

Detecting animal burrows with smoke bombs

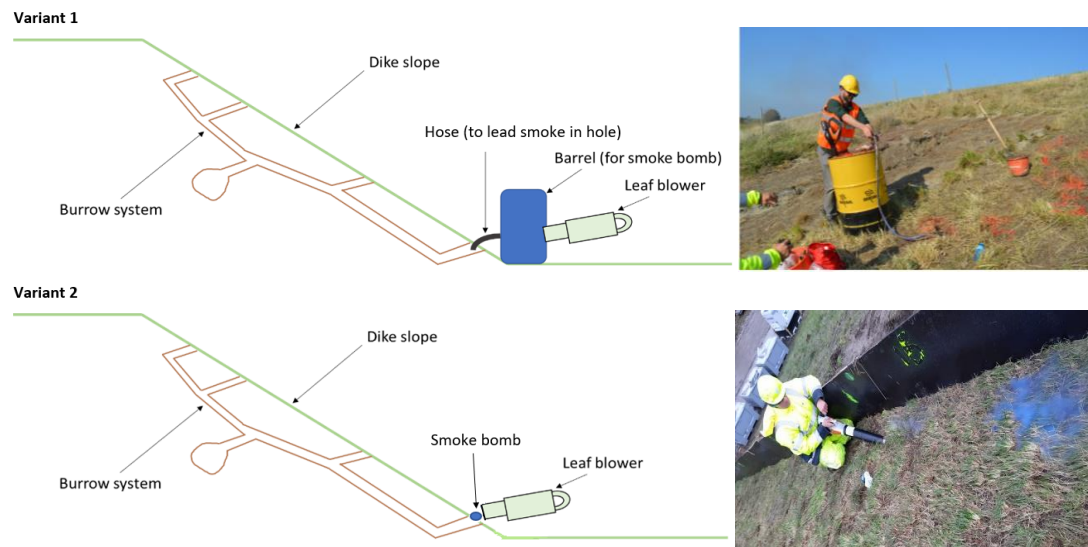
Lessons from Polder2C's trials

What was the challenge in which context:

Within the context of animal burrows surveys that took place in the test season 2021-2022 in the living lab Hedwige-Prosperpolder, an experimental setup with smoke bombs was developed to verify whether detected burrows by small rodents are interconnected in the subsurface. By injecting colored smoke in one of the detected burrows the team could observe if the smoke would exit the ground from other burrows in the proximity gaining insight into the extent of subsurface connections of burrows. The detection of several exit points is a sign that there is a system of tunnels in the levee that leads to a den. This is most likely a weak spot on the levee that requires attention by the levee managers. The test was repeated 5 times using different variants in its assembly and also testing burrows by larger animals. This helped to gradually improve the setup and make it more practical for use by levee inspectors.

Possible configurations

- The smoke test worked well in two different configurations (see figure 1), but they both have advantages and disadvantages.



Characteristics of event

Theme lesson learned Feasibility of smoke experiment

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Relevant publications with hyperlinks [Management of harmful animal activity on levees: Fact finding fieldwork in the Living Lab Hedwige-Prosperpolder](#)

[Effect van dierenholen op stabiliteit van de dijk](#)



- The advantage of the first configuration is that it directs all smoke in the burrow system without any smoke losses. This makes it easier to spot the exit points as there is no additional smoke spread in the atmosphere, especially when it is windy. This also minimizes the inspectors' contact with smoke. Its disadvantage is that a barrel and a hose need to be carried to the location.
- To make application of the first configuration easier, inspectors could try to use a smaller barrel than the one used in the living lab Hedwige-Prosperpolder. In this case though they have to make sure that they combine the barrel with a hose that is heat-proof.
- The advantage of the second configuration is that it only requires a smoke bomb and a leafblower, which are easy to carry to the location even by one person. Its disadvantage is that there are smoke losses at the entry point, which make it more difficult to discern smoke that comes out from exit points.
- When the second configuration is used, it is advisable that inspectors use a face mask and protective glasses to prevent contact with smoke.

Preparation

Materials used for variant 1:

- WORK WG549E.5 leafblower, 18V battery powered, rated for 200 km/hr max velocity.
- Standard garden hose and brass hose barb connectors with hose clamps.
- A used 'standard' 200 L drum was used; choice made because it was free and available, not based on size requirements, except that it needed to be bigger than a paint can (2.5 L) that was used in a previous unsuccessful test run.
- Conventional pull-string-activated 'smoke bomb' (rookbom): 55 m³ smoke volume, 1 minute duration, various colors.
- A bucket with wet clay or 5-10 plexiglass plates.
- Gloves.

Materials used for variant 2:

- BGA 45 leafblower, 18V battery powered, rated for 137 km/hr max velocity.
- Conventional pull-string-activated 'smoke bomb' (rookbom): 55 m³ smoke volume, 1 minute duration, various colors.
- A bucket with wet clay or 5-10 plexiglass plates.
- Face mask, protective glasses and gloves.

Execution

- The test can be executed by one person, but the presence of a second person is preferable to ensure that all exit points are spotted. This is crucial as the exit of smoke happens within seconds.
- During execution of the test with any of the two configurations, it is important that the inspectors block the discovered exit points as soon as possible, so that the remaining smoke is directed to other exit points. This will help discover as many exit points as possible.
- The exit points can be blocked either with wet clay or with plexiglass plates. The plexiglass plates are in general preferable as they can be easily transferred to the location and they do not leave any marks when they are removed.

- The team used smoke bombs that produced orange, red and purple smoke. Orange and red was difficult to see with dry grass; purple was very visible in all weather conditions attempted.

Evaluation

- The trials showed that the smoke experiment is an easy, practical and low-cost technique to detect systems of burrows that are interconnected.
- The trials did not provide satisfactory results in all locations. This shows that there are probably factors that can affect the result of the smoke test. Based on the available information, possible factors are the size of burrows, water content in the soil and other soil properties. This requires further investigation.
- During the successful trial of the test on the Prosperpolder levee, a number of burrows were spotted that had not been detected during the visual inspection. This illustrates how the smoke test can be complementary to visual inspections, and help inspectors spot burrows that they may have missed in a regular visual inspection.
- The test was performed with the second configuration in burrows made by larger animals (fox and rabbit holes) and it worked well. It is worth noting that exit points were discovered in relatively long distances from the entry points (about 10m away), which illustrates the capacity of the technique to detect long underground corridors.
- Further research and feedback from biology and chemistry experts is necessary in order to clarify whether the technique can be used in a manner that is safe for the animals.



Figure 2: Smoke bombs



Figure 3: Burrows covered by plexiglass plates



Figure 4: Execution of the test with variant 2.



Figure 5: Evidence of red smoke exiting the burrows in the red rectangles



Figure 6: Application of wet clay on burrows where smoke was witnessed



Figure 7: Two burrows covered with wet clay.