

Cacophony Project Thermal Camera: Final Report for Predator Free 2050

Executive Summary

- The Cacophony Project Thermal camera is now available for purchase and is the most sensitive tool available for NZ predator detection.
- Testing by Lincoln University shows the thermal camera is approximately three times more sensitive than trail cameras for possum detection. When taking into account labour, it is significantly lower cost than using trail cameras for possum detection and is even lower cost than chew cards.
- The Cacophony Project's thermal cameras are now used in a variety of locations including the Auckland Islands and Taranaki predator free projects.
- All of the hardware and software goals of the project have been achieved along with some of the stretch goals.
- We have a partner company that is set up specifically to professionally manufacture, sell and support the technology developed by the Cacophony Project.
- Extensive blog and social media posts have been published with details of progress made along with a number of public talks to disseminate results.

Agreed Milestones

Milestone No.	Milestone Description	Milestone Due Date
Milestones are to be written as activities conducted rather than outcomes achieved. Critical achievements that are essential for Project progression will be included as Decision Points in the section below.		
Project Aim 1: Hardware consolidation		
Milestone 1.1	Wide-scale-use ready hardware version of the Cacophony thermal camera completed, meeting the listed aims (critical hardware aim to be met: battery life extension to 10 days in the field, using onboard data storage). Brief written report to PF2050 Ltd.	20 April 2019
Milestone 1.2	Updated wide-scale-use ready hardware delivered to Lincoln University for inclusion in OSPRI funded field trialling, as far as logistically possible. Oral report to PF2050 Ltd.	20 June 2019
Project Aim 2: Software consolidation		
Milestone 2.1	Wide-scale use ready on-board software version completed, meeting the listed development aims (critical software aim to be met: on camera A.I. image classifier accuracy >90% for possums, rats and stoats). Software version made available to Lincoln University for inclusion in OSPRI funded field trialling, as far as logistically possible.	20 May 2019
Milestone 2.2	Wide-scale-use ready data management and user interface software versions completed, meeting the listed development aims (critical software aim to be met: updated web portal for end-users, including thermal video capability). Software versions made available to Lincoln University for inclusion in OSPRI funded field trialling, as far as logistically possible.	20 July 2019
Project Aim 3: Dissemination		
Milestone 3.1	Full written report on all hardware and software development conducted under this project schedule, detailing how all listed hardware and software development aims have been addressed, delivered to PF2050 Ltd and made publically available.	20 Sept 2019
Milestone 3.2	Demonstration of wide-scale-use ready hardware and software to PF2050 Ltd landscape projects. Most likely in a workshop forum, in which James Ross from Lincoln University will also be invited to present field trial results to date.	20 Sept 2019

Project Aim 1: Hardware consolidation

Milestone 1.1: Wide-scale-use ready hardware version of the Cacophony thermal camera completed, meeting the listed aims (critical hardware aim to be met: battery life extension to 10 days in the field, using onboard data storage). Brief written report to PF2050 Ltd.

The hardware part of the project was completed in April. The related report that was delivered to PF2050 can be found in Appendix 1. PF2050 projects now have a robust hardware tool that will allow much more sensitive predator detection at a lower total cost.

Milestone 1.2: Updated wide-scale-use ready hardware delivered to Lincoln University for inclusion in OSPRI funded field trials, as far as logistically possible. Oral report to PF2050 Ltd

Ten cameras with the updated hardware and software were delivered to Lincoln University. These cameras have been tested at the animal testing facility at ZIP, at a predator controlled reserve near Christchurch and at Taranaki.

Oral report was given to the PF2050 team on 14/09/19 in Auckland.

Project Aim 2: Software consolidation

Milestone 2.1: Wide-scale use ready on-board software version completed, meeting the listed development aims

All of the detailed software enhancements in the contract have been completed. Details of each of the key parts of the software produced are in Appendix 2. The highlight of this is the world's first thermal camera that is designed to monitor small, fast moving predators of interest to PF2050. This is also the first thermal camera that integrates real-time AI predator detection.

