Department for Environment Food & Rural Affairs

Funded by UK Government

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 2018

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)
Contract holder Institution	Endangered Wildlife Trust
Partner institution(s)	APOPO
IWT grant value	£53,360 (Year 1); £71,798 (Year 2); £125,158 (Total)
Start/end dates of project	1 April 2017 – 31 March 2019
Reporting period (e.g. April 2017-Mar 2018) and number (e.g. Annual Report 1,2,3)	April 2017 – Mar 2018 Annual Report 1
Project leader name	Kelly Marnewick
Project website/blog/social media	www.ewt.org.za; www.apopo.org
Report author(s) and date	Kelly Marnewick (EWT), Kate Webb (APOPO), 26 April 2018

1. Project rationale

Shipping containers are moved in large numbers through busy international sea ports. From seizure information, ports are a known route for smuggling large volumes of wildlife illegally. 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*) as 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-phase 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 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 the most illegally traded mammals in the world. Information on seizures gives an indication of the scale of the poaching threat. One seizure, in 2014, contained more than three tons of pangolin scales, equivalent to the deaths of more than 8,000 animals. In 2016, in the biggest case in five years, four tons of pangolin scales was seized in Hong Kong. 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. The primary threat to pangolins in the wild is trade. They are utilised 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 regulation of trade in pangolins.

It is well documented that 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 derive the real benefits from poaching. Criminal elements that are attracted to wildlife crime in local communities actually promote social decay and poor governance, which exasperate the poverty line.

2. Project partnerships

The Endangered Wildlife Trust (EWT) is a South African non-governmental, non-profit, citizen organization 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) Senior Trade Officer, Dr. Kelly Marnewick, is the Project Leader and the main contact person on this project. She is also responsible for the overall monitoring and evaluation of the project. Ms. Ashleigh Dore is the EWT WITP Manager responsible 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 for various rhino conservation initiatives. Our programme is 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 107,438 landmines and unexploded ordinances as well as more than 12,800 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.

Each partner has played an active role in project planning, monitoring and evaluation, and decision making. The project proposal was developed with input from both parties; the EWT has conducted two trips to the APOPO headquarters to ensure that the EWT team has a good understanding of the operations and training procedures for the rats. These trips were also used to share wildlife trade information with the APOPO team. The wildlife trafficking knowledge of the EWT has been used to design training methodologies for the rats. A good example of this is the use of the EWT wildlife seizure database. We analysed data from this extensive resource to identify key items that are used either as masking agents or that are commonly smuggled with pangolin products. We found that beans, nuts, and seeds were used to disguise pangolin scales in seven of 15 seizures, wood was used in four cases, and synthetic wigs and clothing in single seizures. This information was then used to identify non-target scents that were used in the training of the rats.

Additionally, it was very difficult to source pangolin samples for training purposes in Tanzania, but due to the extensive networks the EWT has in South Africa, we were able to secure additional samples from our partners in country for later use in training.

3. Project progress

3.1 Progress in carrying out project 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.

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

Activities:

1.1. Appropriate training protocols were developed to train the rats to identify odours from target species

Due to a delay in obtaining pangolin derivatives for training samples, we relied on previous APOPO research that indicated pouched rats can be rapidly retrained to detect novel odour targets (unpublished data) to initially train 11 young rats (six males and five females) to detect a surrogate odour target (pure citrus oil). This enabled the rats to learn critical behaviours related to the scent-detection task while awaiting specific training with pangolin scales. The rats learned to navigate APOPO's custom-engineered line cage apparatus to sniff different odours and to signal when they had found a target odour by holding their nose in place over the substance. The rats likewise learned to ignore common masking materials when they

encountered them. During this phase of training, the rats were also trained to ignore seven non-target substances including seeds, coffee beans, synthetic wigs, woven cotton fabric, and cardboard (as informed by seizure data). At the completion of place-holder training, the rats demonstrated successful discrimination between the target odour and non-target substances (Fig 1).

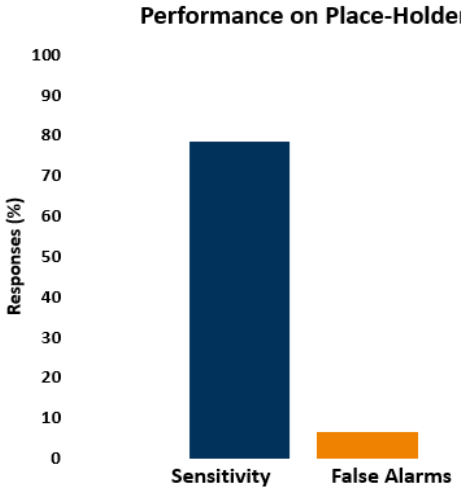

Fig 1: Rats averaged 78% sensitivity (correct identifications) and 6% false alarms (incorrect hits on masking items), during the last phase of training with the surrogate odour: this comprised 37 session of 30 trials each.

After obtaining and preparing the pangolin scales (sun-drying and cutting into smaller samples), we began rapidly retraining with the pangolin samples according to the protocol developed in an unrelated experiment at APOPO. Rats first transitioned to a new semi-automated line cage apparatus that provided more sensitive calculation of response behaviour (that is, automated measurement of the duration that a rat holds its nose over an odour substance) for more in-depth analysis of scent detection performance.

