Wild rat control of Makueni County, Kenya with skin active non-anticoagulant pest control devices.

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Method

Population monitoring

Three Catch3 pest control devices (Aston University) and the PiedPiper (IRIS) device were deployed to a 1 acre walled compound in Westlands, Nairobi, Kenya known to contain a number of rats approximating 80-100. The Catch3 system monitors rat activity through pressure, vibration and infra-red detection and is capable of deploying rat poison to >200 rats when equipped with an appropriate aerosolised container. In this study a poison canister equivalent to approximately 15 activations (Figure 1a) was used. In addition, 2 traps were equipped with a Go-pro camera system and CamDo trigger system for visual monitoring of the systems.

The trial site had been under monitoring by a pest control firm for over 2 years with continual outbreaks associated with drought and population explosion of the neighbouring native forest. The period of study was aligned to begin after the most recent work at the site. This would include the blocking of a known access point in the compound wall as well as removal of accumulated refuge and sighting of baited traps.

The systems were fixed to the ground using flat headed tent pegs in 3 areas of interest. (1) A known rat run identified within a covered grass region close to refuge collection (2 sites). (2) A compound entry point which was recently sealed by a working party. (3) A long concrete floored area at the back of a personal property within the main compound where rats were known to have been seen. The system was not deployed at this site for any period prior to the trial preventing rats becoming accustomed to the object and simulating real world deployment. The PCS's would simulate liquid firing and confirm device reliability for operation as well as provide continuous documentation of activity for the IPM plan.

Wild rat formulation trial

Ten rats independently trapped as part of the IPM monitoring of Mukuyuni were transported to the animal holding facility (Department of Zoological Sciences, Kenyatta University). Rats were individually held in cages and provided with free access to food (Unga Limited Kenya) and water ad libitum. All experimental procedures were performed by Kenyatta university under the permit issued by the National Commission for Science, Technology and Innovation (NACOSTI/P/16/76449/9769) according to the documented protocol (No 1. efficacy evaluation) previously adopted in Davies and Ingham (2015). Rats were acclimatized and at the end of two weeks divided into two groups and cage labelled. Group one comprised experimental mice individually labelled as E1 to E5. Group two comprised the control rats labeled as C1 to C5. The experimental group was given an active dose of 80mg of cholecalciferol topically as a 1.5 ml volume containing (50/50 (v/v) DMSO/ethanol, 15% (v/v) PEG 200 vehicle) using the atomization system of the Catch3 and IRIS PCS's which use the same valve and atomization system (differing mainly in design and triggering mechanisms). The control group was given a topical 1.5 ml application of water at the same site in the same way as the experimental rats.

Feed and water were weighed and rats observed every four hours. Visual appearance was recorded according to the system proposed by Wolfensohn and Lloyd (2003).

Results

Population monitoring.

Active monitoring of a site provides the best environmental protection and eventual success of any IPM plan. Typically monitoring is provide by a single half day inspection that is combined with refilling and re-sighting of any baited control system. In this case however we were able to monitor the site with much greater resolution and present data in a variety of formats to suit the questions asked of the site. end of the experiment.

In Figure 2 we present the number of activations at the differing sites 1(a&b) to 3. The first 10 days shows a lower number of triggered activations; less than 2 activations were recorded at the site on most days with no activations been common over this period. Activations outside this period were in the region of 5-7 with must activity at the refuge site.

Mean activations at the differing sites can be seen in figure 3. 2-way ANOVA tests showed significance at the 95% confidence level for the population differences marked.

Formulation trial

Within the first 48 hours, all rats in both experimental and control groups (E1-E5 and C1-C5) where scored as distressed (mean 3.66 and 3) (figure 4) and noted to have reduced food and water intake. Without experimental alteration control group rats recovered after 48hours and displayed normal behaviour throughout with no further indications of distress.

One rat in the experimental group was found dead at 48h (figure 5). The four remaining experimental rats displayed total distress ranging from 9 to <4 during the remaining experiment. Distress was calculated through addition of the individual scores (1-3) of their general appearance, natural and provoked behaviour and site appearance. Distress across the study period is illustrated in Figure 4. The distress score was recoded every 4 hours and increased for all the rats in cases to as high as 9. Rats that had deceased scored 0 for the remainder of the time periods. Experimental rats died on days 2, 3, 7 and 7 respectively (Figure 2) with 1 rat undergoing a scheduled killing prior to the end of day 14, all control rats displayed normal behaviour at the

Conclusion

This study provides support for the activity of transdermal cholecalciferol in wild type rat populations of Africa, documenting the first ever wild type deaths from an automated skin targeted pest control system.

