Weevils (Coleoptera: Curculionoidea) of the Cook Islands

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3 July 2018

Contents

1 Executive Summary

Weevils (Coleoptera: Curculionoidea) are a large group of exclusively plant-feeding beetles that include a number of economically and environmentally important species. The weevils of the Cook Islands have never received concerted study, despite the economic and scientific benefits such a study would confer. To remedy this, I travelled to the Cook Islands between 14 March and 9 May 2017 for the purpose of collecting weevils and other arthropods to facilitate further research on the invertebrate fauna of the Islands. During this eight week period I travelled to four different islands, spending a week each on Mitiaro, Atiu and Mangaia, and a total of five weeks on Rarotonga. Initial study of the resulting collections reveal a total of 75 weevil species collected during this expedition, including 25 that had not been collected before from the Cook Islands. About 28 putatively undescribed species were discovered, which will be the subject of further research. Additionally, specimens of many other orders were collected and deposited in the New Zealand Arthropod Collection (NZAC) as a resource for other researchers.

2 Acknowledgements

First and foremost, I am indebted to my wife and son, Dalin and William, whose forbearence of my five week absence is greatly appreciated.

In the Cook Islands, Gerald McCormack (Natural Heritage Trust, Cook Islands) provided advice and encouragement throughout all parts of this project. His knowledge of the people, places, fauna and flora of the Cook Islands is immense, and the generosity with which he shared it helped substantially.

The following people also went out of their way to ensure my time in the Cook Islands was pleasant and productive. Their hospitality and generosity is greatly appreciated. On Mitiaro: Tati Tutaka and Inangaro Taia (Kovea Homestay), Nooroa Pouao, the Mayor, Tuakeu Tangatapoto (Executive Officer), Papa Neke Tutini, Paul Teariki Maoate, Nama Benson (Infrastructure Cook Islands), Teariki Rongo On Atiu: Ina Mokoroa (Mayor), Maara Tairi (Executive Officer), Marshall Humphreys (Atiu Homestay and Tours), George Mateariki On Mangaia: Teremoana Atariki (Mayor), Anthony Whyte (Executive Officer), Babe Pokino, Moetu Ruatoe, Ura Herrmann (Babe's Place), Nuku Koroa, Ātē, and Tama (Ministry of Agriculture), my teammates in the Ministry of Internal Affairs volleyball team for the 2017 Easter Volleyball Championship. On Rarotonga: Adrienne Matapuku (Tiare Village), Steele Koronui (Ride Rarotonga), Eddie Chambers (Heritage Holdings Ltd), Charlene Hoff (Office of the Prime Minister), Christopher Story (Ministry of Education), Maja Poeschko (Ministry of Agriculture).

The following curators are gratefully acknowledged for their assistance in providing access to their collections and lending specimens of interest: John Early (Auckland Museum), Rich Leschen and Grace Hall (New Zealand Arthropod Collection) and James Boone and Neil Evenhuis (Bishop Museum, Honolulu, Hawaii). Ines Schoenberger and Mary Korver (Allan Herbarium, Manaaki Whenua Landcare Research, Lincoln) facilitated plant specimen collections and identification. The Bio-Protection Research Centre (Lincoln University) and Mount Albert Research Centre (Plant and Food Research) have provided working space and equipment for sorting and imaging specimens.

Fieldwork in the Cook Islands was carried out under research permit 10/17, dated 21 April 2017, issued by Bredina Drollet through the Office of the Prime Minister.

Finally, I am very grateful for the financial and moral support of the Winston Churchill Memorial Foundation, who considered this project worthy of a Fellowship. Their vote of confidence in offering me this Fellowship was a great encouragement during a tough period of life.

3 Introduction

The Cook Islands are a group of 15 islands, spread between 9°S and 22°S, and 156°W and 167°W. Geographically, the islands are divided into two groups—the Northern Cook Islands, consisting of the atolls Penrhyn, Rakahanga, Manihiki, Pukapuka, Nassau and Suwarrow. The Southern group consist of Palmerston Atoll, and the islands Aitutaki, Manuae, Takutea, Mitiaro, 'Atiu, Ma'uke, Rarotonga and Mangaia. Politically, the islands are independant, but remain closely associated with New Zealand, and share the New Zealand currency, defense agreements, and labour mobility.

Unfortunately, New Zealand's interest in the Cook Islands was largely focused on economic benefits to New Zealand and supplying the basic needs for the wellbeing of the people of the islands. The natural environment of the Islands has been relatively poorly studied, with the result that insect fauna of the Cook Islands is essentially unknown (Gressitt, 1961; Wise, 1971; Miller, 1996). What has been published tends to be restricted to economically and medically important species (Young, 2007; Craig & Craig, 1986). There is a high proportion of introduced invertebrates. For example, all 20 species of ant recorded by Taylor (1967) were considered to be adventive and a survey of the terrestrial molluscs of Mitiaro inferred that 37 species of landsnail were anthropogenic to the island (Brook *et al.*, 2010). To date, however, there has been little research into the indigenous fauna, and what has been done largely consists of scattered species descriptions with no attempt to provide a comprehensive analysis of the fauna of the islands. The Cook Islands Biodiversity Database (CIBD, http://cookislands.bishopmuseum.org) now provides a central portal that collates much of what is known of the Cook Island biota, with a particularly strong focus on plants and vertebrates, but also includes many invertebrates. The paucity of published information on their insect fauna leaves the people of the Cook Islands in a situation where there is little knowledge available regarding the insect species present, especially those endemic to the Cooks. This lack of information can lead to incorrect decisions being made, especially in contexts such as land development, climate change mitigation, or biosecurity threats.

