New Zealand Partnerships for International Development Fund Activity: Building resilience to biosecurity threats from invasive ants throughout the Pacific

Environmental and Social Impact Assessment (ESIA) for Outputs 4 & 5 (management of yellow crazy ant incursions in Tokelau and Kiribati)

PACIFIC BIOSECURITY Cooperate. Control. Protect.

Building resilience to biosecurity threats from invasive insects throughout the Pacific.

Prepared by Monica Gruber PhD, Chief Scientist, Pacific Biosecurity, VicLink Ltd, Victoria University of Wellington, monica.gruber@vuw.ac.nz, PO Box 600, Wellington 6140, New Zealand

Key Terms and Acronyms

Usage of terminology for invasive species sometimes varies depending on context. The terms below are defined in the specific context of the Pacific, and where appropriate the terminology is identical to the SPC and SPREP Guidelines for Invasive Species Management in the Pacific.

Key terms

containment: Keeping an invasive species within a defined area.

control: Reducing the population of an invasive species.

EC_{50}: median effective concentration. This may be reported for sub-lethal or ambiguously lethal effects and is used in tests involving species such as aquatic invertebrates where death may be difficult to determine.

effective management: Achieving operational success (e.g. reducing the pest to defined levels) and desired outcomes (reduced impact and recovery of impacted values) of invasive species management.

environmental threat: invasive ants pose an environmental threat when they are present in sufficient numbers to have measureable and quantifiable ecological effects.

impact(s): A routinely used term in invasion ecology and management that refers to the negative effects of an invasive species on resident native organisms (biodiversity), agriculture, economy, health or lifestyle.

incursion: A single arrival event of an invasive species in a new environment. Typically an incursion is identified at the time of arrival (or first detection), and an incursion response plan developed.

incursion response plan: Effectively an emergency response plan to deal with a newly detected incursion of an invasive species. Incursion response plans include a number of steps including: 1) initial detection and response; 2) delimiting survey and; 3) draft management plan, including a surveillance plan, a plan for treatment and eradication (if possible), a communications strategy, specifications for movement controls, monitoring progress, a budget, and an organisational plan

half-life: the half-life is the time required for half of the compound to break down in the environment. Thus, 1 half-life = 50% remaining, 2 half-lives = 25% remaining, 3 half-lives = 12% remaining, 4 half-lives = 6% remaining, 5 half-lives = 3% remaining. Some chemicals metabolise or degrade into other chemicals of toxicological significance, and half-lives can vary widely depending on environmental factors.

infestation: a single discrete area where the invasive species is localised. An incursion consists of one or more infestations.

introduced species: Plants, animals and other organisms taken beyond their natural range by people, deliberately or unintentionally.

invasive ants / invasive ant species: An exotic or non-native ant species that become destructive to the environment or human interests in one or more ecological or environmental contexts. Not all invasive ants have major negative effects, and for many species the effects are density-dependent (i.e. effects only occur or are perceived by humans as negative when a threshold of abundance is reached). These are **outbreaking** species. **Threat ant species** are those invasive ant species known to have significant impacts in multiple ecological or environmental contexts and / or are prone to outbreaks. **Emerging threat ant species** are those that have recently been identified as having, or having potential to result in significant impacts. In the context of this Activity, this also refers to exotic or non-native ant species that may be considered a threat for the first time, for which there are no existing processes for biosecurity or management.

invasive species: Introduced species that become destructive to the environment or human interests; can also include some native species that proliferate and become destructive following environmental changes caused by human activities.

LC_{50}: Lethal concentration in a single exposure that causes death in 50% of animals tested.

LD_{50}: Lethal dose in a single exposure that causes death in 50% of animals tested.

LOEL: Lowest observed effect level. Relating to a pesticide, the lowest level at which effects are observed.

management: Reducing or eliminating the impacts of established invasive species, by eradication, containment, exclusion, or population reduction by physical, chemical or biological control. Note that although the title of the SPC and SPREP Guidelines for Invasive Species Management in the Pacific refers to management, in this latter context biosecurity is included as part of management.

monitoring: Programmes to detect change, e.g. in the distribution of invasive species, the success of management projects etc.

NOEL: No observed effect level. Relating to a pesticide, the level below which no effects are observed.

RfD: Reference Dose, or in this case, the estimated amount of fipronil ingested per day, *for the rest of their life* without any appreciable risk of adverse health effects.

treatment: application of pesticide or other means of control at a single point in time.

Acronyms

BACIPS: Before After Control Impact Paired Series – a methodology for assessing the differences between treatments and controls in experiments in ecological studies, environmental remediation or perturbation activities. The BACIPS approach involves surveying sites before and after treatment, in both control (untreated) and impact (treated) sites. Control and impact sites are paired and a series of surveys are undertaken before and after treatment.

EDNRE: Department of Economic Development, Natural Resources and Environment, Tokelau

EIA: Environmental Impact Assessment

ESIA: Environmental and Social Impact Assessment

FBA: FBA Consulting, Auckland – professional pest management and consultancy services

IPM: Integrated Pest Manangement

MELAD: Ministry of Environment, Land & Agricultural Development, Kiribati which encompasses **ALD** (Agriculture and Livestock Division), **ECD** (Environment and Conservation Division)

MFAT: Ministry of Foreign Affairs and Trade

MLPID: Ministry for Line and Phoenix Islands Development, Kiribati

NBSAP: National Biodiversity Strategies and Action Plan

NISSAP: National Invasive Species Strategy and Action Plan

PAPP: Pacific Ant Prevention Programme

PIAT: Pacific Invasive Ant Toolkit

PIPA: Phoenix islands Protected Area (Kiribati)

SPC: Secretariat of the Pacific Commission

SPREP: Secretariat of the Pacific Regional Environment Programme

WHO: World Health Organisation

Contents

Executive Summary

In December 2013 the New Zealand Ministry of Foreign Affairs and Trade Partnerships for International Development Fund approved a Concept Note on "Building resilience to biosecurity threats from invasive ants throughout the Pacific" to proceed to the Activity Design stage. The Activity involves strengthening biosecurity and invasive ant management capacity in Tokelau and Kiribati, as well as providing a framework that can be implemented across the Pacific region through SPC and SPREP. One aspect of the proposed Activity involves the use of pesticides to manage the yellow crazy ant on Kiritimati and Tokelau. As part of the Activity Design MFAT requires that an ESIA be conducted regarding the use of pesticide and reported together with the Activity Design Document. As the regulatory conditions differ between Kiribati and Tokelau, and there is no regional framework, this ESIA follows the MFAT guidelines.

The proposed Activity includes two Outputs (4 and 5) that involve use of pesticide in Tokelau and Kiribati. Output 4 involves the planning and execution of containment and control of the yellow crazy ant on Atafu atoll in Tokelau (but see issues regarding comments from the Fakaofo atoll community), which covers an area of approximately 80 hectares on the single inhabited islet of the atoll. Output 5 involves the planning and execution of containment and control of the yellow crazy ant on Kiritimati atoll in Kiribati, which covers approximately 1 hectare centred on a warehouse and import/export holding area within the main settlement of London (Ronton).The containment and control activities also enable training of in-country counterparts in ant management and monitoring.

This ESIA specifically covers the treatment activities of the Outputs, which involve pesticide use and disruptions to everyday activities (potential negative impacts), resulting in a reduction in ant abundance and distribution, and a consequent reduction in environmental and social effects (positive impacts).

The proposed pesticide is manufactured by Animal Control Technologies, based in Victoria, Australia, and is branded Antoff® ant bait (formerly branded as Presto 01®). The active ingredient in Antoff® ant bait, fipronil is a moderately hazardous pesticide, and classified as a WHO Class II chemical, with a number of environmental risks. The concentration of the chemical in the bait is 0.01 g/kg (10 mg/kg). According to information provided by the Australian supplier, the low concentration of fipronil in Antoff® and the low application rate make this product non-hazardous by Australian work-safe standards and not classified as a dangerous good according to the Australian Dangerous Goods Code (2007). While the product appears to involve minimal risk to humans and other mammals, considerable risks are present for fish and invertebrates (particularly the coconut crab *Birgus latro*), which require identification and management. The product has been used effectively in Christmas Island and Arnhem Land, Australia with no known residual effects when properly managed.

The ESIA was carried out between late January and early March 2014 and included site assessments[1] and consultations with the community. Assessments included detailed site inspections, identifying ecological characteristics and native species observations.

Consultations were undertaken as part of this ESIA with those groups and individuals identified as stakeholders in the Activity and included government officials and affected members of the community on Tokelau and Kiribati. The topics for consultation varied among the different groups as the context of the yellow crazy ant infestations differ in Tokelau and Kiribati. The consultation on Tokelau was much broader than on Kiribati as more people are affected (both positively and negatively) by the proposed Activity.

[1]The areas affected by the yellow crazy ant were well known prior to the ESIA but the ESIA process offered the opportunity to assess the status of the infestation on Tokelau and Kiritimati in distribution and abundance of ant populations.

The findings include environmental and social impacts due to both the effects of the pesticide and operational activities (i.e. disruption to the community). Overall the ecological effects of Antoff® and potential for human harm appear to be outweighed by the negative ecological and social effects of the yellow crazy ant. The most significant effects are expected in Atafu, Tokelau, as it is the larger of the areas infested with yellow crazy ants and includes more intact natural environment and higher species diversity, with fewer issues identified for the operations planned for Kiritimati, Kiribati.

The key findings of the consultation were that all the communities surveyed showed overwhelmingly positive support for the use of pesticides to manage the yellow crazy ant with the following provisions: 1) no effect on human health is anticipated; 2) the pesticide is not to be deployed as a spray; 3) any nests inside homes and occupied buildings will be treated without using the pesticide; 4) non-target impacts (particularly on fish) would be managed to minimise the risk to the environment; 5) people would be given full information prior to and during treatment to advise of where the treatment was occurring, and advise on prohibition of food harvesting from these areas (until bait has been removed by the ants and is no longer visible in the environment); 6) people were generally unconcerned about effects on terrestrial wildlife as these impacts were considered to be spatially and temporally limited; 7) on Atafu people were also unconcerned about the potential for disruption to daily life during the treatment operations, as they were far more concerned about the current effects of the yellow crazy ant on the environment and on their lifestyle.

