THREAT ABATEMENT PLAN

BACKGROUND DOCUMENT

To reduce the impacts of tramp ants on biodiversity in Australia and its territories

Australian Government

Department of the Environment and Heritage

BACKGROUND DOCUMENT

for the

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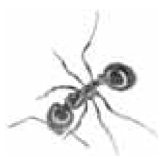

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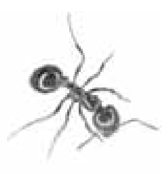
Front cover and sequential page photo: Red Imported Fire Ant (*Solenopsis invicta*) – Steve Wilson.

Note: This background document to the *Threat abatement plan to reduce the impacts of tramp ants on biodiversity in Australia and its territories* provides supporting information on a range of issues such as tramp ant biology, population dynamics, spread, biodiversity impacts and management measures.



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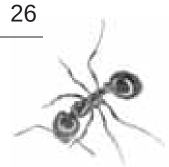
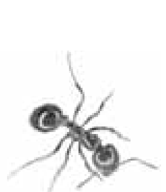
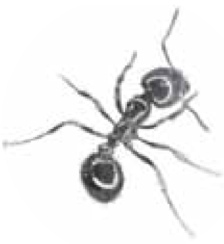




1. Introduction



Invasive alien tramp ants are a diverse group of species originating from many regions of the globe which arrive at Australia's doorstep through a variety of transport pathways. They share genetic, behavioural, and ecological attributes that influence their probability of entry, establishment and spread, ecological dominance, and high impact.

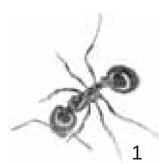
While their impacts on biodiversity in Australia are not well quantified, many tramp ants have the ability to affect Australia's native biodiversity. Their impacts may be felt directly through predation upon or competition with native animals, or indirectly by modifying habitat structure and altering ecosystem processes. Most tramp ants have multi-sectoral impacts, and can affect plant and animal health, social and cultural values, and human health.

The effective and appropriate management of threats from tramp ants poses a formidable challenge to Australia, testing the continuum of biosecurity, from pre-border surveillance through to pest management. Individual tramp ant species are at varying stages in the invasion process, so the nature and scale of management responses will vary accordingly.

The tramp ant threat abatement plan establishes a national framework to guide and coordinate Australia's response to tramp ants, identifying the research, management, and other actions necessary to ensure the long-term survival of native species and ecological communities affected by tramp ants.

The goal of the plan is to minimise the impact of invasive tramp ants on biodiversity in Australia and its territories by protecting threatened native species and ecological communities, and preventing further species and ecological communities from becoming threatened.

The Department of the Environment and Heritage will convene a National Implementation Team to assist and advise on the implementation of the plan. The team will include people with expertise in the research and management of tramp ants. It will also include stakeholders such as state and territory agencies.



2. Background and organisation

2.1 Background

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a framework and mechanism for the listing of a key threatening process that affects biodiversity in Australia and its territories. The process is initiated by a written nomination of a key threatening process, followed by public comment and evaluation of the nomination by the Threatened Species Scientific Committee, a panel of independent experts who make a recommendation to the Minister for the Environment and Heritage on listing of the nominated key threatening process.

If the Minister approves the listing, the Minister then identifies whether to produce a threat abatement plan, which provides for research, management, and other actions deemed necessary to reduce the impact of a key threatening process on affected native species or ecological communities.

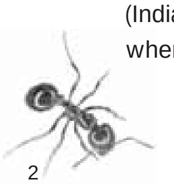
To satisfy the requirements of the EPBC Act the plan must, among other things, state (i) its objectives; (ii) criteria against which achievement is measured; and (iii) actions prescribed to achieve the objectives (see Appendix A).

The red imported fire ant *(Solenopsis invicta,* hereafter RIFA), discovered in Brisbane in 2001 and the target of a national eradication program, was nominated in 2002 as a key threatening process under the EPBC Act. In 2003 another invasive tramp ant, the yellow crazy ant *(Anoplolepis gracilipes*, YCA), was nominated as a key threatening process on Christmas Island (Indian Ocean), an external territory of Australia, where it is currently the subject of a large-scale control program. In April 2003, the Minister for the Environment and Heritage approved listing RIFA as a key threatening process and approved the development of a threat abatement plan to address the key threatening process, and tramp ant species more broadly. In April 2005, the Minister approved the listing of ‘Loss of biodiversity and ecosystem integrity following invasion by the yellow crazy ant *(Anoplolepis gracilipes)* on Christmas Island, Indian Ocean’ as a key threatening process.

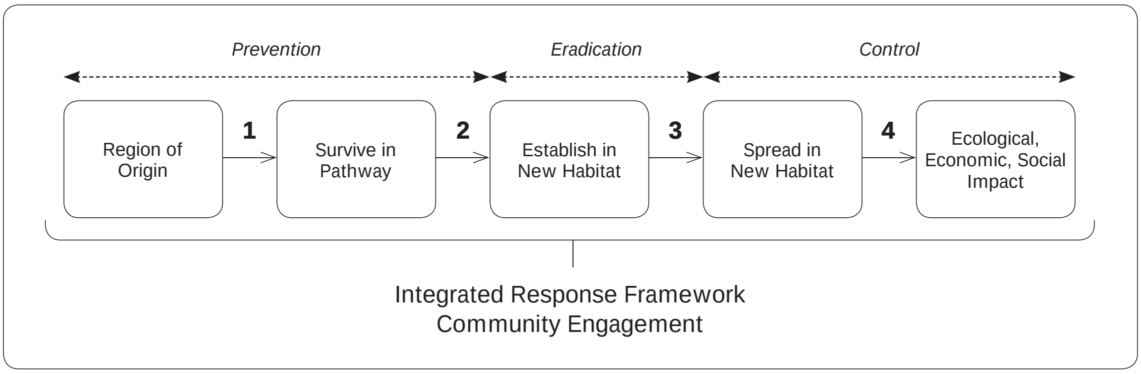
At the same time as these developments, these and other tramp ant species were emerging as threats elsewhere in Australia. Management responses have included eradication programs for the African big-headed ant *(Pheidole megacephala,* BHA) and tropical fire ant *(Solenopsis geminata,* TFA) in Kakadu National Park and an ongoing attempt to eradicate a widespread YCA infestation in east Arnhem Land. Recent incursions by several tramp ant species (eg YCA into northern New South Wales, Brisbane, and Cairns, and the Argentine ant *(Linepithema humile,* AA) in Brisbane) have been followed by rapid responses to achieve eradication.

The threat abatement plan focuses on the production of a coordinated national approach to management, research, and education that increases awareness, prevents entry and spread, provides early detection and diagnosis, and provides rapid response to both incursions and established populations of tramp ants.

The purpose of a threat abatement plan is to define actions to mitigate the impact of a key threatening process on affected native species and ecological communities. However, because almost all tramp ants have a range of impacts including



■ Figure 1. Stages in the invasion sequence of a species (after Kolar and Lodge 2000)



on plant and animal health, social and cultural values, and human health, it is difficult to separate actions (especially at early stages in the invasion process) that mitigate their impacts on biodiversity from those that affect primary industry and social values. The plan focuses on actions to reduce the impacts of tramp ants on native biodiversity and ecological communities, but many, if not all, of these actions are also likely to mitigate impacts on other sectors that are affected by tramp ants.

2.2 Organisation of response

An integrated framework for preparing for and responding to invasive tramp ants must include actions at several stages, and be consistent with generic frameworks for exotic pest incursions where management runs along a continuum from pre-border preventative measures to eradication or control of established invaders, to monitoring and evaluating control activities **(Figure 1)**. Key elements in this integrated framework include:

- identification and assessment of risks
- risk mitigation strategies
- surveillance and diagnostic strategies
- response procedures, with defined roles and responsibilities
- follow-up monitoring and evaluation.

Each solid arrow represents a transition to the next stage (with an associated probability) and a decision point (**1-4**) for managers. Management responses are in *italics*.

The threat abatement plan uses the major stages in the invasion sequence as its organising principle for identifying and prescribing policy, management and research, and actions at the transition between stages (eg point 2, between survival in the transport pathway and establishment in the new habitat). A species invasion can be seen as a series of distinct phases, beginning with the transfer of a source population and ending with a species becoming established in an environment to which it is alien. This new environment could be at any geographic scale (eg a national park, a water catchment, a state, a country, or a region).

Actions taken at a given stage in the invasion sequence aim to reduce the transition probability as far as possible. Actions can be divided into (i) measures to prevent entry and to prepare in advance for incursions; and (ii) responses to eradicate or control incursions and limit their spread so as to mitigate impacts. Research and development, coordination and cooperation among stakeholders, and community engagement including key stakeholders and the public, underpin the success of management responses at any and all of these stages.

3. Characteristics and biology

Invasive tramp ants threaten values – environmental, economic, social, cultural, and health – that underpin Australian society. A special challenge to natural resource managers, tramp ants are a diverse group of ant species derived from many regions. They share common genetic, behavioural, and ecological attributes that influence their probability of entry, establishment and spread, ecological dominance, and high levels of impact in Australia and its territories.

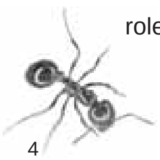
Tramp ants routinely test Australian border defences through their occurrence in a variety of transport pathways and in their association with a diverse range of commodities. There are many examples of the complexity and range of circumstances in which rapid and ongoing management responses are needed. These include the recent incursion of RIFA in suburban Brisbane (Vanderwoude *et al.* 2003), the rapid spread and catastrophic impact of supercolonies of YCA in Christmas Island National Park (O'Dowd et al. 2003), and the detection of the BHA in the World Heritage listed Kakadu National Park (Hoffmann and O'Connor 2004) and Great Barrier Reef islands (Hoffmann *et al.* 2004). Invasive tramp ants present a challenge at every phase in the quarantine continuum.

3.1 The threat – tramp ants as invasive alien species

Ants are among the most ecologically successful groups of animals (Wilson 1992). Worldwide, these social insects comprise at least 15 000 species, occupy most terrestrial habitats and adaptive zones, fill a diversity of key functional roles (eg as predators, herbivores, seed eaters, seed dispersers, scavengers), and act as ecosystem engineers to shape the structure of some ecosystems. From temperate forests to the arid zone to the rainforest canopy, they can dominate ecological communities, helping determine their structure, biodiversity and function (Davidson *et al.* 2003, Andersen 2004). Like most animal groups, the ants have diversified in relative isolation on different continents where they are often restricted to that continent. Nowhere is this better illustrated than in Australia, which has a rich native ant fauna comprising over 100 genera and at least 1300 species, most of which are endemic (ie found only in Australia), with only a minority of species shared with neighbouring regions (Shattuck 1998).

Ants are also the exemplar of invaders. Globalisation of trade and commerce has accelerated exchange of a subset of the ants, perhaps more than 200 species to date, among previously isolated biogeographic regions (McGlynn 1999). Although many of these transported ants continue to fail to establish in areas of introduction, a subset of approximately 35–40 species referred to as 'tramp ants' have established widely beyond their areas of origin, usually in close association with humans (Holway *et al.* 2002). At least 12 of these species, from three major subfamilies, appear to be highly invasive (see **Table 1**).

The issues involved in tramp ant invasions can be illustrated by focusing on six key tramp ant species – the red imported fire ant (*Solenopsis invicta*, RIFA), the tropical fire ant (*S. geminata,* TFA), the little fire ant (*Wasmannia auropunctata,* LFA), the African big-headed ant (*Pheidole megacephala,* BHA), the yellow crazy ant (*Anoplolepis gracilipes,* YCA) and the Argentine ant (*Linepithema humile,*



AA) (**Box 1**). All except *S. geminata* are listed among the world's 100 worst invaders by the Invasive Species Specialist Group of the World Conservation Union (ISSG 2004a). These six tramp ant species have significant impacts on biodiversity and ecological communities elsewhere and represent major threats to Australian biodiversity, agriculture, the economy, social values, and human health. Some species, like RIFA and AA, have been the focus of intensive research and management efforts internationally (and in Australia), so their biologies are relatively well known, and actions for their eradication or control are relatively well developed and tested.

3.2 Invasive attributes

Most of these tramp ant species share a number of characteristics that help explain their invasiveness, ecological dominance, and impact in areas of introduction. These include unicoloniality, low levels of intra-species aggression, polygyny (many-queened nests), generalised nesting habits and frequent nest relocation, broad diets, and well-developed mutualisms (mutually beneficial relationships) with honeydew-secreting Homoptera (Bach 1991, Passera 1994, Holway *et al.* 2002, Helms and Vinson 2002).

