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Manatū Ahu Matua

National Invasive Ant Surveillance Programme Annual Report: 2014

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Executive Summary

The National Invasive Ant Surveillance programme (NIAS) was established by the Ministry of Agriculture and Forestry (now Ministry for Primary Industries) in 2003. The programme was developed following a response to a red imported fire ant (*Solenopsis invicta*) incursion at the Auckland International Airport in February 2001.

The primary objectives of NIAS are to detect newly established nests of invasive ant species at high risk sites around New Zealand and to identify changes in distribution of exotic ant species already established in New Zealand. This is achieved by annual targeted surveys of identified high-risk sites most likely to be the pathways for exotic ant species imported via international trade and shipping.

Pre-selected sites are surveyed by AsureQuality and FBA Consulting ground teams using small plastic pottles placed in systematic grids and alternately baited with either carbohydrate or protein lures. Ants locate these pottles with their natural foraging behaviour and recruit additional worker ants to feed upon the bait. This results in numbers of ants being present inside the pottle upon collection. Pottles are collected after one to two hours, depending on temperature criteria, and are transferred to the FBA Consulting diagnostic laboratory for systematic identification down to species level. Data is transferred to the national database held by AsureQuality Ltd.

Any suspect exotic ant specimens identified are forwarded to the Ministry for Primary Industries Investigation and Diagnostic Centre for taxonomic validation. Identification of any ant species not known to be present in New Zealand is followed up with an incursion response to eradicate any new exotic species found.

This year saw 48,526 pottles deployed with just 19 pottles (<0.1%) recording new exotic ants within them. Of these exotic detections 13 were later confirmed to be independent incursions, as on two occasions the same exotic ant nest was detected by ants found in more than one sample pottle collected close together. Of the 13 detections made, 11 were confirmed to be active established nests, while two exotic detections were not found again during incursion response. All incursions of exotic ants and associated nests were eradicated from the sites where they were found.

Of the remaining survey pottles 13,529 (27.9%) recorded local ant species already established in New Zealand with the majority of pottles (i.e., 34,107 [70.3%]) being void of any ant fauna.

Trends in ant captures in pottles were found to be consistent with long term patterns that have been established since the beginning of the programme in 2003. Northern survey sites typically had higher detection rates for ants than southern sites. Recruitment rates of ants to pottles ranged between 31% and 51% north of Tauranga, whereas locations south of Christchurch would typically rate between 5% and 13%. This trend is consistent with what has been recorded in previous seasons and indicates the NIAS emphasis on surveying northern locations is valid as they are far more likely to support a viable nest of an exotic ant

species. The likelihood of entry is also higher at the more northern sites because these ports receive the highest volumes of commodities imported to the country.

It was difficult to establish long-term patterns or trends in habitat types where ants would be most likely found. In 2014 it was found that broken surfaces, buildings and vegetation were the best habitats for collecting ants, albeit ants were found in a wide variety of habitats. This is likely related to the biology of ants and their ability to forage over long distances and over a variety of habitats. This indicates that the NIAS specification of grid surveying across locations is valid, as foraging ants may be present anywhere at a site and not necessarily near the actual nest or in a particular habitat type.

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Introduction

The National Invasive Ant Surveillance programme (NIAS) was established by the Ministry of Agriculture and Forestry (now Ministry for Primary Industries, MPI) in 2003 following a response to a red imported fire ant (RIFA) (*Solenopsis invicta*) incursion at the Auckland International Airport in 2001.

The primary objective of NIAS is to detect newly established nests of invasive ant species at high risk sites around New Zealand. The secondary objective is to identify changes in distribution of exotic ant species already established in New Zealand for tracking and reporting purposes. Therefore, annual targeted surveys are undertaken of high-risk sites that have been considered to be the most likely pathways for exotic ant importation. These are typically sites associated with international trade and shipping (e.g., seaports/wharves, international airports, container devanning sites and Approved Transitional Facilities).

In 2012 the NIAS program was contracted as a Statement of Work under the Ministry for Primary Industries Surveillance Panel agreement. AsureQuality Limited are contracted to implement the NIAS program including training, quality control and surveys in all areas except Wellington and Auckland. FBA Consulting are subcontracted to provide diagnostic and species identification services for all sites, as well as surveys in Wellington and Auckland. This arrangement has been in place for all NIAS surveys.

NIAS, and the programmes that preceded it, have effectively been running for 13 seasons. This report provides information on the 2014 survey and provides a comparison of the current results with previous surveys.

CURRENT ANT SPECIES IN NEW ZEALAND

New Zealand has a relative paucity of ant species by international standards. Of the 39 species of ant thought to be established in New Zealand (Table 1, from Ward 2005), only 10 are endemic or native. The remaining 29 species have all been introduced by humans (i.e., are exotic). By comparison, Australia has around 1,275 described species of native ant alone (Shattuck 1999).

The exact number and naming priority of endemic and introduced ant species in New Zealand is subject to academic debate. Some species such as *Monomorium antarcticum, Monomorium fieldi* and *Nylanderia* spp. are likely to be species complexes (i.e., multiples of closely related species that are difficult to distinguish) (Gunawardana 2005, Ward 2005). This means that providing an absolute list of ant fauna for New Zealand is difficult and is subject to change as research uncovers new information on species relationships.

There have been many species of exotic ants regularly intercepted over the years, both at the border and post-border, that were subsequently eradicated by border control authorities (Table 2). These species have originated from a variety of locations around the globe, including temperate and tropical regions from both the northern and southern hemispheres. This wide variety of interceptions highlights the importance of invasive ant surveillance to New Zealand. The environmental impacts and biology of invasive ants has been summarised previously (FBA Consulting 2008a, Landcare 2014) and is outside the scope of this report.

Table 1: Species of ants (Formicidae) currently established in New Zealand.

Morphic group	Subfamily	Genus species	Common Name	Status
Poneromorphidae	Amblyoponinae	*Amblyopone australis* (Erichson)	Southern Michelin ant	Introduced
		Amblyopone saundersi (Forel)	New Zealand Michelin ant	Endemic
	Ponerinae	*Hypoponera confinis* (Roger)	Crypt ant	Introduced
		Hypoponera eduardi (Forel)	Crypt ant	Introduced
		Hypoponera punctatissima (Roger)	Rogers ant	Introduced
		Pachycondyla castanea (Mayr)		Endemic
		Pachycondyla castaneicolor (Dalla Torre)		Endemic
		Ponera leae (Forel)	Blind crypt ants	Introduced
	Proceratiinae	*Discothyrea antarctica* (Emery)	Clubbed trigger ant	Endemic
Formicoidiae	Dolichoderinae	*Doleromyrma darwiniana* (Forel)	Darwin's ant	Introduced
		Iridomyrmex sp. cf. *anceps*	Undescribed Australian species	Introduced
		Linepithema humile (Mayr)	Argentine ant	Introduced
		Ochetellus glaber (Mayr)	Little black ant	Introduced
		Technomyrmex jocosus (Forel)	White-footed house ant	Introduced
	Ectatomminae	*Rhytidoponera chalybaea* (Emery)	Blue pony ant	Introduced
		Rhytidoponera metallica (Fr. Smith)	Metallic pony ant	Introduced
	Formicinae	*Nylanderia* spp. (up to 3 undescribed species)	Parrot ant	Introduced
		Prolasius advenus (Fr. Smith)	Small brown bush ant	Endemic
		Plagiolepis alluaudi (Emery)	Little yellow ant	Introduced
	Heteroponerinae	*Heteroponera brouni* (Forel)	Crypt ant	Endemic
	Myrmicinae	*Cardiocondyla minutior* (Forel)		Introduced
		Huberia brounii (Forel)		Endemic
		Huberia striata (Fr. Smith)	Striated ant	Endemic
		Mayriella abstinens (Forel)		Introduced
		Monomorium antarcticum (Fr. Smith)	Southern ant	Endemic
		Monomorium fieldi (Forel)	Tiny brown ant	Introduced
		Monomorium pharaonis (Linnaeus)	Pharaoh ant	Introduced
		Monomorium smithii (Forel)		Endemic
		Monomorium sydneyense (Forel)		Introduced
		Orectognathus antennatus (Fr. Smith)	Goblin ant	Introduced
		Pheidole megacephala (Fabricius)	Big headed ant	Introduced
		Pheidole proxima (Mayr)	Big headed ant	Introduced
		Pheidole rugosula (Forel)	Big headed ant	Introduced
		Pheidole vigilans (Fr. Smith)	Big headed ant	Introduced
		Solenopsis sp.	Thief ant	Introduced
		Strumigenys perplexa (Fr. Smith)	Snappy detritus ant	Introduced
		Strumigenys xenos (Brown)		Introduced
		Tetramorium bicarinatum (Nylander)	Pennant ant	Introduced
		Tetramorium grassii (Emery)	Pennant ant	Introduced

Note: Table modified from Ward (2005).

Table 2: Exotic ant species intercepted at the New Zealand border, 2002 – 2014.

Morphic group	Subfamily	Species Name	Common Name	Year Detected in NIAS
Formicoidiae	Dolichoderinae	*Tapinoma melanocephalum*	Ghost ant	2003, 2006, 2008, 2009, 2011, 2012
		Tapinoma sessile	Odorous house ant	2004
		Tapinoma spp.		
		Iridomyrmex anceps	Flat-backed tyrant ant	
		Iridomyrmex spp.	Flat-backed tyrant ant	
		Technomyrmex spp.	Pedicel ant	
	Formicinae	*Paratrechina longicornis*	Brown crazy ant	2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
		Paratrechina bourbonica	Robust crazy ant	
		Paratrechina spp.	Parrot ant	
		Anoplolepis gracilipes	Yellow crazy ant	2004, 2005, 2008
		Camponotus pennsylvanicus	Carpenter ant	
		Camponotus herculeanus	Red carpenter ant	
		Camponotus spp.	Carpenter ant	2013
		Polyrhachis sp.	Spiny ant	2002
		Oecophylla smaragdina	Weaver ant	
		Formica sp.		
		Lasius neglectus	Invasive garden ant	
	Myrmicinae	*Crematogaster* sp.	Valentine ant	
		Monomorium destructor	Singapore ant	2005, 2006, 2007, 2008, 2010, 2012, 2013
		Monomorium floricola	Bicolored trailing ant	2004, 2008, 2011
		Monomorium		
		Monomorium sechellense		
		Monomorium indicum		2009, 2013
		Monomorium spp. (Several undescribed species)		2004, 2005, 2006, 2007, 2008, 2010, 2011, 2012, 2013, 2014
		Pheidole fervens	Big headed ant	
		Solenopsis invicta	Red imported fire ant	2004
		Solenopsis geminata	Tropical fire ant	2003, 2008, 2013
		Solenopsis papuana	Papuan thief ant	
		Solenopsis spp.		
		Strumigenys rogeri		
		Tetramorium pacificum		
		Tetramorium simillimum	Similar groove-headed ant	
		Tetramorium tonganum		
		Tetramorium spp.		
		Wasmannia auropunctata	Little fire ant	

THE NATIONAL INVASIVE ANT SURVEILLANCE PROGRAMME

How the NIAS programme targets newly arrived ant species

High-risk sites for ant entry are determined by ongoing pathway and site risk analyses undertaken annually by MPI. High risk sites include seaports, airports, devanning sites, sea container storage sites and other Approved Transitional Facilities (ATF) that receive international freight. Once reviewed, sites are then scheduled to be surveyed from mid-summer to early autumn each surveillance season.