Simultaneously, the surrogate target odour was replaced by two novel targets: pangolin scales and African hardwood (*Dalbergia*). The rats were trained to detect each target at three different volumes (roughly translating to three levels of odourant concentration or “stinkiness”). This procedure provides information on the difficulty of each target and the length of training necessary to master detection of each target. By training the rats on different volumes of the target at this early stage, we have already begun preparing the rats for Activities 2.3 and 3.1. During this phase, we also introduced four novel non-target substances: tree pods and seeds, washing powder, and unshelled peanuts (a tasty treat for our rats that they must learn to ignore when working).

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.

These two activities are reported together as they are intimately related and build on Activity 1.1. After the rats mastered the surrogate target and we procured the pangolin and hardwood samples, the rats began training on the novel targets (as described above). During the final week of introducing the new targets, all rats achieved an average of at least 70% sensitivity (aim for 98%) (i.e., the rats correctly indicated the presence of the odour targets ≥ 9 out of the 12 times they were presented in a single session). Fig 2 depicts the average sensitivity of the rats as they learned the two new targets.

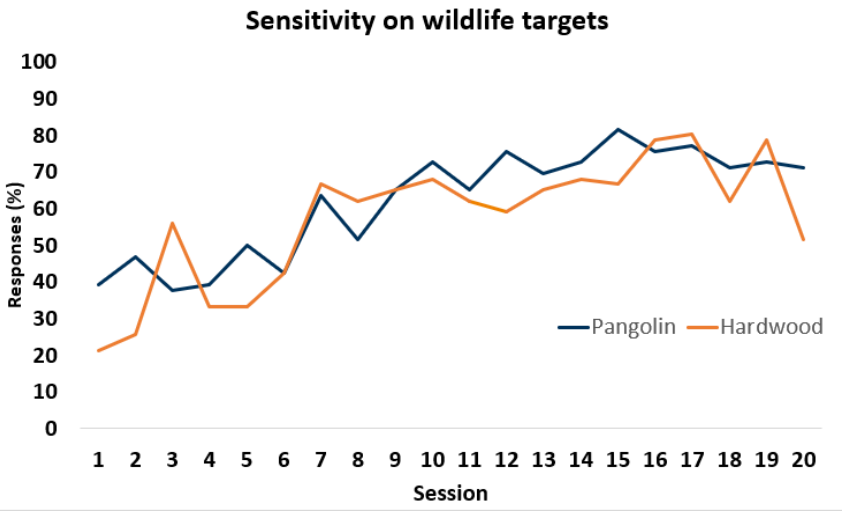

Fig 2: All 11 rats quickly learned to identify both pangolin and hardwood target odours amongst 10 non-target odours as evidenced by the percentage of trials in which they accurately performed an indication response (% Responses).

Rats were then required to identify these targets but ignore non-target substances when they were presented in one of three different positions in the line cage apparatus. Ten non-target substances were used, including the six items used during training with the surrogate odour (see above in 1.1) plus four novel items also found in seized shipping containers with pangolin products (refer to Table 1 below). These non-target items were identified using the EWT seizure database. New non-targets were added at this phase to ensure rat scent-detection was driven by the odour signatures of the targets rather than simply signalling new odours. Fig 3 illustrates how quickly the rats learned to discriminate odour profiles by responding to targets (i.e. sensitivity) and withholding responses to non-targets (i.e. false alarms). By the end of this training phase, the rats clearly demonstrated their ability to discriminate between target species and control scents.

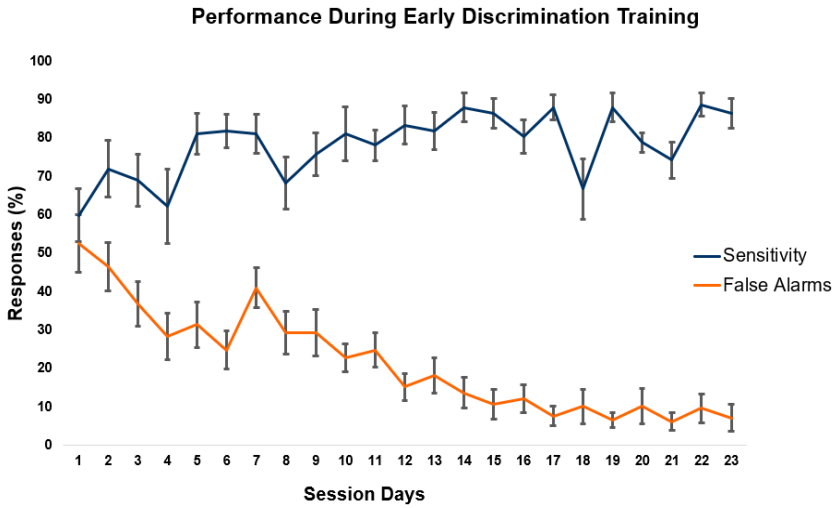

Fig 3: By the second day of training, the 11 rats began discriminating between the targets and non-targets as evidenced by the separation in responses to targets (sensitivity) and non-targets (false alarms).

