Canine Detection Solutions

Case Study

Independent Evaluation of Detection Dog Performance

Advanced Invasives
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ADVANCED INVASIVES

Document

Case Study: this document provides an independent evaluation of detection dog ability to detect invasive knotweeds under field conditions.

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1. Introduction

Detection dogs are increasingly being used across a wide range of fields, including the conservation sector (Seyfarth et al. 2020) and more recently, for the detection of Invasive Non-Native Plants (INNPs). However, the assumption that detection results are linked only to the dog's ability to detect specific scents emitted by invasive plants is incorrect. Rather, olfactory ability, physical structure, energy level, personality and the social traits of dog's must be considered within a rigorous (effective) training programme that includes sufficient variation in target and nontarget species. Complementing effective training, special attention should be paid to interpreting the innate reactions of the detection dog and their specific reactions (further to other considerations identified above) and these should be tested under field-relevant conditions (De Matteo et al. 2019).

2. Methods & Results

2.1 Site: ai:LAB

ai:LAB is Advanced Invasives Ltd continuous research and field-trial project, undertaken in partnership with Swansea University's Department of Biosciences and Complete Weed Control Ltd. This 5-hectare (12-acre site) research facility is home to the world's largest and longest running experiment investigating Japanese Knotweed control. Independent evaluation of detection dog performance, including an invasive knotweed scent detection trial and belowground Japanese Knotweed scent testing were conducted at ai:LAB.

2.2 Invasive knotweed scent detection trial

Sample collection

Invasive knotweed samples (Figure 1) were sourced from a number of locations in South Wales (UK) and returned to ai:LAB by Dr Dan Jones (Advanced Invasives) on 12 March 2021. Samples were propagated in 160 L container pots using soil uncontaminated by knotweed growth.

Common name	Scientific (binomial) name	Notes
Japanese Knotweed	*Reynoutria japonica* var. *japonica*	• Covered under UK legislation
Dwarf Knotweed	*Reynoutria japonica* var. *compacta*	• Covered under UK legislation
Giant Knotweed	*Reynoutria sachalinensis*	• Covered under UK legislation
Bohemian Knotweed	*Reynoutria × bohemica*	• Covered under UK legislation • Hybrids formed from: Japanese + Giant Knotweed Dwarf + Giant Knotweed
Conolly's Knotweed	*X Reyllopia conollyana*	• Not covered under UK legislation • Hybrid = Japanese Knotweed + Russian Vine
Himalayan Knotweed	*Koenigia polystachya*	• Only covered under devolved Scottish Government legislation • Closely related to other invasive knotweeds

Figure 1: Invasive knotweeds which (with the exception of Himalayan Knotweed) are collectively referred to as Japanese Knotweed *s.l.* (*sensu lato*; latin for 'in the broader sense'). All were propagated and subsequently used for scent testing by the detection dogs at ai:LAB.

Sample preparation

Under the supervision of Kat Janczur (Canine Detection Solutions), Dr Jones in sequence removed rhizome/roots from each pot on 29 April 2021. To avoid any scent cross contamination, each species/variety was handled, and samples cut separately (on separate cutting surfaces) with blue nitrile (GL890) gloves, changed (new uncontaminated gloves) between each sampling procedure. For each species/variety, a single c.6 cm length knotweed/root was cut (separate cutting tool for each species/variety) and placed into labelled plastic containers for subsequent scent testing. Samples were stored temporarily in sealed containers 1 m apart to further reduce the likelihood of scent cross contamination.

Further 'distractor' plants (vascular plant material including leaves, living and dead stems; lower plants, moss), not growing onsite (c.500 m away) and therefore uncontaminated by invasive knotweed scent were collected using blue nitrile (GL890) gloves and placed in the same type of a plastic container as the invasive knotweed samples.

Scent testing

Testing was conducted within 1 hr of sample collection in the parking area at ai:LAB. For each scent test, the area was standardised at approximately 50 m^2. Following initial Japanese knotweed sample testing, other invasive knotweed species/varieties were not tested based on taxonomic similarity. Samples and distractors were placed on the ground in the testing area while the detection dogs remained in their pens. Each invasive knotweed sample was accompanied by the placement of new distractors to ensure that the detection dogs were not responding to a novel scent out of place in the environment (which can occur if only the target samples were placed).

Detection dogs were removed from their pens independently and instructed to search. Time from instruction to 'full' indication was recorded by Dr Jones (Figure 2). For the indication to be accepted as a 'full' indication the dog had to perform a 'sit' or a 'down' with no hesitation as the handler was not blind to the test conditions or sample placement (this will be the subject of further research).

Species/variety	Indication	Fenix detection time (sec)	Nica detection time (sec)
Japanese Knotweed	Full	128	9
Dwarf Knotweed	Full	34	17
Conolly's Knotweed	Interest	34	19
Bohemian Knotweed	Full	51	14
Himalayan Knotweed	Full	7	15
Giant Knotweed	Full	6	6

Figure 2: Detection dog response time (seconds, sec) for each invasive knotweed species/variety.

