Argentine Ant Eradication Strategy

Norfolk Island

2015 - 2020

Photo: Ben Thomas

Ben Thomas and Peter Davidson

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THE ADMINISTRATION OF NORFOLK ISLAND
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Abbreviations

AA  Argentine ant (*Linepithemahumile*)

ANI   Administration of Norfolk Island

CSIRO Commonwealth Scientific and Industrial Research Organisation

KAVHA Kingston and Arthurs Vale Historical Area

GIS Geographic Information System

GPS Global Positioning System

Helibaiting Aerial application of ant bait

IBC tank Intermediate Bulk Container

NI Norfolk Island

NINP Norfolk Island National Park

WMC Waste Management Centre

Acknowledgements

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1. Executive Summary
The Argentine ant *Linepithema humile* is one of the world’s worst invasive species, having spread from its native habitat in South America to establish populations on six continents and many oceanic islands.\(^1\) The Threat Abatement Plan to Reduce the Impacts of Tramp Ants on Biodiversity in Australia and its Territories identifies the Argentine ant as one of six species of National priority.\(^2\)

In 2005 the Argentine ant was identified on Norfolk Island and an eradication program commenced in 2008. The wide-spread dispersal of Argentine ant on Norfolk Island is mainly attributed to the processing of contaminated garden waste at the Island’s Waste Management Centre (WMC) which was then sold to the community as mulch. Island-wide investigations and monitoring indicate that Argentine ant infestations are presently limited to 11 distinct ‘zones’ covering approximately 263ha of the Island’s 3,529ha.

Over the past six years infestations have been treated with a range of ant control products with varying degrees of success. The success of the program as a whole has been limited by irregular and insufficient funding – a view supported by the recent Senate Inquiry into Australia’s Biosecurity.\(^3\)

However despite the lack of adequate resources, the perseverance of the Administration of Norfolk Island (ANI) has resulted in progress being made at many of the smaller infestations. Although the eradication of any specific infestation cannot be confirmed for at least two years, Argentine ants have not been detected at four infestations 18 months after their last treatment and the abundance of Argentine ant has been notably reduced in a number of other infestations.

Recent monitoring and treatment indicates that a determined, scientifically-based and consistently funded program can completely eradicate Argentine ants from Norfolk Island.

This strategy sets out a five year program (July 2015 – June 2020) to eradicate Argentine ant from Norfolk Island. All treatments will be completed within the first year with monitoring, evaluation, adaptive management and follow up treatments (if required) over the following four years.

The implementation of this strategy will be supported by the CSIRO Biosecurity Flagship via a consulting services agreement with the Administration of Norfolk Island. The technical support of CSIRO will be crucial in applying an adaptive management framework throughout the implementation of this project – a model that has proven to be highly effective in other programs such as the Lord Howe Island big-headed ant eradication program, and the NE Arnhem yellow crazy ant eradication program.

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2. Introduction

2.1 Objectives
The primary objective of this strategy is to eradicate Argentine ant from Norfolk Island within 5 years by:

- Implementing baiting techniques that:
  - are considered best practice management
  - are cost effective
  - are able to be deployed in an appropriate time frame
  - have minimal impact on native biota
  - have minimal impact on the livelihood of Norfolk Island residents;
- Implementing a reliable and efficient monitoring program that feeds back into program management in real time; and
- Rapidly documenting and disseminating results.

2.2 Impacts
No specific data on the impacts of Argentine ant on Norfolk Island’s biota have been documented however the potential impacts from this widespread invasive are well known. The Argentine ant is a dominant, aggressive competitor which has caused localised extinctions of native ants in other regions of the world. Information gathered from monitoring Argentine ant infestations on Norfolk Island shows a potential for local extinctions to also occur here: where Argentine ant colonies are present, the diversity and abundance of other ant species is notably reduced. By displacing other ant species, Argentine ants can significantly alter ecosystem processes such as pollination and seed dispersal of native plant species.

Because of their aggressive nature and need for protein-based food sources, Argentine ants may pose a threat to the majority of the Island’s vertebrates and invertebrates.

Invasive tramp ants can alter the foraging behaviour and/or reduce the nesting success of various species of avifauna. Kane Anderson, a long term resident of Norfolk Island who lives within the boundary of the oldest and largest infestation has reported noticeable reductions in the abundance of nesting White Terns within infested areas along the western coastline since the arrival of Argentine ants over ten years ago.

At particular risk are ground-nesting sea birds and already endangered species such as the Norfolk Island Green Parrot Cyanoramphus cookii cookii, Norfolk Island Scarlet Robin Petroica multicolor multicolor and Slender-billed White-eye Zosterops tenuirostris. The Lord

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5Administration of Norfolk Island (unpublished data).
Howe Island Skink *Oligosoma lichenigera* and Gecko *Christinus guentheri*, now restricted to Phillip Island, face the same threat if Argentine ants spread to this offshore island.

Argentine ants also farm and protect plant parasites such as aphids for the honeydew that these insects secrete. As a result aphids can become so prolific that they can destroy or significantly reduce the yield of horticultural crops, especially citrus.

In domestic situations, Argentine ant is a significant household pest: infiltrating homes in large numbers in search of food; establishing nests in walls and other cavities within the home. Norfolk Island residents living within infested areas have reported incursions into their homes on many occasions. In one instance a resident woke in the night to find Argentine ants crawling over him. If incursions such as this were to regularly occur in tourist accommodation the island’s principle source of income may be threatened.

### 2.3 Description

Argentine ants are 2-3mm in size and are a uniform honey-brown colour. Worker ants are the same size (monomorphic) and each colony can have multiple queens (polygynous). Argentine ants do not have a typical ant smell when crushed. Argentine ants often form strong foraging trails to baits and food sources that are several ants wide.

The Argentine ant is distinctive compared with the other 24 species of ant recorded on Norfolk Island. The Flat-backed tyrant ant (*Iridomyrmex* spp.) is the most similar to Argentine ant, however to the naked eye Flat-backed tyrant ants are slightly larger and darker than Argentine ant.

