RECOMMENDATIONS FOR FUTURE MANAGEMENT OF LITTLE FIRE ANTS IN THE REPUBLIC OF VANUATU

A report to the Government of the Republic of Vanuatu.

Casper Vanderwoude
Vanderwoude Consulting, Hilo Hawaii

Lilly Fatal,
Vanuatu Department of Environmental Protection and Conservation, Port Vila, Vanuatu; and

Sylverio Bule,
Biosecurity , Port Vila, Vanuatu

September 2015.

This report contributes to the GEF PAS project "Prevention, eradication and control of invasive alien species in the Pacific islands". It is funded by the Global Environment Facility (GEF), implemented by the United Nations Environment Programme (UNEP) and executed by Secretariat of the Pacific Regional Environment Programme (SPREP) in partnership with the Department of Environment Protection & Conservation, Vanuatu"

CONTENTS

EXECUTIVE SUMMARY

Wasmannia auropunctata (The Little Fire Ant or LFA) is a pest ant species with broad and severe potential impacts to the Republic of Vanuatu. This species threatens subsistence and commercial agriculture, tourism, outdoor life, health of people and livestock, as well as the environmental integrity of protected areas. To date, LFA have invaded three Vanuatu provinces: Torba (several islands), Sanma (Espiritu Santo) and Shefa (Efate).

The capacity of Vanuatu to manage this issue is hampered by knowledge and skills gaps, access to specialized equipment and pesticides as well as a lack of funds to dedicate to this issue. During the current phase of this project, capacity for managing this issue has been increased and project staff now have the knowledge and skills required to undertake long-term management of this emerging issue. Without action, the future for Vanuatu may be unpleasant. Little Fire Ants will continue to spread throughout the archipelago and impacts will increase in proportion to the area occupied by this species, affecting agriculture, society, tourism and the environment. Recommendations for long-term management of this issue include:

1. Development and implementation of a national response plan, shaped by the technical feasibility of eradication, aggressive control or longer-term management of known infestations.
2. Active efforts to prevent spread of LFA to uninfected islands, including creation and delivery of public awareness information; and biosecurity efforts that detect and prevent the movement of infested items between islands.
3. Acquisition of long-term funding, including funding for dedicated personnel, infrastructure, materials and travel costs that address this issues through the medium-long term.

BACKGROUND

Little Fire Ants (*Wasmannia auropunctata*) are an established and expanding invasive pest in Vanuatu, present in three of the nation's six provinces. This species poses a serious threat to the economy, ecological health and social well-being of Vanuatu and its inhabitants. Once established, Little Fire Ants form dense three-dimensional supercolonies that resemble a "*living blanket of ants*" [(1)] on the ground, vegetation and tree canopies. Ants nesting in trees are easily dislodged by wind and other minor disturbance and often fall from their arboreal homes onto people and animals below, stinging their victims and causing blindness in domestic animals[(2)]. In natural ecosystems, they prey on, or drive out native fauna, leaving an ecosystem depleted of much of its pre-existing animal life[(3)]. The mutualisms formed between Little Fire Ants and Homoptera cause crop losses in agriculture and declines in plant health for native ecosystems. The presence of Little Fire Ants poses a biosecurity threat to countries receiving goods from Vanuatu, potentially causing rejection of commodities and additional export costs for shippers.

Perhaps more importantly, Little Fire Ants (LFA) readily establish in urban areas and around human

habitation. Here, they cause extreme discomfort to all who live within infested areas by stinging residents in their homes, infesting food gardens [4] and blinding domestic pets and livestock.

This report describes the current situation in Vanuatu, outlines project-specific activities to date, and assesses in-country capacity for surveillance and treatment. Additionally, options for future management are described and discussed.

CURRENT STATUS OF LITTLE FIRE ANTS IN VANUATU

Department of Environmental Protection and Conservation staff, along with project partners, conducted delimiting surveys of the known infested areas in 2014 and 2015. Maps created by this survey effort are appended. Three provinces have at least one site infested by LFA:

1. Torba – Most of the Banks and Torres island groups, excluding Hui and Metoma islands.
2. Sanma – Espiritu Santo island: five sites in and near Luganville (Pepsi, Solway, Mango Station, Lavusvatu and the Talua Ministry Training Centre at the south of the island).
3. Shefa – Efate: four sites in and near Port Vila (Emten Lagoon, Teouma Bush, Malapoa DRK area, Manples area, Holen and Fresh Wota).

Undoubtedly there are many unconfirmed infested sites in these provinces, especially within the cities of Luganville and Port Vila.

PROJECT ACTIVITIES (AUGUST 2015)

The preliminary project report identified that staff had already acquired skills sufficient for surveying and mapping. However skills and knowledge on treatment (pesticide and bait application) were required. Two workshops were conducted; one in Port Vila and another in Luganville. Participants included staff from Department of Environmental Protection and Conservation, Department of Forestry, Department of Agriculture & Rural Development and Biosecurity Vanuatu. A participant list is appended. Each workshop consisted of one day of presentations and a day of practical training. The sessions were as follows:

Day 1

1. Impacts of Little Fire Ants in Hawaii and Tahiti
2. History of LFA spread in the Pacific region including Vanuatu
3. Biology of LFA and the basics of control methodologies
4. Control and eradication options for LFA

Day 2

1. Practical training – mixing HAL gel bait
2. Practical training – application of gel baits to trees and ground

An additional workshop was conducted for the staff of Port Vila's pest control company (EzzyKill) in to

provide pest control operators with basic knowledge to identify and report new infestations encountered during their work day. EzzyKill management has also committed to assisting with supply of pesticides.

Additional time was used for entry meetings, purchase of essential project materials and practical

treatment of infested sites as the weather permitted.

Project staff mixing baits and preparing for bait application

FACTORS THAT DETERMINE FUTURE MANAGEMENT AND RESPONSE

Six interdependent factors will determine which options are available for management of LFA in Vanuatu: capacity for survey, treatment skills, human resources, funding, an agreed plan or strategy and implementation of domestic quarantine procedures.

CAPACITY FOR SURVEY AND IDENTIFICATION

Prior to this project, the ability of project staff to survey and map LFA infestations was strengthened by delivery of a basic GPS and Little Fire Ant identification workshop conducted in 2014 by the Department

of Environmental Protection & Conservation. This workshop was a part of the Little Fire Ant eradication and management activities under the Invasive Alien Species Project Vanuatu. The Biosecurity Vanuatu & Survey Department facilitated this two day training from 1st-2nd September 2014 and included participants from Forestry department, Department of Agriculture and Rural Development and Department of Environmental Protection and Conservation.

Participants from this training course subsequently delimited several LFA infestations in and near Luganville on the island of Espiritu Santo. Five separate infestations were identified and delimited (Figure 2, Appendix A). Four infestations are located in the city of Luganville, and a fifth infestation is located at the Talua Ministry Training Centre, some 25km south-west of Luganville. Additional delimiting surveys have been conducted on Efate where four infestations were discovered (Figure 3, Appendix B).

CAPACITY FOR CONTROL OPERATIONS

Application of baits to infested land is relatively simple. During the workshops conducted in Port Vila and Santo, all participants demonstrated confidence in all aspects of mixing, application and use of appropriate personal protective equipment. During subsequent treatment operations, the project coordinator was able to record and map treatment activities through the use of the track function of a hand held GPS. A Garmin Foretrex™ 301 was used for this purpose as this model is extremely compact, simple to use and functions well under canopy cover. Refresher training (especially for project management and data management) may be required in the future.

BROAD DESCRIPTION OF METHODS

A substantial new body of research conducted in recent years has provided practitioners with effective tools necessary for control and eradication of this species. One factor that sets Little Fire Ants apart from other invasive ant species is a predisposition to form small interconnected colonies in vegetation including the tree canopy. This aspect of LFA biology is observed mostly in areas with higher rainfall and without a pronounced dry season. The windward (south-east) coasts of the islands of Vanuatu experience regular rainfall, warm year-round climates and landscapes with deep shade. These conditions are ideal for proliferation of this species. The leeward (north-west) coasts are more arid and these areas are less suitable for establishment of arboreal colonies.

