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Biodiversity Metric and Priority Habitats and Species of Conservation Priority

New Tool For Environmental Impact Assessments

New Volunteering Platform to Support Community Nature Restoration Projects

Lonneke Klein-Aarts
HOEK

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With the cascading costs of invasive species spread and treatment it is important to find infections as soon as possible. With the input of ecological detection dogs trained in finding invasive knotweed roots, early detection is possible and quality control of treated sites is improved. In treatment processes themselves sustainability and biodiversity issues are increasingly being considered. This article focuses on updates on proven methods and how incorporating monitoring with dogs can prevent further spread.

Introduction

Working as an invasive species consultant for HOEK I have come across many sites in a wide variety of habitats and with a diversity of related problems. After seeing so many sites you start to discover the likelihood of cause, presence and spread. As with all problems, prevention is better than cure. Acting at an early stage has now been made cheaper and easier when working with dogs. This approach is better for the carbon footprint, biodiversity and finances. From that perspective I would like to share the eight Ps of invasive knotweed control.

My Ps of importance while considering sustainability in invasive knotweed reduction are: prevention, people, planning, protection, plants, place, process and problems. It all starts with the most important P, that of prevention.

Figure 1. On the depot of the Nieuwe Kern project with treated soil. You can see healthy soil with a wide variety of herbs that have grown on top. Photo credit: HOEK.

1 Prevention using detection dogs

High-risk sites for invasive knotweed are places where soil has been disturbed; for example, on or near landfill sites, areas of newly laid cables and wires topped-off with contaminated sand/soil, major infrastructure projects for roads and railways and former waste land being used illegally to dump unwanted garden species.

When buying a plot or starting works it might be wise to inspect the area for presence of invasive species. A basic habitat survey by a professional ecologist/botanist is a good start. There are some limitations as plants may be covered up by other vegetation or not easily visually detectable in the dormant stage, and roots can be covered by disturbed layers in demolition of buildings. To overcome the limitations of visual monitoring scent-based monitoring increases the ability to find small plants in high vegetation and in soil with covered roots without upper plant parts. In the UK, Kat Janzur of Canine Detection Solutions uses her team of detection dogs. This provides valuable information required when selling property with historical invasive knotweed infection or as a guarantee of non-presence.

When a site is clear you want to keep it clear. That means that the material you bring in needs to be clean. Machinery previously used on a removal project can cause an introduction. Caterpillar tracks are difficult to clean but dogs regularly detect material on the tyres of trucks, shovel buckets, steps to the driver's cabin or the trailers used for transport. Unfortunately, much work is done by private contractors unaware of transfer risks.

Companies selling soil, compost and sand can increase their reliability using periodic controls with a detection dog and when receiving suspect material. Other possible methods are DNA samples but there are limits to the samples taken whereas a dog gives instant results and can easily search the whole load.

Example

On a 3 ha site someone recognised knotweed in a picture used in an older report. Demolition of buildings had taken place, with transport in all directions, and a top 10 cm layer had been ploughed. There were no upper plant parts to see as it was winter time and the developer was about to start construction.

The full site was checked by walking transects. Infected areas were indicated and excavated to different depths depending on the roots detected by qualified staff. Soil was sent away for treatment at an off-site location. Dogs were used to control the excavation, with a few extra scoops just outside and on the edges of the excavation followed by a final check. Within a month the situation was cleared and resolved.

2 People

A major component of prevention is people, both those who are working with soil, as mentioned above, but also in general. People are important for the recording of invasive plants. The more people are able to recognise and report knotweed the more and earlier that authorities can get a grip on the spots in public and private spaces. Having a webpage on the local authority website and an easy-to-use recording system to report knotweed presence or fly-tipping

Figure 2. On the Nieuwe Kern project, controlling the deeper layers of the depot. Outside control had already taken place 3 months earlier. Photo credit: HOEK.

helps. Information needs to be provided on bins so knotweed does not get mixed with composting material that is not treated under a controlled process in which all root remains will die.

A public authority can assist households with information, subsidies or taking in the material at a specific treatment or amenity site at reduced cost. Employers need to ensure that people are well trained and encouraged to follow the correct procedures. The right people, procedures and proper planning enhance successful treatment.