All rats are currently (April 2018) working at the advanced stage of discrimination training, which involves identifying the target substances (pangolin scales and hardwood at three different volumes/odour concentrations) while ignoring the non-targets (10 substances commonly found in seized shipping containers) when they appear in any of 10 different positions within the line cage apparatus. The slight decrease in performance (Fig 4) corresponds to the increased difficulty in the discrimination task driven by the increased potential locations for sample substances to appear, in other words, the expanded search space. Once the rats master this phase of the task, we will increase the number of samples the

rat is required to evaluate (from 30 to 50 and eventually to 100), while decreasing the prevalence of the targets (from 40% to 24% and eventually 12%), and introducing non-reinforced targets. The non-reinforced targets will simulate an operational setting, where the rats cannot be reinforced with food every time that they find pangolin derivatives because the presence of the target will likely be unknown or unverifiable until later.

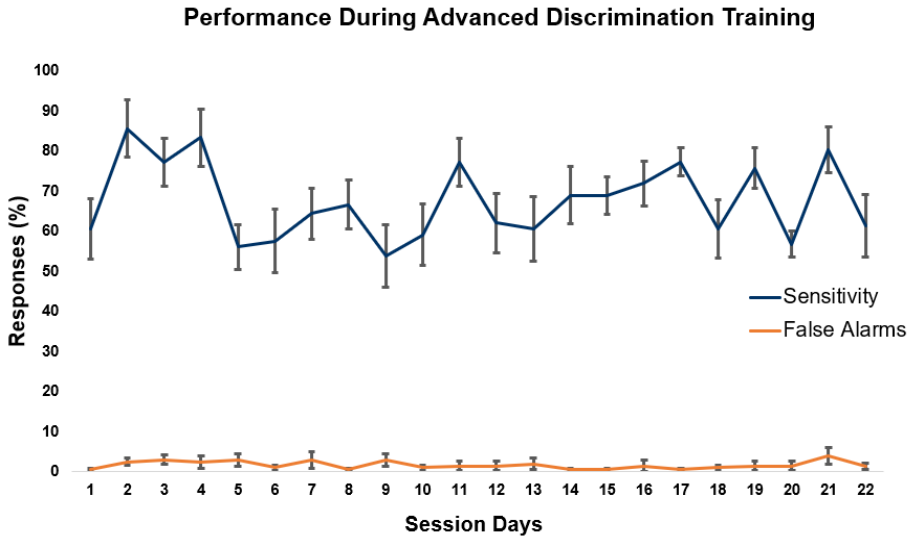

Fig 4: Average discrimination performance on targets (sensitivity) and non-targets (false alarms) during advanced training with 100 total samples per session (12 targets and 88 non-targets).

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

Activities:

2.1. Identification of the most common masking agents through a literature search of seizure data

This Activity was addressed in 1.1 and 1.2/1.3. Table 1 provides a list of common masking agents serving as non-targets in this project. These items were identified from the Wildlife Seizure Database that is maintained by EWT from open source reports.

Table 1. Non-targets the rats are trained to ignore

Masking Agents Serving as Non-Targets for training of detection rats
Cardboard
Coffee beans
Deng (a seed used in local cuisine)
Electrical cable
Synthetic hair wig
Tree seed
Tree seedpod
Unshelled peanuts

Washing powder
Woven cotton material (new socks)

2.2. Procedures to tightly control sample mixture preparation and training procedures are developed

Training of rats and preparation of samples is done according to strict protocols to ensure repeatability of the training. Our first challenge after obtaining the pangolin scales was determining how to best present the samples to the rats. We conducted research to determine what condition the scales are typically found in when they are illegally smuggled to develop our own procedure of sun-drying and preparing the samples we received before they were presented to the rats. We successfully employed the photo-ionization detector (PID) to establish the appropriate volumes of samples. The PID measures volatile molecules released into the headspace above a substance and provides a reading of the relative "stinkiness" of a particular sample of a substance.

To limit the risk for odour contamination, minimize bottlenecks in daily sample preparation, and address other potential logistical limitations, we decided to prepare all training samples in advance and store them in same small plastic containers that are used for presenting them to the rats. We have also instituted a counter-balancing method to eliminate the potential influence of storage duration on the rat's perception of the odours or detection abilities. As we increase the number of samples presented to each rat per day, we believe this sample preparation system, coupled with the rapid training protocol, will enhance the rats' ability to detect the targets and ease the transition from early phases of the project to later phases (e.g., 2.3 below).

2.3. Training on complex scent mixtures, including target scents mixed with commonly used masking agents.

This activity was not pursued during training with the surrogate target; however, training with complex scent mixtures is the next step of the experiment. The training will begin when animals master the new targets (described in 1.3 above), as defined by greater than 90% sensitivity (correct identifications of targets) and less than 10% false alarms (incorrect indications on non-target substances) when evaluating 100 samples (with only 12% prevalence of targets among non-targets). After meeting this criterion, we plan to introduce single samples composed of mixtures of substances. Some mixtures will contain multiple non-targets presented together while others will contain a target substance mixed with various amounts of non-target substances. As mentioned in 1.1, the inclusion of three different volumes of the target at early stages of training, may increase the animals' ability to generalise and detect various volumes of the targets, even when they are concealed by other stinky substances, (i.e., masking agents).