The NIAS programme targets these risk sites that are attractive for ants to colonise by taking into account the biology and behaviour of newly arrived ant species. Ants that have hitchhiked on an item of cargo are unlikely to remain on that item for long, particularly if they have been disturbed by cargo movements and unloading/unpacking. There may also be specific immediate biological needs that they will require. Ants therefore have a pressing impetus to set up a nest in as short a time as possible and immediately start to locate food and moisture. This means that newly established nests are most likely to be close to where the item of cargo was first landed or stored.

Newly landed ants are also limited by the available habitat for nest construction. Most ports, container yards and devanning sites feature large tracts of flat concrete or asphalt pads that are constantly disturbed by vehicle traffic etc., and so are not suitable as nest sites. Ants will therefore seek undisturbed sites and habitat around the margins of concrete or asphalt pads where there are cracks or gaps in the surface and some vegetation and detritus has gathered (e.g. light poles, fence-lines, gutters, drains, buildings).

While these sites may be better than open concrete, they are often still reasonably inhospitable to ants, and frequently have limited food and moisture available. This means that nests may not be particularly productive in growth terms (i.e., the nests may be small) and the nest will be in constant need for resources and will, therefore, continuously send out foragers to find new sources of food.

For this reason a "risk site" is defined as any place where an imported risk item (e.g., sea or air containers, imported cars and other cargo capable of transporting ants) may have rested within 50m of favourable ant habitat (Figure 1). Favourable ant habitats are specifically defined to include; tree trunks, flowers, shrubs and poles, building edges and foundations, hard concrete/asphalt slab edges, cracked concrete/asphalt and junctions between pavers, disturbed sites, drains and culverts, electrical generators and fittings, exposed rocks, fence palings, grass areas and verges, hot water pipes and heaters, isolated weeds, logs, loose gravel, low vegetation, plant pot bases, road margins, rubbish piles, shiny/corrugated surfaces, soil, tree crotches and hollows, vertical surfaces, weed and plant re-growth, wooden structures, underneath stones, concrete rubble and debris (MAF 2008).

The NIAS programme targets these risk sites by specifically placing attractive baited pottles systematically in and around any of these suitable ant habitats present at the selected facilities. By offering a high-energy food source (i.e., carbohydrate and protein) in an environment that is typically depauperate of food for ants, the programme maximises the chances of foraging exotic ants finding, recruiting, and then being captured in baited pottles.

Figure 1: Typical environment of a container storage yard surveyed during NIAS.

Methods

The identified risk sites (i.e., areas where ants are most likely to be present) are surveyed by ground teams that are coordinated by AsureQuality Ltd. Systematic grids of small plastic pottles, alternately baited with either carbohydrate (i.e., sugar solution) or protein (i.e., peanut butter, oil and sausage meat) are placed every 10 x 10m. Additional pottles are used to collect ants where necessary by ground teams if a visual inspection identifies suspect live ants at a location.

Ants typically locate these pottles with their natural foraging behaviour and will recruit additional worker ants to feed upon the bait. This results in an abundance of ants being present inside the pottle upon collection. Pottles are subsequently collected after one to two hours and re-capped with any ants present sealed inside them (Figure 2).

Pottles are left out at a site for approximately two hours between 20 and 24.9°C and approximately one hour between 25 – 28°C. Surveying stops if the temperatures or other environmental factors (e.g., rain) falls outside MPI directed specifications. At temperature below 20°C and above 28°C ant foraging activity is considered to decrease significantly, reducing the likelihood of capture (Krushelnycky et al. 2005). In addition, at temperatures above 28°C the baits used in NIAS are known to rapidly dry out, reducing attractiveness to ants.

Figure 2: NIAS sugar pottle containing foraging *Iridomyrmex* sp. workers.

GPS locations and associated data collected during the survey are recorded by hand held data-loggers. This data is transferred electronically into a secure national AsureQuality database at the end of each days sampling. This data can then be used to undertake follow-up incursion responses if needed as well as providing the technical data and maps used in this report (see Appendices).

Collected pottles are transferred to the FBA Consulting diagnostic laboratory for systematic identification down to species level and then the results are recorded in the national database held by AsureQuality.

Suspect exotic ant specimens are forwarded to the Ministry for Primary Industries Investigation and Diagnostic Centre (IDC) for validation. Identification of any ant species not known to be present in New Zealand is followed up with subsequent incursion responses to eradicate any new exotic species found.

The entire programme is subject to internal and external audit and review (by AsureQuality and MPI respectively). This process means the programme maintains a high quality assurance standard, is fit for purpose and gives the best value to MPI.

Results

ENVIRONMENTAL INFORMATION

Climate description

Climatic influences are a significant factor that affects ant biogeographic distribution, behaviour and nest productivity. Ants are sensitive to a range of environmental influences, including air and soil temperatures, rainfall, soil moisture deficits as well as humidity. A supportive climate in the lead-up to the NIAS surveillance programme has been implicated as a cause of increased exotic interceptions, as invading nests are more likely to successfully establish and thus be detected (Browne et al. 2012).

Outlined below is a summary of the climate from winter 2013 to summer 2014 which is later used to provide information on the likely relative productivity and level of ant activity prior to and during the 2014 NIAS season.

Winter (1 June – 31 August 2013)

It was a warm winter in 2013 for most of the country, with mean temperatures well above average throughout the South Island and parts of the lower half of the North Island. The nation-wide average temperature in winter 2013 was 9.5°C (1.2°C above the 1971-2000 winter average). Based on this winter 2013 was considered the warmest winter on record overall for New Zealand.

Overall, it was a wet winter for much of the South Island from Dunedin to Christchurch, and south-eastern parts of Marlborough and Hawke's Bay. Rainfall was above normal (more than 120% of normal winter rainfall) at most of these areas. In contrast, below normal rainfall (less than 80% of normal winter rainfall) occurred in parts of Manawatu, Taranaki, Bay of Plenty and Waikato. Near normal rainfall was recorded elsewhere (between 80 and 120% of normal winter rainfall) (NIWA 2013a).

Spring (1 September – 31 November 2013)

Following on from the warmest winter on record, New Zealand also experienced a warm spring in 2013. The nation-wide average temperature in spring 2013 was 13.0°C (0.9°C above the 1971–2000 spring average). Well above average temperatures (more than 1.2°C above the spring average) occurred in parts of Northland, Auckland, Bay of Plenty, Gisborne, Hawke's Bay, Taranaki, Manawatu, and Wairarapa. In the South Island, temperatures were above average for many areas, but especially about more western and northern parts.

Overall, near normal rainfall for spring was recorded across many parts of New Zealand (between 80 and 120% of normal spring rainfall). However, it was wetter than normal in some parts, especially about the southeast of the North Island and the southwest of the South Island (NIWA 2013b).

Summer (1 December 2013 - 28 February 2014)

The summer season started off on a warm note throughout the country whereas January was quite a bit cooler and February ended on an average note. Therefore, temperatures this past summer collectively ended up being near average for most of the country (within 0.5°C of the summer average).

In contrast rainfall for the summer season was below normal for much of the North Island (between 50–80% of normal summer rainfall), especially western Northland, all of the Waikato and the central North Island.

For the South Island below normal rainfall (50–80% of normal) occurred in northern areas from Blenheim to Nelson as well as Timaru and the Queenstown Lakes District. The remainder of the South Island recorded near normal rainfall (within 20% of normal) (NIWA 2014).

The overall climate from winter 2013 to summer 2014 is considered to be generally supportive of ant populations. In particular the unseasonably warm fine weather over winter and spring 2013 encouraged general ant activity and nest expansion. This was countered somewhat by the dry climate in January and February which resulted in soil moisture deficits in many areas that in theory are not conductive to ant populations or exotic ant nest establishment.

The fine weather over the summer meant that there were fewer weather interruptions to field operations than are typically encountered during the NIAS season.

RESULTS FROM THE 2014 SURVEY

Database analysis

During the 2014 analysis it was noted that no significant issues were found in the database, with only minor format issues requiring correction to allow data analysis to proceed. Only a basic analysis of the data was undertaken due to the variations in programme methodology from year to year (e.g., specific sites visited) makes it difficult for more robust analysis.

Table 3 displays the sampling effort (i.e., number of baited pottles deployed) for the programme over the last twelve seasons, as well as the number of pottles that have recorded ants. Aside from the first season (which was technically a RIFA response), each NIAS season has typically seen a steady increase in surveillance effort (Table 3). In particular, the deployment of the data-logger GPS barcode scanning system in late 2006 allowed for the number of pottles to almost double in the next NIAS sampling season.

There was a 12.4% increase in the number of pottles deployed in 2014 (48,526) compared to 2013 (43,165). Of the pottles deployed during 2014 the majority (70.3%) did not record any ant activity. A total of 13,529 (27.9%) recorded at least one ant species and 890 pottles (1.8%) were lost during the course of the field survey. This latter result is considered to be an acceptable ratio in the context of the overall surveillance programme.

The increase in pottle deployment in 2014 was partly due to generally favourable weather conditions in January and February allowing rapid and efficient pottle deployments with minimal rain or wind interruptions (see previous sections on climate).

