Potential social, economic and biodiversity impacts of the Argentine ant, *Linepithema humile*, in the Hawke's Bay region

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Summary

Project

- Provision of advice on the potential social, economic and biodiversity impacts, including the potential distribution, of the Argentine ant, *Linepithema humile* (Mayr), in the Hawke's Bay region by Landcare Research in February 2009.

Objectives

- The objectives of this report were to i) outline the potential economic and biodiversity impacts of Argentine ants within the Hawke's Bay region, ii) provide historical records of Argentine ant sightings within the Hawke's Bay region, and iii) provide a map that determines areas of the Hawke's Bay region that are most suitable for Argentine ants (based on habitat and climate).

Results

Horticultural Impacts

- Argentine ants appear likely to be a significant economic pest for a variety of horticultural crops in New Zealand in the future. They have been recorded on a wide variety of commonly grown crops.
- The main economic loss associated with Argentine ants will involve the increased abundance of sap-sucking insects (scales insects, and aphids) and subsequent impacts on crops.
- **Total costs of Argentine ants to the horticultural industry in the Hawkes Bay region are potentially estimated at NZ$3 million per annum.**
- Impacts will also include increased pest control, damage to irrigation systems and electrical systems when ants live inside these, and farm workers being bitten.

Social Impacts

- Argentine ants are an extreme domestic nuisance pest and will have a major impact on people's lifestyle.

- Impacts in New Zealand that have been recorded by council staff, pest controllers and scientists include:
  - "when the ants are in numbers you cannot garden, hold social events on your lawn",
  - "we cannot allow our children to play there because they get aggressively swarmed".
  - "you cannot have pets outside that are encaged and unable to escape ants"
  - "they come into houses and get into cupboards, sealed jars, electrical areas, behind walls, onto your beds".

- We are also aware that:
  - people are selling houses and moving away from the area (Nelson, Coromandel)
  - smaller pets like lizards have been killed (Bay of Plenty, Northland), and it is likely that caged birds will also be killed
  - in the summer months, a significant amount of council staff time has been taken up with enquiries and complaints about Argentine ants (Northland, Bay of Plenty).

Biodiversity Impacts

- Argentine ants directly predate on vertebrates and invertebrates, for example, Argentine ants have killed nestling birds and caged lizards in New Zealand. Competition for food – especially nectar – may also see the decline of some bird species, e.g., tui in urban areas.

- Sap-sucking insects may increase in native habitats, in a similar way to what happens in horticultural systems. This may increase damage and disease to native plants.
- Open canopy habitats (e.g., mangrove, scrub, urban restoration, coastal forest) are most vulnerable to invasion by Argentine ants. It appears that closed canopy forest is not suitable.
- Recent Landcare Research work on Argentine ant impacts in New Zealand has shown that Argentine ants affect litter decomposition and also kill biological control agents used in weed management.

Historical Records

- The Argentine ant was first found established in Auckland in 1990. In the Hawke's Bay, it was first recorded in 2001 from Napier and Hastings.
- There are relatively few records in the Hawke's Bay, which most likely reflect a lack of sampling and not a lack of infestation.

Potential Distribution

- A large part of the Hawke's Bay region is suitable for Argentine ants survival, including all lowland areas and major urban centres.
- Areas that are not considered suitable are essentially those at higher elevation, including the areas of the Ruahine ranges, Kaimanawa mountains, and Kaweka and Huiarau ranges.

Conclusions

- The Hawke's Bay region is very suitable for the survival and spread of Argentine ants.
- This species will have significant cross-sector impacts in the Hawke's Bay region.
- Many of the impacts will have social consequences, impacting heavily on the lifestyle of people in the region and requiring significant council resources to deal with enquiries and complaints about Argentine ants.
- What has been lacking is a New Zealand-wide coordinated response for slowing their spread and invasion into high value sites (e.g., conservation, economic sites), and, where appropriate, their containment in, or exclusion from, certain regions.

