Determining the feasibility of invasive ant control/eradication on Tokelau:

Scoping Phase

A BEST PRACTICE MANUAL

Draft #1

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Background

The biodiversity and unique lifestyle of the Pacific region is under serious threat from several species of invasive ants. Past invasions in other parts of the world have demonstrated that once established outside their native ranges, these ant species cause significant economic, environmental and social impacts. Invasive ants already plague many Pacific Islands (See Appendix G - I for case studies), but special concern has arisen recently because of the presence of the red imported fire ant (RIFA) on both sides of the Pacific. The red imported fire ant causes significant damage to crop and livestock production; threatens native biodiversity and, due to its painful, sometimes fatal, sting has considerable social impact. The farming practices and way of life of island communities make the Pacific particularly vulnerable to these effects.

A coordinated regional effort is underway to address the threat of ant invasions in the Pacific. It is anticipated that this effort will culminate in the implementation of a comprehensive Pacific Ant Prevention Programme. The programme will be based on the Pacific Ant Prevention Plan (PAPP) produced in September 2003 by ant specialists forming a Pacific Invasive Ant Group under the sponsorship of the Invasive Species Specialist Group (ISSG) and its Cooperative Islands Initiative.

The Plan aims to prevent red imported fire ants and other invasive ant species with economic, environmental and social impacts, entering and establishing in or spreading between, or within, countries of the Pacific Region, thereby protecting economic, social and environmental interests in the area. The following ant species have been identified in the PAPP as high risk, high impact species for people and ecosystems on tropical Pacific Islands:

- *Anoplolepis gracilipes* - yellow crazy ant
- *Linepithema humile* - argentine ant
- *Monomorium destructor* - Singapore ant
- *Monomorium phaoronis* - pharaoh ant
- *Paratrechina longicornis* - black crazy ant
- *Pheidole megacephala* - big headed ant
- *Solenopsis invicta* - red imported fire ant
- *Solenopsis geminata* - tropical fire ant
- *Solenopsis papuana* -
- *Tapinoma melanocephalum* - ghost ant
- *Technomyrmex albipes* - white footed ant
- *Wasmannia auropunctata* - little fire ant

The Pacific Ant Prevention Plan lays out the recommended measures - including, measures to ensure the region has procedures and capabilities to manage ant incursions -

that are required to achieve the goal. The development of best practice for managing ant invasions will be crucial for the successful implementation of the programme. This template for a feasibility study for controlling or eradicating exotic invasive ant species will ensure such practices are used throughout the Pacific.

Why conduct a feasibility study?

Failure to successfully control or eradicate invasive insects, and in particular ants, has often been due to lack of planning, minimal knowledge of the species involved, and underestimation of the resources, time and money needed to carry it through to completion. In order to be successful, you need to know if it is actually feasible to do what you want to do, given your resources.

This template aims to provide a step-by-step guide to the initial ***scoping phase*** of a three-phase management programme to control invasive ants on Pacific islands. The three phases are:

1. ***The scoping phase***, in which the feasibility to undertake a successful programme (whether control or eradication) is determined;
2. ***The treatment phase***, which aims to reduce populations of the ant, or eradicate from a specified region, typically using toxic baits;
3. ***The post-treatment monitoring phase***, which confirms results of the treatment/s and might form part of a long-term monitoring system that fills biosecurity needs of your country.

The Scoping Phase

This phase involves the strategic planning, sourcing of funds and laying of groundwork to determine the feasibility of eradicating or reducing ant infestations. For example, is the range small enough that eradication could be successful? There is a fine balance of funding, resources and time required to carry out a successful control/eradication program. Strategy, rationale and initial planning and sourcing of funds are aspects of the programme that each island/country will most likely carry out independently. However, there are details that, without experience in invasive ant control, organisations responsible for the program might overlook.

Use this manual as a step-by-step guide as you conduct a feasibility study. It is intended to be followed in chronological order, but there is valuable information in the appendices that provide details for those new to the field of ant control. Always refer to case studies, methodologies and experimental designs; and find out who to contact and where they are in the appendices. Good luck.

Step 1. Species identification

The species of concern should always be confirmed by a taxonomic specialist in the first instance (see Appendix A for list of taxonomists willing to ID ants form the Pacific region). However, it is important that specimens found in locations during the scoping study be confirmed as the same species. Collect workers foraging on the ground, but also ants from nearby nests. If possible collect queens and other life stages from the nest. Most people will know what workers look like. The queen is a bigger, more robust ant, and sometimes has wings (but see Appendix C for more detail). Place the specimens in a vial or an airtight container filled with a preservative (70% - 95% ethanol is ideal) and put a **label in the vial** that has written on it all collecting details (use a lead pencil so the writing won't fade). Labels should include the location of collection, method of collection (hand collected, at bait, in pitfall trap), habitat collected in (nest, on ground, in stump, under rock), date, time and person who collected it. Some countries require you to state the preservative the specimen is kept in (e.g. Australia). There is quite a lot of information to put on the label. Use both sides if you need space on a small label!
A good example is:

Te Puka, Nukunonu, Tokelau
Hand collected from ground
24.6.2005, 1:00pm
M. Sarty
Preserved in 70% ethanol

Secure the individual vials and pack them well to send international post. You are permitted to send dead ants through international post, but must record the contents of the package on the outside. Include your address and contact details on the outside of the package also; some countries (e.g. New Zealand) will need to inspect the package and will contact you to pay an inspection fee. It is a good idea to be prepared for this!

