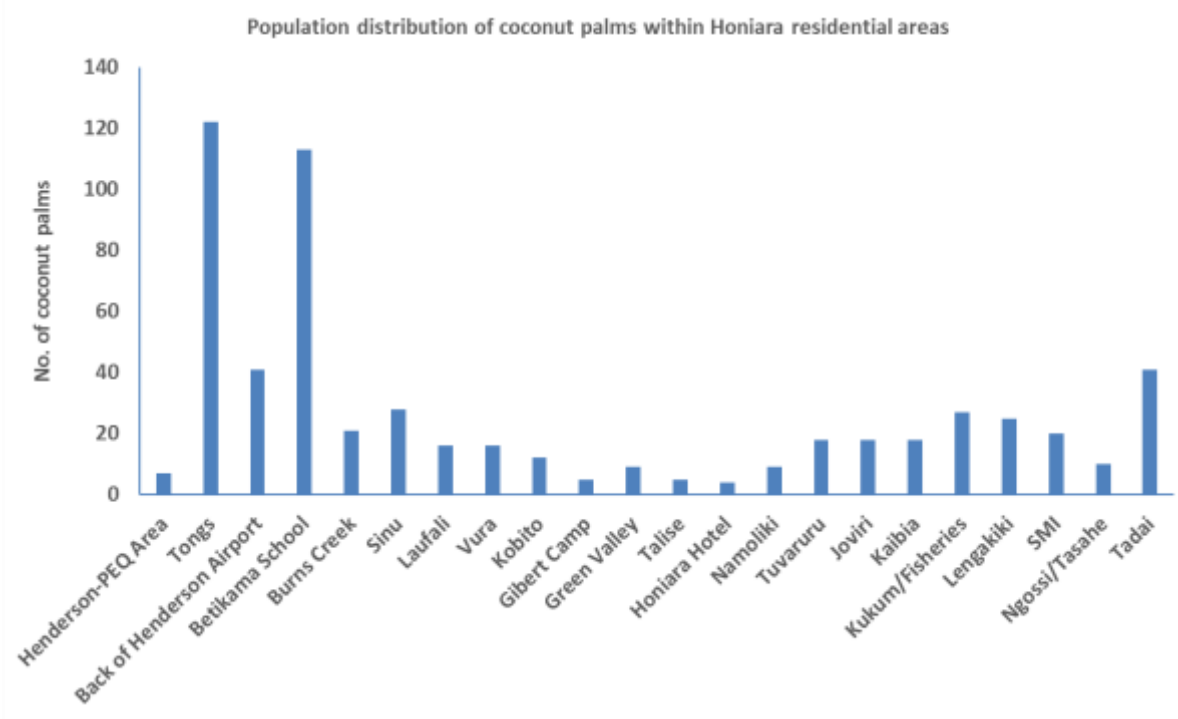


Figure 7. The number of coconut palms assessed in Honiara

The pie chart below indicates that all of the coconut palms in Honiara's residential areas showed some level of damage from CRB-G. 70 per cent of the palms were severely damaged or dead. Of these, 32 per cent were dead or non-recoverable, and 38 per cent may be recoverable if control is applied.