In contrast, the flora of the Cook Islands is well understood, with a recent book published on the plants of the Islands, (Sykes, 2016) and several descriptions of the vegetation of several of the Southern Group islands (Merlin, 1985, 1991; Mueller-Dombois & Fosberg, 1998).

The weevils (Coleoptera: Curculionoidea) are a large group of plant-feeding beetles, many of which tend to be highly host-specific. This host specificity makes several species economically important as pests of crops such as kumara (*Ipomoea batatas*), vī(*Mangifera indica*, nū (*Cocs nucifera*) and meika (*Musa acuminata*). Many other species have very limited distributions, making them vulnerable to environmental disturbance. Prior to this expedition, 34 species of weevil were recorded in CIBD and only two

weevil species had been described from the islands (*Rhyncogonus lineatus* Van Dyke 1937 and *Ptilopodius aitutakii* Beaver & Maddison 1990). Beaver & Maddison (1990) provide the only taxonomic work yet published that focuses on weevils (Scolytinae) of the Cook Islands specifically.

This research began in mid 2016 as an effort to redress the lack of information on the weevils of the Cook Islands. It was also motivated by my long-standing interest in the people and biota of the Pacific, and promised to be a clearly-defined project that would provide substantial insight into the weevil fauna more generally, while remaining tractable and acheivable within a reasonable timeframe. Specimens of weevils from the Cook Islands were obtained on loan from the Auckland War Memorial Museum (AMNZ) and the New Zealand Arthropod Collection (NZAC, administered by Manaaki Whenua Landcare Research, Tamaki, Auckland). I also scoured the literature collating what little had been previously published on the weevils from the group. The results from this preliminary research indicated that around 50 species of weevil were known from the Cook Islands.

Upon receiving a fellowship from the Winston Churchill Memorial Foundation I organised a two month collecting expedition to the Cook Islands from 15 March to 10 May 2017. During this time I spent a week on each of Mitiaro, Atiu and Mangaia, and a total of five weeks on Rarotonga. This expedition was a valuable opportunity to make extensive collections of Cook Islands weevils, including gathering information on their potential host plants. It was a wonderful experience, exploring a part of the Pacific that was previously unknown to me, and learning about a people and place with strong connections to New Zealand, yet whose contribution has often been neglected.

4 Methods

The main method of collecting employed in the Cook Islands was through beating vegetation. This involved constructing a tray (frequently identified by others as a "kite") out of an old sheet stretched across two locally-sourced sticks. Upon learning that the wood of *toa* (*Casuarina equisetifolia*) had been used by Cook Islanders to make weapons prior to the 1800s, I began preferentially using *toa* sticks to make the tray. Once made, the tray was held under vegetation that was then beaten with a stout stick, and the resulting debris on the tray was searched for insects.

The beating tray was also very useful for breaking twigs and dead wood over as I searched for specimens of bark beetles and cossonine weevils.

Another important collection method was leaf litter sifting and extracting. A sifter made of a large-guage mesh inserted in a heavy-duty bag was used to reduced the bulk of leaf litter in the field. This was transported back to my residence, where the siftate was placed in a Winkler bag, formed of

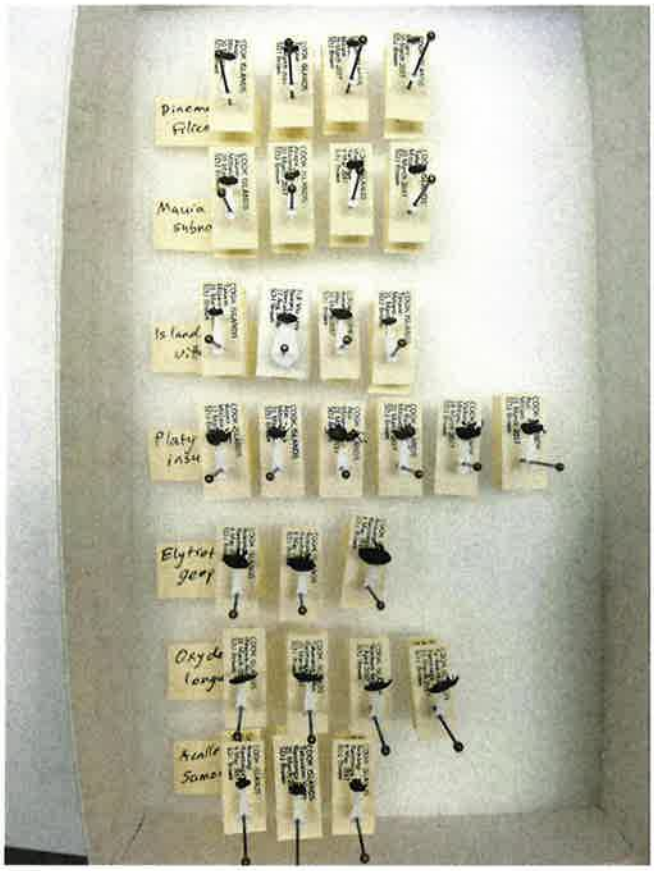

Figure 1: Pinned specimens of weevils from the Cook Islands. These particular specimens have been deposited in the collection of the Bishop Museum, Honolulu, Hawaii.

a mesh baffle suspended in a light-weight protective outer bag, with a bag (Whirl-Pak®) filled with propylene glycol preservative hung underneath. As invertebrates move around in the enclosed sample, they fall out of the mesh bag into the preserving fluid below. The resulting sample is sorted later in the laboratory, where specimens of interest are removed and pinned for further study (Figure 1).