While we have already utilized the PID in the sample preparation of targets and non-targets (described in 2.2), its continued use during this next stage will be critical to ensure that the rats' detection performance is driven by the unique odour identity of the pangolin hidden within the mixture instead of the overall smelliness of the sample (which may occur when multiple items are presented in a single sample).

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.

Activities:

3.1. Determining the concentration gradient for rat scent-detection limits for pangolins

Although this activity is scheduled for year two quarter two, our rapid training protocol partially informs this future step through the use of three different volumes of each target substance, roughly corresponding to various odorant concentration levels of pangolin and hardwood. We have demonstrated it is possible for the rats to detect these three volumes/concentrations of pangolin. Thus, this current data will provide a baseline in our assessment of the broader concentration range the rats can detect.

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

Both of these activities are scheduled to commence during year two quarter two.

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).

Activities:

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

4.5. Determining other variables for successful detection by the rats, such as sample time in the container, container size, etc

Activities for Output 4 are scheduled during year two quarter three and quarter four. In preparation for these activities, the EWT and APOPO have been trying to orchestrate a "Customs Workshop" involving key stakeholders, including port authorities; however, scheduling of this event has proven to be challenging. After a third change to the schedule, we are aiming to hold this event on-site in Tanzania in August 2018.

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

Activities:

5.1 Identify woman staff willing to participate in the project;

The EWT identified Dr. Kelly Marnewick and Ms. Ashleigh Dore. APOPO identified Dr. Cynthia Fast, Ms. Kate Webb, Ms. Dian Kuipers, Ms. Anna Paul Narcis, Ms. Beatrice Malosha, and Ms. Mariam Juma. The project team is 100% female. (See Fig 5 for some of the project team)

5.2. Assign project specific roles and responsibilities;

At the EWT, Kelly is the Project Leader and is responsible for the day-to-day coordination of the project and general project management as well as overseeing the M&E component of the project. Ashleigh is the EWT WITP Manager. Kelly took advantage of an opportunity to present the project to the Southern African Wildlife Management Association's Annual Symposium in Goudini, Western Cape Province, South Africa.

At APOPO, this project is under the direction of the Head of Research and Development, Dr. Cynthia (Cindy) Fast. Two women, Kate and Dian, were assigned as the primary research technicians of this project. They perform daily session planning, data entry, and oversee sample preparation and training. In addition, both women took advantage of a professional development opportunity to present current progress of the project at the 25th annual

International Conference on Comparative Cognition in Melbourne Beach, Florida, USA. Anna, Beatrice, and Mariam, are APOPO rodent trainers and work with the rats during daily sessions.

Fig 5: APOPO trainers Beatrice and Mariam with Kelly from EWT

5.3. Log time against project activities; and

APOPO: staff have logged 2088 hours on the project to date. Our project leader and M&E manager logged 420 hours.

5.4. Monitor and evaluate performance and learning for each woman staff member

As part of our internal procedures, 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

Considerable progress has been made towards this output. These animals have already demonstrated their ability to discriminate targets from non-targets to a high level of accuracy (refer to section 3.1). All 11 rats mastered the place-holder detection task with a surrogate odour. The animals have been training with pangolin targets for less than four months; however, are already approaching high levels or accuracy (considering sensitivity and false alarms as sub-components of overall accuracy).

To date, the rats have completed 76 daily training sessions (sessions are only conducted during normal working days) and all animals have demonstrated the ability to discriminate between the target and non-target substances. According to the planned training progression detailed in 1.3 above, we expect the rats to routinely evaluate 100 samples per session within the upcoming months at the accuracy level defined by this indicator.

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

Substantial work has been done in anticipation of addressing this Output. We have identified training and sample preparation protocols that will be used when we begin presenting targets in complex mixtures (Activity 2.3). Although the difficulty in procuring the pangolin samples caused a delay, we estimate the animals will be training on complex mixtures in quarter three of year two.

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 this activity is scheduled for year two quarter two, our rapid training protocol partly addresses it, by presenting three different volumes, which corresponds to concentration, of pangolin and hardwood. We already have demonstrated it is possible for the rats to detect the three volumes/concentrations of pangolin. This current data will inform our assessment of the concentration range the rats can detect after completing indicator 2.1.

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).

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).

The indication that the rats offer needs to be suited to the environment in which they work. Rats working on landmines work in close proximity to their handlers and use scratching to indicate the presence of a land mine, the TB rats work in a cage and use a three second none-hold over the target sample to indicate the presence of a TB positive sample. A mechanism needs to be developed that will specifically work in the port environment where the rats may be working remotely from the handler. However, without first-hand knowledge of the environment it is difficult to understand what a viable indication behaviour could be. As part of progress towards this output, a workshop will be held at APOPO's headquarters in Tanzania with EWT and key customs stakeholders. Experts in the illegal wildlife trade and SADC port and customs authorities will be invited to attend the workshop and discuss key components of the port environment which will be crucial in determining how to optimally deploy the rats in an operational setting, including the topography or logistics of the response system.