Some of these attributes characterise these ants in their areas of origin, but others are probably a consequence of genetic bottlenecks and founder effects following human-mediated dispersal (Tsutsui and Case 2001, Tsutsui and Suarez 2003). Some attributes (eg generalised nesting habits, polygyny, and association with disturbed habitats) may increase the probability that tramp ants move into and survive in human-mediated transport pathways to reach and establish in new areas. Others, including unicoloniality, low levels of within-species aggression, high levels of inter-species aggression, and omnivorous (broad) diets may be directly related to the ability of these tramp ants to reach high, sustained densities in areas of invasion (Tsutsui and Suarez 2003). For example, unicolonial tramp ants do not defend territories against conspecifics (ants of the same species) so may allocate workers to other tasks that increase colony production and size. Their broad diets may allow a greater variety of resources to be harvested, also increasing colony productivity. Numerical superiority may simply mean that these ants can rapidly mobilise to monopolise resources, which increases population size and hence, impact.

Invasiveness is also shaped by the attributes of the recipient community (Lodge 1993). This may be related to both biotic factors (eg absence of predators, parasites and pathogens, or the presence of mutualists (species that benefit from the ants) in the area of introduction) and environmental factors (eg high levels of climatic and habitat matching, and disturbance in the area of introduction). For example, in areas of introduction, these ants may have far fewer natural enemies (and perhaps competitors) than in their area of origin, allowing them to achieve higher population sizes, and perhaps even broader distributions. Most tramp ants are associated with disturbed habitats in their area of origin and human disturbance may facilitate their establishment and spread in areas of introduction (Suarez *et al.* 1998, Holway *et al.* 2002). Similar climate and habitat in the area of introduction and the area of origin may assist successful establishment and invasion.

3.3 Factors predicting invasions

Much research on the genetics, behaviour, and ecology of tramp ants remains to be done before we are able to accurately predict their probabilities of invasion and the severity of their impact. Their invasive attributes (see Section 3.2 above) are likely to improve their chance of moving between different stages in the invasion process (**Figure 1**) and help to explain why they are such effective and significant invaders. Nevertheless, the most robust generalisations for predicting the success of biological invaders involve three factors (Lonsdale 1999):

- *Invasion history.* If the species has a history of successfully invading elsewhere, its probability of invading here is increased. The worldwide distribution records for each of these six tramp ant species show that each has invaded widely across the globe (**Box 2**).

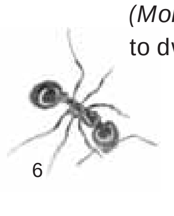
- *'Propagule' pressure.* If introduction pressure ('propagule' pressure) of an alien species is high and sustained, then the probability of successful establishment is increased. The records of these tramp ants intercepted coming into Australia indicate that all are found in a variety of transport pathways, associated with a diversity of commodities, sourced from many regions of the globe, and that their rates of introduction into Australia may be increasing (**Box 3**). The spate of recent tramp ant barrier breaches and incursions in Australia is also consistent with this view.
- *Climatic/habitat matching.* If climatic conditions and habitat attributes are well matched to the area of origin of the introduced species, then the probability of establishment and spread is increased. Climatic modeling predicts that each of these ants has the potential to greatly extend its distribution across the Australian continent well beyond their currently known distributions (**Box 4**). Up to 80 per cent of the Australian continent could be affected by at least one of the tramp ant species examined here. Because most of these ants are of subtropical or tropical origin, implications are likely to be greatest for these regions in Australia. Tropical and subtropical islands have proven particularly susceptible to ant invasions and this is borne out by impacts associated with tramp ant invasions on Australian islands, including Christmas Island (O'Dowd et al. 2003), the Tiwi Islands in the Northern Territory (Hoffmann 2004a) and islands of the Great Barrier Reef World Heritage Area (Smith *et al.* 2003, Hoffmann *et al.* 2004).

3.4 Impacts

Without accurate estimates of the true impacts of invasive tramp ant species it is difficult for governments to justify expenditure of public funds on their management. Yet, the impacts of most tramp ant species, especially in an Australian context, are poorly explored and understood. A few tramp ants, such as the pharaoh ant *(Monomorium pharaonis),* are mostly restricted to dwellings and do not frequently establish in undisturbed habitats. Most tramp ants are associated with at least some human-related disturbance, but some including BHA, YCA, and LFA are able to invade undisturbed natural communities (Holway *et al.* 2002, O'Dowd *et al*. 2003). At least six of these species, hereafter referred to as key tramp species, have significant impacts on biodiversity and ecological communities around the globe (**Table 2**).

The severity of direct and indirect environmental impacts is vividly illustrated by the YCA invasion of rainforest on Christmas Island (Indian Ocean), an external territory of Australia (O'Dowd *et al.* 2003). Formation of 'supercolonies' by this unicolonial ant in island rainforest has resulted in the local elimination of the red crab, the dominant endemic consumer of leaf litter, seeds, and seedlings on the forest floor. In the absence of the native crab, seedling recruitment is deregulated and leaf litter accumulates. Simultaneously, establishment of mutualism between the YCA and introduced scale insects amplifies and diversifies impacts, leading to forest canopy dieback and high mortality of some species of trees. These complex direct and indirect effects extend widely through the food web and lead to 'invasional meltdown', a state of rapid change in the rainforest community, and threaten listed species.

While environmental effects of tramp ants can be significant, most of these ants have multi-sectoral impacts. This is best illustrated by the range of impacts that RIFA has on different sectors, affecting not only the environment, but forestry, agriculture, tourism, social amenity, government infrastructure, and human health (**Table 3**). Integrated environmental, economic, and social costs of invasive tramp ants have not been quantified and are rarely estimated. However, the potential economic cost of RIFA in Australia, if it remained unchecked, has been predicted to be $8.9 billion over 30 years (Kompas and Che 2001). In Texas, RIFA is estimated to now cost $US1.2 billion per year (Lard *et al.* 2001). Extrapolating this figure to the RIFA distribution across the United States, damage and control costs have been estimated to be more than $US6.5 billion per year. It has been estimated that invasive tramp ants cost Indigenous communities in the Top End of the Northern Territory over $1 million annually (Hoffmann 2004a).

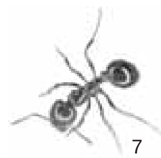


4. Evaluating current management of the threat

4.1 Prevention of entry and spread

Prevention can occur offshore in high-risk source areas (ie pre-border), onshore at potential entry points (the barrier), or just after arrival in new areas (post-border). Controls in each of these situations depend on effective surveillance and monitoring systems for early detection, rapid and accurate diagnostics, and efficient data retrieval systems.

- *Pre-border surveillance systems and inspection.* Offshore surveillance allows potential risks to be identified and risk mitigation strategies to be developed in advance. Prevention and detection of tramp ant incursions could be facilitated through regional cooperation (eg integration into the Northern Australia Quarantine Strategy, partnership in the developing Pacific Ant Prevention Plan, and the Cooperative Initiative on Invasive Species on Islands). Pre-border inspection and treatment of high-risk cargo pathways and commodities can help minimise entry of tramp ant species. However, pre-border checks for invasive ants are not yet required nor are high-risk commodities treated pre-emptively at their origin to assure elimination of tramp ants. Whilst no specific surveillance, inspections, or treatments are currently made for tramp ants before cargoes reach the Australian border, general Australian Quarantine and Inspection Service (AQIS) offshore inspection procedures target contaminants, including ants, and mitigation is required if any quarantine risks are detected during these inspections.
- *Border quarantine measures.* The present system of detecting tramp ants at the border relies on external inspection of all cargo, and specific cargo is targeted for more detailed inspection based on known pathway associations. External inspection will detect a proportion of ant contamination, and relies on the presence of actively foraging ants on the container exterior. Species-specific surveys that target some exotic pests of economic importance are conducted around ports (airports and seaports) that receive imported cargo. Effective border measures also rely on stakeholder and public awareness programs and *ad hoc* reporting, meaning that success also depends on effective community engagement. As part of the RIFA National Eradication Program, a national surveillance program for this ant has been implemented, focusing on active surveillance of high-risk sites such as ports. This monitoring is likely to facilitate detection of other tramp ant species, given sufficient diagnostic capacity. Nevertheless, it will be necessary to conduct further surveys for other tramp ant species.
- *Post-border monitoring and surveillance.* National post-border monitoring programs exist for identified target pests, such as the Asian gypsy moth *(Lymantria dispar)* and fruitflies (eg *Bactrocera papaya)*. However, shortfalls in current surveillance mechanisms for tramp ants are illustrated by chance discoveries of incursions, such as by members of the public. Since the development of the RIFA National Eradication Program, surveillance has been conducted by state and territory governments in high-risk areas (eg freight terminals, nurseries) where RIFA-contaminated materials could arrive from south-eastern Queensland. Otherwise, no



routine monitoring or surveillance for tramp ants appears to be undertaken in other areas of high-risk or value (eg conservation areas). Invasive alien tramp ant species can also be translocated from one part of Australia into new areas, eg in soil, potted plants, and on machinery. Since these pathways do not involve an international border, they can be more difficult to monitor and regulate.

- *Diagnostics and other data.* Rapid and accurate identification of pest species is critical to response. Services for identifying invasive ants in Australia are provided by a combination of government laboratories (State laboratories, the Commonwealth Scientific and Industrial Research Organisation, and universities). However, diagnostic accuracy for ants, as revealed in the Pest and Disease Information System database (1986–2003), appears low. Twenty-five per cent of over 6700 recorded ant interceptions were recorded to species level. Currently, no web-based diagnostic database is available for the rapid identification of pest ant species in Australia. Furthermore, training in taxonomy has declined in recent years, potentially compromising national capacity in ant diagnostics. Data (eg numbers of individuals at each life stage, position of nests on commodities or within containers) additional to species identification can aid development of measures to prevent entry and assess risk profiles (see Section 4.2 below) by indicating relative propagule pressure and, to some degree, likely establishment events.

4.2 Preparedness for response

Preparedness involves advance work and readiness for response to tramp ants (Cole 2003). Many tramp ant species are intercepted repeatedly at the Australian border, showing that new incursions could occur. Furthermore, several tramp ant species are already well established in Australia (**Table 1**), which can lead to new detections in high-value sites.

- *Risk assessment for species and pathways.* Effective border protection involves assessing risks of introduction of high-risk taxonomic groups (eg through the AQIS Weed Risk Assessment process), specific exotic species or commodities (through Biosecurity Australia's Import Risk Analysis and the EPBC Act process for assessing the risk of importing live species). These assessments address risks to human, animal, and plant health and to biodiversity, and the interaction between Biosecurity Australia and the Department of the Environment and Heritage is formalised in a memorandum of understanding. The threat of tramp ant species being a contaminating pest (or 'hitchhiker') of commodities is considered in Import Risk Analysis processes and such species are also considered for inclusion in 'pre-clearance' pest lists. Further risk assessments of pathways and vectors of invasive ants would enable current border and pre-border policy and procedures to be evaluated, and help the management of quarantine to allocate resources to high-risk areas. Information (eg impact and control costs) to inform risk assessments is often unavailable. The Ministry of Agriculture and Forestry New Zealand has produced formal risk assessments for identifying and setting priorities for tramp ant species (Harris *et al.* 2005). The Ministry has also conducted an Import Risk Analysis for ants on sawn timber imported from the South Pacific region (Ormsby 2003).
- *Contingency planning.* Contingency planning provides a basis for rapid response measures as soon as an incursion is detected. A contingency plan incorporates a summary of stakeholders and experts. It outlines pest risks, mitigation strategies, surveillance and diagnostic strategies, costs and availability of control measures, defined roles and responsibilities for action and follow-up, and activities for public awareness and engagement. It also involves making arrangements in advance that enable response measures to be taken, such as securing

financial and technical resources and making cooperative agreements with government and non-government stakeholders. Highly specific plans may increase the efficiency of the management operation, but flexibility is needed for the context of each incursion response. For tramp ants, no set of contingency plans currently exists, in any context. Action plans have only been prepared after the discovery of incursions. Detailed specific action plans, if written and archived, can provide a rich source of information for development of contingency plans. Existing action plans should be collected and stored.

