SENTINEL SITE STRATEGY FOR THE EARLY DETECTION OF PEST AND INVASIVE ANTS

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ABSTRACT

Early detection of invasive ant infestations can greatly reduce resource requirements and costs associated with management. The National Electric Ant Eradication Program (NEAEP) has used a targeted surveillance strategy since its inception to focus surveillance efforts at 'sentinel sites' where high-risk carriers of electric ant (*Wasmannia auropunctata)* aggregate, and/or could support pathways for extensive spread. In addition to early detection, sentinel sites can prioritise and focus future surveillance efforts when a target species is detected within a catchment. In this paper, the NEAEP sentinel site strategy is outlined, and field effort and diagnostic data reviewed. Since the financial year 2011/ 2012 the Program has surveyed a total of 290 sentinel sites. As funding to the program increased, the number of visits to sentinel sites also increased. In the last 5 years, we have detected *W.auropunctata* at sentinel sites 32 times and of these detections, waste transfer stations accounted for 34.21%; illegal dumping 21.05%, and plant nurseries 15.79%. After a detection at a sentinel site, proactive surveillance, focused on the sentinel site catchments, located a further 44 infested areas, with one catchment suspected to contain a population of *W.auropunctata* that is yet to be detected.
It is believed that this sentinel site strategy can be used to detect other ant species, as evidenced by the detections of established invasive species at multiple NEAEP sentinel sites; African big-headed ant *(Pheidole megacephala),* and Singapore ant (*Trichomyrmex destructor).*

Keywords: Invasive alien ants, non-native, tramp, prevention.

INTRODUCTION

The electric ant (*Wasmannia auropunctata),* known globally as the little fire ant, is a highly invasive ant species native to central and South America. As recognised by Lowe *et al* (2000), *W.auropunctata* are a serious threat to biological diversity, and negatively impact human & animal health, agriculture, tourism and social amenities (Cox *et al.* 2020). *W.auropunctata* are tiny, with a worker body size of approximately 1mm. As such, colonies can also be very small when first established (thumbnail size) and can easily hide and be transported within human-associated carriers. *W.auropunctata* has spread to over 58 countries (Wetterer 2013).
Newly established and transported populations of *W.auropunctata* can be easily overlooked because of their small size and ill-defined nests. The average spread rate of *W.auropunctata* in Australia is approximately 50 meters a year (DAF unpublished data) when not assisted by water or human activities which accelerate spread. The slow spread rate, whilst a positive trait for management, creates a challenge to detecting infestations on large, rural, and isolated land parcels. Early detection can significantly reduce the resources required to eradicate an infestation. To claim eradication of an infestation we must have confidence that all populations of *W.auropunctata* have been located for destruction,

requiring substantial resources for surveillance coverage, coupled with a targeted risk-based strategy.

The National Electric Ant Eradication Program (NEAEP; the Program) recognised early that an efficient targeted surveillance strategy was required to gauge the potential presence of undetected *W.auropunctata* infestations within an area. In 2011 a handful of businesses and land parcels that receive electric ant carriers were linked with high-risk businesses within or close to known infestations. These were scheduled for surveillance multiple times a year. These sites were (and are still) called 'sentinel sites' as they aggregate electric ant carriers to one site (e.g. waste transfer stations) or could promote major spread of *W.auropunctata* (e.g. plant nurseries). If *W.auropunctata* is detected at a sentinel site, it is an indication that at least one infestation is within the sentinel site's sphere of collection, providing an opportunity for early detection and management. The 'sentinel site' strategy now falls under the Program's broader 'proactive surveillance strategy' (see poster presentation by Susan Walker at PAWS 2025 for more detail).

METHODS

Determining sentinel sites and surveillance frequency

The NEAEP area of interest (AoI) covers 1.454 million hectares. The risk status of a land parcel within the AoI is determined by the distance from any *W.auropunctata* infestation (active or cleared), human population density, potential carrier movement pathways, and habitat suitability. Each land parcel is identified for either a high, moderate, or minimal risk that a *W.auropunctata* infestation will occur (see Figure 1).

