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**Project title:** Eradication Science: eliminating the last survivors to achieve predator freedom (Programme co-funding)

**PF2050 Ltd reference:** SS/04/08

**Project period reported on:** July 2021 – June 2022

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### **Project overview**

Manaaki Whenua Landcare Research (MWLR) are undertaking a 5-year MBIE project to understand the characteristics of pests (possum, stoat, ship rat) that survive control operations. Our research investigates whether intrinsic behaviours of survivors differ from the behaviour of ‘average’ individuals within a population, as these differences may affect the likelihood of encountering and interacting with control tools. As part of this research, we are studying cues (singly and in combination) that may help target survivors. We are partnering with the Cacophony Project to leverage recent advances in machine learning to test the effectiveness of ‘smart traps’ that can target survivors. We are also partnering to develop automated devices that deploy species-specific sensory cues to improve monitoring and increase interactions with control tools.

### **Funder and aims**

PF 2050 Ltd are providing co-funding to be provisioned in full to MBIE Programme collaborators “The Cacophony Project” to fund the development of hardware and software to the specific aims noted below.

**Project Aim 1:** Develop and test a smart operating system for predator control and detection devices (30/06/2022)

- test differentiating target vs non-target species
- test disarming in presence of non-target

**Project Aim 2:** Investigate the effectiveness of smart devices in deploying appropriate cues to increase survivor interaction (30/06/2022)

- develop AI-supported devices that deploy sound, visual, and odour cues depending on detected pest species
- test identifying targets and deploying target-specific lure
- carry out initial pen trials

### **Progress report**

**Project Aim 1:** *Develop and test a smart operating system for predator control and detection devices*

To support the ambitious aims of New Zealand’s Predator Free 2050 initiative, new technologies that increase trap efficacy are needed. Cacophony has developed a high catch-rate trap that makes catching the last hard-to-get predators less expensive and more scalable while avoiding non-target animals. The novel device has an in-trap camera (IR camera) to determine when a target animal has entered. To distinguish between target and non-target animals, the smart trigger needs to be trained with high volumes of video data, which is difficult to obtain using wild populations. MWLR has provided captive animals at the Lincoln facility to train the IR camera with large volumes of data.

Smart devices were placed in the home pens of different species (possums, stoats, cats, ducks, and quail) to train the IR camera to distinguish between mammals and birds. Automated doors and sensors ensure that non-target animals are released unharmed. Cacophony's digital trigger can now distinguish pests from non-targets, greatly reducing by-catch rates in comparison to traditional mechanical triggers.

We tested a prototype Cacophony trap on stoats and possums at the MWLR animal facility to assess behavioural responses when a pest encounters the device. A cage trap at the back of the main trap was left unset to allow captured animals to exit once the trap was triggered. All stoats (n=5) entered the device and were captured on the first trial night. In a follow-up trial, we tested whether possums (n=23) that survive pest control operations would enter and trigger the smart device in a controlled environment (Lincoln pens). Twenty-one possums entered the device on the first trial night. One possum that failed to interact with the device exhibited high vigilance and caution towards the trap, making multiple approaches and retreats without entering. However, the remaining two possums that avoided the trap entered and triggered the sensor on the second trial night. Although all possums entered the device and triggered the sensor, not every animal was captured, as the 1<sup>st</sup> generation triggering system was not 100% reliable. Reliability has been improved in the 2<sup>nd</sup> generation system. As a comparison, we assessed captures with cage traps using these same individual possums in pen trials. Cage traps failed to capture all possums over four trial nights, with two animals never entering these devices.

*Highlights:*

- Ongoing testing of in-trap camera (IR camera) on targets (possum, stoat) and non-target (ducks, quail) at Landcare Research facilities
- First version of intelligent trigger being field tested at the R&D site in Port Hills
- First AI models being trained using in-trap camera footage
- Growing library of in-trap species video for species identification with the intelligent trigger

***Project Aim 2: Investigate effectiveness of smart devices in deploying appropriate cues to increase survivor interaction***

MWLR received MBIE funding to investigate the effectiveness of smart devices in deploying appropriate cues to increase survivor interaction. We identified a range of sensory cues in the first stage of the research that alters a pests' perceptions of risk and reward. We tested the responses of individual rats, stoats, and possums that survived pest operations to sensory cues (scent, sound, visual) in captive experiments. We have now identified the most attractive auditory and olfactory cues for both general population animals and pests that survive control operations. Visual lure trials are in progress.

The second stage of the research is to develop smart devices that integrate detection and behavioural manipulation by first identifying the target animal, then deploying an appropriate sensory cue. MWLR are partnering with the Cacophony Project to develop smart devices that deploy species-specific sensory cues, as outlined in Figure 1.