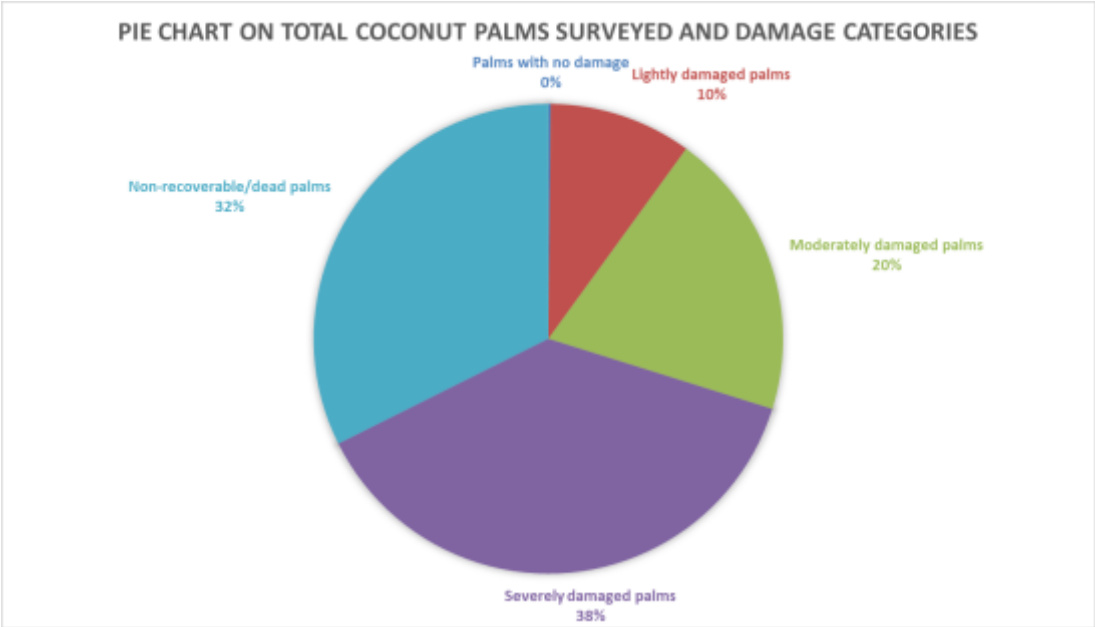


Figure 8. Damage status of coconut palms

The graph below shows different damage levels of palms at the different locations in Honiara. The number of coconut palms in areas such as Tongs, 'Back of Henderson Airport', and Betikama School are high because they are remnants of plantations, such as Levers Pacific Plantations and school plantations. Burns Creek was also part of the Levers Plantations, but most of the coconuts were already cut down to allow space for resident settlement and also to minimise risk as palms have been killed by CRB-G and might fall on residents.

