THE POTENTIAL ECONOMIC IMPACTS OF THE ARGENTINE ANT IN NEW ZEALAND: TREATMENT EXPENDITURE

Ministry of Agriculture and Forestry

December 2002

Abstract

In the absence of quantitative data on the impacts of the Argentine ant, a limited economic impact assessment is undertaken, focusing on a single component - expenditure by affected sectors on treatment to manage Argentine ant numbers in order to prevent or reduce the effects of the Argentine ant. This paper outlines a basic assessment of potential treatment expenditure in household, business, urban open space and conservation sectors in New Zealand without co-ordinated intervention to control the spread of the Argentine ant. Full annual treatment expenditure following the spread of the Argentine ant throughout its predicted New Zealand range is estimated to be $68 million (in 2002 dollars). Given the slow rate of spread of this species, it is likely to be some time before annual treatment expenditure reaches this level. The present value (in 2001/02) of total treatment expenditure over the first 50 years, the period of Argentine ant range expansion and consolidation modelled, is estimated to be $66 million, of which expenditure prior to 2002/03 comprises around $0.6 million. Additional to treatment expenditure are costs associated with other impacts of the Argentine ant that treatment is insufficient to avert in full.

Introduction

Native to Argentina and Brazil, the Argentine ant (*Linepithema humile*) has established in many countries around the world including New Zealand. Outside its native range, it is a serious household and urban pest and can have significant impacts in agricultural and natural environments. The aim of the economic impact assessment is to provide an indication of the costs to New Zealand of living with this pest, in the absence of co-ordinated intervention to control its spread. Reduction in the remaining future costs is the benefit of such intervention.

Methodology

The types of impacts had by the Argentine ant are well identified in the literature but not quantified even for countries in which it is long established. Without quantitative data on the impacts of the Argentine ant, a full economic impact assessment can be undertaken only with difficulty and limited confidence in its results. In this case, a partial assessment is undertaken, focusing on a single component - expenditure by affected sectors on treatment to manage Argentine ant numbers on their properties in order to prevent or reduce the effects of the Argentine ant.

The levels of treatment that affected sectors choose to undertake may be insufficient to avert all effects. It may not be technically and/or economically feasible to avert all effects, given that colonies develop rapidly into large populations, resilient to the loss of workers and reinfesting treated areas. Treatment is worthwhile only at levels at which it costs less than the

effects it averts. Thus some levels of other impacts of the Argentine ant, such as repair or replacement costs and production losses, albeit lower than without Argentine ant treatment, may occur over and above the treatment expenditure incurred.

Treatment expenditure

This assessment models Argentine ant treatment expenditure in four sectors:

- household;
- business;
- urban open space; and
- conservation.

Current technology and prices are assumed throughout, as is access to sufficient quantities of treatment products. All costs are expressed in real terms in June 2002 New Zealand dollars (Statistics New Zealand, 2002).

Household

Households may incur considerable treatment expenditure in attempting to rid their homes of the Argentine ant rather than tolerate its effects (damage to gardens, structural damage and disruption of outdoor household activities, plus wastage of food, risks to hygiene and annoyance, discomfort or distress caused by indoor foraging). In California, where the Argentine ant is long established, it is the pest that extermination companies are most frequently employed to remove from houses (University of California, San Diego, 1999).

In Auckland, professional treatment for the Argentine ant costs typically $380 per property per annum (for treatment of a standard three bedroom house on a basic section, including four visits for perimeter treatments following baiting; van Dyk, 2001; 2002). Although households may try purchased or home-made treatment products initially, for effective control they are likely to have to resort to the services of professional pest control companies (van Dyk, 2001). Given the "patchy" distribution of the Argentine ant, even in areas in which it is well established, this treatment expenditure is modelled as incurred by, on average, one in five households in the upper North Island and proportionately fewer households in other regions according to the lower Argentine ant densities modelled (see p.4), following the spread of this species. Numbers of occupied dwellings by council region are taken from Statistics New Zealand (2001a). Given the likelihood of reinfestation and household intolerance of such pests, treatment is modelled as undertaken every year (van Dyk, 2001).