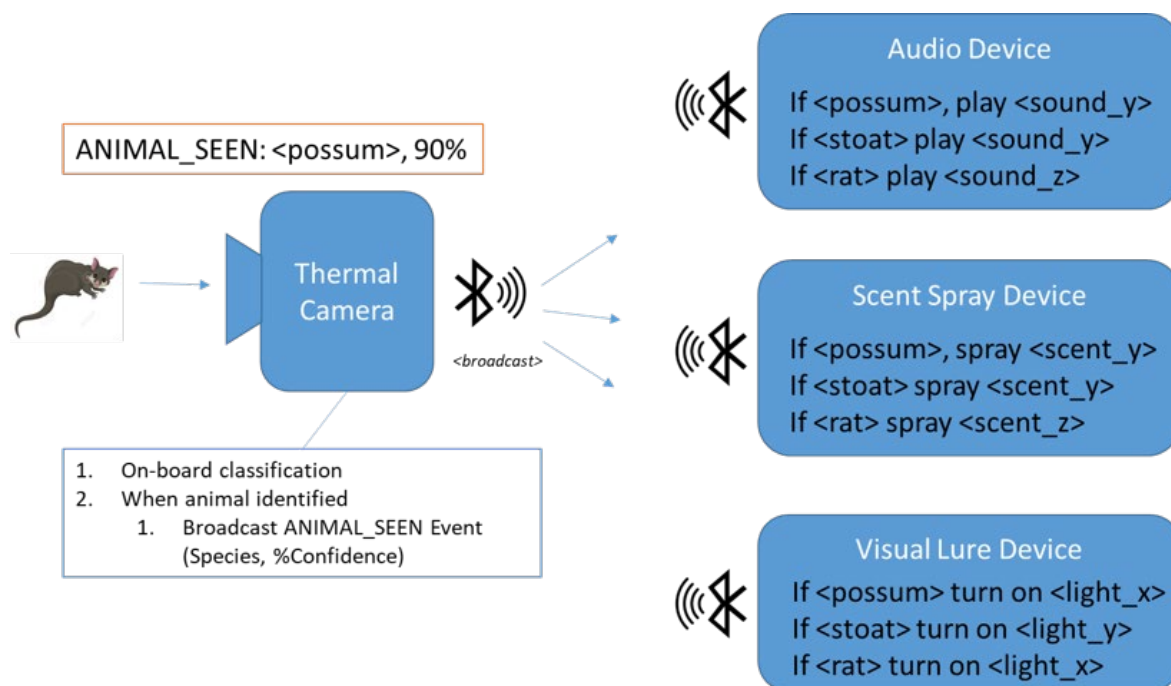


Figure 1. Thermal camera with onboard AI classification that activates audio, visual, or olfactory devices. Image credit: Cacophony website.

A prototype for the audio device was completed in February 2022. The Cacophony Project has developed a thermal camera with onboard AI that can positively identify and automatically classify species. These thermal cameras are connected to a separate speaker via Bluetooth. Audio cues are loaded onto the speakers' sim card and played sequentially once the target pest has been identified with the appropriate confidence level. Bluetooth speakers have an inbuilt date/time function, so different sets of audio cues can be programmed to trigger across time. The Cacophony app allows users to interface with the audio device and specify: the target pest, the required confidence for pest identification, and the duration of the sound lure once triggered.

Pen trials were conducted at the Lincoln animal facility to test thermal cameras, onboard AI, and audio cue devices. We positively identified a range of pests (possum, rodents, cats) to species level with high confidence without a connection to the internet. Cats were selected as the 'target pest' in our trials, with audio cues to trigger once the appropriate confidence level was achieved (80% in our study). Cats responded strongly to audio cues, altering their foraging activity and changing their behaviours once the device was activated. A field study on a range of pests is planned for the coming months.

A prototype for an olfactory lure device has been developed by Cacophony that activates a scent spray at fixed time intervals (30 minutes in our trial). We confirmed that the device triggers at the appropriate intervals and can sustain this pattern for months. The prototype olfactory device will be tested in upcoming field trials to determine its utility in a natural setting. Visual lures will be incorporated into a separate device once data from pen trials have been analysed.

Highlights:

- Thermal cameras with onboard AI positively identify and automated classification species without a connection to cloud/internet
- A species-specific sound cue was played when the appropriate pest was detected and identified
- Programmable audio lure test platform delivered

- Prototype scent lure device tested with spray can. Spray times can be altered as required.

Our next step for the smart trap is to continue growing the library of videos, using animals at the Lincoln facility, to train the intelligent trigger. Cacophony are field testing the smart trap at their R&D site in the Port Hills to ensure the trigger can differentiate between target and non-target species, disarming in the presence of non-targets. MWLR will undertake a one-month field trial with the AI-supported audio cue device to test whether a range of proven sound cues can attract stoats, rats, and possums. We will also test the olfactory device by deploying possum pheromones in a spray can during the trial. Visual lures that attract possums will be incorporated into a new device after pen trial data have been analysed (Aug 2022). Visual lures for stoats and rats are currently being trailed and will inform the design of the visual lure device for these species.