From an ecological perspective the main taxa likely to be affected by the pesticide use include those groups that scavenge and are attracted to fish products, including many ant species, cockroaches, crabs and potentially migrant shore birds. However, the Impact Management Plan addresses how these non-target effects will be minimised.

Overall any deleterious effects of the pesticide treatment on non-target species and human environments are limited spatially and temporally, and appear to be outweighed by the support of the communities for the mitigation of the effects of the yellow crazy ant.

Policy, legal and administrative framework

Environmental Impact Assessment requirements in Tokelau

The Tokelau Environment Policy and Action Plan 2012 – 2015 states that "all development proposals must be authorized by the Taupulega (village council) and be subject to an environmental impact assessment (EIA) at an appropriate scale". However, to date no specific requirements for EIA assessment have been drafted. An Action item on the plan specifies that EDNRE "develop proposed EIA policy, guidelines and procedures to ensure all development activities identify and manage environmental risks (e.g. take into account climate change risks and protect critical resources, including native ecosystems and species)", which was scheduled to be undertaken around March – June 2014.

Despite a lack of formal legislation, informal protocols do exist for the use of pesticides in Tokelau, with chemicals (pesticides and herbicides) banned by default. Any use of pesticide or other chemicals is at the discretion of the Taupulega on the affected atoll. If the proposed Activity is funded, Taupulega approval will be sought prior to implementation.

Other relevant documents in Tokelau

The Tokelau Biosecurity Rules 2003 outline the biosecurity regulations and responsibilities of individuals and importers.

Through its association with New Zealand Tokelau is party to 1986 Convention for the Protection of the Natural Resources and Environment of the South Pacific Region. The convention is referred to in Tokelau legislation including the Marine Pollution Act which prohibits pollution of Tokelau waters. Briefly, the convention establishes expectations regarding EIA assessment (Article 16) for activities such as pollution that may have "deleterious effects as harm to living resources and marine life marine environment".

Environmental Impact Assessment requirements in Kiribati

In Kiribati environmental impact assessment is covered by the Environment Act 1999, which requires specific intervention for development for industrial or commercial purposes (Part III), as well as pollution (Part IV). The EIA requirement for the use of pesticides in Kiribati is not explicitly outlined on the legislation. For example, the proposed Activity does not conform to the definitions of development (Part III), and the legislation for pollution (Part IV) does not require environmental impact assessment. The requirements for environmental impact statements for development (Part III, 20) have a number of detailed and extensive stipulations that clearly apply to projects of much larger scope than the proposed Activity. Therefore this Environment Act 1999 does not appear to apply in this situation. However, this appears to be ambiguity in the legislation rather than a lack of provision for EIA for pesticide use. MELAD (ECD) officers report that all activities involving pesticides must obtain permits, which require an environmental impact assessment. If the proposed activity is funded, the permit process will be followed for implementation in Kiribati. MELAD (ECD) have indicated that the ESIA outlined in this document is acceptable for permit processes.

Other relevant documents in Kiribati

The following documents that have relevance to this Activity have also been reviewed:

- Kiribati Development Plan 2012-2015
- Line Islands Invasive Species Action Plan (NISAP) 2008
- National Biodiversity Strategies and Action Plan (NBSAP) 2006

New Zealand MFAT requirements

The environmental and social impact assessment requirements for this project under New Zealand MFAT Environment and Social Impacts Operational Policy (ESI-OP)differ from those required by Tokelau and Kiribati. Compared to Tokelau the MFAT requirements are greater in terms of legal and policy requirements and public consultations, and require a full impact management plan. Compared to Kiribati, the MFAT requirements are similar for development, but the proposed Activity has no specific mention for environmental impact assessment under the Kiribati Environment Act 2011. The MFAT requirements were followed for this assessment because of the differences in requirements between Tokelau and Kiribati.

Appraisal of the Concept Note defined the proposed Activity "Building resilience to biosecurity threats from invasive ants throughout the Pacific" as meeting the criteria for MFAT Environmental and Social Impacts Guideline Category A or P(A) Activities, with ESIA reporting requiring the required to cover environmental and social impacts. The format of this report follows that suggested in the MFAT guideline.

In assessing the potential risks for pesticide use, MFAT refer to relevant in-country and regional guidelines (such as the Guidelines for Invasive Species Management in the Pacific) and the guidelines from other donors such as the World Bank Operational Policy on Pest Management (OP4.09).

Description of the Activity

The Activity "Building resilience to biosecurity threats from invasive ants throughout the Pacific" is a proposed Partnerships for International Development Fund Activity of the New Zealand Aid Programme. The five partners involved are Pacific Biosecurity (New Zealand lead), PII, SPREP, SPC, the Tokelau government (EDNRE), the Kiribati government (MELAD). The project goal is to enhance resilience to the biosecurity threat of invasive ants Pacific-wide by in-country managers and regional support organisations. The Activity will deliver 5 Outputs to achieve this goal:

1. Sustainability Plan developed for invasive ant biosecurity & management
2. Pacific Invasive Ant Toolkit (PIAT) developed for ant biosecurity & management
3. Workshops delivered to Tokelau, Kiribati, SPC and SPREP
4. Management plan developed and implemented for yellow crazy ant in Atafu, Tokelau
5. Management plan developed and implemented for yellow crazy ant in Kiritimati, Kiribati

The ESIA outlined in this report covers Outputs 4 & 5 of the proposed Activity, and has been prepared as part of the Activity Design phase. Outputs 4 & 5 relate to management of the yellow crazy ant.

Output 4 involves the planning and execution of containment and control of the yellow crazy ant on Atafu atoll in Tokelau, which covers an area of approximately 80 hectares on the single inhabited islet of the atoll. Output 5 involves the planning and execution of containment and control of the yellow crazy ant on Kiritimati atoll in Kiribati, which covers approximately 1 hectare in a warehouse and import/export holding area within the main settlement of London (Ronton).

No other projects are proposed or exist in relation to ant management in either Tokelau or Kiribati.

The phases of both Outputs include the following activities:

1. Develop adaptive management plan covering Communication, Delimiting, Containment (including movement controls), Surveillance, Treatment, Monitoring (elements from the SPC General Emergency Response Plan for Invasive Ant Incursions 2008)
2. Communication with affected stakeholders
3. Implement containment measures
    a. Surveillance and Delimiting
    b. Movement controls (in line with enforcement powers outlined in by the Tokelau Biosecurity Rules 2003 and Kiribati Biosecurity Act 2011)
4. Implement treatment measures
    a. Treatment: pesticide control of yellow crazy ant (Year 1)
    b. Monitoring (Year 1)
    c. Treatment: pesticide control of yellow crazy ant (Year 2)
    d. Monitoring (Year 2 - 5)

This ESIA specifically covers the treatment activities of the Outputs, which involve pesticide use and disruptions to everyday activities (potential negative impacts), resulting in a reduction in ant abundance and distribution, and a consequent reduction in environmental and social effects (positive impacts).

Materials, equipment and resources

In Tokelau the chief materials, equipment and resources required include 850kg Antoff® ant bait, with fipronil at a concentration of 0.01g/kg in a proprietary bait matrix that is attractive to ants, equipment to disperse the bait (motorised blowers and manual "Scott" spreaders, bait containers for trees and around homes), fuel (400 litres unleaded 91 octane petrol) for the motorised blowers, and safety equipment. Secure storage facilities are required to ensure the ant bait, equipment and fuel is safely contained. In Kiritimati the requirements are similar, with the exceptions being only 10-20kg of Antoff® ant bait, no motorised spreaders, no bait containers and no fuel required.

All equipment will be sourced in New Zealand. Antoff® bait will be manufactured by Animal Control Technologies Pty Ltd. in Australia, and shipped to Tokelau via Apia, Samoa and Auckland, New Zealand (by sea), and to Kiritimati via Wellington, New Zealand (by air). Work on Atafu is sub-contracted to FBA consulting with the oversight and assistance of Pacific Biosecurity staff, EDNRE staff and local villagers, and on Atafu will be undertaken by Pacific Biosecurity staff with the assistance on MELAD staff.

Pesticide description and hazard information: Antoff® ant bait

The active ingredient in Antoff® ant bait, fipronil is a moderately hazardous pesticide, and classified as a WHO Class II chemical, with a number of environmental risks. The technical information available[2] on which the following assessment is based relates to fipronil in its undiluted form. The concentration of the chemical in the bait is 0.01 g/kg (10 mg/kg). According to information provided by the Australian supplier, the low concentration of fipronil in Antoff® and the low application rate make this product non-hazardous by Australian work-safe standards and it is not classified as a dangerous good according to the Australian Dangerous Goods Code (2007).

Chronic effects on humans

The RfD (Reference Dose) is 0.019 mg/kg of body weight. For a 50 kg human this is equivalent to 0.95 mg per day. Given that the fipronil concentration in Antoff® bait is 10mg/kg, a 50 kg human would need to ingest nearly 100g of bait per day for life to generate possible chronic effects. Clearly doses are lower and risks are higher for small children (who are also more likely to pick up baits from the ground and eat them). For a 15kg child, the RfD would be less than 30g of bait. However, reference materials note that no data is available on what chronic effects might be, and it appears none have been reported – even among pest management contractors. In addition there are no recommended or regulatory occupational exposure limits for fipronil in the US. Fipronil is reported as a possible carcinogen in chronic doses, however it has not been shown to cause mutations in mutagenicity screening tests designed to screen chemicals for carcinogenicity. Ingestion rates of 2.5 mg/kg per day in rats (i.e. equivalent to ~80g of Antoff® bait for a 15 kg child per day for life) have been associated with delayed sexual development and growth. Chronic effects would occur only with continual exposure over time and acute effects (due to the nature of pesticide use in the context of this Activity) are a higher risk.

