How do we know the zeroes are real? - Surveillance to declare eradication

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How do we know the zeroes are real and there is truly nothing left? Mandy Barron, Landcare Research Lincoln explains by using the example of Argentine ants on Kawau Island.

Surveys undertaken near the end of an eradication programme often will not find any target pests remaining and the search results will consist of many zeros. But how do we know those zeroes are real and there is truly nothing left? Maybe some individuals have survived control but haven't been detected because they're so rare and the search effort was insufficient to find them. Some eradication programmes declare "success" after a certain time during which the pest has not been found (e.g. 2 years). However, "not finding in a certain time" is a meaningless criterion unless the surveillance effort required to find a pest at low density is specified. It is easy to find nothing with only a few surveys or when only part of the area is searched! To answer the "are-they-true-zeroes" question, surveillance sensitivity must be quantified in terms of the probability of detecting an organism if it is present. With this information, managers can then estimate the probability that eradication has been achieved and thus avoid prematurely declaring success due to insufficient survey effort or, conversely, avoid wasting resources on surveys when the pest has already been eradicated from an area.

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We applied these concepts to the eradication programme for Argentine ants from Kawau Island. We used the spatially explicit surveillance data model developed by Anderson et al. (2013) to estimate the probability that Argentine ants had been eradicated from the Schoolhouse Bay area. This method quantifies the sensitivity of each search method using a maximum probability of detection parameter (assumed to be when the target is directly on the search path or the detection device) and a spatial decay parameter describing the decline in detection probability with increasing distance from the device or searcher. All search paths or device locations are used to calculate a combined probability of detection for that survey (i.e. the surveillance sensitivity) and a map of the surveillance coverage is produced. Each time a survey is done the surveillance sensitivity estimate is used to update the probability of ant eradication derived from the previous survey. For the very first survey a 'prior' probability of the ants being eradicated is derived from expert opinion or is left deliberately vague, e.g. equally likely to be somewhere between 20% and 80%.

For the Kawau Island ant eradication project there have been four surveys since the Spring 2012 poisoning of ants in the approximately 3-ha infested area at Schoolhouse Bay. Three surveillance methods were used for these surveys: visual hand searching; baited vials (with non-toxic "Inform" bait); and a sniffer dog (trained by Auckland Council, see sniffer dog article in this issue). Several "paths" were used to cover the entire Schoolhouse Bay area. These paths were documented with a GPS and used for all three surveillance methods. The spatial sensitivity parameters used are shown in Figure 1, where a sniffer dog has a greater search range than a human visually searching. An example map of surveillance sensitivity, for the combined methods of people searching, baited vials, and sniffer dogs, is shown in Figure 2.

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How do we know the zeroes are real? (cont.)

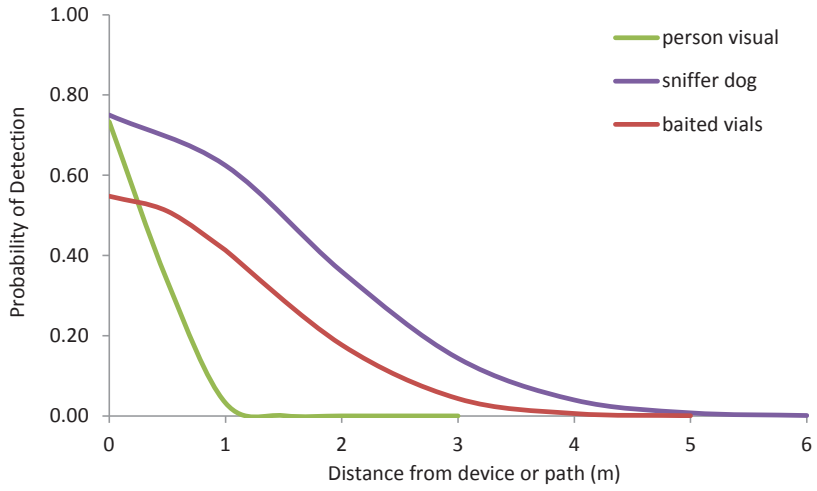

Figure 1. Spatial decay functions (half-normal) describing the probability of detecting an argentine ant or nest with distance from a device (baited vials) or from a point along a path (person visual, sniffer dog).

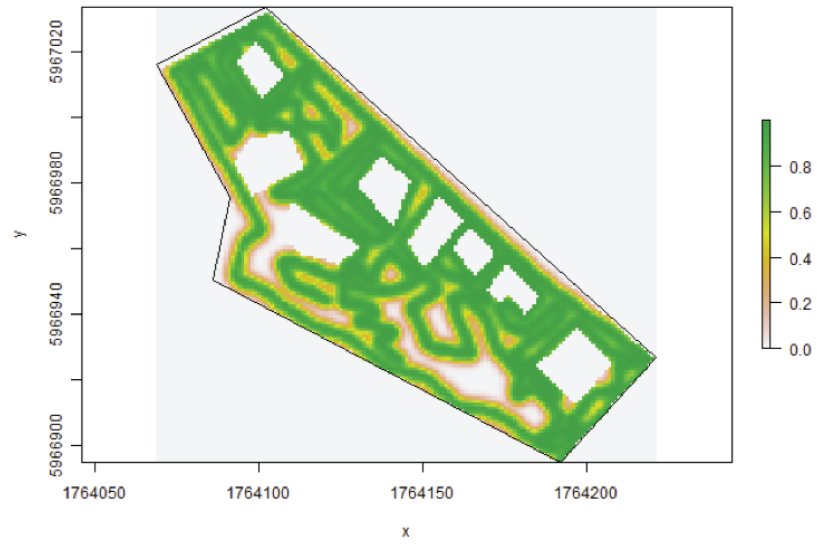

Figure 2. Combined system sensitivities for the detection of Argentine ants across the Schoolhouse Bay study area for the February 2014 survey using baited vials, visual searching and the sniffer dog. Green areas = high probability of detection, red-white areas = low probability of detection; the large square white areas are houses, which were excluded from analyses.

No Argentine ants have been detected at Schoolhouse Bay since the control operation in 2012. The estimated probability of eradication (POE) increased sharply as each survey was conducted. Analysis of the four post-control surveys estimated a median probability of eradication of 96% with a high level of confidence in the POE result (87% of the POE estimates were greater than the threshold value of 90%). Sniffer dogs gave the highest probability of detection per "path" searched and thus the predicted number of surveys to reach a threshold POE of 95% was less using this survey method than the other two methods.

Combined modelling of all surveys and sampling devices indicates there are several small spatial gaps that have had less survey effort. Such gaps might be a refuge for a small Argentine ant population. These gaps are generally on the north-facing slope behind the residences and will be targeted for surveillance in future monitoring.

References

Anderson, D.P., Ramsey, D.S.L., Nugent, G., Bosson, M., Livingstone, P., Martin, P.A.J., Sergeant, E., Gormley, A.M. & Warburton, B. (2013) *A novel approach to assess the probability of disease eradication from a wild-animal reservoir host.* Epidemiology & Infection, 141, 1509-1521.