The continuous monitoring of rats with the Catch3 system demonstrates active detection of rats while avoiding miss identification of not target species and has allowed monitoring of a Population reduction strategy. Such systems can be used to actively monitor IPM measures and quantifiably document rat population growth or reduction at a specific site.

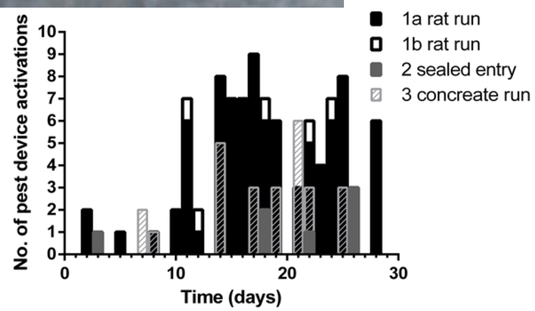


Figure 2: Individual Pest control visits at sites 1a-3. (1a) and (1b) rat run identified within a covered grass region close to refuge collection. (2) Compound entry point recently sealed. (3) Concrete floored area of a personal property.

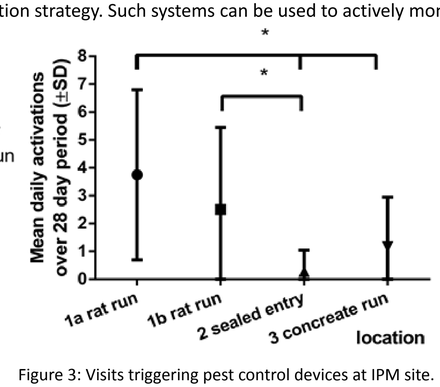


Figure 3: Visits triggering pest control devices at IPM site. * indicates statistical significance (95% confidence).

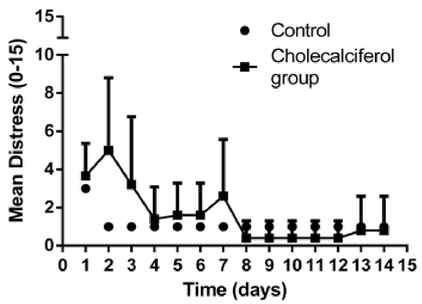


Figure 4: Distress score in rats following application of cholecalciferol (a non coagulant rodenticide). Distress score is generated from the following observation: 1 = general appearance; 2 = appearance on application site; 3 = Natural behavior; 4 = provoked behavior and 5 = food and water intake. Each of the parameters is given a score 0-3 with 3 being maximum distress for each of the parameters. Total distress is generated by summation of the scores of the five parameters giving maximum distress score of 15 and minimum of 0.

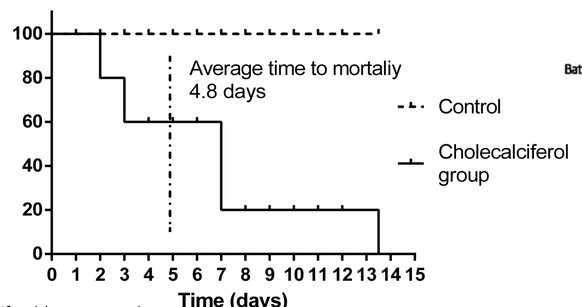
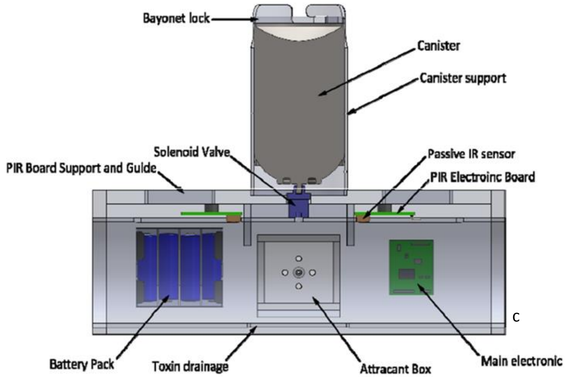


Figure 5: Survival curve for wild rats (n=5) following application of cholecalciferol (a non-coagulant rodenticide). Control mice (n=5) remained health throughout the experimental period.


a


b



c

Figure1 : (a) image of deployed liquid spray pest control device (Aston university). (b) image of deployed commercial spray pest control device (IRIS). (c) Perpendicular to plane of rat entry cross section showing illustrative example of main components (IRIS engineering with permission).

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