TECHNICAL REPORT #7

DEFENDING OPENINGS IN PREDATOR FENCES: USING LIGHT AS A DETERRENT

Tom Agnew – November 2018

This project was one of a suite of projects initiated and largely carried out during 2015- 2017, with funding from six New Zealand dairy companies, i.e. Fonterra, Tatua, Synlait, Westland Milk Products, Open Country Dairy and Miraka.

INTRODUCTION/BACKGROUND

One of ZIP's objectives is to develop the knowledge, tools and techniques that prevent predators re-establishing in a 'protected area' (i.e. an area from which predators have been completely removed) on mainland New Zealand. At our Bottle Rock (Queen Charlotte Sound) field site we have demonstrated that a 'virtual barrier' that comprises multiple lines of traps can be a highly effective way of reducing reinvasion by possums and rats into a protected area. However, a virtual barrier may not be a practical or socially-acceptable method within rural and semi-urban landscapes.

A fence is a potential method of excluding predators from protected areas in rural and semi-urban landscapes. Traditional predator fences at a height of 1.8m from the ground to the top of the cap have been installed at numerous sites throughout New Zealand, to physically prevent cats, possums, rats and stoats from being able to move into a protected area (Burns et al 2012). If cats are not a target species, then our previously reported research (Agnew and Nichols 2018) indicates that a predator fence at a height of 1.1m or lower can contain almost all possums, rats and stoats.

An opening is the weakest point in a predator fence. Openings may be deliberately constructed to allow access (e.g. a road, footpath or railway line) or as a result of damage (e.g. as a result of tree fall or landslide). Research at Maungatautari (a sanctuary utilising 47km of predator fencing) found that any breach in the fence was highly likely to be located and exploited by a predator within 24 hours with an estimated 99% and 85% likelihood of occurring in summer and winter respectively. Aside from a predator gate, there is currently no effective way to protect a deliberate opening in a predator fence from being breached by predators.

Farnworth, Innes and Waas (2016) found that both wild and captive mice displayed avoidance behaviour towards well-lit areas in pen trials and in the Maungatautari predator free sanctuary. This behaviour was attributed to increased wariness of predation risk in well-lit areas. Other authors have described similar effects on mice behaviour when using light as a deterrent (Shapira et al. 2013; Bird, Branch and Miller 2004).

There is very little information available regarding the effect of illumination on the behaviour of ship rats. Lincoln University student Shannon Gilmore (2016) investigated the effect of the moon cycle and natural illumination on ship rat and possum activity in a variety of habitats on Banks Peninsula. She found that while moon cycle had little effect on the activity of both species, higher levels of illumination appeared to cause a reduction in overall activity (as shown by camera traps and bite marks on non-toxic wax tags). Like the authors of other studies above, Gilmore also attributed this reduction in activity to increased wariness of predation risk during times of higher natural illumination.

Consequently, we hypothesised that ship rats would seek to avoid the perceived predation risk of areas well-lit by artificial illumination. We therefore initiated a project to investigate the utility of light as a deterrent at deliberate openings in predator fences.

OBJECTIVES

This initial objectives of this project were to test whether:

1. Light alone could deter ship rats from invading through an opening in a predator fence; and
2. Ship rats would seek shelter from the light and therefore could be trapped.

Initial results led to the adoption of a third objective, whether:

3. Light could be used to 'channel' ship rats into trap boxes.

TRIAL DESIGN/METHODS

This trial was carried out within a 2ha enclosure bounded by a 1.8m high predator fence, at the ZIP predator behaviour facility at Lincoln. The enclosure is bisected by two 40m x 40m L-shaped sections of predator fence, with a 20m wide corridor between the two sections. This corridor was used to simulate a deliberate opening in a predator fence.

Four light towers were erected across the entrance to the corridor. Each light tower comprised a 1.8m high x 150mm diameter fence post, with a Philips Tango G2 LED light fitting attached to the top of each post, and wired to the mains power supply within the enclosure. The combined effect of the four towers was to create approximately 1,000 lux at ground level for at least a 1m distance into the corridor. Shields were used on each light fitting to achieve a sharp 'line' of light at the entrance of the corridor and to restrict light spill, in an attempt to reduce the ability of rats to habituate to intense light prior to attempting to cross it. The strong "light zone" extended approximately 7m into the corridor.

