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A nose for danger

Ten years ago, a Belgian rodent-lover decided that rats were smart enough to detect land mines. Now, he's training an African species to do just that - and it's working

By Rich Cookson

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At the Sokoine University of Agriculture in eastern Tanzania, one field is always kept under guard. It may look like an innocuous suburban allotment, its 24 hectares divided up into neat plots, but there's a good reason for the high fence and round-the-clock security: 14 different kinds of land mine, 2,000 of them in total, are buried in the soil. Each of the plots contains up to 20 explosive devices, packed with TNT.

Early every morning, while the air is still cool, an open-sided lorry arrives from the university campus carrying researchers and about 40 large rats in plastic cages. In the shadow of the craggy Uluguru Mountains, the researchers unload the rats, fit them into harnesses, clip them on to lengths of rope stretched across each plot and send them out across the minefields.

The rats - each the size of a domestic cat - sniff the ground in a wide arc as they walk. When one gets to the other side of the plot, the researchers move the rope about a foot across the minefield, turn the rat round, and send it back across the earth. It is when the rats stop, sniff the ground hard and start to paw at the soil that their skills become clear. These rodents are the latest and most innovative weapons in the fight to uncover the millions of mines and other unexploded ordnance (UXO) that maim or kill tens of thousands of civilians every year. Their scratching indicates the exact location of an unexploded bomb.

For centuries, rats have been reviled for destroying crops and spreading disease, but the African giant pouched rat (Cricetomys gambianus) may be about to change their image. Intelligent and easy to train, they are set to improve radically the way land mines are detected in Africa. Twenty are already working in Mozambique - whose civil war left a legacy of about 500,000 unexploded mines - and with another 240 in training, they could soon be saving lives from Sudan and Ethiopia to Angola.

The project is the brainchild of Bart Weetjens, a 38-year-old product designer from Belgium. "I've always been a rodent-lover," he says. "As a boy, I kept rats and mice and bred them." In the early 1990s, he was working for a coach- manufacturing company when he saw a documentary about low-cost prostheses for land mine victims. "I was not very happy working in an office. I wanted to do something more important and it was clear that land mine detection was a really big problem,' he says. Several months later, Weetjens came across some papers written by US researchers in the 1970s. "They had trained gerbils to detect explosives," he says. "it involved putting electrodes in their brains and stimulating their pleasure centres every time they smelled explosives, so that they'd start to associate the two." It was a eureka moment. "if they could do it with gerbils, then why not rats? I wanted to do it in a completely different way - one that didn't involve electrodes - but I was sure it could be done."

Weetjens started writing proposals, but it was two-and-a-half years before he made any real progress. "The idea was simply too crazy," he says. Then, in November 1997, the Belgian

government gave him a grant for a feasibility study and he registered APOPO - a Flemish acronym for Anti-Personnel Mines Demining Product Development - as an NGO.

Of the 2,000 types of rat, the African giant pouched species has clear advantages for this kind of work: it’s widespread throughout Africa and so can work almost anywhere on the continent; it lives for up to eight years (compared with two years for other species); it is relatively large (rats of this type weigh up to 1.5kg), so it can be seen and handled easily in the field but it's not so heavy that it's likely to set off mines; and, most importantly, it has an incredibly sensitive sense of smell. Even so, Weetjens had his work cut out. "We caught some rats in Tanzania and took them back to Belgium. It took us two-and-a-half years to prove that they could be bred and trained to recognise TNT - but even then we hadn't proved they could detect land mines out in the field."

In 2000, APOPO established modest offices, a laboratory and a field-testing site (just five hectares) in Tanzania. Now, it employs 70 staff and receives nearly 1m (£700,000) in funding from bodies including the European Union and the Geneva International Centre for Humanitarian Demining (GICHD). "The rats have been officially accredited [by GICHD], but we are still looking for sustainable sources of funding. It's like designing a car: we have a prototype, but now it needs constant refining," says Weetiens. It's urgent work. The International Campaign to Ban Landmines estimates that 15,000 to 20,000 new casualties are caused by land mines every year - an average of one every 30 minutes.

Research assistant Shirima Vendeline explains how the rats are trained. "At five weeks, the rats are separated from their mothers and nursed by hand, so they get used to humans. At about six weeks, we start click training, so they begin to associate the sound of the clicker with food. Then we put them in a cage with one hole that's filled with an explosive sample. When the rat sniffs the hole for a few seconds, we sound the clicker and give it some food, so it starts to associate the smell of TNT with food. We then introduce them to cages with three holes, one containing a sample of TNT and two neutral samples."

Once they're used to walking around in a harness, the rats are trained with small metal containers that emit an explosive scent, before being moved on to real mines. "Finally," explains Weetjens, "we move on to intermittent rewarding - in the field, we don't feed them every time they find something so they have to get used to that. We aim for an 80 per cent detection rate and no more than 10 per cent false detection. In the field, we use three rats on each suspect area. That way they provide 100 per cent detection."

Weetjens and his colleagues now believe the training can be modified to enable the rats to detect TB. "I saw a BBC news piece saying that two million people died from TB every year. I knew there were real problems with spittoon smear microscopy, the standard test for TB in low-income countries. There's only a 70 per cent detection rate and it takes six weeks to diagnose the disease. I thought: 'if rats can detect landmines, why not TB?'," says Weetjens.

Initial tests were encouraging - "a skilled lab technician can process 20 samples a day whereas a rat does 150 in 20 minutes" - and that enabled APOPO to lever $165,000 (£85,000) funding from the World Bank for a full study. If tests prove that rats are up to the job, it could mean the development of a cheap and accurate diagnostic tool for use in labs throughout the developing world.

And it doesn't end there. "Rats could easily go into rubble to find earthquake victims," enthuses Weetjens. "They could also be used for detection of polluted soils, toxins in food, drugs, arms - you name it. It's a growing area of research. Scientists in Israel are training pigs to detect explosives, and other research groups are looking at using wasps and moths." But, he adds, "right now our main focus remains firmly on land mines."