New best-practice methods for treatment of LFA include the manufacture and application of species-specific gel baits. These baits, which have a consistency similar to mayonnaise, allow application to vegetation and tree canopies. The bait matrix (the attractant) can be made locally with readily available ingredients and are mostly comprised of oil, water and peanut butter. Two concentrate ingredients are needed to complete the bait: an emulsifier-thickener which facilitates the mixing of the oil and water; and an insecticide. Both items are needed in very small quantities reducing difficulties associated with ordering, transportation and importation. The total cost of ingredients to make 1 kilogram of finished bait is approximately $2.30. Treatment rates vary depending on the density of vegetation. In heavy vegetation, 20kg maximum may be needed for a single application (USD$46.00-$51.00 per ha)

Vegetable oil (soya oil is preferred) is available in food stores in Port Vila for approximately USD$4 per litre. As the bait contains 35% soya oil, the cost per kg will be USD$1.40. Peanut butter is required at a rate of 30 grams per kg bait which adds a cost of approximately USD$0.50.

The most suitable emulsifier-thickener for this purpose is xanthan gum. This is a powdered product manufactured for thickening food items such as sauces, yoghurt and other food items. It is not readily available in Vanuatu but can be purchased through overseas suppliers. A total of 7 grams xanthan are needed to produce one kg bait. Xanthan can be purchased for USD$35 per kg and shipping is $55 for 5kg product. This is approximately USD$0.33 per kg finished bait.

An effective insecticide needs to be non-detectable, effective when greatly diluted and slow acting. There are several insecticides available for purchase through a pest control company in Port Vila or from Australian suppliers.

Termidor™ or generic equivalents contain 9.1% fipronil. It is used worldwide for ant and termite control and is especially effective against LFA when used in a bait. Only 0.05% product is needed in finished bait (0.5ml per kg finished bait) having an effective concentration of 0.00455% active ingredient. One litre of Termidor™ will be sufficient to manufacture 2000kg finished bait at an approximate cost of USD$0.05 per kg.

Arilon™, contains 20% indoxacarb. This active is used in agriculture for lepidopteran control in vegetables and tree fruits. The toxicological profile of this active is exceptionally benign and is therefore a preferred option for use in food gardens and near water (fipronil is very toxic to aquatic life). Arilon™ should be mixed with the gel bait at a rate of 6g/kg (equivalent to 0.024% a.i. in finished bait). The approximate cost of Arilon™ is USD$0.20 per kg finished bait.

Baits can be applied using backpack type (piston pump type) sprayers modified with a 2D nozzle, or good quality one litre spray bottles. Bait can also be applied to the ground with a plastic water bottle after drilling a small hole in the lid[a].

ACCESS TO FUNDS

There are few successful examples of eradications for any social insect invasion worldwide. However, those projects that have succeeded share some common features. One critical feature is long-term dedicated funding for the project. This is the most critical factor and the main variable that determines project outcomes. Eradication of LFA from a single site requires a technically feasible plan that is backed by good science, repeated timely applications of bait, trained staff, close monitoring of the target population during the treatment phase and long-term post-eradication monitoring. The process of treatment and monitoring to ensure no viable colonies remain may take as long as four years and

[a] Labels must be removed and the bottles marked to clearly indicate the contents are toxic

sometimes longer. Additionally, domestic and international quarantine systems need to be implemented to ensure new introductions are prevented or managed before they spread. Without a financial commitment that funds the entire process, eradication at site, island, provincial or national scales will not be successful.

Currently the anticipated funding level, or commitment to fund any management plan, is unknown. This confounds any attempt at development of a plan. Rather than recommending a response plan, options will be presented as determined by availability of funds.

HUMAN RESOURCES

Staffs in partner agencies within Vanuatu (Biosecurity, Agriculture, Environment and Forestry) are well trained, skilled and have the technical capacity to undertake eradication or management of LFA in Vanuatu. However, these officers already have considerable workloads and cannot be expected to include additional responsibilities in their work programmes. Therefore, new positions dedicated to managing project outcomes are needed. They will need to be supported with adequate infrastructure including materials, supplies, vehicles and travel budgets.

A RESPONSE PLAN

Essential to implementing a response strategy, is a plan that includes provisions for controlling further spread (prevention), delimiting, treatment, monitoring and public outreach. One key variable is the anticipated level of funding as discussed in the previous section. A response can be categorized by project outcomes and are usually shaped by the level of funding commitment:

Eradication

A successful eradication requires that every individual of an invasive species is detected and removed from the target area. This control effort needs to be undertaken in conjunction with an effective delimiting survey to identify all instances of the invasive species and a period of post-eradication monitoring that establishes to a high probability that the invasive species has been successfully eradicated. Eradication efforts also require a high degree of public awareness and cooperation coupled with an active domestic and national biosecurity program that prevents new incursions and eliminates new populations.

Aggressive control (objectives determine budget)

Programs utilizing an aggressive control strategy place more emphasis on reducing impacts of an invasive species to levels that fall below an agreed thresh-hold. Additionally, all infestations are no longer treated as equally important. Those infestations with a lower probability of vectoring further spread, or infested sites where impacts are lesser, now have a lesser value than others.

Long-term management (budget determines objectives)

A long-term management strategy may be comprised of: provision of technical assistance, research, strategic control operations or any combination of these activities. The scope of efforts is governed by the existing budget rather than specific control objectives and is usually aimed at providing the greatest reduction in impacts with an externally determined allocation of resources.

No management

In some instances, there is no response to the presence of an invasive species. This can be for a variety of reasons including a lack of defined pest impacts, insufficient resources, or an absence of effective control options. The costs of not actively managing an invasive species are the future impacts (in perpetuity) of allowing further spread of the species.

DOMESTIC AND NATIONAL QUARANTINE

Quarantine systems are designed to reduce risks of pest and disease incursions at international borders and to respond quickly to new incursions. For island nations, domestic (or inter-island) quarantine systems can also be effective at preventing spread within a country. While Vanuatu has an effective (albeit poorly resourced) quarantine system in place, there is no provision for inter-island quarantine. Thus, if an island-scale eradication project is implemented, there is no certainty that new incursions will not re-infest pest free islands. Should eradications focus on an island-by-island approach, additional quarantine systems will need to be implemented to maintain pest free status for individual islands.

For island nations, this can be difficult to implement. First, substantial resources are required and these need to be complemented by a high level of public cooperation. Additionally, it can be very difficult to manage "grey" traffic between islands – small craft that do not necessarily depart from, or arrive at, regulated points of entry. Risks within this type of commodity movement can only be effectively reduced through a strong public outreach and awareness program that results in a high level of voluntary compliance with quarantine provisions.

OPTIONS FOR FUTURE MANAGEMENT AND RESPONSE

FACTORS DETERMINING EFFECTIVE TREATMENT

Management of Little Fire Ants is influenced by two main factors: site variables, and the biology of the species, which mostly hamper effective management.

Little Fire Ants thrive in regions with warm temperatures, regular rainfall and heavy shade. Vanuatu experiences mild seasons with little variation in temperature, humidity and rainfall though the year. Rainfall is year-round and differences in temperature between seasons are mild or moderate. This contrasts with locations elsewhere which have climates that include periods of extended cool or dry

weather. Ants living in mild climates such as Vanuatu are able to reproduce year-round rather than have bursts of colony growth followed by periods of nil growth due to conditions that are cooler or drier than optimal. These factors provide Little Fire Ants with a competitive advantage and facilitate constant reproduction and colony growth.

Colonies of many ant species have only a single queen. The production of new workers is therefore governed by the egg-laying capacity of just one queen. In contrast, Little Fire Ants have many queens – usually one queen for every 250-400 or so workers. Reproductive ability is not dependent on a single queen and recovery from a catastrophic event (such as treatment with toxic baits) can be shared by multiple queens. Colonies can recover from bait treatment in as little as eight weeks.

One trait that assists management efforts is that newly mated Little Fire Ant queens do not disperse by flight, preferring to stay with the parent colony. This limits natural spread to lateral colony expansion which may be as little as tens of metres per year. Spread over longer distances requires human assistance through transportation of colony fragments or natural events such as flooding which can expedite downstream spread.