Once you know what ant species you are dealing with, have a look at a case study that has dealt with the same species. It will help you become familiar with that species before moving on.

Step 2. Determining the ant's distribution

You need to know where all the ants are in order to kill them. It is important to determine whether control or eradication is possible, especially as the ant might be more widely spread than originally thought. Mapping its distribution will ensure that control efforts are not wasted. Techniques for mapping the distribution of an invasive ant infestation depend on the species and its biology (see Appendix B and next section – Biology & Ecology of the ant). Most basic methods will initially be based upon presence/absence visual surveys conducted ad hoc in areas ranging from natural vegetation to households, and done either on foot or in a vehicle around the most accessible parts of the island. However, formalising this process of mapping the distribution of infestations is key to the success of the program. ***DO IT THOROUGHLY!*** It may even expose other species of invasive ants previously unrecorded or unknown from some areas. In many cases, even when an invasive ant species is not detected visually, it may still be present, and several methods of detecting ants may be required, and work together, to determine the full extent of the infestation. The questions below may help in finding ants in hard-to-find areas.

Try and answer all of the following questions:

- What is the area infested (with each species of ant if more than one)?
- If there are separate infestations? If so, how many are there?
- Are there multiple islands infested?
- If there are separate infestations, or more than one island infested, are there the same number of ants in each location? (see Appendix B for methods of doing this)
- Is the area infested of conservation or economic importance?
- Are the ants actively foraging down to the waters' edge?
- Are the ants in houses (including wall cavities, electrical sockets etc)?
- Are the ants in natural areas?
- Are there food crops present? If so, are there honeydew-producing insects on any of them?
- Are the ants in disturbed areas?
- Are the ants associated with food/pot plants?
- Are the ants nesting in the canopy of trees?
- Are the ants continuing to be spread by humans?
- Have you access to a handheld GPS and GIS/mapping software (and do you need it)?

A note on getting to the ants (accessibility)

Access is likely to become the most important factor in planning the operational phase of the program (and possibly subsequent monitoring programs). Access includes access to natural as well as household situations. It will likely involve getting permission to access private land and government owned areas. If much of the natural ecosystem that is infested is NOT accessible by foot, alternative methods of placing bait must be investigated (e.g. quad bike, helicopter, ultralight plane, mechanical blowers). Both helicopters and fixed wing aircraft have been used to disperse toxic baits for the control of invasive species in uninhabited areas; possums in New Zealand, brown tree snakes in Guam, feral pigs and rabbits in Australia, and invasive ants in Hawaii and Christmas Island.

You can increase accessibility in some areas by burning understorey vegetation or clearing using bush knives or other available cutters. However, it is essential to assess the potential impact these methods have on islands where there are endangered species or other species of conservation importance. However, above all, it is vital that you be realistic in terms of how quickly people can move through thick understorey vegetation. Fatigue caused by long hours in dense scrub and high daytime temperatures can lead to reduced efficiency of bait deployment and coverage, plus low morale and motivation levels for field crew.

Mapping the infestation/s

The most accurate method of mapping the distribution of ant infestations is with Global Positioning System (GPS) equipment. If you have access to a hand-held GPS, record the locations of isolated infestations or boundaries when you are in the field. You can use these points to produce a digital map of the ant's distribution using GIS software on a computer, or to help pinpoint infestations on topographic maps that show latitude and longitude. There are many software programs available that will allow you to produce, and modify, a digital map (e.g. ArcView GIS, MapInfo) This way you can keep a log of infestations as they are found, and plan a control program accordingly.

If you do not have access to a GPS, computer or mapping software, try and draw ant infestation boundaries as accurately as you can onto a topographic map of the island, and update this map whenever you find new infestations or see a change in the distribution of each ant species. Keep all the maps you produce. They will provide essential documentation for the program.

Finding nests

Each invasive ant species makes and uses nests that look slightly different from the outside. One common trait amongst these species however, is that they have very generalist nesting habits, and will therefore attempt to nest in just about anything! Appendix C provides a guide for what to look for when searching for a particular ant species.

If you are curious about how these ant species got where they are without you noticing, the next section – the biology/ecology of the ant – will give you an idea of the attributes of invasive ants that make them good invaders.

Step 3. The biology/ecology of the ant

Some knowledge of the biology of each invasive ant species can aid in finding the ants themselves, their nests, determining its distribution, and provide tips on the timing of a baiting program. In fact, any successful control program requires an understanding of the mechanisms that promote invasion success. Invasive ant species generally have attributes that make them good invaders, but difficult to control/eradicate, and the information available on the biology/ecology of each species varies greatly. Below is a list of attributes, which are common to many 'tramp' ant species, and how each attribute might affect their susceptibility to a control/eradication program.