The third most important collecting method was the use of a mercury-vapour lamp to attract nocturnal insects (Figure 2). A 160 W self-ballasted mercury vapour bulb was used in a custom-made fitting, and hung against a white shower curtain. Insects attracted to the light rest on the curtain, from where they could be collected at leisure.

Three forms of insect traps were used during my time in the Cook Islands. Unfortunately, the results from these methods were generally disappointing and not all traps were deployed on all islands.

Lindgren traps consisted of a series of funnels strung up to form a tower,

Figure 2: Mercury Vapour lamp sheet in action on Atiu. Two large *Gnathothlibus eras* (Boisduval, 1832) hawk moths (Lepidoptera: Sphingidae) are being attracted to the lamp, which is just out of view at the top of the photo. Several other smaller insects are visible if you look closely.

Figure 3: Pitfall trap set up on Mitiaro. The cup is underneath the purple icecream container lid cover. Note that the lid is held up by the midribs of coconut leaves, demonstrating yet another use for coconut-derived materials. Coconut midribs were also used to repair my jandals when they broke.

with a pottle of propylene glycol affixed to the bottom funnel. This mimics a branch, and as insects attempt to alight upon the funnels, they fall into the preservative below. They are often used to monitor wood-boring insects.

Pitfall traps were made by sinking plastic cups into the ground, such that the rim of the cup is level with the ground. The trap is protected from rainfall by putting a cover (in this case made out of an ice-cream container lid) over the top of the trap (Figure 3). Propylene glycol is put into the cup to preserve the catch. Crawling insects fall into the cup as they move around.

Flight intercept traps were a modified design of Warner (2017), made by suspending a length of 1 m wide polyethylene film between two parallel ropes stretched between two trees (Figure 4). A stick was placed in the catenary of the film to make it taut, and a series of dishes filled with a mixture of seawater and dishwashing liquid placed underneath. This trap takes advantage of the behaviour of flying beetles to drop when they encounter an obstacle.

All specimens were collected into propylene glycol, a non-toxic, non-flammable liquid preservative. This had the dual benefits of ensuring easy passage through MPI biosecurity inspections, and also adequately preserved

Figure 4: Flight intercept trap set up on Mitiaro. Unfortunately, this trap was disturbed by wandering pigs, as I should've realised due to the grubbing seen in this photo.

DNA for any potential future molecular analyses. Upon my return to New Zealand, specimens were removed from propylene glycol and either dried and pinned, or stored in ethanol.

5 Results

5.1 Overall

This collecting expedition was extremely successful, with 75 species of weevil collected over the eight weeks spent in the Cook Islands. This represents 81% of the total known weevil fauna of the Cook Islands. A list of the weevil species found on this expedition is given on page 24. Weevils in the subfamily Cossoninae were particularly common, and formed a large portion of the new discoveries. These weevils tend to be small, concealed in wood (Figure 5), and often go unnoticed by those who are not searching for them specifically. The group as a whole is difficult to identify, with little recent research focusing on the group.

Unique weevils were found on each of the four islands visited. Although further collecting may reveal these species to be more widespread, similar collecting efforts were expended on most islands, with the result that these

Figure 5: *Pacindonus halodorum* (Perkins) from Mangaia, *in situ* under the bark of a small twig. Cossonine weevils like this one made up the majority of new discoveries, as they are small and rarely targeted by collectors.

observations accurately represent their abundance on the islands. These unique species highlight the isolation and unique environmental settings of each of the islands visitied. It also emphasises the need for the communities inhabiting each island to develop a strong conservation ethic that values areas of indigenous vegetation, in order to maintain the distinct biological communities that inhabit them.

5.2 Important finds

On Mangaia, *Viticis* was found to be abundant on the leaves of *avoa* (*Ficus prolixa*). Members of this genus have many features that make them of great interest, and this increased understanding of their biology may provide important insight into the evolution of weevils more generally.

Several species were found which had been previously known from only a handful of specimens. These include new species of *Cranopoeus* from Rarotonga (Figure 6) and Atiu and a species of *Dynatopechus* found in association with *Mucuna* seedpods. Having more specimens allows the variation within each species to be appreciated and taken into account when deciding what populations may comprise different species. Greater numbers also allow

Figure 6: My delight in finding an undescribed species of *Cranopoeus* on Raemaru, Rarotonga, off *Metrosideros collina*. It was a hot day, I was still acclimatising to the different climate, and I had just walked up a hill.

paratype specimens to be distributed to more institutions, which provide greater access for researchers wishing to verify specimen identifications and provides a degree of insurance in the event of a catastrophic loss of any one collection due to natural disaster or shortsighted beaureaucratic decisions.