Effective treatment and eradication of Little Fire Ants therefore requires repeated application of baits at intervals less than the capacity of colony recovery. Frequent baiting is hampered by the fact that ants surviving one treatment will associate the bait with its effects for some 4 or more weeks and refuse to recruit to new applications during that time. The time between treatment applications therefore needs to be more than four weeks and less than eight weeks. Experience in Hawaii, which has a similar mild climate, has demonstrated repeat treatments every 4-6 weeks over a 12 month period are needed for site-level eradication. This needs to be followed by a post-treatment monitoring phase of at least three years to ensure all colonies have been eliminated. Standard operating procedures, drawn from other reports[14] are appended for reference.

CHOICE OF TREATMENT PRODUCTS

Most commercial bait products suitable for this species are manufactured in granular form. These baits have the advantage of being easy to apply to the ground. However, for Little Fire Ants in tropical locations, they have several disadvantages. First, these baits become inactivated once wet. Vanuatu experiences frequent rainfall, especially during warmer months when ant activity is greatest. Second, arboreal (tree-dwelling) colonies do not necessarily leave their aerial homes to forage on the ground[11] and granular baits are difficult if not impossible to apply to vegetation. Finally, the baits are bulky and not readily available in Vanuatu. The cost of shipping will further increase project costs.

The gel baits used during training and application to infested sites are less expensive, easy to apply to vegetation and have proven effective in Hawaii and now Vanuatu. These baits were applied to all known infested sites in Luganville with excellent results reported by affected residents. Only two ingredients need to be especially imported: the active ingredient (which can be supplied by a local pest control company) and the emulsifier (which can be supplied via Hawaii). Although mixing the bait is an

additional procedure, it is a relatively simple exercise. Aside from allowing treatment of arboreal colonies, the gel baits are not inactivated by rainfall making them a better choice for use in these environments.

OPERATIONAL FOCUS

Infestations can be managed at site, island, provincial and national scales, with a goal of eradication, aggressive control, long-term management or nil response. The most appropriate response will be determined by availability of funds and human resources and may contain all variables mentioned above. Table 1 below outlines approximate efforts and costs needed to achieve desired outcomes.

Table 1. Option matrix for managing Little Fire Ants in Vanuatu

Scale	Eradication	Aggressive control	Long-term management
Site	• Material cost appr. USD$500 per hectare plus equipment • Requires ongoing site-level commitment by residents to follow through • Provision of training and instruction • Implementation of a local quarantine system managed by residents	• Annual material cost USD$250-500 per hectare plus equipment, with lower costs expected over time • Provision of training and instruction for residents	• Material cost USD$100-250 per hectare plus equipment, per year with costs constant over time • Continuing training and instruction for residents as infested area becomes larger
Island	As above plus: • On-island coordinator with vehicle and office infrastructure • Access to labour or community assistance • Commitment to follow-through for 4-5 years • Island-wide survey to ensure no new sites • Inter-island quarantine system	As above plus: • On-island coordinator with vehicle and office infrastructure, becoming 0.5FTE after year 2 • Access to labour or community assistance • Commitment to ongoing follow-through in perpetuity • Effective public engagement that detects most new infestations and prevents new incursions	As above plus: • 0.5FTE on-island coordinator with vehicle and office infrastructure • Ongoing training for residents as infestations increase • community supplies all labour • new infestations managed as they are discovered
Province	As above plus: • Budget for travel and on-island vehicle[b] • Additional labour resources • Province-wide survey to ensure no new sites • Provincial quarantine system	As above plus: • Budget for travel and on-island vehicle[b] • Additional labour resources • Provincial quarantine system	As above • Provincial coordinator may be full time or 0.5FTE as needed[b]
National	As above plus: • National coordinator • Office and travel budget • Strengthen national quarantine system if possible	As above plus: • National coordinator • Office and travel budget	As above plus: • 0.5FTE national coordinator • Travel in conjunction with other projects

[b] On-island coordinator may not be needed

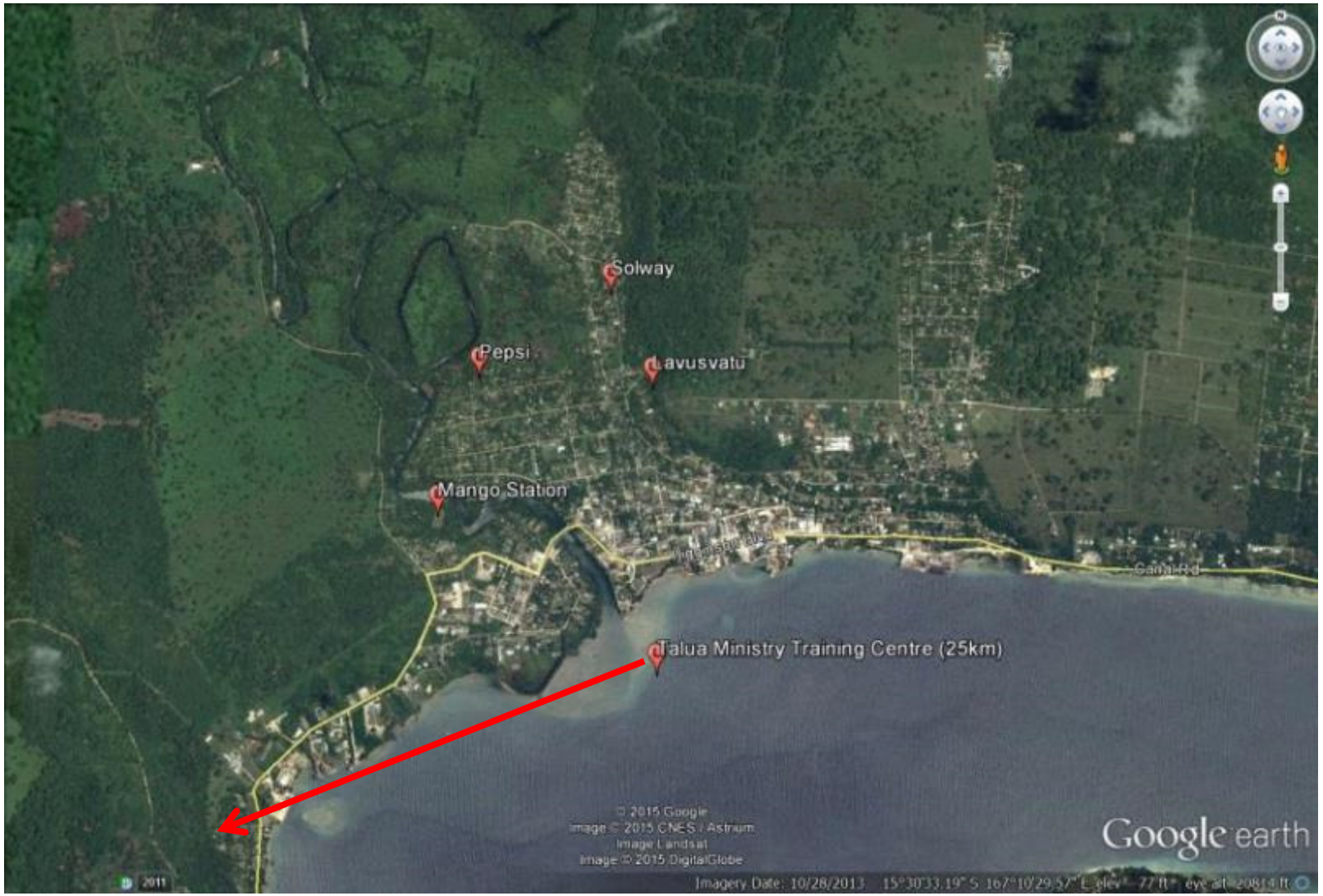


Figure 2. map of Luganville Espiritu Santo, showing areas infested with LFA (refer to Appendix A for detailed maps)

