

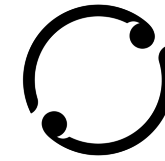
Thermal cameras on helicopters and drones: Some pros and cons of new technology

Bruce Warburton & Andrew Gormley

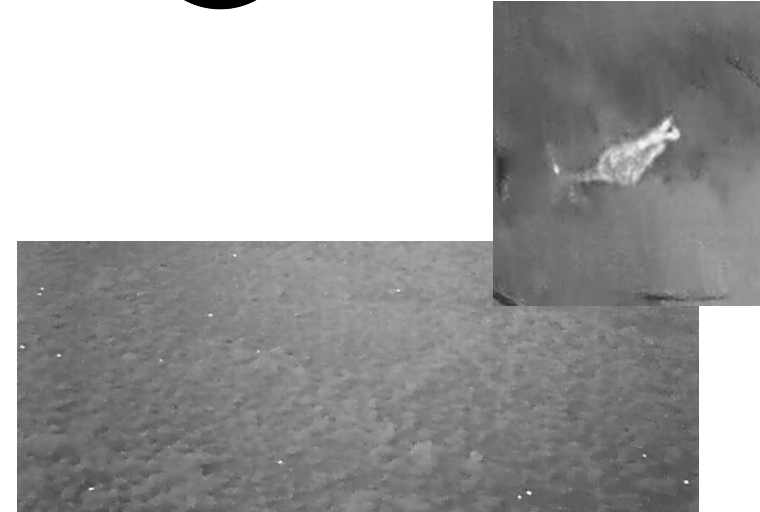
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Content

- Using a thermal camera and UAV for assessing %kill
- Understanding thermal cameras
- Pros and cons of using UAVs and helicopters with thermal cameras



Manaaki Whenua
Landcare Research





Assessing % kill of Bennett's wallabies (1080 operation)




Methods

- UAV (DJI Matrice)*
- Thermal camera (640x512)
- 8, 1-km transects in both treatment and non-treatment blocks
- Flown twice pre- and post-control
- C. 60m above ground
- Camera 40 degrees down from horizontal

* Service provided by GCH Aviation

Study site and transects



-  Treatment lines
-  Non-treatment lines

Results...1



Line	Poison (treatment)			
	Pre-control		Post-control	
	Night 1	Night 2	Night 1	Night 2
1	1	5	0	0
2	2	6	0	0
3	1	1	0	0
4	0	0	0	0
5	2	1	0	1
6	**		**	
7	7	-*	-	0
8	8	-	-	0