Milestone 2.2: Wide-scale-use ready data management and user interface software versions completed, meeting the listed development aims

All details of the data management and user interface have been completed (see Appendix 2). The highlight here is the new track based tagging feature that dramatically streamlines and increases the accuracy of tagging of animals in video footage. This will accelerate the rate of improvement of future AI classifier models.

Project Aim 3: Dissemination

Milestone 3.1: Full written report on all hardware and software development conducted under this project schedule, detailing how all listed hardware and software development aims have been addressed, delivered to PF2050 Ltd and made publically available.

This report covers this milestone.

Milestone 3.2: Demonstration of wide-scale-use ready hardware and software to PF2050 Ltd landscape projects. Most likely in a workshop forum, in which James Ross from Lincoln University will also be invited to present field trial results to date.

We have presented results to the Pestival conference with 500 participants as well as a specific presentation to Waiheke Predator Free group. We have offered to talk to all of the other predator free groups as introduced by PF2050 Ltd.

Below is a list of Relevant blog posts that cover in more detail the development and the results of the Cacophony Project AI thermal camera.

[Radio New Zealand interview](#)

Grant Ryan interviewed on nine-to-noon explaining The Cacophony Project

[Trial results: AI heat camera is more sensitive and cheaper than trail cameras for possum detection](#)

Results from the Lincoln University trails showing the Thermal Cameras is 3.5 time more sensitive and also lower cost for detecting possums.

[Thermal camera 5-20 times more sensitive for rats](#)

Results showing trail cameras miss 80-95% of all rats running around the bush!

[Winners at the NZ Hi-Tech Awards!](#)

The Cacophony Project won an award for the best High tech project working in the public good space in New Zealand

[Trial update: rat detection rates 10-50 times better than trail cameras](#)

Follow up with more test results showing how good the AI thermal Camera solution is

[The importance of scent trails](#)

An example of new animal behaviour that has been discovered with this new more sensitive detection tool.

[Why specialised thermal cameras are well suited to NZ predator management](#)

A detailed discussion of the value of thermal cameras for monitoring NZ predators

[A powerful new way to test sound lures](#)

How we can use the AI Thermal camera to rapidly test sound lures.

[Effectiveness vs Power Consumption](#)

Discusses the tradeoff between making a tool that is sensitive and effective compared to lower power less sensitive tools.

Appendix 1: Hardware Improvement Details

29/03/19

Feature	Importance	Results
Thermal camera platform	More sensitive predator detection & easier AI classification	Key parts of platform performing consistently well with recording uploading and AI classification
Always-on for high sensitivity	More sensitive than current trail cameras that miss small, fast moving predators	Independent tests show camera is 3.5 times more sensitive for possums (like more sensitive for other predators)
Wireless connectivity (3G & WiFi)	Makes data management & remote monitoring significantly easier	New Jasper IOT communications is platform performing very well
Robust lightweight mechanical setup	Allows consistent height & angle adjustment independent of terrain	New custom fitting and tripod more stable lightweight and flexible
Weather resistant enclosure	Robust in most NZ weather	Platform has performed well in rough weather and is now specified for production
Battery for 4-6 days recording	Allows remote locations to be monitored	We have 15 battery packs with the OSPRI trial that we are testing
Large onboard data storage	For remote locations without 3G or WiFi coverage	The cameras can support large onboard storage capacities.
Flexible power input	Flexibility to use mains power, most battery technologies & solar power	New power configuration now works on multiple power inputs (mains, battery and solar). New plugs integrated so they cannot be used incorrectly.
UI for camera setup	Allows a nearby phone to be used to perform setup tasks (no need for the complexity & cost of a screen on the camera)	The Sidekick mobile app has been improved and field tested. It is used to assist with camera positioning, diagnostics and wireless data retrieval.
Remote power management	Allows for full remote device reset - useful for software updates & problem resolution	Remote power reboot working - though not needed as the platform is more stable now

Battery backed real-time clock	Ensures correct recording timestamps even when device is unpowered	This is working well
Hardware based on/off scheduling	To conserve power, the device can power itself on & off according to a configurable schedule	This has been working well. Default configuration now is to turn on/off based on calculated sunset/sunrise at GPS location.
Hardware watchdog	Ensures the device automatically recovers in the event of software or hardware issues	Tested and working well
Audio output for digital luring	This may become a key feature for low density monitoring allowing one device can monitor a larger area	The hardware for this is included on all cameras now