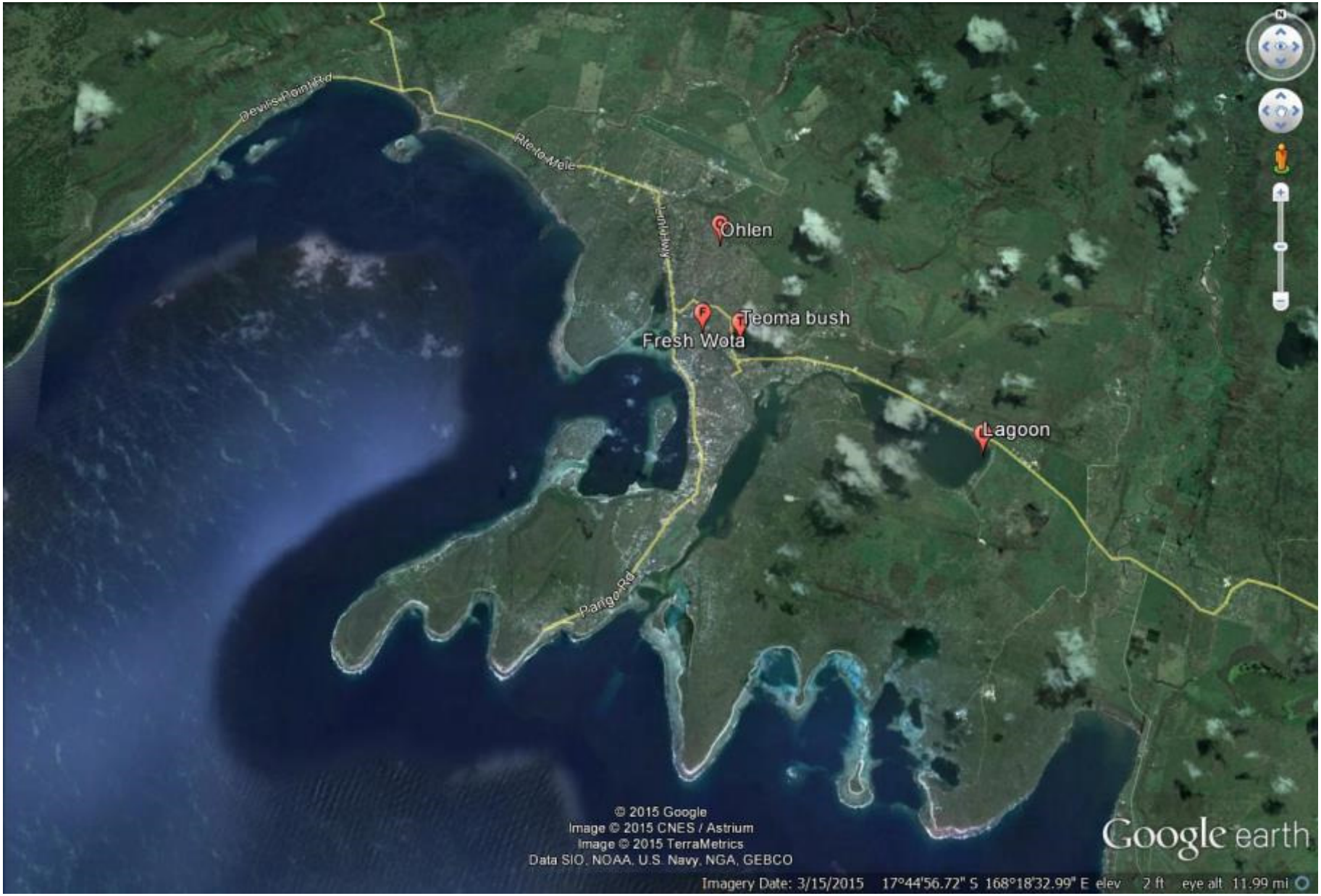


Figure 3, Map of Port Vila, Efate, showing locations infested with LFA

REFERENCES

1. Holldobler B, Wilson EO. *The Ants*. USA: Springer-Verlag, 1990.
2. Theron L. Hypothèse d'une kératopathie liée à *Wasmannia auropunctata*, le modèle Polynésien [masters]. University de Liege, 2005.
3. Jourdan H. Threats on Pacific islands: the spread of the tramp ant *Wasmannia auropunctata* (Hymenoptera: Formicidae). *Pacific Conservation Biology* 1997;3:61-64.
4. Fasi J, Brodie G, Vanderwoude C. Increases in crop pests caused by *Wasmannia auropunctata* in Solomon Islands subsistence gardens. *Journal of Applied Entomology* 2013;137:580-88.
5. Andersen AN. A classification of Australian ant communities, based on functional groups which parallel plant life-forms in relation to stress and disturbance. *Journal of Biogeography* 1995;22:15-29.
6. Armbreght I. The Little Fire Ant *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) as a diversity indicator of ants in tropical dry forest fragments of Colombia. *Environmental Entomology* 2003;32(3):542-47.
7. Souza E, Follett PA, Price DK, Stacy EA. Field suppression of the invasive ant *Wasmannia auropunctata* (Hymenoptera: Formicidae) in a tropical fruit orchard in Hawaii. *Journal of Economic Entomology* 2008;101(4):1068-74.
8. Ulloa-Chacon P, Cherix D. The Little Fire Ant *Wasmannia auropunctata* (R.) (Hymenoptera: Formicidae). In: Vander meer RK, Jaffe K, Cedeno A, editors. *Applied Myrmecology A World Perspective*: Westview Press, 1990:281-89.
9. Fabres G, Brown jnr W. The recent introduction of the pest ant *Wasmannia auropunctata* into New Caledonia. *Journal of the Australian Entomological Society* 1978;17:139-42.
10. Ikin R. Cocoa tree-ant. *Quart. Newsl. FAO Asia Pac. Plant Protect.Comm* 1984;27:8.
11. Wetterer JK, Porter SD. The Little Fire Ant, *Wasmannia auropunctata*: distribution, impact and control. *Sociobiology* 2003;41(3):1-41.
12. Vanderwoude C. Little Fire Ant (*Wasmannia auropunctata*) in Port Vila: Report to Secretariat of the Pacific Community on activities 5-14th October 2007, and recommendations for future management: VCL New Zealand, 2007.
13. Foucaud J, Orivel J, Loiseau A, Delabie JHC, Jourdan H, Konghouleux D, et al. Worldwide invasion by the little fire ant: routes of introduction and eco-evolutionary pathways. *Evolutionary Applications* 2010:1-13.
14. Vanderwoude, C., Haynes, D., Richards, E., Quinquis, B. Moverley, D. and Skelton, P.A. Managing the impacts of the little fire ants (*Wasmannia auropunctata*) in French Polynesia. Secretariat of the Pacific Regional Environment Programme, Apia, SAMOA, 2014.

APPENDIX A. DETAILED MAPS OF DELIMITED LFA INFESTATIONS IN LUGANVILLE

Lavusvatu

Mango Station

Pepsi

Solwei

Talua Ministry Training Centre

APPENDIX B. DETAILED MAPS OF DELIMITED LFA INFESTATIONS IN PORT VILA

Fresh Wota

Lagoon area

Ohlen

Teoma

APPENDIX C. SCHEDULE OF IN-COUNTRY ACTIVITIES 17-28 AUGUST

16-17 August
Travel from Hilo Hawaii to Port Vila Vanuatu

18 August
Entry meeting with project managers
Meet with Project staff at Vanuatu Department of Environmental Protection and Conservation
Presentation to workshop participants:

5. Impacts of Little Fire Ants in Hawaii and Tahiti
6. History of LFA spread in the Pacific region including Vanuatu
7. Biology of LFA and the basics of control methodologies
8. Control and eradication options for LFA

19 August
Practical training – mixing HAL gel bait
Practical training – application of gel baits to trees and ground

20 August
Meeting with George Regenanu, operations manager of Ezzykill Pest control re future supply of chemicals, application equipment and personal protective equipment
Training – Methods for managing GPS survey and treatment data, basic mapping and QA of treatment operations

21 August
Field application of baits in infested areas (cancelled due to rain)

22 August (Saturday)
Presentation by C. Vanderwoude and L. Fatdal to professional pest control operators regarding impacts and importance of reporting suspected LFA infestations

23 August (Sunday)
rest

24 August
Travel to Espiritu Santo

25 August
Meet with project staff at Vanuatu Department of Environmental Protection and Conservation, Vanuatu Department of Biosecurity and affected neighborhood residents.
Presentation to workshop participants:

1. Impacts of Little Fire Ants in Hawaii and Tahiti
2. History of LFA spread in the Pacific region

3. Biology of LFA and the basics of control methodologies
4. Control and eradication options for LFA

26 August
Practical training – mixing HAL gel bait
Practical training – Treatment of Solwei infested area

27 August
Field treatment of remaining infestations at Luganville
Exit meeting

28 August
Return to Port Vila,
Depart Port Vila

Little Fire Ant Management and Control Training

Date : 25th Aug 2015

Field Work: 26th/08/2015 Solwei, 27/08/2015 Lavusvatu, Pepsi, Mango Station & -28/08/2015 Talua