When a potential new sentinel site is identified, it is shortlisted for assessment. The assessment determines inclusion into the sentinel site schedule and surveillance frequency. For a sentinel site to be shortlisted, it must be at a site that meets one or more of the following criteria; a) be within or has catchment within the AoI (see Figure 1), and; b) receives or supplies green or hard waste that could be *W.auropunctata* carriers, or; c) receives or supplies raw materials or plants that could be *W.auropunctata* carriers, or; d) has a history of illegal dumping.

Sentinel sites are then categorised into; illegal dumping sites; council sites; and private sites. Each proposed sentinel site is assessed on a case by case basis, but generally, considers; a) the type of *W.auropunctata* carrier and frequency of movement in and/or out of the site; b) site procedures and quarantining practises (if relevant); c) logistics of training external staff to undertake surveillance (if relevant); d) status of illegal dumping (active or inactive) and assumed frequency (if any); e) site location within the AoI and potential catchment area (with the assessment considering gaps in sentinel site coverage and site density in higher population suburbs with existing *W.auropunctata* infestation).

If a sentinel site is approved to be added to the schedule, the surveillance frequency is determined by the likelihood of *W.auropunctata* being moved to the site in a given timeframe, and if *W.auropunctata* is present, the likelihood that *W.auropunctata* will be moved or destroyed in a given timeframe.

The NEAEP has changed size many times due to fluctuating funding commitments but the 'sentinel site' strategy has adapted to the changes in resourcing and expanded to cover additional local government areas and to encompass high-risk sites near newly detected

infested areas. Since financial year 2011/2012 the program has surveyed 290 distinct sentinel sites, and currently schedules 272 sentinel sites for monthly, quarterly, bi-annual, or annual surveillance.