**Figure 1:** Argentine ant *Linepithema humile* (left) & Flat-backed Tyrant ant *Iridomyrmex* spp. (right)

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11 Pers. comm. Kane Anderson, Norfolk Island resident May 2014.
2.4 Habitat
Argentine ant nests may be found in a range of environments: establishing nests in cracks in concrete, behind retaining walls or between boards and timber. In natural settings they tend to nest at shallow depths in leaf litter, under bark and in rotting timber. Nests have also been observed in the upper canopy of tall trees.

2.5 Dispersal
Argentine ant distribution on Norfolk Island is patchy. New colonies can be established by budding or fission (where a new queen and workers split from an existing colony) and jump-dispersal through human-assisted transportation (including movement of potted plants, rubbish, and earthmoving equipment). On Norfolk Island human-mediated dispersal appears to have mainly occurred via contaminated garden waste received at the Waste Management Centre (WMC) where it was processed and sold to the community as garden mulch between late 2006 and early 2008.

Dispersal of Argentine ants by budding is much slower than by human assisted means. Although no specific data for Norfolk Island exists, maximum rates of spread recorded elsewhere average ≤150m/year. Argentine ants do not perform nuptial flights as do many other species of ant. Rather, a queen and a group of workers leave the main colony and walk to a new site where they can quickly secure a food source and establish a new colony. This typically occurs in spring after the emergence of a new generation of reproductive castes (males and queens).

Norfolk Island’s climate is generally favourable for Argentine ants, with foraging and breeding activity and establishment of new nests peaking during the warmer summer months. However, anecdotal evidence suggests that during the Norfolk Island winter, when maximum temperatures range between 18 to 19°C, the foraging activity of Argentine ants contracts.

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2.6 Distribution on Norfolk Island

At May 2015, Argentine ants were known to occur in 11 defined ‘zones’ across Norfolk Island, covering a total area of ~263 ha.

The application of ant bait products – primarily Xstingnish (see section 8.2) – has occurred at each of these zones at varying intervals and application rates since 2008. As a result the current status of each infestation is different. Table 1 provides a summary of treatment history and current known status.

Figure 2: Extent and location of known Argentine ant infestations on Norfolk Island at May 2015
### Table 1: Treatment history and current status of each infestation on Norfolk Island

<table>
<thead>
<tr>
<th>Zone</th>
<th>Name</th>
<th>Size (ha)</th>
<th>Status at May 2015</th>
<th>History</th>
</tr>
</thead>
</table>
| 1    | Anson Bay - Headstone         | >130      | Boundary delineated in May 2014. Highly fragmented, unknown rate of spread and current size. | • Original infestation. Incursion likely to be around late 1990’s or early 2000’s.  
• In 2008 this infestation was mapped at 68ha.  
• Treatment regime poorly documented prior to 2013 but likely that >80% of the infestation has been treated at least once between 2008-2013 with Xstinguish.  
• Area east of Headstone Rd treated with SAS PRO & ANTagonist PRO in May 2014 to test product as a containment measure.  
  ○ Post-treatment monitoring conducted in May 2015 has shown a notable reduction in AA abundance but has fragmented perimeter of infestation even further.  
• No other treatment has occurred within this infestation since 2013. |
| 2    | Western cliffs (cliffs)       | 24        | Unknown rate of spread to the north and south: ≥3km of cliff face ≤80m high. | • No treatment history                                                                                                                                                                                                                                                                                                                |
| 2    | Hundred Acres                 | 2         | Possibly eradicated, ongoing monitoring required to confirm | • Public reserve managed by the ANI.  
• Incursion caused by contaminated garden mulch.  
• Size of infestation and treatment regime prior to 2013 poorly documented.  
• A 1.8ha area treated with Xstinguish and SAS PRO in February 2014.  
• No AA detected in November 2014. |
| 3    | New Farm Rd                   | 9         | Remnant colonies likely to still persist, monitoring required to identify and map current infestation boundary. | • Predominantly a residential area.  
• Incursion caused by contaminated garden mulch.  
• Size of infestation and treatment regime prior to 2013 poorly documented.  
• Monitoring in spring 2013 revealed a 6ha infestation.  
• Treated on two occasions with SAS PRO.  
• Monitoring in spring 2014 revealed remnant AA nests within the treated area but also discovered AA outside the treatment areas where they were not previously detected. Total infestation size increased from 6ha to 9ha.  
• Area was treated with Xstinguish in November 2014 and January 2015. |
| 4    | Waste Management Centre (WMC) | >55       | Current boundary of infestation unknown. | • At the centre of this site is the Island's catchment for all household waste. Also within the infestation is the ANI roads depot, NI International Airport, Bureau of Meteorology, ANI Health & Quarantine office, a privately operated rock crushing plant and farmland.  
• Incursion caused after receiving contaminated garden waste at the Waste Management Centre from a zone 1 property before AA were confirmed to be on Norfolk Island.  
• In 2008 the infestation was thought to be 12ha.  
• Treatment prior to 2013 poorly documented. Infestation was treated at least once with Xstinguish between 2008-2013.  
• 80% of perimeter surveyed by March 2014. Unknown rate of spread since.  
• Southern perimeter treated with SAS PRO in May 2014 – efficacy not yet evaluated.  
• Monitoring of northern boundary not complete. |
| 5    | Mt Pitt Rd / NINP             | 20        | Remnant colonies likely to persist, monitoring required to confirm. | • Infestation is spread across Norfolk Island National Park and Botanic Gardens; accommodation units, residential properties and farmland.  
• Unconfirmed cause of incursion.  
• Delineation completed in spring 2014.  
• Two treatments of Xstinguish completed in November 2014 and February 2015.  
• Treatment regime and size of infestation prior to 2013 unknown. |
<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Infestation Size</th>
<th>Status and Monitoring Required</th>
<th>Notes and Details</th>
</tr>
</thead>
</table>
| 6   | Hospital                  | <1               | Possibly eradicated, ongoing monitoring required to confirm | Unknown cause of incursion,  
|     |                           |                  |                                | Unknown size and treatment regime prior to 2013.  
|     |                           |                  |                                | Monitoring and thorough visual searching found only one nest near the entrance of the hospital. This area was treated with SAS PRO and ANTagonist PRO in November 2013.  
|     |                           |                  |                                | Monitoring in autumn and spring 2014 returned negative results for AA. |
| 7   | Collins Head Rd           | <5               | Possibly eradicated, ongoing monitoring required to confirm | Residential area.  
|     |                           |                  |                                | Incursion caused by contaminated garden mulch.  
|     |                           |                  |                                | Treated in November 2013 and February 2014 with Xstinguish  
|     |                           |                  |                                | Remnant colonies detected in spring 2014.  
|     |                           |                  |                                | Treated again with Xstinguish in November 2014 |
| 8   | Ball Bay                  | <2               | Possibly eradicated, ongoing monitoring required to confirm | Public reserve managed by the ANI.  
|     |                           |                  |                                | Incursion caused by movement of contaminated material from WMC to the reserve.  
|     |                           |                  |                                | Treated in November 2013 on three occasions separated one week apart.  
|     |                           |                  |                                | Monitoring in spring 2014 returned negative results for AA.  
|     |                           |                  |                                | Infestation size and treatment regime prior to 2013 unknown. |
| 9   | Two Chimneys & Hibiscus Drive | >18         | Infestation split into two sectors:  
|     |                           |                  | – Two Chimneys & Hibiscus Drive.  
|     |                           |                  | Two Chimneys sector is possibly eradicated after treatment in 2013/14, ongoing monitoring required to confirm.  
|     |                           |                  | Current size of Hibiscus Drive sector unknown. | Incursion caused by contaminated garden mulch.  
|     |                           |                  |                                | 3.1ha of the Two Chimneys sector was treated with Xstinguish twice, seven days apart, in December 2013. A third treatment was applied in April 2014.  
|     |                           |                  |                                | Monitoring in spring 2014 of Two Chimneys sector detected one positive lure outside of treatment area. This was treated with Xstinguish in January 2015.  
|     |                           |                  |                                | No AA have been detected within the Two Chimneys treatment area since November 2013.  
|     |                           |                  |                                | No treatment or monitoring has been completed in the Hibiscus Drive sector in 2014/15.  
|     |                           |                  |                                | Unknown rate of spread and current extent of infestation since last monitoring in 2013/14 season. |
| 10  | Burnt Pine                | 8                | Remnant colonies likely to persist, monitoring required to confirm | Incursion discovered in 2013. Unknown origin.  
|     |                           |                  |                                | Treated with Xstinguish shortly after discovery.  
|     |                           |                  |                                | Area treated with Vanquish Pro in November 2014 and February 2015.  
|     |                           |                  |                                | Third treatment not applied due to limited resources.  
|     |                           |                  |                                | Remnant AA colonies likely to persist across the infestation. |
| 11  | Prince Phillip Drive      | 13               | Infestation delineated by March 2015 | Unknown cause of incursion but potentially caused by relocation of materials from WMC to the area.  
|     |                           |                  |                                | Site first discovered in November 2014.  
|     |                           |                  |                                | Mapping not complete until March 2015.  
|     |                           |                  |                                | Hydrogel bait lure treatment first trailed at this site over a 3ha area |
|    | TOTAL                     | 263              |                                |                      |
3. Monitoring
An intensive monitoring program has been implemented to determine the extent and current status of each infestation.

