Pen testing the animal welfare performance of the DOC200 kill trap within a 'baffled' wooden box to kill ship rats

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Summary

Project

Zero Invasive Predators assessed the animal welfare performance of the DOC200 kill trap, housed within a Haines Trap Co. box, for ship rats (*Rattus rattus*) during August 2018.

Methods

This work was carried out with approval of the Lincoln University Animal Ethics Committee (AEC#2017-42, December 2017).

Rats were penned individually and the trap tested in a free-approach test. Once a rat was struck by the trap, the time to loss of corneal reflex was measured to determine whether the trap had rendered the trapped animal irreversibly unconscious within 3 minutes. The NAWAC (2011) specification for acceptable killing effectiveness of Class A kill traps allows, with a chosen sample size of 20 animals, a maximum number of 3 animals to retain corneal reflexes after 30 seconds, and a maximum of one animal to retain corneal reflexes after 3 minutes.

A total of 30 testing events were carried out, involving 29 rats, one of which was exposed to the testing environment twice after an initial refusal to engage with the trap.

Results

18 out of a total 20 strike events resulted in irreversible unconsciousness for the target animal in less than 30 seconds. One death was confirmed between 30 seconds and three minutes, and one strike event exceeded three minutes, after which the animal was euthanised.

During 30 testing events, eight rats refused to trigger the device within one hour, and were removed from the testing pen, and another two rats were able to trigger the trap without being struck.

Conclusions

The DOC200 trap housed inside a Haines Trap Co. box passed the NAWAC trap-testing guideline with Class A performance level when tested on 20 wild-caught ship rats.

1. Introduction

Traps are an essential component of the Remove and Protect model that Zero Invasive Predators Ltd (ZIP) is developing to help free the New Zealand mainland from possums, rats and stoats. Under this model, traps are used to (i) defend a predator-free area from incursion by these predators, and also (ii) detect any individual animals that evade natural or virtual barriers, so that they can then be removed before successfully re-establishing a population in the area.

For projects where the goal is to completely remove predators, it's essential that the traps used are highly effective – the project goal will never be achieved if too many individual predators can successfully evade the traps, because those predators may breed and establish a population.

The DOC200, housed inside a Haines Trap Co. box, is widely used to control populations of stoats throughout New Zealand, with Norway rats, ship rats, and hedgehogs commonly caught. Ship rats are typically the most numerous capture (N. Poutu, pers. comm.). Its use for this purpose is currently considered best practice, although to date the animal welfare performance of this device for ship rats has not been verified.

Since the establishment of ZIP in February 2015, we have been trying to develop more effective rat and stoat traps, based around the DOC200 kill trap. In order to do this, we need to understand how effectively the DOC200 trap captures rats, and the National Animal Welfare Advisory Committee (2011) guideline for assessing the welfare performance of kill traps provided a very good basis for doing this, as well as enabling the assessment purpose of the guidelines.

Consequently, with the support of the Department of Conservation, during late-August to mid-November 2018, we assessed the welfare performance of the DOC200 kill trap to kill ship rats (*Rattus rattus*).

2. Purpose

This document reports on a project undertaken to assess the welfare performance of the DOC200 kill trap to kill rats according to National Animal Welfare Advisory Committee (2011) guideline.

3. Methods

3.1 Kill trap

Testing was carried out using the standard DOC200 kill trap made by CMI Springs Ltd, in a single set, single entrance wooden box manufactured to the Department of Conservation (2019) design and dimensions (by Haines Trap Co.).

The box contains a wire mesh baffle to (i) minimise the risk of non-target species being struck by the trap when used in the wild, and (ii) slow an animal's movements through the trap, and orient the animal's body towards and across the kill plate.

3.2 Test enclosure

The project involved a series of tests carried out within a 2.4 x 1.1 metre testing pen at the ZIP predator behaviour facility, at Lincoln, Canterbury. The pen has two plywood sides, with mesh doors on each end and a mesh roof. The base of the pen sits flush on the floor, and was layered with sawdust to remain consistent with the housing pens of the captive animals. As per the conditions of the animal ethics application, *ad libitum* laboratory diet pellets and water were provided for all test animals.

