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Illegal Wildlife Trade (IWT) Challenge Fund

Annual Report

To be completed with reference to the "Writing a Darwin Report" guidance: (http://www.darwininitiative.org.uk/resources-for-projects/reporting-forms). It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

Submission Deadline: 30th April 2019

IWT Challenge Fund Project Information

Project reference	IWT039
Project title	A novel system to detect illegal wildlife in shipping containers
Country/ies	Tanzania (APOPO) South Africa (EWT)
Lead organisation	Endangered Wildlife Trust
Partner institution(s)	APOPO
IWT grant value	£125,158
Start/end dates of project	April 2017 – October 2019
Reporting period (e.g. April 2018-Mar 2019) and number (e.g. Annual Report 1,2,3)	April 2018 – Mar 2019 Annual Report 2
Project leader name	Ashleigh Dore
Project website/blog/social media	www.ewt.org.za; www.apopo.org
Report author(s) and date	Ashleigh Dore (EWT), Cindy Fast (APOPO), 30 April 2018

1. Project rationale

The project rational remains the same as that stipulated in the previous annual report. Shipping containers are moved in large numbers through busy international sea ports and, from seizure information, ports are a known route for smuggling large volumes of wildlife. They represent a particularly challenging environment for law enforcement officials as current methods of screening shipping containers are expensive, time consuming, and potentially disruptive to port operations.

The aim of our project is to test a novel detection system suitable for the port environment – using African giant pouched rats (*Cricetomys ansorgei*) to detect pangolins (skin and scales) in shipping containers. While this proposal formally focusses on pangolins, we have also trained the rats and reported on African hardwood (*Dalbergia*), a commonly trafficked timber species. *Dalbergia* was included in an earlier phase of the project and we felt it sensible to continue including it in the training.

Our project follows a four-phased approach:

1. Proof of concept, for which we have received matched funding from the United States Fish and Wildlife Service (USFWS), to test if the rats can discriminate between target (pangolins) and non-target scents;
2. Training rats on complex scent mixtures, including commonly used masking agents used by smugglers;
3. In-depth psychometric analysis of the rats' sensitivity and specificity in detection of target samples, including identification of the minimum concentration of target among masking agents; and
4. Simulation of an operational environment to monitor and evaluate typical workplace-based performance of the giant pouched rats.

As reported by the CITES Secretariat during the CITES CoP17, pangolins are one of, if not the most, illegally traded mammal in the world. Information on seizures gives an indication of the scale of the poaching threat, where two recent seizures resulted in 26 tonnes of pangolin scales being removed from illegal trade.

The illegal trade in pangolins has become a significant activity within organised crime worldwide and sub-Saharan Africa has not escaped the attention of these criminal syndicates. As a result, all species of pangolin are listed under CITES Appendix 1 and their conservation status ranges from Vulnerable to Critically Endangered. Trade is the primary threat to pangolins in the wild. They are used in both African and Asian traditional medicines, and their meat is consumed as bush meat or as a delicacy. Lesser threats include habitat fragmentation, electrocution on fences, and road deaths. Our project addresses the key threat to the species through improved detection and thus better enforcement of illegal trade in pangolins.

The location of the project is Tanzania and while the focus of the project is not community upliftment the communities impacted by wildlife trafficking are local communities within the project area. When wildlife trade is legal, sustainable and well managed, it can benefit local communities, however, when it is poorly managed and largely illegal, benefits to communities are lost.[1] Pangolins exemplify this, due to illegal international trade, all pangolin species were uplisted to Appendix I in 2016, removing any opportunity for their commercial trade. Further, crime and violence associated with the illegal wildlife trade can undermine governments, economic development and stability due to a lack of broader economic opportunities available to rural populations.[2] Circumstances like these can render rural communities vulnerable or sympathetic to the financial support of poachers.[3] Lastly, illegal wildlife trade can directly encourage or finance civil conflict and insecurity and even cause localised weak economic development or exposure to price shocks.[4]

2. Project partnerships

The project partners remain the same as those involved in the project in Year 1. The Endangered Wildlife Trust (EWT) is a South African non-governmental, non-profit, citizen organisation dedicated to conserving threatened species and ecosystems in southern and East Africa to the benefit of all people. The EWT Wildlife in Trade Programme (WITP) Manager, Ashleigh Dore, is the Project Leader and the main contact person on this project. She is also responsible for the overall monitoring and evaluation and for general oversight of the project. The EWT's WITP works to reduce the illegal trade in wildlife and wildlife products through various initiatives, including capacity building among law enforcement agencies and the judiciary, cooperation and strategy development with other conservation NGOs, commenting on proposed legislation, and support

[1] Roe, D. 2008. The origins and evolution of the conservation-poverty debate: A review of key literature, events and policy processes. Oryx 42:491-503.
[2] Humphreys, J., & Smith, M. L. R. (2011). War and wildlife: the Clausewitz Connection. International Affairs, 87(1): 121-142.
[3] Gettleman, J., 2012. Elephants Dying in Epic Frenzy as Ivory Fuels Wars and Profits. New York Times, New York City.
[4] Douglas, L. R., & Alie, K. 2014. High-value natural resources: Linking wildlife conservation to international conflict, insecurity, and development concerns. Biological Conservation 171: 270-277.

for various rhino conservation initiatives. Our programme remains very well positioned to engage with this project.

APOPO is a non-profit social enterprise that researches, develops, and implements scent detection technology, using rats, for humanitarian purposes such as land mine- and tuberculosis-detection. APOPO is a Belgian NGO, with headquarters in Tanzania and operations in Tanzania, Mozambique, Angola, and Cambodia. The results of this ground-breaking and innovative work speak for themselves, including the destruction of more than 107,900 landmines and unexploded ordinances as well as more than 14,700 additional cases of tuberculosis detected by the rats to date. APOPO is the partner responsible for housing, training, and testing the rats for this project. Dr Cynthia Fast, APOPO's Head of Training & Behavioural Research & Development, serves as the project lead on behalf of APOPO.

While APOPO are world leaders in training and managing detection rats, the EWT has expertise in the wildlife trade sector with active contacts in customs and ports authorities. As such, each partner has a key strength that contributes to the success of the project, forming a cohesive project team.

The partnership between the EWT and APOPO continues to go from strength to strength. Our communications are primarily remote, due to the location of the two organisations, with APOPO in Tanzania and the EWT in South Africa but we are in regular communication with one another and in December 2018 were able to bring all the project members together in Dar es Salaam for a week which only strengthened the relationship. We have also received formal buy in for the project from the South African Revenue Service and the Tanzanian Joint Port Control Unit and we look forward to working closely with both agencies as the project move into its final phase.

3. Project progress

3.1 Progress in carrying out project Activities

Each activity is numbered according to the output that it contributes towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1.

Output 1: Proof of concept that African Giant Pouched Rats can detect and discriminate pangolin scents.