5.3 New discoveries

A number of weevils were collected that had neither been previously reported from the Cook Islands in the published literature, nor had I seen specimens from NZAC or AMNZ. These included:

- *Valenfriesia cylindrica* on Mitiaro, Atiu and Mangaia
- *Jordanthribus planifacietus* on Mitiaro and Mangaia
- *Proterhinus* undescribed species on Mitiaro (Figure 7)
- *Microcryptorhynchus* undescribed species on Mitiaro
- *Islanderia vittata* on Mitiaro, Atiu, Mangaia and Rarotonga
- *Cranopoeus* undescribed species on Mangaia (Figure 8)

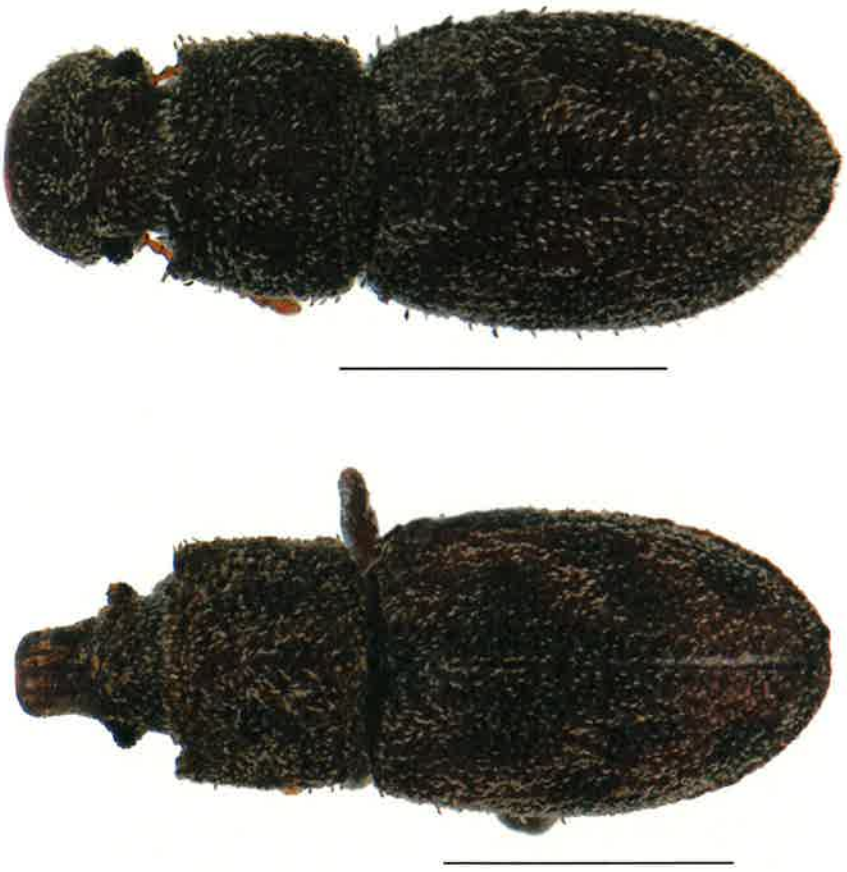

Figure 7: A newly discovered species of *Proterhinus* found on Mitiaro. The formal scientific description of this species is currently in preparation. There is pronounced sexual dimorphism in this species—the male is above, the female is below.

Figure 8: An undescribed species of *Cranopoeus* from Mangaia, photographed in the field. This species has never been collected prior to this expedition, to the best of my knowledge.

- *Viticis marquesanus* on Atiu
- Many species of cossonine weevils, including *Pacindonus halodorum* (Perkins) and *Oxydema fusiforme* (Wollaston) (Figure 5)

These taxa are known from other Cook Islands, or from French Polynesia, so their discovery was not completely unexpected. However, it was an incredible feeling being able to recognise, in the field, that I had just discovered a new weevil species, either for that particular island, or even more excitingly that had never been collected before.

That said, it is possible that some of these species had been collected previously and have been deposited in collections which I have not yet seen. Particularly important collections which I have not yet had access to include the personal collections of Al Samuelson (Honolulu, Hawaii) and Peter Maddison (Katikati, New Zealand).

5.4 Non-weevil invertebrates

Over the course of collecting, a number of non-weevil invertebrates were also collected. These specimens have been retained for deposition in NZAC, and include pinned specimens and specimens preserved in ethanol. The invertebrate groups represented include Crustacea (Talitridae [sandhoppers]

and Oniscoidea [slaters]), Myriapoda (Diplopoda [millipedes] and Chilopoda [centipedes]), Arachnida (Araneae [spiders], Acari [mites], Pseudoscorpiones [pseudoscorpions] and Schizomida [shorttailed whipscorpions]) and Mollusca.

Two species of Psylloidea (lerp insects) that were previously unrecorded from the Cook Islands were discovered and will be the subject of scientific paper that is currently in preparation (Martoni and Brown, in prep.). Specimens of the insect order Embioptera (webspinners), which had not been previously recorded from the Cook Islands, were also collected.

5.5 Traps

It was found that the traps deployed were not particularly useful for collecting weevils. In particular, the use of pitfall traps were discontinued after my time on Atiu, in favour of spending more time beating and sifting leaf litter.

Pitfall traps tended to require substantial amounts of time in deployment and collection and resulted in low numbers of invertebrates and very few weevils. My lack of success with flight intercept traps is in part due to unwise placement of the traps in areas where they were disturbed by livestock, and by using inappropriate catching dishes. The poor performance of the Lindgren traps can be ascribed to not using ethanol as the collecting fluid, which acts as an attractant for many bark beetles (Galko *et al.*, 2014).

In general, the insect collecting on Rarotonga was difficult and unproductive. Despite appearences to the contrary, a lot of the forest in the Rarotonga interior has been degraded to a greater or lesser extent by invasive weeds and deforestation. Accessing relatively intact forest requires substantial effort, due to the rugged terrain of the island. However, even in these areas, my experience was that weevils were generally uncommon, and a lot of effort had to be put in to get relatively few specimens.