A Techview QV-3140 home security system with four cameras (full D1 resolution, 100 frames per second, IR illumination) was installed to provide: (i) a wide-angle view of the testing pen from above, (ii) a close-up view of the outside of the trap box from the side showing the entrance end, (iii) an internal view of the trap from the roof of the trap box, and (iv) a close-up view of the examination table. These camera angles allowed researchers to trace the movements of all animals for the entire time they were inside the testing pen.

Figure 1.1: Side view of pen, including examination table with camera

Figure 1.2: Top view of the pen

Figure 1.3: Inside view of trap box in the pen

3.2 Animals

A sample size of 20 strike events (i.e. 20 animals) was agreed upon prior to the commencement of testing. A total of 29 wild-caught ship rats (sourced from both Christchurch and Nelson), were supplied to ZIP by an independent contractor. The animals comprised: 21 male rats, with a body weight range of 90–183 grams, and 8 females, with a body weight range of 94–160 grams.

All of the rats were acclimatised to captivity in individual cages for at least two weeks before being exposed to the pen.

3.3 Pen tests

Prior to each testing event, a single DOC200 kill trap box located inside the testing pen was baited with Pic's Peanut Butter® (placed within the 3 nail prongs typically used to hold an egg or meat lure) and then set following the Department of Conservation instructions (Department of Conservation 2019), with a trap trigger weight of 80g.

Each animal was transported to the testing pen inside its housing cage. Each cage was placed inside the testing pen, and opened to allow the animal access to the pen. Researchers then exited the pen, switched off the lights and closed the door of the room.

A researcher outside the test room throughout each trial, and observed each animal's interactions with the trap via a series of infrared cameras.

After the DOC200 was triggered and had trapped an animal (labelled a "strike event" for the purpose of this report), the trap box was removed from the testing pen, placed on the examination table, and the top opened in front of the camera. The camera above the examination table allowed us to document the assessment of consciousness for each trapped animal. Corneal reflex tests were then immediately carried out to determine the time taken to loss of corneal reflex, indicating the animal had been rendered irreversibly unconscious. The corneal reflex test (often referred to as a blink test) is a commonly used laboratory and veterinary method for assessing an animal's state of consciousness (Erasmus, Turner and Widowski 2010). It is often used during trap welfare assessments, as it is the last response that remains immediately before death can be confirmed. The blowing of air or light pressing of a blunt instrument on the corneal muscles around the eye should invoke an involuntary blinking response. A lack of response to the corneal reflex test suggests the animal has suffered brain death, and is technically irreversibly unconscious.

Once an animal was confirmed deceased, it was labelled, bagged and stored frozen for a pathological assessment at a later date.

Animals that did not trigger the trap after an hour in the testing pen were removed and replaced, in order to accelerate the testing process.

Between tests, the trap was cleaned and rebaited. The water and pellet bowls were topped up, and extra sawdust was added to the testing pen as required. At the conclusion of all tests, the footage was downloaded onto hard drives and stored for review.

All tests were carried out with permission from the Lincoln University Animal Ethics Committee.

4. Results

The overall results of the tests are presented in Table 1.

Table 1: Results of the tests to assess the welfare performance of the DOC200 kill trap to kill rats

Test #	Date	Weight:	Sex:	Test Result	Strike Position
1	29/8/2018	125 g	Male	Trap sprung, animal not struck	-
2	29/8/2018	135 g	Female	Kill <30 Seconds	1/3 of body across plate. Strike between nose and eyes, behind ears and upper body
3	30/8/2018	90 g	Male	Kill <30 Seconds	3/4 of body across plate. Strike on nose, ears and middle of body
4	30/8/2018	160 g	Female	Refusal - tested treadle	-
5	31/8/2018	170 g	Male	Kill <30 Seconds	1/2 of body across plate. Strike above eyes and upper body
6	31/8/2018	112 g	Male	Refusal - tested treadle	-
7	31/8/2018	140 g	Female	Refusal – did not interact with trap	-
8	11/9/2018	160 g	Male	Kill 30-180 Seconds	1/4 of body across plate. Strike above eyes as the animal retreated from the trap upon spring off
9	11/9/2018	90 g	Male	Euthanised by staff, after >180 seconds post-strike by kill bar	Glancing strike as animal retreated from trap upon spring off; animal left writhing to side of trap. Euthanised by staff
10	2/10/2018	134 g	Male	Kill <30 Seconds	1/4 of body across plate. Strike below eyes, across ears and shoulders
11	2/10/2018	117 g	Male	Refusal - tested treadle	-