Acute effects on humans

Technical grade (undiluted) fipronil is considered moderately toxic by ingestion with an oral LD_{50} of 97 mg/kg in rats and 95 mg/ kg in mice. Although no data is available for human LD_{50}, based on the rat and mouse data a 50 kg adult would need to ingest ~10kg of Antoff® bait in a single dose, and a 15 kg child would need to ingest ~3 kg of bait to cause death in a single exposure.

[2]Technical information has been summarised from: 1) Tingle et al. 2003. Fipronil: environmental fate, ecotoxicology, and human health concerns. Rev. Environ. Contam. Toxicol. 176:1-66; 2) Jackson et al. 2009. Fipronil Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/fiptech.html.

Signs of acute toxicity reported for humans after ingestion of fipronil include sweating, nausea, vomiting, headache, abdominal pain, dizziness, agitation, weakness, and seizures. These signs are reported as being generally reversible and resolve without treatment.

Fipronil is considered of low to moderate in toxicity via inhalation. The proposed output does not involve spraying, but the fipronil Technical fact sheet reports low to moderate in toxicity by inhalation with the 4-hour LC_{50} ranging from 0.390 to 0.682 mg/L in rats. The fact sheet also relates the case of a 50-year-old man who complained of headache, nausea, vertigo, and weakness after spraying his field with a fipronil product for five hours. Inhalation or dermal contact were identified as probable causes of exposure in this case. Symptoms were reported to have developed after two hours and resolved spontaneously.

Fipronil metabolism in soil

The half-life of fipronil is 122-128 days in aerobic soils. Under aerobic conditions, naturally occurring soil organisms break down fipronil to form fipronil-sulfone. Fipronil can also be hydrolyzed to form fipronil-amide.

Fipronil degrades on soil surfaces by ultraviolet radiation (i.e. sunlight) to form fipronil-desulfinyl, and has a measured half-life of 34 days in loamy soil. However, soil particles may prevent light from penetrating any significant depth of soil under field conditions and thereby increase residence time for buried particles (i.e. bait returned by worker ants to the nest). In studies to determine the fate of fipronil in soil, researchers found "no evidence of volatility" of fipronil or fipronil metabolites. Fipronil has low mobility in soil and is not expected to leach into groundwater. After soil treatment, fipronil usually does not travel further than the upper six inches of soil, and significant lateral movement is not expected.

Fipronil metabolism in water

Fipronil degrades rapidly in water when exposed to UV light to form fipronil-desulfinyl. Under these conditions, fipronil has a half-life of 4 to 12 hours. Fipronil is stable to hydrolysis (i.e. it does not degrade in water) at pH 5 - pH 7. However, it degrades in alkaline conditions in direct proportion to increasing pH values. Fipronil-amide is the primary residue formed from hydrolysis.

One study on fipronil accumulation in sediments indicated that fipronil degradation products accumulate in riverbed sediment while the parent compound does not.

Fipronil-desulfinyl photodegrades more quickly in water than soil, and in aerated and static water half-lives of 120 (± 18) hours and 149 (± 39) hours, respectively have been recorded.

Ecotoxicity

As Tokelau and Kiritimati are home to no freshwater fish or invertebrates, this discussion relates only to marine life. When applied to water, fipronil varies in its toxicity and potential to bio-accumulate in aquatic invertebrates, depending on the species. The proposed Activity will not apply Antoff® to water, not use sprays, and a number of measures will be taken to avoid run-off (See Impacts and mitigation measures).

Fipronil is highly toxic to marine fish, however, the half-life of fipronil in water is 4 – 12 hours. The 96-hour LC_{50} is 0.083 mg/L for bluegill sunfish, and 0.130 mg/L for sheepshead minnows. The primary metabolites in fish are fipronil-sulfone and fipronil-sulfide. Fipronil-sulfone is 3.3 times more toxic to bluegill sunfish than the parent compound fipronil. Laboratory tests have shown fipronil accumulation in fish with a bioconcentration factor of 321 for whole fish, 164 for edible tissue, and 575 for nonedible tissue. However in these tests treated fish eliminated fipronil completely 14 days after being transferred to clean water. Thus, in areas with large volumes of water, such as the lagoon or ocean, together with the low concentration of Fipronil in the ant bait, and the application method more likely to result in the toxin remaining on land, the likelihood of bioaccumulation in fish is minimal.

Fipronil is highly toxic to marine invertebrates. In daphnids (planktonic crustaceans), the NOEL for fipronil was measured at 9.8 µg/L, and the LOEL 20.0 µg/L. In this study the fipronil-sulfone and fipronil-desulfinyl metabolites were 1.9 times more toxic to than the

parent compound. In one study, male copepods (benthic and planktonic crustaceans) raised in a 0.63 µg/L fipronil solution had a 75-89% decrease in reproductive success. Fipronil has been found to be highly toxic to oysters with an EC_{50} of 0.77 mg/L, and very highly toxic to shrimp with a 96-hour LC_{50} of 140 ng/L. Again, in the context of the proposed Activity, the large volumes of water, together with the low concentration of Fipronil in the ant bait, and the application method more likely to result in the toxin remaining on land, the likelihood of effects on marine invertebrates are minimal.

Fipronil is also toxic to terrestrial invertebrates, and has been found to kill 38.8-94.5% of beneficial predators. When used for locust control, fipronil killed >90% of the resident non-target insects Carabidae, Tenebrionidae, (both beetles) Scelionidae, and Sphecidae (both wasps) populations in 2 days, with poor recolonization. Fipronil treated soil is non-toxic to worms, including earthworms. These examples all relate to spray application, which is not the deployment method advocated in the proposed Activity. Fipronil is also highly toxic to bees, which is an important consideration in cropping environments and when the pesticide is deployed by spray. Bees are not scavengers, and as the bait matrix base is fishmeal, bees are unlikely to be attracted to it. Although non-target effects of fipronil-based baits on invertebrates have been demonstrated in laboratory settings, in field tests no effects have been detected in leaf litter invertebrates, most likely because yellow crazy ants at high abundance exclude invertebrates from baits, or the ants have already extirpated other invertebrates from the local area[3]. Other ant species will also be affected by Antoff® treatment, but only if they are attracted to the bait matrix.

Fipronil is toxic to birds, although toxicity can vary by taxonomic group. For example, fipronil toxicity appears higher in Galliformes (e.g. chicken, quail) than on other bird species[4]. Reports include LD_{50} of 11.3 mg/kg in quail (*Colinus virginianus*), 31.0 mg/kg in pheasants, 1000 mg/kg in house sparrows (*Passer domesticus*)[5], and < 2150 mg/kg in the mallard duck (*Anas platyrhynchos*)[6]. Given that the fipronil concentration in Antoff® bait is 10mg/kg, the lethal dose for a 1 kg chicken would be ~1kg of bait, and for a sparrow (weighing ~ 30 g) the lethal dose would be ~3 kg of bait. Note, however, that in these studies birds are force-fed fipronil i.e. there is no option for them to not eat the bait even though they may find it unpalatable.

The technical information does not mention effects on reptiles, however these species may be affected through loss of prey insects in fipronil treated areas[7].

Pesticide resistance

The supplier information for insecticide resistance of advises the product is a Group 2C insecticide. It is possible that some biotypes or genotypes of insect species are resistant to Antoff® and other Group 2C insecticides, due to naturally occurring genetic variability in any population. Resistance has not been reported in any yellow crazy ant populations, nor has resistance been reported in any ant species.

[3]Marr et al. 2003. Assessment of non-target impacts of Presto®01 ant bait on litter invertebrates in Christmas Island National Park, Indian Ocean. Report to Parks Australia North

[4]Kitulagodage et al. 2011. Fipronil toxicity in northern bobwhite quail *Colinus virginianus*: Reduced feeding behaviour and sulfone metabolite formation. Chemosphere 83:524-530

[5]Goodyear. 1994. DER. Review. M&B 46030 Technical: 14-Day Acute Oral LD50 Study in House Sparrows. Submitted by Rhone-Poulenc Ag Company, Research Triangle Park, USA. MRID No. 429186-18. USEPA, Ecological Effects Branch

[6]Goodyear. 1994. DER. Review. M&B 46030 Technical: 21-Day Acute Oral LD50 Study in Mallard Ducks. Submitted by Rhone-Poulenc Ag Company, Research Triangle Park, USA. MRID No. 429186-16. USEPA, Ecological Effects Branch

[7]Peveling et al. 2003. Impact of locust control on harvester termites and endemic vertebrate predators in Madagascar. Journal of Applied Ecology 40:729-741

Details of operational processes

Effective ant management requires that the ant queen(s) must be killed to kill the colony (colonies of yellow crazy ants can have hundreds or thousands of queens). Ant baits containing pesticides must be attractive to workers, so that the workers return the bait to the nest for the queen to feed on, but the bait must be not so toxic that it kills the workers before the bait is returned to the nest. Ants are attracted to protein and sugar, however some combinations are more attractive to specific ant species than others. Antoff® bait has been used extensively for yellow crazy ants in Australia and its effectiveness and non-target effects are well known.

Yellow crazy ant colonies are made up of long-lived queens (~3-5 years), short-lived workers (~3 months), and short-lived males that die immediately after mating. Queens produce new workers year-round, and produce new queens and males during certain environmental conditions. Typically production of queens and males coincides with the onset of the wet season (when there are distinct wet and dry seasons). While the new queens are in pupal stage they do not eat, and while treatment at this stage will kill adult queens, the pupal queens will be unaffected and thus the colony will not be killed.

Thus, effective treatment must take into account the biology of the ant, and its relationship with environmental conditions, as well as an appropriate pesticide concentration and bait matrix for the target species. For these reasons treatment is best undertaken during the dry season[8][9]. The second reason for undertaking treatment in the dry season is to minimise the risk of non-target effects through run-off into the marine environment due to more frequent rain in the wet season.

The number of treatments (within a season and throughout the management programme) depends on the objective of the operation. Typically eradication involves application over a number of years, and as the populations of invasive species are lower with progressive years, the amount of residual pesticide is likely to increase as population size declines. The objective of the proposed Activity is to reduce the abundance of the yellow crazy ants to levels below which environmental effects are likely to be severe, and below which people perceive the ant to be a serious social problem. Thus, only two control treatments in successive years are proposed, followed by three years of monitoring. Eradication is feasible on Kiritimati, but on Atafu would likely require further treatments.