- *Public awareness and engagement.* The successful prevention of invasive species' entry depends on public understanding and engagement. The public awareness program following the discovery of RIFA in Brisbane is a model for community engagement at all stages of response. This awareness and education campaign generated public support for the program, effective passive surveillance, and increased awareness of high-risk materials and processes associated with RIFA. Through this national awareness campaign, RIFA has become an 'icon species' for the threat of biological invasions in Australia. More modest public awareness campaigns have facilitated positive community attitudes towards and participation in tramp ant control programs on Christmas Island and in the Northern Territory (eg Hoffmann 2004b).

4.3 A generic response framework

A generic response framework to control tramp ants can be used to outline responses to both new incursions and known populations of established tramp ant species. Response can be divided into four phases: (i) the trigger, initiated by detection and diagnosis of the ant species followed by notification of stakeholders, and then followed by interim management (eg containment); (ii) the scoping phase, where the scale and intensity of the problem is determined and decisions are made on the nature, costs, and timeframe of the response; (iii) the operational phase where action – eradication of the ant or mitigation of its impact – is taken; and (iv) follow-up surveillance, monitoring, and a decision to stand down (or, if needed, additional action) (**Figure 1**).

All of these can be used in response to new incursions of tramp ant species, whereas it is more likely that the latter two phases (scoping and response) can be employed in managing known established tramp ant species. It is important to draw this distinction in management activities and to note that the starting point in any management strategy will depend on the nature and extent of any tramp ant population, as species occur at a variety of stages of the invasion process. Some species are in pathways only (eg LFA), others are in the early stages of establishment (eg TFA, YCA), while others have much more established and consolidated distributions (eg AA).

4.3.1 'Trigger' phase

- *Detection, diagnosis, and data management.* As indicated previously (Section 3.1), early detection and authoritative identification of invasive ants are critical to the success of future management. As exemplified by the Fire Ant Information System, efficient data storage and retrieval systems are needed to document, track, and evaluate responses to tramp ant incursions.
- *Notification and communication with stakeholders.* Rapid notification of stakeholders is vital for a coordinated and efficient response to invasive tramp ants. Immediate communication with stakeholders establishes a clear understanding of roles and responsibilities. Roles and responsibilities should be set out in contingency plans prior to detection (ie there should be pre-arranged agreement among stakeholders).
- *Interim management response*. Containment and movement controls may be the initial, interim management response to a tramp ant incursion. Effectiveness depends upon monitoring spread at the margins of the

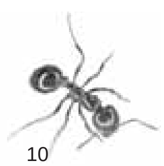
incursion and restricting movement of high-risk materials from the incursion zone. By restricting further spread of invasive ants, these interim measures can give ‘breathing space’ to assess the extent and impact of the invasion and to develop appropriate methods of eradication or control.

4.3.2 Scoping phase

- *Evaluation and decision on response options.* It is necessary to evaluate the likelihood of success, cost effectiveness, and any potential detrimental impacts for the range of possible management responses to a tramp ant incursion. While eradication of invasive ants remains the ideal of any response program, it is not feasible under all circumstances (eg widespread infestation, insufficient resources, absence of suitable treatment and delivery options, inability to contain infestation). Strategies that reduce ant densities to mitigate impacts may be the only feasible option.
- *Rapid assessment of geographical extent.* Calculating the area covered by the invasion is critical to decisions on the feasibility and nature of the management response. Mapping boundaries with visual searches and attractant baits can establish the area covered and population size. Geographical positioning and information systems allow efficient visualisation and evaluation of records.
- *Availability and delivery of treatment.* Availability of treatment is critical to any rapid incursion response to invasive ants. Nevertheless, there is a lack of rigorous testing of toxins and baits against the full range of invasive tramp ant species (Stanley 2004). Three main approaches have been used to control invasive tramp ants: chemical, biological, and cultural control. Chemical control, using toxicants or insect growth regulators, is by far the main management tool (and usually the only available tool) for invasive tramp ants. Bait formulations with attractants usually provide greater specificity for target ant species. Effective and appropriate systems for delivering bait (eg hand or aerial broadcasting) are also essential. Registration of chemical formulations can be a lengthy process. All of these issues can be incorporated into contingency plans. Classical biological control, involving the importation and introduction of host-specific natural enemies from the native habitat of the ant to reduce its abundance and impact, has not been applied widely to invasive ants. There are no examples of successful reduction in density and impact of any invasive ant following release of a control agent (Gilbert 2002). Cultural control involves manipulating habitat so as to reduce the densities and impacts of invasive ants. For example, use of fire in undeveloped areas may be one effective control method but has not yet been tried.
- *Environmental assessment of response.* Environmental assessment of operational response to invasive tramp ants, including the full range of potential impacts (eg on flora and fauna, social and cultural values, and human health) is an essential component of any program. The potential for non-target impacts of chemical control on native biodiversity will be especially great in many high-value conservation sites. These non-target impacts could prevent any action at all, or require extreme measures to allow treatment to proceed.

4.3.3 Operational response phase

Ant control programs, ranging from eradication to mitigation/control, are conducted under a wide range of circumstances across Australia and its territories, and in the region (**Table 4**). A range of key tramp ant species have been targets, including RIFA, YCA, BHA, AA, and TFA, so knowledge is rapidly accumulating. Most programs have focused on urban and periurban areas while a few others have targeted high-value conservation sites. The areas managed in these programs range from just 11 ha for an AA infestation on Tiritiri Matangi in New Zealand to more than 50 000 ha for the RIFA National Eradication Program in Brisbane.



Cost estimates vary accordingly, from $NZ15 000 to $AU175 million. Consequently, the tactics and strategies for management, even if the goals are similar (ie eradication), can differ markedly.

- *Eradication.* Eradication is the ideal goal of any management response. It involves the complete removal of all individuals of the population down to the last potentially reproducing individual (or the reduction of their population below sustainable levels). Attempts have been many, but cases of successful eradication of invasive tramp ants are rare. In any attempt at eradication, at least six criteria must be met (Myers *et al.* 2000):
  - *Sufficient resources.* Funds must be made available until the conclusion of the program.
  - *Authority.* Lines of authority must be clear and must allow individuals or agencies to take the necessary actions.
  - *Attributes of the tramp ant.* Its biology must make it susceptible to control.
  - *Prevention of reinvasion.* Eradication will only be temporary if the influx of individuals continues.
  - *Detectability at low densities.* It is essential that the tramp ant be detectable at low densities for early eradication from new and reinvaded areas before it becomes widespread.
  - *Public support and engagement.* Public support is critical as indicated by the response of the community to the public awareness campaign in the RIFA eradication program.

Two eradication programs in Australia, for RIFA in suburban Brisbane and BHA in the World Heritage listed Kakadu National Park (Vanderwoude *et al.* 2003, Hoffmann and O'Connor 2004), meet these criteria. Although eradication is often viewed as unachievable over large areas, both programs, under very different circumstances, point towards success.

- *Mitigation/control.* When eradication is judged not feasible, tramp ant populations can be contained and suppressed. Mitigation/control involves the suppression of invasive tramp ants by reducing population size and limiting spread to reduce impact below an ecological or economic threshold (eg Green *et al.* 2004). Since control is not absolute, repeated actions are usually needed to keep ant densities low after initial suppression. Long-term chemical control programs, in the absence of alternative measures, may be acceptable only if benefits continue to outweigh costs of control. Consequently, it is important to evaluate any alternative management strategies, especially those that might offer a sustainable means of control and that can complement and decrease dependency on recurrent chemical control. Potential research and development options for control could include (i) genetic manipulation to increase genetic diversity and breakdown unicoloniality; (ii) classical biological control; and (iii) indirect biocontrol of tramp ant species through classical biological control of their Homopteran mutualists (O'Dowd and Green 2004).
- *Monitoring and follow up.* Progress must be monitored to ensure that objectives (eradication or mitigation/control) are being met. Well-designed monitoring surveys and surveillance can be used at regular intervals to evaluate success of treatment and ensure prompt response to re-invasion of treated areas. Standard protocols could be developed and included in contingency plans. Evaluations of treatment effectiveness can be used to adapt management to changing circumstances.
- *Recovery plans for threatened species or ecological communities.* Apart from activities directed at the target tramp ant species, other actions to abate threats need to be considered, where appropriate. Where tramp ants are a direct threat to listed threatened species or indirectly threaten their habitats, recovery actions could include ex situ conservation of threatened species, and quarantine and hygiene arrangements to prevent the establishment of new infestations in listed threatened ecological communities or habitats with listed threatened species. Listed species known to be threatened or species and ecological communities that could be threatened by either RIFA or YCA in Australia or its territories are at Chapter 9.

5. Developing a national and regional approach to management

5.1 Coordination and cooperation in a national approach

The effective management of threats to biodiversity from invasive tramp ants poses a challenge to Australia. It requires leadership, coordination, and cooperation to reach an agreed national approach across all tiers of government, other stakeholders, and the community.

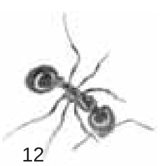
- *Issues within Australia and its States and Territories.* Tramp ants pose several challenges for current arrangements within the Australian Government, between the Australian Government and state and territory governments, and within state and territory jurisdictions. As tramp ants have impacts across a range of sectors, clearly defined responsibilities for their management are required for an effective response. As response frameworks for invasive species have developed primarily in the context of plant and animal health, the question of who is responsible can arise when tramp ant incursions occur in an environmental context, and can lead to delays in response. Many tramp ant species (eg YCA, RIFA, BHA) are both agricultural and environmental pests requiring clear designation of responsibilities to enable effective response measures.

  In some situations, overlap in responsibilities between agencies poses a managerial challenge and can result in delays to an effective response.

  Jurisdictional responsibility at various stages in the invasion process requires clear delineation (eg between state and territory governments and the Australian Government). For example, the delineation between a barrier breach (a response to which is an Australian Government responsibility) and post-barrier management (a state or territory government responsibility) requires each jurisdiction to have a clear understanding of its responsibilities in order to avoid any potential delays in responding.

  Cost arrangements also differ markedly for those incursions considered a threat to primary industry or to the environment. For incursions that threaten plant and animal health and are deemed eradicable (eg RIFA in Brisbane), cost-sharing arrangements between states and territories and the Australian Government can be initiated. Similar formalised arrangements, however, do not currently exist for those species considered as primarily environmental threats (eg YCA).

- *Strategic challenges.* To be effective, a national framework for the management of invasive alien tramp ants needs to address four strategic challenges. It must:
  1. integrate biodiversity/environmental considerations with economic and social factors in decision-making
  2. enhance coordination and cooperation within sectors and between tiers of government to respond more rapidly and effectively to tramp ant invasions and the pathways of their invasion
  3. increase capacity in areas critical to the management of invasive alien tramp ant species
  4. incorporate a broader, regional perspective to management of invasive alien tramp ants.



Several response frameworks have evolved at the state and territory, and national levels, and in the region to coordinate management and funding arrangements for invasive alien species with multi-sectoral impacts (**Box 5**). These frameworks can serve as models to resolve, in advance, the coordination and funding issues (eg cost sharing) for tramp ant management and meet the strategic challenges outlined above. A framework for tramp ant management could be developed either within existing legislation and policy or as part of broader biosecurity measures.

Many of the response frameworks and much of the skill base required to manage tramp ants have developed in the protection of primary industries. So, it is essential to integrate, adapt, and apply this technical and policy experience to effectively mitigate the impacts of tramp ants in an environmental context.

Development of an effective framework is a key purpose of the threat abatement plan. In the interim, other measures will be necessary. These measures could include memoranda of understanding between government agencies and among stakeholders to establish agreed roles, responsibilities, and cost-sharing arrangements to manage tramp ants.

5.2 Coordination and cooperation within australia's region

A national approach to tramp ant management in Australia would be strengthened with an effective extra-territorial, regional framework. Because invasive tramp ants are found in a variety of transport pathways and commodities, and originate from many countries (**Box 3**), cooperation and capacity building is important in the region to manage risk and prevent entry into Australia.

Development of agreements and participation in bilateral and regional partnerships, eg the National Invasive Ant Programme in New Zealand and the Pacific Ant Prevention Plan (**Box 5**), can minimise duplication, decrease costs, and expedite actions to achieve more effective management of tramp ants in Australia and the region.

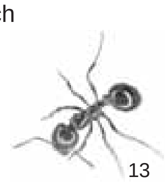
Bilateral and regional cooperation and coordination could include:

- agreements to share information and expertise
- mechanisms for cooperation and cost-sharing to build capacity and provide training within the region, so as to mitigate risks at their source (ie offshore) and minimise the transferral of tramp ants to Australia and its territories
- agreements to collaborate in research and development
- consultation and assistance in rapid responses to tramp ant in the region
- fostering awareness through sharing lessons learned in preventing and dealing with invasive tramp ants.