Polygyny

Monogyny – one queen per nest; **Polygyny – many queens in one nest**. Most invasive ant species are polygynous (except monogynous form of RIFA). The biggest challenge for control in this case is getting toxin to all the queens in the nest. Queens that do not receive a dose of toxic bait will survive to reproduce and continue the ant problem. Often it is a good idea to confirm that there is more than one queen in a nest. Excavate some nests to check.

Unicoloniality

This literally means that these ant species can form *one big colony*, consisting of many interconnected nests, where individual ants do not fight within one large supercolony. This is also called polydomy – many nests in one big colony, as opposed to monodomy, which is characterised by single isolated nests between which individual ants fight to retain their territories. Unicoloniality makes the detection of whole infestations a little bit easier, as opposed to searching for isolated nests, where foragers might be scarce (e.g. RIFA).

High interspecific aggression

Invasive ant species are intolerant of other ant species foraging in their territory. They are highly aggressive toward them, and often displace whole colonies of other (including native) species. If your problem ant has already displaced other species, it can be an advantage for control in that the impact of toxic bait on other species in the area is minimised: they have already been driven away by the invasive species.

Colony reproduction by budding

The mating of most invasive ant species occurs in their own nest, after which the newly mated queen walks to a new nest site fairly close by to start a colony of her own. Sometimes she will take some workers with her to help her out. This process often results in dense populations and enables an invasion front to expand from a single location. This characteristic can be an advantage for a control/eradication program because it eliminates the need to search for isolated nests formed in distant areas by a queen flying to start her own colony. The infested areas will most likely be aggregated and allow easier distribution of toxic bait. However, queens of the monogyne form of RIFA take part in mating flights and can start new nests at some distance from their original nest. It is also suspected that queens of the yellow crazy ant may fly to distant areas to start nests.

Association with honeydew-producing insects

Honeydew-producing insects (HDPI's; e.g. scale insects, aphids, plant hoppers) can become a pest in their own right if tending by invasive ants increases their populations dramatically. After eliminating ants, populations of HDPI's will often decrease. Alternatively, if scale insects or aphids are a problem, you might have to consider control of their populations in coordination with that of ants.

High nest and forager density

The above characteristics can lead to extreme densities of invasive ants on the ground. If the ants are at extremely high densities, they are more likely to find toxic bait, get it to the queen faster and kill the colony quicker. By removing all the bait rapidly they are also helping minimise the effects of toxic bait on other invertebrates. Often ants in the tropics are least active in the middle of the day when it is hottest. If the ants are at low densities, it provides an opportunity for other organisms to get the bait, and also for degradation of the active ingredient to occur, possibly contaminating the surrounding environment. Aim to distribute toxic bait when densities of ants are at their peak.

To determine the abundance of the pest ant species relative to other ants in the environment, use pitfall traps to collect them over a 24 or 48-hour period (see Appendix B for methods). If you have the expertise to identify other ant species, go ahead, otherwise assign 'sp. A', 'sp. B' and 'sp. C' to each different type of ant.

Read back over a case study to familiarise yourself with your particular ant species

Step 4. Resources – people, time & money

Typically, the human resources required to successfully control, or achieve eradication of invasive ants have been **massively underestimated**. If eradication is the goal, it will not be possible on the first attempt, but indeed possible, and people-power is needed for every step; determining the distribution, gathering initial information, for broadcasting bait, or deploying bait stations, for monitoring ant response to baiting, and for ongoing and continuous checking for presence of invasive ants.

PEOPLE

You will need these people to ensure a successful ant eradication/control program:

1. *Project coordinator/manager*
2. *Field crew leader* – someone who knows the area well and can supervise and manage people in the field.
3. *Field crew* (at least 3 – 4 dedicated staff)
4. Extra people for distributing toxic bait if large areas are to be baited.

The project coordinator is the first point of contact for the project. They will be responsible for setting priorities, strategic planning for the project, ordering bait and liasing with other agencies that might have done the same thing. They might also manage the maps, data and other information given to them by the field crew and residents. They will also be responsible for gaining the necessary permissions to access private land, houses, and other properties not readily accessible to the public.

The field crew leader will be responsible for planning the day-to-day activities in the field. For example, surveys to determine the distribution, collecting and correctly labelling and storing ant specimens, maintaining equipment and organising the field crew.

Ensuring there is a dedicated field crew that can work on the project until completion is crucial to its success. The field crew are directly responsible for the activities in the field every day. They are the people who will most likely know, or get to know, most about the ants' biology, habits and idiosyncrasies that are often helpful in planning baiting programs.

TIME

The timeline for an ant eradication/control program can vary enormously, depending primarily on funding and people power. In Kakadu National Park, Australia, eradication of a 33 ha area of the tropical fire ant and big-headed ant took 10 months from identification of one ant species to the start of the 2-year post treatment assessment phase. However, eradication of the little fire ant from Marchena Island, Galapagos Archipelago, has taken almost 12 years, probably because populations were missed and the area of infestation was underestimated in the initial attempt at eradication, and due to lack of funding.