As in past years, there were significant finds of exotic ant species made. These finds triggered urgent measures to eradicate any ants and nests found. The current season of NIAS has shown a slight decrease in the number of detections of exotic ants (19) compared to the previous year (20 detections; Table 3). Of these exotic detections 13 were from independent nests. This is a decrease from last season where 15 independent nests were found. On two occasions the same exotic nest was detected by ants found in two or more different sample pottles collected close together.

Of the 13 separate detections, 10 were confirmed to be from active established nests during follow up inspections under urgent measures, while three exotic incursions were not found again during follow up inspections. All exotic ants and associated nests were eradicated from the sites where they were found.

Table 3: Summary statistics for pottles deployed in the NIAS programme across years.

Year	Survey Period	Number of pottles laid	Empty Pottles		Pottles with ants		Pottles with exotic ants		Lost/Void pottles	
2002	Jan – Apr 2002	*50 744	*41 445	(81.7%)	*9 299	(18.3%)	17	(<0.1%)	no data	--
2003	Jan – May 2003	13 548	7 858	(58.0%)	5 445	(40.2%)	129	(1.0%)	116	(0.9%)
2004	Feb – May 2004	14 706	10 690	(72.7%)	3 836	(26.1%)	11	(0.1%)	169	(1.1%)
2005	Jan – Apr 2005	15 185	10 054	(66.2%)	4 826	(31.8%)	13	(0.1%)	292	(1.9%)
2006	Jan – May 2006	23 480	14 792	(63.0%)	8 628	(36.7%)	27	(0.1%)	33	(0.1%)
2007	Jan – May 2007	45 168	26 861	(59.5%)	16 211	(35.9%)	11	(<0.1%)	2 096	(4.6%)
2007 – 2008	Nov 2007 – May 2008	47 765	30 239	(63.3%)	15 871	(33.2%)	49	(0.1%)	1 655	(3.5%)
2008 – 2009	Dec 2008 – Mar 2009	44 236	28 189	(63.7%)	13 682	(30.9%)	7	(<0.1%)	2 358	(5.3%)
2010	Jan – Apr 2010	48 015	31 184	(64.9%)	15 816	(32.9%)	4	(<0.1%)	1 010	(2.1%)
2011	Jan – Apr 2011	43 352	27 632	(63.7%)	14 761	(34.0%)	20	(<0.1%)	959	(2.2%)
2012	Jan – Mar 2012	47 712	32 185	(67.5%)	14 807	(31.0%)	18	(<0.1%)	720	(1.5%)
2013	Jan – Mar 2013	43 165	29 887	(69.2%)	12 552	(29.1%)	20	(<0.1%)	726	(1.7%)
2014	Jan – Apr 2014	48 526	34 107	(70.3%)	13 529	(27.9%)	19	(<0.1%)	890	(1.8%)

Note: * Indicates approximate figures only as no precise data available.

The details for the finds for the 2014 season are listed in Table 4. Two independent exotic species were recorded including *Paratrechina longicornis* and *Monomorium* sp. Of the 19 pottles that recorded exotic ants 13 were from separate incursions (i.e., 6 pottles recorded the same incursion). The number of active nests found during follow-up incursion response varied, from nil (i.e., no nest found) up to three satellite nests for a single incursion. The number of exotic ants found in pottles also varied, from two workers up to 36 workers.

The Ports of Auckland recorded 5 exotic finds, while the Port of Tauranga recorded 3 exotic finds. The Port of Timaru and the Port of Lyttelton recorded one exotic find each. The other finds were found in Authorised Transitional Facility (ATF) sites in Auckland and Lyttelton (Table 4).

None of the exotic detections this season were large or significant enough to generate a large scale incursion response and delimiting survey. All were contained to a small area and were successfully eradicated.

Table 4: Location and numbers of exotic ants detected during NIAS 2014

Species	Location	Date of detection	No. of pottles detected in	No. of ants in pottle	No. of nests found
Paratrechina longicornis	Port of Wellington	11 Jan	1	-	1
Paratrechina longicornis	Ports of Auckland	22 Jan	2	-	nil
Paratrechina longicornis	Ports of Auckland	23 Jan	5	32,6,2,3,3	3
Paratrechina longicornis	Ports of Auckland	29 Jan	1	20	nil
Monomorium sp.	Port of Tauranga (Sulphur Point)	29 Jan	1	6	1
Monomorium sp.	Port of Tauranga	30 Jan	1	20	1
Paratrechina longicornis	Ports of Auckland	30 Jan	1	13	3
Monomorium sp.	UCL Oak Road (Auckland)	5 Feb	1	16	nil
Monomorium sp.	Port of Tauranga (Sulphur Point)	11 Feb	1	10	1
Paratrechina longicornis	Port of Lyttelton	17 Feb	1	-	2
Paratrechina longicornis	Ports of Auckland	24 Feb	2	2, 6	2
Monomorium sp.	LPC Depot (Christchurch)	24 Feb	1	4	1
Monomorium sp.	Port of Timaru	27 Feb	1	2	1

Survey locations and trapping effort

A detailed breakdown of sites visited and trapping effort for each site is shown in Table 5. As in previous years the main emphasis in deployments was at the major ports and airports at the main centres. Table 5 also shows that the split between carbohydrate and protein baited pottles were laid out in equal proportions in the sampling grid, with visual samples accounting for <0.1%.

Table 5: Number of pottles deployed by bait lure and location, NIAS 2014.

Location (north to south)	Visual	Carbohydrate	Protein	Total
Whangarei		185	184	369
North Port - Whangarei		49	49	98
Auckland	3	2 449	2 465	4 917
Ports of Auckland	4	2 531	2 546	5 081
Auckland International Airport	2	2 187	2 179	4 368
Mt Maunganui	1	806	803	1 610
Port of Tauranga		3 062	3 062	6 124
Tauranga		91	91	182
Napier		943	943	1 886
Port of Napier		1 595	1 598	3 193
Hastings		139	139	278
Port of New Plymouth		2 017	2 019	4 036
Palmerston North		125	125	250
Wellington		81	83	164
Port of Wellington		1 574	1 566	3 140
Wellington International Airport		356	354	710
Port of Nelson	1	1 039	1 047	2 087
Christchurch International Airport		1 110	1 110	2 220
Christchurch		976	981	1 957
Ashburton		111	112	223
Port of Lyttelton		792	792	1 584
Port of Timaru		793	787	1 580
Queenstown Airport		251	250	501
Port Otago		685	681	1 366
Dunedin		299	303	602
Grand Total	11	24 246	24 269	48 526

Table 6 shows the breakdown of the month each site was visited during the course of the programme. This shows that high risk northern port and airport sites were typically visited first in January, while the rest of the country was mostly done in February. Almost all sites were completed by the end of February, with just 6 sites remaining to be finished in March and a single site (NZL Tauranga) completed in April.

Table 6: Number of pottles deployed by month and location, NIAS 2014.

Location (north to south)	January	February	March	April	Grand Total
Whangarei	40	329			369
North Port - Whangarei			98		98
Auckland	180	4 737			4 917
Ports of Auckland	3 912	1 169			5 081
Auckland International Airport	4 368				4 368
Mt Maunganui		1 215		395	1 610
Port of Tauranga	4 325	1 799			6 124
Tauranga		182			182
Napier	1 856		30		1 886
Port of Napier	3 193				3 193
Hastings	278				278
Port of New Plymouth	1 136	2 449	451		4 036
Palmerston North		250			250
Wellington	164				164
Port of Wellington	2 822	318			3 140
Wellington International Airport	710				710
Port of Nelson	1 357	656	74		2 087
Christchurch International Airport	1 669	551			2 220
Christchurch	1 614	343			1 957
Ashburton	223				223
Port of Lyttelton	226	1 358			1 584
Port of Timaru		1 001	579		1 580
Queenstown Airport		501			501
Port Otago		1 366			1 366
Dunedin		602			602
Grand Total	28 073	18 826	1 232	395	48 526

Bait type analysis

The species of ant collected together with bait type for each species is shown in Table 7. The data shows that ants were more likely to be recorded from pottles baited with protein (64.1% of total finds; 8,371 pottles) during the 2014 survey. This is consistent with previous NIAS surveys. A chi-square contingency test on these results (Table 8) shows that there was a significant difference in the number of ants captured in pottles baited with protein compared to those baited with carbohydrate ($P < 0.0001$).

Table 7: Abundance of ant species by type of bait lure, NIAS 2014.

	Number of finds		
Species	Visual	Carbohydrate	Protein
Cardiocondyla minutior	0	47	64
Doleromyrma darwiniana	1	59	121
Hypoponera eduardi	0	0	1
Huberia striata	0	4	18
Iridomyrmex sp cf. *anceps*	4	2 412	2 998
Linepithema humile	0	249	384
Mayriella abstinens	0	0	2
Monomorium antarcticum	0	303	807
Monomorium fieldi	0	2	11
***Monomorium* sp.**	0	3	3
Monomorium sydneyense	0	39	114
Nylanderia sp.	1	1 305	1 833
Ochetellus glaber	0	286	293
Paratrechina longicornis	2	7	4
Pachycondyla castanea	0	0	2
Pheidole megacephala	1	10	46
Pheidole proxima	0	111	271
Pheidole rugosula	3	502	1310
Pheidole vigilans	0	4	19
Prolasius advenus	0	1	3
Rhytidoponera chalybaea	0	0	1
Technomyrmex jocosus	0	20	51
Tetramorium bicarinatum	0	4	24
Tetramorium grassii	0	34	55
Total	12	5 355	8 371

Note: Exotic species are highlighted in bold. Cohabitation is not independent of positive finds.

Table 8: Chi-square contingency analysis on the capture of ants in pottles vs. differing baits during NIAS 2014.

Observed results	Carbohydrate	Protein	Total
Pottles positive for ants	5,288	8,230	13,518
Pottles negative for ants	18,552	15,555	34,107
Total	23,840	23,785	47,625
		χ^2=	902.96
		d.f.=	1
		P=	<0.0001

Monthly detection analysis

A breakdown by month shows detections occurred across the entire survey period January to March (Table 9). Table 10 displays the comparison of species recorded across months.