5.3 Roles and responsibilities

For a national approach to be most effective, responsibility for managing statutory and strategic arrangements should be clearly allocated. For multi-sectoral pests like tramp ants, responsibility is also likely to be shared among different government sectors (at the Australian Government, state and territory government, and local government levels) and other stakeholders. It is necessary to:

- have a clear definition of the different roles and responsibilities of each stakeholder in relation to tramp ant management
- ensure an effective way of reducing competition for funding and/or responsibilities and resolving conflicts of interest between stakeholders
- make formal arrangements, in advance, through incorporation in contingency plans, to coordinate management activities at each stage of the invasion process.



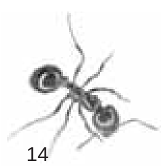
5.4 Stakeholder participation

All stakeholders should be identified and involved in planning for tramp ant management. Each must be consulted about the goals of the threat abatement plan and the actions needed to reach these goals. Consultation should be open and any questions and concerns raised by the stakeholders addressed to resolve any conflicts of interest. Key stakeholders in tramp ant management include:

- *The public.* More than any other group of stakeholders, the public can influence the outcome of invasive species management at every stage in the invasion sequence. Their awareness, engagement, and participation shape the success or failure of tramp ant management. The public is the primary agent of passive surveillance for tramp ants, reporting incursions, and through outreach, participates in tramp ant management. The public is also a primary benefactor of successful management.
- *Local government.* Local government has a range of functions, powers and responsibilities – as land managers and as land use planners – that influence tramp ant management on both private and public lands. These include the power to place statutory controls on freehold land and to implement risk control measures. Local government is a primary advocate for and coordinator of local community groups and interests. In these contexts, local government has a key role in translating the policies of Australian Government and state and territory governments into on-ground actions (Australian Local Government Association 2005).
- *Indigenous management groups*. Invasive alien tramp ant species can threaten the natural and cultural values of Indigenous peoples. Indigenous management groups play a significant role in detection, rapid response, and management of invasive alien tramp ant species on Indigenous-owned lands. Traditional ecological knowledge will contribute to detection and management of invasive tramp ant species in these and other areas.
- *Academic and government scientists.* The primary source of innovation in invasive species management comes from the integration of science and management. Science is a critical component of any coordinated response to invasive tramp ants, so it is critical that scientists are consulted and integrated into a national approach to tramp ant management. This should include consultation with universities, the CSIRO, cooperative research centres, and state and territory government research institutes to foster technical innovation and solutions to the tramp ant problem.
- *Industry.* Industry plays a key role in invasive species management in at least two ways. First, industry, through trade and commerce, is the primary human agency for movement of tramp ant species. Second, through the development and provision of technologies and services for the control and management of pest species, industry is a key stakeholder in invasive tramp ant management. In both roles, industry needs to be consulted and integrated into a national approach to tramp ant management.
- *Non-government organisations.* Non-government organisations have an important role in effective development, implementation and planning of invasive species management, both as partners with government and as independent advocates. They have been especially effective in mobilising public opinion to influence government decision-making. As such, they need to be consulted and their views integrated into a national approach to tramp ant management.

5.5 Building stewardship

Stewardship recognises the shared responsibilities of governments and stakeholders, as well as the benefits of partnerships and collective action. It can be facilitated through community and stakeholder awareness, education, and outreach.



- *Community and stakeholder awareness.* Long-term awareness building may make a larger contribution to tramp ant management than any other single activity. Increasing the awareness of the public and stakeholders is a crucial strategic objective for successful tramp ant management. Awareness promotes more careful practices that can encourage detections, prevent incursions, and deter spread. By facilitating greater understanding of the scope of invasive tramp ant impacts, awareness building leads to greater engagement, cooperation and innovation among stakeholders in managing tramp ants. Central to this is the need to provide accurate and timely information on invasive tramp ants to the public and other stakeholders in accessible and readily available forms.

  Campaigns to generate awareness should be strategic and systematic, using well-tested techniques. Focused efforts must be complemented by broader outreach efforts, including the development of educational curricula, which raise awareness of the need to prevent future introductions and manage established populations of invasive tramp ant species. For example, the public and stakeholder awareness campaign built around the RIFA National Eradication Program has generated public and stakeholder consciousness to create an 'iconic' invasive species. RIFA now acts as an 'umbrella' species, increasing awareness of other key tramp ant species – and invasive alien species in general – in Australia and the region.
- *Community education and outreach.* Targeted national education initiatives are essential for responding to tramp ant invasions. Education and outreach initiatives can facilitate on-the-ground action through programs that involve communities directly in the management of invasive tramp ants. A key illustration is the partnership between Indigenous management groups and other natural resource managers in the control of invasive tramp ants in the Northern Territory (Hoffmann 2004).

5.6 Setting priorities

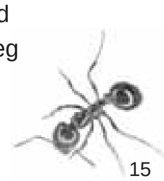
Priority setting is critical for the development and implementation of a national approach to the management of invasive alien tramp ants. An agreed mechanism needs to be established so that resources are allocated in such a way as to ensure the best outcome for the protection of Australia's biodiversity from invasive tramp ants.

To begin to set priorities, careful consideration must be given to identifying (i) a national priority list of tramp ant species; (ii) high-risk pathways, vectors, and commodities, both into and within Australia; and (iii) regions and habitats most at risk.

Criteria should include (i) risk analysis that sets priorities for tramp ant species, pathways, and regional and habitat susceptibility to invasion; (ii) the availability of effective surveillance, control, and monitoring measures; and (iii) the cost-benefit of the proposed management measures. Those tramp ant species, pathways, and susceptible high-value habitats that present unacceptable risks would receive higher priority in the allocation of resources.

- *National priority species.* Although most tramp ants have caused or are likely to cause impacts, some species have the potential for greater impacts than others. At least six key tramp ant species are of national priority for their impact or potential impact on Australian biodiversity (**Box 1, Table 2**). They are:
  - red imported fire ant (*Solenopsis invicta* – RIFA)
  - yellow crazy ant (*Anoplolepis gracilipes* – YCA)
  - African big-headed ant (*Pheidole megacephala* – BHA)
  - Argentine ant (*Linepithema humile* – AA)
  - little fire ant (*Wasmannia auropunctata* – LFA)
  - tropical fire ant (*Solenopsis geminata* – TFA).

  Because all of these species are of concern worldwide (ISSG 2004a), their biologies and impacts are increasingly well understood (eg



Holway *et al.* 2002) and all have been targets of control or eradication campaigns, either in Australia or elsewhere (**Table 4**). Quantitative risk assessment, as has been applied in New Zealand for a full range of tramp ants (Harris *et al.* 2005), would provide an objective basis for setting national priorities for these and other tramp ant species in Australia and could incorporate weightings for affected sectors (eg environmental or agricultural), as is done in weed risk assessment systems (Pheloung 2001). While these six species would constitute an initial priority list, other species may emerge (eg the European garden ant *(Lasius neglectus)* which is now spreading across western Europe but has not yet been intercepted at the Australian border) or their priority rankings could shift (eg if LFA became established in Australia). Any list must remain open to regular review and amendment by scientists, managers, and other stakeholders.

A secondary priority list ('species of concern') could comprise those species deemed of lesser impact or potential impact (ie the remaining six species in **Table 1**), and those which may be emerging as invasive species elsewhere (eg *Pheidole obscurithorax* in the southern United States – Storz and Tschinel 2004).

- *Priority pathways, vectors, and commodities.* The National Pest and Disease Information database and other databases can be used to trace back interceptions to quantitatively assess source ports, pathways, vectors, and commodities with which intercepted tramp ants were associated (**Box 3**). These retrospective analyses, when linked with trade volumes from and into particular ports (see Harris *et al.* 2005 for New Zealand examples), can be used to identify high-risk ports, pathways, vectors, and commodities. This information can be incorporated into priority setting.
- *Priorities for regions and habitats.* Without a fuller understanding of the biology, physiological tolerances and dispersal of key tramp ant species it is difficult to forecast regions and habitats most at threat. Since all of these species, except AA, have native and introduced distributions primarily in the tropics and subtropics, it is likely that their combined potential impacts are greatest in those regions of Australia with a similar climate (ie northern Western Australia, the Top End of the Northern Territory, north Queensland, central and south coastal Queensland, and northern coastal New South Wales). This is supported by climatic modeling (**Box 4**). Islands, with high levels of species restricted to a particular island, are the ecosystems most frequently affected by invasive tramp ants; these high-value sites are at high risk from tramp ant impacts and merit high priority.

  Habitat associations of the broad spectrum of tramp ants are even less clear. However, many of these tramp ant species are associated with open and relatively disturbed habitats. Habitat models, using satellite imagery to predict preferred habitats and likely patterns of spread for RIFA, have been developed to guide and target surveillance activities in the RIFA eradication program (George 2004; see Harris *et al.* 2002 for a different approach for AA in New Zealand). Nevertheless, much research is necessary to assess the actual, or predict the potential, habitat associations of key tramp ant species in Australia.
- *Priorities for filling knowledge gaps.* Knowledge gaps, identified in Sections 2 and 3, occur across all stages in the invasion sequence for tramp ants, and need to be filled. Priorities can be set by determining whether the information gained is likely to make an important contribution to decreasing transition probabilities of tramp ants at any stage of the invasion process, set against the cost effectiveness of gaining the information and the availability of funding.
- *Priorities for actions.* In a biodiversity context, priorities for action would be based on the risks that specific tramp ant species pose to threatened species and ecological communities, or other high-value species and communities, or on other criteria that

define high-value conservation sites. In many instances, however, these criteria would need to be integrated with others evaluating risks to the economy, social and cultural values, and human health. To effectively set priorities, a broad, integrated assessment of the environmental, economic, and social costs of tramp ant invasions is needed.

Priority actions must be practical, realistic and achievable. Resources must be available for the foreseeable duration of the proposed action. Furthermore, priorities will differ in their respective requirements for short-term or ongoing funding. While some prevention activities that require legislative and regulatory changes may require ongoing funding for implementation, many management measures may achieve their intended results within a five-year period or less (see examples of eradication in **Table 4**).

Priorities can be set by determining whether the action is likely to make an important contribution in decreasing transition probabilities of tramp ants at any stage of the invasion process. Since 'an ounce of prevention is worth a pound of control' (Leung *et al.* 2002), actions that target pathways carrying a variety of tramp ant species may be especially cost effective in reducing introduction pressure. Nevertheless, actions to improve capacity to eradicate incursions or control established populations of specific tramp ants of unacceptable risk are critical.

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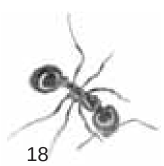

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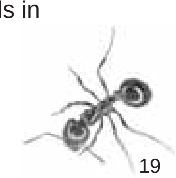

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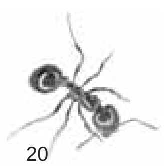

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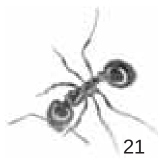


7. Glossary and abbreviations

Tramp ant species

AA	Argentine ant *Linepithema humile*
BHA	African big-headed ant *Pheidole megacephala*
LFA	Little fire ant *Wasmannia auropunctata*
RIFA	Red imported fire ant *Solenopsis invicta*
TFA	Tropical fire ant *Solenopsis geminata*
YCA	Yellow crazy ant *Anoplolepis gracilipes*

Adaptive management A systematic process for continually improving management policies and practices for tramp ants by learning from the outcomes of operational programs.

AQIS Australian Quarantine and Inspection Service

Barrier breach Escape of an alien species beyond barrier controls but prior to its establishment.

Commodity A type of organism, product, or other article being moved for trade or other purpose that could harbour tramp ants.

Containment Application of measures in and around an infested area to prevent spread of an invasive tramp ant beyond a defined area.

Contingency plan A carefully considered outline of the action that should be taken upon the suspected detection of an incursion of an unwanted alien species. Contingency plans are prescriptive in relation to matters such as communication, management, diagnosis, survey, and quarantine.

Control Suppression of population of the invasive species below an acceptable threshold of environmental or economic impact.