Business

The Argentine ant may also infest some private and public sector business premises, necessitating treatment around product storage areas and other buildings, such as processing facilities, to prevent product contamination, disruption of work or loss of business. Some businesses, such as in food and medical industries, may have zero tolerance of the Argentine ant, given hygiene requirements. These businesses are likely to have existing programmes for pest control, but, given the aggression and persistence of the Argentine ant, significant additional treatment may be necessary (Green, 2001).

Professional treatment of business premises for the Argentine ant is modelled as incurring additional costs averaging at least as much as household treatment at $380 per property per annum, as above. Numbers of geographic units (business outlets) by council region are taken

from Statistics New Zealand (2001b). Approximately 35 per cent of the total number are in industries that may be more liable to and/or have lower tolerance of Argentine ant infestations: agriculture, forestry and fishing, wholesale and retail, accommodation, cafes and restaurants, transport and storage and health and community services. Treatment expenditure, following the spread of the Argentine ant, is therefore modelled for one in ten business premises in the upper North Island and proportionately fewer business premises in other regions according to the lower Argentine ant densities modelled (see p.4). This treatment is modelled as necessary every year (Green, 2001).

Whilst treatment may be required around storage and processing areas to prevent product contamination, existing spraying programmes for horticultural crops, other than in organic production and integrated pest management systems on low pesticide regimes, are thought likely to be sufficient for little additional treatment of fields and orchards to be necessary. Expenditure in organic production systems on treatment for the Argentine ant and/or the increase in populations of homopterous insects that it supports depends on whether treatment products acceptable to the organic sector are available. If not, treatment expenditure by this sector may be low but production losses significant. A risk assessment for New Zealand's horticultural crops rates grapes and citrus fruit at highest risk from the Argentine ant and notes significant economic impacts on these crops in Australia, South Africa and the USA (Lester and Longson, 2002). Currently, around 95 hectares of grape production and 45 hectares of citrus production in New Zealand are certified organic (BIO-GRO New Zealand, 2002).

A further way in which the Argentine ant may have potential to affect New Zealand's agricultural sectors is through impacts on exports. Additional inspection and/or treatment of consignments, including containers and packing materials, may be required, or market access jeopardised, if existing procedures are determined to be inadequate to detect and/or prevent the presence of the Argentine ant in exports to destinations where this species is not yet, but has the potential to become, established. Expenditure on treatment around ports and transport yards is modelled, under the category of urban open space.

Urban open space

In addition to residential and business properties, in urban environments the Argentine ant may infest recreation sites and other areas of open space providing suitable habitat and access to food and water.

Easy terrain large area treatment as undertaken at the Port of Nelson requires three kilograms of bait per hectare, at a cost of $72 per kilogram, and 4.5 hours of labour per hectare (Harris, 2001; Statistics New Zealand, 2002). With the average cost of labour set at $31 per hour, the total treatment cost per hectare is $355. This cost is modelled as applying to, on average, one in five hectares of urban open space in the upper North Island and proportionately fewer hectares in other regions according to the lower Argentine ant densities modelled (see p.4), following the spread of the Argentine ant. Urban open space land area by council region is taken from Ministry of Agriculture and Forestry (1997). It is assumed that some recovery in Argentine ant numbers is tolerated for the efficient use of bait, such that treatment is undertaken every other year.

Conservation

Even without funding co-ordinated intervention to control the spread of the Argentine ant, some government expenditure may occur in treating areas administered by the Department of

Conservation most vulnerable to the effects of the Argentine ant (e.g. locations of susceptible, endangered, native flora or fauna) or of the highest levels of human activity (e.g. areas receiving most visitors, including picnic sites and camp grounds, where the Argentine ant most impacts on human activities or, given the higher levels of disturbance and the presence of food and rubbish, establishes first and in the greatest densities and from where it forays into the surrounding area).

