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Management in Practice

The first eradication of an exotic ant species from the entirety of Australia: *Pheidole fervens*

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Abstract

In July 2019 an established infestation of *Pheidole fervens* was detected in Australia for the first time. An eradication program was conducted, and by November 2022 the ant had not been detected for 31 months so it was declared eradicated. This is the first time an exotic ant species has been eradicated from within Australia without other infestations of the same species being found in the meantime. Much of the achievement can be attributed to early detection of the incursion by Australia's National Border Surveillance program.

Key words: ants, ecology, Hymenoptera: Formicidae, impacts, invasive

Introduction

Many ant species have become dispersed throughout the world outside of their native range (McGlynn 1999; Wong et al. 2023), with a great variety of consequences (Holway et al. 2002; Gruber et al. 2022) and associated costs (Angulo et al. 2022), increasingly requiring management action for control or eradication (Hoffmann et al. 2016). The ant species *Pheidole fervens* (Figure 1) is one such species that has been accidentally dispersed to so many places globally, and with much of that dispersal happening so long ago, that there is uncertainty over its origins as native to either SE Asia or the Pacific (Wilson and Taylor 1967; Eguchi 2004; Sarnat et al. 2015). In 2019 an established (i.e. having a viable colony living within local substrate, not associated with the goods within which it was originally transported) infestation of *P. fervens* was detected in Australia for the first time. Although this species is not known to have any serious environmental, social or agricultural impacts, an eradication program commenced based on the precautionary principle that it would be better to eliminate the incursion before any potential impacts became realised, and the species had spread so widely that eradication becomes impossible or prohibitively expensive. Here we describe that eradication, which has now been successfully completed, coincidentally being the first time an exotic ant has

Figure 1. *Pheidole fervens* major worker collected from the incursion. Photograph by Tony Robinson.

been eradicated from within Australia without other infestations of the same species being found in the meantime.

Methods and results

In July 2019, lures were placed at a bulk terminal facility (a Biosecurity Entry Point) at Murrarie, Port of Brisbane, Queensland (22.44921389°S; 153.09516667°E), as part of Australia's National Border Surveillance program which routinely surveys locations around Australia where new incursions of exotic species may establish. Lures were 50 mL urine sample jars containing either protein in the form of a slice of hot dog sausage (Don Footy Franks®), or carbohydrate in the form of a half teaspoon of golden syrup, positioned randomly throughout the area. Lures were placed on the ground on their side with their lid off for approximately one hour before being collected. Subsequent laboratory assessment of the captured ants identified *P. fervens*. Specimens had been found in lures that had been placed on the ground along a concrete gutter structure. Additional specimens were hand collected from the same location soon afterwards and sent to the Okinawa Institute of Science & Technology in Japan for DNA confirmation. Identification was confirmed on 21 August 2019.

The incursion was delimited in September 2019. First, approximately 30 ha was assessed visually, with assessments extending out 300 m from detection locations. Lures were then used to refine the infested areas. Lures with different food sources were alternated on the ground and were spaced in an approximate 5 × 5 m grid within the visually estimated infested areas. An approximate 10 × 10 m grid was used in the surrounding non-infested areas extending out 100 m from the periphery of the visual detection locations. The assessments used approximately 1250 lures, and the ant was found to inhabit a combined

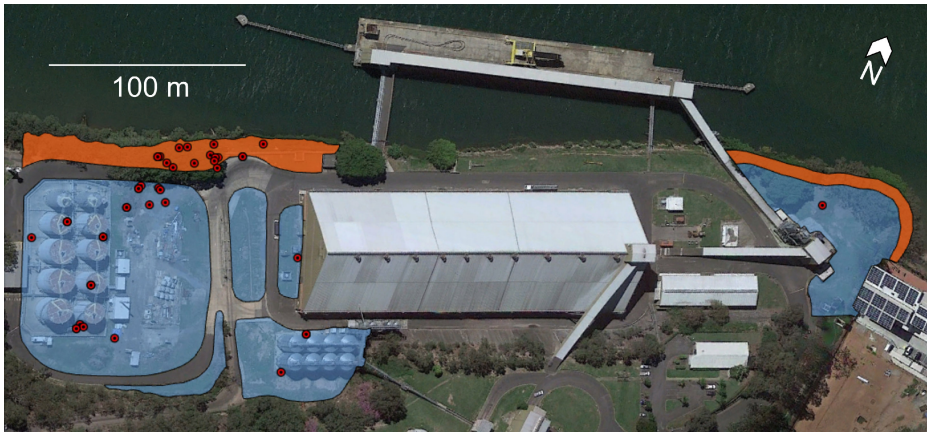

Figure 2. Detection points (red points) for *Pheidole fervens* and areas treated by spray (blue polygons) or granular product (orange polygons).

area of 1.84 ha in two spatially discrete areas covering 14,400 m^2, and 4000 m^2 on one property (Figure 2). The two infestations were separated by approximately 350 m. An eradication plan was subsequently drafted and underwent a rapid consultation process with biosecurity representatives from all Australian States and Territories, as well as ant eradication specialists. In October 2019 the eradication plan was finalised (Department of Agriculture 2019). On 13 October 2019, a spray treatment of Termidor® Residual Termiticide and Insecticide containing the active ingredient fipronil (100 g/L) was applied over six areas containing exposed ground (i.e. not sealed roads) up to 5 m from the river (Figure 2). The spray mixture was prepared as per the product label (BASF 2019) using 6 mL Termidor per 1 L water and applied at the rate of 1 L per 25 lineal metres. The area within 5 m of the river was treated using the granular product Distance® Plus containing the active constituent pyriproxyfen (5 g/kg), applied at the rate of 4 kg/ha (Sumitomo Chemical Australia 2019).