Activity 1.1 (appropriate training protocols are developed to train the rats to identify odours from target species) was fully completed in Year 1. Activity 1.2 (laboratory tests are conducted to test if the rats are able to discriminate between target species and control scents) and 1.3 (the rats have a 98% accuracy rate of detection) were fully completed by October 2018. Both activities 1.2 and 1.3 were designed to show the rats progression to advanced stage of discrimination training which required the rats to identify the target substances (three different volumes of pangolin scales roughly corresponding to different odour concentrations), while ignoring the non-targets (10 substances commonly found in seized shipping containers). During each of these training and evaluation sessions, the rats were presented with 100 samples containing only 12 targets (six pangolin samples and six hardwood samples), which could appear randomly in any of 10 different positions within the line cage apparatus. To ensure that the detection behaviour of the rats was not driven by subtle cueing from the human trainers, or any idiosyncratic biases that the rats may have developed throughout the course of training, two of the targets were coded as non-targets (i.e., they served as blind trials because the trainers could not know that these were target samples) and the rat's indication of these targets was not reinforced with a food reward. In addition to controlling for potential cueing and bias, these blind trials simulate an operational setting in which the human handler does not know where a target might occur and the rats likewise cannot be reinforced with food every time they find the target pangolin scales because the presence of which would be unknown or unverifiable in real-time.

During the final stage of training and testing, we assessed the rats' accuracy by calculating a discrimination ratio for each evaluation session and rat. The discrimination ratio provides a unitary measure of both sensitivity (correct hits) and specificity (correct rejects) by dividing the number of correct hits minus incorrect hits by the total number of hit responses, (i.e., Discrimination Ratio = [((correct hits + correct rejects) – (false alarms + missed targets))/((correct hits + correct rejects) + (false alarms + missed targets)))]) Thus, perfect discrimination is

represented by 1 while chance performance is reflected by a ratio value of 0.5. The 10 rats achieved an average of 97% correct responses across 1000 trials. As further evidence of the rats' stellar detection performance, they correctly rejected 99% of the 880 non-target samples encountered across 1000 trials, meaning the rats only committed an average of eight false alarms over 880 opportunities.

Output 2: The African Giant Pouch Rats can detect pangolins and hardwood masked in other scents

Activity 2.1 (identification of the most common masking agents through a literature search of seizure data) was fully completed in during Year 1 (please see Year 1 report).

Activity 2.2 (procedures to tightly control sample mixture preparation and training procedures are developed) was completed during Year 2. Although the photoionization detector (PID) was procured in Year 1 and underwent standard calibration that allowed its use with a surrogate odour during early training phases, we have been unable to use the PID with the pangolin derivatives because of the unexpected need for non-standard calibration with an additional gas. Without this secondary calibration, the PID cannot detect the organic compounds in use for this project. Through consultation with the PID manufacturer, organic chemists, and physicists specializing in volatile organic compounds, a promising gas for this calibration gas was identified and recently sourced internationally. The secondary calibration has been scheduled in the upcoming weeks. Nonetheless, we have been cautioned by the manufacturer and the consulting physicists that there is no guarantee this calibration gas will enable detection of volatiles emitted by all substances in use for this project. Therefore, we developed an alternative procedure to control the "relative stinkiness" of the samples by using the mass of each sample substance as a proxy for odour concentration (please refer to Table 1 below). Although this procedure is less precise, our base line tests, discussed below at page 7, show that it has been successfully implemented to control the odorants in use with Activities 1.2 and 1.3.

Activity 2.3 (training on complex scent mixtures, including target scents mixed with commonly used masking agents) was slightly delayed but started at the end of 2018 by presenting the rats with single odour samples composed of mixtures of two substances (relying on computed relative volume of each substance within the mixture to prevent any one odour overshadowing another). Some mixtures contain multiple non-targets presented together (such as coffee beans and washing powder), while others contain the target substance mixed with varying proportions of a non-target substance (for example, pangolin scales with coffee beans). The following ratios of target:non-target substances were used during the final test: 1) 50:50, 2) 25:75, 3) 10:90 and 4) 05:95. These proportions make use of the relative volumes determined in Activity 2.2 whereby a 50:50 mixture contained one unit of the target sample and one unit of the non-target sample, even if these were not equivalent volumes (e.g., a unit of washing powder contained less volume than a single unit of electrical cables). For more details please see Table 1 below.

Before conducting training with the mixtures, we evaluated how well the rats could spontaneously find the trained target when it was hidden among the masking items, by testing the rats with 60 samples of a target hidden among non-target items (including 20 mixtures with a 50:50 ratio of target:non-target, 20 mixtures of 25:75, and 20 mixtures of 10:90), as well as 45 mixtures (50:50) of two non-target items (including all possible combinations of the 10 non-target substances). As a reference standard, these tests also included 6 trials with the pure targets used during the previous stage of training (3 pangolin and 3 hardwood) and 29 trials with the pure non-targets (for results please see below, Figure 1 below).

After this test, the rats began focused training with various concentrations ranging from 50:50 to 10:90 to find the targets hidden in mixtures with the non-target items. This training is still ongoing and we expect to complete it in June 2019.

Table1. Volumes of sample substances used to roughly approximate the smelliness of each item when presented in a mixture. To this end, smellier substances were presented in smaller volumes. Bold items (pangolin and hardwood) represent target items while all others served as non-targets. Volumes represent a single unit of each substance (e.g,. as used in a 50:50 ratio) which was increased or decreased according to the ratio of target to non-target contained in a specific mixture sample (e.g., a 25:75 mixture of target:non-target would contain half of the target volume depicted in the table and 1.5 the volume of the non-target).

Sample item	Volume (g)
Pangolin	**0.5**
Hardwood	**1.5**
Electrical Cable	4
Cardboard	0.5
Coffee	0.5
Dengu seeds	4
Peanuts	0.5
Christmas Tree Seedpod	0.5
Christmas Tree Seed	4
Cotton textiles	0.5
Washing powder	0.2
Synthetic wig	0.5

Output 3: Feasibility of future operational application is assessed through in-depth psychometric analysis of the rat's sensitivity in detection of target samples, including identification of the minimum concentration among masking agents

Our rapid training protocol established during Activities 1.1 and 2.2 partially informed activity 3.1. (determining the concentration gradient for rat scent-detection limits for pangolins). During these activities, we used three different volumes of each target substance in an effort to ensure that they roughly corresponded to various odorant concentration levels of pangolin and hardwood. Although the rats showed an initial preference to detect the largest volumes, after our training protocol, all rats learned to detect all three volumes/concentrations of the pangolin. Furthermore, preliminary results from the interim test conducted during the training stage revealed that the rats show the greatest accuracy in detecting targets when they are a larger proportion of the mixture, with the poorest detection performance occurring when the target represented only 5% of the mixture (5:95). This result supports our strategy to equate odour intensity by using volume of the substances. It is worth noting that rats showed significant improvements in their ability to find targets hidden among non-targets following training and, because the rats were not trained on the 5:95 ratio, we can only speculate on their ability to find these and even lower target concentrations at this time.

Activity 3.2 (identification and analysis of psychometric properties of rat's pangolin and hardwood scent detection abilities) and 3.3 (assessment of translational relevance to real-life port activity through comparison to seizure data concentrations of illicit material among masking agents) are reported on jointly. These activities are dependent on full completion of Output 2 but the results described above indicate that the rats' ability to detect the targets (pangolin and hardwood) does depend to some extent on concentration (please see Figures 1 and 2 below) but also if the rat received explicit training with the sample and concentration in question.

Output 4: A system is developed to signal positive detection of pangolin to the rat handlers in a simulated operational environment (i.e. one that simulates conditions for screening containers in a seaport).

