Department for Environment Food & Rural Affairs

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Illegal Wildlife Trade (IWT) Challenge Fund
Half Year Report

(due 31st October 2018)

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
Collaborator(s):	APOPO
Project leader:	Kelly Marnewick
Report date and number (e.g. HYR1):	HYR2
Project website/blog/social media:	www.ewt.org.za; www.apopo.org

1. Outline progress over the last 6 months (April – Sept) against the agreed project implementation timetable (if your project has started less than 6 months ago, please report on the period since start up to the end September).

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

Activities:

1.1 Appropriate training protocols are developed to train the rats to identify odours from target species;

Completed during Year 1 (see prior report).

1.2. Laboratory tests are conducted to test if the rats are able to discriminate between target species and control scents; and

We recently completed the final stage of the proof of concept study, utilising the protocols developed during Year 1 (Activity 1.1). This advanced stage of discrimination training 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 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 samples were actually from the target) 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.

1.3. The rats have a 98% accuracy rate of detection.

During this 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 rats' accuracy is shown in detail below.

Measurable Indicator(s):

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 training, with an average accuracy of 94.3% across 1000 trials. 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 pre-occupied 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.

Means of Verification:

1.1 Number of accurate indications logged against non-target controls;

Among the 1000 trials described above were 120 targets (60 each of pangolin and hardwood derivatives), leaving 880 samples of the 10 different non-target controls. Averaging performance across the 10 rats revealed that they responded correctly on 973 trials (i.e., 97.3% of trials were correct) with 100 of the 120 targets found (53 of 60 the pangolin targets and 47 of the 60 Hardwood targets). Perhaps equally important, from an operations efficiency perspective, the rats only committed false alarms on 10 of the 880 controls, this is despite the fact that 440 of the trials included potential food stuffs for the rat, including highly palatable peanuts.

Finally, we also examined the rat's detection accuracy when working in teams of two or more rats (as APOPO currently employs for other operational tasks, such as landmine detection). Here, the rats scored 100% in detecting all pangolin samples and only failed to find one hardwood sample across a total of 60 target samples each. In other words, if this laboratory trial reflected the real-world setting, the rats would have searched 1000 shipping containers and correctly stopped 119 of these containers that contained illicit wildlife products (missing only one container with hardwood products.

1.2 Log sheet recording the duration of training for each trial and the number of successful trials, (at least 950)

A data file for the final 10 sessions (1000 trials) is available and can be shared.

1.3 Number of laboratory trials documented.

Each rat experienced an average of 8780 trials during the course of this training. The final phase of training included an average of 5000 trials per rat. With 100 trials, occurring per daily session and sessions conducted five days per week, this means that the rats required only two months of training at the final stage to achieve the mastery reported above.

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

Activities:

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

Completed during Year 1 (see prior report).

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

Partially completed during Year 1 (see prior report). Although the photoionization detector (PID) was procured in Year 1 and underwent standard calibration that allowed its use during early training phases with a surrogate odor, we have been unable to use the PID with the pangolin derivatives because an additional (non-standard) calibration gas is needed to enable the PID to detect the organic compounds in use for this project. Through consultation with the PID manufacturer, organic chemists, and physicists specialising in volatile organic compounds, a potential calibration gas has been identified and is in the process of being delivered to APOPO (purchase was made early Year 2, Quarter 1; however, due to transportation delays and setbacks with customs, the gas has not yet arrived as of the time of this report). There is, however, no guarantee that this calibration gas will enable detection of volatiles emitted by all substances in use for this project. Therefore, we have developed an alternative procedure to control the "relative stinkiness" of the samples by using the mass of each sample substance as a proxy for odor concentration. Although this procedure is less precise, it has been successfully implemented in the interim to control the odorants of Activities 1.2 and 1.3.

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

This activity has been slightly delayed due to the unexpected challenges of obtaining the training samples required for the Output 1 activities (previously reported during Year 1) and the PID calibration gas (as described in Activity 2.2 above). Nonetheless, we have recently begun this activity by presenting the rats with single odor samples composed of mixtures of two or more substances, using the alternative measurement procedure developed in Activity 2.2 (computed relative volume of each substance within the mixture). 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). As with the activities of Output 1, the rats continue to work in the line cage and are presented with 100 samples per session containing only 12 target samples (now appearing in mixtures).

Measurable Indicator(s):

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.

It is too premature to report on this indicator at this time.

Means of Verification:

2.1 Tightly controlled variations of target to non-target ratio odour mixtures are developed with stable PID measurements.

This metric will depend on successful re-calibration of the PID to detect all organic materials in use for this project

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) and 2.4 Number of laboratory trials documented. All to be reported during next period.

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;

Our rapid training protocol established during Activities 1.1 and 2.2 have partially informed this step. During these activities, we utilized three different volumes of each target substance in an effort that they roughly corresponded to various odorant concentration levels of pangolin and hardwood. Following our training protocol, however, all rats learned to detect all three volumes/concentrations of the pangolin. Thus, this existing data will provide a baseline in our assessment of the broader concentration range the rats can detect. Given the difficulties with the calibration of the PID (as described in 2.2 above) we are awaiting functional use of the PID to continue this experiment but have adopted a contingency plan to use different volume ratios of samples, as established for Output 2, should PID use prove impossible.