Recommendations

- Argentine ants will spread further in New Zealand, and efforts to restrict their spread is highly recommended.
- For the Hawke's Bay region, it is recommended that:
  - the Hawke's Bay Regional Council give considerable attention to the potential seriousness of the biosecurity threat Argentine ants pose for the region
  - a regional survey be conducted to determine the extent of Argentine ant infestation. Such a survey would provide an important baseline for future planning and management options.
  - the Hawke's Bay Regional Council support a coordinated response between regional councils for slowing the spread and invasion of Argentine ants into high value sites (e.g., conservation, economic sites).

1. Objectives & Scope

- Provision of advice on the potential economic and biodiversity impacts, including the potential distribution, of the Argentine ant, *Linepithema humile* (Mayr), in the Hawke's Bay region, was undertaken for the Hawke's Bay Regional Council by Landcare Research in February 2009.

- The objectives of this report were to:
  - outline the potential economic and biodiversity impacts of Argentine ants within the Hawke's Bay region,
  - provide historical records of Argentine ant sightings within the Hawke's Bay region, and
  - provide a map that determines areas of the Hawke's Bay region most suitable for Argentine ants (based on habitat and climate).

2. Background to Argentine Ants in New Zealand

The Argentine ant, *Linepithema humile* (Mayr), is a native of South America, from the Paraná river basin of Argentina, Brazil and Paraguay (Wild 2004). The native habitat of *L. humile* is generally lowland floodplains with open, grassy vegetation, and of a warm dry 'Mediterranean' climate (Wild 2004).

The Argentine ant is highly invasive and has been accidentally introduced by human trade to many countries throughout the world (Suarez et al. 2001). The ants are considered the second worst pest ant species in the world, after the red imported fire ant, *Solenopsis invicta*. Argentine ants are often associated with human settlement, and are well suited to high levels of disturbance (Passera 1993). However, Argentine ants are also capable of invading some types of native ecosystems. These include: coastal sage scrub in southern California; riparian woodland in California; matorral in Chile; fynbos in South Africa; subalpine shrubland in Hawaii; and oak and pine woodland in Portugal (see Holway et al. 2001).

Argentine ants were first found in New Zealand in 1990, when a small population was found in Auckland (Green 1990). Currently, Argentine ants are widespread in many North Island towns and cities, and also occur in several locations in the South Island, including Christchurch, Nelson and Blenheim.

The first known site of conservation importance to be invaded in New Zealand was Tiritiri Matangi Island in the Hauraki Gulf, a highly valued conservation sanctuary. The invaded area consisted of replanted native vegetation, some remnant forest in gullies, and semi-native coastal vegetation. The population has subsequently been reduced to very low levels by poison baiting (Harris 2002, Harris et al 2003), but eradication remains elusive. Several other native habitats around Auckland and Northland are also known to be invaded, including and regenerating forest, scrub, planted restoration sites, and mangrove swamps (Harris et al 2002, Ward & Harris 2005).

Early investigations on Argentine ants in New Zealand (Charles 2001, Harris 2001, 2002, Harris et al 2002) surveyed their distribution and highlighted the 'beginning' of problems in urban areas. However, at that stage, relatively few problems had been reported.

Since then, however, numerous reports and problems have occurred from many locations (Nelson, Christchurch, Gisborne, and across the Bay of Plenty, Auckland and Northland), involving many different sectors (DOC, council, public, community). These problems have resulted in considerable local media coverage and several national workshops involving scientists, pest controllers, council staff and government departments.

There has also been some further scientific work on Argentine ants in New Zealand, especially on determining their potential distribution (Hartley & Lester 2003, Hartley et al 2006), spread by humans (Ward et al 2005, Ward 2006), presence in horticultural crops (Lester et al. 2003) and invasion into native habitats (Ward & Harris 2005).

What has been lacking is a New Zealand-wide co-ordinated response for slowing their spread and invasion into high value sites (e.g. conservation, economic sites), and where appropriate, their containment in, or exclusion from, certain regions.

3. Impacts of Argentine Ants

Argentine ants have a huge range of potential cross-sector impacts. It is convenient to place these impacts into three impact categories: i) horticultural and agricultural; ii) human health and residential; and iii) biodiversity.