Appendix 2 - Software Improvement Details

Feature	Importance	Results
Camera Software		
Flexible motion detection	Software based detection is more sensitive & adaptable than PIR based motion detection on standard trail cameras	This is working nicely and for possums shows it dramatically reduces the cost of detection
Record buffer, store & send	Continuous recording means that no predators are missed - we can't get to zero if we can't see everything	Working well. New recording throttling feature can be used to limit data volumes in high activity areas.
Remote management & monitoring	The software is being continually improved & so it can be accessed & updated remotely	Remote management is working well
Smartphone app for local management & retrieval of recordings	In remote locations without 3G coverage, a smartphone application operated by a person standing near a camera will be used for retrieval of recordings & device management. This uses a local wireless network, avoiding the need for externally exposed sockets or handling of SD cards.	This has been tested in the field with DOC, Lincoln University and OSPRI.
AI classifier running on camera	Having the AI based predator classifier running on the camera opens up a range of possibilities including autonomous monitoring & trap activation.	Initial versions of this have been tested and work well. This will form the basis of a product that will allow an AI triggered trap device.
Ability to play digital lures	Using software to play digital lures allows for flexible & wide ranging luring experiments.	This is now working and is being tested. Initial results look promising.
AI triggering of traps	The AI classifier can be used to trigger traps greatly reducing the by-catch.	Out of scope
Data Management		

Auto upload of recordings to cloud	It may sound trivial but data manual handling of recordings is time consuming, expensive & error-prone.	Working reliably
API access to recordings	Recordings can be accessed by public APIs so that they can be analysed externally.	Working reliably
Tracking state & location of cameras	Asset management becomes increasingly important as the number of deployed devices increases.	Various new management features and, setting and reporting of device location implemented.
Data access controls	For privacy reasons, it is important to ensure that some recordings are only accessible to specific groups of users.	Working reliably
Data backup	Automated backups are important to ensure that recordings remain available for long term analysis.	Working reliably
Web Portal		
Flexible querying of recordings	Queries using a variety of criteria are important for generating ad hoc insights.	Many UI improvements made based on user feedback
Playback of recordings	Recordings can be played using any web browser	May UI improvements to make it easier to use.
Secure user accounts	Standard part so different users can access different cameras	All working well
Accurate tracking of animals in thermal videos	A key part of predator classification is accurately identifying the regions of video which contain animals & be able to follow the animal as it moves.	We have significantly improved this
AI classification of predators	The initial machine learning model has the categories for rat, stoat, possum, hedgehog, bird, false positive. Accuracy will get better as more training is done.	This is an ongoing project but already allows for dramatically faster analysis

Efficient tagging of recordings	The web portal allows anyone to tag the recordings so this information can be fed back to the classifier to make it more accurate.	This was one of the largest parts of work and makes maintaining and improving the AI model much easier
Device failure alerts	When a camera stops working or is experiencing some technical issues it is desirable for operators to be alerted.	Not yet completed
End user documentation	The documentation will all be online so it can be kept up to date.	Comprehensive 44 page end user manual is now available
User forum for support	A user forum is a common approach for users to access details on any issues that arise.	Out of scope
Graphical summaries of predator numbers	Visualisations & dashboards will provide better understanding of predator counts.	Initial set of visualisations have been developed
Graphical summaries of bird numbers	A side benefit of the sophisticated tool for monitoring predators is that it is also great for monitoring some species of birds. We will be able to see how bird numbers respond to predator control.	Out of scope
Daily/weekly summaries	Ultimately it will be possible to have daily & weekly summaries on all of the cameras.	Out of scope
Mapping tools to highlight trends	Predator detections will be presented on maps to see the progress towards Predator Free 2050 in different parts of the country.	Out of scope
Tools for managing digital lures	Experiments can be set up & run via online portal to trial different digital lure strategies.	We have made good progress on this