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.

These activities will be dependent on completion of Output 2, we therefore anticipate reporting on this output during the next period.

Measurable Indicator(s):

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.

To be reported during next period.

Means of Verification:

3.1. Rat accuracy is reliably predicted by target concentration.

Preliminary results gleaned from Activities 1.1 and 2.2 failed to support this metric that partially naïve rats more readily detect target odors at higher concentrations compared to the same substance encountered in lower volumes (concentrations). Further examination is necessary with completion of Activities 3.1 and 3.2.

3.2 Number of accurate indications logged against non-target containing samples and mixtures.

Dependent on Output 2, reporting anticipated during the next period.

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).

All output 4 activities are planned for Quarters 3 & 4 of Year 2 and will be informed by a workshop that has been planned with local port authorities and other stakes holders. (See section 2a below)

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. Dian Kuipers, Ms. Anna Paul Narcis, Ms. Beatrice Malosha, and Ms. Mariam Juma. During this reporting period, Dr Cindy Fast was on maternity leave for four months. During this time her responsibilities were handled by Dr Miriam Schneider. The direct project team is 100% female.

5.2. Assign project specific roles and responsibilities;

Completed at start of project.

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 progress to the Southern African Wildlife Management Association's Annual Symposium in Bela-Bela, Limpopo province South Africa. Ashleigh had a wonderful opportunity to discuss this project and the progress we have achieved at the 2018 London Illegal Wildlife Trade Conference. At APOPO, this project is under the direction of the Head of Research and Development, Dr. Cynthia (Cindy) Fast – replaced by Dr Miriam Schneider during maternity leave. Several women, (including Dian, Kate Webb, and Haylee Ellis) have served as primary research technicians of this project. The research technician handles 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. Additionally, both Dian and Kate shared the progress of this project at an international scientific conference held in the USA.

5.3. Log time against project activities; and

APOPO: staff have logged 2888 hours on the project to date. The EWT logged 270 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.

Measurable Indicator(s):

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 have been involved in daily 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 2,888 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 EWT WITP Manager is also a woman. Hours logged by the EWT amounts to 270 hours.

2a. Give details of any notable problems or unexpected developments/lessons learnt that the project has encountered over the last 6 months. Explain what impact these could have on the project and whether the changes will affect the budget and timetable of project activities.

As above we experienced unexpected challenges (as detailed in Output 2 above) with functional application of the PID. Should we experience further delays in delivery of the calibration gas, or should the gas not work to enable detection of all (12 in total) organic substances in use for this project, we plan to continue to use this alternative method.

During the majority of this reporting period, the principle investigator, Dr. Fast, was away from the project on maternity leave. In her absence, responsibilities were transferred to new researchers without prior involvement in this project. The additional time needed to acclimate to the project, identify challenges, and troubleshoot solutions contributed to the slight delay in the completion of all activities associated with Output 1 (and subsequent outputs).

Finally, we are expecting a delay for the delivery of Output 4, since this deliverable is directly dependent on the occurrence of a planned workshop with port officials and important stakeholders. For a variety of

reasons, this workshop has had to be postponed and is now planned for the first week of December 2018. We expect to have this Output completed by January 2020 and we will be requesting a no-cost extension for this portion of the project.
2b. Have any of these issues been discussed with LTS International and if so, have changes been made to the original agreement?
Discussed with LTS: ~~Yes/~~No
Formal change request submitted: ~~Yes/~~No
Received confirmation of change acceptance ~~Yes/~~No
3a. Do you currently expect to have any significant (e.g. more than £5,000) underspend in your budget for this year? **Yes** ☐ **No** ☒ Estimated underspend: £
3b. If yes, then you need to consider your project budget needs carefully. Please remember that any funds agreed for this financial year are only available to the project in this financial year. If you anticipate a significant underspend because of justifiable changes within the project, please submit a rebudget Change Request as soon as possible. There is no guarantee that Defra will agree a rebudget, so please ensure you have enough time to make appropriate changes if necessary.
4. Are there any other issues you wish to raise relating to the project or to IWT Challenge Fund management, monitoring, or financial procedures?
We will be requesting a no-cost extension for Output 4 until January 2020, we will be putting in a Change Request to LTS to this end.

If you were asked to provide a response to this year's annual report review with your next half year report, please attach your response to this document. Additionally, if you were funded under R4 and asked to provide further information by your first half year report, please attach your response as a separate document.

Please note: Any planned modifications to your project schedule/workplan can be discussed in this report but should also be raised with LTS International through a Change Request.

Please send your **completed report by email** to Victoria Pinion at IWT-Fund@ltsi.co.uk. The report should be between 2-3 pages maximum. **Please state your project reference number in the header of your email message e.g. Subject: IWT001 Half Year Report.**