Safe storage, handling and operations

Manufacturer's precautions for safe handling and storage

The proposed Activity will follow the manufacturer's guidelines for safe handing, which are as follows: "To avoid risks for people and environment the instructions for use on the product label are to be followed. Avoid all contact with the product and wear protective clothing and gloves." The Activity has budget provisions for gloves and face masks for all participants.

Manufacturer's conditions for safe storage

The proposed Activity will follow the manufacturer's guidelines for safe storage, which are as follows: "Store in the closed, original container in a dry, cool, well-ventilated area out of direct sunlight. Store in a locked room or place, away from children, animals, food, feedstuffs, seed and fertilisers and ignition sources. Fipronil is stable in normal temperatures for one year." Facilities are available in Tokelau and Kiritimati for secure storage. However, temperature cannot be controlled in these facilities. FBA consulting report that in their experience with Antoff® in hot climates, the product will remain use-able as long as it is stored covered and not exposed to the full heat of the sun. The worst effect of excess heat is that the external bait granules congeal and are unusable. The

[8]Boland et al. 2011. Heli-baiting using low concentration fipronil to control invasive yellow crazy ant supercolonies on Christmas Island, Indian Ocean. In: Veitch CR, Clout MN, Towns DR, editors. Island Invasives: Eradication and Management. IUCN, Gland, Switzerland. pp. 152-156

[9]Abbott et al. 2014. Seasonal shifts in macronutrient preferences in supercolonies of the invasive Yellow Crazy Ant *Anoplolepis gracilipes* (Smith, 1857) (Hymenoptera: Formicidae) on Christmas Island, Indian Ocean. Austral Entomology: in press

proposed Activity will use all Antoff® bait within the few days / weeks of treatment and long-term storage is not anticipated.

Distribution of bait around Atafu inhabited islet

Approximately two days prior to when baiting operations are planned to commence, a meeting will be called involving the entire Atafu village. Details of the operation and the expectations regarding the presence of bait around the village will be highlighted, for example, not touching any bait, not harvesting any food or firewood from the vao or village area until two days after baiting has ceased, ensuring children do not interfere with the bait containers or bait around the vao. At this point the families that own pigs will ensure the pigs are penned into small areas and not allowed to roam free throughout the pigsty area. Signs will be erected around the affected areas informing of treatment activities and prohibited activities.

Local people and EDNRE staff who are going to be involved in the baiting operation will be given specific safety briefings and training in the baiting operation. In the planning activities in the months prior to the baiting operations, participants will be advised of the safety requirements regarding protective clothing (gloves, close-toed shoes, long-sleeved shirts and trousers), and that protective items must not be washed in the lagoon or ocean. The entire operation will be filmed for training purposes.

Antoff® ant bait will be stored in locked facilities in Atafu until required. Baiting will only take place when the ground is dry and there is minimal chance of rain for at least 4 hours after cessation of baiting activities.

Four-six teams of 3-4 people, each led by a staff member of FBA Consulting, and made up of local people, will distribute the Antoff® ant bait. Throughout the uninhabited vao (bush) area, this will be done by broadcast spreading using "Scott" spreaders and motorised blowers at a rate of 10kg / hectare. Individual containers of Antoff® will be placed around homes, and on trees within the pigsty, where pigs have been penned. In the broader pigsty area, bait will be broadcast spread.

Although the entire islet will be treated, a buffer area of five metres above the high tide mark will not be baited. If there are trees within this buffer area, and ants are present on these trees bait containers will be placed on the trees, well above where the sea level would reach at high tide.

Distribution of bait around Kiritimati commercial area (London)

Approximately two days prior to when baiting operations are planned to commence a meeting will be called involving businesses in the commercial area, and local residents who use the area. The details of the operation will be described and the expectations regarding the presence of bait around will be highlighted, for example, not touching any bait, ensuring children do not interfere with the bait. Signs will be erected around the affected areas informing of treatment activities and prohibited activities.

MELAD staff who are going to be involved in the baiting operation will be given specific safety briefings and training in the baiting operation. In the months prior to the baiting operations, participants will be advised of the safety requirements regarding protective clothing (gloves, close-toed shoes, long-sleeved shirts and trousers), and that protective items must not be washed in the lagoon or ocean. As a group the team undertaking baiting will wash affected clothing at the accommodation facilities PB uses on Kiritimati. These facilities include freshwater hoses with good pressure and are away from the lagoon.

Antoff® ant bait will be stored in locked facilities in London until required. Baiting will only take place when the ground is dry and there is minimal chance of rain for at least 4 hours after cessation of baiting activities.

One-two teams of 3-4 people, led by a staff member of Pacific Biosecurity, and made up of Kiritimati MELAD staff, will distribute the Antoff® ant bait by broadcast spreading using "Scott" spreaders at a rate of 10kg / hectare. Excessive baiting will be avoided to minimise residual bait in the field (i.e. unsuitable habitat areas such as roads will not be baited). The area treated will include the detection area of the ant, plus a buffer zone of 50 metres around the perimeter of the known infestation, except where this buffer zone impinges an

area within 5 metres of the high tide zone. The entire operation will be filmed for training purposes. Motorised blowers will only be used in the vao area and well outside the buffer zone.

Disposal

All Antoff® ant bait not used, together with used gloves, masks and other safety equipment that cannot be safely cleaned, will be shipped back to New Zealand for disposal according to New Zealand laws and regulations and manufacturer instructions.

It is expected that the vast majority of bait in the field will be consumed by the yellow crazy ants, particularly on Tokelau where the ant abundance is high. Treatment on Kiritimati will be much more targeted than on Tokelau due to the nature of the infestation, and thus residual bait will be minimised. As outlined earlier, the fipronil in Antoff® bait has a half-life of approximately 122-128 days in the soil before degrading, and degrades on soil surfaces by ultraviolet radiation with a measured half-life of 34 days.

Description of the Environment: Tokelau

Atafu atoll is the most isolated of the three Tokelau atolls, and lies ~100 km from Nukunonu, its nearest neighbour and ~580 km from Upolu, Samoa, the nearest airport. Transport is entirely by ship, which makes regular trips between Apia and the atolls (approximately 3 trips per month). Approximately 400 people reside on each atoll, but people often travel so the populations fluctuate.

Atafu atoll is made up of approximately 40 islets circling the lagoon (Figure 1). Only one islet is inhabited. Atafu village occupies the southern half of the islet and the north-eastern half of the islet also contains the cemetery, fuel storage, solar installation and pig sty, together with some disused buildings surrounded by 'vao' (bush). The vao area is used for refuse disposal, harvesting of coconuts (both for food and fire) and wood, and collection of coconut and other crabs. Coconuts and coconut crabs are also important food sources for the local community. One pig sty covers a large area surrounded by a coral concrete wall about 1.5 m tall and subdivided into pens, although the area is not entirely inhabited by pigs. Trees grow throughout the pig sty. Pigs are an important food resource, particularly for celebrations, and families regularly tend to the animals, feeding and observing them.

Figure 1: Aerial view of Atafu atoll, Tokelau, indicating the extents of the vao and village areas in the yellow crazy ant infested islet. Image sourced from NASA (eol.jsc.nasa.gov).

Spatial boundaries of treatment activity

The yellow crazy ant was first noticed by the residents in approximately 2008, at the fuel depot. By 2011 (the first outside survey of the ant), the ant was in high density throughout the vao area, reaching to the pig sty, as well as one or two isolated houses in the village at low density. These were likely transported via coconuts used for fuel that were transported from the vao area.

By late 2012 the ant density had increased in the vao and spread from there toward the village, and the village infestation had spread outward, but remained in low density. In 2012[10] people were reporting that yellow crazy ants were killing coconut crabs. At the most recent assessment (February 2014) the ant abundance was at high density in the vao area (and garden areas in the village), but lower than in 2012. In 2014 the distribution through the village had increased and was in medium density throughout the area where the ant was first detected in the village, but in relatively low density elsewhere, apart from within some garden areas near the centre of the village.

In the 2012 survey and 2014 consultation, people reported killing of coconut crabs and hermit crabs, but also indicates the ants have not resulted in eradication of the coconut crab population. The distribution of the ant covered almost the entire islet, with only 50 metres or so at the southern tip being free of yellow crazy ants (Figure 2). In the 2012 survey, 89% of people reported that they considered the yellow crazy ants to be a problem. The 11% of people who did not consider the ants to be a problem either did not go to the vao area or did not have the ants around their homes. 89% of respondents were afraid the ants might cause more problems. 96% of people wanted help to make the ants less of a problem. Most people (89%) were not concerned about using poisons that didn't have an effect on humans. Although most people were concerned about side effects of poisons used to kill ants, others commented that short term effects of poison were more acceptable than the ant problem[10].

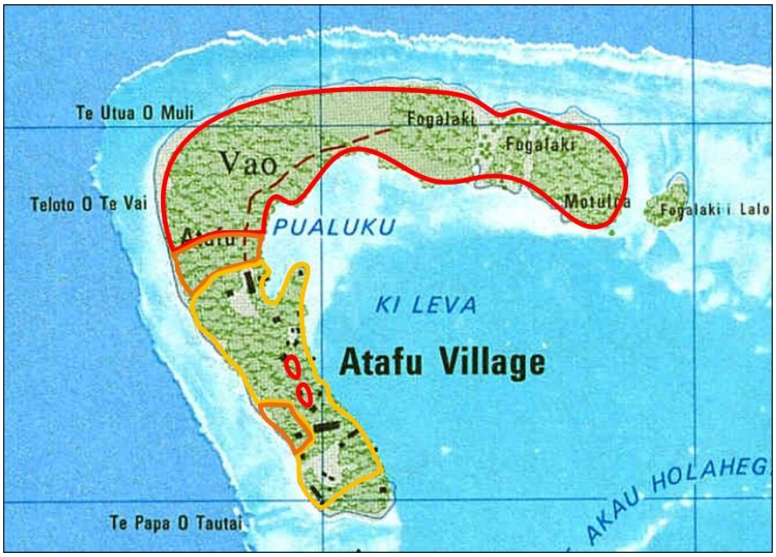

Figure 2: Distribution of the yellow crazy ant on Atafu islet, Atafu atoll, Tokelau in February 2014. Red indicates high abundance, orange medium abundance and yellow sparse abundance. The high yellow crazy ant density area covers approximately 40 hectares, and the remainder of the infestation covers approximately 30 hectares.