3 Planning

Everything starts with a masterplan. For example, for large-scale infrastructure projects or green urban spaces it is recommended to start a priority plan for all known sites and install alarm messages and pop-ups in geodata for works relating to other departments. When working in busy cities like Amsterdam, minimal use of traffic routes is key. Machinery is left on site for the duration of the works, and is cleaned and checked for root fragments prior to being moved. Creating an off-site treatment location that rotates material with similar local soil conditions can speed up the treatment of different sites. Each spot needs to be indicated as one to be treated or one that is contained within boundaries. Containment is an option if there are budget limitations. A well-placed and -connected root barrier is a secure way to protect adjoining properties or objects/sites of special interest.

Project management on sites with invasive plant material should be similar to sites with chemically contaminated soil: with well-marked and divided clean and contaminated areas. That means clear risk assessments, work protocols and instructions that are signed for. Embracing basic procedures is important; for example, make it part of a routine for people working on site or doing a survey to use a boot-cleaning facility on site or have a cleaning kit at hand in their car.

It is important with vulnerable material to have an organised control loop in place. Check routes, surrounding areas and vehicles on the day after work is completed. In case of widely spread small plants you can take out scoops and have staff trained to recognise the edges of the excavations on site, without the need to go unnecessarily deep as you can use dogs to check the spot on the following day. Without a dog a site needs to remain monitored and left untouched for 4 weeks in the growth season, April–September. In the months before or after this growth patterns are too variable due to weather and local conditions. If you have or hire dogs trained to detect roots you can prolong the season in which you carry out checks. With mild winter conditions this can be nearly year-round, but inspections by dogs are limited by very low temperatures, heavy downpours and wind.

4 Protection of the contaminated area

As soon as a location of knotweed is known it needs to be fenced off. Too often someone with poor instructions or without knowledge will pass by with a mower or digger and take root material elsewhere. If you know what grows on site you know what needs to be protected during works, such as rare species of plants, trees or fauna, or relics of historical importance. That means planning ahead, mitigating and often dividing the site into parts that can be fully treated and parts that require a unique method to save what must not be damaged.

The area around and the drive towards the site need to be fully protected with road plates and tarpaulins to prevent spillage. Even upper plant parts can grow roots when cut material ends up in waterways.

5 Plants

In the Netherlands different hybridised plants were found to be able to reproduce seed in standard growth conditions as far back as 2008 (Duistermaat *et al*. 2008). A test I ran in 2021 on seeds found in monitored locations showed the problem is more widespread than assumed and that knotweed produces viable seedlings in other provinces of the Netherlands as well. On mature sites knotweed seedlings will be outcompeted by light later in the season but other vectors that cause spread, such as visitors, birds, the coats of mammals and transport through the air, can cause further uncontrolled spread away from the original location. Therefore, learning to recognise male plants and eliminating them before pollination of flowers takes place should be on the to-do list in any plan, regardless of whether the site is treated.

Knotweed is able to be dormant as rhizomes over winter and for several years even if conditions are not optimal for the plant, so treatment should always involve root biomass reduction. Usually the process is split into an initial treatment and a secondary one. Whether a method is successful depends on local soil conditions and the stability of the treatment conditions during the treatment process. For example, if you want to limit root development by causing wet rot, the full site needs to be inundated even during a heatwave in the summer. As soon as the waterline retreats the plants start to re-emerge.

6 Place

Each place is unique. I advise always looking around what resources are available: soil profile, a 3D profile, obstructions and the presence of fresh or salt water. Stressing the plant or root by using the elements is sometimes easily done if time is available. The more time, the more sustainable options that are open to you.

7 Process

With rising energy costs and a focus on climate-sustainable methods it is important to elect the most suitable option for the site conditions with the lowest energy/carbon footprint. The methods 'we' have come across over the years with proven real-world field results are in Table 1. They are dived in full treatments, primary root mass reduction and secondary treatments.

Example

In project Nieuwe Kern, a former sludge and soil depot for the city of Amsterdam, two large depots had soil contaminated by invasive knotweed as well as several spots outside that were near earlier excavations. The area had been visually inspected for over a year. It was the first operational field work for root detection dogs Bliss and Bruce. They indicated spots in an area where sand had been added. Roots and trunks of removed trees also held knotweed

Table 1. The most practical treatments for removing knotweed from soil.