Monitoring consists of counts of ants attracted to non-toxic baited lure pots (pottles) placed in a grid of 4pottles/100m² (10x10m grid) across and around a known or suspected infested area. Post-treatment monitoring requires an increase in the density of lures to 4pottles/25m² to allow for the reduction in ant abundance and detectability. A GPS ‘waypoint’ is recorded at the location of each lure. After 1-2 hours the lures are collected and the species of ant recorded. In densely vegetated terrain a survey flag is placed next to the lure to aid retrieval.

A collection of labelled specimens preserved in ethanol has been maintained at the ANI Health & Quarantine office to aid identification.

The location of each lure is uploaded into a GIS database (MapInfo®) and the waypoint numbers for lures containing Argentine ants are noted and marked accordingly in the GIS.

Figure 3: Example of mapping produced from monitoring data.

The cost of monitoring is approximately $190/ha. This figure is based on the average cost of labour and non-toxic lures used between 2013 and 2015 to monitor infestations using 4 pottles/25m².
3.1 Island-wide monitoring

In 2014-15 monitoring of high risk sites across the Island revealed no new infestations. All potential sightings reported by the public also returned negative results. Monitoring of high risk sites will continue throughout the eradication program to ensure that any new infestations are identified as soon as possible. Sites considered to be high risk include:

- Mulch recipient sites;
- ANI managed reserves and forestry depot;
- High visitation sites within Norfolk Island National Park (Palm Glen, Cooks Lookout);
- Phillip Island;
- Firewood suppliers depots;
- Private contractor depots;
- ANI works depots;
- Properties of ANI staff who work in infested areas;
- Nurseries; and
- KAVHA.

Figure 4: 2014/15 Island-wide monitoring locations
3.2 Detection dog

Professionally trained sniffer dogs are now routinely used for detecting ants in all major ant eradication programs in Australia and New Zealand. These dogs are highly cost effective because they can survey areas more quickly and with greater confidence than people using other methodologies.

A detection dog and qualified handler certified for Argentine ant should be deployed on Norfolk Island as soon as possible to perform a rapid survey of the Island where monitoring has not yet taken place to ensure there are no previously undetected infestations and finalise the determination of the treatment areas.

The detection dog should return to Norfolk Island 12 months after the final treatment has taken place so that any remnant colonies of Argentine ant can be located and treated.