[10] Gruber MAM. 2012. Report to the Taupulega of Atafu and EDNRE of Tokelau on the status of the yellow crazy ant invasion in Atafu in September 2012. Unpublished report

Overall the relief of Atafu atoll is low-lying, at most 3 metres above sea level and little variation in elevation. The vegetation of Atafu[11] is dominated by planted and regenerating coconuts and a small number of other tree species including *Pandanus tectorius*, *Tournefortia argentea*, *Guettarda speciosa*, *Pisonia grandis*, *Cordia subcordata* and the seashore shrubs *Pemphis acidula* and *Scaevola taccada,* and *Morinda citrifolia*. The understorey is dominated by seedlings of these species plus the ferns *Asplenium nidus* and *Phymatosorus grossus*. A single non-native *Calophyllum inophyllum* is present on near the centre of the village.

Approximately half of the area affected by the proposed Activity on the motu consists of vegetation of varying density, mostly coconut canopy, with scattered *Cordia, Guettarda* and *Pisonia*. The understorey is typically made up of tree seedlings and ferns (which are a food source), *Morinda* and coral rubble. Towards the lagoon and sea boundaries, *Pemphis* is patchily common. In the pig sty area vegetation is sparse, and consists of mature *Cordia* trees and coconut without understorey (Figure 3).

Figure 3: Photo montage of representative areas around the vao on Atafu village, Tokelau, including the pig pen area at the edge of the vao (lower left images).

[11]Information on the ecology and land use of Atafu atoll was obtained by observation during the consultation visits, and from Pierce et al. 2012. Conservation Survey of Tokelau. Unpublished report for Tokelau and Conservation International

Figure 4: Garden areas within the village on Atafu islet, Atafu atoll, Tokelau in February 2014. Main crops are banana, papaya, taro and pumpkin. The yellow crazy ants are relatively more abundant in the gardens than in other areas of the village. Although the effects of the ants on the crops have not been assessed, their high abundance suggests some effect on crop productivity is likely.

Outside of the vao, vegetation in the village includes grasses, weeds (*Wedelia*), ornamental shrubs around houses, and a small number of garden areas with banana, papaya and pumpkin and taro patches (Figure 4). Throughout the village area are numerous mature breadfruit trees, and some coconut palms. The fringes of the lagoon and ocean sides of the village are dotted with coconut, pandanus, and *Scaevola* and *Tournefortia*. Most of the area around houses is relatively lacking vegetation (Figure 5).

Figure 5: Photo montage of typical areas around the village on Atafu village, Tokelau.

Temporal boundaries of treatment activity

The proposed treatment activity will take place once per year (during the dry season) for two successive years. After treatment monitoring of ant distribution and abundance will occur and decisions made by the Atafu community and EDNRE on further treatment.

Impacts and mitigation measures

The treatment activities on the atoll will take up to four weeks each year. These treatments could interfere with normal activities, given the amount of effort required and constraint on taking food from the affected areas. This was noted as an issue for consultation.

Treatment with Antoff® will reduce the abundance of yellow crazy ants on Tokelau. A reduction in the numbers and distribution of the invasive yellow crazy ant on the atoll will enable the community to reclaim their outdoor lifestyle, remove the fears about the effects of the ants on health, well-being and the environment, and natural and cultivated food will be more secure. Women in particular will benefit from management as their responsibilities focus around the home, gardens and children and they are thus keenly aware of and concerned about the effects of the ants.

Invertebrates in Tokelau that are likely to be affected by the ant bait include species of hermit crab, which is used by local people for bait for fishing, and the coconut crab (*Birgus latro*) and *Cardiosoma* land crabs, which are traditional food sources. Antoff® ant bait is known to affect land crabs. In control programmes using the same ant bait on yellow crazy ants on Christmas Island (Australia) it was found that the Antoff® attractant bait matrix was also highly attractive to coconut crabs, and mortality rates of crabs after treatment were variable but occasionally high mortality rates were noted. As the coconut crab is protected on Christmas Island, Parks Australia North staff removed as many coconut crabs as they could find in the treatment area prior to treatment, and returned them afterwards. Invertebrates, and ants in particular, are affected by yellow crazy ant predation. Where yellow crazy ants are abundant, the number ad diversity of ant and other invertebrates declines.

On Atafu vertebrates that could be affected by Antoff® ant bait include skinks and shore birds. Snake-eyed skinks (*Ablepharus boutonii* IUCN least concern) and blue-tailed skinks (*Emoia cyanura* IUCN not classified) are common and black skinks (*E. nigra* IUCN least concern) are uncommon in Tokelau except in the area of the pig sty and YCA infestation on Atafu. Lupe (Pacific pigeons *Ducula pacifica* IUCN least concern) are present in the Atafu Village islet and throughout the atoll, as are the shore birds Pacific golden plover (*Pluvialis fulva* IUCN least concern), Wandering tattler (*Heteroscelus incanus* IUCN least concern) Bristle-thighed curlew (*Numenius tahitiensis* IUCN vulnerable), Ruddy turnstone (*Arenaria interpres* IUCN least concern), and the Long-tailed koel or cuckoo (*Eudynamis taitensis* IUCN not classified), all of which are potential visitors and forage terrestrially. Migrant shore birds can be present any month of the year but are typically are most abundant on Tokelau between August and May. The migratory shining cuckoo (*Chrysococcyx lucidus* IUCN least concern) is likely to be present on Tokelau between March and September. These birds may potentially be attracted to Antoff® ant bait as they have very good taste/smell receptors and seafoods are the normal diet. In addition shore birds scavenge on *Coenobita* crabs, which, if they have been killed by ant bait, would potentially cause bio-accumulation in the birds[12], although no information exists on the effects of fipronil on seabirds. Chickens, although present in the village, are not used as a regular supply of meat or eggs as these products are imported, thus any potential effects on chickens will not affect community food supplies. Yellow crazy ants are known to have negative impacts on the chicks of ground- and tree- nesting birds.

[12]Advice on shore-bird and cuckoo susceptibility to taking Antoff® bait from Dr. Ray Pierce, Eco-Oceania Pty Ltd

Uncertainty exists around the effect of Antoff® ant bait treatment on coconut crab population dynamics, as mortality ranges can vary from almost none to the majority of the population. The time the population on Atafu would take to recover is also hard to predict. Coconut crabs are abundant on the other islets in the atoll and thus recruitment to the population is unlikely to be limited by the treatment activities. The effects of fipronil-based baits on seabirds, shore-birds, the shining cuckoo and reptiles is unclear. If there are any effects, the population recovery trajectory would be is also difficult to assess, given these are migrant species. At best, no effect would be expected (i.e. if effects are similar to house sparrows or ducks). At worst, some mortality may occur (i.e. if effects are similar to quails and other Galliformes birds) if the birds find the baits palatable despite their toxicity. The results of this Activity will provide valuable data that can be used to make these decisions more straightforward in the future.

Before and after each treatment on Atafu, assessments will be made of living and dead: coconut crabs and hermit crabs, birds (sea birds and shore birds), and skinks to assess the impacts of treatment on these species. This information will be discussed with the community, and along with their local knowledge on animal abundance and range, enable the community and the project team to assess the risks of continuing yellow crazy ant control, and whether changes are needed to the management programme.

Description of the Environment: Kiribati

Kiritimati, the world's largest atoll, is part of the Line Islands group and has air connections to Hawaii and Fiji, which operate weekly. Connections for cargo and passengers are by ship to Tarawa (the capital Kiribati), the other islands in the Gilbert, Line and Phoenix groups.

The atoll is made up of a number of islets, with the lagoon almost entirely encircled by one large and a few small islets, and remainder interspersed between hypersaline ponds within the lagoon (Figure 5). Although the entire atoll is a wildlife sanctuary, a number of islets have special protection status and landing is only allowed by permit (e.g. Cook Island, Motu Tabu).

Figure 5: Aerial view of Kiritimati atoll, Kiribati showing locations of infestation, conservation areas, settlements, port and airport. Image sourced from Expedition 4 of the International Space Station (http://earthobservatory.nasa.gov).

The main settlements on Kiritimati are Banana, near Cassidy airport in the north, and London (Ronton), the main commercial area, together with the settlements of Tabwakea and Poland. Approximately 6-8,000 people live on Kiritimati, and the population is growing rapidly.

Spatial boundaries of treatment activity

The yellow crazy ant infestation is distributed over approximately one hectare within the Ronton commercial area as at February 2014 (Figure 6). The infestation is centred in a warehouse and holding area used for shipments of copra to the atoll from outer islands and then onward from Kiritimati to Tarawa for processing. At the time of the discovery of the infestation in February 2013 the area was not used, and had not been used for approximately 6-10 months. More recently the area has been used for storage prior to departure for Tarawa, which presents a biosecurity risk to the PIPA. A cursory survey of Betio Port and the copra warehouse and processing plant in Tarawa as part of the consultation process found no evidence of yellow crazy ants. As well as the warehouse and holding area in Ronton, the neighbouring water and sanitation depot is also infested. This depot is used for storage of pipes and equipment prior to distribution to other settlements and there is no water supply from the depot. A second survey in February 2014 found that since initial detection the distribution of the ant has spread in an eastward direction, to the Fisheries Office and a building owned by the Captain Cook Hotel. Although the ant is in relatively low and patchy abundance, the longer the duration until eradication, the more likely it will be that the ant increases its distribution and colonises new areas. The current distribution is close to where boats depart for the outer islets, which places the conservation islands at greater risk.

Figure 6: Photo montage of typical areas in the yellow crazy ant infestation in Ronton, Kiritimati atoll, Kiribati.