Method	Time available	Type	Size	Soil type	Proximity to water needed?	Cost	Energy
Inundation	At least 1 year	Full	Any	All; best on loam/clay	Yes	£	Solar pump
Root reset	7 months	Field, full	>100 m2	All	Yes or watertank	£	Tractor
Root reset	5 months	Depot, full	Any	Sand; clay easier in situ	Yes or watertank	££	Tractor
JD-killer	from 1 day	On-site plant	40 m3/day	Sandy	No	£££	Biodiesel
Electrocution	3 years+	Primary	100 m2/day	All	No	£££	Generator/diesel
Electrocution	1 year+	Secondary	100 m2/day	All	No	£	Generator/diesel
Heat injection	2 years+	Primary and secondary	100 m2/day	Sand	If practical	££	Diesel
Biological psyllid	Long term	Secondary	Unknown	All	No	£	No
Ecosystem resilience	Long term	Secondary	Any	All	No	£	For excavation and planting

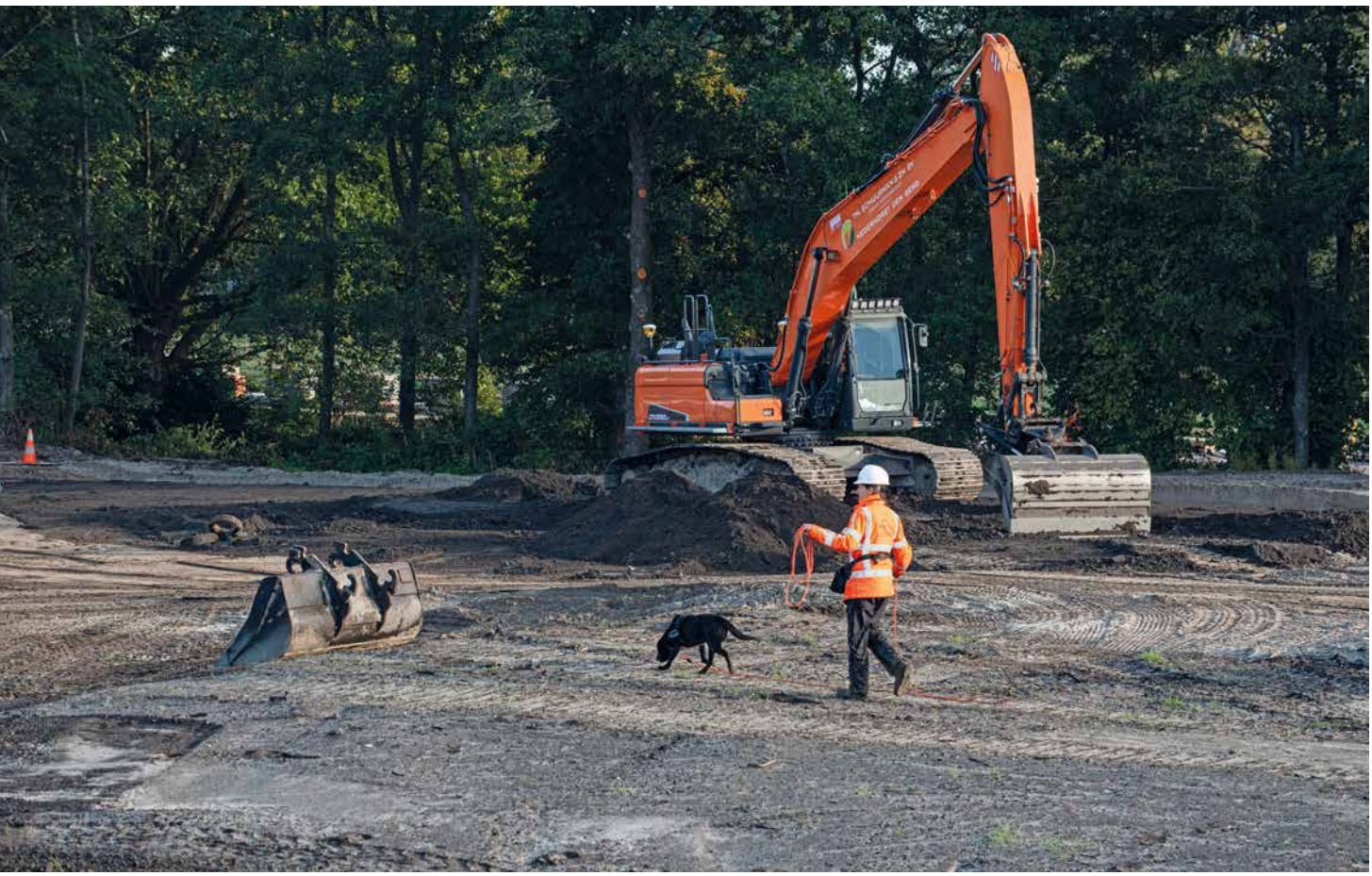

Figure 3. On the Nieuwe Kern project, checking soil that has already been spread to ensure that there is no site contamination. Photo credit: HOEK.

roots and so needed to be treated accordingly. On the day after excavation the site was checked to see if removal had been successful.