The survey in 2014 continued the procedure undertaken in most previous seasons where surveillance typically began in January. Only in two previous seasons (2007 - 2008 and 2008 - 2009) did surveillance start earlier in November and December (Table 3). In the most recent season 96.6% of all pottle deployments occurred in January and February 2014, and percent positive returned ranged between 13 – 52%; (Table 9). Note that the results for March and April is based on a small sample size of just 1,232 and 395 pottles from only 6 sites respectively (Table 6) which has likely skewed the result.

Table 9: Summary statistics for number of pottles deployed by month, NIAS 2014.

Month	Number of pottles deployed	Number of pottles with ants	% Positive per month
January	28 073	8 097	29%
February	18 826	5 062	27%
March	1 232	164	13%
April	395	206	52%
Grand Total	48 526	13 529	28%

Table 10: Abundance of ant species by month they were collected, NIAS 2014.

Species	January	February	March	April	Grand Total
Cardiocondyla minutior	22	57	0	32	111
Doleromyrma darwiniana	89	92	0	0	181
Hypoponera eduardi	1	0	0	0	1
Huberia striata	0	22	0	0	22
Iridomyrmex sp cf. *anceps*	3 343	1 928	61	82	5 414
Linepithema humile	371	261	0	1	633
Mayriella abstinens	0	2	0	0	2
Monomorium antarcticum	635	418	57	0	1 110
Monomorium fieldi	8	5	0	0	13
***Monomorium* sp.**	2	4	0	0	6
Monomorium sydneyense	128	25	0	0	153
Nylanderia sp.	1 774	1 323	31	11	3 139
Ochetellus glaber	357	217	2	3	579
Paratrechina longicornis	10	3	0	0	13
Pachycondyla castanea	2	0	0	0	2
Pheidole megacephala	36	19	2	0	57
Pheidole proxima	376	0	6	0	382
Pheidole rugosula	1 005	713	4	93	1 815
Pheidole vigilans	6	17	0	0	23
Prolasius advenus	0	4	0	0	4
Rhytidoponera chalybaea	0	1	0	0	1
Technomyrmex jocosus	59	11	1	0	71
Tetramorium bicarinatum	10	17	0	1	28
Tetramorium grassii	50	35	0	4	89
Total	8 284	5 174	164	227	13 849

Note: Exotic species are highlighted in bold. Cohabitation is not independent for positive finds.

Habitat preferences

Habitat preferences of where ants were likely to be found were recorded and are presented in Tables 11 and 12. This data showed that most pottles (84.5%) were deployed on vegetation, buildings or structures and broken surfaces (15,570, 13,070, and 12,354 respectively), with the highest rate of positive detections of ants being on soil and vegetation (59% and 41% respectively). Tables 11 and 12 also demonstrate that ants are detected across a wide variety of habitat types. No particular preference by individual ant species could be determined.

Table 11: Summary statistics for number of pottles deployed by habitat type, NIAS 2014.

Habitat	Number of pottles deployed	Number of pottles with ants	% Positive per habitat type
Broken surface	12 354	2 927	24%
Building or structure	13 070	2 225	17%
Electrical	1 701	399	23%
Heater	6	1	17%
Light	2 635	825	31%
Rubbish	415	123	30%
Soil	292	171	59%
Vegetation	15 570	6 430	41%
Water	2186	407	19%
Wood	291	18	6%
No data	6	3	50%
Grand Total	48 526	13 529	28%

Geographic spread

Historical data (i.e., AsureQuality and FBA Consulting reports 2008 – 2013), shows that there has been a latitudinal gradient in detection rates, with northern locations typically recording more positive finds of ants compared to southern locations (Table 13). In 2014 the highest detection rates were recorded at Whangarei, Auckland International Airport, ATF sites in Mt Maunganui and ATF sites in Auckland (from 44% to 51% positive for ants); while lowest detection rates were recorded at Queenstown Airport and ATF sites in Wellington, ATF sites in Dunedin and Port of Wellington (4% to 7% positive for ants).

Table 12: Abundance of ant species by habitat type they were recorded in during NIAS 2014.

Species	Broken surface	Building or structure	Electrical	Heater	Light	Rubbish	Soil	Vegetation	Water	Wood	No data	Grand Total
Cardiocondyla minutior	5	2	3	0	6	0	0	92	3	0	0	111
Doleromyrma darwiniana	46	25	4	0	2	1	0	101	0	1	1	181
Hypoponera eduardi	0	0	0	0	0	0	0	0	1	0	0	1
Huberia striata	0	10	1	0	0	0	1	10	0	0	0	22
Iridomyrmex sp cf. *anceps*	1 393	596	110	1	376	59	90	2 683	97	8	1	5 414
Linepithema humile	144	114	29	0	21	10	0	287	28	0	0	633
Mayriella abstinens	0	0	0	0	0	0	0	2	0	0	0	2
Monomorium antarcticum	104	372	20	0	48	0	2	527	30	7	0	1 110
Monomorium fieldi	4	2	0	0	2	0	0	5	0	0	0	13
***Monomorium* sp.**	2	0	1	0	2	0	0	1	0	0	0	6
Monomorium sydneyense	11	8	10	0	8	0	0	113	3	0	0	153
Nylanderia sp.	664	452	91	0	211	24	45	1 565	84	2	1	3 139
Ochetellus glaber	177	103	21	0	55	13	1	189	20	0	0	579
Paratrechina longicornis	5	6	0	0	2	0	0	0	0	0	0	13
Pachycondyla castanea	0	0	0	0	1	0	0	1	0	0	0	2
Pheidole megacephala	22	17	3	0	3	1	0	5	6	0	0	57
Pheidole proxima	81	149	20	0	14	4	0	96	18	0	0	382
Pheidole rugosula	287	356	85	0	77	13	25	856	116	0	0	1 815
Pheidole vigilans	7	11	1	0	2	0	0	1	1	0	0	23
Prolasius advenus	0	0	0	0	0	0	0	4	0	0	0	4
Rhytidoponera chalybaea	0	1	0	0	0	0	0	0	0	0	0	1
Technomyrmex jocosus	4	19	2	0	6	1	6	26	7	0	0	71
Tetramorium bicarinatum	3	1	3	0	2	0	0	13	6	0	0	28
Tetramorium grassii	13	10	1	0	3	0	1	61	0	0	0	89
Total	2 967	2 252	402	1	835	126	171	6 546	417	18	3	13 738

Note: Exotic species are highlighted in bold.

Table 13: Summary statistics for number of pottles deployed by location, NIAS 2014.

Location (north to south)	Number of pottles deployed	Number of pottles with ants	% Positive per location
Whangarei	369	187	51%
North Port - Whangarei	98	39	40%
Auckland	4 917	2 187	44%
Ports of Auckland	5 081	1 420	28%
Auckland International Airport	4 368	2 228	51%
Mt Maunganui	1 610	750	47%
Port of Tauranga	6 124	2 574	42%
Tauranga	182	57	31%
Napier	1 886	527	28%
Port of Napier	3 193	574	18%
Hastings	278	68	24%
Port of New Plymouth	4 036	1 058	26%
Palmerston North	250	23	9%
Wellington	164	7	4%
Port of Wellington	3 140	220	7%
Wellington International Airport	710	104	15%
Port of Nelson	2 087	535	26%
Christchurch International Airport	2 220	233	10%
Christchurch	1 957	261	13%
Ashburton	223	18	8%
Port of Lyttelton	1 584	134	8%
Port of Timaru	1 580	130	8%
Queenstown Airport	501	27	5%
Port Otago	1 366	131	10%
Dunedin	602	37	6%
Grand Total	48 526	13 529	28%

Note: Locations are listed from north (top) to south (bottom) to show differences in latitude for ant detections.

Table 14 is colour coded to display the percentage of each ant species captured in pottles at each of the main ports and seaports during NIAS 2014. The table shows that there is generally a greater richness (i.e., wider variety of species) found in northern ports (to the left of the table) compared to southern ports (to the right of the table). The table also shows that species such as *Iridomyrmex* sp cf. *anceps*, *Nylanderia* sp., *Ochetellus glaber*, and *Pheidole rugosula*, were dominant at northern ports. In more southerly regions these species generally decreased in percentage of detections, while the endemic species *Monomorium antarcticum*, generally increased.

Table 14: Percentage of ant captures in pottles deployed at each major port or airport during NIAS 2014.

	North Port - Whangarei	Ports of Auckland	Auckland International Airport	Port of Tauranga	Port of Napier	Port of New Plymouth	Port of Wellington	Wellington International Airport	Port of Nelson	Christchurch International Airport	Port of Lyttelton	Queenstown Airport	Port of Timaru	Port Otago
Cardiocondyla minutior				0.78%	0.03%									
Doleromyrma darwiniana		0.04%			0.34%		0.10%				7.07%			
Hypoponera eduardi									0.05%					
Huberia striata														1.61%
Iridomyrmex sp cf. *anceps*	32.65%	15.55%	29.10%	16.26%	7.33%	7.83%		0.14%	0.19%	0.32%	0.38%			0.07%
Linepithema humile		0.06%	0.48%	1.53%	2.32%	0.02%		6.20%	5.94%					
Mayriella abstinens														
Monomorium antarcticum		0.02%	0.05%	0.07%		1.56%	6.18%	8.17%	2.73%	9.73%	0.63%	5.39%	8.04%	7.76%
Monomorium fieldi		0.02%		0.03%		0.07%	0.06%		0.14%	0.05%				
***Monomorium* sp.**				0.05%									0.06%	
Monomorium sydneyense				1.93%	0.34%									
Nylanderia sp.	1.02%	6.28%	15.41%	6.34%	0.41%	15.68%	0.45%		15.38%	0.09%	0.06%		0.13%	
Ochetellus glaber	1.02%	2.15%	1.35%	2.34%	0.56%	0.12%	0.13%		0.14%	0.41%	0.25%			
Paratrechina longicornis		0.22%					0.03%				0.06%			
Pachycondyla castanea							0.06%							
Pheidole megacephala	2.04%	0.37%	0.05%	0.34%										
Pheidole proxima					6.73%									
Pheidole rugosula	3.06%	3.50%	4.97%	13.15%	0.06%	0.42%	0.06%		1.29%					
Pheidole vigilans		0.06%	0.05%	0.26%										
Prolasius advenus														0.29%
Rhytidoponera chalybaea				0.02%										
Technomyrmex jocosus		0.04%	0.32%	0.28%	0.03%	0.12%								
Tetramorium bicarinatum		0.04%	0.02%	0.15%		0.02%								0.07%
Tetramorium grassii		0.04%	0.37%	0.10%		0.92%		0.14%						

Note: Clear cells indicate species did not occur at that site. Colour gradient from yellow to green indicates increasing percentage of captures. Exotic species are highlighted in bold

TRENDS ACROSS ALL NIAS SAMPLING SEASONS

Cohabitation

The relative rate of cohabitation across survey seasons is fairly stable. Across all years a mean of 67% (range 59% - 73%) of all samples contained no ant species present (Table 15). A further 32% held at least one ant species and roughly 1% on average held more than one ant species. This indicates that cohabitation of ant species in the areas surveyed is rare. This is most likely due to inter-specific competition. Ants are known to exclude other species of ant from food sources, and many species are also known for their inter-specific aggression and will attack and eliminate nests of other nearby ant species (e.g., *Linepithema humile*).