CSIRO Commonwealth Scientific and Industrial Research Organisation

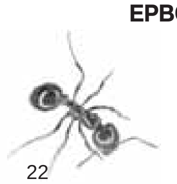
DAFF Australian Government Department of Agriculture, Fisheries and Forestry

DEH Australian Government Department of the Environment and Heritage

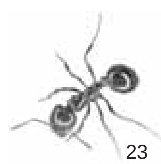
Ecological community As defined in and listed under the EPBC Act, an assemblage of native species that: (a) inhabits a particular area in nature; and (b) meets the additional criteria specified in the regulations (if any) made for the purposes of this definition.

Endangered species As defined in and listed under the EPBC Act, a native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

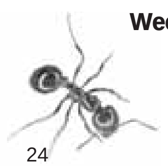
EPBC Act *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth legislation)



Eradication	Application of measures to eliminate an invasive alien species from a defined area.
High-value sites	Areas of high biodiversity value such as those reserved for conservation, habitats of threatened species, and areas that are free of invasive tramp ant species.
IGR	Insect growth regulator that control tramp ants by disrupting reproduction and development.
Incursion stage	Period following the arrival of an alien species in a new environment but prior to the point when it becomes established.
Introduction pressure	The intensity (number of individuals) and frequency (number of introductions per unit time) of introduction of a species.
Invasive alien species	A species transported outside its area of origin that threatens species, habitats or ecosystems or proliferates and spreads in ways that are destructive to the environment, the economy, and society.
IPMC	Inter-agency Pest Management Committee (Queensland)
ISSG	Invasive Species Specialist Group of the World Conservation Union (IUCN)
KTP	Key threatening process
MAF	Ministry of Agriculture and Forestry (New Zealand)
Movement controls	Regulations or activities to prevent human-assisted movement of high-risk materials associated with tramp ants from inside a containment area to outside the area.
NAQS	Northern Australia Quarantine Strategy
NGO	Non-government organisation
PAPP	Pacific Ant Prevention Plan
Pathway	The routes by which species move from one locale to another, either within a country or between countries.
PDI	Pest and Disease Information database
Periurban	Low density housing and road development on the periphery of urban areas, still retaining small areas of rural land within networks of suburban building.
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment.
Regional management plan	A strategic document that details species and ecological communities that are currently under threat or potentially under threat and the areas and high-level actions required to manage those threats.
Region (Australia's)	Countries and states closely associated with Australia in the South Pacific, South-east Asia, and Eastern Indian Ocean.
Risk analysis	A systematic approach to decision making regarding alien species through risk identification, assessment, management, and communication.
Risk assessment	The evaluation of the probability of the introduction and spread of a pest and of its associated potential impacts.



Significance	Twenty species form the Weeds of National Significance. Species that made the list were nationally prioritised on a detailed analysis of their level of invasiveness, current impact, potential for spread and socioeconomic and environmental aspects.
Stakeholder	Any person or organisation who will be affected, or thinks they will be affected, positively or negatively by a given management response. This may include landowners, local communities, government agencies with jurisdiction over the managed area, the public, relevant non-governmental agencies, and special interest groups. The latter two groups may represent a range of interests such as environmental and biodiversity protection, heritage conservation, or a particular industry.
Stewardship	The careful and responsible management of something entrusted to one's care.
Supercolony	Extended areas, sometimes spreading over tens of square metres to thousands of square kilometres, of interconnected populations of unicolonial tramp ants.
TAP	Threat abatement plan
The Department	Australian Government Department of the Environment and Heritage
The team	The National Implementation Team for the Threat Abatement Plan.
Threatened ecological communities	Refers to the Australian Government list of threatened ecological communities divided into the following categories as per the EPBC Act: critically endangered; endangered; vulnerable.
Threatened species	Refers to the Australian Government list of threatened native species divided into the following categories as per the EPBC Act: critically endangered; endangered; vulnerable; conservation dependent.
Toxins	Metabolic and nerve poisons used to kill targeted pest species.
Tramp ants	A diverse group of ant species originating from many regions that are readily moved across the world through a variety of transport pathways. They share genetic, behavioural, and ecological attributes that increase their probability of entry, establishment and spread, ecological dominance, and high impact in areas of introduction.
Transition probabilities	The probability of a species successfully moving from one stage to another in the invasion sequence.
TSSC	Threatened Species Scientific Committee
Unicoloniality	The free movement of ants of the same species between nests that is highlighted by a lack of intra-species aggression and low genetic diversity.
Vector	The means by which species from a source population follows a pathway to a new destination.
Vulnerable species	As defined in and listed under the EPBC Act, a native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Weeds of National WONS	Weeds of National Significance



8. Acknowledgements

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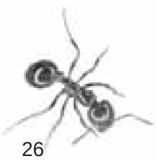
9. Tables, boxed inserts, appendices

Table 1. Twelve tramp ant species, eleven of which are already recorded in Australia

Highly invasive species occur in each of the three most species-rich subfamilies. Six species, in **bold**, are considered in more detail in the threat abatement plan. For conciseness, codes (AA, YCA, etc) are used throughout this background document. General status refers to the distribution of the ant in Australia (not present, localised incursion(s), or widely established), which affects the nature and priority of the management response.

* = species recorded in Australia.

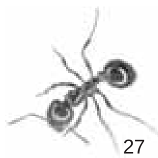
Species	Common name	Code	General status
Dolichoderinae			
Linepithema humile*	**Argentine ant**	**AA**	**Widely established**
*Tapinoma melanocephalum**	Ghost ant	GA	Widely established
*Technomyrmex albipes**	White-footed ant	WFA	Widely established
Formicinae			
Anoplolepis gracilipes*	**Yellow crazy ant**	**YCA**	**Incursions**
Lasius neglectus	European garden ant	EGA	Not present
*Paratrechina longicornis**	Crazy ant	CA	Widely established
Myrmicinae			
*Monomorium destructor**	Singapore ant	SA	Widely established
*M. pharaonis**	Pharoah ant	PA	Widely established
Pheidole megacephala*	**African big-headed ant**	**BHA**	**Widely established**
Solenopsis geminata*	**Tropical fire ant**	**TFA**	**Incursions**
S. invicta*	**Red imported fire ant**	**RIFA**	**Incursions**
Wasmannia auropunctata*	**Little fire ant**	**LFA**	**Incursions**



■ Table 2. Some examples of impacts on species populations, community composition, and ecosystem processes caused by six tramp ant species and some of the mechanisms of impact.

After Harris *et al.* 2005.

Species	Modification	Examples of impact	Probable mechanisms
Solenopsis invicta	Species abundance/ community composition	Ants, other invertebrates, birds, lizards, small mammals, seeds and seedlings, plants	Predation, resource competition, mutualism with Homoptera
	Ecosystem processes	Seed dispersal, decomposition/nutrient cycling	Displacement of mutualists; direct predation, monopolisation of resources
Anoplolepis gracilipes	Species abundance/ community composition	Ants, other invertebrates, lizards, birds, seeds, seedlings, canopy tree species composition	Direct predation, monopolisation of resources, habitat alteration, mutualism with Homoptera,
	Ecosystem processes	Litter decomposition; seed dispersal	Indirect through predation of dominant native litter consumers; displacement of seed dispersal agents
Pheidole megacephala	Species abundance/ community composition	Ants, other invertebrates, plants, sooty moulds	Direct predation, monopolisation of resources, mutualism with Homoptera
	Ecosystem processes		
Linepithema humile	Species abundance/ community composition	Ants, other invertebrates, lizards, plants	Direct predation, monopolisation of resources, mutualism with Homoptera
	Ecosystem processes	Pollination, seed dispersal	Displacement of pollinators and seed dispersal agents
Solenopsis geminata	Species abundance/ community composition	Ants, other invertebrates, seeds, seedlings	Predation, resource competition
	Ecosystem processes		
Wasmannia auropunctata	Species abundance/ Community composition	Ants, other invertebrates, lizards	Predation, resource competition, mutualism
	Ecosystem processes	Decomposition/nutrient cycling	Changing invertebrate community composition



■ Table 3. Illustration of the multi-sectoral impacts of the red imported fire ant *(Solenopsis invicta)*

Relative impact is estimated (■ = minor, ■■ = significant, ■■■ = substantial).
Modified from Davis and Grimm (2003).

Sector	Impact examples	Relative impact level
Environment	Altered biodiversity and degradation of conservation values. Predators, competitors of almost all ground active animals, including insects and other invertebrates, birds, lizards, small mammals; seed and seedling predators, disruption of seed dispersal	■■■
Forestry	Decreased production in open plantations caused by direct attack on seedlings/saplings; indirect effect through culture of sap-sucking Homoptera	■
Social amenity, tourism	Decreased use and enjoyment of amenity areas (eg parks, sports grounds), negative effects on tourism.	■■■
Agricultural industries	Decreased yields through seed predation, direct damage to plants, flowers, and fruits. Indirect effects on production through culture of sap-sucking Homoptera. Attack young farm animals. Mounds interfere with harvesting operations and damage agricultural equipment.	■■
Health	Human health hazard through alkaloid-based venom which causes pustules to develop and can lead to permanent scarring. Anaphylactic shock. High medical costs.	■■■
Government infrastructure	Damage to electrical devices at substations, traffic control signals, electrical motors. Undermine paving and roads	■■■

■ Table 4. Selected control programs for invasive tramp ant incursions in Australia (species, location, management goal, duration, cost and outcome) and New Zealand

(The table illustrates the variety of circumstances in which tramp ant management is conducted.)

Species	Location	Management goal	Duration (yr)	Cost	Outcome
Solenopsis invicta	Brisbane Urban/ agricultural/ woodland	Eradication	6	$175 million	In progress
Anoplolepis gracilipes	Cairns Industrial	Eradication	1	$120 K	In progress
A. gracilipes	Brisbane Commercial	Eradication	1	$40K	Successful
A. gracilipes	Christmas Island (Indian Ocean) Rainforest	Area-wide mitigation of impacts	Ongoing	$1.5 million	Suppression
A. gracilipes	East Arnhem Land NT Woodland	Eradication	3+	$3 million	In progress
Pheidole megacephala/ Solenopsis geminata	Kakadu NP NT Savannah woodland	Eradication	2+	$60K	Successful
Linepithema humile	Perth Urban	Eradication	26+	$15 million	Failure
L. humile	Tiritiri Matangi Is., NZ Native regrowth	Eradication	1+	$NZ15K	In progress

■ Table 5. Threatened species affected by tramp ants

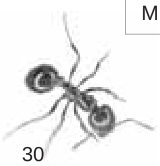
The following species are listed under the *Environment Protection and Biodiversity Conservation Act 1999*. It is considered that they may be adversely affected by the red imported fire ant *(Solenopsis invicta)* or the yellow crazy ant *(Anoplolepis gracilipes)*. No other species listed under the EPBC Act are currently considered at risk from other tramp ant species considered in the plan.

E = Endangered, V = vulnerable, U = unlisted.