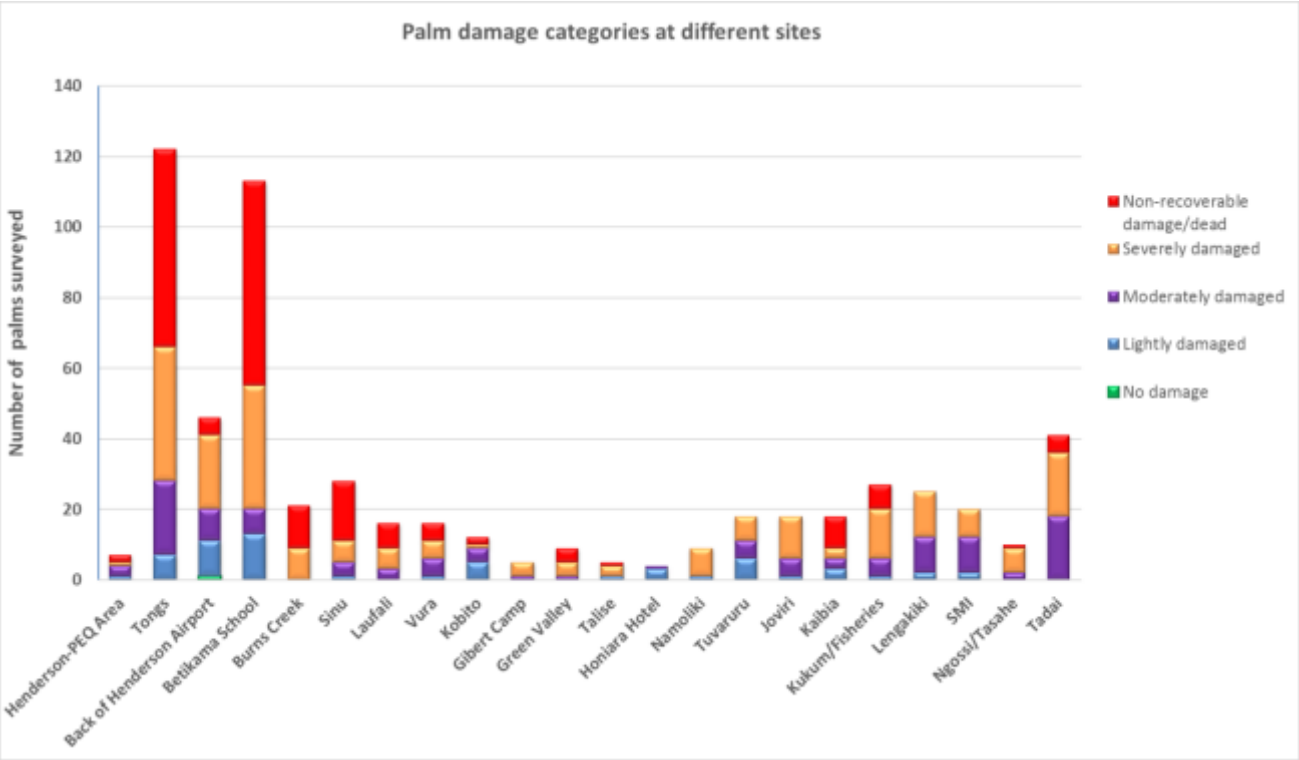


Figure 9. Coconut palm damage categories at different sites in Honiara

DISCUSSION

All of the coconut palms in Honiara, including the ornamental palms, were damaged. The gravity of damage that this beetle has been causing to palms as it progressively moves across the island of Guadalcanal is quite alarming. Palms have been dying within two years of CRB-G invasion. As it is, eradication is no longer an option on the island of Guadalcanal. As coconut palms are grown around the island, it will just be a matter of time before CRB-G will cover the whole island. At a rate of 50 km coverage over two and a half years, if no effective control is applied soon the beetle will achieve complete coverage within five years.

The male aggregate behaviour of CRB-G and its healthy status have attributed to the severity of the infestation in Honiara's residential areas. As opposed to its sister biotype – CRB – in Fiji and Samoa, and CRB-P, which does not kill palms, the CRB-G on Guadalcanal is the same biotype that continues to kill palms in Guam. The fact that CRB-G adult beetles are resistant to OrNV and therefore healthy and strong, has made this beetle capable of burrowing into the meristem of the palms. This along with the tendency of male beetles to aggregate has led to severe damage.

Seventy per cent of the coconut palms surveyed in Honiara's residential areas were badly damaged, non-recoverable, and already dying because of CRB-G. It seemed that all of the palms within the Honiara city boundary had been damaged to some degree. With this rate of damage and without effective interventions, most palms would be dead within a year from the time of the survey, posing a serious threat to coconut and oil palm industries in Solomon Islands.

The magnitude and rate of progression of the damage within a period of only two years is unprecedented and worrying. It is imperative that the general public become aware and involved.

RECOMMENDATIONS

One approach to monitor and contain the spread of CRB-G would be the development of an Emergency Response Plan (ERP). Public awareness is another necessary step to curb further spread of the pest. For example, the general public should be made aware that the coconut rhinoceros beetle feeds on compost and palm plant materials, thus compliance to proper quarantine measures are required when taking such materials from infested locations to non-infected ones. Allocation and mobilisation of funding to strengthen awareness and outreach, monitoring and surveillance, and border control are other critical measures that should be put in place. Coordination of capacity building to strengthen technical responses to CRB-G at the community level is also important.

Updates of the damage and distribution status of CRB-G in Solomon Islands, especially in Guadalcanal and Malaita provinces, should be provided regularly.

CRB-G is both a national and global concern that should be recognised and given highest priority in terms of biosecurity/quarantine and control. There is a need to establish stakeholder partnerships and work out a plan of response and action. Research and exploration of potential biological controls to address rapid spread of CRB-G is important and requires appropriate financial and human resources.

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APPENDICES:

1. **Names of sites visited and assessed**
    a. Henderson Airport, Quarantine Office area
    b. Tongs area (near Henderson Airport)
    c. Back of Henderson Airport (Northern side of the runway)
    d. Betikama Adventist High School
    e. Burns Creek Settlement
    f. Solomon Islands National University (Panatina Campus)
    g. Lau Valley
    h. Vura
    i. Kobito
    j. Gilbert Camp
    k. Green Valley
    l. Talise
    m. Honiara Hotel
    n. Namoliki
    o. Tuvaruhu
    p. Joviri
    q. Kaibia
    r. Lengakiki
    s. SMI Compound
    t. Ngossi/Tasahe
    u. Tandai

2. Some photos of damaged palms taken during the survey in Honiara