This season (2014) two pottles recorded four separate ant species within it. Such occurrences are relatively rare in NIAS. In the 2007 - 2008 survey one pottle from the Port of Tauranga did however contain five different species of ant.

Table 15: Cohabitation of ant species within pottles by NIAS season.

	No. of ant species recorded per pottle					
Year	0	1	2	3	4	5
2006	14 792	8 424	272	18		
2007	26 861	15 217	467	20		
2007 - 2008	30 239	14 575	602	29		1
2008 - 2009	28 189	12 771	439	11		
2010	31 184	15 387	415	15		
2011	27 632	14 525	234	2		
2012	32 185	14 382	404	20	1	
2013	29 887	12 357	189	6		
2014	34 107	13 227	286	14	2	

Note: Table does not include lost pottles.

Bait preference

Overall, ants have shown a consistent preference across all NIAS seasons for protein over carbohydrate baited pottles (Table 16). This is generally no more than a few percentage points (mean difference = 6%, range 3 – 10%). This trend may be caused by the local environment surveyed having few natural protein sources available, combined with the possibly that the protein bait may have a stronger odour than the carbohydrate bait and therefore ants are more easily able to detect and recruit to it within the time frame of the survey (1-2 hours).

Table 16: Percentage of bait type from total pottle count that recorded ants across NIAS seasons.

Year	Carbohydrate	Protein
2006	16%	22%
2007	15%	21%
2007 - 2008	15%	18%
2008 - 2009	13%	17%
2010	15%	19%
2011	14%	20%
2012	13%	19%
2013	12%	17%
2014	11%	17%
Mean	14%	19%

Monthly detection

Table 17 shows that across all NIAS surveys most ants have been detected during December, January and February. The overall trend for March, April and May shows a general decline as autumn progresses. The overall result for November was based on a small number of pottles (n = 467) that were deployed in the 2007 - 2008 season and should be excluded from comparisons. The high percentage of detections for November (52%) is therefore likely to be biased by the small sample size. Additionally the overall result for December (38%), while based on a large number of deployed pottles (12,227 in 2007 - 2008 and 21,738 in 2008 - 2009) is only from two seasons in total. Thus some caution is needed as it cannot be fully determined whether this result will be consistent in the future.

The 2014 season can be considered typical compared to the overall mean percentages across survey months (Table 19). Although the 2014 March percentage (13%) was lower than the mean value (29%) and the April result higher than the mean (57%) it must be noted these values are based on a small sample size of just 1,232 and 395 pottles from only 6 sites respectively (Table 6) which has likely skewed the result.

Table 17: Percentage of ants detected in pottles by month, NIAS 2003 to 2014.

Year	November	December	January	February	March	April	May
2003	-	-	43%	54%	38%	36%	26%
2004	-	-	-	25%	29%	25%	26%
2005	-	-	29%	34%	36%	6%	-
2006	-	-	41%	41%	23%	12%	12%
2007	-	-	36%	37%	21%	23%	22%
2007 - 2008	52%	37%	32%	27%	17%	19%	0%
2008 - 2009	-	38%	25%	16%	25%	-	-
2010	-	-	36%	29%	38%	38%	-
2011	-	-	37%	32%	42%	3%	-
2012	-	-	34%	33%	22%	-	-
2013	-	-	30%	28%	49%	-	-
2014	-	-	30%	27%	13%	57%	-
Total	52%	38%	34%	32%	29%	24%	17%

EXOTIC ANT FINDS

Bait preference

Exotic ants that have been collected during the various NIAS seasons demonstrate a slight preference towards pottles baited with protein (Table 18). It can also be determined in Table 18 that visual pottles produce a disproportionally high rate of exotic finds compared to baited pottles. Visual pottles typically account for less than 0.001% of overall pottle deployments, yet account for 14% of positive exotic finds. This is due to the deliberate targeted nature of visual pottles, where the field staff are trained to collect ants they consider highly suspect based on appearance and behaviour.

Based on these results it can be concluded that visual sampling combined with baited pottles is an effective sampling method. Although protein baited pottles can be demonstrated to collect more exotics than carbohydrate baited pottles the difference is negligible and both bait types should be continued.

Table 18: Bait preference of exotic ant species recorded in pottles, NIAS 2003 to 2014.

Species	Visual	Carbohydrate	Protein
Anoplolepis gracilipes		1	1
Camponotus sp.	1		
Monomorium destructor	3	3	18
Monomorium sp.	1	13	26
Monomorium floricola	1	2	
Monomorium indicum			1
Paratrechina longicornis	15	52	32
Solenopsis invicta		3	4
Solenopsis geminata		1	3
Tapinoma melanocephalum	3	6	4
Tapinoma sessile			1
Total	24	81	90

Monthly detection

Across time most exotic ant detections (85%) are made during the peak months of January and February (Table 19). While this is consistent with ant detections generally (as described in Table 17 above), this result is most likely due to trapping effort being concentrated during these two months (see Table 6).

Table 19: Numbers of exotic ant species by month, NIAS 2003 to 2014.

Species	December	January	February	March	April	May
Anoplolepis gracilipes		1	1			
Camponotus sp.		1				
Monomorium destructor	6	7	11			
Monomorium sp.		10	28	2		
Monomorium floricola	1	1	1			
Monomorium indicum			1			
Paratrechina longicornis	5	51	31	10	1	1
Solenopsis invicta		7				
Solenopsis geminata		3	1			
Tapinoma melanocephalum	1	8	3	1		
Tapinoma sessile				1		
Total	13	89	77	14	1	1

Geographic spread

Table 20 shows that most exotic detections (85%) occurred in Auckland, Tauranga and Napier, while other locations had far fewer finds. This result is likely related to the volume of cargo shipped through the first three ports compared to the latter as well as the more northerly latitude being more conductive to ant establishment (see Table 13).

Table 20: Location of exotic ant detection, NIAS 2003 to 2014.

Species	Auckland	Tauranga	Napier	New Plymouth	Nelson	Wellington	Christchurch	Timaru
Anoplolepis gracilipes	2							
Camponotus sp.	1							
Monomorium destructor	7	5	8		3		1	
Monomorium sp.	9	14	7				9	1
Monomorium floricola	2		1					
Monomorium indicum							1	
Paratrechina longicornis	58	19	10	2		7	3	
Solenopsis invicta			7					
Solenopsis geminata	2	1	1					
Tapinoma melanocephalum	4	1	5			3		
Tapinoma sessile			1					
Total	85	40	40	2	3	10	14	1

Discussion

The NIAS programme has shown that it continually fulfils its primary goal of detecting newly arrived exotic species. Approximately 335 pottles have recorded exotic species out of a total of 485,602 pottles deployed over 13 sampling seasons since 2002. While this appears a low rate of exotic detections (0.07%), it must be noted that most of those detections were made of ants from established and functional nests. This means there could potentially have been many more problematic ant species established in New Zealand had the NIAS programme and other biosecurity programmes not been in place.

The current season of NIAS has shown a similar number of positive detections of exotic ants (n = 19) compared to the 2013 survey (n = 20). Of these exotic detections there were 13 separate incursions detected. Ten of these were confirmed as being from active independent nests (for three incursions a nest was not found). Although it is encouraging that the NIAS programme is successful it also indicates that exotic ants are bypassing the current border controls.

Previous reductions in positive detections of exotic ants had been partially attributed to two factors:

- The work being under taken in the Pacific and Melanesia, particularly the Sea Container Hygiene System (SCHS) programmes in various island nations; and
- The precautionary baiting programmes undertaken in various high risk locations throughout New Zealand. These programmes continued in 2014.

The differences observed between years of the NIAS surveys provide an indication that there are still external and stochastic factors not fully understood that can cause unexpected high or low detections of exotic ants to occur from year to year. A key role of quarantine is to identify and mitigate the external factors and have sufficient processes in place to manage the unexpected challenges. Such factors may include aspects such as climatic conditions, changes to the port environments, impacts of ant populations in the global markets, and changes to the number and type of goods etc. As an example, changes in the number, type and port of origin of sea containers imported to New Zealand from year to year is not accounted for by the NIAS programme yet can significantly impact on the risk of importing an exotic ant.

The 2014 NIAS survey was similar to the 2013 season in that it began in January. Overall 58% of all 2014 pottle deployments were undertaken in January, most of these at the northern high risk port and airport sites (Table 6).

The numbers of exotic ants found was relatively consistent between 2014, 2013, 2012 and 2011 (19, 20, 18 and 20 respectively) and was more than in the preceding two years (4 exotics in 2010 and 7 in the 2008 – 2009 survey). In earlier seasons, surveillance has begun as early as November (i.e., 2007 – 2008; Table 19). In the last few years it has been considered that surveying sites at differing times of the year may influence detection rates of exotic species due to biological factors. Nest size, foraging activity, ant behaviour and bait preference may change during different periods over spring and summer, resulting in variations in the likelihood of detection. At this stage surveillance during mid-summer appears to provide the best combination of results per effort and cost.

The warmer than average climate prior the 2014 NIAS season was generally supportive of ant activity and was expected to potentially produce higher than normal numbers of exotic ant detections. This was countered, however, by a dry summer with high soil moisture deficits, which in theory reduces the potential for exotic ants to be able to establish nests successfully. The result was a season where exotic finds were on a par with previous seasons.