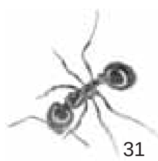
Red imported fire ant *(Solenopsis invicta)*

http://www.deh.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl

Common names	Species	Current status	Distribution
Listed threatened species that may be adversely affected and could become listed at a higher threatened category			
Southern cassowary	*Casuarius casuarius johnsonii*	E	N Qld
Eastern bristlebird	*Dasyornis brachypterus*	E	SE Qld, NSW, Vic.
Star finch (eastern)	*Neochmia ruficauda ruficauda*	E	Qld, NT, WA
Night parrot	*Pezoporus occidentalis*	E	SW Qld, SA
Buff-breasted button-quail	*Turnex olivei*	E	N Qld
Golden-shouldered parrot	*Psephotus chrysopterygius*	E	N Qld
Gouldian finch	*Erythrura trichroa*	E	N Qld, NT, WA
Western whipbird (western heath)	*Psophodes nigrogularis nigrogularis*	E	WA
Western ground parrot	*Pezoporus wallicus flaviventris*	E	WA
Southern emu-wren (Fleurieu Peninsula), Mount Lofty southern emu-wren	*Stipiturus malachurus intermedius*	E	SA
Bathurst copper butterfly	*Paralucia spinifera*	V	S. NSW
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	Qld, NSW
Plains-wanderer	*Pedionomus torquatus*	V	SA, Qld, NSW, Vic
Black-breasted button-quail	*Turnix melanogaster*	V	Qld, NSW
Slender-billed thornbill (western)	*Acanthiza iredalei iredalei*	V	WA
Thick-billed grasswren (eastern)	*Amytornis textilis modestus*	V	NSW, SA, NT
Thick-billed grasswren (Gawler Ranges)	*Amytornis textilis myall*	V	SA
Thick-billed grasswren (western)	*Amytornis textilis textiles*	V	WA
Noisy scrub-bird	*Atrichornis clamosus*	V	WA
Partridge pigeon (western)	*Geophaps smithii blaauwi*	V	WA
Partridge pigeon (eastern)	*Geophaps smithii smithii*	V	NT
Malleefowl	*Lipoid ocelot*	V	WA, SA, NSW, Vic
Western whipbird	*Psophodes nigrogularis*	V	WA, SA, Vic
Southern emu-wren (Eyre Peninsula)	*Stipiturus malachurus parimeda*	V	SA
Mallee emu-wren	*Stipiturus mallee*	V	SA, NSW, Vic



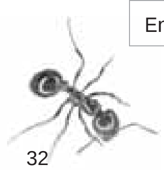
Common names	Taxon	Current status	Distribution
Unlisted species or taxa that could be adversely affected			
Ants	Subfamily Formicidae	U	Widely distributed
Butterflies and moths	Order Lepidoptera	U	Widely distributed
Flightless carabid beetles	Family Carabidae	U	Widely distributed
Land snails	–	U	Widely distributed
Earthworms	–	U	Widely distributed
Trap-door spiders	Family Mygalolomorpha	U	Widely distributed
Quails	Subfamily Phasianinae	U	Widely distributed
Button-quails	Family Turnicidae	U	Widely distributed
Australian brush-turkey, orange-footed scrubfowl	Family Megapodiidae	U	N. Australia and Qld, NSW
Bustards	Family Otididae	U	Widely distributed
Wetland birds (eg grebes; herons, egrets and bitterns; geese, swans and ducks)	Families Podicipedidae, Ardeidae, Anatidae	U	Widely distributed
Waders	Families Jacanidae, Burhinidae, Rostratulidae, Haematopodidae, Charadriidae, Recurvirostridae, Scolopacidae, Phalaropodidae, Glareolidae	U	Widely distributed
Pigeons, doves	Family Columbidae	U	Widely distributed
Ground-nesting seabirds (eg gulls and terns)	Family Laridae	U	Coastal regions



Yellow crazy ant *(Anoplolepis gracilipes)*

http://www.deh.gov.au/biodiversity/threatened/ktp/christmas-island-crazy-ants.html;
http://www.deh.gov.au/biodiversity/threatened/species/e-a-enastri.html

Common names	Species/taxon	Current status	Distribution
Listed species that are adversely affected and could become listed at a higher threatened category			
Christmas Island pipistrelle	*Pipistrellus murrayi*	E	Christmas Island
Christmas Island shrew	*Crocidura attenuate trichura*	E	Christmas Island
Christmas Island gecko	*Lepidodactylus listeri*	V	Christmas Island
Gove crow butterfly	*Euploea alchathoe enastri*	E	NE Arnhemland
Listed species that are adversely affected but for which there is no evidence that their listing status should change			
Abbott's booby	*Papasula abbotti*	E	Christmas Island
Christmas Island goshawk	*Accipter fasciatus natalis*	E	Christmas Island
Christmas Island frigatebird	*Fregata andrewsi*	V	Christmas Island
Christmas Island hawk-owl	*Ninox natalis*	V	Christmas Island
Unlisted species that are adversely affected and could become eligible to be listed as Vulnerable			
Tahitian chestnut	*Inocarpus fagifer*	U	Christmas Island
Christmas Island flying fox	*Pteropus melanotus natalis*	U	Christmas Island
Emerald dove	*Chalcophaps indica natalis*	U	Christmas Island
Christmas Island thrush	*Turdus poliocephalus erythropleurus*	U	Christmas Island
Red land crab	*Gecarcoidea natalis*	U	Christmas Island
Unlisted ecological communities that are adversely affected and could become eligible to be listed as Vulnerable			
Terrace rainforest		U	Christmas Island
Shallow soil rainforest		U	Christmas Island
Limestone scree slopes and terraces		U	Christmas Island
Deeper plateau and terrace soils evergreen forest		U	Christmas Island
Unlisted species or taxa that are adversely affected but for which there is no evidence that they would become listed			
Christmas Island giant gecko	*Cyrtodactylus sadlieri*	U	Christmas Island
Blue-tailed skink	*C. egeriae*	U	Christmas Island
Forest skink	*Emoia nativitatis*	U	Christmas Island
Robber crab	*Birgus latro*	U	Christmas Island
Blue crab	*Cardisoma hirtipes*	U	Christmas Island
Little nipper	*Geograpsus grayi*	U	Christmas Island
Endemic litter invertebrates		U	Christmas Island



Box 1

A selection of six tramp ant species, with well-known impacts, from 12 tramp ant species of concern (Table 1). Five of these ants are included in the 100 of the World's Worst Invasive Species (see http://www.issg.org/ database for more detailed information on each of these ants). Effects of most of these invasive ants are multisectoral, including impacts on biodiversity, primary production, social/cultural values, and human health. Knowledge about their biology, impacts, and control remains very uneven.

Solenopsis invicta, the red imported fire ant (RIFA). The most notorious of invasive ants. Of South American origin, RIFA was accidentally introduced to the United States in the early 20th century. Earlier attempts to control its spread in the United States have been labeled "the Vietnam of American Entomology." Discovered in 2001 in Brisbane, RIFA is now the target of a $175 million eradication program and the KTP that generated the tramp ant TAP.

Anoplolepis gracilipes, the yellow crazy ant (YCA). The origins of YCA are obscure, probably Africa or South Asia. Introduced widely across the tropics, the YCA has severe impacts on native biodiversity on Christmas Island, an external territory of Australia. Multiple breaches and incursions have occurred on the Australian mainland and are the focus of eradication campaigns. Listed as a KTP in 2005.

Pheidole megacephala, the African big-headed ant (BHA). Of African origin, the BHA has been moved widely across the tropics. Also known as the brown coastal ant in Australia, it decreases native invertebrate biodiversity. BHA is the most widely distributed invasive alien ant in Australia and the subject of a successful eradication campaign in the Northern Territory.

Linepithema humile, the Argentine ant (AA). Along with RIFA, the best studied of invasive ants. AA is primarily distributed in temperate, Mediterranean regions, making it distinctive to other tramp ants considered here. Displaces native ants and other invertebrates, disrupts seed dispersal and indirectly affects vertebrates. A human nuisance in urban environments, AA has been the target of an eradication/control campaign in Perth.

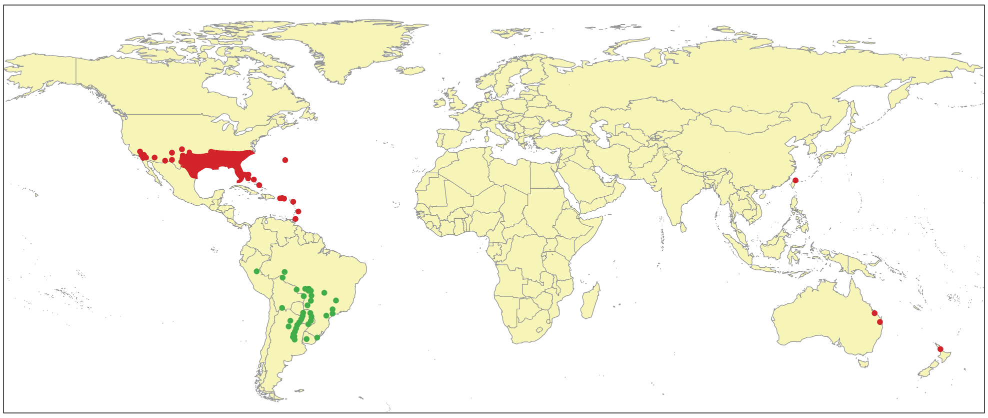
Solenopsis geminata, the tropical fire ant (TFA). In its native distribution in Central and South America, this polymorphic ant has strong impacts on other ant species and invertebrates, and is an important seed predator in agricultural systems. Established in the Northern Territory with recent incursions in Queensland.

Wasmannia auropunctata, the little fire ant (LFA). The little fire ant, native to Central and South America, has been repeatedly intercepted at Brisbane and is the subject of one incursion north of Cairns. Known to displace native ants and other invertebrates, decrease lizard species richness in New Caledonia, and damage eyes of elephants in Central Africa. Target of an eradication campaign in the Galapagos Islands.

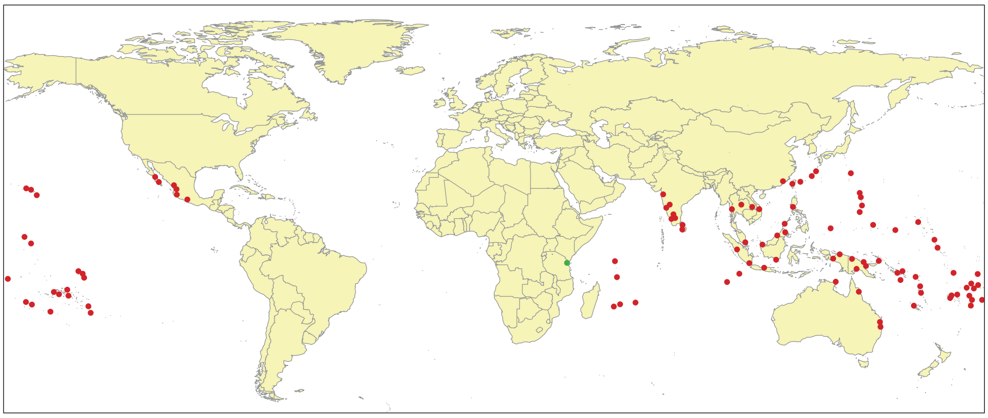
Photos: Japanese Ant Database; Biotrack; C. Richert

Box 2

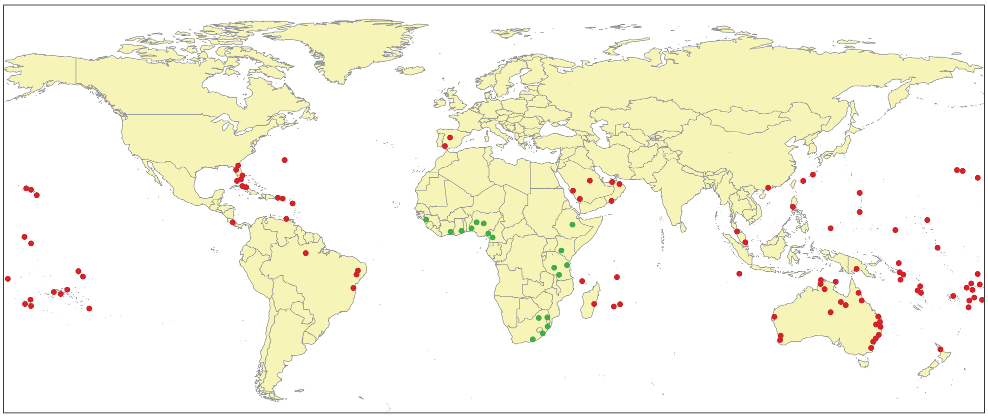
Invasion success for six tramp ant species as indicated by global distribution records. Red circles are records in the introduced range; green circles indicate records from hypothesized native range. Together these records indicate that these ants have invaded widely outside their native range. Distributions provided by R. Harris, Landcare Research, New Zealand.