Venue : PWMU Conference Room, Centenary Church , Santo

Date	*Name*	*Contact*	*Organization*
8/25/2015	New Tangis	5536717	Sanma Sports Officer
8/25/2015	Vuti Takasi	5546335	South Santo Area 2 rep
8/25/2015	Jojo Erickson	5360467	Trainee, Biosecurity
8/25/2015	Simon Jack	5448227	Trainee, Biosecurity
8/25/2015	Manford Genegle	5363785	Trainee, Biosecurity
8/25/2015	Judith Damien	7743671	Solwei Community Rep
8/25/2015	Jaymi Andy	5457279	Solwei Community Rep
8/25/2015	Frank Norman	5965415	Solwei Community Rep
8/25/2015	Tahe Tamath	7761527	Pepsi Community
8/25/2015	Bibi Leonardo	5603029	Pepsi Community
8/25/2015	Borang Henry		Solwei Community Rep
8/25/2015	Nalsyn Kelep	7773808	Pepsi Community
8/25/2015	Warakar Ser	36807	Live & Learn Invasive Species Officer
8/25/2015	Tony Rapick	5453889	
8/25/2015	Ray Vilvil	rayvilvil@gmail.com/ 7777192	Luganville Environmental Officer
8/25/2015	John Freddy	jkouback@vanuatu.gov.vu	Department of Agriculture, Santo
8/25/2015	Robinson Solomon	5669715	Department of Agriculture, Efate
8/25/2015	Philemon Ala	7726670	Assistant Botanist,Department of Forestry
8/25/2015	Sylverio Bule	5624447	Plant Health Officer, Biosecurity
8/25/2015	Ethel Aru	5481679	Trainee, Department of Forestry
8/25/2015	Maylene Muru	imuru56@gmail.com/ 5608289	Trainee, Department of Forestry
8/25/2015	Rinneth Kaltong	leahk323@gmail.com/548891	Trainee, Department of Forestry

APPENDIX D. STANDARD OPERATING PROCEDURES FOR TREATMENT ACTIVITIES

STANDARD OPERATING PROCEDURE - APPLICATION OF GRANULAR BAITS TO CONTROL LITTLE FIRE ANTS

PURPOSE AND SCOPE

This standard operating procedure describes recommended methods for treating Little Fire Ant (*Wasmannia auropunctata*) nesting on the ground or in vegetation under 1.5 metres in height. This standard operating procedure should only be used by persons who have undergone practical training in this activity.

INTRODUCTION

Little Fire Ants nest on the ground, around houses and other structures and in vegetation, including the canopy of mature trees. Treatment for control of colonies nesting on the ground or in low vegetation (less than 1.5 metres) is accomplished most easily with granular baits. For treatment of colonies nesting in trees and vegetation, please refer to the standard operating procedure for gel baits.

MATERIALS

- Granular ant bait (see below)
- Hand held or motorized bait spreader
- Nitrile or latex gloves
- Long pants, long sleeved shirt, shoes and socks (mandatory)[3]
- Dust mask and eye protection (if desired)

METHOD

The intent of treatment with granular baits is to deliver an even distribution of the bait over the soil surface at an approximate rate of 2 kilograms per hectare. Most, but not all, granular baits manufactured for control of Red Imported Fire Ants (*Solenopsis invicta*) are suitable for control of Little Fire Ants.

Granular baits are mostly manufactured using similar ingredients for the bait matrix with the active ingredient differing from brand to brand. The matrix is comprised of corn grits and vegetable oil. The oil is soaked into the grits resulting in light, fine granules 1mm – 3mm diameter. The product is usually a bright yellow color and has a faint odor of vegetable oil. Once the bait container has been opened, the unused product will degrade over

[3] Some bait products may have additional safety equipment mandated on the product label.

approximately 3 months, eventually spoiling. Opened bait containers should be stored in a cool dry location. unopened containers more than two years old are likely to be spoiled also. Bait that is spoiled will have a rancid odor and should not be used.

APPLICATION

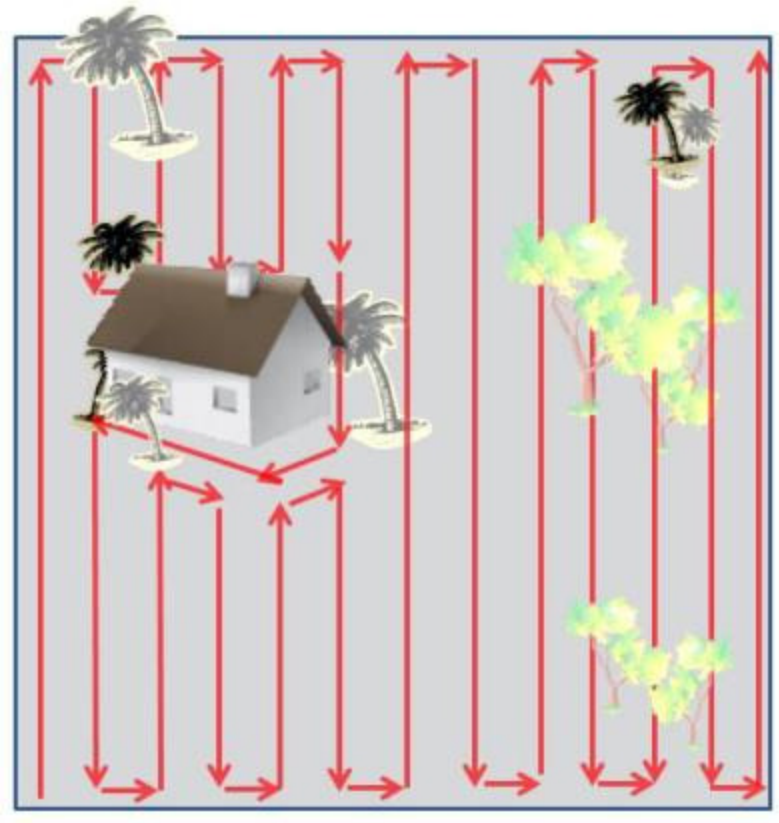
Two main application methods are used: hand-held spreaders and motorized blowers. There are also spreaders that can be attached to tractors or ATV vehicles for treatment of larger areas.

Hand-held spreaders

These are available at low cost from hardware and pesticide stores. They feature a hopper for holding the bait, a winding handle that agitates the bait and scatters it over the ground, and an adjustable aperture that is used to calibrate output. These spreaders are also used to scatter seeds and fertilizer.

Typical hand held bait spreader showing the winding handle (a), the aperture adjustment (b) and correct grip. Set the aperture at "1".

With the aperture set at "1" (see above) the operator winds the spreader handle at approximately 60 rpm while walking at 2-3 mph. The swath width thus created is approximately 4 yards. When applying the bait over the target area, an overlapping series of parallel swathes is recommended. This is accomplished by starting on one boundary of an infested site and proceeding 1 yard inside the boundary. Once the operator reaches the end of the treatment area, he or she takes 2-3 paces towards the untreated area and returns parallel to the original path, working around buildings and other obstacles (see below). Continuing this process, the designated area can be systematically covered. It is important that all ground is treated including spaces between buildings and corners of gardens. An additional sweep around buildings, garden edges and other structures is recommended. Rainfall within 12 hours of treatment will reduce effectiveness so plan to conduct treatment when rain is not expected for 12 hours.



Example of a treatment path taken by an operator treating around an urban structure.

Improving the agitator

Ant bait is light and fluffy. Often it does not feed through spreaders evenly, and two main alterations should be considered: The agitator is the orange plastic "T" shaped device in the bottom of the hopper. This can easily be pulled out. Wrap a small cable tie around the stem and tighten the tie as tightly as possible. Then cut it down so an inch or so is left sticking out. The cable tie should wrap around the stem in an anti-clockwise direction when viewed from above so when it is in the hopper, it is wrapped the way shown in the figures below. Cut the cable tie down to leave a one inch end after placing it onto the stem so it will be easier to tighten. This will assist the bait to flow more evenly.