Test #	Date	Weight:	Sex:	Test Result	Strike Position
12	3/10/2018	118 g	Male	Kill <30 Seconds	1/2 of body across plate. Strike on nose, behind ears and upper body
13	3/10/2018	137 g	Male	Kill <30 Seconds	1/4 of body on plate. Strike below eyes, on ears and on shoulder
14	3/10/2018	110 g	Male	Kill <30 Seconds	1/2 of body across plate. Strike on nose and back of head
15	4/10/2018	135 g	Male	Refusal – did not interact with trap	-
16	8/10/2018	110 g	Male	Refusal - tested treadle	-
17	15/10/2018	114 g	Male	Kill <30 Seconds	Whole body across plate. Strike across nose, top of head, and lower half of body
18	15/10/2018	110 g	Male	Kill <30 Seconds	3/4 of body across plate. Strike across eyes, behind ears and lower half of body
19	15/10/2018	113 g	Male	Kill <30 Seconds	1/2 of body across plate. Strike on tip of nose, behind ears and middle of body
20	16/10/18	100 g	Female	Kill <30 Seconds	3/4 of body across plate. Strike just below eyes, back of head and middle of body
21	17/10/18	140 g	Female	Kill <30 Seconds	3/4 of body across plate. Strike on eyes, ears and middle section of body
22	17/10/18	130 g	Male	Kill <30 Seconds	1/4 of body across plate. Strike on nose, eyes and behind head
23	2/11/2018	183 g	Male	Kill <30 Seconds	1/2 of body across plate. Strike on middle of nose, back of head and upper body
24	2/11/2018	112 g	Male	Refusal - tested treadle	-
25	15/11/18	94 g	Female	Kill <30 Seconds	Whole body across plate. Strike on eyes, ears, back of head and lower half of body

Test #	Date	Weight:	Sex:	Test Result	Strike Position
26	15/11/18	175 g	Male	Kill <30 Seconds	1/4 of body across plate. Strike on tip of nose, on ears and upper section of body
27	15/11/18	161 g	Male	Refusal - tested treadle	-
28	16/11/18	161 g	Male	Kill <30 Seconds	1/4 of body across plate. Strike above eyes, above ears
29	16/11/18	122 g	Female	Trap sprung, animal not struck	-
30	16/11/18	124 g	Female	Kill <30 Seconds	1/2 of body across plate. Strike on eyes, behind ears and upper half of body

4.1 Killing effectiveness

Out of the 20 strike events:

- 18 resulted in irreversible unconsciousness for the target animal in less than 30 seconds
- 1 resulted in irreversible unconsciousness between 30 seconds and three minutes
- 1 animal remained conscious beyond three minutes, and was euthanised by the testers[1]

Based on these results, the DOC200 trap, housed within a Haines Trap Co. box, achieved Class A animal welfare standard.

4.2 Sprung trap events

Two rats (tests #1 and 29) were able to trigger the trap and avoid being struck by the kill bar by leaping backwards.

4.3 Refusals

A further eight rats (tests #4, 6, 7, 11, 15, 16, 24 and 27) did not trigger the kill trap within one hour.

Six of these animals tested the treadle (up to five times by one individual), whilst the other two did not interact with the trap at all. We refer to these interactions as "refusals".

All eight rats that tested and refused the trigger eventually returned to their housing cage to sleep, and were removed from the testing pen after one hour of inactivity.

5. Discussion

5.1 Difficulties associated with assessing killing effectiveness

We noted several difficulties with assessing the killing effectiveness of the DOC200 kill trap. First, the use of corneal reflex assessment as the primary indicator of consciousness relies on researchers being able to access the eyeballs and surrounding muscle tissue of each rat, but this area was often obscured by the kill bar of the trap, resulting in severe head trauma.

In these instances, other indicators used to determine consciousness were checking for a heartbeat, breathing and directional leg movement, although these can also be difficult to monitor. Checking for a heartbeat can be made difficult due to the position of the kill bar, and breathing can last for 2-3 minutes following irreversible unconsciousness (Jane Arrow 2018, personal communication).