Detailed reporting on the Output 4 activities will be included once they are completed. In the interim, we have made progress in the completion of Output 4; a workshop was held in December 2018 in Dar es Salaam, Tanzania. Please see the workshop report referenced in Annex 4 and

sent as a separate PDF for full details. While accurate detection of targets is of utmost importance, it is also highly relevant that trainers and handlers correctly identify what the rat is communicating through its behaviour and that this behaviour can be identified despite potential physical barriers that might be encountered in the port environment. The rats in this project have been trained so far according to well-established training protocols in a standardised lab environment, which has allowed for controlled testing of various concentrations of the novel wildlife targets. Here, animals are indicating the presence of a target substance by keeping their snout in a sample hole for a specific duration (e.g., 3 seconds). However, it will not be possible to use this same line cage apparatus within a port environment (unless a remote scent tracing procedure using an air filtration system is adopted).

One novel indication response we are in the process of trialling involves the use of a newly developed harness equipped with a microswitch. The microswitch allows the rat to directly and unequivocally communicate to a human handler that it has detected an odour target by pulling a small ball which activates an unambiguous auditory signal – a clearly audible "beep". So far, five young rats have been successfully trained to use a prototype of this device. The success of these rats clearly establishes the feasibility of the device and supports its further development. For example, should such a device be deemed suitable for use in the port environment, the microswitch could be wired to transmit an Ultra Wideband signal to a trainer's handheld device that could include additional information such as precise location relative to other Ultra Wideband transponders (essentially reconstructing the port environment in a virtual grid). This could be potentially useful in situations where the rat is not expected – or able – to stay within sight of the trainer.

A second novel training procedure is also under development. This involves training our rats to press a lever in a portable chamber whenever they detect a target odour. This apparatus could be particularly useful in a port environment to keep the rat in a protected and contained area while easily transporting it to various odour-sampling areas such as vent holes of shipping containers. We could even envision placing the chamber on a small elevator (or forklift) system to grant the rat access to stacked shipping containers or simply positioning the rat in its mobile unit alongside existing technologies such as X-ray scanners. Although our rats have never before been trained to press levers, we have successfully trained four pouched rats to perform this lever press behaviour, thereby clearly establishing its feasibility from a training perspective.

Output 5: Women, where ever possible, are included as project staff and are empowered and capacitated at both organisations

At the EWT, Ashleigh is the Project Leader and is responsible for the day-to-day coordination of the project and general project management, overseeing the M&E component of the project. At APOPO, this project is under the direction of the Head of Research and Development, Dr Cynthia (Cindy) Fast, with day-to-day research activities closely monitored and conducted by Dr Miriam Schneider and Ms Mariam Juma. There are currently 2 male trainers and 1 male lab technician involved in the project, making the current APOPO team 50% female.

Over the course of this project, several women, (including junior scientists/students Dian Kuipers, Kate Webb, and Haylee Ellis) have served as primary research technicians of this project. The research technicians handle all day-to-day activities to ensure training is progressing as planned, including planning the daily training sessions, entering data into the workbook, and overseeing sample preparation and training procedures.

APOPO: staff have logged 3600 hours on the project to date. The EWT logged 250 hours. As part of the internal procedures for both the EWT and APOPO, each staff member undergoes a performance appraisal twice a year. This appraisal considers the performance over the reporting period and areas of learning opportunities for each staff member.

3.2 Progress towards project Outputs

Output 1: Proof of concept that African Giant Pouched Rats can detect and discriminate pangolin scents.

Indicator 1.1 *The 8 rats have more than 95% accuracy rate of indication on target species, in a set of at least 1000 trials, in* ex situ *conditions versus control samples within six months after the commencement of training*

Calculating the discrimination ratio (as described above) revealed near perfect discrimination of the 10 rats. In fact, the 10 rats achieved an average of 97% correct responses across 1000 trials. As further evidence of the rats' stellar detection performance, they correctly rejected 99% of the 880 non-target samples encountered across 1000 trials, meaning the rats only committed an average of eight false alarms over 880 opportunities. The very low false alarm rat is especially impressive when considering the inclusion of highly desirable food stuffs (such as peanuts) as non-target samples. That is, our rats showed incredible restraint to not be distracted by, or otherwise react to, the presence of food. Furthermore, we exceeded our goal of eight rats meeting the 95% accuracy criterion, with nine of the 10 rats achieving an average accuracy (measured as percent correct) of over 95% across the 1000 trials.

Output 2: The African Giant Pouched Rats can detect pangolins and hardwoods masked in other scents.

Indicator *2.1 The rats achieve an 85% success rate in detecting pangolin scent when mixed with at least one typical masking agent in 1,000 trails, within 10 months of training*

Results from the baseline test revealed that even without training, rats showed some ability to detect targets hidden in masking agents (Figure 1a). Although training is still ongoing, preliminary results from an interim test revealed that with some training, the rats can find these targets even when they are just 5% of the mixture (Figure 1b).

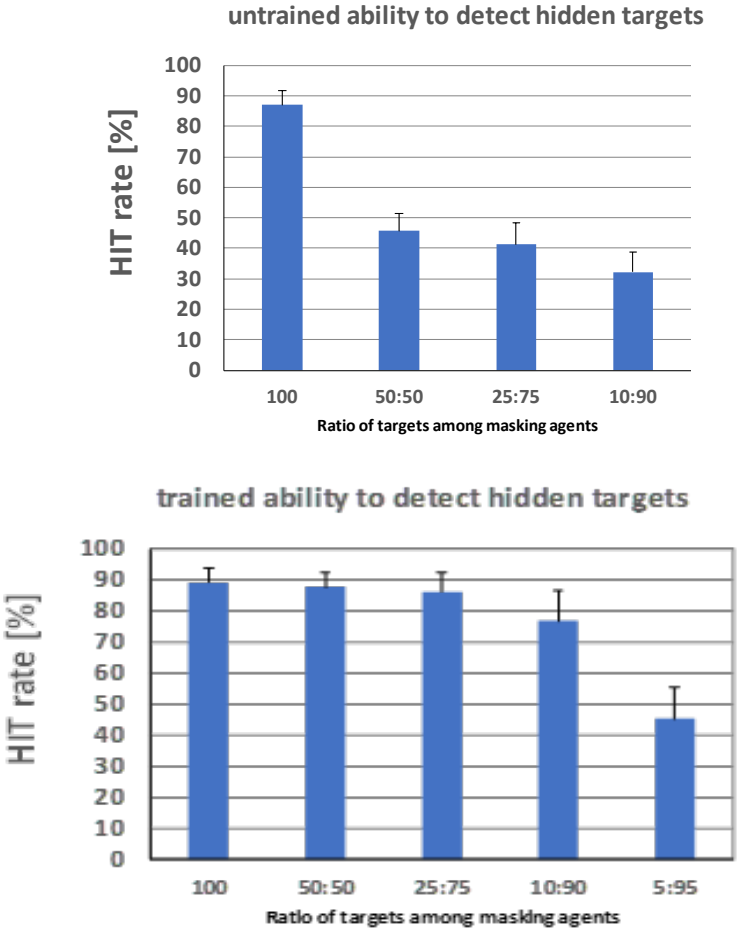

Figure 1. African giant pouched rats can find pangolin derivatives hidden among other items. A) (top) Untrained rats were able to detect the targets hidden among some of the mixtures with non-target items during a baseline test. B) (bottom) Interim test of trained rats showing marked improvement in finding the targets hidden in mixtures with non-targets. Not only did the rats find more of the hidden targets compared to during the baseline test (before training), they were also able to find the targets when they were only a small portion (e.g., 10:90) of the mixture. Additionally, rats detected a very low concentration they had not been trained on (5:95).

Output 3: Feasibility of future operational application is assessed through in-depth psychometric analysis of the rat's sensitivity in detection of target samples, including identification of the minimum concentration among masking agents.