Cable tie ready for placement (left) with agitator re-attached (right)

Holding the aperture adjuster open for long periods can cause discomfort and fatigue for operators. The trigger can be locked in place simply by inserting a self-tapping screw through the assembly while holding the aperture open at the desired setting. Usually #1 is sufficient, but a better position is half way between #1 and #2. Drill a small pilot hole and drive a self tapping screw through the assembly so the trigger remains open.

Screw holding the trigger permanently open.

Motorized blowers

Motorized blower-misters can be used to cover large areas quickly and offer several advantages:

- Blowers can project granular baits more than six metres
- An operator can cover much greater area in the same time, and
- Granules can be blown into areas that are not easily accessible

Their disadvantages include high purchase costs, a requirement for gasoline and specialized maintenance, additional weight and difficulty calibrating output. Several manufacturers produce these machines, with a common one being made by Maruyama.

A Maruyama MD155DX blower-mister

CHOOSING BAITS FOR CONTROL OF LITTLE FIRE ANTS

Many baits manufactured for control of Red Imported Fire Ants are effective against Little Fire Ants. However, some are not attractive to Little Fire Ants and these should not be used. Both the Hawai'i Ant Lab and Dr Arnold Hara of the University College of Tropical Agriculture and Human Resources have tested many baits available in USA. Together, their research shows that baits containing methoprene or pyriproxifen as the active ingredient are NOT effective against Little Fire Ants, while those containing hydramethylnon, indoxacarb and fipronil work best. Below is a table of ant bait formulations that are attractive to Little Fire Ants and therefore recommended. There may be other bait products available from other countries, however, use this as a guide for baits sourced from the United States.

Some product formulations suitable for control of Little Fire Ants.

Product brand	Manufacturer	Active ingredient	Concentration	EPA registration number
Amdro Block® Amdro Fire Ant Bait®	BASF	Hydramethylnon hydramethylnon	0.880%	73342-2
Probait®	Zoecon	hydramethylnon	0.730%	73342 -1-2724
Advion fire ant bait®	Dupont	indoxacarb	0.045%	352-627
Siesta Fire Ant bait	BASF	Metaflumizone	0.063%	969-232

Cautions

The active ingredients in ant baits may affect aquatic life to varying degrees. Extreme caution should be taken when selecting and applying baits near water bodies, both salt and fresh water. It is recommended the LC50 (96hr) for *Oncorhynchus mykiss* or a similar measure be used to select the least toxic option for use near waterways. Further, operators should be trained and all label provisions for safe application should be followed when using these products.

.

STANDARD OPERATING PROCEDURE - TREATMENT OF LITTLE FIRE ANTS WITH GEL BAITS

PURPOSE AND SCOPE

This standard operating procedure describes recommended methods for treating vegetation and structures within a designated outbreak of Little Fire Ant (*Wasmannia auropunctata*). Little Fire Ants nest on the ground and in vegetation. This means all vegetation needs to be treated in addition to ground treatment. This standard operating procedure should only be used by persons who have undergone practical training in this activity.

MATERIALS

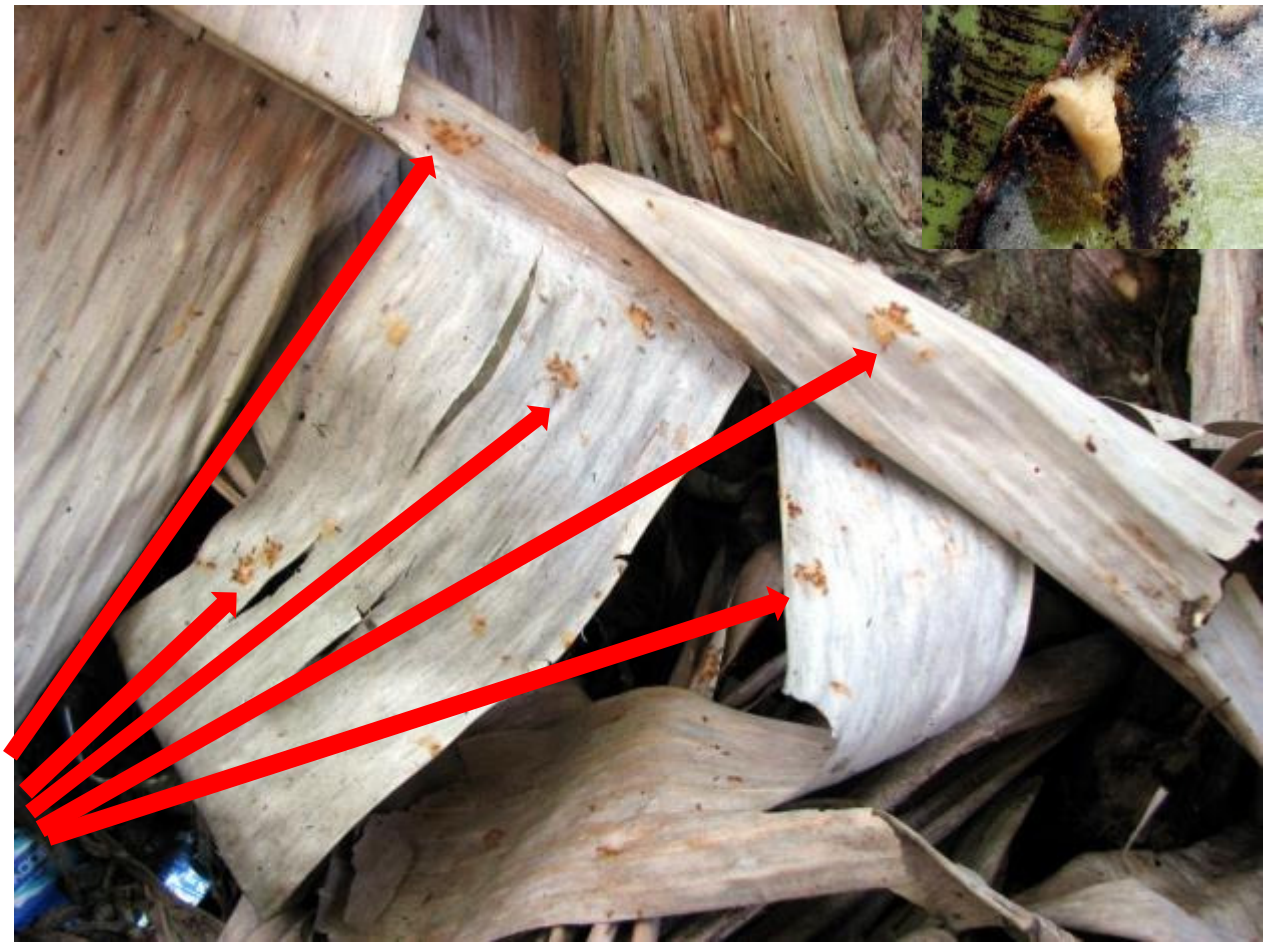
- Gel baits (see mixing instructions in separate operating procedure)
- ZEP brand spray bottle or good quality 2 gallon pump-up sprayer
- Nitrile or latex gloves
- Long pants, long sleeved shirt, shoes and socks
- Hat and eye protection

METHOD

The intent of treatment with gel baits is to ensure areas not adequately covered by granular baits are also treated. Little Fire Ants are like to nest in trees, vegetation and even the crowns of coconuts. Worker ants from these colonies do not forage great distances and may not always reach the ground-applied bait granules.

The gel bait is made mostly from water and vegetable oil. It is the texture of ketchup and sticks to vegetation when sprayed. The bait is easily applied to cracks, crevices, branches, vertical surfaces etc and it is therefore very suitable for use on trees, shrubs and buildings. The recommended application rate is 10kg per hectare depending on how much vegetation cover is present. Rainfall within 12 hours of treatment could reduce effectiveness, however, most of the gel baits will remain unless rainfall is very heavy.

Aim to produce spatters – small drops of bait between 5-10 mm in diameter, with at least one drop of bait every 30 centimetres.



Bait applied to a banana leaf. Some of the droplets are highlighted with arrows, and ants can be seen feeding on the bait.