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 the primary researchers for the project and are directly supervised and mentored by the Head of Training & Behavioral Research, who is also a woman. In addition, three female rodent trainers are involved daily with training and care of

this project's animals for a total of six women assigned to key roles of this project. To date a total of 2,088 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 are currently two EWT women staff members directly involved in the project: the project coordinator and the project M&E are both done by a female staff member and the new EWT WITP Manager is also a woman. The appointment of the manager falls outside the reporting period for this report but the hours logged by the project coordinator and the project M&E staff member amounts to 420 hours.

3.3 Progress towards the project Outcome

Outcome

The feasibility of a cost-effective, reliable and efficient screening method to detect illegal pangolin in shipping containers is assessed.

Outcome indicators

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

Significant developments towards the completion of this indicator have occurred. 11 rats are currently being trained to detect pangolin and hardwood substances while ignoring ten other substances that are commonly found in shipping containers with pangolin products or derivatives. Initial delays in procuring target substances necessitated that we implement a pre-training phase using a surrogate odour; however, since acquiring pangolin scales for training, the rats have experienced nearly four months of training. Current data demonstrates that the rats can reliably detect pangolin and hardwood when the target is presented alone. The upcoming stage of this experiment, presenting complex mixtures during training sessions, will directly address whether the rats possess the ability to detect the target masked by non-targets.

0.4 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 compile and disseminate data on cost-effectiveness of this screening method in the second year of this project.

3.4 Monitoring of assumptions

Assumption 0.1: Successful proof of concept phase.

Comments: At this time, we can provide evidence (see Figs 3 and 4 in 1.2/1.3) that the first part of the proof of concept training design is successful. All 11 rats are accurately discriminating between the targets and non-targets. The next proof of concept phase is to provide evidence that the rats can detect varying concentrations of the targets when they occur in a mixture with other non-target substances.

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

Comments: The preliminary results of the proof of concept support this assumption. The rats possess an incredible sense of smell and can detect pangolin and hardwood. Moreover, in less than four months of training (76 sessions), the rats learned how to evaluate samples and signal to a human handler when they detect the target odour, ranging in volume from 0.5 grams to 1.5 grams, in a new apparatus.

Assumption 2.1: The proof of concept was successful.

Comments: Although it is premature to gauge the overall success of the entire proof of concept, the preliminary results suggest the rats are capable of detecting pangolin (and hardwood) while ignoring other, non-target substances.

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 is compiled of open source seizure reports since 2012. Products most commonly used to smuggle illegal wildlife, including pangolin, were selected from the reports and remain synonymous with current smuggling trends.

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 working on the detection task.

Through the training procedure, the rats learn 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 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 in this level of details. 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.

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

Comments: As discussed in Activity 2.3 above, this assumption will be assessed during the upcoming training phase, which will include trials of complex mixtures (target substance presented in conjunction with a non-target substance(s), as well as mixtures of non-target substances without the target).

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

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

Comments: These assumptions will be addressed by Activities in the coming year. Currently, the EWT and APOPO are jointly planning a workshop with port authorities to continue brainstorming how best to approach the evaluation of shipping containers in a mock setting that closely resembles the true port environment. This workshop will also serve as a forum to discuss the optimal method of deploying the rats in the port environment.

Assumption 5.1: Low turn rate of women in these positions

Comments: The EWT has increased the number of women on the project through the new Programme Manager being a woman. Although the originally identified Project Leader left the EWT, this occurred prior to project inception. Kelly Marnewick (EWT) has thus been in place for the entire life of the project.

The women from APOPO assigned to this project have been involved for its entirety. Given the nature of APOPO's research department, which is to provide opportunities for early-career

scientists, one of the primary researchers will be leaving APOPO to attend a graduate school program. However, training of a new researcher, also a woman and a senior researcher, began in Quarter 1 of this year.

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 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).

Additionally, from a presentation on the project done by Kelly Marnewick (EWT) at the Southern African Wildlife Management Association's annual symposium in 2017, a lot of interest has been generated with resulting discussion around other uses for rats in preventing poaching. A key application is the potential use of rats for monitoring vehicles for wildlife contraband and firearms at game reserve gates.

Impact on poverty alleviation:

If the use of rats in new wildlife crime prevention and detection areas realised, this would result in more jobs being created and skills being developed in new areas.

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

This project addresses the following IWT Challenge Fund Themes:

Strengthening law enforcement

If our project is successful, the rats will provide an effective tool for strengthening law enforcement in the port environment by increasing detection of pangolin products in shipping containers.

This project also has links to the following:

London Declaration on the Illegal Wildlife Trade: 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.

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.

London Declaration on the Illegal Wildlife Trade: 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.

The implementation of rats will contribute to further developing technologies – building on the successes that detector dogs can have in detecting wildlife contraband.

Kasane Statement: 8

Engage with the transport industry within our countries to raise awareness of the role they can play. We welcome the creation of an international Task Force on the transport industry and the illegal wildlife trade, and support the development and implementation of industry-wide protocols and/or guidelines by the logistics and transportation sector on strengthening due diligence and other measures to eliminate the illegal trade in wildlife. We look forward to further consultation in due course on the emerging findings of the Task Force.

The implementation of rats in shipping ports will contribute to other measures to eliminate illegal trade in wildlife.

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.