Temporal boundaries of treatment activity

The proposed treatment activity on Kiritimati will take place once per year (during the dry season or dry periods in the wet season, as Kiritmati often experiences long periods of drought in the wet season) for two successive years. After treatment monitoring of ant distribution and abundance will occur and decisions made by MELAD on further treatment.

Impacts and mitigation measures

The treatment activities on Kiritimati will take no more than a few days each year. However, this might interfere with normal activities of the businesses in the area, which will need to be be minimised. This was noted as an issue for consultation with the affected businesses. The management plan addresses communication with the affected stakeholders including discussion and signage.

Although Kiritimati is home to 18 species of seabirds as well an endemic Kiritimati Island warbler, locally known as 'te bokikokiko', as well as migrant shore birds the size and nature of the infestation (around one hectare in a commercial area), makes it highly unlikely these non-target species will be affected. However, *Cardiosoma* land crabs are also found around these buildings close to the shoreline. As there is very little food to be scavenged it is likely these crabs will take up the bait. Some bee hives are kept in Kiritimati around Banana in the north of the atoll Kiribati, a significant distance from the yellow crazy ant infestation, so these are unlikely to be affected, particularly as bees do not scavenge on protein-based foods. No chickens were observed in the vicinity of the treatment area, and the majority of chicken meat is imported.

Results of public consultations

Consultation in Tokelau

Stakeholders identified on Atafu, Tokelau included the village council (Taupulega), the men's group (Aumaga), women's group (Fatupaepae) and youth (Tupulaga). The Taupulega is responsible for all decisions affecting the atoll. Consultations were undertaken with stakeholder groups on Atafu atoll between 3 and 7 February 2014. Unfortunately a meeting could not be arranged with the Tupulaga due to difficulties in finding a suitable time to meet, changed boat schedules and a shortened trip duration. Approximately 110 people were involved in the consultation meetings on Atafu: 30 from Taupulega, 50 from Aumaga and 30 from Fatupaepae.

In addition to consultations in Atafu, because of the wider implications of the proposed Activity on Tokelau, consultations with the same groups on Fakaofo atoll were undertaken. Consultations on Nukunonu were also planned but not completed due to the changes in boat schedules. However, a brief meeting with the Taupulega on Nukunonu reinforced previous understanding that yellow crazy ants were not considered a concern (but were present on the atoll). A brief informal meeting was also held with the Faipule and Pulenuku (leaders of the Taupulega), and with the Health Officer. By contrast, the meetings on Fakaofo revealed a strong desire to manage the ant there, but concerns about chemicals were raised (see Analysis and Issues to be resolved on Tokelau). Approximately 60 people were involved in the consultation meetings on Fakaofo: 10 from Taupulega, 30 from Aumaga and 20 from Fatupaepae.

Consultations were conducted in English with Tokelauan translation (and translation of responses from Tokelauan to English). Topics of discussion with stakeholders in Tokelau included:

- An overview of the proposed Activity, including short- and long-term goals
- Non-chemical means of control around homes that are currently being used (see Analysis of alternatives), additional actions that could be taken around the home and suggestions for improved biosecurity (movement controls)
- An outline of the treatment aspects of Output 4 including:
  - A description of the pesticide
  - A description of the risk factors associated with fipronil-based ant baits
  - A discussion of alternative options
  - Risk mitigation actions (see Impact Management Plan)
  - Specific features of the environment that might require different approaches to treatment (pig pens, village area, vao area, coconut crabs)
  - The potential for disruption of other activities on the atoll during the treatment activities
- The need for on-going management of the ant after Activity completion (i.e. continuation of control efforts around the home)

Analysis of views and concerns expressed in Tokelau

On Atafu the attitude from all groups was supportive of treatment, and all groups were eager for control of the yellow crazy ant to begin sooner rather than later, re-affirming the strongly negative social effects of the invader. People consistently asked what else they could do in the meantime before the treatment would be undertaken. The site-specific environmental measures were again outlined, and it was stressed that these activities are likely to be required continually as eradication is unlikely. In a highly positive move, the Taupulega endorsed the inclusion of women in the workforce for treatment activities. This was welcomed by the women, although some signalled a preference to act in a supporting role (provision of food, refreshments etc.), or working in the village treatment rather than the vao treatment, while others wanted to participate equally with the men.

On Atafu the general perspective on the pesticide non-target effects was that the treatment was on the single islet and other islets had abundant coconut crabs, which were the species that caused most concern to the residents. All groups stressed an aversion to chemical sprays. The suggestion of moving coconut crabs prior to baiting was met with a lukewarm response: "the ants are killing the crabs anyway" and "it's very hard to dig out the crabs". Overall, the concern of the community was more focussed on the effects of the ants rather than non-target effects of the pesticide.

On Fakaofo, the first question asked was "Why only Atafu?", as the ant is perceived to be an increasing nuisance on Fakaofo also. However, aversion to pesticide use was noticeably stronger than on Atafu, although some Fatupaepae members noted that if non-target effects were minimised and humans were unlikely to be affected this was acceptable. The Aumaga raised the issue of the earlier baiting (2005-2006) and referred to this as a 'natural' bait. There was some surprise when they were informed this was also a chemical, albeit with a lower toxicology profile than the Antoff® bait[13]. The Aumaga asked if there could be a 'trial' of this bait on Fakaofo to compare it with fipronil on Atafu. This view was supported in later discussion with the Faipule and Pulenuku (Taupulega leaders). However, we now know the bait used was Antoff®[13], so a trial is unnecessary.

During the brief meeting on Nukunonu the Taupulega expressed gratitude for the presentation about the project but did not respond further. The Taupulega were more concerned about a current problem regarding mosquitos on the atoll which they asked for help with. The brief informal meeting with the Faipule and Pulenuku revealed an interest in biosecurity but a lack of awareness of the role all members of the community play in this issue. The meeting with the Health Officer revealed that advice had been sought from SPC and had been communicated to the Taupulega.

Issues remaining to be resolved in Tokelau

It appears there are no issues that require resolution before proceeding with treatment Atafu. If treatment is to be undertaken on Fakaofo this requires a full survey of the distribution and abundance of the ant there, along with ESIA. Further consultation will be required with the community to clarify that the bait that was used earlier is the same as proposed for this treatment. Women in particular had strongly negative views about pesticides, so these issues need to be openly discussed before proceeding to any treatment.

During the consultation process on Atafu it was discovered that some groups are excluded (either by choice or circumstance) from the standard approach to group consultation in Tokelau (i.e. formal consultation is often limited to discussions with Taupulega, Aumaga, Fatupaepae and Tupulaga). The Tupulaga (youth) could not be consulted on either Fakaofo or Atafu Although village working men (Aumaga) were consulted, many people (mostly women) work for the village public service, and were thus not available for the Fatupaepae or Aumaga meetings as these are typically held during the working day. Many women (particularly younger women and those employed) apparently choose not to take part in the Fatupaepae activities. Many residents of non-Tokelauan ethnicity work for the public service so these people were unlikely to have been involved in the consultation activities. However, the project was discussed with them in ad-hoc and informal settings during the visit to Atafu. The consultation also revealed that information provided to the Taupulega, Aumaga and Fatupaepae does not consistently result in information filtering through to the wider community. To address these gaps, prior to the treatment being undertaken, a meeting will be held with the entire village, to discuss environmental impact and safety concerns. The Taupulega calls meetings like this from time to time and all villagers are required to attend.

[13]Conflicting information about the active ingredient used in 2005-2006 meant that at the time of consultation it was assumed that the bait used contained indoxacarb. Indoxacarb was reported to have been chosen as it had a lower toxicological profile than fipronil. Since the consultation it has become apparent that Antoff® (formerly known as Pestoff 01®) was used in 2005-2006.

If the proposed Activity is funded, time will need to be spent on Nukunonu to raise awareness of the importance of biosecurity, and the importance of being prepared for the types of problems caused by invasive species and pests, and to focus on prevention rather than acting in a reactive way once problems are established. The Health Officer voiced support for the Activity and highlighted the fact that biosecurity is also important for keeping disease out of the atolls (e.g. the concern about mosquitos in light of the current outbreak of Dengue fever in Fiji and Kiribati) meant that a greater need for co-operation among departments was needed.

Consultation in Kiribati

A visit to Tarawa was undertaken between 17 and 21 February to consult with government partners for the proposed Activity (ECD and ALD in MELAD), and the environmental impact aspect of the work was discussed to identify any concerns and the process required for EIA. No community consultation was undertaken as no treatment is planned on Tarawa.

On Kiritimati, the primary stakeholders identified were the owners and employees of the businesses in the area where the yellow crazy ant infestation occurs. As the buffer zone for treatment does not encroach on any residential land the consultation was limited to businesses in the affected area. The Permanent Secretary for MLPID was also identified as a stakeholder. Stakeholders were consulted individually on 28 February. In total, 9 of the 10 shop owners at the edge of the infestation were consulted, along with the employees of the MLPID building yard, MLPID water supply and sanitation project, Government Fisheries Office, Captain Cook Hotel boatyard, Central Pacific Producers (private fisheries), Kiribati Shipping Service Limited, Ministry of Commerce Industry Co-operatives, Wildlife Conservation Unit, and the MLPID generator housing. A total of 35 individuals were consulted. The Officer in charge for ALD in Kiritimati undertook the consultation after a briefing, and translated the responses from i-Kiribati into English.

Although the wider community will benefit from treatment of the yellow crazy ant from a biosecurity perspective, the awareness of the problem is confined to only a few stakeholders.

Topics of discussion with stakeholders included:

- A brief overview of the reason for the consultation
- An outline of the treatment aspects of Output 4 including:
  - A description of the pesticide
  - A description of the risk factors associated with fipronil-based ant baits
  - Risk mitigation actions (see Impact Management Plan)
  - The potential for disruption of other activities during the treatment activities

Analysis of views and concerns expressed in Kiribati

Although the yellow crazy ant is not present on Tarawa, the issue of the ant and biosecurity against the threat of invasive ants in general was seen as a high priority for the directors of ALD (Tianeti Beenna Ioane) and ECD (Nenenteiti Teariki-Ruatu) and the Officer-in-Charge of Biosecurity (Roota Paula). In fact, ECD is already undertaking awareness workshops on the outer islands to increase vigilance against invasive species, including the yellow crazy ant in their presentations. The groups voiced strong support for management of the ant on Kiritimati and are concerned with conservation implications, possible effects on agriculture and trade constraints if the ant is not managed. This view was also shared by the Permanent Secretary for MLPID (Wiriki Tooma) who was consulted during the visit to Kiritimati, and who signalled a preference for some action to be taken to manage the yellow crazy ant this year if possible.