Results

Japanese, Dwarf, Giant and Bohemian Knotweeds were detected with a 'full' indication by both detection dogs. For Fenix and Nica, mean detection time for these key UK invasive knotweeds was 45.2 and 12.2 secs, respectively. The closely related Himalayan Knotweed was also detected with a 'full' indication by both dogs within 15 secs. Interest in Conolly's Knotweed was shown within 34 secs, though this did not represent a 'partial' indication.

2.3 Japanese Knotweed belowground scent testing

Testing areas

Japanese Knotweed has been effectively controlled and managed at ai:LAB using glyphosate-based herbicides since 2012. Three testing areas where no visible aboveground knotweed growth is present were identified by Dr Jones for scent testing prior to arrival of Canine Detection Solutions (29 April 2021).

These areas (approximately 50 to 100 m^2) consisted of:

1. Main lawn– treatment undertaken between 2012 and 2018
2. Lawn near house – treatment undertaken between 2012 and 2017
3. Car park – treatment undertaken between 2012 and 2017

Scent testing

Detection dogs were removed from their pens independently and instructed to search by their handler (Kat Janczur). Time from instruction to ‘partial’ and/or ‘full’ indication was recorded by Dr Jones, as he had prior knowledge of the locations of Japanese Knotweed which has been previously treated (Figure 3). As the handler was blind to the test conditions and knotweed locations ‘partial’ and/or ‘full’ indications were accepted: ‘full’ indication involved the dog performing a ‘sit’ or a ‘down’; ‘partial’ indications were instances when the handler initially identified changes in the dog’s behaviour. Changes in behaviour included an increased interest in a specific spot, often accompanied by sneezing. Following identification of ‘partial’ indications (particularly for detection dog Fenix), Dr Jones was able to identify changes in behaviour and record this data accordingly. Note that in the video data captured, there are often several ‘partial’ indications following the first in areas of treated knotweed (this will be the subject of further research).

ai:LAB location	Fenix		Nica	
	Partial (sec)	Full (sec)	Partial (sec)	Full (sec)
Main lawn 1	2	N/A	7	12
Main lawn 2	12	N/A	15	26
Main lawn 3	6	N/A	N/A	4
Main lawn 4	No data	No data	N/A	8
Main lawn 5	No data	No data	12	27
Main lawn 6	No data	No data	N/A	8
Lawn near house 1	5	N/A	12	36
Lawn near house 2	10	20	N/A	12
Lawn near house 3	N/A	35	N/A	16
Carpark 1	42	N/A	N/A	30
Carpark 2	N/A	17	No data	No data

Figure 3: Detection dog (Fenix + Nica) response time (seconds, sec) for ‘partial’ and/or ‘full’ indications over historically treated Japanese Knotweed with no aboveground growth visible. Where: No data = no test performed at this location; N/A = no partial/full indication.

Results
Belowground living Japanese Knotweed rhizome (root) was reliably detected by both detection dogs within 60 secs in all three testing areas.

3. Discussion

3.1 Invasive knotweed scent detection trial

All key invasive knotweed species present in the UK and subject to a wide range of legislation were detected with a ‘full’ indication by both detection dogs i.e., Japanese, Dwarf, Giant and Bohemian Knotweeds. Mean detection times for all key UK invasive knotweeds was less than 60 secs by both dogs. The closely related Himalayan Knotweed, subject to devolved Scottish Government legislation, was also detected with a ‘full’ indication by both dogs within 15 secs.

For the rare Conolly's Knotweed, interest was shown by the dogs within 34 secs and the dogs did not show any interest in the distractors. This may suggest that there are similarities in the scent of Connolly's knotweed and the other invasive knotweeds that are strong enough to make the dogs pause, but not similar enough to treat it the same as the other knotweeds. This is presumably because Conolly's Knotweed is a hybrid of Japanese Knotweed and Russian Vine (Hocking et al. 2019) and the scent profile of this plant differs from the other invasive knotweed species/varieties (this will be the subject of further research).

In summary, detection times were rapid given the relatively large testing area (50 m^2) and considering the small size of the samples, combined with the use of distractors. This test demonstrated the reliability of using well trained detection dogs for aboveground location of key UK invasive knotweed plants.

3.2 Japanese Knotweed belowground scent testing

Both detection dogs reliably detected belowground living Japanese Knotweed rhizome (root) within 60 secs in all three testing areas. Some of this treated knotweed has displayed no aboveground growth for more than 3 years (Jones pers obs.). This highlights how belowground growth remains alive and continues to emit scent compounds for several years following effective treatment with glyphosate-based herbicides (Jones et al. 2018). Further, the main lawn testing area was in close proximity (<20 m) to extensive managed and unmanaged Japanese Knotweed; despite this distraction, both dogs successfully and reliably detected belowground treated knotweed.

These findings have practical relevance for those buying and/or selling land that is likely to contain Japanese Knotweed that has been effectively treated historically with glyphosate-based herbicides. This is because such sites infrequently contain any aboveground knotweed growth and costly intrusive surveys involving excavation may reinvigorate knotweed growth.

4. Sources Cited

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