It is proposed that, should the rats be successful in detecting pangolins in shipping containers, there would be more arrests of smugglers – as well as convictions – with a concurrent loss of income to smugglers and organised crime syndicates. 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 ultimately ease the pressure on pangolin populations from poaching, and allow populations to recover.

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. Project support to poverty alleviation

It is well documented that wildlife trafficking can have a direct impact on communities and poverty. While the poachers themselves receive some benefit from poaching, it is the organized crime syndicates that reap the real benefits from poaching. Criminal elements that are attracted to wildlife crime in local communities actually promote social decay and poor governance, which exasperates the poverty line.

Our project location is Tanzania, 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.

APOPO and the EWT are jointly planning a workshop with local port authorities to discuss how to best utilize our rat scent-detection technology to target poachers and broadly, address the exasperating poverty line.

Specifically within the last year, 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).

8. Consideration of gender equality issues

In the first year of the project, both APOPO and the EWT identified and assigned women staff to this project. At APOPO, six women, including three Tanzanians, are directly involved with the day-to-day operations of the proof-of-concept experiment. Both organizations actively improve the status of its female staff by empowering them in our operations and promoting their activities and successes in our media campaigns. A notable achievement from this year was woman at both organizations presented preliminary findings at two international conferences (International Conference on Comparative Cognition, Florida, USA and at the Southern African Wildlife Management Association Conference, Western Cape, South Africa).

9. Monitoring and evaluation

The means of verifications continue to be relevant to the measurable indicators of each outcome. This year's focus was primarily on Output 1 (proof of concept that rats can detect and discriminate pangolin scents) and Output 2 (rats' ability to detect pangolin in a complex mixture). As discussed throughout this report, the rats are successfully detecting both pangolin and hardwood. Despite extensive delays in legally securing pangolin samples, we continue to make timely progress towards exceeding our measurable indicators, including a minimum of eight rats achieving 95% accuracy in a set of 1,000 trials.

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 milliseconds using infrared photobeams and detectors) and number of behavioral 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

Obtaining the pangolin samples for training the rats was much more difficult than we anticipated. We could not get samples in Tanzania initially, then when we finally sourced two deceased pangolin specimens from the Dar Es Salaam zoological park, the permits took excessively long to obtain and supporting information was continually required. Although samples were available in South Africa, we required CITES permits to export them as they are on Appendix I, and obtaining the import permits from Tanzania was again difficult and time consuming. We are currently attempting to obtain the export permits from South Africa. If we were to do this again we would have exported the samples from South Africa from the very beginning and started the process long before proposal submission.

The delay of the samples reflects in our postponement of training. Given our previous research, which supported a procedure to rapidly retrain rats on novel targets, we were still able to train rats on the task with a place-holder target. A benefit of this pre-training step was the rats learned how to walk and evaluate samples in the line cage. This made it possible to begin indication training, the training that introduces the rats to their new targets, immediately after preparing the samples. However, the additional procedure may have an effect on the length of training required to master the targets. In the future, it may be more effective to train rats on pangolin and hardwood from the beginning.

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

Not applicable.

12. Other comments on progress not covered elsewhere

Not applicable.

13. Sustainability and legacy

The feedback from relevant parties (port authorities, behavioural scientists, wildlife trade experts, etc.) on this project has been overwhelmingly positive. An effort has been made to increase interest within Tanzania, at APOPO's external exhibitions, and South Africa. Furthermore, we have promoted the project at international events, such as the International Conference on Comparative Cognition where we discussed the preliminary findings of the proof-of-principle experiment.

Funding from the IWT Challenge Fund will ensure that the project moves from the proof of concept phase to the next stage of assessing pre-implementation feasibility and deployment strategy. Should this proof of concept prove successful, it would have a major impact on illegal wildlife trafficking, and is expected to be rolled out operationally moving forward.

The project dovetails with various strategies and policies to tackle illegal wildlife crime both at national and regional level. We are certain that governments in the region will support future implementation of our initiative (they do already for APOPO's mine detection and TB projects). The target species range for the rats should also be expanded to include other widely trafficked species such as elephants (ivory), rhinos (horn) and various timbers – there is clear scope to work with a wide range of target species – making the project hugely expandable.

Additional funding as necessary will be sought from shipping companies, freight companies and other stakeholders who either have a vested interest in stopping the smuggling illegal wildlife products or are required to by law. In addition, this could lead to sustainable business opportunities for individuals, leading to job creation.

14. IWT Challenge Fund Identity

The IWT Challenge Fund is recognised on EWT's webpage, see Fig 6 and https://www.ewt.org.za/fundraising/Patron%20R250%20000.html as well as in the 2016-2017 Integrated Report see Fig 7 and http://www.ewt.org.za/Integrated%20Reports/IR%20report%202017%20small%20file.pdf

Dohmen Family Foundation

Elizabeth Wakeman Henderson Foundation

Eskom

European Union
European Regional Development Fund
Investing in your future

HANS HOHEISEN charitable trust

Illegal Wildlife Trade (IWT) Challenge Fund

Fig 6: Screen grab of the EWT web page showing IWT Challenge support as a Patron Supporter.