The diagram below displays the lux readings in the corridor. The light towers generated the desired 1,000 lux at ground level across most of the corridor width for 1m into the light zone, and almost complete darkness just 1m back from the entrance.

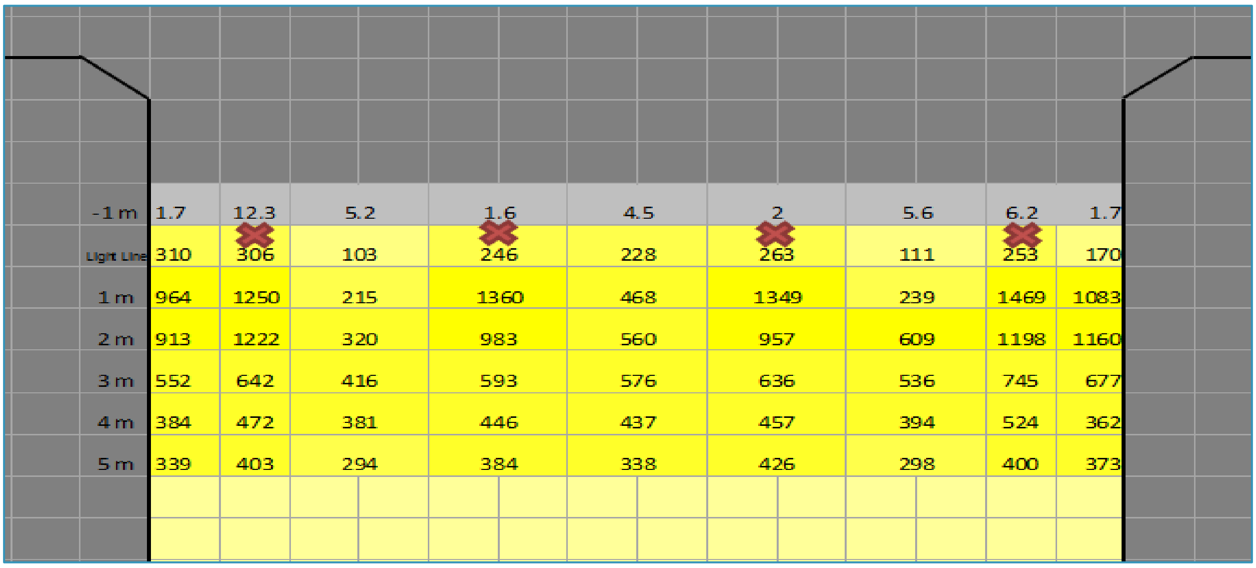

Figure 1. LUX levels on the ground across the 20m-wide corridor. The black lines are the "L-shaped" sections of predator fence that bisect the enclosure. The crosses symbolise the position of the light towers. Rats entered the light zone from the top of the figure. The light-yellow coloured areas represent the strongly lit 'protected area'.

Within the light zone, a run through tunnel architecture trap with two DOC200 kill traps set side-by-side inside (but no lure) was placed against each of the two fence line edges of the corridor, 5m from the light line. The kill bars were restrained with shackles but the treadles could still fire the kill bar. Their treadle plates were inked, and tracking cards placed inside each tunnel entrance, in order to detect whether a rat would have triggered the trap.

Little Acorn 5210A trail cameras were installed alongside the fence lines on either side of the corridor, and set to record 30 second video clips, with a 5 second delay between videos. Footage was reviewed to record animal movements and behaviour in the lead up to the lit zone, around the deterrent light line, and in the vicinity of trap boxes. A trail camera also recorded animals that entered each trap.

Figure 2. View of the original light zone from the perspective of the invading rat.

Between June and September 2016, ten individual rats were released individually, after dark, inside the predator enclosure, on the entrance side of the corridor, and allowed to move around on their own for three nights. Water, food and shelter within nest boxes was provided throughout the trial. Live-capture cage traps were used to intercept rats that successfully crossed the lit corridor. For five of the rats, all of the light towers at the entrance of the corridor were turned on, completely illuminating the corridor. The other five rats were used as a control, where no light towers were turned on.