The combined 1.84 ha of infested areas was surveyed again in January 2020 using 525 lures in the same manner as detailed for the delimitation survey (Supplementary material Figure S1), with two individuals of *P. fervens* being found in two adjacent lures. In March 2020, a second treatment was applied. Additionally, green-waste piles approximately 50 m from the infestation were removed, and placed in layers into large industrial bins, with each layer sprayed as they were placed in the bins with Termidor® at the concentration detailed prior.

Additional post treatment assessments were conducted in May and November 2020, and November 2021 throughout the same 1.8 ha, with no *P. fervens* being collected within 321, 1591 and 1339 lures respectively (Figure S1). However, in order to verify distribution had not spread to neighbouring areas another survey was conducted incorporating areas up to 300 m away from the infested areas. Between 26 October 2022 and 24 November 2022, an additional 1304 lures were deployed over approximately 16 ha (Figure S1), with no *P. fervens* being found. The ant was subsequently

declared eradicated, with its actual eradication date likely occurring in March 2020 immediately following the second treatment.

The treatments had a minor and short-term effect on other ant species in the treatment area. Pre-treatment, 27 species (excluding *P. fervens*) were present, including another exotic *Pheidole* the African big-headed ant *P. megacephala* (Table S1). In the three post-treatment assessments of the treated area 14, 25 and 25 species were found respectively, but not *P. megacephala*. In the final assessment over a broader area that wasn't treated, 31 species were found.

Discussion

There are at least 20 exotic ant species established in Australia (Majer and Heterick 2015) but this is the first established species to have all known infestations eradicated. Despite numerous site-level and regional eradications of other species including yellow crazy ant *Anoplolepis gracilipes*, red imported fire ant *Solenopsis invicta*, tropical fire ant *Solenopsis geminata*, African big-headed ant *Pheidole megacephala*, Argentine ant *Linepithema humile*, browsing ant *Lepisiota frauenfeldi*, and little fire ant *Wasmannia auropunctata* (Hoffmann et al. 2016, 2023; Wylie et al. 2016), all of these species still have infestations remaining extant elsewhere in Australia.

Possibly the greatest reason that *P. fervens* has been the first species eradicated from within Australia without other infestations of the same species being found in the meantime, as well as being done so quickly and for only AUD$30,000, is that the incursion appears to have been detected at a very early stage, and prior to secondary dispersal events that would have extended work to other locations. Notably, previous surveillance conducted at this location in April 2017 had not detected *P. fervens*, so presumably population levels were so low and small at that point that they were not detected, or the incursion occurred after April 2017. Other rapid eradications that can be attributed to early detections are the three declared eradications of *S. invicta* from New Zealand in 2003, 2007 and 2009 (Pascoe 2003; Sarty 2007; Christian 2009), Port Botany in Sydney in 2017 (New South Wales Government *unpublished data*), Brisbane airport in 2019 (Queensland Government *unpublished data*), and Port of Brisbane in 2021 (Queensland Government *unpublished data*), all of which were single nests when found. All these detections were made within national surveillance programs and illustrate the benefit of conducting such surveillance.

Although the protocols used here successfully achieved eradication, we acknowledge that normally the treatments would have included a buffer area extending away from the infested area to accommodate the potential that the infested area had not been delimited accurately (FAO 1988). We are not able to offer a reason why a buffer zone was not included in the protocols used here, but note that a best-practice document is still lacking for invasive ant eradication protocols for anywhere in the world. Therefore, even within

Australia, which is conducting numerous eradication programs, there is great variability in the protocols being used by different entities focused on the same species. However, we recommend all future programs treat a buffer zone around the infested area. This is the first time an exotic ant species has been eradicated from within Australia without other infestations being found in the meantime. We acknowledge that this species may indeed be currently undetected in another location, but this is much more unlikely than in the past, given that the Australia's National Biosecurity Program now frequently assesses primary and secondary destinations of international goods, and there is also an immense number of locations being assessed simultaneously as part of the numerous ant eradication programs currently occurring within Australia.

As international trade increases globally, and subsequently exotic species are unintentionally and increasingly travelling in cargo (Essl et al. 2011; Seebens et al. 2017), it is highly likely that more incursions of *P. fervens* will occur. It is also possible for this incursion that a secondary infestation has occurred and remains unknown and will be found in the future. In both instances, the work presented here has demonstrated that eradication of such an incursion is achievable, and is no doubt more economically viable than the cost of living with such exotic species (Angulo et al. 2022).

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Authors' contribution

JE and CM led the eradication. BH, JE and CM drafted the manuscript. All authors edited and approved the final manuscript.

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Supplementary material

The following supplementary material is available for this article:

Figure S1. Locations of the lure assessments with and without *Pheidole fervens* present before and after treatment.
Table S1. Ant species found in pitfall trap samples around the infested premise.

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http://www.reabic.net/journals/mbi/2023/Supplements/MBI_2023_Hoffmann_etal_SupplementaryMaterial_2.pdf