Indicator 3.1 A concentration gradient, which determines the lowest threshold of ratio of one and/or two targets amongst five masking agents of the rats' scenting abilities, is established by month 15

Although training is ongoing, preliminary results reveal that the rats are capable of detecting a target when it represents only 5% of a total mixture with non-target items. It is likely that with additional training, this concentration could be reduced even further.

Output 4: A system is developed to signal positive detection of pangolin to the rat handlers in a simulated operational environment (i.e. one that simulates conditions for screening containers in a seaport).

Indicator 4.1 All eight rats are able to give their handlers an indication of a positive target scent within 15 months of training, with an obvious three second or more detection behaviour (e.g. scratching).

To be reported on once the activities have been completed.

Output 5: Women, where ever possible, are included as project staff and are empowered and capacitated at both organisations

Indicators *5.1 At least three women staff are assigned with project specific responsibilities at APOPO with at least 250 work integrated learning hours logged during project implementation, mentored by the Head of Training & Behavioural Research;*

Two women at APOPO serve as principle investigators for the project. Dr Cynthia Fast (the Head of Training & Behavioral Research) and Dr Miriam Schneider (Senior Researcher) In addition, one female rodent trainer has been involved in daily training and care of this project's animals. To date, a total of 3,600 work hours have been logged on the project.

5.2 At least one woman staff member is assigned with project-specific responsibilities at the EWT with at least 250 work integrated learning hours logged during project implementation, mentored by the EWT Wildlife in Trade Programme Manager.

There is currently one EWT woman staff member directly involved in the project who logged 250 hours.

3.3 Progress towards the project Outcome

Outcome indicators

0.1 A minimum of 8 rats reliably detect pangolin (and hardwood) products mixed among other masking odours within six months after the commencement of training.

All the rats have proven to detect pangolin (and hardwood) products reliably, even when they are mixed among masking agents. Although training is ongoing, preliminary results reveal that the rats are capable of detecting a target when it represents only 5% of a total mixture with non-target items. It is likely that with additional training, this concentration could be reduced even further. Figure 2 (below) depicts the average performance of the rats over the last 10 training sessions. The results show that rats can detect targets hidden in mixtures while rejecting mixtures of just masking agents.

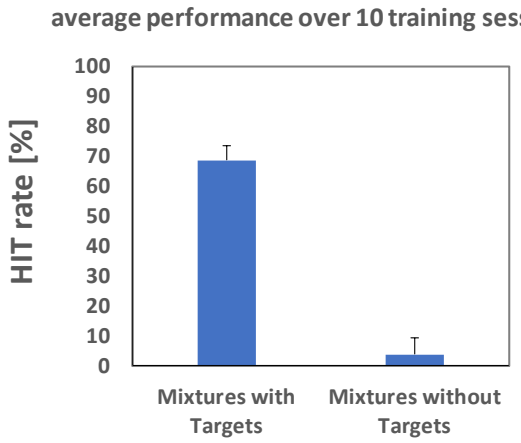

Figure 2. Percentage Hit rate on mixtures with and without targets.

Although training is ongoing, to date all rats have received 55 sessions of training with 100 samples each (for a total of 5500 trials). From these 5500 trials, rats were trained on approximately 350 trials containing 25:75 target: non-target mixtures and 200 trials with 10:90 mixtures

0.2 The rats can be shown to be 50% more cost effective as detection agents than other methods such as detection dogs, measured within a 12-month cycle.

We expect to finalise this outcome indicator and disseminate data on cost-effectiveness of this screening method after the conclusion of Output 4, however preliminary results show the following:

Table 2: an overview was provided on the differences between rats and dogs:

Details	**Rats**	**Dogs**
Time to train	9 months	2 years
Longevity	7–8 years	7–8 years
Cost to train	< R 3,000	R 25,000 – 75,000
Trainer qualification	On-the-job	Specialist
Handler specific	No	Yes

0.3 At least 50% of the project team is female.

The project team currently comprises of 4 women and 3 men and is therefore at over the 50% threshold.

3.4 Monitoring of assumptions

Assumption 0.1: Successful proof of concept phase.

Comments: We have successfully completed the proof of concept phase, showing that the rats can accurately discriminate between the targets and non-targets, can detect varying targets and varying concentrations of the targets when they occur in a mixture with other non-target substances. Please see the above discussion for output 1 and 2 at section 3.2. This assumption has therefore been validated and upheld.

Assumption 1.1: Rats have a sufficiently good sense of smell, and are trainable

Comments: We have successfully proven this assumption. The rats possess an incredible sense of smell and can detect pangolin and hardwood even when it constitutes only 5% of the full sample. The rats good sense of smell and trainability was assessed against the aforementioned discrimination ratio, the rats showed near perfect discrimination and proved highly trainable, even ignoring desirable foods such as peanuts when used as non-target samples. Please see the above discussion at output 1 at section 3.2.

Assumption 2.1: The proof of concept was successful.

Comments: The rats showed that they are capable of detecting pangolin (and hardwood) while ignoring other, non-target substances. Please see the above discussion at output 2 at section 3.2 which confirms that rats can find pangolin derivatives hidden among other items. A base line test was undertaken and the rats were able to detect the targets hidden among some of the mixtures with non-target items. After a period of training the rats underwent interim tests which showed marked improvement in terms of finding the targets hidden in mixtures with non-targets. Thus this assumption has been upheld.

Assumption 2.2: Masking agent(s) used are synonymous with current smuggling trends including pangolins.

Comments: The masking agents, or non-targets, were identified from the Wildlife Seizure Database maintained by EWT. The database comprises of open-source seizure reports, documented since 2012. Products most commonly used to smuggle illegal wildlife, including pangolin, were selected from the reports and remain synonymous with current smuggling trends. This assumption has been validated.

Assumption 2.3: Masking agent(s) are equally inherently neutral odours to the rat as are pangolins.

Comments: Both the targets and nearly all the non-targets were inherently neutral odours to the rats. The inclusion of peanuts as a masking item was meant to mock an operational setting, which may require the rats to ignore edible items with a high appetitive value while still working on the detection task. Through the training procedure, the rats learnt that pangolins and hardwoods are associated with a tasty food reinforcement, but no food reward is provided in the presence of non-targets. It is through this operant training procedure that the rats learn to respond differently to the previously neutral (or biologically relevant, in the case of peanuts) odours.

Assumption 3.1: Seizure data indicates range in ratio quantities of illicit material to masking material

Comments: The seizure data we have has not given information at this level of detail. However, we feel that we are still able to address the issue of understanding the amount of target scent required through training the rats of varying ratios of target scent to masking scent. For example, if 1 kg of pangolin scales are being smuggled, our rats have shown they could find this even if it was hidden within 20 kg equivalent of non-illicit materials.

Assumption 3.2: The rats can detect target odours from pangolins when they are presented in a mixture with common masking agents

Comments: We have successfully upheld this assumption; Please see the above discussion at output 3 at section 3.2 which shows the rats are able to detect target odours in complex mixtures (target substance presented in conjunction with a non-target substance(s), where the target substance comprises as little as 5% of the total mixture).

Assumption 4.1: The rats are able to access the mock containers;

Comments: This assumption will be addressed by the completion of activities in the upcoming 6 months.

Assumption 4.2: The equipment allows the rats to access and give an indication on mock shipping containers

Comments: This assumption will be addressed by the completion of activities in the upcoming 6 months.