The treatment of areas of coastal vegetation in the conservation estate as undertaken on Tiritiri Matangi requires six kilograms of bait per hectare, at a cost of $72 per kilogram, and 18 hours of labour per hectare (Harris, 2001; Statistics New Zealand, 2002). With the average cost of labour set at $31 per hour, the total treatment cost is $986 per hectare. For the purpose of this assessment, this is modelled as representative of the average cost of treating conservation land. The land area treated is unknown and would depend on what impacts the Argentine ant is found to have in New Zealand ecosystems, as well as on competing budget priorities. This initial assessment of treatment expenditure does, however, include additional treatment of a small area of Department of Conservation land, following the spread of the Argentine ant, in the order of one tenth of one per cent in the upper North Island and proportionately less in other regions according to the lower Argentine ant densities modelled (indicated below). Department of Conservation land area by council region is derived from Department of Conservation (2000) and Land Information New Zealand (2000). This treatment is modelled as undertaken every other year.

Argentine ant distribution

Range

The potential range of the Argentine ant in New Zealand has been explored using climatic modelling. Charles *et al.* (2001) suggests that the Argentine ant could establish throughout most of New Zealand, with the exception of Buller, Westland and Fiordland. Harris (2001) considers the lower South Island likely to be too cold to support permanent populations and most of the rest of the South Island and much of the central North Island likely to be too cold for establishment outside urban areas. Harris *et al.* (2002) finds the potential for the Argentine ant to invade native habitats to be highest in northern New Zealand, with much of non-urban New Zealand likely to be too cold. Lester and Longson (2002) indicates the probability of survival of the Argentine ant in horticultural areas to be highest in Northland, high across most of the North Island and low in the northern South island, with the rest of the South Island considered unsuitable for Argentine ant infestation.

Given regional data classifications and differences in climate, influencing where and in what densities the Argentine ant occurs, different average levels of treatment are modelled for:

- the upper North Island;
- the rest of the North Island; and
- the upper and eastern South Island.

The upper North Island comprises the Northland and Auckland regions. The rest of the North Island includes the Coromandel Peninsula and coastal Bay of Plenty, which are climatically similar to the upper North Island, but also parts of the central North Island. The upper and eastern South Island comprises the Tasman, Nelson, Marlborough and Canterbury regions. No treatment expenditure is modelled for the western or lower South Island.

Density
Relative to Argentine ant density in the upper North Island, densities in other regions, reflected in treatment levels, are modelled as averaging:

- 50 per cent in the rest of the North Island;
- 25 per cent in household, business and urban open space areas of the upper and eastern South Island; and
- zero in conservation areas of the upper and eastern South Island.

On the basis of these relative densities, for example, the assumption that one in five households in the upper North Island incurs Argentine ant treatment expenditure implies the assumption that treatment expenditure is incurred by one in ten households in the rest of the North Island and one in twenty households in the upper and eastern South Island.

Rate of spread
Although Argentine ant populations multiply rapidly, this species spreads relatively slowly, through a combination of localised diffusion, by the reproductive mode of budding, and human-assisted jump dispersal. Suarez *et al.* (2001) finds the former to average a maximum distance of 150 meters per year whilst the latter extends over distances of around 150 kilometres per year. For the purpose of estimating potential treatment expenditure, the period to completion of Argentine ant range expansion and consolidation is modelled as 50 years.

The Argentine ant was first recorded in New Zealand (in Mt Smart, Auckland) in January 1990 (Green, 1990), but investigation found it to be already widespread in the surrounding area and at one location it was reported to have been present for a couple of years previously. Treatment expenditure is therefore modelled as commencing in 1988/89, although there may have been some minor treatment undertaken in earlier years. Under the assumption of a 50-year period of range expansion and consolidation, this implies full annual treatment expenditure from 2037/38.