Similar to previous surveys the 2014 season showed northern sites typically recording higher numbers of ants found than in southern sites. Numbers of ants were highest in places such as the Whangarei, Auckland International Airport, ATF sites in Mt Maunganui and ATF sites in Auckland (based on percentages by pottle volume). It also indicates the NIAS emphasis on northern locations is valid as they are far more likely to support a viable nest of an exotic ant species. This is most likely due to northern sites having typically a warmer climate with fewer cold spells through the winter. Cold air and soil temperature are known factors affecting ant nest viability and geographic distribution (Krushelnycky et al. 2005).

As seen in previous seasons, there was a general trend towards ants favouring pottles baited with protein. Although some species (e.g., *Pheidole rugosula*, *Monomorium antarcticum*) have a strong bias for protein-baited pottles a large number of ants were recorded in carbohydrate baited pottles. As both bait types consistently record high numbers of ants this indicates that the NIAS specification of alternating protein and carbohydrate bait should be continued.

In 2014 habitat types consisting of vegetation, buildings or structures and broken surfaces were the best habitats for collecting ants, albeit ants were found in a wide variety of habitats with no species demonstrating a particular single habitat type. This result is consistent across the various NIAS surveys to date and is likely related to the biology of ants and their ability to forage over long distances and over a variety of habitats. While ants may have particular specific preferences for an actual nest site, workers are obviously able to forage over a range of surfaces and habitat sites. This indicates that the NIAS specification of grid surveying across locations is valid, as foraging ants may be present anywhere at a site and not necessarily near the actual nest or in a particular habitat type.

Innovation and Efficiencies

For the 2014 NIAS season, all voided pottles were removed manually from the database to enable proper interrogation of information relating to numbers of pottles lost or destroyed. Those voided due to environmental conditions were not included in the analysis.

Efficiency gains were made by a reduction in laboratory pre-screening activities when lower volume throughput did not require the additional step of pre-screening suspect samples prior to taxonomic examination. Further laboratory efficiency gains were made by refining the data entry process to allow faster selection of appropriate ant species as each individual surveillance pottle was examined and entered. Both these efficiencies enabled a savings to the programme through a reduction in time inputs.

For the 2014 survey the Ports of Auckland was again inspected twice due to the previous detections of exotic ants via the NIAS programme. A second survey of high risk areas around the Multi-Cargo wharves is undertaken a month after the initial full scale NIAS survey to detect any ant fauna that arrived since the first survey of the season. This proved successful as additional exotic ants were detected in the second survey.

Similar to 2013, in the 2014 survey the way risk sites were prioritised was reviewed. MPI reprioritised lower risk transitional facility sites such as small freight forward businesses in a bid to target the surveillance more efficiently. Lower priority sites were placed down the list of sites to be surveyed and some left as “back-up sites” in the event other sites could not be completed. This meant that more surveillance effort was focused on sites with a previous history of finds and sites with high risk profiles (e.g., devanning yards, ports, airports). It also meant that if sites were withdrawn from the schedule (e.g., because they had gone out of business etc.) the back-up sites were already available to fill the gap and there was no inefficient additional approval and communication processes required to select new sites. In addition, inputs into the site selection process prior to the 2014 season from both AsureQuality and FBA Consulting identified lower priority sites where cost savings could be made and efficiencies gained.

Further reprioritising and removal of lower risk transitional facility sites and lower risk areas within sea and airport buffer zones were reviewed. Where appropriate, low risk areas in designated survey buffer zones were removed with MPI approval. This included residential and commercial properties that extended outside of port boundaries, although on all occasions both sides of the road outside of port facilities was surveyed. The removal of lower risk areas meant better use of resources to target higher risk locations that would otherwise not be surveyed within the budget for the programme.

The compulsory use of paint or crayon spots to mark the location of each pottle laid was removed in 2013 which streamlined the laying of bait pottles. It was found that at many locations paint or crayon marks stretching back a number of seasons was not only undesirable aesthetically but also became confusing to traceability within the programme. For all exotics that are found traceability is based on the GPS location recorded for all bait pottles laid and these readings provide accurate locations for map creation and follow up activities. It should be noted that the option to use paint or crayon is still available particularly in locations where long grass or terrain would otherwise make finding pottles on pick up harder to find. Also all visual pottles and situations where three or more pottles are consecutively lost marking with paint or crayon is compulsory.

Efficiencies were gained by beginning the programme at most sites on the designated training day. This was found to be the most effective use of the programme coordinators time and costs. For example, at the Queenstown airport site the cost of training local staff or transporting trained staff from other locations was found to be cost prohibitive (due to the remoteness of the location). Therefore this site was surveyed independently by the programme coordinator as additional travel added to training days scheduled in Timaru and Dunedin.

As in the 2013 NIAS season, the 2014 survey was undertaken by locally based staff in each district location to minimise travel expenses. Area management was carried out by locally based area coordinators who reported to the programme coordinator on technical issues and work progress. A total of 11 area coordinators managed up to 30 staff. These numbers include trained back-up and part time staff. All area coordinators and surveillance staff were trained in the Field Operations procedures, whilst laboratory technicians were trained in laboratory procedures to ensure the programme is run as efficiently and accurately as possible.

To confirm that programme specifications are met and further efficiencies identified all area coordinators and laboratory managers are audited by the process coordinator. It should be noted that no critical non-compliances were raised that would impact on the programme and the process coordinator was satisfied procedures and specifications were met for the 2014 season.

Recommendations

The current specifications for NIAS are valid and do not require any significant modification. However, there are some recommendations that can be made resulting from the findings in this report.

1. A meta-analysis should be undertaken of the types, quantities and port of origin of goods imported to New Zealand, together with a climatic analysis which may reveal reasons for the stochastic variation in detections of exotic ants from year to year.
2. Continue to review the timing and sequence of surveys at high risk ports (e.g., Port of Tauranga) to determine if additional coverage of the temporal span after NIAS is undertaken in January is required to detect exotic ants that arrive after this time at these sites.
3. Review risk areas and buffers at all survey locations annually to ensure that all higher risk areas are captured and (where applicable) low risk areas are removed with the Ministry for Primary Industries approval.
4. Re-establish annual site selection planning meetings to profile and prioritise site lists to ensure high risk/high quality sites are surveyed first.

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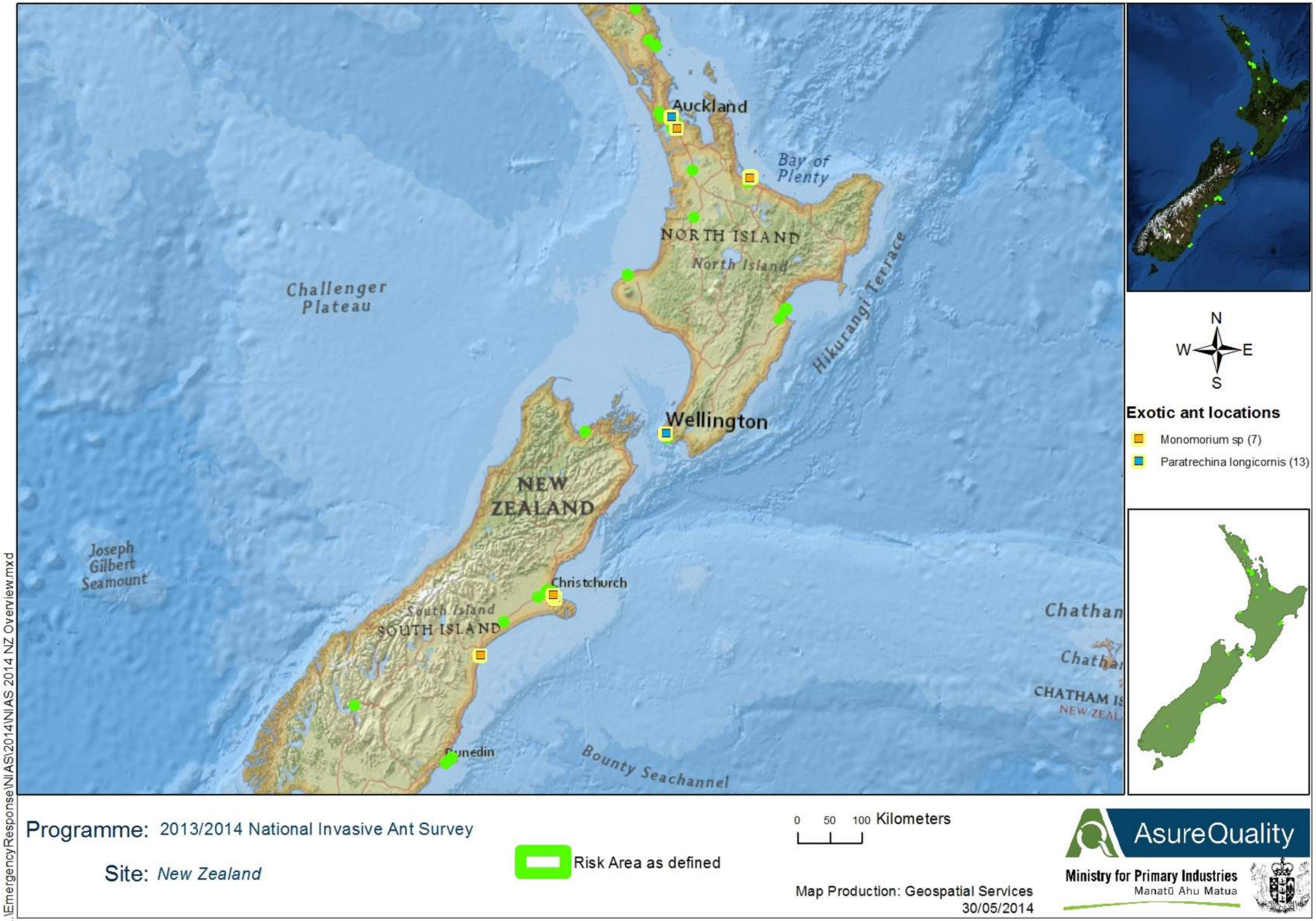
Appendix 1: Site maps for NIAS 2014

Maps of the international air and seaports surveyed in the NIAS programme during the 2014 season.