For me, the clearest example of this was the rarity of *Microcryptorhynchus* on Rarotonga. This is a genus of minute weevils which is found across the Pacific. It is perhaps best known for providing one of the most stunning examples of an evolutionary radiation on islands, with over 77 species known from the tiny (40 km^2) island of Rapa in the Austral Archipelago (Zimmerman, 1938; Paulay, 1985). Many species of *Microcryptorhyncus* are also found in New Zealand and they can be easily collected, sometimes in large numbers, from dead twigs or vines in any sort of habitat, including urban areas (Kuschel, 1990, 1997). I was aware that a couple of species of *Microcryptorhynchus* had been collected on Rarotonga previously (Paulay, 1985) and so prior to my arrival I assumed that I would readily encounter these weevils soon after I got into any sort of indigenous vegetation. It was not to be, however, and I spent much time forlornly looking at my beating tray wondering if I was just not seeing them after I had beaten yet another promising-looking thicket. I did find them in the end—I collected four specimens from ferns (*Blechnum glabrescens*) at the very top of Te Manga, which

at 658 m is the highest point on the island. Even these four were not found together, and I found them over the course of two hours.

5.6 Ongoing research

Although several hundred specimens have already been sorted and pinned, there remain many more mixed samples that require sorting as time allows. Identification of already pinned specimens is progressing well, based on comparison with weevil specimens collected from other Pacific Islands held in NZAC and by consulting the available literature.

I have been fortunate to have had a short visit to the Bishop Museum (Honolulu, Hawaii) already, and I am hopeful that opportunities for further visits to the Bishop Museum and the Natural History Museum (London, UK) will present themselves in the near future. These visits will give me the chance to compare specimens against the holotype specimens of species described from the Pacific. These holotype specimens are the anchor of names, and my being able to see them will allow me the greatest possible confidence of ascertaining if the specimens represent species which have been previously described, or which remain unnamed.

Those species declared to be new to science will require description, which will involve dissecting specimens to inspect their internal morphology and illustrating features of particular interest. It is expected that multiple scientific papers will result from this work. The first, which is likely to be submitted in late 2018, will describe the species of *Proterhinus* from Mitiaro (Figure 7). The second is intended to provide descriptions of the *Cranopoeus* species which were found on Atiu, Mangaia and Rarotonga. Finally, I intend to produce an illustrated identification key, which will be designed to allow other scientists and interested amateurs to identify the weevils of the Cook Islands.

6 Conclusions

Although this research remains incomplete, the following conclusions can be drawn.

First, the weevil fauna of the Cook Islands is depauperate. When compared with islands in a similar geographic context, such as Tahiti and Rapa, there is has been substantially less speciation on Rarotonga and the other Cook Islands. This may be due to the recent age, small size and relatively homogenous climate and vegetation of the islands. This impression of a lower number of species present is heightened by the low abundance of many of the indigenous species. Many of these are known from very few specimens, despite the intensive collecting carried out as part of this expedition.

Second, the biogeographic relationship of the Cook Islands weevils are almost exlusively with those islands to the East, especially the Society Is-

lands. Many species are shared between the Cook and Society Islands, and those species endemic to the Cook Islands appear to be closest to those in the Societies. From these preliminary results, there are no taxa that appear to have reached the Cook Islands from Samoa or Niue, but have not made it to the Society Islands.

Third, the Cossoninae are the most speciose group of weevils in the Cook Islands. Oceanic islands are known to have faunas with an overrepresentation of cossonine weevils (Wollaston, 1873; Zimmerman, 1940). Unfortunately, however, the Cossoninae of the Pacific have been poorly researched to date, and this lack of previous work hinders some of the inferences presented above. An important outcome of this research will be to provide a solid foundation for future work on the cossonine weevils of the Pacific.

7 Reflections

My eight weeks in the Cook Islands, especially my time spent on Mitiaro and Mangaia, was a very influential experience. I greatly admired the adaptability, generosity and joy shown by the Cook Islanders, despite the many challenges which are encountered in living on small, remote islands.

The Cook Islanders are a remarkable people who have adapted admirably to substantial challenges since their introduction to Western culture and philosophies. I consider that they have taken, adapted and incoporated into their own culture those aspects of Western culture and practise which they consider attractive. They retain a strong connection to the past, bolstered through church activities. Indeed, through my attendence of church services I came to consider that some of the oldest expressions of Cook Island culture are retained as part of the rituals and praxis of the Cook Islands Christian Church.

In these thoughts I differ from many other observers, who consider that the arrival of Europeans led to the population of the Cook Islands becoming victimised and losing their culture through political oppression and religous imperialism. While I agree with them that many aspects of pre-European Cook Island culture have been lost in the past 200 years, I am less inclined to consider the Cook Islanders as being completely passive or at the mercy of external influence in the decline and loss of those cutural features. The mid 1800's must have been exciting times for the Cook Islanders, as their world was rapidly expanding with increased transportation and encountering different philosophies and ideologies. My reading of the history of that time suggests that the Cook Islanders enthusiastically took advantage of this brave new world, and made the most of the opportunities that were available to them. The tragic influence of disease and the resulting population decrease had a profound influence on the loss of many skills, art, traditions and knowledge.

It is easy to mistake the people of the Cook Islands, especially those on the outer islands, as being very insular and traditional in their outlook. To do so, however, is to make a grevious mistake. Most of the people that I met had spent extensive time overseas and had family in New Zealand, Australia, the United States, or scattered across all three. One of the implications of this, is that the lifestyles encountered in the islands are the result of choices made over alternatives. Those who return from overseas use the skills they have developed to further their communities and their own quality of living. Papa Neke, for example, is an excellent horticulturalist who spent several decades in New Zealand. He has lovingly created an amazing garden in the difficult terrain of Mitiaro. Among his achievements is the cultivation of the rare palm tree *iniao* (*Pritchardia mitiaroana*) (Figure 9), which is likely to be of importance in future conservation initiatives.