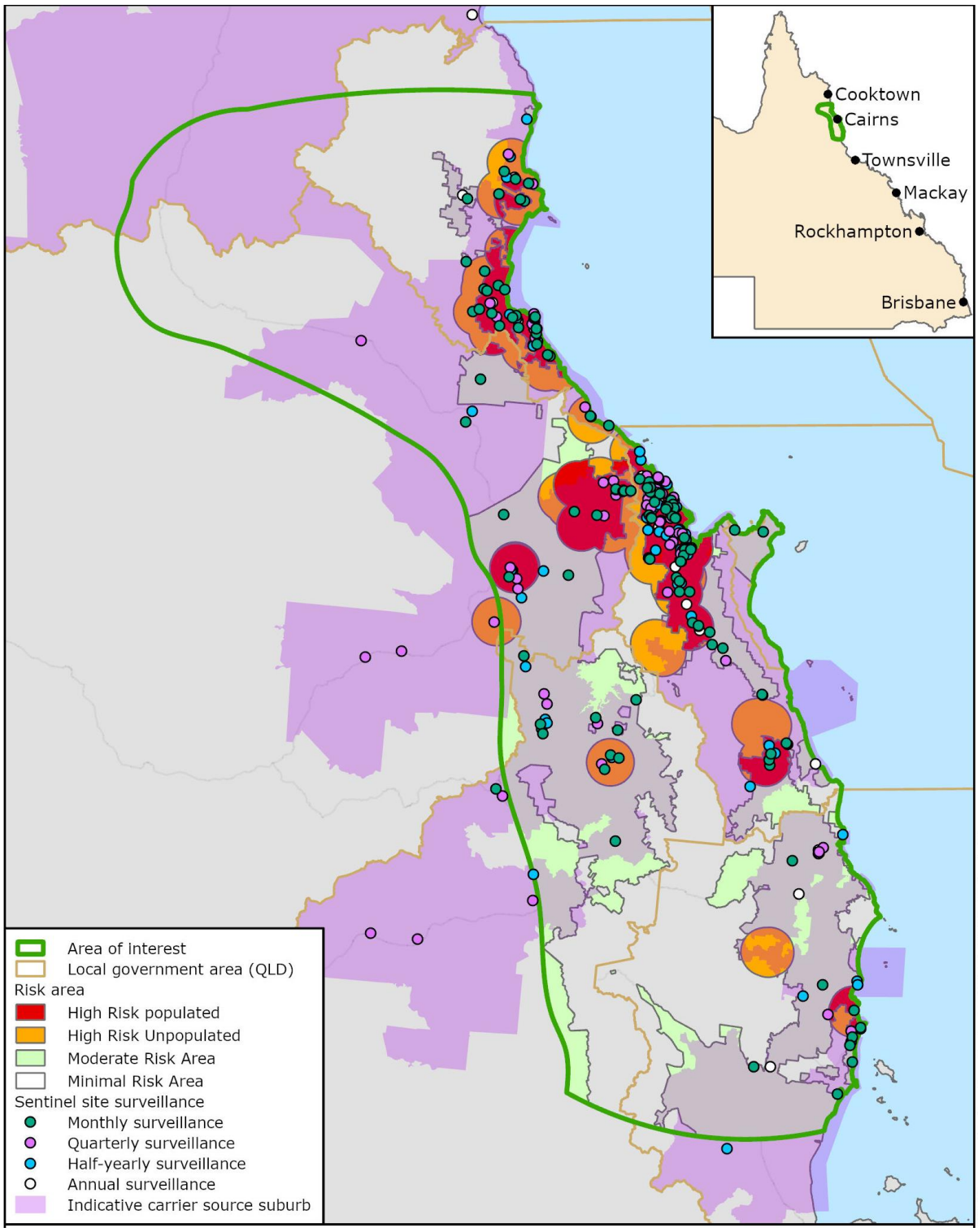

Figure 1. Distribution of the 272 National Electric Ant Eradication Program sentinel sites scheduled for surveillance at the end of 2023/2024, land parcel risk status, and the indicative carrier source suburbs of each sentinel site catchment within the area of interest.

Sentinel site vs. resourcing

To review sentinel site visits, surveillance data were categorised into twelve site types to provide detail on industry risk or movement pathway of *W.auropunctata*. When a sentinel

site fell into multiple categories, the highest carrier risk was selected for 'site type'. Expenditure figures are actual spend of the Program for the financial year, extracted from internal DPI annual reports. Sentinel site data was extracted from 'field effort' reports produced by the Electric Ant Information System (EAIS). A total of 3,121 surveillance visits across 290 sites were assessed. Data prior to 2011 did not contain enough information to match surveillance visits to a sentinel site, therefore the data set date range is 1st July 2011 to June 30th 2024 and analysed by financial year.

Ant species detected at sentinel sites

The NEAEP has a standardised luring protocol which is used for all surveillance activities; a small piece of hotdog sausage is skewered into the ground with a bamboo flag and left for 60 minutes. The skewered sausage is collected and each piece placed into a vial containing 70% ethanol. Samples are processed immediately upon receipt at the electric ant diagnostics laboratory. Ants are identified to genus using keys from Shattuck (2000) and incorporate the revised classification of *Paratrechina* (LaPolla and Fisher 2014). Ant species are identified using Anderson (1991) with reference to PIA key factsheets and comparison charts (PIA key 2000a, 2000b). Sentinel site ant genus and species data were extracted from EAIS 'diagnostic report' for dates between 1st January 2020 to 31st December 2024. After 'no ant' and 'negative' diagnostics were removed, a total of 6,742 diagnostic records were analysed, containing 2,584 unique sample numbers. Data was grouped into the same twelve site types as the field effort data by matching unique site codes. With reference to McGlynn (1999), genera and species were grouped by Australian residency status; native, established invasive, exotic invasive, and established invasive/native for those ant genera which encompass both native and established invasive species. The proportion of total detections of each ant genera or species were calculated for each sentinel site type. The ant richness and percentage of total detections for each sentinel site was calculated. The percentage of total detections were also calculated for each ant genera, species, and residency group.

RESULTS & SUMMARY

Sentinel site surveillance and resourcing

The data shows a clear increase in sentinel site visits as funding, and therefore expenditure, increased. The steep increase in annual sentinel site visits at the end of 2020 was due to a Program review highlighting that the Program needed a wider net to fill surveillance gaps at high risk populated areas.