If you are planning to tackle the eradication/control program with current staffing levels and local expertise, you must take into account existing demands and how any new project, especially if it is considered a priority, will fit in with these. There are some projects that cannot be put on hold, and must be coordinated to fit in with an invasive ant control program. Most importantly, BE REALISTIC.

MONEY

Funding is repeatedly the limiting factor in these kinds of operations. Funds for control of invasive ant species is becoming increasingly sought after. Appendix D provides a list of agencies and organisations that might be able to help you source funds. Sourcing funds may be an ongoing activity throughout the program; often you can complete steps one, and sometimes two, without having to apply for funding. However, most of the time there will be no spare money, and sourcing funds will have to be the first thing you do.

Step 5. Choosing a bait

If the control/eradication program is to proceed smoothly, you must choose which toxic bait you will use to kill the ants at a relatively early stage, mainly to avoid logistical hold-ups. It can often take a very long time to source the appropriate amount of a specific ant bait, ship it to the island, and ensure it is in a usable form (e.g. not too wet or dry). Furthermore, if the bait is not registered in your country, you will require a permit to use it, and these can also take time to process. Appendix E provides details of commercial ant baits as a starting point for choosing your bait. There are two main types of ant baits that are used in medium-large scale ant control; they are toxins that kill ants directly, and insect growth regulators (IGRs) that kill ants indirectly, by affecting the queens' egg laying capacity or the potential for the next generation of workers to grow properly.

TOXIC BAITS

Toxic baits are still the best way to control invasive ants. The advantage of toxic baits is that they are easy to use, soil types do not affect their efficacy, one or two treatments are usually sufficient for long-term control, they have a relatively rapid knockdown effect – the density of ants should be reduced within two weeks in most cases, and treatment requires a very small amount of toxicant compared with insecticidal spray, thus reducing contamination of the environment.

INSECT GROWTH REGULATORS

Insect growth regulators (IGRs) are toxicants that disrupt the endocrine system of insects, affecting development, reproduction, or metamorphosis. IGRs include juvenile hormone (JH) mimics and chitin synthesis inhibitors (CSIs). They have a much slower mode of action than synthetic chemical insecticides. A whole colony may not die for up to 6-8 weeks after application of an IGR. However, they are a good option for long-term ant control and eradication with potentially minimal non-target effects and environmental contamination.

IS THE BAIT ATTRACTIVE TO YOUR ANT SPECIES?

It is absolutely vital that the bait that you prefer for ant control/eradication is attractive to the ant species in question, and that they take it back to the nest and eat it. It sounds obvious, but foraging workers have been known to pick up the bait and actually dump it on a waste pile instead of feeding it other colony members. Bait on a waste pile will NOT kill the colony! Appendix F provides some methods of testing the attractiveness of granulated baits to the species of ant you are interested in controlling. In most cases, you can obtain samples of the bait from a supplier or the chemical company directly for these trials.

AVAILABILITY AND DELIVERY

Planning ahead is the best way to ensure that the bait is ON THE ISLAND or in appropriate hands before baiting is scheduled to begin. The bait must be either commercially available, registered for use at that location, or be used under a permit situation. Check the requirements for bait permits with your local environmental protection authority or chemical registration council.

Transportation of bait (especially large quantities) needs to be planned at the start of the program. Ideally, bait should be stored and transported in cool dry conditions (often difficult in the tropics).

Step 6. Non-target impacts and environmental contamination tolerance of toxic baits

Risk analyses of the potential non-target impacts of using toxic baits should be completed before a control/eradication program is initiated. This should happen through the Department for Economic Development, Natural Resources and the Environment, based in Apia, Samoa. The impacts of chemicals that have been used previously in Tokelau have left a prominent perception amongst Tokelauans that all chemicals will harm the environment. However, this is not the case. The use of DDT, for rhinoceros beetle control, Deildrin and Abate for mosquito, Zinc Phosphide, Cyanide and Warfarin for rat control are examples of how there were no risk assessments undertaken, more monitoring carried out to assess the impact on the environment of Tokelau. Consequently, the real effect of these chemicals is unknown, but the observable effect and perception is negative.

The General Fono 2003 resolution to ban the importation of any pesticide and or chemicals that will affect the people and the environment of Tokelau means that all chemicals earmarked for use on the atolls should be subject to risk analysis. Further, the Taupulega of each atoll should be aware of the risks, and make a decision on whether they will tolerate these risks for the benefit of controlling or eradicating ants.