OUR SUPPORTERS

STRATEGIC PARTNERSHIPS

Eskom Holdings SOC Ltd
International Crane Foundation

INSTITUTIONAL SUPPORTERS

Deloitte Southern Africa
Cliffe Dekker Hofmeyr

PATRON SUPPORTERS (R250 000 +)

African Parks
Bakwena Platinum Corridor Concession
Barloworld Trust
BirdLife International
Bridgestone South Africa
Charles van der Merwe Trust
Department of Environmental Affairs, Natural Resource Management Programme
Disney Conservation Fund
Dohmen Family Foundation
Elizabeth Wakeman Henderson Charitable Foundation
Eskom Holdings SOC Ltd
European Union
Hans Hoheisen Charitable Foundation
Illegal Wildlife Trade (IWT) Challenge Fund
International Fund for Animal Welfare
Leisure Charitable Trust
MacArthur Foundation
Mohammed bin Zayed Species Conservation Fund
MyPlanet Rhino Fund
N3 Toll Concession (RF) Proprietary Limited
National Geographic Big Cats Initiative
National Lottery Commission
Rainforest Trust
Rand Merchant Bank/Tshikululu
Relate Trust
Segre Foundation
South 32
The Anglo American: Inyosi Coal, Kriel Colliery
The Department of Environmental Affairs
US Department of State, Bureau of International Narcotics and Law Enforcement Affairs (INL)
UNDP New World
United States Fish and Wildlife Service
Whitley Fund for Nature
WWF Nedbank Green Trust
WWF Zambia

GROUNDBREAKER SUPPORTERS (R100 000 TO R249 999)

Africa Raptor Trust
First Rand Foundation
Foundation for Human Rights
Gaie Fergusson
GCCL2
Global Environment Facility – Convention on the Conservation of Migratory Species of Wild Animals
Global Environment Facility – United Nations Development Programme
Hawk Conservancy Trust
HCI Foundation
Headley Trust
Investec
Jim and Yuko Brumm
MySchool MyVillage MyPlanet

Fig 7: Screen grab of the EWT's 2016–2017 Integrated Report showing recognition of the IWT Challenge Fund support.

APOPO recognized IWT Challenge Fund in their 2017 annual report (Fig 8) 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.

CURRENT STUDIES

Deterring wildlife trafficking
In collaboration with Endangered Wildlife Trust (EWT) of South Africa, we are investigating the potential for detection rats to combat the illegal wildlife trade. The first step of this project includes training rats to detect both pangolin scales and African hardwoods. The rats are showing great potential in the controlled laboratory setting to detect both targets from among materials commonly used to mask illegal wildlife products during the smuggling process, such as coffee beans, textiles, cardboard, etc. Funding for this project is provided by the **U.S. Fish and Wildlife Services** and the **U.K. Illegal Wildlife Trade Challenge Fund**.

Discrimination training procedures and odorant concentration influence scent-detection performance
We examined the fundamental principles of learning and olfactory abilities in our rats using pure odorants, which can be tightly controlled and manipulated in the laboratory setting. We investigated many factors, including the optimal duration of a rat's indication response, how the prevalence of target

Dr. Cindy Fast holds a Ph.D. and master's degree in psychology, specializing in learning and behavior and behavioral neuroscience from UCLA. She investigated the neurobiology of olfactory learning and perception in rodents as a postdoctoral scholar in the behavioral and systems neuroscience area at Rutgers University in New Jersey. In addition to a number of other accolades in her field, Dr. Fast was recently awarded the

Figure 8: Draft version of the current studies APOPO's R&D annual report.

Fig 9: IWT Challenge Fund recognised on APOPO's recent poster presentation.

15. Project expenditure

Table 1: Project expenditure <u>during the reporting period</u> (April 2017-March 2018)

Project spend (indicative since last annual report	**2017/18 Grant (£)**	**2017/18 Total actual IWT Costs (£)**	**Variance %**	**Comments (please explain significant variances)**
Staff costs (see below)				
Consultancy costs				
Overhead Costs				
Travel and subsistence				
Operating Costs				
Capital items (see below)				
Others (see below)				
TOTAL				

Highlight any agreed changes to the budget and **<u>fully</u>** explain any variation in expenditure where this is +/- 10% of the budget. Have these changes been discussed with and approved by IWT?

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)

This is the first time that APOPO have trained rats on wildlife products and the first time that the rats have been trained on two target scents simultaneously, this sets new precedents in the training of the rats. It is also the first time that a preferred food item (peanuts) has been used as a non-target scent in the rat training. In the beginning the rats were indicating more frequently that would be expected on the peanuts, however, as the training has proceeded, the rats are learning to ignore the tasty peanuts and only indicate on pangolin and African hardwood. This is also a new training method for APOPO.