The use of a detection dog will dramatically decrease the time required to monitor an infestation compared with using monitoring pottles (above).

4. Treatment

A range of ant control products have been used on Norfolk since 2008. These include residual surface sprays and granular products such as Termidor® Residual Insecticide; Antagonist® PRO Residual Ant Insecticide; and SAS PRO® Professional Granule Ant Killer. These products have proven useful only in situations where rapid knockdown is required to eliminate the risk of human mediated dispersal of Argentine ant – such as residential areas or the WMC. Monitoring data has shown that the use of these products on a broad scale results in a highly fragmented infestation, rather than eradication.

The only true ant ‘bait’ product used on Norfolk Island prior to the development of this strategy is Xstinguish™ Argentine ant bait (see section 4.2). This product has been used extensively across the majority of Argentine ant infestations on Norfolk Island and is also the recommended product for treatment of Argentine ant in New Zealand. Xstinguish will continue to be used in this strategy, however where practical it will be replaced as the primary bait in this eradication program by a recently developed, more effective method that can be applied at less cost (section 8.1 below).

A combination of bait products and application methods is needed to achieve eradication on Norfolk Island: due to variations in topography, treatment histories and current status of each infestation. This provides a unique opportunity to monitor the effectiveness of different baits and application methods and make comparisons in real time: underpinning adaptive management of the eradication program through the timely identification of issues.

4.1 Hydrogel bait

Hydrogel water absorbing beads are a practical and effective method for deploying attractive liquid bait to eradicate Argentine ant infestations in rugged terrain and dense vegetation. This methodology was developed and tested by the Nature Conservancy and the US National Parks Service on Santa Cruz Island (Channel Islands National Park) in 2013. On...

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Santa Cruz Island a total of 12 treatments were applied over a 24 week period. No Argentine ants have been detected after six months of searching since the last treatment.\textsuperscript{19}

Trials conducted on Norfolk Island during April-May 2015 have verified the results found on Santa Cruz Island. Two 1.5ha areas were treated with hydrogel beads with different volumes of active constituent: fipronil at 0.00125\% (high dose) and 0.0005\% (low dose) respectively. Counts of ant numbers at monitoring lures have shown an immediate and sustained reduction of Argentine ant activity within both treatment plots.

**Figure 5**: Argentine ant abundance per monitoring lure at two treatment and control areas.

The success of this methodology on Santa Cruz Island, supported by the trials conducted on Norfolk Island, justifies the use of hydrogel bait as the primary treatment method in this eradication plan. The trials conducted on Norfolk Island have indicated that this methodology comes with significant logistical challenges, but also significant savings in time and money.

**4.1.1 Logistics**

Hydrogel beads supplied by the U.S. company Magic Water Beads cost US$240 per 25kg container including shipping. 12 treatments will require approximately 3,700kg of hydrogel beads.

\textsuperscript{19}Boser et al 2014
Approximately 45,000kg of sugar is required to produce the required amount of sucrose solution. The sugar will be sourced by the Norfolk Island Foodlands supermarket and shipped from New Zealand at a cost of approximately $26 per 20kg bag.

A helicopter will need to be deployed to Norfolk Island for the duration of the treatment program to distribute hydrogel bait. As there is not a helicopter permanently based on Norfolk Island, one will need to be flown or freighted to the Island from Australia or New Zealand. Discussions regarding deployment and operation (see section 4.1.1.3) are currently underway with aviation companies experienced in heli-baiting.

Significant resources will also be required to prepare and transport the required amount of hydrogel bait around the Island. Mixing methods are outlined below in section 4.1.1.1.

### 4.1.1.1 Mixing

Hydrogels are soaked in a ~25% sucrose solution containing fipronil at a concentration of 0.0005% as the active constituent.

Using a 1000L Intermediate Bulk Container (IBC) as the mixing vessel, sugar is dissolved at the rate of 22kg/100L of water containing 0.0005% fipronil. At room temperature, the sucrose solution requires ~10 minutes of regular agitation to fully dissolve. Food colouring may be added to make the beads easier to see in the field during and after application, but this is not essential.

Once the sugar has dissolved, hydrogels are added at 1.15kg/100L. The hydrogels take approximately 12 hours to absorb ≥95% of the liquid.

Once fully hydrated, the required quantity of hydrogel bait is then transported as close to the treatment site as practicable for application by hand or by helicopter to minimise the time spent in transit during the application period.
Figure 6: Mixing sugar water in an IBC tank cut in half (red food dye has been added)

Figure 7: Hydrogels 50% hydrated in sucrose solution
Figure 8: Hydrogels 100% hydrated in sucrose solution

Figure 9: Transporting hydrogels to treatment site
4.1.1.2 Application

4.1.1.2.1 Hand Broadcasting
Standing 5-8m apart, team members (applicators) will carry 10-15L of hydrogels in buckets and continuously disperse handfuls in a sweeping arc whilst slowly walking a grid pattern across the treatment area. Another team member will be responsible for refilling and ferrying buckets to the applicators from a central point.

Hand broadcasting will be used where aerial application (heli-baiting) is not feasible, i.e. close to dwellings and other occupied buildings.

Hand broadcasting takes 2-4 hours of labour per hectare, aiming for an application rate of 100L/ha (approximately 9 beads/m²).

Figure 10: Hydrogels in buckets ready for application

4.1.1.2.2 Heli-baiting
Each aerial application will utilise a helicopter with an underslung, petrol powered fertiliser bucket. A unit with sufficient capacity (hopper size) and capability (motor, broadcast mechanism) will be selected in consultation with the helicopter contractor to ensure compatibility with the aircraft. As large a unit as possible will be required due to the high volume of bait to be applied (e.g. 100L/ha). However, the size of the helicopter must be matched with the size of the bucket for maximal efficiency with regards to flying time and operating costs.
The bucket will be tested, and adjusted as necessary, to ensure calibration to the desired application rate; the speed of the bucket impeller will need to be adjusted to avoid the hydrogels being pulverised as they exit the bucket. Testing will be conducted well before the first application including ground and aerial trials.