Each of the rats used in this trial was examined beforehand, to ensure that it was healthy; the examination included whether or not it had any cloudiness in its eyes, which would indicate potential poor vision.

All trials were conducted under approval from the Lincoln University Animal Ethics Committee.

INITIAL RESULTS

All ten individual rats passed through the corridor – i.e. whether the light towers were turned on or off - which indicated that artificial illumination alone was not a strong deterrent.

Notably, all ten rats passed through the kill trap boxes located at the base of the fence on their way through the lit zone.

MODIFIED METHOD

We then modified the trial to test whether we could ‘channel’ invading rats into trap boxes through the use of lighting. The four original light towers were repositioned and an extra light tower was installed, so that we could operate a three-on/two-off set up, in order to create a 15m wide light zone alongside one fence line and a 5m wide dark zone along the opposite-facing fence line.

The trial was set up this way to test whether a rat that approached the lit zone would initially be deterred and would later cross to the dark zone of the corridor. We trialled this set-up using 20 rats, released one at a time.

RESULTS

Two of the 20 rats did not enter the corridor; instead they remained pretty much where they were released. Consequently, the sample size for the trial of whether light could be used to ‘channel’ rats into trap boxes was 18 individuals.

All 18 rats crossed the corridor, eventually into the protected area.

Each rat crossed the corridor directly from the side where it entered it - i.e. from either the lit zone or the dark zone. In other words, none of the rats that first encountered the lit zone were initially deterred and later crossed using the dark zone of the corridor.

Only 1 out of the 8 rats that first encountered the lit zone crossed it immediately. Camera footage showed a high degree of hesitation among the seven rats that encountered the lit zone before they crossed it. Nonetheless, all of these rats eventually crossed the lit zone on the same or a subsequent evening.

In comparison, 7 of 10 rats that first encountered the dark zone crossed it immediately, i.e. without any hesitation.

17 of the 18 rats passed through the trap boxes in the course of making their way through the corridor. However, there was a significant difference in the behaviour way of the rats, depending on whether they crossed from the lit zone or the dark zone. Rats that crossed through the lit zone showed much less hesitation entering the trap box compared to rats that crossed through the dark zone – i.e. rats that crossed the lit zone entered the trap boxes faster than rats that crossed through the dark zone.

DISCUSSION

As a prey species, rats are forced to continuously make decisions that balance risk and reward. Our initial hypothesis that rats would seek to avoid the perceived predation risk of areas well-lit by artificial illumination was disproven early on in this project. This trial suggests that illumination alone is not enough of a risk to deter rats from moving through a large opening in a predator fence.

We also learned that artificial illumination alone is not enough of a deterrent to steer rats passing through an opening in a predator fence towards a darkened area.

While light did not appear to steer a rat towards a darkened area, rats were less likely to linger in a lit zone – and as a result entered the trap boxes more quickly than the rats passing through a dark zone.

This suggests to us that artificial illumination may be useful in a ‘layered’ deterrent system, whereby light is used to slow down approaching animals to further increase the effectiveness of other deterrents, e.g. such as an electrified cattle grid (which we have also trialled).

It may also be worthwhile to investigate the utility of a more direct light, such as by locating the LEDs at ground level, directly facing invaders, to increase the perceived predation risk (as animals physically cannot see what lies behind the lights). Direct light may also increase the level of pain/discomfort, which may improve its effectiveness as a deterrent.

The single rat that was not deterred at all by the lit zone and did not track through the trap boxes represents the 'perfect invader', i.e. one that is not perturbed by indirect deterrents (such as illumination) and is not drawn to shelters or lures.

The trial also confirmed the common knowledge that rats like to run along the edges of structures, because the solid side (even of a predator fence) protects them from that side, helps them navigate by whisker touch and familiarity, and often indicates nearby shelter.

ACKNOWLEDGEMENTS

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Thanks also to the ZIP animal behaviour team who designed the trial, prepared all the paperwork, cared for the rats, and carried out these trials.

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