Assumption 5.1 Women staff are interested and available to participate in the project

Over the project period project, women project members have taken every opportunity to present on the value and impact this project will have in combatting wildlife trafficking. These opportunities include presentations on the project at Southern African Wildlife Management Association's Annual Symposium, 25th annual International Conference on Comparative Cognition in Melbourne Beach, Florida, USA, and the Animal Behavior Management Alliance annual conference in Portland, Oregon, USA, as well as showcasing the project at the 2018 London Illegal Wildlife Trade Conference. This indicates strongly that the women staff of the project team is clearly interested in the project and meeting the outputs.

Assumption 5.2: Low turn rate of women in these positions

Comments: the project has seen a high turnover of staff but it is noteworthy that the attrition rate does not differ significantly from that observed on other projects within the participating organisations. In particular, the junior researcher position at APOPO is viewed as a valuable mentee opportunity to serve as launching board for these individuals to further pursue scientific careers. Indeed, two women that were previously involved in this project are now in the process of completed PhDs in related scientific fields.

4. Impact: achievement of positive impact on illegal wildlife trade and poverty alleviation

Impact as per application form:

A reduction in the illegal wildlife trade in pangolins, which would impact positively on poverty in communities affected by wildlife trafficking.

Project contribution to this impact:

As shipping containers are the only primary transcontinental route for transporting large volumes of goods, having an effective detection system in place will help to disrupt this route for the organised crime syndicates, who struggle to find an alternative for the volumes shipped by sea (should our work prove successful the same principles apply to other illegally traded species). It is also important to note that the more detection systems in place the harder it is to make use of corrupt officials, as the various detection layers work as a check and balance system when used by multiple teams. This applies equally to human error. Therefore once the rats are deployed they can operate alongside other detection systems such scanners, providing an additional layer screening or can operate alone to facilitate faster screening processes, in either instance contributing to combating wildlife trafficking.

An unexpected development is the application of the rats at wildlife reserves. A key application is the potential use of rats for monitoring vehicles for wildlife contraband and firearms at game reserve gates (though this aptitude has not yet been field-tested), thus providing an added level of security and contributing to preventing poaching

Impact on poverty alleviation:

This project is not able to address poverty directly, but rather through 1. Creation of jobs for women in the project where a total of six people were employed in Tanzania directly through this project, and 2. Improving local governance and the resulting impacts thereof on organised crime on communities. As above when wildlife trade is legal, sustainable and well managed, it can benefit local communities, however, when it is poorly managed and largely illegal, benefits to communities are lost.[5] Pangolins exemplify this, due to illegal international trade, all pangolin species were uplisted to Appendix I in 2016, removing any opportunity for their commercial trade. Further, crime and violence associated with the illegal wildlife trade can undermine governments[6] and illegal wildlife trade can cause localised weak economic development or exposure to price

[5] Roe, D. 2008. The origins and evolution of the conservation-poverty debate: A review of key literature, events and policy processes. Oryx 42:491-503.

[6] Humphreys, J., & Smith, M. L. R. (2011). War and wildlife: the Clausewitz Connection. International Affairs, 87(1): 121-142.

shocks.[7] Therefore a detection system that strengthens controls at ports, resulting in decreased illegal trade, can enhance overall governance. Increased and effective enforcement also changes the perception that wildlife crimes are low risk high reward, which does contribute to steering would-be participants away from these illegal activities.

5. Project support to the IWT Challenge Fund Objectives and commitments under the London Declarations and Kasane Statement

The London Conference Declaration XIII: Invest in capacity building to strengthen law enforcement to protect key populations of species threatened by poaching. Effective law enforcement requires an increase in the number of well-equipped and well-trained law enforcement officers at key sites, using appropriate tools and techniques.

This project addresses this goal through investigating novel tools and techniques that can be used in strengthening enforcement. Once the rats are deployed in the port environment they will contribute to law enforcement officials being well equipped and will provide appropriate tools and techniques for strengthening law enforcement. Additionally port officials will receive training on the use of the rats, thereby increasing capacity at the ports and building new skills within the enforcement agencies.

The London Conference Declaration XV: Provide the necessary conditions for, and further support, including through international co-operation to share expertise, the use of the full range of investigative techniques and tools already deployed against other forms of domestic and transnational organised crime. This should include, but is not limited to: criminal intelligence; controlled deliveries; traceability systems; risk profiling detector dog's; ballistic analysis and the use of existing forensic technology, including the further development of such technologies.

This project addresses this goal through borrowing international expertise from landmine and TB detection and applying it to wildlife crimes. If rats are implemented in the port environment, then they can provide a useful tool in better detecting transnational crimes. Further, the value of collaboration between stakeholders was one of the main points raised in the 2018 London Illegal Wildlife Trade Conference. This project directly speaks to that, with NGOs from different nations working to assist law enforcement to combat illegal wildlife trade.

The Kasane Statement point 8. Engage with the transport industry within our countries to raise awareness of the role they can play.

This project actively addresses this by engaging with the Tanzanian Port Authority (the Joint Port Control Unit) on the potential for implementation of this project. This provides opportunities to focus on the ability of rats to detect wildlife products and to highlight the importance of wildlife crimes with the port authorities.

6. Impact on species in focus

As pangolins are the most traded mammals on earth, any intervention that acts as a deterrent should benefit these species. This intervention will focus on applying better detection probability at the point of export in the supply chain. This should discourage syndicates from targeting pangolins for profit and using shipping containers as a relatively easy way of smuggling their body parts out of Africa in large volumes. Thus, this intervention would contribute to easing the pressure on pangolin populations from poaching by increasing the cost of doing business for the syndicates.

As shipping containers are the only transcontinental route for transporting large volumes of goods, having an effective detection system in place will help to disrupt this route for the organised crime syndicates, who struggle to find an alternative for the volumes shipped by sea (should our work prove successful the same principles apply to other illegally traded species)

[7] Douglas, L. R., & Alie, K. 2014. High-value natural resources: Linking wildlife conservation to international conflict, insecurity, and development concerns. Biological Conservation 171: 270-277.

Different measures will need to be implemented to address other pinch points in the supply chain, these are however outside the realm of this project.

7. Project support to poverty alleviation

As shown above at section 1 wildlife trafficking can have a direct impact on communities and poverty. While the poachers themselves receive some benefit from poaching, it is the organised crime syndicates that reap the real benefits from poaching. Criminal elements that are attracted to wildlife crime in local communities promote social decay and poor governance, which exacerbates the poverty line.

Our project is located in Tanzania, a country that is classified as a Least Developed Country (LDC), with high levels of poverty and unemployment. Tanzania's tourism industry is critical to the economy. Tanzania attracts about one million tourists a year and is the main foreign exchange earner for the country. While Tanzania is an important source and transit country for pangolins, this project can also potentially impact communities in other source countries in sub-Saharan Africa, which use Tanzanian ports to smuggle pangolins.

This project has directly combatted poverty for the local Tanzanian women employed full-time as rodent trainers with APOPO. These women receive competitive salaries equivalent to male colleagues in the same position, as well as medical and other benefits (including paid holiday leave, work apparel, on-the-job-training as needed, and even vouchers for lunch from a local vendor). Further, as the rats are not handler specific, (so can be worked by multiple people) and the handler qualifications is on-the-job training, the future job opportunities arising from rat deployment are vast.

8. Consideration of gender equality issues

Over the project period, both APOPO and the EWT identified and assigned women staff to this project. Both organisations actively improve the status of their female staff by empowering them in our operations and promoting their activities and successes in our media campaigns.