The selection of an appropriate-sized helicopter and associated equipment will be made in consultation with an aviation company experienced in environmental baiting. Given the density of houses and businesses on Norfolk Island, a skilled pilot with relevant experience is required for the safe and efficient completion of the heli-baiting and the overall success of the Argentine ant eradication program.\textsuperscript{20}

\textbf{Figure 11}: Fertiliser spreader used for the application of ant bait

4.1.2 Ideal treatment window
Mid-summer to early autumn (January – March) is the most suitable period for the application of hydrogel baits on Norfolk Island: all of the Argentine ant sexual castes will have reached maturity; no new sexual larvae will be produced until the following spring; and foraging activity is at its highest. The success of hydrogel baiting relies on Argentine ants continually feeding on the baits throughout the eight week baiting period.

Climatic conditions at this time of year are also relatively stable and conducive to aerial and ground baiting on Norfolk Island.

4.2 Xstinguish™ Argentine ant bait
Xstinguish™ Argentine ant bait is a carbohydrate and protein paste matrix packaged in 325g tubes. Xstinguish is applied by depositing a small amount (1-2 grams) on the ground using a caulking gun. It takes an average of 14.5 hours to apply 3-6kg of Xstinguish in a 2x2m grid across a one hectare infestation.

Xstinguish is manufactured by FBA Consulting in New Zealand and is supplied to the ANI at a cost of NZ$40 per 325g tube.

Xstinguish is readily consumed by Argentine ants however its efficacy can be adversely affected by field conditions.

It is difficult to consistently and thoroughly apply Xstinguish in steep, heavily vegetated terrain. It can also be difficult to ensure even bait spacing in large areas of open ground. Lines of field staff must work well together and be conscientious to ensure there are no gaps
in the ‘grid’ of deposited bait. In steep and densely vegetated terrain the likelihood of gaps in bait placement are increased.

Xstinguish has been proven to consistently attract Argentine ant and the paste is readily consumed when encountered. However sunlight and/or rain limits the life-span of Xstinguish to less than 24 hours and it quickly becomes unpalatable to ants. For Xstinguish to be effective in eradicating an infestation of Argentine ant, the volume of bait consumed must be enough to be transmitted to all the individuals within an entire nest, including multiple queens and their brood. If insufficient bait is available it is possible that the time taken for Argentine ant workers to forage for and consume the required amount of bait to eradicate an infestation is greater than the field life of the bait.

These deficiencies may be reduced by:

1) Stringent supervision and communication with field staff to ensure there are no gaps in the baiting grid;
2) Applying bait during a period of fair weather, i.e. not before forecast rain periods;
3) Correct placement of bait: wherever possible bait should be deposited under leaf litter or grass tussocks to avoid exposure to sunlight; and
4) Accurate monitoring and mapping of each population to ensure the bait is being applied in the correct areas and at a higher application rate in densely infested areas.

Figure 13: Xstinguish ant bait in caulking gun
4.2.1 Ideal treatment window

Monitoring data collected on Norfolk Island suggests that a minimum of three applications of Xstinguish are required to eradicate an infestation of Argentine ant. The ideal time between applications on Norfolk Island remains unproven but current best practice for control programs in New Zealand is 6-8 weeks.\(^{21}\) Trials in New Zealand have also shown that initiating the first treatment of Xstinguish in spring has proven just as effective as beginning in mid-summer.\(^{22}\) Monitoring data collected on Norfolk Island indicates that all infestations that have been potentially eradicated have had treatments that began in late spring. Also, starting treatments in mid-summer does not allow enough time to complete three treatments before weather conditions on Norfolk Island become cooler, wetter and generally less conducive for the consumption of bait by Argentine ant.

Therefore treatments requiring the use of Xstinguish will begin in late spring (November) with a second treatment beginning in January and the third treatment in March.

4.2.2 Western cliffs

The Argentine ant infestations along the western cliffs of Norfolk Island pose a significant logistical challenge. Argentine ant has been detected at the top of 3km of cliff edge stretching from Puppys Point in the north to Headstone in the south. The height of the cliffs ranges between 50 and 80m. The terrain along the western cliffs varies; some sections are vegetated from the top to the high water mark; most have a significant vertical rock face.

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Argentine ant has been detected at the high water mark at one location where it is accessible by foot.  

In order to safely and evenly apply bait to the western cliffs, rope access specialists will be engaged to apply Xstinguish in a 2x2m grid while descending and ascending all of the cliffs along this 3km section.

Logistics and cost estimates for this operation are based on preliminary consultation with rope access specialists. One abseil would be required every 10m (the abseiler will need to ‘swing’ 4m each way) with bait being deposited on the decent and again on the ascent. This will require 300 abseils over the 3km. Allowing for six abseils per person per day, a single treatment would take a three person team 17 days to cover 3km of cliff face.

---

23Pers. comm. Kane Anderson, Norfolk Island resident May 2014
Figure 15: Western cliffs at Headstone

Figure 16: View of western cliffs at Puppys Point from the water
4.3 Impacts of baiting on non-target species

Fipronil has been commonly used as the active constituent in numerous ant control/eradication programs in Australia. A study into the effects of the aerial baiting of Yellow Crazy Ant (Anoplolepis gracilipes) on Christmas Island, a program very similar to the one on Norfolk Island, found that there was “no effect of the fipronil aerial baiting … on the total ground dwelling arthropod community”. Furthermore, “analysis of soil, water and sediment samples found no evidence that fipronil or three toxic degradation by-products, fipronil sulphide, fipronil sulfone and fipronil desulfynyl, are accumulating in the environment on Christmas Island”.

The concentration of fipronil used in the Norfolk Island eradication program will be the same as or lower than that used on Christmas Island; it is expected that there will be no adverse impacts on the Norfolk Island biota. In addition, the post-baiting data collected on Norfolk Island to date has shown an increase in the abundance and diversity of other ant species once Argentine ants have been eliminated from an area using ant bait containing fipronil.