National annual treatment expenditure is phased in over this period, modelled as increasing annually, as the number of concurrently expanding infestations increases, although at a decreasing rate, as the Argentine ant spreads into areas of less favourable habitat and climate (annual expenditure increasing by 50 per cent initially and thereafter by one percentage point less each succeeding year).

Results

This initial assessment suggests full annual treatment expenditure, following the spread of the Argentine ant throughout its predicted New Zealand range, of $68 million.

This includes expenditure of $0.564 million per annum (less than one per cent of the total) on treatment in conservation areas. Household sector expenditure accounts for 88 per cent of the full annual total, business sector expenditure for 11 per cent and urban open space expenditure for one per cent. Expenditure in the North Island represents 93 per cent of the full annual total (57 per cent in the upper North Island, 36 per cent in the rest of the North Island[1]). This distribution reflects the larger human population and more favourable climate

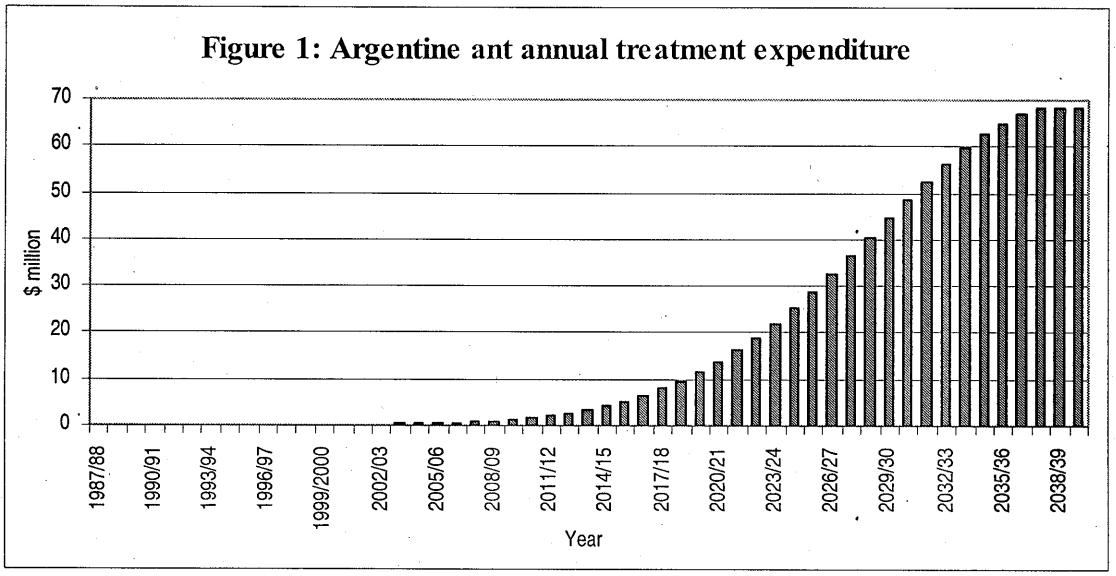
[1] At $4 million, full annual treatment expenditure in the Bay of Plenty represents six per cent of the national total.

of the North Island. The largest single component, at 50 per cent of full annual Argentine ant treatment expenditure, is spending by upper North Island households.

The extent to which the distribution of estimated treatment expenditure can be considered indicative of that of the actual costs to New Zealand of the Argentine ant is, however, limited, in that treatment expenditure is modelled with greater certainty for some sectors and regions (e.g. households, the upper North Island) than others and costs associated with impacts additional to treatment expenditure may be quite differently distributed (e.g. whilst treatment expenditure to avert the effects of the Argentine ant may dominate household impacts, it may be a less important component of the impacts on other sectors).

Annual treatment expenditures over the first 50 years to completion of the expansion and consolidation of the Argentine ant's New Zealand range are illustrated in Figure 1, commencing in 1988/89 and of full magnitude from 2037/38.