Kiribati has defined processes for permits for activities involving pesticide use and environmental impact assessment is a requirement of the permitting process, managed by ECD in Tarawa. This will be undertaken if the proposed Activity is approved.

On Kiritimati, some time was spent discussing the yellow crazy ant with the people on the periphery of the infestation. Only one of the 10 shop owners had seen the ant. Most of the shops sell general household groceries and some food. The shops were also home to the proprietors, one of which was a family with young children (1-3 years old). Many people offered help in keeping children away from the pesticide. Two people were concerned about ants bringing pesticide inside the shop, and were advised that ants would only bring the pesticide inside if there were nests inside and that we would treat any nests inside with hot water prior to Antoff® treatment. One person was concerned about the cats he kept for pest control. As the cats on Kiritimati are not fed by people, they may be attracted to the bait matrix. Although they may be unlikely to ingest a sufficient amount to cause harm it is possible they could eat enough to interfere with the efficacy of baiting. People seemed unconcerned about the effects on land crabs or fish, but this may have been because they accepted the mitigation measures that were discussed. A number of people were concerned about children tampering with the bait. One person reported that residents in the area have their children collect *Morinda* fruit at night to feed to the pigs. However, this does not happen on a daily basis. No chickens were observed foraging around the proposed treatment area, but they may be present at the time of treatment.

Issues remaining to be resolved in Kiribati

If the Activity is approved, a permit for the Treatment will be required by ECD in Tarawa, using this ESIA as a basis for risk assessment.

The issue of whether cats and chickens eat Antoff® bait, how it might affect them, and how it might affect baiting if they do eat it could be followed up. It would be beneficial to have a night watchman on duty in the area of the infestation to make sure children do not use the area. Although we talked to employees of the businesses in the affected areas, the supervisors or managers were often not present, or in Tarawa, so will need to be contacted prior to treatment being undertaken.

The option of not undertaking treatment has not been considered in the case of either Atafu or Kiritimati. In Atafu, the people have strongly indicated on numerous occasions they wish something done about the ant. As the yellow crazy ant is known to have significant effects on conservation and environmental values, preventing its spread to PIPA (the world's largest UNESCO World Heritage Area) in Kiribati is a high conservation priority. In addition both ECD and ALD have expressed support for management of the ant in Kiritimati. In order of preference integrated pest management should involve: 1) site-specific environmental measures; 2) biological control; 3) pesticide application. However, the most important measure is prevention, and a major focus of the proposed Activity is on enhancing biosecurity and preparedness.

Site-specific environmental measures

The majority of people of Atafu did not implement any measures until approximately 2011, when the ant became an increasing nuisance around a number of houses. Since then families have increasingly been using a number of site-specific environmental measures to limit the effects of the ant around the home such as luring away from houses with sugar solutions, keeping the proximity of houses free from rubbish and plant refuse, and applying hot water or sea-water to nests to kill queens. Recently EDNRE has offered a "bounty" of $2 per head for every queen ant caught. These measures are proving effective to some degree in reducing the effects of the ant around homes, and the survey of ant abundance in February 2014 observed that some homes were being kept relatively ant free. However, these options are only effective at a small scale, and the presence of the ant at high densities in the vao continues to be unsettling to the community. The major infestation of ants at high density in the vao of Atafu is too extensive to be treated using the measures discussed, and concerns from the community about the ant reaching the same abundance in the village suggest that alternative measures may also be of benefit around the homes (i.e. pesticide use). It has been stressed on numerous occasions that eradication is not achievable and the site-specific measures will likely continue to be required over the long term.

On Kiritimati the situation is markedly different, as the yellow crazy ant infestation is in a commercial area and limited to one hectare (at time of detection in early 2013). When the infestation was first discovered, site-specific environmental actions included distributing sea-water onto the nests. This resulted in flushing out a large number of queen ants which were then killed, however limited resources (time, staffing, transport) and the effort required to undertake this method of control has meant this has been discontinued. Unfortunately however, movement controls have not been enforced. As pesticide treatment is relatively quick and less labour intensive at this small scale, with relatively small risks to the environment, it seems highly prudent to effect this before the problem gets out of hand, and address the issues regarding resources to enhance biosecurity and capacity to manage these ants (and other potential invasive ants) in the future as a longer term goal (See Activity Design Document).

Biological controls

No biological control options are currently available for ants, and most ant species typically have no significant predators. However, the population crashes occasionally seen in yellow crazy ants and other ants suggests disease may be responsible (similar to colony collapse disorder in bees). Some work is being undertaken by various research groups on the potential of viruses, microsporidia and other parasites and pathogens as biological controls, but this work is complex and to date no effective option has been identified.

Pesticide options

Preferred options for treatment products for ants are those whose effects on target and non-target species are well known. For yellow crazy ants the product with the most information on these aspects is Antoff®, which has been used successfully for eradication of yellow crazy ants in Arnhem Land and Christmas Island, Australia.

Insect Growth Regulators (Distance Plus® with pyriproxyfen as the active ingredient) have been trialled on yellow crazy ants in Arnhem Land, Australia , Dr Ben Hoffmann of CSIRO Australia, but its efficacy is short term and non-target effects are observed on resident invertebrates. Dr Hoffmann indicates that Distance Plus® provides 'great control' (i.e. management goals have been met but eradication has not been achieved except on a small trial on three nests). In addition, this option requires 3-4 treatment within a season and long-term use, adding significantly to the cost and effort of the work.

A number of treatments with different active ingredients have been or are used to treat yellow crazy ant infestations. Spray treatment has also been used (on individual nests only), but more often the active ingredient is combined with a bait matrix. In addition to fipronil other candidate active ingredients for yellow crazy ants include indoxacarb, hydramethylnon and bipenthrin. All have some non-target effects. Biforce® with bifenthrin is used in Fiji, and SPC Entomologist Maclean Vaqalo has used this in Nauru in partial treatment of a seven hectare infestation of yellow crazy ants. Mr Vaqalo reports that Biforce® is very fast-acting. Fast-acting pesticides are effective in killing workers. However, to be able to kill queens, pesticides need to be slow-acting so that they do not kill the workers before they have fed the queens. Thus colonies persist. This fast action is likely due to the relatively high concentration of the active ingredient (2g/kg of bait). In addition Biforce® requires an application rate of 60kg per hectare, and non-target effects are similar to fipronil. Although no information is available on the effectiveness of Biforce® on yellow crazy ants this option does not appear to be an optimal choice, given the high concentration of the active ingredient and fast action.

In Arnhem Land in Australia's Northern Territory, in earlier work Ben Hoffmann compared broad scale coverage of pyriproxyfen Insect Growth Regulators (Distance Plus®) at the rate of 5 kg per hectare and hydramethylnon pesticide (Campaign®) at the rate of 5 kg per hectare) with the fipronil based product (Presto 01®) at a rate of 10 kg per hectare. Although eradication was achieved after a number of applications with Campaign®, Dr Hoffmann concluded that the fipronil-based product (then called Presto 01® and now Antoff®) obtained the best results.

No publicly available, peer-reviewed quantitative assessments have been made to compare the efficacy and risk profiles of Insect Growth Regulators, indoxacarb-, bipenthrin-, fipronil- and other pesticide based ant baits on yellow crazy ants in atoll environments.

Pesticide resistance has not been reported in any ant species including yellow crazy ants. However, excessive use of pesticides is linked to resistance, and the proposed Activity minimises the exposure to pesticide with treatments only proposed annually.

The World Bank requirements for funding projects that require the use of pesticides stipulate that: "(a) They must have negligible adverse human health effects; (b) They must be shown to be effective against the target species; (c) They must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them; (d) their use must take into account the need to prevent the development of resistance in pests". The proposed Treatment plan meets all of these requirements.

Weighing up the evidence (or lack there-of) the fipronil-based product is most appropriate for the proposed Activity as it has proven effective in Arnhem Land and Christmas Island, Australia and its non-target effects are reasonably well-known. In addition, the lessons learned on Christmas Island are of particular relevance to the Pacific atoll environment due to a number of similar ecological characteristics e.g. the effects on coconut crabs, tropical environment, porous soils, and risks of pesticide entering the marine environment.

Impact management plan

The risk components shared by both Tokelau and Kiritimati include the proximity to people's homes and businesses and proximity to the ocean and lagoon. Should treatment take place on Fakaofo, the same processes for impact management and monitoring will be undertaken.

Mitigation of risk

Pacific Biosecurity (and on Tokelau FBA Consulting) will mitigate the risks to human health in the following ways:

- Communication of the baiting process approximately two days prior to baiting to home and business owners in the vicinity of the affected area in Kiritimati and the entire village on Atafu (including school children and youth), and advice to supervise young children during the baiting period
- Placement of signs advising the community of baiting around the affected area (using images, clear symbols and local language), perimeter tape around the infestation in Kiritimati, and perhaps a 'night watchman' to watch out for children in the evening
- Prohibition of harvesting natural food in the vao in Atafu (supported by the Taupulega, communicated during the village meetings and signposted) in the days during and after treatment (until bait has been removed by the ants and is no longer visible in the environment)
- Moving pigs to smaller pens within the pig sty rather than allowing them to roam freely in the area. Use of bait containers in trees rather than broadcast baiting around homes and in the penned areas where pigs will be held
- Following the safety precautions for storage, handling and disposal recommended by the manufacturers and outlined in the operational processes. Ensuring all workers follow these precautions
- All safety equipment will be brought to site if there is not suitable equipment already at each location.
- Personal protective equipment will be provided to all of those involved, and a safe washing procedure for cleaning clothes after use will be identified
- Providing safety training to all workers
- Potential health effects will be advised to the community (based on the reported effects of sprays)
- Surveys to identify any human health effects will be undertaken as part of monitoring. Although no effects have been reported for Antoff®, this may be because the product has not been used in areas where people are present, or no monitoring has been reported. If it is suspected that health effects have occurred, treatment may be discontinued at the discretion of the community.