Early in the Program the canine team were utilised for sentinel site surveillance, until 2019/2020 when a proportion of surveillance at council-run sites started to be conducted by council employees trained in the Program's luring protocol. External type surveillance accounted for 10-20% of all sentinel sites, with the exception of 2020/ 2021 where external surveys accounted for 45% of total sentinel site surveillance due to the exceptional circumstances of COVID.

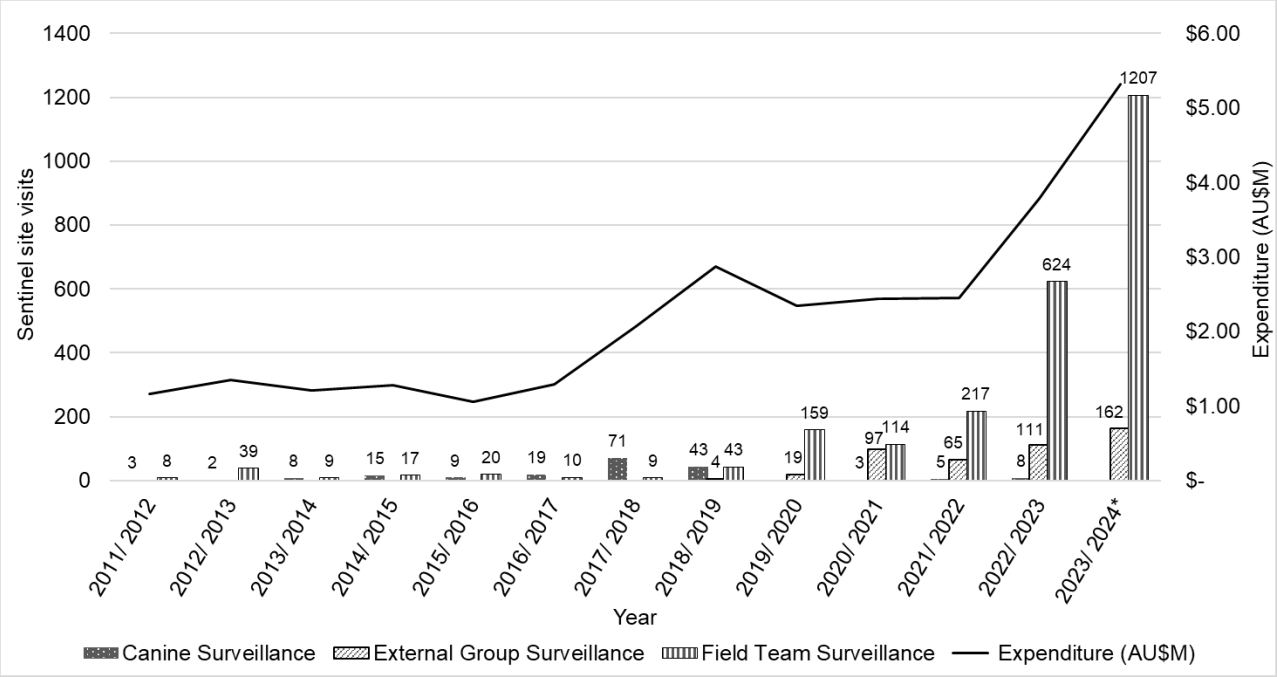

Figure 2. National Electric Ant Eradication Program sentinel site visits separated by surveillance type (canine; external; field team), and Program funding expenditure (AU$ Million).

Ant genus and species detected at sentinel sites

A total of 39 ant genus and eight ant species were identified from sentinel site diagnostics. The sentinel site type resulting in the highest ant richness was markets/fetes (n=37), closely followed by nurseries (n=36) and waste transfer stations (WTS, n=34) (Table 1). Nursery and WTS sites were surveyed more frequently than all other sites. The number of visits to each sentinel site type is presented in Table 1. The native ant group, encompassing 35 of 47 genera/species, resulted in the highest detection percentage of 34.22%. The total detection percentage varies by 2% between the ant residency groups, with the exception of the exotic group (0.56%) as *W.auropunctata* is the sole constituent. The two established invasive groups (established invasive, and established invasive/native), contain only 5 species and 6 genera respectively, highlighting the abundance, transport and widespread nature of established invasive species and genera. Despite a similar number of site visits, *W.auropunctata* was detected in higher proportions at WTS than nurseries, suggesting that WTS sites are of more value as a sentinel site than nursery sites. *W.auropunctata* were detected at nine of the 12 sentinel site types. The three highest ranked *W.auropunctata* sentinel site proportions are WTS, illegal dumping, and nurseries. The two genus or species with the highest total detection percentage of each residency group are listed (Table 1). The highly diverse and speciose genera of Pheidole and Iridomyrmex account of 19.8% of the total detection percentage of the native residency ant group, and similarly, *Pheidole megacephala and Monomorium floricola* account for 22.7% of the established invasive ant residency group.