Polynesian hospitality and generosity is well-known, and to experience it is has been an immense privilege. Everywhere I went, I encountered people and communities who would freely share their time, food or possessions. To list all the examples would be impossible; however, some of the most memorable occasions include being given a massive massive *'ei* when departing Mitiaro (Figure 10), being part of the 'home team' at the visit of HSBC representatives to Mitiaro as they inspected a significant development project on the island, enjoying icecream and taro given to me at Mangaia night markets, joining in the Mangaia Easter volleyball tournament with the Ministry of Internal Affairs (Figure 11), being guided into the *makatea* of Mangaia and Mitiaro, and spontaneously being offered rides on Mitiaro and Rarotonga. It is my hope that the results of my research on the weevils of the Cook Islands will, in some small way at least, reciprocate the generosity shown to me during my time there.

One of the major challenges facing the outer islands is depopulation, especially of people aged between high school and retirement age. Many people leave to further their education, and to seek better economic opportunities overseas. Those who leave often retain strong links with their home islands, and with the advent of increased communications through cellphone coverage and internet access non-resident Mangaians can continue to be involved with the community through social media and the like. However these linkages can also cause issues, as non-residents often dislike seeing things change back "home", without being aware of the opportunites such changes offer those who remain on the island.

Linked with the depopulation issue are the low rates of private enterprise on the islands. The government is by far the greatest employer of people on the outer islands, with very few people taking advantage of local business opportunties. This was made clear to me during the Easter Volleyball tournament on Mangaia (Figure 11) where of the approximately 20 teams involved, the vast majority were made up of people employed by various government departments.

Figure 9: Papa Neke in front of c. 20 year old *iniao* palm tree (*Pritchardia mitiaroana*) that he raised from seed. These palms are found only on Mitiaro and a few islands in the Tuamotu Archipelago. As far as is known, Papa Neke is the only person to have grown them in cultivation.

In a number of the conversations I had with residents, they offered observations that the biota, including the insect fauna, had changed substantially in their lifetimes. Some ascribed the majority of change to the period in the 1970s, as large-scale changes in land use were implemented. Those spoken to were concerned about these changes, but there was a certain feeling of helplessness and an inability to do anything about it. Given the infrequency of collecting on many of these islands, it is difficult to quantify these anecdotal reports of changes.

At the time of this expedition to the Cook Islands, I was unemployed and in the immediate post-PhD holding pattern of applying for various jobs. While I was in the Cook Islands I learned that I had been turned down for two postdoctoral positions which I had considered strong possibilities, and in that particular period there were very few other possibilities on the horizon. In many ways, it was one of the bleakest times of that phase of life. Therefore, the purpose and focus of my Cook Islands collecting efforts was a great encouragement to me. When compounded by the generosity and care shown to me by the people of the Cook Islands, this has ensured that my time in the Cook Islands has gained a significance in addition to the scientific merit of the expedition.

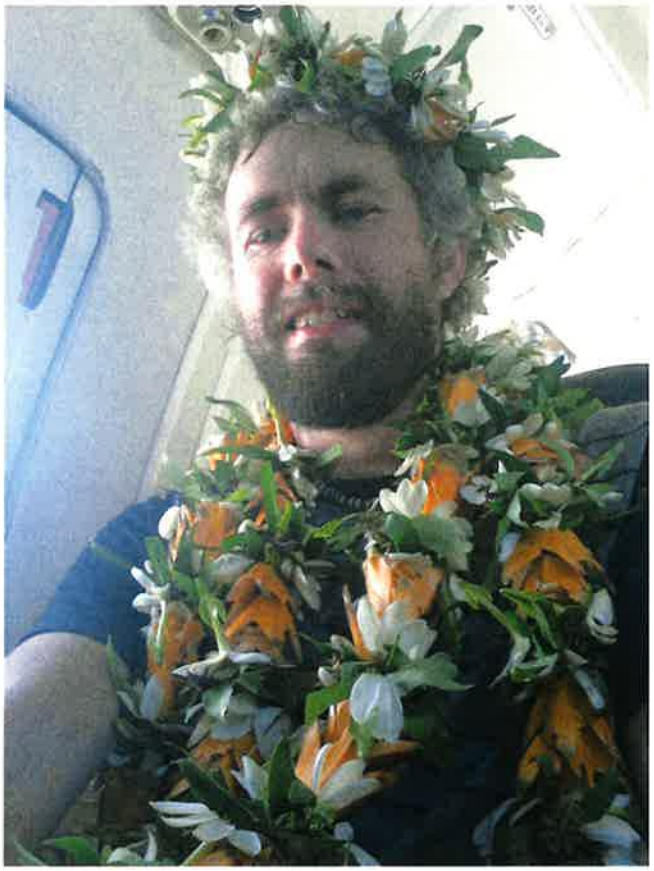

Figure 10: Me with a spectacular *'ei* given on my departure from Mitiaro.

Figure 11: The Ministry of Health (blue) against the Ministry of Education (Red) in the Mangaia Easter Volleyball Tournament. My teammates from the Ministry of Internal Affairs (green) look on.