Every tree, shrub, structure building within the treated area will need to be treated as follows:

Trees

Vegetation under 6 metres in height can be treated from the ground. Shoot 1-2 squirts onto every limb, branch junctions, hollows, areas with dead wood, areas where debris has collected and along branches. Large trees like coconuts may need to be climbed. Go as high as it is safe to do so and apply several shots into the crown of each coconut, in foot holds and hollows of the trunk. If Little Fire Ants are seen, place additional amounts of bait along foraging trails. The bait should be placed at approximately 1 meter intervals.

Bananas

Banana clumps are perfect habitat for Little Fire Ants. In infested areas, almost all the spaces between leaf axils and the stem will house a small colony. Spray bait in the areas of the stem where green or dying leaves are attached. Also spray the trash around the banana clump and place some bait along fallen or cut trunks.

Shrubs and small trees

Flowering plants, fruit bearing trees and small shrubs are often used by Little Fire Ants for food gathering. These are generally too fragile to climb but spray across these with an even coverage of "splatters". If a foraging trail is seen, follow it to the ground and/or to the nest and place some bait there also.

Buildings and structures

The bases of buildings and other structures are places where Little Fire Ants will be found. Work around each building, placing splatters of bait every 30 centimetres or so. The best spots to place baits are cracks crevices, hollows and places where foraging trails can be seen. If ants are seen foraging up walls or posts, place additional bait as high as can be safely reached. Always choose the shady side of posts to place bait as Little Fire Ants prefer to forage in shady locations.

Spray tools

Gel baits can be sprayed with good quality squirt bottles (not the cheap kind). With these sprayer types, it is possible to shoot a thin stream of gel 6-6 metres. This is very handy for spraying vegetation or covering larger areas. As you depress the trigger, wave the wand or bottle in the air to form a shower of smaller droplets. ZEP brand spray bottles work very well, however, different brands may also be available. Often these sprayers have a small filter at the bottom of the inlet tube. This needs to be removed prior to use.

Good quality spray bottles

Another way to spray larger areas is with a pump-up sprayer. The cheaper types do not work very well. Search for a sturdy model with a wide (13mm) outlet hose that connects to the bottom of the sprayer. The pump

assembly must also be good quality as high pressure is needed. The Redmax brand sprayers work well. Make sure the one you purchase has a metal wand or purchase a metal wand separately because it will need to be modified as follows:





First, hold the wand in a vice and bend until it snaps. This should leave it almost closed at the tip. Squeeze the tip almost closed with a pair of pliers or vice grips. You can drill two very narrow holes in the tip or leave it as it is. Either way, it will need more crimping to get the spray pattern right. Experiment with a batch of blank gel bait. You will need to adjust the tip until the bait squirts out in a nice thin stream. After carefully adjusting it, this should be able to spray around 5-6 metres, or even further.

CLEANING AND MAINTENANCE

The gel baits used in this standard operating procedure is viscous and oily. Equipment must be thoroughly cleaned with an industrial degreaser to remove all residues inside the bottles, plungers and wands. If equipment is not carefully cleaned on a daily basis, any remaining oil will harden and block the wand, nozzles and other pump components. It is recommended to use a heavy-duty degreaser to thoroughly rinse the tank and spray through the nozzle until only clear soapy liquid emerges. Then rinse out old cleaner, re-fill with new detergent and allow some to be sprayed through the wand. Leave the degreaser standing in the hoses, tank and wand, and thoroughly rinse immediately before the next time the sprayer is used.

STANDARD OPERATING PROCEDURE - MIXING GEL BAITS FOR CONTROL OF LITTLE FIRE ANTS

PURPOSE AND SCOPE

This standard operating procedure describes recommended methods for mixing a Gel bait for control of Little Fire Ant (*Wasmannia auropunctata*). Gel baits are easier to apply to vegetation where ants frequently nest and are less affected by rain than conventional baits. This standard operating procedure should only be used by persons who have undergone practical training in this activity.

INTRODUCTION

The Little Fire Ant (*Wasmannia auropunctata*) is very difficult to control. They have many small colonies, each with many queens, and will have nests on the ground as well as in trees and other vegetation. All these small colonies are inter-connected and if some die out, they are re-populated by neighboring colonies. One management problem is that virtually all commercial baits consist of small granules. These are easy to spread on the ground, but can not be applied to vegetation. If only the colonies on the ground are treated, neighboring ants living in trees will quickly spread back to the ground. The bait granules are also inactivated by rainfall. Once the granules become soggy, they are no longer attractive to ants. Tahiti experiences regular and frequent rain. In some locations it is difficult to predict if it will rain on any given day.

Contrary to popular belief, ants do not eat solids - they only consume liquids. Granular baits are made from corn granules soaked with vegetable oil, and when a worker ant finds a bait granule, she sucks the oil out of the granule and leaves the rest behind. Ants can consume a gel bait far more easily than a granular product, so in theory, gels should be more effective than granules.

Baits in liquid or gel form do not have the same limitations as granular products. They can be applied to vegetation where they will stick to the leaves and branches and are not affected as quickly by rainfall. They are, however, a bit more difficult to apply compared with granular baits. Also, gel baits suitable for control of Little Fire Ants are not available commercially and need to be prepared before treatment can begin.

Pesticide regulations differ between countries, change over time, and in some cases, the use patterns described here may contravene these regulations. Before employing these methods, it is a requirement to consult with appropriate regulators to ensure they comply with local laws. Currently, the Service du Developpement Rural is the agency responsible for administering pesticide laws in French Polynesia.

METHOD

INGREDIENTS

1. Toxicant
2. Corn, safflower or similar vegetable oil
3. Water
4. Xanthan gum
5. Peanut butter (creamy)or powdered liver

6. Dye or coloring agent if desired

MIXING EQUIPMENT

1. 20 litre plastic bucket with tight fitting lid
2. Electric or battery drill
3. Whisk or paint mixer
4. Measuring jugs
5. Scales
6. Chemical resistant apron or similar
7. Rubber gloves
8. Eye protection

Choice of toxicant

The following pesticides have been used experimentally in gel baits against Little Fire Ants[4]

Product name	Manufacturer	Active ingredient	Concentration in product	Amount **product** needed per kg bait
Arilon®	Dupont	indoxacarb	200 g/kg	6.0 grams
Termidor®	BASF	fipronil	91 g/kg (suspension concentrate)	0.5 grams

Vegetable oil

Most edible vegetable oils used in cooking appear to be suitable. It is easy to compare palatability of various oil options be presenting foraging Little Fire Ants with a choice of several types and recording which type attracts more ants.

Xanthan gum

Xanthan is an emulsifier and thickener used in cooking. Addition of this product is necessary to mix the oil and water in a way that does not cause the ingredients to separate before use. It also mixes the toxicant with the oil. Normal xanthan gum is a powder and can be difficult to mix with water. Hot (60-70^{o} C) water will mix a little more readily. Bulk "rapid dispersal" xanthan gum is preferred and is much easier to mix. It is available from Philoutlet, email philoutlet@gmail.com or phone +1 312 733 0000. Normal xanthan is available elsewhere through health food stores and pharmacies.

[4] Mixing and use of gel baits with these active ingredients may require approval from pesticide regulators

Peanut butter

Any creamy or smooth variety is acceptable. The cheaper brands are best as they are already homogenized making them easier to mix.

Coloring

It may be desirable to add food coloring or other edible dye to make it easier to observe where treatment has taken place. However, colorings may also stain structures, concrete and plants.

MIXING PROCEDURE

This method uses quantities sufficient to make 8 kilograms of gel bait. Make the bait mixture the afternoon before it is needed. The mixture will not keep fresh for more than 2-3 days.

- Add 4.8 litres of water and toxicant to the bucket.
- Mix with drill and whisk until thoroughly incorporated.
- Slowly add 56 grams of xanthan gum to the water while mixing. Make certain to add the xanthan powder slowly so that it does not form lumps. Continue to mix until a uniform jelly-like consistency is achieved.
- Add 2.8 kg oil and 240g peanut butter. Continue to mix until all the oil is combined with the water and a consistent color and texture is achieved.
- Sometimes small lumps form in the mixture despite best efforts to avoid them. In this case, leave the mixture overnight and mix again in the morning just prior to use.