To further test this hypothesis assessments will be conducted measuring non-target effects of the treatments, especially within environmentally sensitive areas of the Norfolk Island National Park.

Fipronil has a very low mammalian toxicity and extremely high and unrealistic consumption would be required to achieve toxicity. This also applies to the Island’s avifauna including chickens.

Cattle, dogs, cats, chickens, and children will not need to be excluded from the treatment areas during or after the application phases of this program.

---

### 4.4 Treatment strategy

The table below summarises the treatment strategy to be implemented for each infestation and the associated costs, including materials and labour for monitoring and baiting. This table does not include costs for other critical components such as project governance, research and post-treatment monitoring. An indicative budget for the implementation of this eradication plan is at section 9.

#### Table 2: Norfolk Island Argentine ant treatment strategy

<table>
<thead>
<tr>
<th>Zone</th>
<th>Name</th>
<th>Size (ha)</th>
<th>Eradication Strategy</th>
<th>Remitted budget</th>
<th>Total estimated cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anson Bay - Headstone</td>
<td>&gt;130</td>
<td>Delineate boundary of infestation in spring 2015; monitoring required across 35ha.</td>
<td>$136,540.90 + helicopter</td>
<td>$147,627.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aerial application of hydrogel bait across &gt;125ha beginning January 2016</td>
<td>Hydrogel materials = $126,692.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across ~5 ha</td>
<td>Hydrogel application = $3,089.60 + helicopter</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Western cliffs</td>
<td>24 (3km x 80m)</td>
<td>Treatment to begin in November 2015 using methods outlined in section 3; monitoring required across approximately 20ha.</td>
<td>Indicative costs for specialist labour = $30,600 per treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Three treatments to be conducted 6-8 weeks apart</td>
<td>Xstinguish @ 8kg/ha x 24ha x 3 applications = $15,927.36</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hundred Acres</td>
<td>2</td>
<td>Monitor site in spring 2015</td>
<td>Monitoring = $396.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If AA are detected Xstinguish will be used to 'mop up' remnant colonies</td>
<td>Monitoring to confirm extent prior to baiting (7ha)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>New Farm Rd</td>
<td>9</td>
<td>Delineate boundary of infestation in spring 2015</td>
<td>Monitoring = $1,757.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across entire infestation</td>
<td>Hydrogel materials = $9,771.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 treatment per week over 2 months (36 man-hours/treatment)</td>
<td>Hydrogel application = $5,561.28</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Waste Management Centre (WMC)</td>
<td>&gt;55</td>
<td>Delineate boundary of infestation in spring 2015 using methods outlined in section 3; monitoring required across approximately 20ha.</td>
<td>Delineation of boundary; monitoring 22ha = $4,248.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aerial application of hydrogel bait across 100% of the infestation beginning January 2016</td>
<td>Hydrogel materials = $33,600.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across ~5 ha</td>
<td>Hydrogel application = $0 + helicopter</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Mt Pitt Rd / NINP</td>
<td>20</td>
<td>Monitor boundary to confirm extent prior to baiting (7ha)</td>
<td>Delineation of boundary; monitoring 7ha = $1,251.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aerial application of hydrogel bait across 15ha beginning January 2016</td>
<td>Hydrogel materials = $17,691.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across ~5 ha</td>
<td>Hydrogel application = $3,089.60 + helicopter</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hospital Rd</td>
<td>&lt;1</td>
<td>Monitor site in spring 2015</td>
<td>Monitoring = $193.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If AA are detected Xstinguish will be used to 'mop up' remnant colonies</td>
<td>Monitoring to confirm extent prior to baiting (4ha)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Collins Head Rd</td>
<td>&lt;5</td>
<td>Monitor site in spring 2015</td>
<td>Monitoring = $965.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If AA are detected Xstinguish will be used to 'mop up' remnant colonies</td>
<td>Monitoring to confirm extent prior to baiting (8ha)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Ball Bay</td>
<td>&lt;2</td>
<td>Monitor site in spring 2015</td>
<td>Monitoring = $386.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If AA are detected Xstinguish will be used to 'mop up' remnant colonies</td>
<td>Monitoring to confirm extent prior to baiting (4ha)</td>
<td></td>
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<tr>
<td>9</td>
<td>Two Chimneys &amp; Hibiscus Drive</td>
<td>18</td>
<td>Monitor site in spring 2015</td>
<td>Monitor Two Chimneys sector (8ha) = $396.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If AA are detected Xstinguish will be used to 'mop up' remnant colonies</td>
<td>Delineation of Hibiscus Dr sector; monitoring 7ha = $1,251.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hibiscus Drive sector (&gt;13ha):</td>
<td>Hydrogel materials = $12,669.28</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Monitor boundary to confirm extent prior to baiting (7ha)</td>
<td>Hydrogel application = $2,471.68 + helicopter</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aerial application of hydrogel bait across ~9ha beginning January 2016</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across ~4 ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Burnt Pine</td>
<td>8</td>
<td>Monitor to confirm extent prior to baiting (8ha)</td>
<td>Monitoring (8ha) = $1,544.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Treatment to begin with Xstinguish in November 2015</td>
<td>Treatment materials = $18,609.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treatment labour = $6,719.88</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Prince Phillip Drive</td>
<td>13</td>
<td>Monitor boundary to confirm extent prior to baiting (4ha)</td>
<td>Delineation of boundary (4ha) = $772.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aerial application of hydrogel bait across ~11ha beginning January 2016</td>
<td>Hydrogel materials = $12,465.28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand broadcasting of hydrogel bait across ~2 ha</td>
<td>Hydrogel application = $1,235.84 + helicopter</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone</th>
<th>Name</th>
<th>Size (ha)</th>
<th>Eradication Strategy</th>
<th>Remitted budget</th>
<th>Total estimated cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>263</td>
<td></td>
<td>215 ha available for aerial application</td>
<td>8 applications, 1 week apart</td>
<td>Monitoring (8ha) @ $1650/hr = $95,400 x 8 treatments</td>
<td>$475,200</td>
</tr>
</tbody>
</table>

Sub TOTAL: $442,960.46

Helicopter operating costs

TOTAL (delineation & treatment): $918,160.46
5. Monitoring and adaptive management
Monitoring the effect of bait treatments in real time is essential to detect any potential issues as soon as they arise, and to quantify project performance against expectations. CSIRO will design and monitor the entire operation to provide a quantitative assessment of project progress, and identify any issues as quickly as possible so that they can be resolved without compromising project integrity. Simultaneously, assessments will be conducted measuring non-target effects of the treatments, especially within environmentally sensitive areas of the Norfolk Island National Park. Monitoring data will be pivotal for quality control, project evaluation, assessment of eradication success and disseminating project information.