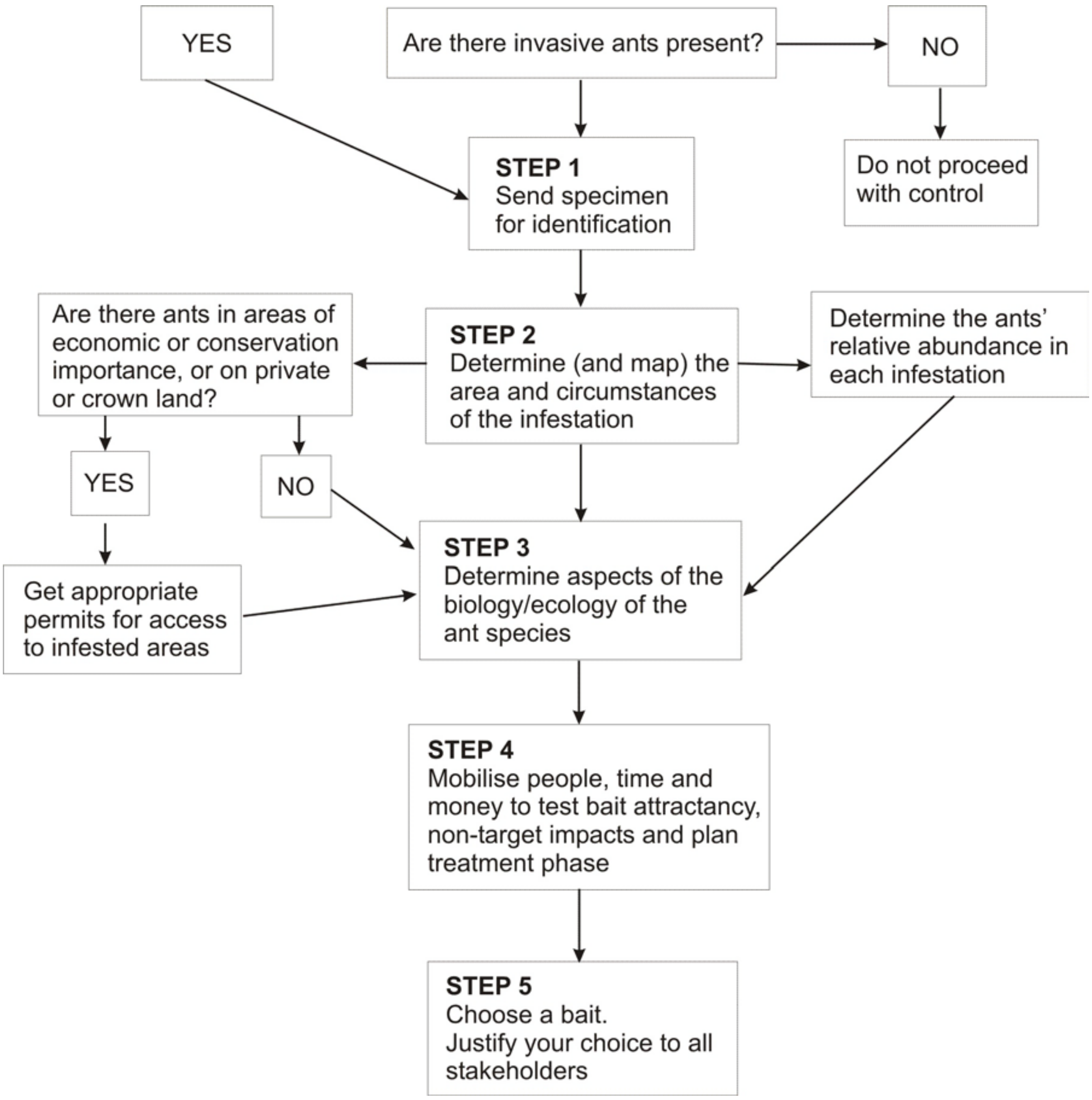
TEMPLATE FOR RISK ANALYSIS – for Tokelau to complete

POTENTIAL NONTARGETS – for Tokelau to complete

REGISTRATION ISSUES – for Tokelau to complete

Quick-reference flow chart of steps in the feasibility study:

[INCOMPLETE]



Appendix A

List of contacts for taxonomists willing to identify ants from Tokelau:

Dr Phil Lester
School of Biological Sciences
Victoria University of Wellington
PO Box 600, Wellington
New Zealand
http://www.vuw.ac.nz/staff/phil_lester/
Phone: +64 4 463 5096
Fax: +64 4 463 5331

Vivienne Van Dyk
Flybusters / AntiAnts
Box 100-287 NSMC
Auckland New Zealand
phone (09) 486 4411 int +64 9 486 4411

Disna Gunadarawana
Ministry of Agriculture and Forestry
Auckland New Zealand

Darren Ward
Landcare Research
Private Bag 92170
Auckland, New Zealand
Email: wardda@landcareresearch.co.nz

Appendix B

Methods for determining distribution

Visual surveys and hand collecting

Visual surveys are an intensive method of detecting sometimes hard to find ant species. This method allows you to look in many different habitats, e.g. tree hollows, fallen branches, soil, leaf litter and on plants. Spend the same amount of "people-hours" collecting in each area. For example, if you have 3 people collecting for half an hour each, you have completed 1.5 "people-hours" of collecting.

You will need forceps, some vials filled with a preservative (70% ethanol is good), labels for the vials, a pencil and a good notebook. Remember to keep notes on what time of day you collected, as sometimes it is too hot in the middle of the day for some species to be out foraging.

Can be done on bush walks? Anecdotal evidence at least allows more thorough checking in that area.