a) New Zealand overview
b) Port of Whangarei (North Port)
c) Ports of Auckland
d) Auckland International Airport
e) Port of Tauranga
f) Port of Mount Maunganui
g) Port of New Plymouth
h) Port of Napier
i) Port of Wellington
j) Wellington International Airport
k) Port of Nelson
l) Port of Lyttelton – East
m) Port of Lyttelton – West
n) Christchurch International Airport
o) Port of Timaru – North
p) Port of Timaru – South
q) Queenstown Airport
r) Port of Otago

a)


Auckland
Bay of Plenty
NORTH ISLAND
North Island
Challenger Plateau
Hikurangi Terrace
Wellington
NEW ZEALAND
Joseph Gilbert Seamount
Christchurch
South Island
SOUTH ISLAND
Chatham
CHATHAM IS
NEW ZEAL
Dunedin
Bounty Seachannel
N
W
E
S
Exotic ant locations
Monomorium sp (7)
Paratrechina longicornis (13)
..\EmergencyResponse\NIAS\2014\NIAS 2014 NZ Overview.mxd
Programme: 2013/2014 National Invasive Ant Survey
Site: New Zealand
Risk Area as defined
0 50 100 Kilometers
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua

b)

North Port
N
S
W
E
Motukaroro Island
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Programme: 2013/2014 National Invasive Ant Survey
Site: WR96
North Port
Marsden Pt, Whangarei
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
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c)


Bayswater
Vauxhall
Stanley Bay
Auckland
Parnell
Eden Terrace
Mount Eden
Remuera
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Ports of Auckland
Programme: 2013/2014 National Invasive Ant Survey
Site: AKS1
Ports of Auckland
Auckland
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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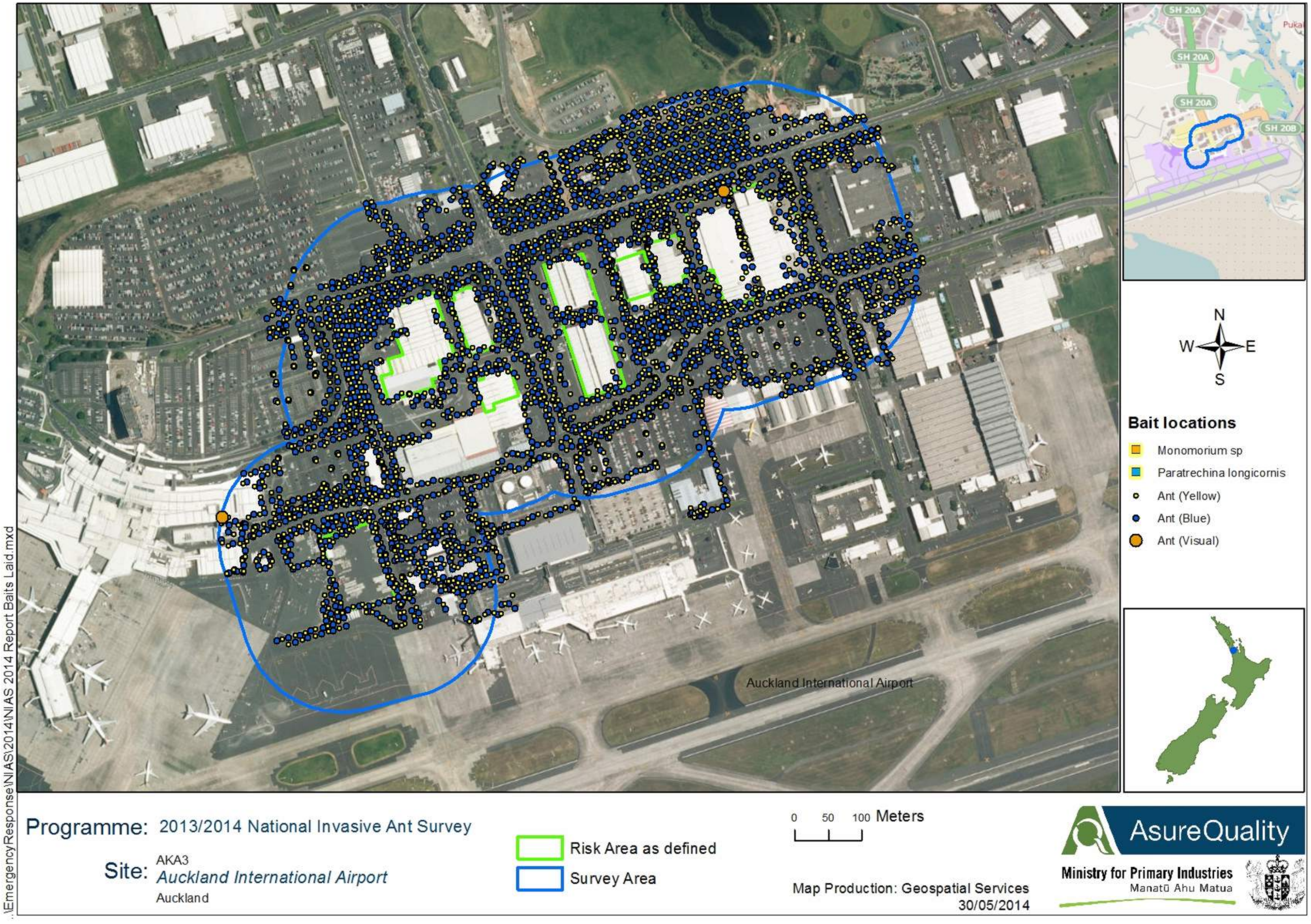
d)



Auckland International Airport
SH 20A
SH 20B
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Programme: 2013/2014 National Invasive Ant Survey
Site: AKA3
Auckland International Airport
Auckland
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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e)


Mount Maunganui
Tauranga
SH 2A
SH 29
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Tauranga
Programme: 2013/2014 National Invasive Ant Survey
Site: TGS4
Port of Tauranga
Tauranga
Risk Area as defined
Survey Area
0 50100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
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f)

Mount Maunganui
Tauranga
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Mt Maunganui
Programme: 2013/2014 National Invasive Ant Survey
Site: MMNS5
Port of Mt Maunganui
Tauranga
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
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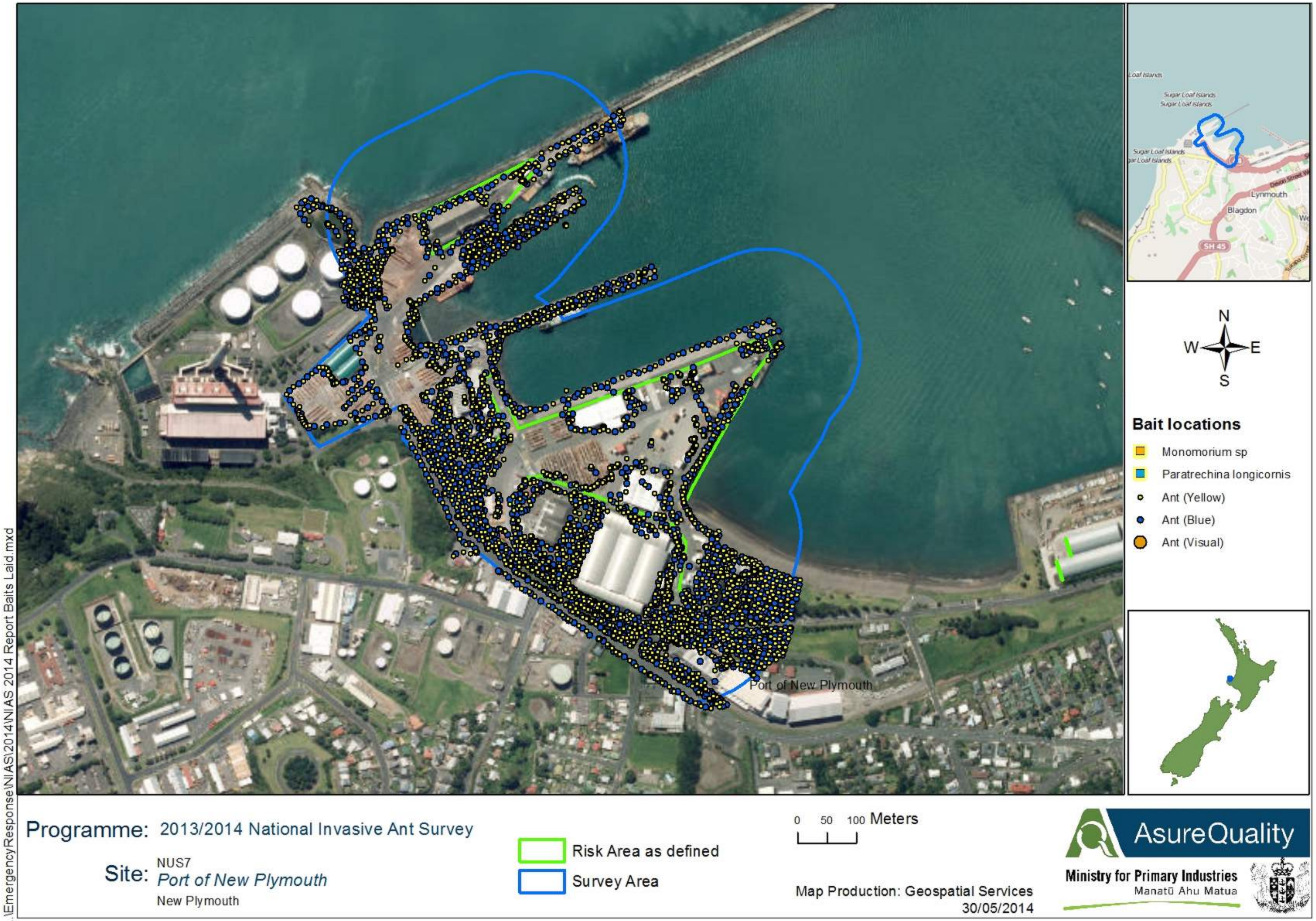
g)


Port of New Plymouth
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Programme: 2013/2014 National Invasive Ant Survey
Site: NUS7
Port of New Plymouth
New Plymouth
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
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h)

Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
N
W
E
S
Programme: 2013/2014 National Invasive Ant Survey
Site: NAS6
Port of Napier
Napier
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
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i)