9. Monitoring and evaluation

The means of verification remain the same and continue to be relevant to the measurable indicators of each outcome. As discussed throughout this report, the rats are successfully detecting both pangolin and hardwood. The majority of the indicators of achievement, are defined by quantitative measures of data. We continue to keep log sheets with the duration of training for each session and the number of successful trials. We record nearly all aspects of the training sessions including sniff time on individual odour samples (as measured to the nearest 15 milliseconds using infrared photobeams and detectors) and number of behavioural indications committed in the presence of target and non-target substances. Through meticulous record keeping (employing automated means where possible), we can accurately document the total number of laboratory trials. In the past year, monitoring and evaluation has exceeded expectations as we made both hardware and software modifications to the apparatus. These new additions have enhanced training.

10. Lessons learnt

A key lesson learnt over this period is administrative in nature and links to the importance to submission of change requests and more adaptive management where there are project delays beyond the control of the project team. This includes anticipating changes/challenges in the future and taking a more proactive approach to address them.

11. Actions taken in response to previous reviews (if applicable)

In October 2018, we submitted a full response to queries we received on our Year 1 annual report as well as an amended the log frame, where indicators were amended to be more SMART (specific, measurable, achievable, relevant and time bound). This amended log frame was approved by IWT and has been included and reported against below.

12. Other comments on progress not covered elsewhere

At the beginning of Year 2, we fine-tuned the log frame and submitted the same to IWT. We have also conceptualised the next phase of this project which will conclude with a pilot phase operationalisation of the rats in either Tanzania and / or South Africa. The only anticipated risk is ongoing financial support for the next phase of the project, which we are mitigating by proactively applying for funding.

13. Sustainability and legacy

The feedback from relevant parties (port authorities, behavioural scientists, wildlife trade experts, etc.) on this project has been overwhelmingly positive and, in December 2018, we received full support for the operationalisation of the rat by both the South African Revenue Service and Tanzanian Joint Port Control Unit.

Funding from the IWT Challenge Fund has ensured that the project moved from the proof of concept phase to the current stage of assessing pre-implementation feasibility and deployment strategies. We are in the process of developing a full funding plan to ensure that there is seamless transition from Output 4 to the deployment of the rats.

14. IWT Challenge Fund Identity

The IWT Challenge Fund is recognised on EWT's Integrated Report see Figure 3 and

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Dorian and Hilmari Wharton-Wood
Dorothy Barfoot
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Flynn – Smart Noel
Fran De Jager
Fund for Animals

Figure 3: Screen grab of the EWT's 2017–2018 Integrated Report showing recognition of the IWT Challenge Fund support.

IWT is also noted in the programme flyer we have developed that is distributed at all meetings and public events

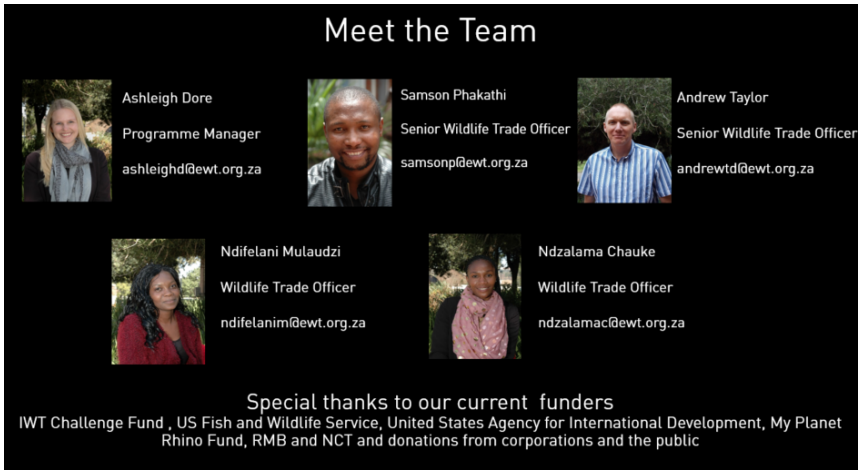


Figure 4 the back of the WIT Programme Flyer

APOPO has recognised IWT Challenge Fund in their 2018 annual report which is currently in preparation. This recognition is in the project description on the Research and Development (R&D) section. APOPO's R&D section of the website is currently undergoing revisions and we plan to include a list of funding sources with logos in the new version.

As we field media requests and host media visits, we will continue to mention the support of IWT Challenge Fund and the UK Government.

15. Project expenditure

Table 1: DRAFT Project expenditure during the reporting period (April 2018-March 2019)

Project spend (indicative) since last annual report	**2018/19 Grant (£)**	**2018/19 Total actual IWT Costs (£)**	**Variance %**	**Comments (please explain significant variances)**
Staff costs				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items				
Others				
TOTAL				

A project extension has been secured until October 2019. Due to the nature of this project, costs such as care of the rats could not be halted and costs such as consultancy costs and purchase of laboratory supplies were paid for in advance. £ has been allocated for spend over this extension period, which will cover the variance costs and allow for final payment to be made to APOPO upon conclusion of the project activities, as stipulated in the agreement between the EWT and APOPO.

16. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for the IWT Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

Over the period 3–5 December 2018, in Dar es Salaam, Tanzania, the EWT and APOPO hosted a workshop with officials from the South African and Tanzanian customs agencies. The objectives of the workshop were:

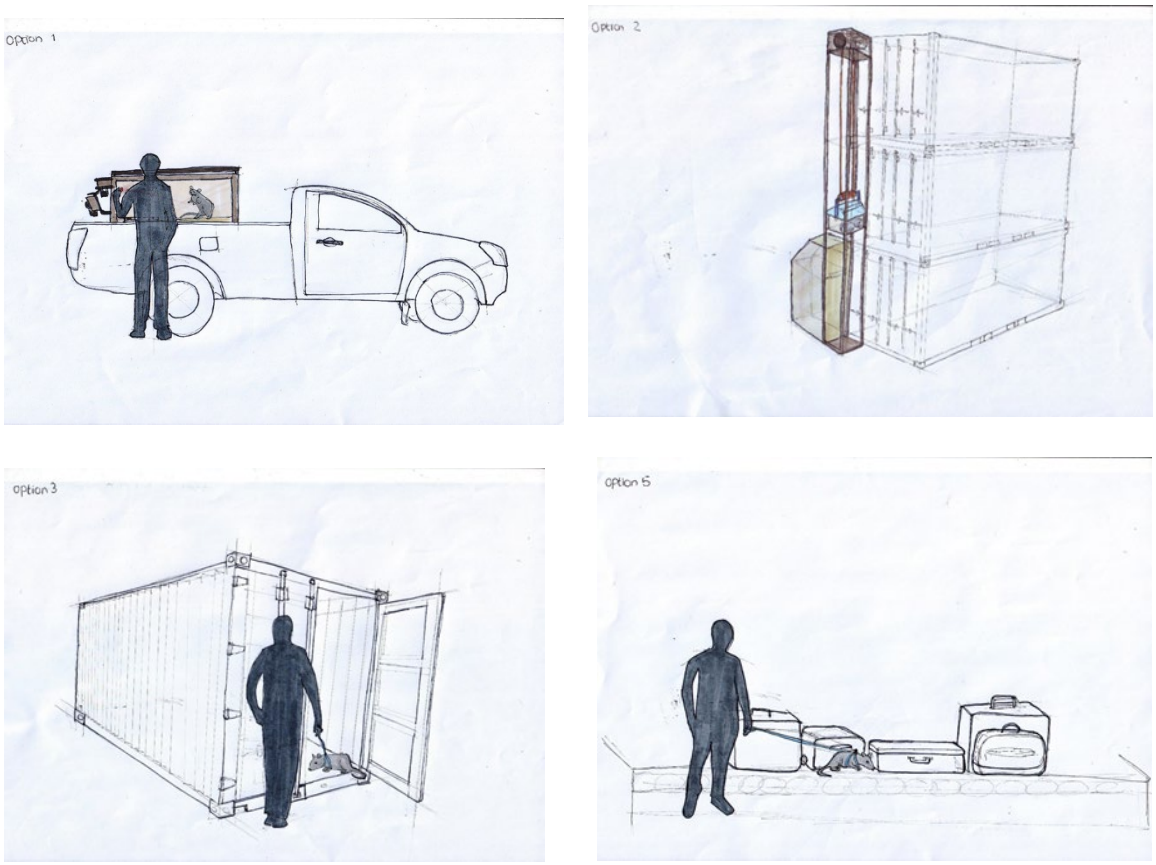
- To allow the authorities to witness the capabilities of African giant pouched rats;
- For APOPO to better understand the processes, limitations and opportunities where African giant pouched rats can detect wildlife contraband (in a port environment);
- For APOPO to modify the training if required, and where possible; and
- To solicit buy-in and support from authorities for future piloting and roll out of African giant pouched rats in their countries of operation.