Mixing devices

A battery or electric drill with a kitchen whisk or a paint mixer works best for mixing. The best type of drill is one with higher speed (RPM). Standard type paint mixers work well. Others prefer a kitchen whisk modified to fit into the drill chuck.

	amount of bait needed				
ingredient	**1 kilo**	**2 kilo**	**4 kilo**	**8 kilo**	**16 kilo**
water (ml)	600	1200	2400	4800	9600
Termidor™ (ml) OR Arilon™	0.5 6.0	1.0 12.0	2.0 24.0	4.0 48.0	8.0 96.0
xanthan gum (grams)	7	14	28	56	112
powdered liver or peanut butter (grams)	30	60	120	240	480
oil (grams)	362.5	725	1450	2900	5800

STANDARD OPERATING PROCEDURE - SURVEILLANCE AND MONITORING METHODS FOR LITTLE FIRE ANTS

PURPOSE AND SCOPE

This standard operating procedure outlines procedures and specifications for detection, delimitation and quarantine inspection of commodities for *Wasmannia auropunctata* (Little Fire Ants).

INTRODUCTION

There are three main survey types: detection surveys, delimiting surveys and inspection for quarantine purposes. (The standard operating procedure for quarantine inspection can be found in a separate document). Each survey type has a different aim and the type of information that needs to be gathered is also different. In a detection survey, the objective is to determine if a site does, or does not, have an invasive ant. This is the easiest type of survey to conduct because all that is needed to confirm presence of the ant is a single specimen. In delimiting surveys, the purpose is to map the extent of an infestation. For quarantine detections, the goal is to determine if a commodity is infested with the target species.

Detection of ants can be accomplished by several means including visual searches, placement of long term trapping devices like pitfall traps or by placing lures of attractive food items within the survey area. The use of lures has several advantages for most survey types including low cost, ease of deployment and systematic nature. Briefly, lures that are attractive to the target species are deployed in a grid pattern over the search area, left exposed for sufficient time to be discovered by the target species, then collected and the specimens identified by a trained taxonomist.

Little Fire Ants are consistently attracted to peanut butter, so this makes a good lure. Depending on the nature of the survey, there are two recommended lure designs: a bait stick, or a vial. Preparation of these two lure types are detailed below.

PLANNING THE SURVEY

When planning the survey, work out the area to be covered and obtain a map or aerial image of the site. Google Earth is a good source of maps but most ports have port plans which can also be used. Contact site management at least a day before the survey to make sure you have permission to enter and arrange any passes etc that might be needed. In the case of an airport or sea port, try to pick a time when no planes are expected or ships are being loaded/unloaded. Also, plan to conduct the survey during clear weather when rain is not expected.

LURE PREPARATION (BAIT STICK METHOD)

When field identification is possible, or only a few specimens are anticipated, surveys can be conducted with the bait stick method. This is the most rapid survey method but is least accurate if detailed information such as ant density is needed.

Materials

1. Disposable chopsticks (cut in half), disposable coffee stirrers or popsicle sticks
2. Bright-coloured spray paint
3. Smooth peanut butter
4. Zip-lock bags
5. Marking pen
6. GPS unit

Preparation and deployment

Paint both sides of the chopsticks or coffee stirrers with bright-coloured spray paint (this makes locating deployed sticks much easier). Once the paint has dried, grab a handful of sticks and dip them into the jar of peanut butter. Withdraw the sticks and place them into a zip-lock or other plastic bag with the peanut butter end inside the bag. Pull the sticks out one by one as needed, making sure to leave only a thin smear of peanut butter on each stick. Place the sticks in specified locations and at a spacing determined by the type of survey to be conducted.

Collection

Leave the lures in the field for 45-90 minutes and then retrieve them. If the collector can identify Little Fire Ants in the field, take a GPS waypoint at every location where Little Fire Ants are detected. If the samples are to be returned to the laboratory for identification, place the sticks individually into a zip-lock bag. Seal the bag, take a waypoint and write the waypoint number onto the bag. This way, positive samples can be mapped after they have been identified. Place samples in a freezer at -18^{o}C until ready for identification.

LURE PREPARATION (VIAL METHOD)

When all samples need to be returned to a laboratory for identification, the vial method may be the best alternative.

Materials

1. Clear plastic vials (30-60 CC) with lids.
2. Smooth peanut butter
3. Marking pen
4. GPS unit

Preparation and deployment

Its best to make only enough baits for a day's work. This way the baits will be fresh and attractive to ants (ants are not as interested in old baits). If possible, make them up the day before and store them in a refrigerator overnight.

Smear a thin layer of peanut butter onto the inside of each vial. Replace the caps and store prepared samples in a carry bag ready to take into the field. Place the vials in specified locations and at a spacing determined by the type of survey to be conducted.

Collection

Leave the vials in the field for 45-90 minutes and then retrieve them. Take a GPS waypoint at every location where a vial has been placed and write the waypoint number onto the vial. Make certain to keep one collector's vials separate from other collector's vials and ensure a record of waypoint numbers and GPS coordinates accompany the vials to the laboratory. This way, positive samples can be mapped after they have been identified. Place samples in a freezer at -18^{o}C until ready for identification.

CONDUCTING THE SURVEY

The aim of the survey is to thoroughly sample the ants at the site. This is done by placing baits in a grid pattern over the entire area, placing protein baits and sugar baits alternately. The spacing between baits should be around 10 paces for general detection surveys. It is not important to have the grids at **exactly** this spacing as long as they are approximately correct. See Table 3 for survey specifications for different types of survey. Sections of the survey site that are all concrete or asphalt do not need to be sampled because few ants nest in these locations. Common ant habitats are listed in Table 4 and it is important that these are all sampled.

Bait vials should be collected 45-90 minutes after placement. It takes much less time to retrieve vials than it does to deploy them. As a guide, teams should place vials for one hour, then stop and retrieve the vials they have deployed in the order they were deployed. This way, the vials placed at the beginning will have been out for 60 minutes and the ones deployed last will have been exposed for about 45 minutes depending on ant species. Try to plan out a route that will take you back to the point where you started – it saves extra walking.

Surveillance should not occur during or after rain when the ground surface is still wet, or on windy days. Also no rain should fall between placement of bait traps and their retrieval. If rain is imminent, it is a good idea to stop deploying baits and retrieve the ones already out. If this is not possible, collect the baits one hour after the rain has stopped. If not many ants are at the baits, it might be necessary to re-survey the rain-affected section.

Bait vials should be placed in the shade where possible. Remember the sun might have moved by the time you collect the vials so place them carefully to avoid this. As a hint place your vials with the opening away from prevailing wind and angle the entrance slightly to the ground. This helps prevent vials filling with water and debris if you encounter a sudden down pour.

Any unusual ants (that look different from common established species) sighted while conducting surveillance should also be collected.

Table 3. specifications for surveys

	Detection survey	Delimiting Surveys	Commodity inspection
Methods	Vials	Vials or bait sticks	Bait sticks or visual
lure spacing	200-400/ha, 1 vial every 5-7m depending on available resources	100/ha, 1 vial every 10m. Once no ants detected, switch to 1 vial every 5 m at least 20m beyond the limits of detection	Visual inspection of 1% of commodity or bait sticks in 1-10% of pots for potted plants
Frequency/ length of program	Six monthly annually (2 rounds per year)	Immediately, if results negative follow up every six months for 2 years If results positive, treat and monitor out to delimiting boundary	As needed
Buffer zone	50m	20m	
Visual Surveillance	Very efficient in high density areas especially if surveyors are familiar with the ant. Habitat is 3 dimensional- in soil, intermediate canopy, vegetation, target bananas and coconut trees first. A good visual method is to use a smear of peanut butter on a bait stick.		

Table 4. list of common ant habitats

1.	Tree trunks (visual inspection and bait at base if appropriate)
2.	Flowers and trunks of trees
3.	Shrubs and poles
4.	Building edges and foundations
5.	Concrete slab edges
6.	Cracked concrete
7.	Disturbed sites
8.	Drains and culverts
9.	Electrical generators and fittings
10.	Exposed rocks
11.	Fence palings
12.	Grass areas
13.	Verges
14.	Hot water pipes and heaters
15.	Isolated weeds
16.	Logs
17.	Loose gravel
18.	Low vegetation (including grass)
19.	Plant pot bases
20.	Road margins
21.	Rubbish piles
22.	Soil
23.	Tree crotches and hollows
24.	Vertical surfaces
25.	Weed and plant re-growth
26.	Wooden structures
27.	Underneath stones or concrete rubble