Table 1. Ant detections at NEAEP sentinel sites from 1st January 2020 to 31st December 2024. Ant diagnostics grouped by residency status in Australia; native (n=35); established invasive (n=5); established invasive/ native (n=6); exotic invasive (n=1). The two genera or species with the highest total detection percentage of each group are detailed. Proportions for each species detected grouped by surveillance site type. WTS, waste transfer station. “a” denotes absence. %T, percentage of total detections.

Ant detections at National Electric Ant Eradication Program sentinel sites	Community Garden	Community Hub	Freight Depot	Green stockpiles	Illegal dumping	Machinery Depot	Markets/ Fetes	DPI site	Nursery	Raw materials	Stockpiles	WTS	%T
Native	**0.04**	**0.01**	**0.02**	**0.08**	**0.09**	**0.09**	**0.12**	**0.00**	**0.22**	**0.04**	**0.08**	**0.22**	**34.22**
Pheidole	0.05	0.01	0.02	0.07	0.11	0.09	0.14	a	0.23	0.04	0.08	0.17	11.10
Iridomyrmex	0.02	0.01	0.02	0.11	0.09	0.09	0.06	a	0.17	0.05	0.07	0.30	8.68
Established invasive/native	**0.04**	**0.01**	**0.02**	**0.07**	**0.07**	**0.09**	**0.10**	**0.00**	**0.22**	**0.05**	**0.09**	**0.23**	**32.99**
Paratrechina	0.01	0.01	0.02	0.08	0.06	0.10	0.07	a	0.27	0.05	0.13	0.19	9.21
Tetramorium	0.04	a	0.02	0.08	0.07	0.09	0.16	a	0.20	0.06	0.08	0.22	8.96
Established invasive	**0.04**	**0.01**	**0.02**	**0.11**	**0.04**	**0.08**	**0.05**	**0.01**	**0.19**	**0.07**	**0.09**	**0.30**	**32.22**
Pheidole megacephala	0.05	0.01	0.01	0.09	0.04	0.07	0.05	0.01	0.20	0.05	0.06	0.34	15.62
Monomorium floricola	0.03	0.01	0.01	0.13	0.04	0.09	0.05	a	0.13	0.05	0.09	0.36	7.09
Exotic invasive													
Wasmannia auropunctata	a	a	0.00	0.08	0.21	0.05	0.03	a	0.16	0.03	0.11	0.34	**0.56**
Richness:	19	13	18	26	23	24	37	5	36	22	27	34	
Number of site visits:	69	9	27	161	131	125	115	17	267	113	162	293	
%T:	**3.78**	**0.58**	**1.97**	**8.49**	**6.96**	**8.92**	**8.81**	**0.28**	**21.17**	**5.15**	**8.63**	**25.26**	

The detection of *W.auropunctata* at a sentinel site will initiate treatment activities (to reduce spread risk), and depending on current resources and operational commitments will trigger follow-up activities in the catchment suburb. If footpath or field staff-based surveillance cannot be conducted, the NEAEP community engagement team will target the suburb with pop-up information stalls, letterbox drops of awareness leaflets and elicit requests from members of the public to survey their properties. Since the start of 2020, we have detected *W.auropunctata* 32 times from 24 different sentinel site suburbs. These detections and the subsequent targeted surveillance has led to approximately 44 *W.auropunctata* detections within those sentinel site suburbs. To date, there is one sentinel site detection (in the Tablelands region) where a source infestation is yet to be detected.

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