Solenopsis invicta

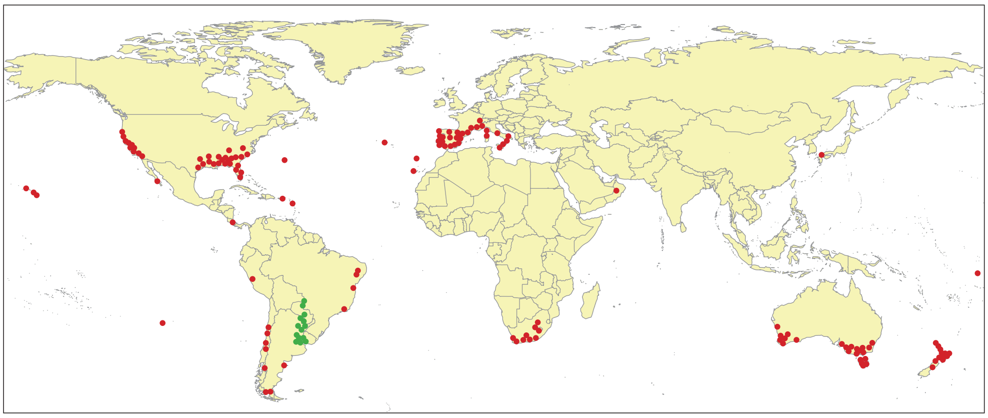


Anoplolepis gracilipes

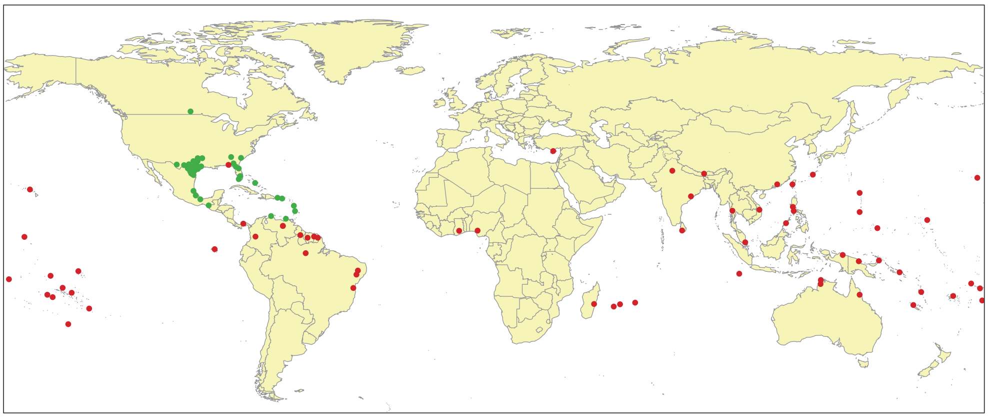


Pheidole megacephala

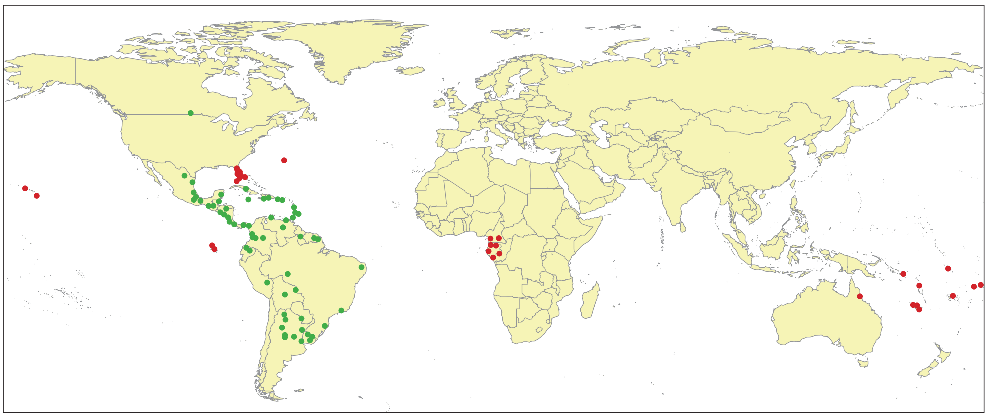
Box 2 (continued).



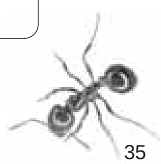
Linepithema humile



Solenopsis geminata



Wasmannia auropunctata

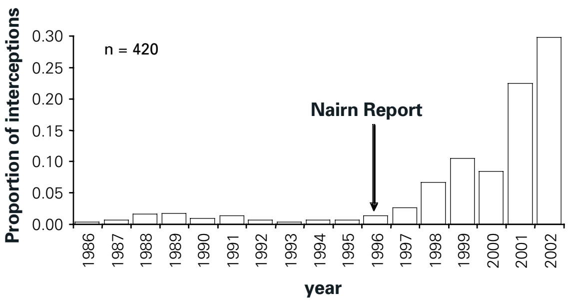


Box 3

Introduction pressure of key tramp ants into Australia.

The Pest and Disease Information Database, recording over 6700 barrier interceptions of ants made by AQIS since 1986, encompasses interceptions of at least 105 species from 73 genera. It is a useful, but imperfect surrogate for introduction pressure of tramp ants. Analysis suggests that the introduction pressure of tramp ants is accelerating (**Point 1**), derived from diverse source areas but strongly biased to our neighbouring regions (**Point 2**), and biased towards subtropical and tropical ports of entry in Australia (**Point 3**). These tramp ants arrive by a diversity of pathways (**Point 4**) in association with a wide range of commodities (**Point 5**).

Barrier Interceptions of Key Tramp Ants, 1986 – 2002

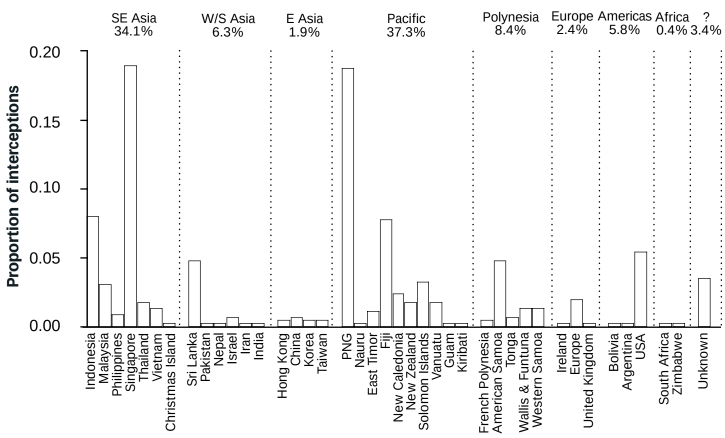


From PDI database, Market Access and Biosecurity

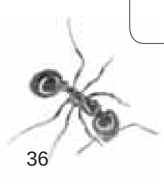
Point 1. Interception rate of key tramp ant species has accelerated. Over 90% of all recorded interceptions in the database have occurred in the five years to 2002. Increased rates of interception are probably a consequence of both increased trade volumes and higher funding levels to AQIS following the Nairn Report in1996.

Point 2. Source regions of key tramp ant interceptions into Australia are diverse and include countries on all continents. However, the majority of interceptions (79%) can be sourced to countries in our neighbourhood - Southeast Asia and the Pacific.

Source regions and countries for interceptions of key tramp ants, 1986 – 2002 (n = 464)

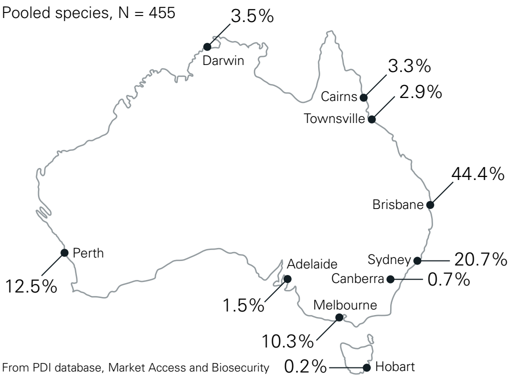


From PDI database, Market Access and Biosecurity



Box 3 (continued).

Distribution of Port Interceptions, 1986–2003

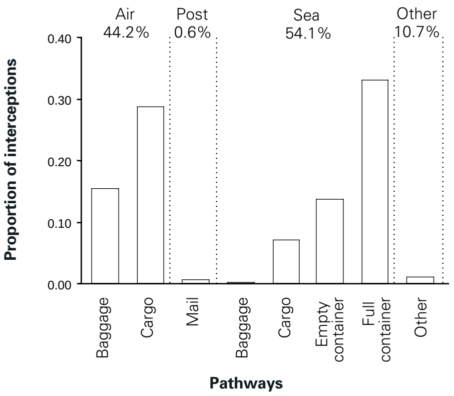


From PDI database, Market Access and Biosecurity

Point 3. Tramp ants have been intercepted at entry points into every capital city in Australia. However, the relative frequency of interceptions is greatest in the subtropical and tropical ports of entry not the ports with greatest volumes of trade. These entry points are in the same regions with the best climatic match to the majority of key tramp ant species.

Point 4. Diverse pathways are involved in the transport of tramp ants. Interceptions are almost equally divided between air and sea. Baggage and cargo comprise all interceptions by air, whereas both empty and full containers are the primary avenue of entry by sea. Postal interceptions are infrequent.

Pathways for interceptions of key tramp ants, 1986 – 2002 (n = 466)



From PDI database, Market Access and Biosecurity

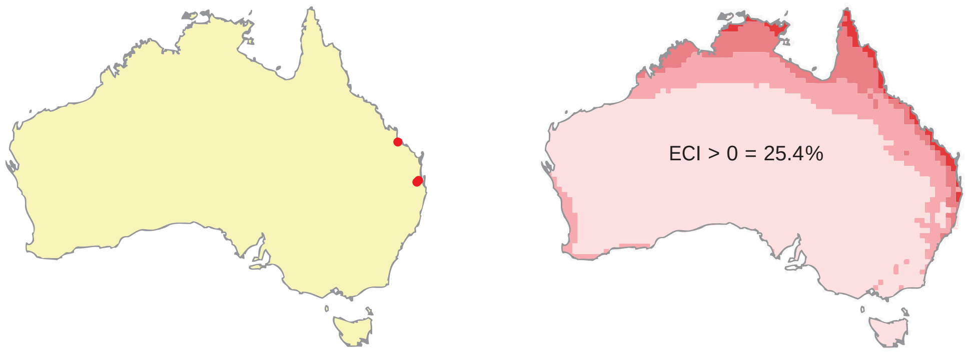
Vectors for interceptions of key tramp ants, 1986 – 2002 (n = 469)

From PDI database, Market Access and Biosecurity

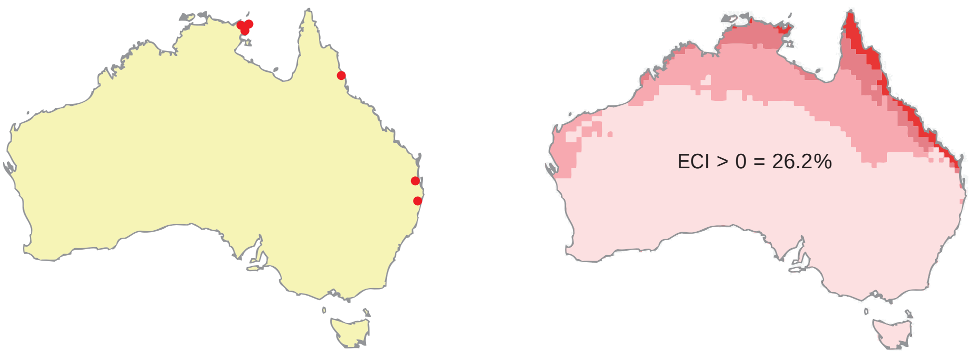
Point 5. Vectors associated with interceptions of tramp ant species. Containers are the most frequent vector of tramp ants, but they are also associated with a variety of commodities, including plant material (e.g., flowers), food, and raw timber and wood products.

Box 4

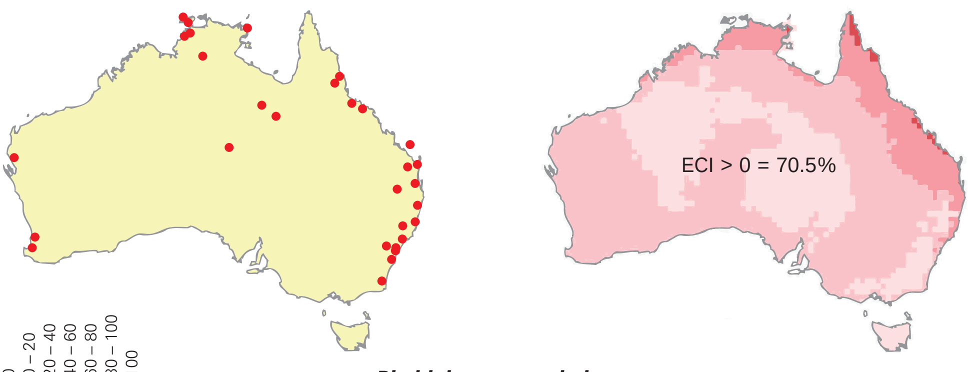
Current known distributional records (left) paired with predicted distribution based on climatic matching for six key tramp ant species. CLIMEX is a computerised system for assessing the likelihood that a species will establish and survive in a given location (Sutherst *et al.* 1999). Ecoclimatic indices (ECI, higher index values indicate better climatic matching) are given for 2964 0.5-degree grids across Australia. Estimated areal extent for ECI > 0, as a percent of the continent, is given for each ant species.