6. Community engagement
The vast majority of the community and affected landholders have provided 100% support for the eradication program since its inception in 2008 and this is expected to continue. However a shift from ground baiting to aerial baiting in some areas may raise concerns amongst the community.

A series of community meetings publicised on local radio, written media and online, will be held to provide opportunities to discuss the eradication strategy with all island residents.

Targeted meetings will also be held with the owners of infested lands that will be directly affected by the eradication program. Direct discussions will also be initiated with each affected landowner.

7. Project governance
The Argentine ant eradication program is currently managed by a full time coordinator under the direction of the Manager, Land Use and Environment, Administration of Norfolk Island. It is expected that this arrangement will continue until the program is completed.

7.1 Technical support
Technical support will be provided by CSIRO via a consulting services agreement. Dr Ben Hoffmann, Principle Research Scientist, has provided support in the development of this plan and will continue to support its implementation. His experience in dealing with large scale ant eradications in complex environments will greatly aid the smooth running and success of this program.

7.2 Casual labour
A pool of casual field assistants will be engaged on an as-needs basis. It is expected that a sufficient amount of labour will be available on Norfolk Island to implement this plan from start to finish.

8. Quarantine
Successful Argentine ant eradication can only be achieved with the implementation of effective quarantine and biosecurity measures. This is applicable to both individual infestations and Norfolk Island as a whole.
8.1 Zone Quarantine

As discussed in section 5, human-mediated dispersal is the major contributor to the spread of Argentine ant from the original introduction, hence the current distribution on Norfolk Island. Without controlling the movement of infested materials by humans the likelihood of success of the eradication program is low – that is people must not move infested or potentially infested materials from known infested areas.

Preventing the spread of Argentine ant is the responsibility of all of the whole community. Without the participation and engagement of the community the likelihood of success is severely diminished, hence the need for an effective community engagement program. Engagement must highlight the importance and need for standstills or restrictions on movement of certain goods from within the known infested areas and early reporting of suspected infestations.

ANI staff, individual landholders and the broader community are often advised that the transportation of items from an infested area must either not occur at all or be thoroughly inspected by eradication program staff before being moved.

These items include:

- Garden waste;
- Plant and machinery (chippers, slashers, earthmovers, etc);
- Firewood;
- Cow manure;
- Soil & gravel;
- Hard rubbish; and
- Potted plants.

Infected items can be treated, inspected and cleared (or prevented from movement until disinfested) for transport by eradication program staff.

8.2 Norfolk Island Biosecurity

Once Island-wide eradication has been achieved, on-going effective biosecurity measures need to be implemented to minimise the likelihood of the re-introduction of Argentine ant to Norfolk Island.

Currently, the Norfolk Island Health & Quarantine Service inspects all incoming cargo from private and commercial flights and shipping vessels. Any unwanted biological contaminants are treated immediately by either the application of insecticides or incineration.

Responsibility for this service is expected to transfer to the Australian Government at 1st July 2016.
9. Projected budget

Table 3: Indicative budget for treatment, monitoring and evaluation of the eradication strategy.

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Zones</th>
<th>Area (ha)</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>Project management</td>
<td></td>
<td>In-kind (ANI)</td>
<td>$ 67,000</td>
</tr>
<tr>
<td>All</td>
<td>All</td>
<td>Technical support (CSIRO)</td>
<td></td>
<td></td>
<td>$ 6,000</td>
</tr>
<tr>
<td>1</td>
<td>Sep - Dec</td>
<td>1,3,4,5,9,10,11</td>
<td>85</td>
<td>Monitoring*: Delineation of infestations prior to baiting</td>
<td>$ 17,000</td>
</tr>
<tr>
<td>1</td>
<td>Sep - Dec</td>
<td>2,6,7,8</td>
<td>15</td>
<td>Monitoring: evaluation of previous baiting</td>
<td>$ 3,000</td>
</tr>
<tr>
<td>1</td>
<td>Jan-Mar</td>
<td>231</td>
<td></td>
<td>Treatment: Hydrogel bait (materials)^</td>
<td>$ 240,000</td>
</tr>
<tr>
<td>1</td>
<td>Jan-Mar</td>
<td>25</td>
<td></td>
<td>Treatment: hand broadcast (labour)</td>
<td>$ 16,000</td>
</tr>
<tr>
<td>1</td>
<td>Nov, Jan, Mar</td>
<td>10, western cliffs</td>
<td>32</td>
<td>Treatment: Xstinguish</td>
<td>$ 75,000</td>
</tr>
<tr>
<td>1</td>
<td>Nov, Jan, Mar</td>
<td>10</td>
<td>8</td>
<td>Treatment: labour`</td>
<td>$ 8,000</td>
</tr>
<tr>
<td>1</td>
<td>Nov, Jan, Mar</td>
<td>Western cliffs</td>
<td>24 (3km)</td>
<td>Treatment: rope access specialists</td>
<td>$ 100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>SUBTOTAL (year one treatment):</strong></td>
<td><strong>$ 1,001,000</strong></td>
</tr>
<tr>
<td>2</td>
<td>Sep-March</td>
<td>All</td>
<td>263</td>
<td>Monitoring of all infestations*</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>2</td>
<td>Nov</td>
<td>Western cliffs</td>
<td>24 (3km)</td>
<td>Monitoring: rope access specialists</td>
<td>$ 35,000</td>
</tr>
<tr>
<td>3</td>
<td>Sep-March</td>
<td>All</td>
<td>263</td>
<td>Monitoring and evaluation</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>4</td>
<td>Sep-March</td>
<td>All</td>
<td>263</td>
<td>Monitoring and evaluation</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>5</td>
<td>Sep-March</td>
<td>All</td>
<td>263</td>
<td>Monitoring and evaluation</td>
<td>$ 50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>SUBTOTAL (monitoring and evaluation years 2-5)</strong></td>
<td><strong>$ 235,000</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>$1,236,000</strong></td>
</tr>
</tbody>
</table>