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2017-2018

Project summary	Measurable Indicators	Progress and Achievements April 2017 - March 2018	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 0.1 A minimum of 8 rats reliably detect pangolin (and hardwood[1)] products mixed among other masking odours within six months after the commencement of training. 0.2 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.	0.1 11 rats are currently in training and are on track to be reliably detecting pangolin (and hardwood) within six months of training. The rats are currently working at 78% accuracy after four months of training. 0.2 A complete costing will be done at project closure. Careful tracking of all expenses is being done.	0.1 Ongoing training of the rats to obtain 90% accuracy by six months. Training on complex scent mixtures to be done Simulation of port environment to be done 0.2 Ongoing tracking of all expenses.
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.	Eleven rats currently have a 78% accuracy rate on the target species, in 22 trials in ex situ conditions within four months of introduction of the pangolin and hard wood samples. Evidence in Section 3.1, point 1.1 and Figure 1 of report	
Activity 1.1 Appropriate training protocols are developed to train the rats to identify odours from target species;		Completed, see Section 3 point 1.1 of the report	
Activity 1.2 Laboratory tests are conducted to test if the rats are able to discriminate between target species and control scent		Completed, see Section 3 point 1.2 of the report	
Activity 1.3 The rats have a 98% accuracy rate of detection.		The rats are currently working at 78% accuracy rate, this will improve with experience and further training. See Section 3 point 1.3 of the report and Fig 1.	

[1] Funded through the USFWS only.

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.	The rats are currently working at 78% sensitivity (i.e., the rats correctly indicated the presence of the odour targets ≥ 9 out of the 12 times they were presented in a single session), in the first four months of training. This is envisioned to improve with training and the number of trials and training period will be achieved timeously. Evidence in Section 3, point 2.1 and Fig 2 of the report
Activity 2.1 Identification of the most common masking agents through a literature search of seizure data;		Completed, see Section 3, points 1.1 and 1.2 / 1.3 and Table 1 of the report The EWT Wildlife Seizure Database (assimilated from open source seizure reports) was used to identify masking agents not only for pangolin but for other smuggled contraband.
Activity 2.2 Procedures to tightly control sample mixture preparation and training procedures are developed.		Completed, see Section 3 point 2.2 of the report
Activity 2.3. Training on complex scent mixtures, including target scents mixed with commonly used masking agents		Activity assigned to Year 2 of the project when the accuracy described in 1.3 exceeds 90% (currently 78%). The PID has been procured and used in sample preparation as described in Section 3 point 2.2 in the report.
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.	All Activities addressing this Output are scheduled for Year 2 Quarter 2 of the project
Activity 3.1 Determining the concentration gradient for rat scent-detection limits for pangolins;		Activity scheduled for Year 2 Quarter 2
Activity 3.2 Identification and analysis of psychometric properties of rat's pangolin and hardwood scent detection abilities; and.		Activity scheduled for Year 2 Quarter 2
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 scheduled for Year 2 Quarter 2
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 during Year 2 Quarter 3 & 4

Activity 4.1 Habituation of the rats to a mock port environment		Activity Scheduled for Year 2
Activity 4.2. Assessment of equipment needs to operate in a port environment		Activity Scheduled for Year 2
Activity 4.3. Construction of the required equipment		Activity Scheduled for Year 2
Activity 4.4. Assessment of indication system feasibility in a port environment		Activity Scheduled for Year 2
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 2
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[2]; 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 project team thus comprises of 100% 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 point 5.1 of the report
Activity 5.2. Assign project specific roles and responsibilities;		Completed, see Section 3 point 5.2 of the report
Activity 5.3. Log time against project activities		Completed, see Section 3 point 5.3 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.

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

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[3]	Means of Verification	Important Assumptions
Impact: 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.	0.1 A minimum of 8 rats reliably detect pangolin (and hardwood[4]) 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.	0.1 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.	Successful proof of concept phase.
Outputs: **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.	1.1 Number of accurate indication logged against non-target controls. 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.	1.1 Rats have a sufficiently good sense of smell, and are trainable.
2. The African Giant Pouched Rats can	2.1The rats achieve an 85% success	2.1 Tightly controlled variations of target	2.1 The proof of concept was successful.

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

Project summary	Measurable Indicators[3]	Means of Verification	Important Assumptions
detect pangolins and hardwoods masked in other scents.	rate in detecting pangolin scent when mixed with at least one typical masking agent in 1000 trails, within 10 months of training.	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.	2.2 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.
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,	5.1 Project staff organigram for both organisations 5.2 Terms of reference for each women staff member	5.1 Women staff are interested and available to participate in the project 5.2 Low turn rate of women in these positions

Project summary	Measurable Indicators[3]	Means of Verification	Important Assumptions
	mentored by the Head of Training & Behavioural Research[5]; 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.	5.3 Time and project activity sheets for female project staff 5.4 Project monitoring and evaluation report	
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 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.			

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

Annex 3 Standard Measures

In future years it is our intention to develop a series of standard measures in order to collate some of the quantitative measures of activity, input and output of IWT projects. These will not be measures of the impact or effectiveness of IWT projects but will contribute to a longer term dataset for Defra to draw upon. The collection of standard measures data will be important as it will allow us to understand the combined impact of all the UK Government funded Challenge Fund projects. This data will therefore provide useful information for the Defra Secretariat and for Defra Ministers regarding the Challenge Fund.

The standard measures for the IWT Challenge Fund are currently under development and it is therefore not necessary, at present, to complete this Annex. Further information and guidance about the IWT standard measures will follow.

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

Rat in a training cage

Pangolin scales prepared for training of rats.

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.	Yes
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.	No
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.	Yes
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.	No
Have you involved your partners in preparation of the report and named the main contributors	Yes
Have you completed the Project Expenditure table fully?	No
Do not include claim forms or other communications with this report.	