Figure 1: Argentine ant annual treatment expenditure



At a discount rate of ten per cent, to express future costs in terms of their present values in 2001/02, estimated total treatment expenditure over the 50-year period 1988/89 to 2037/38 inclusive has a present value of $66 million. Of this, expenditure prior to 2002/03 has a present value of $0.572 million. Present value total treatment expenditure over the first 50 years is further dominated by household, business and urban open space sector and North Island expenditures than is full annual treatment expenditure, given the spread of the Argentine ant from initial establishment in urban Auckland, as discounting gives greater weight to expenditures incurred in earlier years.

In comparing future treatment expenditure, in the absence of co-ordinated intervention to control the spread of the Argentine ant, with the costs of operating a control option, it is necessary to consider how much of this future treatment expenditure is averted, depending on how long it takes to achieve the control objective, during which time affected sectors continue to incur some treatment expenditure. Consideration should also be given to any additional impacts of the control option on the activities of affected sectors (e.g. the costs of complying with movement controls or mandatory treatment) and the costs of maintaining the control objective once it has been achieved (e.g. the costs of surveillance for and responses to subsequent reinfestations, given their probability or frequency).

Sensitivity analysis

Treatment expenditure is estimated under considerable uncertainty as to the rates and frequencies, as well as, to a lesser degree, the unit costs, of Argentine ant treatment.

Estimated total treatment expenditure is most sensitive to the coefficients adopted for household spending, particularly in the North Island, given the dominance of estimated total treatment expenditure by this sector and region. If treatment expenditure is incurred by one in three households, estimated present value total treatment expenditure over the 50 year period modelled is increased by 59 per cent from $66 million to $105 million. If treatment expenditure is incurred by only one in ten households, or by one in five households but required only every other year, present value total expenditure is 44 per cent lower at $37 million. Were an effective bait suitable for household use to become commercially available, treatment costs would be much lower. This may, however, result in a greater number of households choosing to treat infestations. At an annual cost of $50 per household, in place of the $380 currently required for treatment by pest control professionals, and 50 per cent more households undertaking treatment for the Argentine ant, present value total expenditure is reduced by over two thirds to $20 million.

If business premises require treatment only every other year, present value total expenditure falls by 5 per cent to $63 million. If large scale baiting is sufficiently effective to be required only every third year, present value total expenditure is reduced by $0.192 million for treatment of urban open spaces and $0.183 million for treatment of conservation areas.

There is uncertainty as to the potential distribution of the Argentine ant in New Zealand. If the Argentine ant is unable to establish in conservation areas other than in the upper North Island, estimated present value total treatment expenditure is reduced by $0.454 million. If its range excludes all of the South Island (and it takes just as long to spread throughout the now smaller range of the North Island only), present value total expenditure is $4.828 million, seven per cent, lower. Alternatively, if the Argentine ant is able to establish in conservation areas of the upper and eastern South Island, present value total expenditure increases by $0.200 million. If its range includes household, business and urban open space areas in the lower South Island, at an average density of ten per cent of that in the upper North Island, present value total expenditure is $0.878 million higher (under the same period of range expansion and consolidation).

The potential rate of spread of the Argentine ant is also uncertain. The Argentine ant may take several hundreds of years to spread throughout all suitable New Zealand habitats (Harris, 2001). The adoption of a considerably slower rate of spread across all sectors reduces substantially estimated present value total treatment expenditure over the period of range expansion and consolidation. The Argentine ant is likely to spread first, however, largely to urban areas, plus some non-urban households and businesses through inadvertent transportation from infested areas. With the completion of Argentine ant range expansion and consolidation of household, business and urban open space areas within the first 50 years but not yet any significant spread into any conservation areas, present value total expenditure over this period is reduced by $0.548 million. Thus, given that total treatment expenditure is dominated by the household, business and urban open space sectors, the effect of a slower rate of spread is relatively small unless this applies in these areas also.

