Journal of Conventional Weapons Destruction

Volume 5
Issue 3 *The Journal of Mine Action*

Article 40

December 2001

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Recommended Citation
McLean, Ian (2001) "What the Dog's Nose Knows," *Journal of Mine Action* : Vol. 5 : Iss. 3 , Article 40.
Available at: https://commons.lib.jmu.edu/cisr-journal/vol5/iss3/40

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Journal of Mine Action

Wednesday 13th July 2016Wednesday 13th July 2016

What the Dog's Nose Knows

Mine clearance is an ongoing process that is both tedious and expensive. Mine detection dogs are one tool in the toolbox. These dogs are far from fool-proof, yet they are constantly making strides in assisting demining efforts worldwide.

by Ian G. McLean, *Research Analyst, GICHD*

Introduction

The Kharga site being cleared prior to laying of test mines.

Over 100 million landmines scattered across the planet block access to productive land. Such access creates food, an economy, a community and a life. Just the possibility of one mine can prevent the return of entire communities to their homelands. The mines must therefore be found and removed. Removing mines is necessarily a hazardous occupation. Unfortunately, mines are secretive by nature and design. A mine that cost $5 (US) to buy, 10 seconds to arm and two minutes to lay will take a 12-person team a full day to locate and remove. The cost will be about $1000. Clearly, any method for reducing that cost must be explored and exploited.

One solution is that most mysterious of mammalian senses: olfaction. The skills of dogs as odor-detection devices are well known. Their ability is exploited in many different roles, ranging from drugs and bomb detection to search and rescue. So why not mine detection? Why not indeed! Today, about 400 dogs are used globally to search for mines with impressive success. The biggest program is in Afghanistan, where 130 dogs work six days a week on the daunting problem of detecting the undetectable. How mine detection dogs in Afghanistan achieve that task is the subject of the first study ever to link searches by dogs to the availability of odor signals given off by mines.

Processing the Signals

Listen to a person speaking a foreign language. The sounds are easily detected, but without an assigned meaning, the signals are just a stream of noise. Learning the language involves a two-stage recognition process: first, the sounds must be broken down into defined units; second, each unit must be assigned a meaning. The process is one of plucking sense from nonsense, or of linking signal detection to meaning. Once the two are joined, recognition has occurred.

For a dog, learning to detect a mine involves the same process. Its nose is constantly bombarded with chemical signals, or what we call odors. Most of those odors are noise—they have no meaning and are of no interest. The dog will already have a simple odor language, consisting of simple concepts

such as "rabbit" or "the female dog who lives next door" and can effortlessly separate those recognizable odors from background noise.

Journal of Conventional Weapons Destruction, 2001, Iss. 5, Art. 40

Odor Signals

The problem in mine detection is for the dog to assign meaning to the odor signals given off by a mine. Unfortunately, mines have no interest in communicating with dogs. Compounding the problem is that the main explosive substance used in mines, TNT, has very low volatility. The problem can be compared to listening in on a whispered conversation in a foreign language at a cocktail party; not only are the signals hard to recognize, but they are swamped by a noisy background and are not intended for you anyway.

Dogs can do it. Asking dogs to find mines pushes their detection skills to the limit. A significant unknown factor in the detection process is the availability of signals to detect. Just what odor signals does a mine provide, and are there conditions when signal availability falls below the recognition threshold for the dog? Clearly, such conditions might cause the dog to miss the mine and must be avoided.

The Afghanistan study is addressing these questions. The dogs are tasked with searching for mines in test mine fields (the mines are real, but triggers have been removed) under carefully controlled conditions. Immediately after the dog has found (or missed) a mine, soil samples are taken and weather conditions are recorded. The behavior of the dog is continuously filmed for later analysis, and the handler is interviewed.

Soil

Why soil samples? TNT molecules that leak out of the mine migrate slowly to the surface, assisted by soil moisture and electrostatic processes. Once at the surface, they remain bound to dust particles. How they enter the dog's nose is not yet understood, but it is known that detection is improved if the dog's nose is at ground level—the dog must sniff the ground rather than the air. The availability of TNT molecules in each sample will be assessed by chemists. The dog searches at the ground/air interface, thus the chemists should similarly measure TNT in the surface layer of soil. The study will run for two years, during which dogs will be asked to search for mines in all typical weather conditions.

A camel crossing a test field. Wildlife and domestic animals are at serious risk from landmines, with about 300,000 having been killed in the last 10 years.

Worldwide, mines are still being laid at higher rates than they are being cleared. However, clearance rates are improving, due in large part to the use of dogs for mine detection. Increased understanding of how dogs detect mines and the limits to that detection skill will serve to improve the quality and safety of clearance operations globally.

Conclusion

Currently, 5000 Afghans work in mine clearance programs. At great personal risk, they return thousands of hectares of mine-contaminated land to economic productivity every year. They work towards a vision of a safe and productive environment, a functioning economy, and a stable socio-political landscape for Afghanistan. That vision is ambitious enough. But beyond even

that, they hope that the dog's nose project will allow others to benefit from the devastation wrought in their country. Their extraordinary commitment must be applauded and supported.

All photos courtesy of the author.

A dog signals the presence of explosives during the preliminary clearance of one of the test fields. Another clearance site can be seen in the foreground.

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Publisher: MAIC **Contact:** MAIC@jmu.edu **Last updated:** 07/13/2016 13:30:52**Last updated:** 01/11/2016 20:48:33

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