*Monitoring costs based on 10hrs/ha @ $19.31/hr
^Material costs include hydrogels, sugar, fipronil, and equipment required for mixing and application (gloves, buckets, etc)
`Hand broadcast of hyrdogels based on 4hrs/ha @ $19.31/hr
~labour for application of Xstinguish based on 14.5hrs/ha @ $19.31/hr
#Cost of monitoring manually (see section 3). This will be substituted for the cost of a detection dog if available.
10. Conclusion

The impact of Argentine ant around the world is well documented. On Norfolk Island Argentine ant has the potential to alter ecosystem processes and add more pressure to already endangered species such as the endemic Norfolk Island Green Parrot.

Failure to eradicate Argentine ant from Norfolk Island jeopardises the progress and investment made in other environmental programs such as the Norfolk Island Green Parrot recovery program. The Argentine ant also poses a real threat to the Island’s principal industry: tourism. This invasive ant species thus has the potential to negatively affect the Island’s economy to a significant extent.

This strategy outlines a cost effective plan that has a very high probability of successfully eradicating the Argentine ant from Norfolk Island.

The implementation and adaptive management of this strategy will be supported by a Consulting Services Agreement with CSIRO Biodiversity Flagship and includes a strong focus on continuous monitoring and evaluation of results.

The apparently successful eradication of Argentine ant from a number of infested areas on Norfolk Island confirms the efficacy of the basic methodologies of the Administration’s scientifically-based Argentine ant eradication program. The considerable investment by the Norfolk Island community and the Commonwealth in this program is at risk if the Argentine ant eradication program is not ramped up to achieve Island-wide eradication in the shortest possible time.

This strategy provides a clear, scientifically based and costed pathway to achieve eradication of Argentine ant on Norfolk Island within 12 months: employing proven methodologies, with 2 – 3 years post-eradication monitoring.
## Appendix

### Table 4: Application rates and associated costs of treatment products over the 2013/14 season (chronological order)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Date of application</th>
<th>Treatment Product</th>
<th>Unit price</th>
<th>Price per kg or mL</th>
<th>amount used Kg or mL</th>
<th>Application rate Kg/ha or mL</th>
<th>Product Cost</th>
<th>Labour (hours)</th>
<th>Labour $/hr</th>
<th>Labour cost</th>
<th>Total treatment cost</th>
<th>Treatment cost/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1.0 11/09/2013</td>
<td>Xstinguish 325g tube</td>
<td>$40.00</td>
<td>$123.08</td>
<td>7.96</td>
<td>8.2942</td>
<td>$979.94</td>
<td>36.0</td>
<td>$18.05</td>
<td>$649.80</td>
<td>$1,629.74</td>
<td>$1,697.64</td>
</tr>
<tr>
<td>8</td>
<td>1.0 12/09/2013</td>
<td>Antagonist PRO 1000mL bottle</td>
<td>$90.54</td>
<td>$0.09</td>
<td>480.00</td>
<td>15</td>
<td>$43.46</td>
<td>3.0</td>
<td>$20.00</td>
<td>$60.00</td>
<td>$103.46</td>
<td>$107.77</td>
</tr>
<tr>
<td>8</td>
<td>1.0 19/09/2013</td>
<td>Xstinguish 325g tube</td>
<td>$40.00</td>
<td>$123.08</td>
<td>5.44</td>
<td>5.6705</td>
<td>$670.03</td>
<td>17.5</td>
<td>$18.05</td>
<td>$315.88</td>
<td>$985.91</td>
<td>$1,026.99</td>
</tr>
<tr>
<td>8</td>
<td>1.0 26/09/2013</td>
<td>Xstinguish 325g tube</td>
<td>$40.00</td>
<td>$123.08</td>
<td>2.93</td>
<td>3.0468</td>
<td>$360.00</td>
<td>15.0</td>
<td>$18.05</td>
<td>$270.75</td>
<td>$630.75</td>
<td>$657.03</td>
</tr>
<tr>
<td>3</td>
<td>4.9 29/10/2013</td>
<td>SAS PRO 20kg bucket</td>
<td>$154.45</td>
<td>$7.72</td>
<td>627.00</td>
<td>128.46</td>
<td>$4,842.01</td>
<td>36.5</td>
<td>$18.05</td>
<td>$658.83</td>
<td>$5,500.83</td>
<td>$1,126.99</td>
</tr>
<tr>
<td>3</td>
<td>4.9 1/11/2013</td>
<td>Antagonist PRO 1000mL bottle</td>
<td>$90.54</td>
<td>$0.09</td>
<td>3170.00</td>
<td>15</td>
<td>$287.01</td>
<td>11.0</td>
<td>$18.05</td>
<td>$198.55</td>
<td>$485.56</td>
<td>$99.48</td>
</tr>
<tr>
<td>7</td>
<td>4.1 30/10/2013</td>
<td>Xstinguish 325g tube</td>
<td>$40.00</td>
<td>$123.08</td>
<td>17.23</td>
<td>4.1506</td>
<td>$2,120.00</td>
<td>44.5</td>
<td>$18.05</td>
<td>$803.23</td>
<td>$2,923.22</td>
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