Present value total treatment expenditure is fairly sensitive to the discount rate applied and, consequently, to the way in which annual treatment expenditure is phased in (reflecting the pattern of spread of the Argentine ant). This can be attributed to the relatively slow rate of spread of this species, as changes in the discount rate have a greater effect the more distant the future expenditures to which the discount rate is applied. Reducing the discount rate from ten to seven per cent almost doubles the present value of total expenditure over 50 years, whilst increasing the discount rate from ten to twelve per cent reduces it by 34 per cent.

Conclusion

This initial assessment of potential treatment expenditure in household, business, urban open space and conservation sectors, in the absence of co-ordinated intervention to control the spread of the Argentine ant, suggests full annual treatment expenditure, following the spread of the Argentine ant throughout its predicted New Zealand range, of $68 million (June 2002 dollars). The majority of this expenditure is by North Island households.

Given the slow rate of spread of this species, it is likely to be some time before annual treatment expenditure reaches this level. Present value (in 2001/02) total treatment expenditure over the first 50 years, to completion of Argentine ant range expansion and consolidation, 1988/89 to 2037/38 inclusive, is estimated to be $66 million, of which expenditure prior to 2002/03 comprises around $0.6 million.

This assessment has been undertaken under considerable uncertainty and with the expectation of revision with the availability of further information on the effects of the Argentine ant in New Zealand environments and the responses of affected sectors.

Additional to expenditure on Argentine ant treatment are costs associated with other impacts of the Argentine ant that this treatment is insufficient to avert in full. There may, however, be some reduction in the impacts of, and/or saving in expenditure on treatment for, pest species displaced by the Argentine ant.

References

BIO-GRO New Zealand (2002) Personal communication.

Charles, J.G., Suckling, D.M., Froud, K.J., Allan, D.J., Dentener, P.R., Connolly, P. and Verberne, H. (2001) *National Survey of Argentine Ants*, Final report to Ministry of Agriculture and Forestry Biosecurity Authority, July, 2001, HortResearch and AgriQuality New Zealand.

Department of Conservation (2000) Tenure boundaries, September 2000.

Green, C. (2001) Personal communication, Department of Conservation, Auckland.

Green, O.R. (1990) Entomologist sets new record at Mt Smart or *Iridomyrmex humilis* established in New Zealand, *Weta*, 13, pp. 14-16.

Harris, R.J. (2001) Personal communication, Landcare Research, Nelson.

Harris, R.J., Ward, D. and Sutherland, M.A. (2002) *A survey of the current distribution of Argentine ants, Linepithema humile, in native habitats in New Zealand, and assessment of future risk of establishment*, Report to Ministry of Agriculture and Forestry Biosecurity Authority, May, 2002, Landcare Research.

Land Information New Zealand (2000) Regional council boundaries.

Lester, P.J. and Longson, C.G. (2002) *Argentine ant distribution investigation: horticultural areas*, Report to Ministry of Agriculture and Forestry Biosecurity Authority, May, 2002, School of Biological Sciences, Victoria University of Wellington.

Ministry of Agriculture and Forestry (1997) Land cover database statistics, www.maf.govt.nz/statistics

Statistics New Zealand (2001a) *2001 Census of Population and Dwellings (final counts)*, www.stats.govt.nz

Statistics New Zealand (2001b) *New Zealand Business Demographic Statistics*, February 2001 with 1997 industry coverage, www.stats.govt.nz

Statistics New Zealand (2002) Consumers price index, all groups, June years.

Suarez, A.V., Holway, D.A. and Case, T.J. (2001) Patterns of spread in biological invasions dominated by long-distance jump dispersal: insights from Argentine ants, *Proceedings of the National Academy of Sciences in the United States of America*, vol. 98, no. 3, pp.1095-1100, www.pnas.org

University of California, San Diego (1999) *Success of introduced Argentine ants tied to reduced genetic variation*, USCD News, 15 May, 1999, http://ucsdnews.ucsd.edu/newsrel/science/mcants.htm

van Dyk, V. (2001; 2002) Personal communication, Flybusters, Auckland.