Overall interest from both of the customs agencies was immense and informed the development of six potential options to deploy the rats to combat wildlife smuggling. These options are:

1. A Mobile Rat Lab
2. Development of a Rat Elevator
3. Rats searching open containers
4. Deploying rats at courier facilities
5. Deploying rats to search passenger luggage
6. Development of a self-contained, handheld (or otherwise portable) container in which to deploy rats.

We have included illustrative sketches of the options below.

Figure 5 deployment option sketches developed to visually illustrate the various possible deployment options identified for the rats



Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2018–2019

Project summary	Measurable Indicators	Progress and Achievements April 2018 - March 2019	Actions required/planned for next period
Impact A reduction in the illegal wildlife trade in pangolins, which would impact positively on poverty in communities affected by wildlife trafficking		Because this project is yet to be implemented in a port environment there has been no measurable impact to date, however, if this proof of concept proves viable, then the potential to increase detection of illegally traded pangolin in shipping ports can be greatly improved.	
Outcome The feasibility of a cost-effective, reliable and efficient screening method to detect illegal pangolin in shipping containers is demonstrated.	0.1 A minimum of 8 rats reliably detect pangolin (and hardwood[8]) products mixed among other masking odours within six months after the commencement of training. 0.2 The rats can be shown to be 50% more cost effective as detection agents than other methods such as detection dogs, measured within a 12-month cycle. 0.3 At least 50% of the project team is female.	0.1 We exceeded our goal of eight rats meeting the 95% accuracy criterion, with nine rats achieving an average accuracy (measured as percent correct) of over 95% across the 1000 trials proving rats can reliably detect pangolin and hardwood products 0.2 A complete costing will be done at project closure. Careful tracking of all expenses is being done. 0.3 The project team currently comprises of 7 members, 4 women and 3 men, meaning the project team is at least 50% female.	0.1 Simulation of port environment to be done 0.2 Ongoing tracking of all expenses. 0.3 Maintaining at least a 50% women project team
Output 1. Proof of concept that African Giant Pouched Rats can detect and discriminate pangolin scents.	1.1 The 8 rats have more than 95% accuracy rate of indication on target species, in a set of at least 1000 trials, in *ex situ* conditions versus control samples within six months after the commencement of training.	We exceeded our goal of eight rats meeting the 95% accuracy criterion, with nine rats achieving an average accuracy (measured as percent correct) of over 95% across the 1000 trials Evidence in Section 3.1, point 1.1 and Figure 1 of report	

[8] Funded through the USFWS only.

Activity 1.1 Appropriate training protocols are developed to train the rats to identify odours from target species;		Completed, Year 1
Activity 1.2 Laboratory tests are conducted to test if the rats are able to discriminate between target species and control scent		Completed, Year 1
Activity 1.3 The rats have a 98% accuracy rate of detection.		Completed, see Section 3.2 point 1.1 of the report
Output 2 The African Giant Pouched Rats can detect pangolins and hardwoods masked in other scents.	2.1 The rats achieve an 85% success rate in detecting pangolin scent when mixed with at least one typical masking agent in 1000 trails, within 10 months of training.	Preliminary results from an interim test revealed that with some training, the rats can find these targets even when they are just 5% of the mixture. Evidence in Section 3.2, point 2.1 and Figures 1 and 2 of the report. Final rate of detection accuracy will be determined after this phase of training is completed in the upcoming months.
Activity 2.1 Identification of the most common masking agents through a literature search of seizure data;		Completed, Year 1
Activity 2.2 Procedures to tightly control sample mixture preparation and training procedures are developed.		Completed, Year 1
Activity 2.3. Training on complex scent mixtures, including target scents mixed with commonly used masking agents		Training is ongoing, see section 3.1 and 3.2
Output 3. Feasibility of future operational application is demonstrated through in-depth psychometric analysis of the rat's sensitivity in detection of target samples, including identification of the minimum concentration among masking agents.	3.1 A concentration gradient, which determines the lowest threshold of ratio of one and/or two targets amongst five masking agents of the rats' scenting abilities, is established by month 15.	Although training is ongoing, to date, all rats have received 55 sessions of training with 100 samples each (for a total of 5500 trials). From these 5500 trials, rats were trained on approximately 350 trials containing 25:75 target:non-target mixtures and 200 trials with 10:90 mixtures.
Activity 3.1 Determining the concentration gradient for rat scent-detection limits for pangolins;		Activity is ongoing, see section 3.1
Activity 3.2 Identification and analysis of psychometric properties of rat's pangolin and hardwood scent detection abilities; and.		Activity is ongoing, see section 3.1
Activity 3.3. Assessment of translational relevance to real-life port activity through comparison to seizure data concentrations of illicit material among masking agents		Activity is ongoing, see section 3.1

Output 4. A system is developed to signal positive detection of pangolin to the rat handlers in a simulated operational environment (i.e. one that simulates conditions for screening containers in a seaport).	4.1 All eight rats are able to give their handlers an indication of a positive target scent within 15 months of training, with an obvious three-second or more detection behaviour (e.g. scratching).	All Activities addressing this Output are scheduled to commence in mid-2019.
Activity 4.1 Habituation of the rats to a mock port environment		Activity Scheduled for Year 3
Activity 4.2. Assessment of equipment needs to operate in a port environment		Activity Scheduled for Year 3
Activity 4.3. Construction of the required equipment		Activity Scheduled for Year 3
Activity 4.4. Assessment of indication system feasibility in a port environment		Activity Scheduled for Year 3
Activity 4.5. Determining other variables for successful detection by the rats, such as sample time in the container, container size, etc.		Activity Scheduled for Year 3
Output 5. Women, where ever possible, are included as project staff and are empowered and capacitated at both organisations	5.1 At least three women staff are assigned with project specific responsibilities at APOPO with at least 250 work integrated learning hours logged during project implementation, mentored by the Head of Training & Behavioural Research[9]; 5.2. At least one woman staff member is assigned with project-specific responsibilities at the EWT with at least 250 work integrated learning hours logged during project implementation, mentored by the EWT Wildlife in Trade Programme Manager.	Completed APOPO assigned six women staff to the project as described in Section 3 point 5.1 & 5.2 The EWT assigned two women staff to the project as described in Section 3 point 5.1 & 5.2 The majority of the project team are women members. We aimed to involve four women and there are current eight women involved.
Activity 5.1 Identify woman staff willing to participate in the project;		Completed, see Section 3.1 and 3.1 part 5 of the report
Activity 5.2. Assign project specific roles and responsibilities;		Completed, see Section 3.1 and 3.1 part 5 of the report

[9] This post is presently filled by a woman.