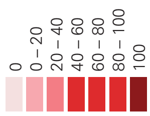


Solenopsis invicta

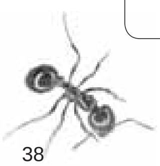


Anoplolepis gracilipes

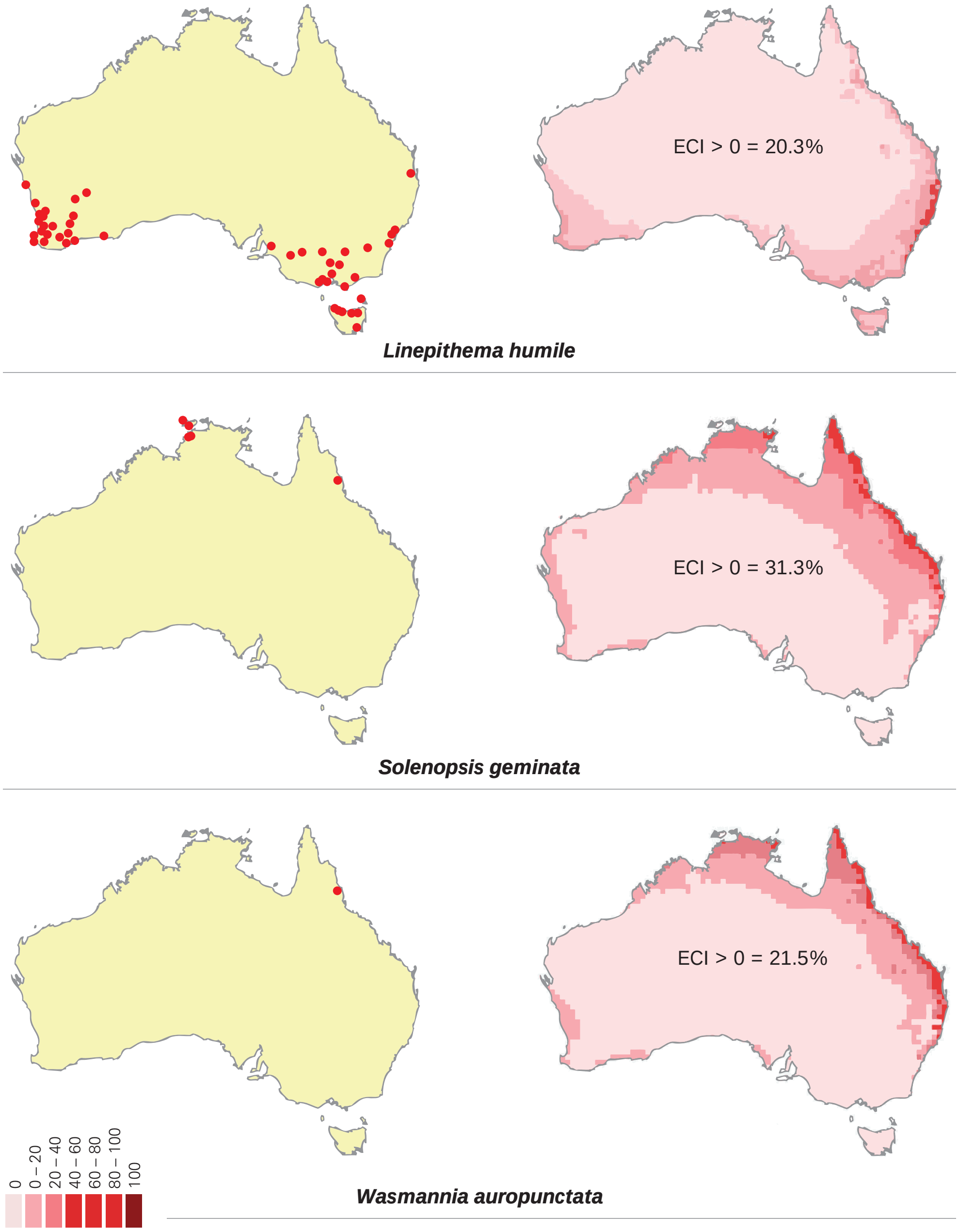




Pheidole megacephala



Box 4 (continued).



Linepithema humile

Solenopsis geminata

Wasmannia auropunctata

Box 5

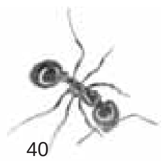
Moving forward – frameworks for response to tramp ants

Several frameworks can guide effective management of tramp ants. Below several plans of action – within state, at the national level, and for the region – illustrate evolving integrated approaches that could be adapted for tramp ant management.

Whole-of-State response. Queensland has developed a multi-agency committee, the Inter-agency Pest Management Committee, that includes representatives from Treasury, Premier and Cabinet, Environmental Protection Agency, Department of Primary Industries and Fisheries, Department of Health, Department of Local Government and Planning, and Natural Resources and Mines that manage invasive species where an interagency response is required. This led to the formation of the Crazy Ant Task Force that coordinates a management response on current Queensland infestations that includes relevant national, state and local government agencies.

Whole-of-government responses. Jointly managed by DAFF and DEH, the National Weeds Strategy focuses on identifying weeds of national significance (WONS) and setting priorities for action. Significant outcomes include (i) preventing new weed problems, (ii) reducing impact of existing weeds, (iii) providing a framework for on-going management, and (iv) producing a framework for management of environmental weeds. Strategic plans for many WONS have been developed, including many environmental weeds. The strategies are detailed and nationally agreed assessments of the threat, and identify the roles and responsibilities of key stakeholders in each weed strategy. An analogous framework for tramp ant species could resolve some of the current issues about (i) state/territory/commonwealth responsibilities, (ii) environmental/ agricultural jurisdiction of response, and (iii) funding arrangements. It also provides a framework for effective community awareness and engagement. Another "whole-of-government" approach, The National Invasive Ant Programme (MAF NZ), aims to create a cohesive program, with central coordination, for tramp ant management in New Zealand. Its goals include (i) efficient and effective national invasive ant surveillance, (ii) efficient and appropriate management of existing and future exotic invasive ant investigations and responses, including research, (iii) contingency plans for high-risk invasive ant incursions for species identified through the invasive ant pest risk assessment, (iv) biosecurity measures that appropriately manage the risks associated with invasive ants – drawing on import and pest risk analyses and cost-benefit analyses, and (v) up-to-date sources of information on projects and responses (e.g., public awareness materials).

Whole-of-region response. The Pacific Ant Prevention Plan (PAPP) is a regional framework for tramp ant prevention aimed to stop invasive ant species with economic, environmental and social impacts from entering and establishing in or spreading between, or within, countries of the Pacific Region, thereby protecting economic, social and environmental interests in the area. PAPP focuses on entry and establishment. Measures to prevent entry include:
(i) legislation, regulations or standards to deal with invasive ants pre-border and at the border; (ii) risk analysis that covers the region but which can be adapted for implementation to each country or territory; (iii) regional trade agreements which accommodate risks associated with invasive ants; and (iv) operational measures which can be applied to each territory and will actually prevent ants gaining entry. Measures to prevention establishment include:
(i) rapid surveillance to detect any new invasive ant in each territory; (ii) incursion response procedures and the capability to enact them; (iii) a regional public awareness strategy to ensure the ant species concerned have appropriate public profiles so the risks of their establishment are well understood by all sections of the community; and (iv) an active research program to ensure the measures used to prevent establishment have a sound scientific base and thus the greatest likelihood of success.



Appendix A: Extracts from the EPBC Act relating to the requirements for developing threat abatement plans

Section 271 Content of threat abatement plans

(1) A threat abatement plan must provide for the research, management and other actions necessary to reduce the key threatening process concerned to an acceptable level in order to maximize the chances of the long-term survival in nature of native species and ecological communities affected by the process.

(2) In particular, a threat abatement plan must:

(a) state the objectives to be achieved; and

(b) state the criteria against which achievement of the objectives is to be measured; and (c) specify the actions needed to achieve the objectives; and

(d) state the estimated duration and cost of the threat abatement process; and

(e) identify organisations or persons who will be involved in evaluating the performance of the threat abatement plan; and

(f) specify the major ecological matters (other than the species or communities threatened by the key threatening process that is the subject of the plan) that will be affected by the plan's implementation; and

(g) meet prescribed criteria (if any) and contain provisions of a prescribed kind (if any).

(3) In making a threat abatement plan, regard must be had to:

(a) the objects of this Act; and

(b) the most efficient and effective use of resources that are allocated for the conservation of species and ecological communities; and

(c) minimising any significant adverse social and economic impacts consistently with the principles of ecologically sustainable development; and

(d) meeting Australia's obligations under international agreements between Australia and one or more countries relevant to the species or ecological community threatened by the key threatening process that is the subject of the plan; and

(e) the role and interests of indigenous people in the conservation of Australia's biodiversity.

Section 274 Scientific Committee to advise on plans

(1) The Minister must obtain and consider the advice of the Scientific Committee on:

(a) the content of recovery and threat abatement plans; and

(b) the times within which, and the order in which, such plans should be made.

(2) In giving advice about a recovery plan, the Scientific Committee must take into account the following matters:

(a) the degree of threat to the survival in nature of the species or ecological community in question;

(b) the potential for the species or community to recover;

(c) the genetic distinctiveness of the species or community;

(d) the importance of the species or community to the ecosystem;

(e) the value to humanity of the species or community;

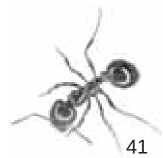
(f) the efficient and effective use of the resources allocated to the conservation of species and ecological communities.

(3) In giving advice about a threat abatement plan, the Scientific Committee must take into account the following matters:

(a) the degree of threat that the key threatening process in question poses to the survival in nature of species and ecological communities;

(b) the potential of species and ecological communities so threatened to recover;

(c) the efficient and effective use of the resources allocated to the conservation of species and ecological communities.



Section 279 Variation of plans by the Minister

(1) The Minister may, at any time, review a recovery plan or threat abatement plan that has been made or adopted under this Subdivision and consider whether a variation of it is necessary.

(2) Each plan must be reviewed by the Minister at intervals not longer than 5 years.

(3) If the Minister considers that a variation of a plan is necessary, the Minister may, subject to subsections (4), (5), (6) and (7), vary the plan.

(4) The Minister must not vary a plan, unless the plan, as so varied, continues to meet the requirements of section 270 or 271, as the case requires.

(5) Before varying a plan, the Minister must obtain and consider advice from the Scientific Committee on the content of the variation.

(6) If the Minister has made a plan jointly with, or adopted a plan that has been made by, a State or self-governing Territory, or an agency of a State or self-governing Territory, the Minister must seek the co-operation of that State or Territory, or that agency, with a view to varying the plan.

(7) Sections 275, 276 and 278 apply to the variation of a plan in the same way that those sections apply to the making of a recovery plan or threat abatement plan.

Environment Protection and Biodiversity Conservation Regulations 2000

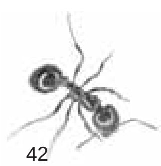
2000 NO. 181 - REG 7.12 Content of threat abatement plans

For paragraph 271 (2) (g) of the Act, a threat abatement plan must state:

(a) any of the following that may be adversely affected by the key threatening process concerned:

- (i) listed threatened species or listed threatened ecological communities;
- (ii) areas of habitat listed in the register of critical habitat kept under section 207A of the Act;
- (iii) any other native species or ecological community that is likely to become threatened if the process continues; and

(b) in what areas the actions specified in the plan most need to be taken for threat abatement.



Appendix B: Workshop for a National Threat Abatement Plan for Invasive Tramp Ants *(Turning the Tide on Invasive Tramp Ants, Canberra 11–12 October 2004)*
(folder or file names are in *italics*)

1. *Workshop report.* This is a distillation of major recommendations for action made at the workshop. Workshop notes, with these recommendations, were circulated for comment to all participants two weeks after the workshop was held.
2. *Workshop booklet,* 'Turning the tide on invasive tramp ants'. This booklet was produced for the workshop and copies provided to each participant. Included in the booklet were the workshop aims, schedule, abstracts for all presentations, and the Issues Paper.
3. *Workshop presentations.* Included are PDF files of each of the presentations given at the workshop. The presenter's name identifies each talk which is included with the authors' permission. A PDF of the workshop organisation is also included.
4. *Workshop participants.* This folder includes the names, institutional affiliations, and contact details for each participant and a group photograph taken on the final day of the workshop.
5. *Supplementary paper.* This paper describes modelling of the potential distribution of six tramp ant species (RIFA, YCA, BHA, AA, TFA, and LFA) in Australia. This was used to produce **Box 4**.