3.1. Horticultural and Agricultural Impacts

There is no publication in New Zealand that has quantified the impacts of Argentine ants on the horticultural and agricultural industry.

However, Lester et al (2003) found Argentine ants on a variety of plants including 15 of 18 common horticultural crops they surveyed [Pipfruits (apple, pear), Citrus (orange, mandarin, grapefruit, lemon), Grapes, Kiwifruit, Stonefruit (peach, plum, nectarine, cherry), and others (avocado, olive, feijoa, persimmon, tamarillo, passionfruit)]. They concluded that, because they are opportunistic, Argentine ants appear likely to be a significant economic pest for a variety of crops.

The main economic loss associated with Argentine ants will involve the increased abundance of sap-sucking insects (scales insects, and aphids) and subsequent impacts on crops.

Sap-sucking insects produce honeydew when they feed on plants (e.g. citrus, vineyards in Harris 2002). As Argentine ants use honeydew as an energy-rich food source they protect sap-sucking insects from being eaten by predators, and move them around plants to increase their output of honeydew.

Because of Argentine ants, there is an substantial increase in sap-sucking insects. As a consequence, there is more damage to plants and much more likelihood that plant disease will be transmitted by the movement of sap-sucking insects. It is likely that there are economic losses from an increase sap-sucking insects on plants (crop loss, poor quality); however, this has not been quantified in New Zealand.

Impacts will also include increased pest control, damage to irrigation systems and electrical systems when ants live inside these, and farm workers being bitten.

Potential Economic Losses

Horticultural production in the Hawkes Bay region equates to approximately 18,000 ha, including 22% of all the wine/grape growing land, and 50% of all apple growing land in New Zealand (Agricultural Survey 2002).

Total costs of Argentine ants to the horticultural industry in the Hawkes Bay region are potentially estimated at NZ$3 million per annum.

I make this estimate based on data from the New Zealand Agricultural Survey (2002), and on the following figures/assumptions:

- export earnings from horticultural crops in New Zealand are NZ$2.11 billion in 2002, and the Hawkes Bay region contributes approximately 16.3% of horticulture land in New Zealand,
- the cost/losses associated with Argentine ants are 1% of earnings (a subjective figure, if the impacts of Argentine ants is greater, then total cost with increase).

- that Argentine ants have reached their maximum distribution, until this time, economic imapcts will be less.

However, these economic losses are probably an underestimate because:

- this estimate doesn't include economic losses for grazing, crop industries, but is based only on fruit and vegetable crops.
- it treats all crops as equal with respect to losses caused by Argentine ants. If losses are higher in the grape and apple industries (main components of horticultural in the Hawkes Bay region) then losses will increase.
- the above estimate only considers export earnings (the only available data from the Agricultural Survey 2002 report).

It should be noted that this is not a thorough economic analyses.

3.2. Human Health/Residential Impacts

There is no publication in New Zealand that has quantified the impacts of Argentine ants on humans.

However, Argentine ants are an extreme domestic nuisance pest and will have a major impact on people's lifestyle. They invade houses and food containers, and inhabit spaces in the walls and roofs of houses. They infest gardens, making outdoor dining difficult, and when disturbed, will run up legs and arms of people and bite. Some people are sensitive to their bite, and they have the potential to carry and hence spread disease, which affects hospitals, food outlets, and the food industry.

Their increase in urban residential areas will also see an increase in the need for pest control and an increase in insecticide use (as has occurred in the USA for fire ants).

Impacts in New Zealand that have been recorded by council staff, pest controllers and scientists include:

- "when the ants are in numbers you cannot garden, hold social events on your lawn",
- "we cannot allow our children to play there because they get aggressively swarmed".
- "you cannot have pets outside that are encaged and unable to escape ants"
- "they come into houses and get into cupboards, sealed jars, electrical areas, behind walls, onto your beds".

We are also aware that:

- people are selling their houses and moving away from the area (Nelson, Coromandel)
- smaller pets like lizards have been killed (Bay of Plenty, Northland), and it is likely that caged birds will also be killed
- in the summer months, a significant amount of council staff time has been taken up with enquiries and complaints about Argentine ants (Northland, Bay of Plenty).