When an animal's central nervous system is struck, muscle twitches can cause involuntary movement of limbs. However, if these leg movements appear as an animal's conscious

[1] This animal was euthanised after 3 minutes, due to misinterpretation of the NAWAC testing guidelines led us to conclude the trap had prematurely failed. Upon consultation with NAWAC committee members, it was confirmed that the testing could continue. Due to the performance of the trap in subsequent test events, this error was not consequential to the animal welfare result for this trap – which achieved Class A standard.

attempts to extract itself from a trap, it might suggest the animal has survived the initial impact. Although involuntary limb movement can occasionally be difficult to distinguish from an animal's attempts to extract itself from a trap, when a kill bar has obscured the head region and made checking for a heartbeat difficult, it can be a useful measure of consciousness.

We concluded that because strike-based kill traps result in strike events with more complicated outcomes (c.f. methods, such as strangle traps, where an animal's eyes are not obstructed) a combination of tests to confirm consciousness might be required.

5.2 Kill bar strike location

As previous researchers involved with testing the welfare performance of kill traps have found, the strike location of the kill bar is a key predictor of how humane an individual strike event will be (Jane Arrow 2018, personal communication). Animals that had crossed more than one-quarter of the width of the plate before committing sufficient body weight to trigger the device were more likely to have one of the bars on the kill arm strike them between the eyes and the top of the skull, resulting in irreversible unconsciousness within 30 seconds.

The vast majority of animals that were rendered irreversibly unconscious within 30 seconds had suffered very clear head trauma due to the impact of the kill bar(s) on the skull. After tests were completed, three carcasses were opportunistically run through the Lincoln University small mammal CT scanner, to enable us to determine precisely where each had been struck by the kill bar and the level of trauma incurred. Figure 2 shows the CT image of a rat struck in the "ideal" location by the kill bar, i.e. between the top of the skull and the eyes. This individual was pronounced irreversibly unconscious within 30 seconds of being struck by the kill bar.

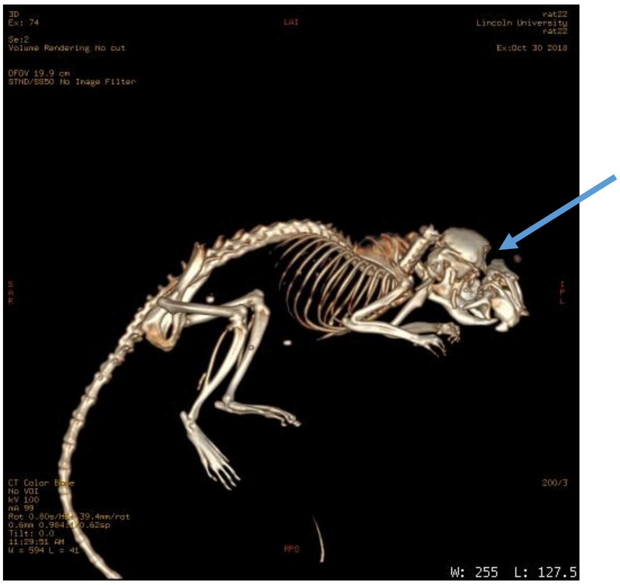

Figure 2: CT scan image of rat struck by kill bar in mid-section of skull, with arrow pointing to strike location

The two strike events that exceeded 30 seconds were the result of both animals triggering the trap and receiving either a glancing blow (testing event #9) or being struck by the kill bar at the front end of the skull (testing event #8).

5.3 Trigger weights

The recommended trigger weight for the DOC200 trap inside the wooden box is 80 grams. This weight requires a sub-adult or adult rat to commit over half of its body weight onto the treadle plate before it will fire, which increases the likelihood of a clean strike and a humane kill. However, the trap may not be triggered by some smaller juvenile rats.

5.4 Decision to accelerate testing process

The decision to remove animals from the testing pen after one hour of refusal to interact with the trap may have influenced the testing results by removing hesitant or shy animals from the test. These animals may be more likely than bolder animals to prematurely trigger the trap by testing the treadle, resulting in an escape, or a less humane kill. That said, welfare status can only be assessed when a strike event has occurred.

6. Conclusions

The standard DOC200 kill trap, in a single set, single entrance wooden box manufactured to the Department of Conservation (2019) design and dimensions met the NAWAC (2011) specification for acceptable killing effectiveness of a Class A kill trap.

7. Acknowledgements

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