Attractive baits

Baiting uses food substances to attract foraging ants to a point where they can be collected or observed. From experience, people have found that tuna or cat food works extremely well in the tropics for attracting *P. megacephala, S. geminata, A. gracilipes* and *P. longicornis*. Sources of carbohydrates or sugar are also a good way of detecting ants. Use apricot, fig or some other jam, or honey on a card. This is often a good way to detect *T. melanocephalum* and *L. humile.* Some people have also used peanut butter, sausage or hot dog meat and sardines. This technique is commonly used to estimate the composition and richness of the active ground-foraging fauna, but it is a good way to confirm the presence or absence of a particular species from an area.

Pitfall traps

Pitfall traps are a simple and cheap method for recording the relative abundance of ground-dwelling ants in an area. They can be constructed out of plastic cups.

Appendix C

Finding nests – a guide for what to look for when searching for ants

- *Anoplolepis gracilipes* (yellow crazy ant)

Yellow crazy ants will literally make nests in any material that creates a small space for the queen and her brood to be protected. The most common place to find nests is under large flat rocks, corrugated iron, in or under rotting stumps and logs and debris, near drains and drainpipes, and backyard rubbish. In natural areas they will nest in cracks in the ground, burrows created by land crabs or vertebrates, and in the crowns of large trees, including coconuts. Look for swarms of ants coming form an opening and you will almost certainly have found a nest. The nest will be characterised by small white pupae inside, and often many queens. The queens are very large relative to the workers (almost 5 times the size) with a black abdomen. They are very conspicuous.

The yellow crazy ant forms supercolonies where nests are interconnected, and workers are continuous over the ground.

- *Linepithema humile* (Argentine ant)

Argentine ants prefer moist places to nest, and are often found in cracks in the concrete, under weed sheets in the garden and along streambeds. They tend to follow already made lines, so edges are a good place to find trails of Argentine ants.

- *Monomorium destructor* (Singapore ant) & *Monomorium phaoronis* (Pharaoh ant)

These two ant species are often found in and around houses, but can also inhabit natural areas a long way away from infrastructure. They inhabit wall cavities and especially like electrical wiring and sockets, where there are small warm spaces for them to make nests.

- *Paratrechina longicornis* (Black crazy ant)

Similar to yellow crazy ants, this tropical species will make nests in many places. They are commonly found in tight crevices and porous vegetation, including soft tree stumps and backyard rubbish. They will also nest in any sort of rubbish that provides shelter for the queen and her brood.

- *Pheidole megacephala* (African big-headed ant)

Nests of the big-headed ant are easily observable because of the ants' prolific soil moving activities. Nests typically occur as a mound of soil with many entrances. This ants has general nesting requirements, and hence nests are found in many different locations including lawns, at the bases of trees or buildings, within cracks and crevices, hollowed logs, up trees, in pot plants and other goods. The big-headed ant also forms distinctive foraging trails, especially along the edge of buildings, joins in concrete, and when recruiting to a food source. Big-headed ants also from supercolonies, where workers are continuous over large areas of interconnected nests.

- *Solenopsis geminata* (tropical fire ant)

Nests of this ants are typically loose piles of dirt with any number of entrances. The piles of dirt are commonly up to 50 cm wise, and can be found in the direst open locations to the wettest shadiest locations. Favourite nesting locations include watered lawns, underside of rubbish bins and 44 gallon drums, beneath irrigation pipes and underneath backyard debris. Tropical fire ants are rarely found inside houses, but instead are in the surrounding yards. It is rarely found trailing up and down trees, but prefers to stay on the ground. Nests are very transient, and the number of ants in a colony can be greater than 100,000.

Appendix D

Details of commercial ant baits **(modified from Stanley 2004, LC0405/044)**

Manufacturer details and toxin concentration in papers and reports vary according to date of publication. Company mergers and takeovers have resulted in different manufacturers on labels and registration. Manufacturer in this appendix refers to current (2004) manufacturer (company name). In general, it is easier (and faster) to obtain registration for a bait product if the active ingredient (toxin) is already registered. NB. Baits are in alphabetical order within toxin type (rapid mortality toxins; IGR; rapid mortality toxins + IGR).

Bait Trade Name	Toxin	Bait Matrix (attractant + carrier)	Bait Formulation	Manufacturer	Registered?	
					Bait	Toxin
Advance Granular Carpenter Ant Bait®	0.11% Avermectin (Abamectin)	Soy bean oil on corn grit combined with meat meal and sugar	Granules	Whitmire Micro-Gen Research Laboratories Inc., USA.		NZ
Advance Granular Ant Bait®	0.011% Avermectin (Abamectin)	Soybean oil on corn grits	Granules	Whitmire Micro-Gen Research Laboratories, Inc., USA.		NZ
Advion®	0.045% Indoxacarb	Soybean oil on corn grits	Granules	DuPont, USA.		NZ, Australia, USA
Amdro® Fire Ant Bait	0.73% Hydramethylnon	Soybean oil on corn grits	Granules	Ambrands (BASF Corporation), USA and Australia.		NZ, Australia, USA
Amdro® Lawn & Garden Ant Bait	0.9 % Hydramethylnon	Protein & carbohydrate	Granules	Ambrands (BASF Corporation), USA and Australia.		NZ
Arinosu-Korori®	0.88% Hydramethylnon	Ground silkworm pupae	Granules	Earth Chemical Company, Japan.		NZ
Ascend (Affirm)®	0.011% Avermectin (Abamectin)	Soybean oil on corn grits	Granules	Whitmire Micro-Gen Research Laboratories Inc., USA.		NZ
Blitz®	0.03% Fipronil	Citrus pulp bait	Granules	Bayer CropScience, Brazil.		NZ
Bushwacker®	18% Boric acid	Ground shrimp offal	Granules	Bushwacker & Associates Inc., USA.		NZ
Chipco Firestar®	0.00015% Fipronil	Undisclosed	Granules	Bayer Environmental		NZ