After the area in which sand transport had started was cleared, the roots reset method (Table 1) was used to treat the depots and the extra material from last-minute excavations. Roots reset is a unique biological method, making use of the plant-based CleaRoot granulate, which is incorporated into the soil followed by covering the soil and making it oxygen-tight. CleaRoot feeds specific microbes already present in the soil. As a result, these microbes grow rapidly and consume all the available oxygen in the soil. Within 2 days the oxygen level drops to less than 1%. In the absence of oxygen, further fermentation takes place. This process is harmful to the roots of invasive plants; the roots die within 6 months. Currently projects are still monitored until 4 months after finalising the process for extra security. This is suitable for on-site treatment with few obstructions or for use at depots. It is a cost- and energy-efficient natural option, works on heavy soils and only requires normal contractors' machinery. But it is also essential that the application is applied correctly and can be disturbed by wildlife or people. Sites need to be well protected during the treatment process. The 8500 m3 in this project were left consolidated for 7 months and were ready for re-use in June 2022 without any regrowth of knotweed but with lots of flowers and wildlife.

JD-killer

Instant on-site result when little time at hand. Can run on bio-oil. Need space around the treatment spot of 20 by 10 m for the treatment plant set-up. Based on sieving coarse material, heat treatment of residue that can be placed back directly. Suitable for sandy soils.

Inundation

Inundation can be used if the treatment period of a year is an option, even in an extremely dry summer. We ran trials on mature sites with positive results. Twelve months are required to fully kill roots over 25 mm in diameter. It is also practical as a secondary treatment after excavation in the wet winter season, for example. It can eliminate deeper-situated small rhizomes and small roots. Trees like willow and elm can survive the treatment. It is a low-cost option and we used a pump that worked on solar panels with little noise to avoid disturbing wildlife.

Ecosystem resilience

Ecosystem resilience (Bargerveen 2019) is based upon increased plant competition using native species. This is an option where containment is elected after initial biomass reduction in the top layer. It works with shade-tolerant competition in all layers with trees or shrubs for example with beech, lime tree, hazel and hop. In mature sites brambles reduce the speed by which knotweed horizontally spreads over the season but it does not push back mature knotweed.

8 Problems

Trees of high historical or ecological value create special challenges as you want to differentiate between roots that need to thrive and those that must die. Electrocution is an option but requires over five return visits if you are unable to reduce the knotweed root biomass first. Success depends on root biomass and interconnection and always involves repeat treatments. Some deciduous tree species are well adapted to pollarding and then it is easier for the tree to deal with some root reduction or enclosure to prevent horizontal spread. The disadvantage for the tree is that it cannot spread naturally but that counts for the knotweed as well. We ran trials combining horizontal and vertical root barriers with a 20 cm top layer of clean soil to create downward pressure. Horizontally placed barriers placed for long periods should made of material that allows oxygen and water to cross them. Barriers need to stay in situ for 6 years so the end results are not yet known. The site can be made to look presentable using native flora during the treatment period.

Another problem is that in the search for space, roots often find drainage, water or sewage pipes, or use underground cables to spiral around and grow along. Dogs have been shown to be helpful in finding roots much further down along pipework when the location of the upper plant parts is visible.

Conclusion

In the control of knotweed progress is being made in sustainable on-site methods that reduce transport emissions and reuse of material. There are more options on large sites for contractor's machinery to be treated with little need for soil handling. Even when excavation is required use of trained staff and dogs can limit the amount of soil to be taken and a high success rate still be achieved. There is evidence that the nineth P, pesticides, can be moved from the number one method in the UK towards the bottom of the list of options available, as environmentally friendlier, more sustainable methods are taking over.

Future challenges are in the prevention of further spread of knotweed by controlling and limiting transport of contaminated soil, incorporating invasive species surveys, implementing control in major infrastructure works and making priority plans for large land owners. Dogs are valuable in the period after infection takes place but before growth on site and an exponential rise in costs. This work can create a diverse site with native species to be proud of.

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About the Author

Lonneke Aarts works as an invasive knotweed consultant and handler of trained detection dogs for HOEK. Her areas of expertise are natural processes, plants, trials and protocol writing. She was asked to extend earlier lab experiments to a Living Lab location on a chemically contaminated site on the outskirts of Amsterdam. This government-funded testing involved several methods on a large scale, monitoring the results and its ecological impact.

Contact Lonneke at: lklein@hoekgroen.nl