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9 List of weevils collected

The following is a provisional list of the weevil species represented in collections made from Rarotonga, Mitiaro, Atiu and Mangaia between 14 March and 10 May 2017. Daggers indicate species which were collected in the Cook Islands for the first time as a result of this expedition.

Anthribidae

1. *Araecerodes* unidentified species†
2. *Araecerus levipennis* Jordan, 1924
3. *Araecerus lutatus* (Fairmaire, 1849)
4. *Cisanthribus* unidentified species 1†
5. *Cisanthribus* unidentified species 2†
6. *Cisanthribus* unidentified species 3†
7. *Cisanthribus* unidentified species 4†
8. *Cisanthribus* unidentified species 5†
9. *Dinema filicorne* Fairmaire, 1849
10. *Jordanthribus planifacietus* Zimmerman, 1938
11. *Mauia subnotata* Boheman, 1859
12. *Plesiobasis dorsalis* Kuschel, 1998†
13. *Stenorhis amplus* Jordan, 1928
14. *Valenfriesia cylindrica* (Jordan, 1933)†

Belidae

15. *Proterhinus* new species from Mitiaro†

Brentidae

16. *Cylas formicarius* (Fabricius, 1798)

Curculionidae

DRYOPHTHORINAE

17. *Cosmopolites sordidus* Germar, 1824
18. *Diocalandra taitensis* Guérin-Méneville, 1834
19. *Dryophthorus* unidentified species†
20. *Polytus mellerborgi* (Boheman, 1838)
21. *Rhabdoscelus obscurus* (Boisduval, 1835)
22. *Sitophilus* unidentified species

PLATYPODINAE

23. *Crossotarsus externedentatus* (Fairmaire, 1849)

MOLYTINAE

24. *Acicnemis variegata* Fairmaire, 1849
25. *Acicnemis* unidentified species
26. *?Aeschylus* unidentified species†

27. *Anchonus duryi* Blatchley, 1916
28. *"Acalles" samoanus* Marshall, 1931†
29. *Elytroteinus geophilus* Lucas, 1861
30. *Islanderia vittata* Zimmerman, 1936†
31. *Microcryptorhynchus* new species from Mitiaro†
32. *Microcryptorhynchus* new species from Rarotonga
33. *Orochlesis gibbera* Zimmerman, 1936†
34. *Tamphilus amplicollis* (Fairmaire, 1849)

BARIDINAE
35. *Athesapeuta cyperi* Marshall 1928

CURCULIONINAE
36. *Cranopoeus* new species from Atiu
37. *Cranopoeus* new species from Mangaia†
38. *Cranopoeus* new species from Rarotonga
39. *Viticis marquesanus* Zimmerman, 1963

COSSONINAE
40. *"Agastegnus"* unidentified species
41. *Aphanocorynes humeralis* Marshall, 1931
42. *"Choeororrhinoides"* unidentified species
43. *Cossonus* unidentified species†
44. *"Cylindrotyrpetes"* unidentified species†
45. Cossoninae unidentified species 1†
46. Cossoninae unidentified species 2†
47. *Dryotribus* unidentified species†
48. *Dynatopechus* unidentified species 1 from Mitiaro†
49. *Dynatopechus* unidentified species 2 from Rarotonga *Mucuna*
50. *Dynatopechus* unidentified species 3 from Rarotonga forest†
51. *Microtribus* undescribed species†
52. *Ochronanus pumilus* Marshall, 1931
53. *Oxydema fusiforme* Wollaston, 1873†
54. *Oxydema longula* (Boheman, 1859)
55. *Pacindonus halodorum* (Perkins, 1926)
56. *Pacindonus* unidentified species 2 'broad rostrum'†
57. *Phloeophagosoma* unidentified species
58. *Proeces* unidentified species†
59. *Stenotrupis ponesetosa* Marshall, 1937
60. *Rhyncolus samoanus* Marshall, 1921
61. *Rhyncolus* species 1

ENTIMINAE
62. *Platysimus insularis* (Boheman, 1843)

63. *Rhyncogonus lineatus* Van Dyke, 1937

Scolytinae
64. *Coccotrypes cyperi* (Beeson, 1929)
65. *Ficicis porcatus* (Chapuis, 1869)
66. *Hypocryphalus mangiferae* (Stebbing, 1914)
67. *Hypocryphalus mollis* †
68. *Hypothenemus birmanus* (Eichhoff, 1878)
69. *Hypothenemus crudiae* (Panzer, 1791)
70. *Hypothenemus eruditus* Westwood, 1836
71. *Ptilopodius marquesanus* Beeson, 1935
72. Scolytinae unidentified species
73. *Xyleborus bispinatus* Eichhoff, 1868
74. *Xyleborus perforans* (Wollaston, 1857)
75. *Xylosandrus compactus* (Blandford, 1894)

10 Travel and collecting details

Christchurch to Rarotonga

Departed Christchurch Wednesday 15 Mar 2017 0600 hrs, arrive Auckland 0720 hrs.
Depart Auckland Wednesday 15 Mar 2017 0850 hrs, arrive Rarotonga Tue 14 Mar 1335 hrs.

Rarotonga collecting, 14–17 March 2017

Tuesday 14 March 2017: Met Gerald McCormack.
Wednesday 15 March 2017: Cross island trail.
Thursday 16 March 2017: Raemaru trail.

Rarotonga to Mitiaro

Depart Rarotonga Friday 17 Mar 2017 1130 hrs, arrive Mitiaro 1210 hrs.