Mitigation of the risk of pesticide contamination of the ocean and lagoon (including marine life) includes:

- Using a granular bait matrix rather than spray application
- Undertaking management only in the dry season
- Undertaking management on days where the risk of rain in the 4-6 hours following baiting is highly unlikely
- Ensuring a buffer zone of 5 metres above the high tide level
- Relocating coconut crabs found in the treatment area.

Managing the potential for pesticide resistance will include:

- Limiting treatment to annual occurrences (this is also the maximum feasible number of treatments for logistic and financial reasons).

Given that the infestation on Kiritimati is in a degraded, developed terrestrial environment, non-target effects on crops, natural food resources and natural enemies are highly unlikely. The risks most likely to occur in Tokelau are to land invertebrates (natural enemies and natural food sources, particularly coconut crabs), and possibly shore birds. As the community was accepting of coconut crab mortality, this risk will not be mitigated for (however, if coconut crabs are found in the open prior to and during baiting, they will be

moved out of the area). The Activity will, however, monitor animal abundance and mortality. Any effects on fauna will be assessed and reported back to the community.

Monitoring program

The purpose of monitoring is to assess the non-target impacts, which will provide useful information for management of yellow crazy ants in other projects, and validate the success of the treatment in reducing ant abundance and distribution. This information will also enable assessment of the risk versus reward of continuing yellow crazy ant treatment. Outcomes of monitoring will be reported back to the Steering Committee.

Treatment and monitoring timetable

Table 1: Approximate timetable of treatment and monitoring activities, based on treatment activities occurring in the dry season in both Tokelau and Kiritimati. Red text indicates Pacific Biosecurity and in-country staff undertaking treatment / monitoring. Blue text indicates Pacific Biosecurity, FBA consulting and in-country staff undertaking treatment / monitoring (in Year 2 this is potentially without FBA Consulting depending on the capacity developed in Year 1 and the effect of treatment in Year 1). Green text indicates in-country staff independently undertaking monitoring.

	Years 1 - 2			Years 3 - 5		
	May - June	November - December	February - March	May - June	August - September	November - December
Kiritimati	treatment	monitoring	monitoring	monitoring	monitoring	monitoring
Tokelau	treatment	monitoring	monitoring	monitoring	monitoring	monitoring

Monitoring methodology

Ecological monitoring

A BACIPS approach will be used for monitoring, comparing multiple sites within the infested area before and after treatment, and comparing treated sites with control sites on islets (or areas) uninfested by yellow crazy ants. Surveys will be repeated twice per year, continuing 2 years after the final treatment.

In Atafu (and likely later in Fakaofo) standard assessments (along ten 100 metre X 2 metre transects throughout the treated area) will be made of living and dead: coconut crabs and hermit crabs, birds (sea birds and shore birds), and lizards to assess the impacts of treatment on these species. Pitfall traps will also be placed along the transects and retrieved after 24 hours to assess invertebrate diversity and yellow crazy ant abundance. Card counts[14] will also be used to assess yellow crazy ant abundance. The lagoon shore around the treatment area will be scanned for washed up marine life.

On Kiritimati, the nature of the site of the infestation makes monitoring for non-target effects via the use of transects un-workable. Instead monitoring will be via visual surveys of the entire area, and a corresponding uninfested area of the same size.

The ecological outcomes of monitoring will be assessed and reviewed immediately after monitoring has taken place, and reported back to the stakeholders (EDNRE / MELAD, local communities). The treatment programme will be adapted and may be revised dependent on the results of monitoring. For example, if monitoring uncovers unforeseen negative impacts, further treatment may be discontinued. If monitoring reveals an absence of yellow crazy ants (for example on Kiritimati after Year 1) treatment may be discontinued (however monitoring will continue).

[14]Gruber et al. 2012. Population decline but increased distribution of an invasive ant genotype on a Pacific atoll. Biological Invasions:1-14

Social monitoring

In addition to monitoring non-target effects, surveys of the local community will be undertaken on Atafu and Kiritimati to attempt to detect possible effects on human health, to determine if symptoms reported to occur in spray treatment with fipronil also occur granular Antoff®, or if other symptoms are evident. As Pacific Biosecurity is attached to Victoria University, the university's human ethics regulations apply for surveys involving people's health. Surveys will be designed according to the university's Human Ethics Guidelines and will be vetted and approved by the Victoria University Human Ethics Committee.

At the end of Year 3 surveys will also be taken of the Atafu community to gain their perceptions of changes in the effects of yellow crazy ants on their lifestyle, and effects on the environment. This will be compared with the 2012 survey and will be designed according to the university's Human Ethics Guidelines and vetted and approved by the Victoria University Human Ethics Committee.

The ecological and social outcomes of monitoring will be assessed and reviewed immediately after monitoring has taken place, and reported back to the stakeholders (EDNRE / MELAD, local communities). The treatment programme will be adapted and may be revised dependent on the results of monitoring. For example, if monitoring uncovers unforeseen negative impacts, further treatment may be discontinued. If monitoring reveals an absence of yellow crazy ants (for example on Kiritimati after Year 1) treatment may be discontinued (however monitoring will continue).

Quality Assurance of Operational Processes

Overall management of the treatment and monitoring activities is the responsibility of Pacific Biosecurity. Pacific Biosecurity is responsible for ensuring all mitigation measures, safety procedures and monitoring is undertaken according to the details outlined in this plan.

On Tokelau FBA Consulting will undertake operations according to their own professional standards and processes. However, they are responsible for following the safety procedures according to the details outlined in this plan. Should any conflicts arise between the FBA Consulting operations and the safety procedures and mitigation measures outlined in this plan, Pacific Biosecurity will have the final decision. These conditions will be noted in the service agreement / contract between Pacific Biosecurity and FBA Consulting

To ensure the operational processes follow all the safety recommendations, and that mitigation measures are adhered to, a checklist will be devised and reviewed prior to the start of each round of treatment.

Communication, complaints and reporting plan

We will seek active and open communication and engagement with the Tokelau and Kiribati stakeholders at every step of the programme. If the Activity is endorsed, the Atafu (and potentially Fakaofo) and Kiritimati communities will be further consulted at the beginning of the implementation phase, to confirm the schedule for management and identify any constraints to the schedule (i.e. other activities on the atolls that would preclude treatment occurring), confirm work schedules with community leaders and equal pay and opportunity.

Logistic planning, particularly on Tokelau, is important to the success of the project, and effective communication among stakeholders (e.g. transport department, the village council and village public service) is vital to ensure the success of the management activities. In-country, New Zealand and regional project champions (see Activity Design Document) are responsible for ensuring effective communication and will work together to ensure that logistic requirements are met.

Communities on Atafu and Kiritimati will be informed of their right to raise issues (complaints or conflicts) arising out of the management activities with the in-country partner and New Zealand lead partner (PB), or FBA Consulting at any time. All issues will be reported to Pacific Biosecurity. Contact details will be provided on signage, and to community leaders & EDNRE / MELAD staff, and made available at public meetings. All

complaints or conflicts will be recorded (including details on gender, approximate age, and name of complainant). The intention is that any issue will be resolved between the parties where possible, and as soon as possible. If complaints or conflicts cannot be resolved, these will be escalated to the Activity Steering Group for resolution (see Activity Design Document for description of Steering Group).

FBA Consulting will provide a report to PB within one month of treatment activity completion. PB will report to the communities (and EDNRE / MELAD) regarding the outcomes of treatment and monitoring within two months of activities being undertaken. This reporting will feed into the Monitoring and Evaluation Plan for the Activity as a whole (see Activity Design Document for Workplan).

Table 2: Roles and responsibilities of parties

Organisation and Role	**Responsibilities**
Pacific Biosecurity Activity Leader	Undertake treatment and monitoring on Atafu and Kiritimati, Ensure appropriate parties (Taupulega and community on Atafu, business owners on Kiritimati) are fully informed, Ensure all safety and mitigation measures are followed, Maintain professional practice, Report outcomes of monitoring as described, Comply with local law and cultural expectations, Ensure effective communication, Ensure that logistic requirements are met
FBA Consulting Treatment provider for Atafu	Undertake treatment on Atafu according to best practice pest control, Meet all safety requirements, Train local workers to assist with baiting, Ensure local workers meet safety expectations, Report to PB, Maintain professional practice, Comply with local law and cultural expectations, Ensure effective communication, Ensure that logistic requirements are met
EDNRE Support Activity on Atafu In-country logistics and liaison	Ensure staff participate in treatment and monitoring, Ensure staff receive training, Undertake monitoring independently (Years 3 – 5), Ensure Taupulega and community owners informed, Comply with the safety guidelines, Adhere to the instructions given by PB and FBA, Participate in treatment, Raise concerns with appropriate parties, Report concerns to PB, Ensure effective communication, Ensure that logistic requirements are met
MELAD Support Activity on Kiritimati In-country logistics and liaison	Ensure staff participate in treatment and monitoring, Ensure staff receive training, Undertake monitoring independently (Years 3 – 5), Ensure business owners informed, Comply with the safety guidelines, Adhere to the instructions given by PB and FBA, Participate in treatment, Raise concerns with appropriate parties, Report concerns to PB, Ensure effective communication, Ensure that logistic requirements are met
Local workforce (Atafu) Provide labour for treatment and monitoring on Atafu	Comply with the safety guidelines, Adhere to the instructions given by PB and FBA, Participate in treatment, Raise concerns with appropriate parties, Report concerns to PB
Taupulega and Communities on Atafu	Support the Activity, Comply with the safety guidelines, Raise concerns with appropriate parties, Report concerns to PB
Business owners on Kiritimati	Support the Activity, Comply with the safety guidelines, Raise concerns with appropriate parties, Report concerns to PB