3.3. Biodiversity Impacts

A wide range of biodiversity and environmental impacts have been documented for Argentine ants in native systems (Holway et al 2001, Harris 2002).

Overseas, the biggest impact of Argentine ants is the changes to native ants, but is unlikely to be a problem in New Zealand because of our small native ant fauna, which primarily live in forest.

However, in New Zealand Argentine ants will negatively affect other native invertebrates through predation and competition as overall ant biomass increases. They have the potential to seriously affect populations of rare species (e.g. flax snails), particularly in open canopy habitats.

Direct impacts on vertebrates are also possible, for example, Argentine ants have been observed attacking nesting birds in New Zealand (Harris 2002). Competition for food – especially nectar – may also see the decline of some bird species, e.g. tui in urban areas. Overseas, lizard species are affected from competition for food with Argentine ants.

Sap-sucking insects may increase in native habitats, in a similar way to what happens in horticultural systems (see section 3.1). This may increase damage and disease to native plants.

Argentine ants are thought to disrupt natural environments in a number of ways, and have an overall negative effect for native species, pollination, and soil and plant health.

Ward and Harris (2005) showed that 'open canopy habitats' (e.g. mangrove, scrub, urban restoration, coastal forest) are most vulnerable to invasion by Argentine ants. It appears that closed canopy forest is not suitable.

Recent (Landcare Research unpublished data 2008) work on Argentine ants impacts in New Zealand has shown that Argentine ants affect litter decomposition. There are significantly fewer landhoppers (Amphipods) at invaded Argentine ants sites, and it appears that Argentine ants predate or displace landhoppers when they invade. Landhoppers are an abundant and common part of many natural environments in New Zealand, and play a major role in 'shredding' leaf litter for decomposition. Also at invaded sites there was a much lower microbial biomass, indicating that fungal and microbial decomposer communities have been altered with invasion, and further sampling revealed slower breakdown of leaf litter was occurring at invaded sites.

Forgie et al (2008) also have preliminary data that show Argentine ants significantly lower the establishment of the boneseed leaf roller moth, a biological control agent introduced into New Zealand in 2007 for the control of boneseed.

4. Historical Sightings of Argentine Ants in the Hawke's Bay Region

Surprisingly, there are very few records of Argentine ants from the Hawke's Bay region (Table 1). Most are records from the 2001 national survey of Argentine ants by Charles et al (2001). Unfortunately, this list is unlikely to represent the only records of Argentine ants in the Hawke's Bay region.

Table 1 Known locations of Argentine ants in the Hawke's Bay region as of January 2009 (Landcare Research 2009).

Location	Easting	Northing	Year	Reference
Napier				
Breakwater Rd - to Marine Parade, Port area	2847095	6184355	2008	D.Ward pers obs
"Napier"	2844900	6181700	2001	Charles et al 2001
Hastings				
A&P show grounds	2841625	6168160	2001	Charles et al 2001
Cnr Mayfair Ave and Caroline Rd	2840985	6167670	2001	Charles et al 2001
Coventry Rd	2841150	6168385	2001	Charles et al 2001
Harlech St	2841255	6167980	2001	Charles et al 2001
"Hastings"	2840000	6167000	2001	Charles et al 2001
Hastings, juice producer	2840000	6167000	2001	Charles et al 2001
Kitchener St	2840400	6167535	2001	Charles et al 2001
Omahu Rd	2837835	6168815	2001	Charles et al 2001
Rangiora St	2840225	6168155	2001	Charles et al 2001
Tomoana Rd	2840085	6167815	2001	Charles et al 2001
Tomoana, cnr Tomoana Rd and Williams St	2840760	6168250	2001	Charles et al 2001
Warwick Pl	2841250	6167720	2001	Charles et al 2001
Williams St	2840800	6168175	2001	Charles et al 2001

5. The Potential Distribution of Argentine Ants in the Hawke's Bay Region

The potential distribution of Argentine ants in the Hawke's Bay region was modelled on climatic and habitat variables.