Programme: 2013/2014 National Invasive Ant Survey
Site: WNS8
Port of Wellington
Wellington
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
N
W
E
S
Port of Wellington
Broadmeadows
Ngaio
Crofton Downs
Kaiwharawhara
Wadestown
Thorndon
Wellington
Mt. Victoria
Hataitai
Brooklyn
Vogeltown
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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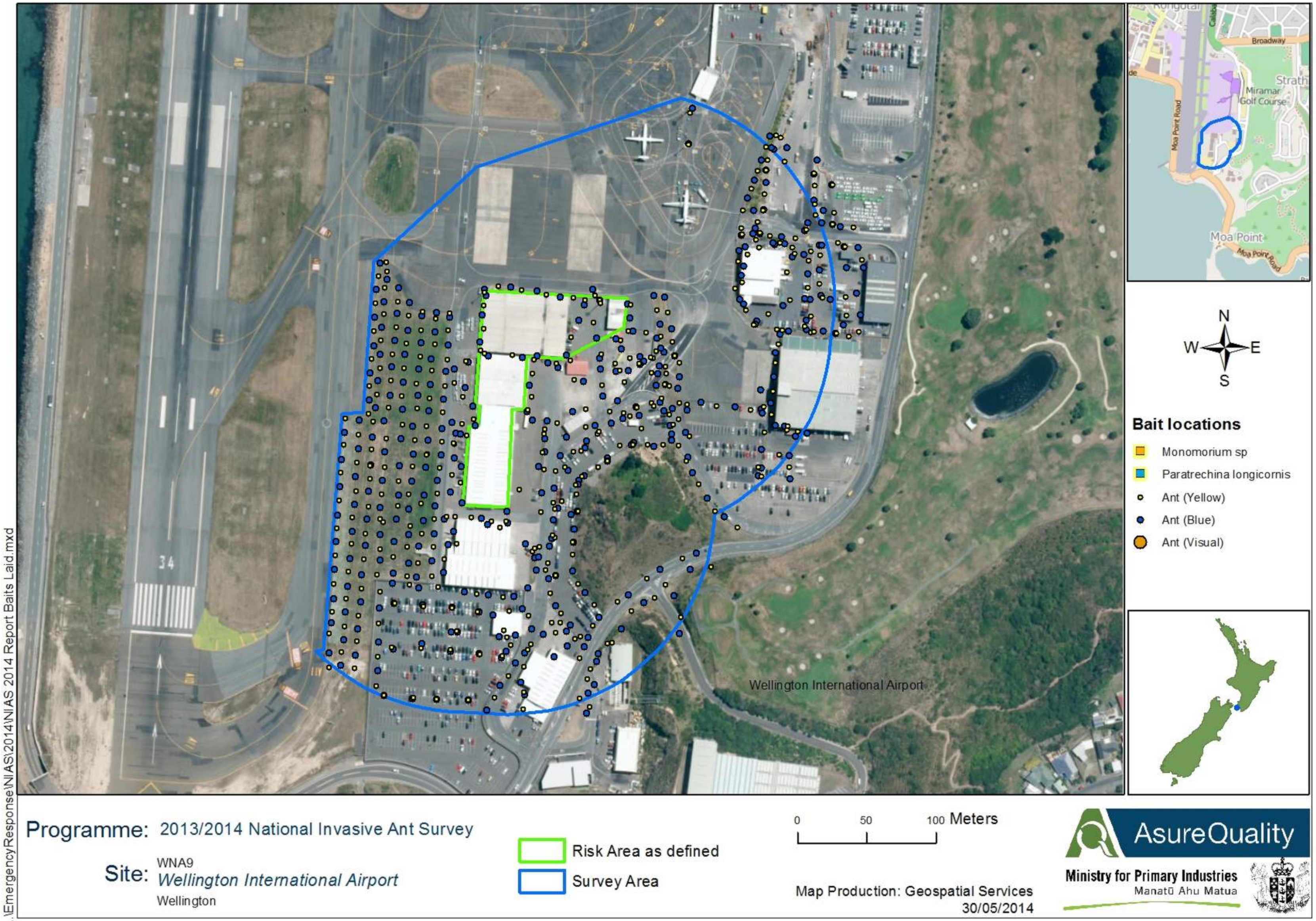
j)



Broadway
Strath
Miramar Golf Course
Moa Point Road
Moa Point
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Wellington International Airport
34
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Programme: 2013/2014 National Invasive Ant Survey
Site: WNA9
Wellington International Airport
Wellington
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
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k)

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Port Nelson
Nelson
Washington Valley
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Nelson
Programme: 2013/2014 National Invasive Ant Survey
Site: NNS10
Port of Nelson
Nelson
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
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l)

Mt Pleasant
499m
445m
SH 74
Lyttelton
Diamond Harbour
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Lyttleton - East
Programme: 2013/2014 National Invasive Ant Survey
Site: LY12
Port of Lyttleton - East
Christchurch
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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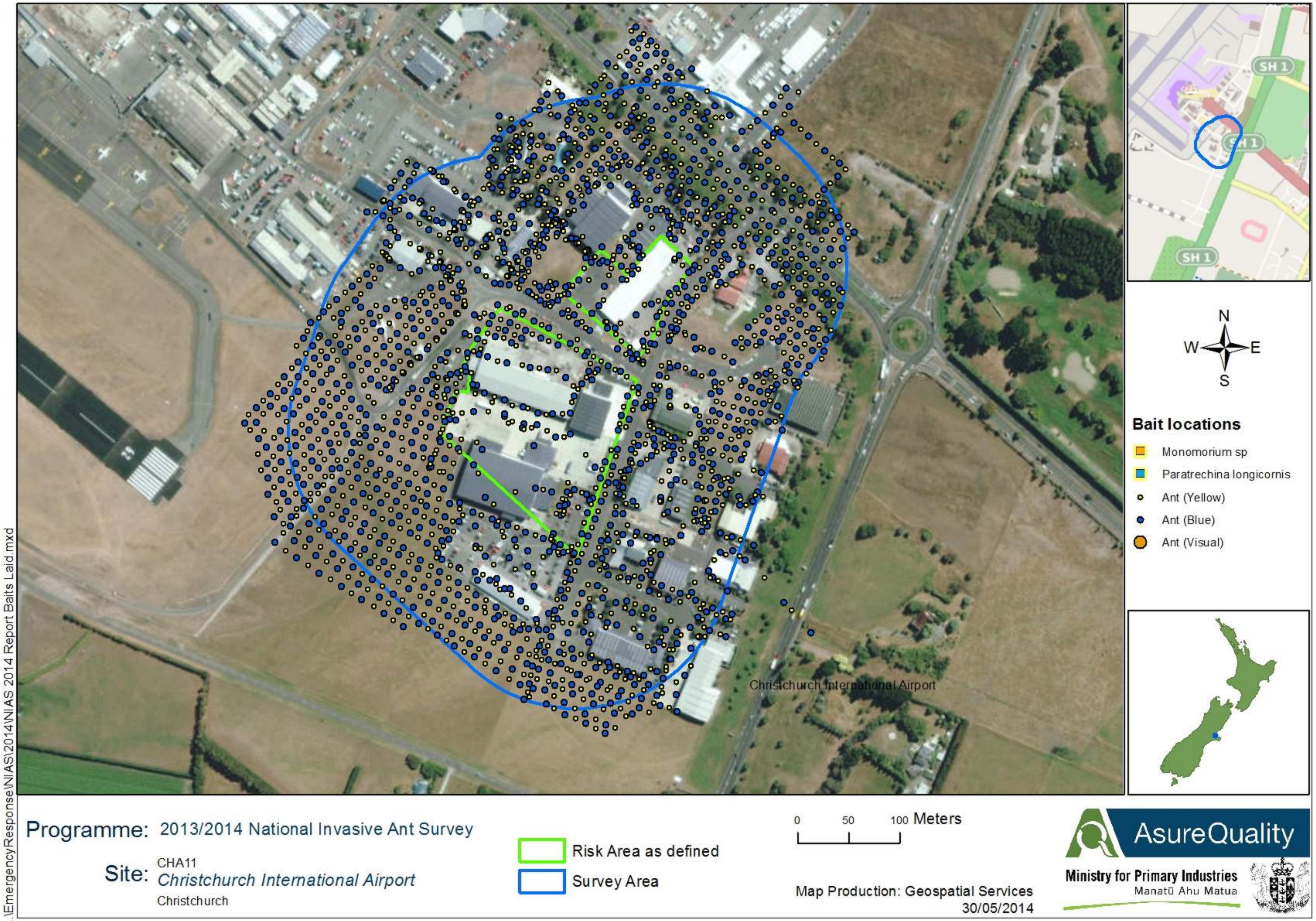
m)

Mt Pleasant
499m
445m
SH 74
Tunnel Road
Lyttelton
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Lyttleton - West
..\EmergencyResponse\NIAS\2014\NIAS 2014 Report Baits Laid.mxd
Programme: 2013/2014 National Invasive Ant Survey
Site: LY12
Port of Lyttleton - West
Christchurch
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua

n)


Christchurch International Airport
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
SH 1
Programme: 2013/2014 National Invasive Ant Survey
Site: CHA11
Christchurch International Airport
Christchurch
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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o)


Port of Timaru - North
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
N
W
E
S
Programme: 2013/2014 National Invasive Ant Survey
Site: TM152
Port of Timaru - North
Timaru
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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p)


Port of Timaru - South
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Programme: 2013/2014 National Invasive Ant Survey
Site: TM152
Port of Timaru - South
Timaru
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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q)


Queenstown Airport
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Programme: 2013/2014 National Invasive Ant Survey
Site: QT150
Queenstown Airport
Queenstown
Risk Area as defined
Survey Area
0
50
100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua
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r)


Deborah Bay
Carey Bay
Port Chalmers
Goat Island/Rakiriri
Roseneath
Quarantine Island/Kamau Taurua
Portobello
Broad Bay
N
W
E
S
Bait locations
Monomorium sp
Paratrechina longicornis
Ant (Yellow)
Ant (Blue)
Ant (Visual)
Port of Otago
\EmergencyResponse\NIAS\2014\NIAS 2014 Report Baits Laid.mxd
Programme: 2013/2014 National Invasive Ant Survey
Site: SOT19
Port of Otago
Dunedin
Risk Area as defined
Survey Area
0 50 100 Meters
Map Production: Geospatial Services
30/05/2014
AsureQuality
Ministry for Primary Industries
Manatū Ahu Matua