Activity 5.3. Log time against project activities	Completed, see Section 3.1 and 3.1 part 5 of the report
Activity 5.4. Monitor and evaluate performance and learning for each woman staff member	Continual evaluation to be reported on at the end of the project.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

N.B. if your application's logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact IWT-Fund@ltsi.co.uk if you have any questions regarding this.

Project summary	Measurable Indicators[10]	Means of Verification	Important Assumptions
Impact: (Max 30 words) A reduction in the illegal wildlife trade in pangolins, which would impact positively on poverty in communities affected by wildlife trafficking.			
Outcome: The feasibility of a cost-effective, reliable and efficient screening method to detect illegal pangolin in shipping containers is demonstrated. (Max 30 words)	0.1 A minimum of 8 rats reliably detect pangolin (and hardwood[11]) products mixed among other masking odours within six months after the commencement of training. 0.2 The rats can be shown to be 50% more cost effective as detection agents than other methods such as detection dogs, measured within a 12 month cycle. 0.3 At least 50% of the project team is female.	0.1 Rats demonstrate high sensitivity (indicate even at low concentrations) and specificity (minimal to no false alarm indications) in detecting target items known to be hidden among masking agents. 0.2 Rats demonstrate equivalent accuracy (sensitivity and specificity) when the presence of targets are unknown (blind performance). 0.3 Time to evaluate a set number of samples will be measured to further assess efficiency. 0.4 Detailed cost-analysis of training and maintenance per rat in comparison to the costs of a dog to achieve the same result. 0.5 Project staff organigram for both organisations	Successful proof of concept phase.
Outputs:	1.1 The 8 rats have more than 95% accuracy rate of indication on target species, in a set of at least 1000 trials, in *ex situ* conditions versus control samples	1.1 Number of accurate indication logged against non-target controls.	1.1 Rats have a sufficiently good sense of smell, and are trainable.

[10] Please refer to the implementation timetable for the timescale for each of these indicators.
[11] Funded through the USFWS only.

Project summary	Measurable Indicators[10]	Means of Verification	Important Assumptions
1. Proof of concept that African Giant Pouched Rats can detect and discriminate pangolin scents.	within six months after the commencement of training.	1.2 Log sheet recording the duration of training for each trial and the number of successful trials, (at least 950) 1.3 Number of laboratory trials documented.	
2. The African Giant Pouched Rats can detect pangolins and hardwoods masked in other scents.	2.1The rats achieve an 85% success rate in detecting pangolin scent when mixed with at least one typical masking agent in 1000 trails, within 10 months of training.	2.1 Tightly controlled variations of target to non-target ratio odour mixtures are developed with stable PID measurements. 2.2 Number of accurate indications logged against non-target containing samples and mixtures. 2.3 Log sheet recording the duration of training for each trail and the number of successful trials, (at least 850). 2.4 Number of laboratory trials documented.	2.1 The proof of concept was successful. 2.2 Masking agent(s) used are synonymous with current smuggling trends including pangolins. 2.3 Masking agent(s) are equally inherently neutral odours to the rat as are pangolins.
3. Feasibility of future operational application is demonstrated through in-depth psychometric analysis of the rat's sensitivity in detection of target samples, including identification of the minimum concentration among masking agents.	3.1. A concentration gradient, which determines the lowest threshold of ratio of one and/or two targets amongst five masking agents of the rats' scenting abilities, is established by month 15.	3.1. Rat accuracy is reliably predicted by target concentration. 3.2 Number of accurate indications logged against non-target containing samples and mixtures.	3.1 Seizure data indicates range in ratio quantities of illicit material to masking material. 3.2 The rats can detect target odours from pangolins when they are presented in a mixture with common masking agents.
4. A system is developed to signal positive detection of pangolin to the rat handlers in a simulated operational environment (i.e. one that simulates conditions for screening containers in a seaport).	4.1 All eight rats are able to give their handlers an indication of a positive target scent within 15 months of training, with an obvious three second or more detection behaviour (e.g. scratching).	4.1 Rat accuracy is equally reliable across the initial training cage and the simulated operational environment 4.2. Number of accurate indications logged against non-targets. 4.3. Detailed system documentation including apparatus design and indication standard operating procedures.	4.1. The rats are able to access the mock containers 4.2 The equipment allows the rats to access and give an indication on mock shipping containers.

Project summary	Measurable Indicators[10]	Means of Verification	Important Assumptions
5. Women, where ever possible, are included as project staff and are empowered and capacitated at both organisations	5.1 At least three women staff are assigned with project specific responsibilities at APOPO with at least 250 work integrated learning hours logged during project implementation, mentored by the Head of Training & Behavioural Research[12]; 5.2. At least one woman staff member is assigned with project-specific responsibilities at the EWT with at least 250 work integrated learning hours logged during project implementation, mentored by the EWT Wildlife in Trade Programme Manager.	5.1 Project staff organigram for both organisations 5.2 Terms of reference for each women staff member 5.3 Time and project activity sheets for female project staff 5.4 Project monitoring and evaluation report	5.1 Women staff are interested and available to participate in the project 5.2 Low turn rate of women in these positions
Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1) 1.1. Appropriate training protocols are developed to train the rats to identify odours from target species; 1.2. Laboratory tests are conducted to test if the rats are able to discriminate between target species and control scents; and 1.3. The rats have a 98% accuracy rate of detection.			
2.1. Identification of the most common masking agents through a literature search of seizure data; 2.2. Procedures to tightly control sample mixture preparation and training procedures are developed; and 2.3. Training on complex scent mixtures, including target scents mixed with commonly used masking agents.			
3.1. Determining the concentration gradient for rat scent-detection limits for pangolins; 3.2. Identification and analysis of psychometric properties of rat's pangolin and hardwood scent detection abilities; and 3.3. Assessment of translational relevance to real-life port activity through comparison to seizure data concentrations of illicit material among masking agents.			
4.1. Habituation of the rats to a mock port environment; 4.2. Assessment of equipment needs to operate in a port environment; 4.3. Construction of the required equipment; 4.4. Assessment of indication system feasibility in a port environment; and			

[12] This post is presently filled by a woman.

Project summary	Measurable Indicators[10]	Means of Verification	Important Assumptions
4.5. Determining other variables for successful detection by the rats, such as sample time in the container, container size, etc.			
5.1 Identify woman staff willing to participate in the project; 5.2. Assign project specific roles and responsibilities; 5.3. Log time against project activities; and 5.4. Monitor and evaluate performance and learning for each woman staff member.			

Annex 3 Standard Measures

NA

Annex 4 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Checklist for submission

	Check
Is the report less than 10MB? If so, please email to IWT-Fund@ltsi.co.uk putting the project number in the subject line.	
Is your report more than 10MB? If so, please discuss with IWT-Fund@ltsi.co.uk about the best way to deliver the report, putting the project number in the subject line.	
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	
Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number. However, we would expect that most material will now be electronic.	
Have you involved your partners in preparation of the report and named the main contributors	
Have you completed the Project Expenditure table fully?	
Do not include claim forms or other communications with this report.	