5.1. Model Inputs

Argentine ants are found in many different habitats apart from closed forest. The Landcover Database 2 (LCDB2) was used to exclude certain habitat types from the model, these were: 14. Permanent Snow and ice; 20. Lake and Pond; 21. River; 22. Estuarine Open Water; 66. Pine Forest - Closed Canopy; 67. Other Exotic Forest; 68. Deciduous Hardwoods; 69. Indigenous Forest. Argentine ants are predicted to be present where the mean daily temperature in July is between 7 and 14°C, and the maximum daily temperatures during February is 19-30°C. These values come from analysis of global distribution of the Argentine ant by Hartley et al (2006).

5.2. Model Results

The models show that a large part (approximately half) of the Hawke's Bay region is suitable for Argentine ants to survive, including all lowland areas and major urban centres (Fig. 1). This map is consistent with previous models of the potential of the potential distribution of Argentine ants in New Zealand (Harris 2002, Hartley & Lester 2003).

Areas that are not considered suitable are essentially those at higher elevation, including areas of the Ruahine ranges, Kaimanawa mountains, and the Kaweka and Huiarau ranges (Fig. 1). However, it should be noted that Argentine ants might be able to survive at some sites within these broad areas if microclimate conditions were suitable. They would also likely survive within peoples houses in these broad regions.

6. Conclusions and Recommendations

6.1. Conclusions

The Hawke's Bay region is very suitable for the survival and spread of Argentine ants and the species will have significant cross-sector impacts in the region.

Many of the impacts will have social consequences, impacting heavily on the lifestyle of people in the region and requiring significant council resources to deal with enquiries and complaints about Argentine ants.

A dollar-value is difficult to quantify, however, the horticulture industry will be affected, potentially to the value of NZ$3 million per annum in the Hawke's Bay region.

In 2002 we predicted that Argentine ants have currently established in a very small fraction of the sites they are likely to invade (Harris et al 2002). Unfortunately since then, their presence has been recorded in many new towns and cities in New Zealand, and they have the potential to spread to a large number of other regions, and areas within regions.

Fortunately, Argentine ants have an extremely low ability to self-disperse. Their spread is almost entirely based on human assistance. Proximity to human settlement and transportation networks are key factors in the spread of Argentine ants. We have very strong anecdotal evidence that Argentine ants are being spread by humans - for example, in furniture rental, trucks, pot plants, soil/bark for landscaping. These pathways are able to be targeted for surveillance (and control).

This presents a considerable opportunity to slow their spread and reduce the number of new populations (especially in 'sites of importance').

However, what has been lacking is a New Zealand-wide co-ordinated response for slowing their spread and invasion into high value sites (e.g. conservation, economic sites), and where appropriate, their containment in, or exclusion from, certain regions.

6.2 Recommendations

Argentine ants will spread further in New Zealand, and efforts to restrict their spread are highly recommended.

For the Hawke's Bay region, it is recommended that:

1. the Hawke's Bay Regional Council give considerable attention to the potential seriousness of the biosecurity threat Argentine ants pose for the region.

2. a regional survey be conducted to determine the extent of Argentine ant infestation. Such a survey would provide an important baseline for future planning and management options. A number of regional councils, including Northland, Bay of Plenty, and Tasman, will be able to provide advice on the management of Argentine ants. The Marlborough and Southland regional councils have recently completed region wide surveillance for pest ants species, and could be consulted for recommendations on such a survey in the Hawke's Bay.

3. the Hawke's Bay regional council support a co-ordinated response between regional councils for slowing the spread and invasion of Argentine ants into high value sites (e.g. conservation, economic sites). The sooner new populations of invasive ant species are identified, the better the chances of successful control, containment, or eradication. Having advance knowledge of high-risk sites and potential distribution of invasive species greatly enhances the effectiveness of surveillance and the subsequent management of pest incursions.

7. Acknowledgements

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Fig. 1 The potential distribution of Argentine ants (red) in the Hawkes Bay region based on climate and habitat categories. Regional and district boundaries are indicated by the solid black line, and ocean, rivers and lakes in blue. Unsuitable areas are white.