				Science, USA.		
Combat Ant Killer®	1% Hydramethylnon (granular & fipronil Combat products also available)	?	Solid: bait stations	Clorox Company, USA. (owned by Bayer/Aventis)	No	Yes
Exterm-An-Ant®	8% Boric acid + 5.6% sodium borate	Sweet solution	Liquid	Tasmex Laboratories, New Zealand.	Yes	Yes
Finitron®	0.6% Sulfluramid	Soybean oil on corn grits	Granules	Griffin Corporation (withdrawn from US market 2003)	No	Yes
Maxforce® (Granular Insect Bait)	0.9% & 1% Hydramethylnon	Ground silkworm pupae	Granules	Bayer Environmental Science, USA.	Yes	Yes
Maxforce® (FC Ant Bait Stations)	0.01% Fipronil (0.001% Fipronil Maxforce® gel bait is registered)	?	Solid: bait stations	Bayer Environmental Science, USA.	No	Yes
Mortein Nest Stop®	5.3% Boric acid + 4.3% sodium borate	Dual bait: peanut butter and honey	Solid: two inseparable baits in a bait station	Reckitt Benckiser, Australia.	Yes	Yes
NAF-464	0.05% Spinosad	Protein and sugar bait matrix	Granules	Dow AgroSciences, USA.	No	Yes
Ortho Fire Ant Killer Bait Granules®	0.015% Spinosad	?	Granules	Dow AgroSciences, USA.	No	Yes
Presto 01®	0.01% Fipronil	Fish meal pellets	Granules	BASF Australia, Australia.	No	Yes
Presto 001®	0.001% Fipronil	Fish meal pellets	Granules	BASF Australia, Australia.	No	Yes
Raid Max®	0.5% Sulfluramid	Peanut butter	Solid	S.C. Johnson & Son, USA. (Withdrawn from US market 2003).	No	Yes
Siege®	2% Hydramethylnon	?	Gel bait	BASF (CB Professional Products), USA.	No	Yes
Terro Ant Killer II®	5.4% Boric acid	Sweet/syrup solution	Liquid	Senoret Chemical, USA.	No	Yes
Volcano®	0.5% Sulfluramid	Citrus pulp bait	Several formulation types	Griffin Corporation, USA.	No	Yes

				(Withdrawn from US market 1998 – special needs permits only).		
Xstinguish®	0.01% Fipronil	Egg (protein) and sucrose (carbohydrate)	Paste	Bait Technology, New Zealand	Yes	Yes

Bait Trade Name	**Insect Growth Regulators**	**Bait Matrix (attractant + carrier)**	**Bait Formulation**	**Manufacturer**	**Registered?**	
					Bait	**Toxin**
Biopren BM® (Protect-B®; Pharaoh Ant Killer Bait®)	0.5% Methoprene	? (strong liver odour)	Granules (also available in dual attractant bait stations)	Babolna Bio, Hungary.	No	Yes
Distance®	0.5% Pyriproxyfen	Soybean oil on corn grits	Granules	Sumitomo Chemical, Australia.	No	Yes
Engage®	0.5% Methoprene	Soybean oil on corn grits	Granules	Sumitomo Chemical, Australia.	No	Yes
Esteem®	0.5% Pyriproxyfen	Soybean oil on corn grits	Granules	Valent USA Corporation, USA.	No	Yes
Extinguish®	0.5% Methoprene	Soybean oil on corn grits	Granules	Wellmark International, USA.	No	Yes
Logic® (Award®)	1% Fenoxycarb	Soybean oil on corn grits	Granules	Ciba-Geigy Corporation, USA.	No	Yes

Bait Trade Name	**Toxin (Rapid mortality + IGR)**	**Bait Matrix (attractant + carrier)**	**Bait Formulation (granules, paste, etc.)**	**Manufacturer**	**Registered in NZ**	
					Bait Toxin	
Extinguish Plus®	0.365% Hydramethylnon & 0.25% Methoprene	Soybean oil on corn grits	Granules	Wellmark International, USA.	No	Yes

Appendix E

Suggested attractancy trials for granular ant baits

For one bait type:

Place approximately 2g of bait on a 10cm x 10cm white piece of paper or cardboard, heaped in the middle of the card. If you have time, watch the card for an hour and record a) the time for the first ant to discover the bait, b) how many granules are removed in that hour (if feasible at 10-minute intervals), c) the number of ants at the bait at 10-minute intervals, d) any other ant species that come to the bait, and e) the time for ants to remove 100% of the bait (if they do). Do this with at least 5 bait cards at as many sites as you can manage/have time for. If you don't have time to watch the cards, leave them and come back at half hour intervals to record the variables (be careful they don't get disturbed by cats/dogs/chickens/pigs etc if you leave them).