Mitiaro collecting, 17–24 March 2017

Mitiaro to Rarotonga

Depart Mitiaro Friday 24 March 2017 1230 hrs, arrive Rarotonga 1310 hrs

Figure 12: Map of Rarotonga, with localities and tracks where collections were made between 14 and 17 March .

Figure 13: Map of Mitiaro, with localities and tracks where collections were made between 17 and 24 March.

Figure 14: Map of Rarotonga, with localities and tracks where collections were made between 24 and 29 March.

Rarotonga collecting, 24–29 March 2017

Saturday 25 March 2017: Start of Te Kou trail.
Monday 27 March 2017: Met Maja Poeschko, cycled around island.
Tuesday 28 March 2017: Maungatea Bluff trail with Gerald, Jesse, Alana, Liam and Kelvin.

Rarotonga to Atiu

Depart Rarotonga Wednesday 29 Mar 2017 1630 hrs, arrive Atiu 1720 hrs

Atiu collecting, 29 March–5 April 2017

Atiu to Rarotonga

Depart Atiu Wednesday 5 April 2017 1205 hrs, arrive Rarotonga 1255 hrs

Rarotonga collecting, 5–6 April 2017

Thursday 6 April 2017: Tereora Hill trail

Figure 15: Map of Atiu, with localities and tracks where collections were made between 29 March and 5 April.

Figure 16: Map of Rarotonga, with localities and tracks where collections were made between 5 and 6 April.

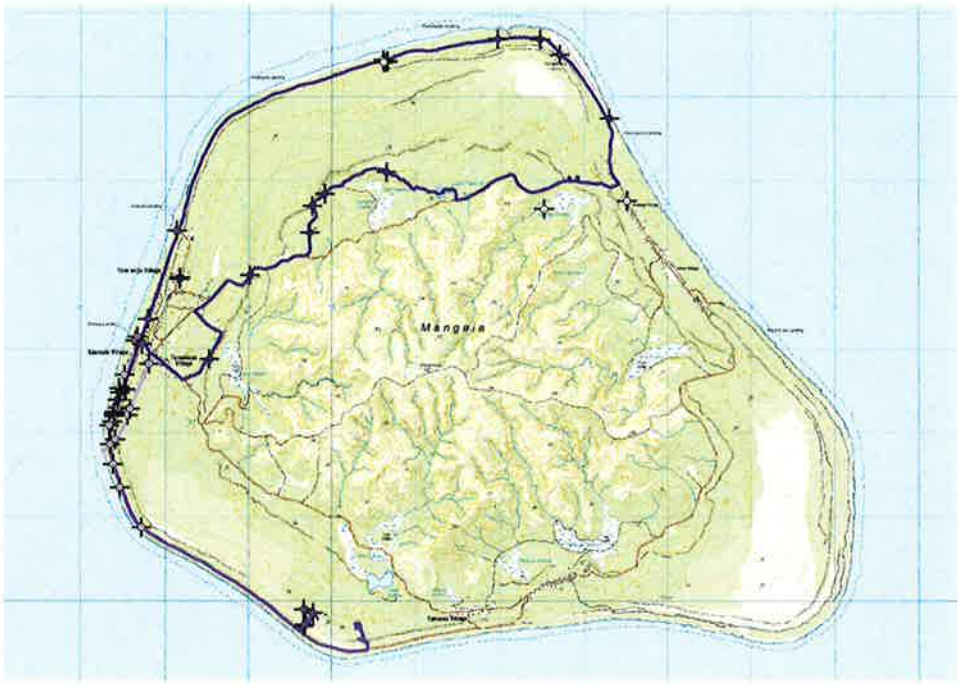

Figure 17: Map of Mangaia, with localities and tracks where collections were made between 7 and 14 April.

Rarotonga to Mangaia

Depart Rarotonga Friday 7 Apr 2017 0900 hrs, arrive Mangaia 0940 hrs

Mangaia collecting, 7–14 April 2017

Saturday 8 April 2017: Walk around southwestern coastal road.
Sunday 9 April 2017: Church, little collecting undertaken.
Monday 10 April 2017: Explore makatea on south western part of island.
Tuesday 11 April 2017: Walk around northern part of island.
Wednesday 12 April 2017: Rain, very little collecting undertaken.
Thursday 13 April 2017: TV interview, rain, volleyball competition.

Mangaia to Rarotonga

Depart Mangaia Friday 14 April 2017 1000 hrs Flight 673 Arrive Rarotonga 1040 hrs

Figure 18: Map of Rarotonga, with localities and tracks where collections were made between 15 April and 9 May .

Rarotonga collecting, 14 April–10 May 2017

Saturday 15 April 2017: Te Manga track
Monday 17 April 2017: Avana River road
Tuesday 18 April 2017: Dalin and William arrive
Friday 21 April 2017: Collections at Maungatea and Tupapa
Tuesday 25 April 2017: Te Manga track
Wednesday 26 April 2017: Avana River road
Thursday 27 April 2017: Te Kou track
Tuesday 2 May 2017: Tikioki collecting
Thursday 4 May 2017: Raemaru
Friday 5 May 2017: Papua Valley

Rarotonga to Christchurch

Depart Rarotonga Tue 9 May 2017 1555 hrs NZ0045 Arrive Auckland Wed 10 May 2017 1830 hrs

Depart Auckland Wed 10 May 2017 2000 hrs NZ0571 Arrive Christchurch 2125 hrs

Figure 19: On top of the island. A selfie taken near the summit of Te Manga, highest point on Rarotonga. Looking East down the Tupapa Valley, with the prominent peak peak Oroenga visible in the background.