As a quick and dirty idea of how the ants might take bait that is not clumped, but scattered, as it would be when broadcasted, scatter some bait and simply watch for the ants recruiting to, and removing the bait. Watch where they take it. Sometimes, if they don't like that bait, they will take it to their garbage site and dump it, never to be taken to the queen! Clearly, this spells disaster! It is important that you observe the ants taking the bait BACK TO THE NEST.

For a few bait types:

It is helpful to test the attractancy of a few different bait types while they are close together (on the same card) and also separated (on different cards placed at least 50cm away from each other). Sometimes a particular bait type might attract ants to a card with other types of bait on it, and they will not remove the "attractive" one, but another, more suitable "food" type for them. It is important to ascertain the bait that will attract foraging ants to it, and is an appropriate food for them to take back to the nest. This can also be a function of the stage that a colony is at (e.g. brood production etc). Use the same method, collecting the same information, but first with the different bait types on the same card, and then with them on different cards.

Bait stations:

Tropical, low-lying Pacific islands (particularly atolls) are sensitive environments, where the water table is often very shallow, and where residents rely on local plants and animals for food. Furthermore, many of the problems associated with invasive ants are domestic, and social. If environmental contamination by insecticides, or exposure to humans, is an issue for these places (either as decided by elders, local councils or scientists), bait stations, where bait is kept out of direct contact of soil or water, might be an alternative for ongoing control. Trialling these bait stations is simply a matter of putting them out and observing the bait being removed and taken back to the nest. The stations need to be secured in place once they are deployed (e.g. with glue, tape, wire or cable ties).

Appendix F

Case Study #1: Eradication of Big-headed ant (*Pheidole megacephala*) and Tropical fire ant (*Solenopsis geminata*) from Kakadu National Park

Hoffmann, B. D. & S. O'Connor (2004). Eradication of two exotic ants from Kakadu National Park. *Ecological Management & Restoration* 5(2): 98-105.

Target species: Big-headed ant (*Pheidole megacephala*) and Tropical fire ant (*Solenopsis geminata*)

Location: Kakadu National Park, Northern Territory, Australia

Area infested: Big-headed ant – approximately 30 hectares
Tropical fire ant – approximately 3 hectares

Circumstances of infestations: Many residential and urban sites, especially preferred microsites including potplants, irrigated areas, gardens, footpaths, and edges of buildings.

Organisation responsible for program: Parks Australia North (Managers of Kakadu NP)

Bait used: Amdro® (BASF Australia) – active ingredient hydramethylnon.

Bait distribution method: By hand – thrown from small containers or with hand-held fertiliser spreaders.

Timeline:

- Infestations systematically mapped over 3 weeks in October 2001 using visual surveys and attractive tuna baits.
- Vegetation within infested savanna areas burnt 2 weeks prior to treatment to allow easier access for bait distribution.
- First treatment outside township of Jabiru conducted in October-November 2001 (before the wet season).
- Infested areas within township of Jabiru treated in April 2002 (beginning of dry season).
- Bait stations placed around buildings….?
- Final treatment in April 2003 of liquid drench of 1000 ppm Diazinon in commercially available form of Nucidol® Dog Wash under a small scale trial permit issued by the Australian Pesticides and Veterinary Medicines Authority.
- Intensive surveys 12 months post-treatment, followed by less intense surveys between 12-24 months post-treatment.
- 24 months post-treatment with zero detection = eradication.

Appendix G

Cast Study #2: Eradication of little fire ant (*Wasmannia auropunctata*) from islands in the Galapagos archipelago

Causton, C.E., C.R. Sevilla & S.D. Porter (2005) Eradication of the little fire ant, *Wasmannia auropunctata*, from Marchena Island, Galápagos: on the edge of success? *Florida Entomologist* 88(2): 159-168.

Target species: Little fire ant (*Wasmannia auropunctata*)

Location: Marchena Island, Galápagos Archipelago

Area infested: approximately 21 hectares

Circumstances of infestations: Uninhabited natural areas. Dry eroded soil and fresh lava fields covered most of the infested area, but where vegetation was dense it was dry forest dominated by *Bursera graveolens, Croton scouleri, Waltheria ovata, Lantana peduncularis, Opuntia helleri* and *Castela galapageia*.

Organisations responsible for program: Galápagos National Park Service (GNPS) and the Charles Darwin Research Station (CDRS).

Bait used: Amdro® (BASF Australia) – active ingredient hydramethylnon.

Bait distribution method: By hand broadcasting – thrown from small containers while people walk parallel to each other along adjacent transects.

Timeline:

- Initial program started in 1992 when infested area was 0.5 hectares.
- In 1996 the program was suspended because of lack of funding
- The final program was started in 2001.
-

Helpful references for hints and history on ant control (More details and some PDF's available on the GISP website – http\:www.gisp.org.au)

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