-* These lines couldn't be flown because of wind

** Outside poison operation

Results...1

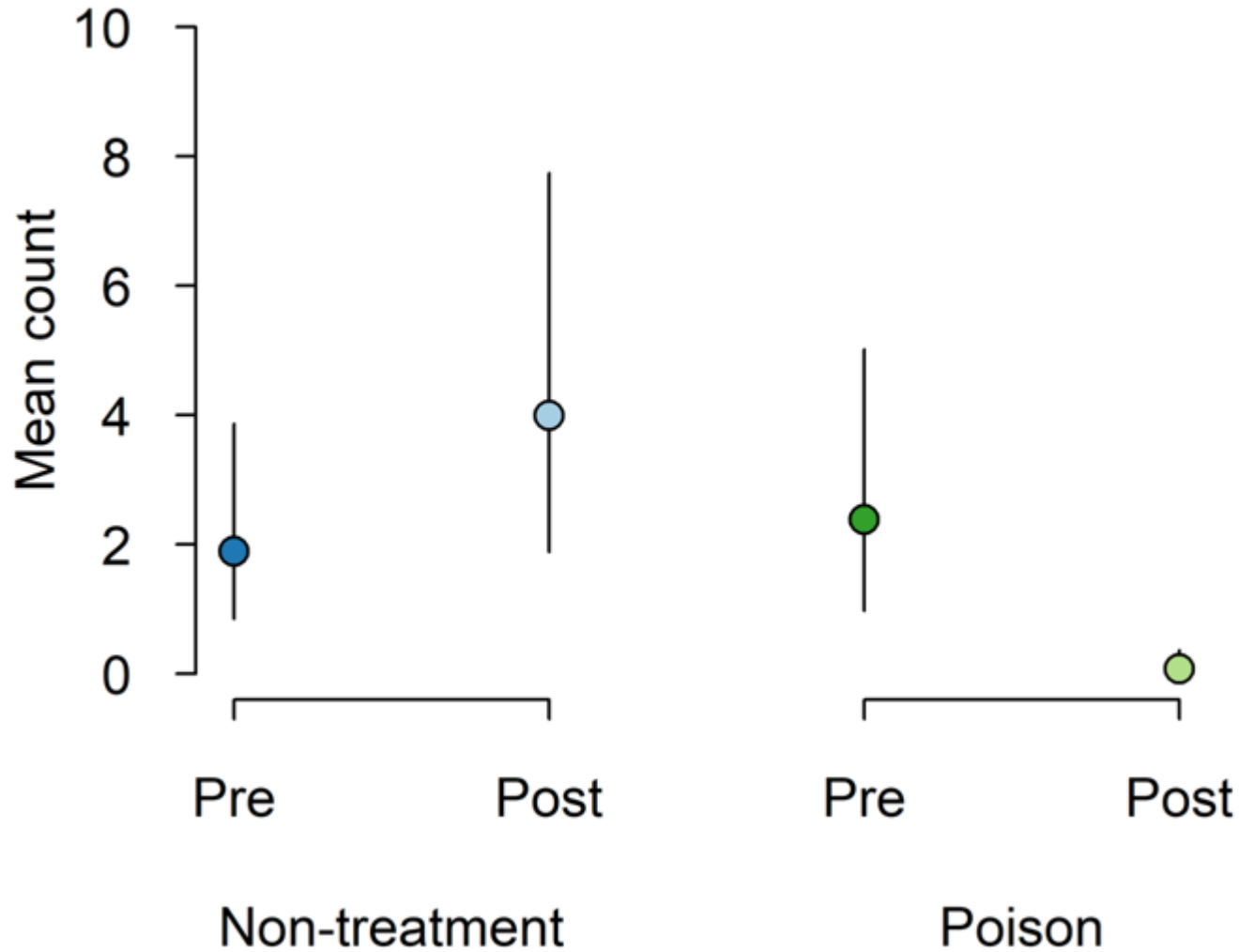


Line	Poison (treatment)				Non-treatment			
	Pre-control		Post-control		Pre-control		Post-control	
	Night 1	Night 2	Night 1	Night 2	Night 1	Night 2	Night 1	Night 2
1	1	5	0	0	0	1	5	10
2	2	6	0	0	0	1	4	2
3	1	1	0	0	6	6	4	10
4	0	0	0	0	1	0	0	0
5	2	1	0	1	1	-*	9	11
6	**		**		1	-	0	8
7	7	-	-	0	6	-	3	10
8	8	-	-	0	4	-	1	0

-* These lines couldn't be flown because of wind

** Outside poison operation

Results...2



Estimated percentage kill

98.4%

CI=92.8% - 99.8%



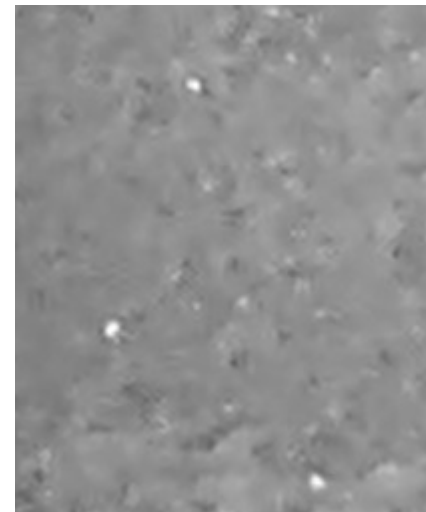
Thermal cameras

Resolution

Camera resolution and number of pixels on an animal

Johnson's criteria (DRI)

- Detection 2-4 (an object)
- Recognition 5-10 (a deer)
- Identification 15+ (a stag)





Thermal cameras

Resolution, pixel pitch, sensitivity,

Frame rate

Common resolutions:

80 x 60 pixels

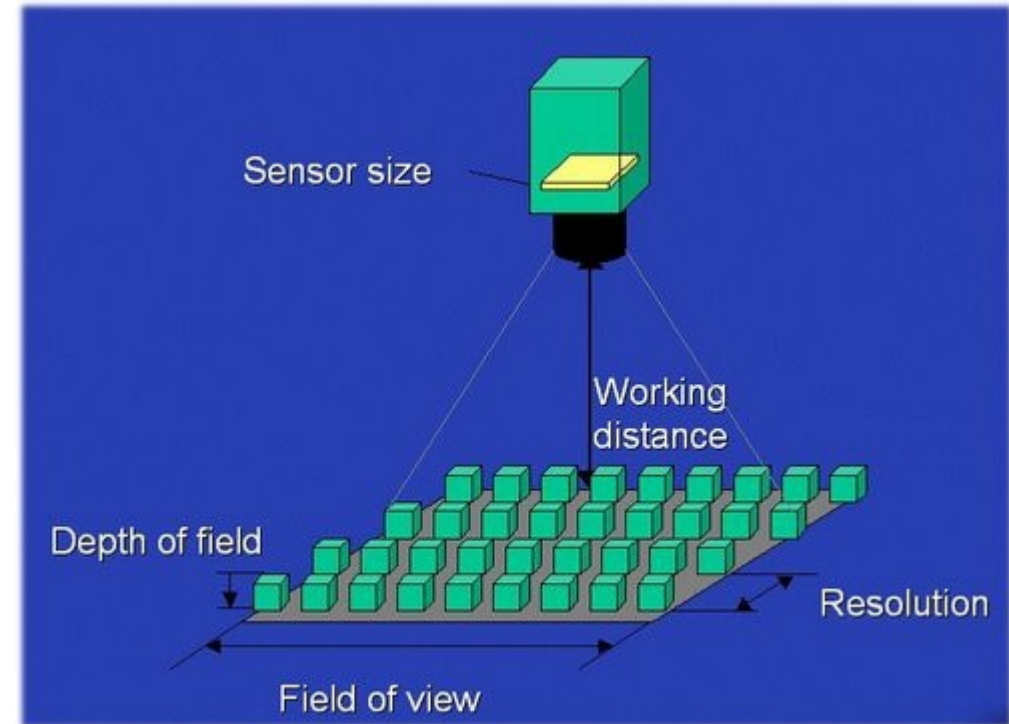
320 x 240

640 x 480

640 x 512

1024 x 768

1920 X 1200



- Camera resolution and size of target determines distance/height from target that you need to be, and swath width.
- Frame rate impacts on speed (to avoid blurring)

<https://www.ni.com/en-nz/support/documentation/supplemental/18/calculating-camera-sensor-resolution-and-lens-focal-length.html#>

Selex Merlin thermal camera



100m



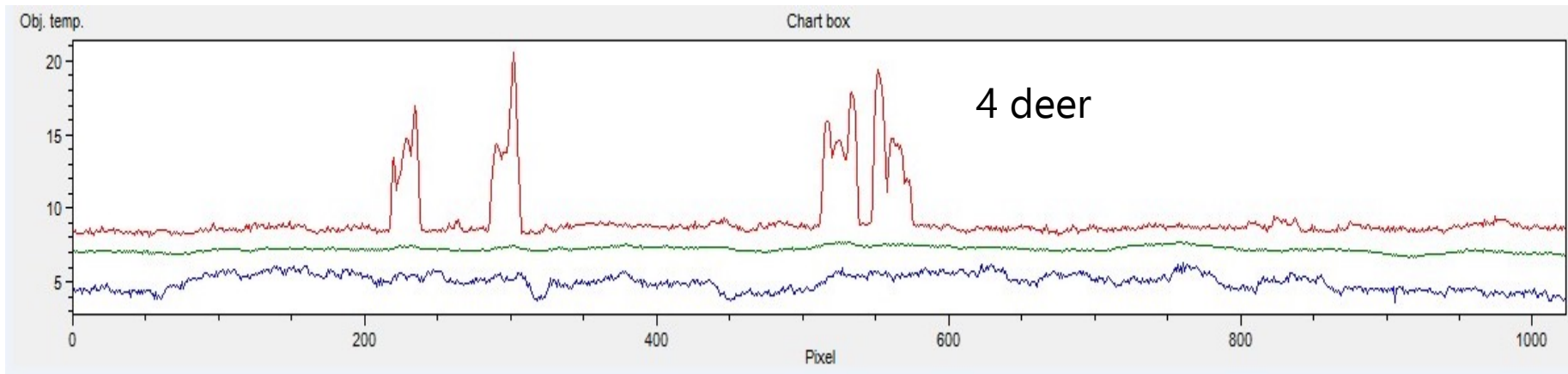
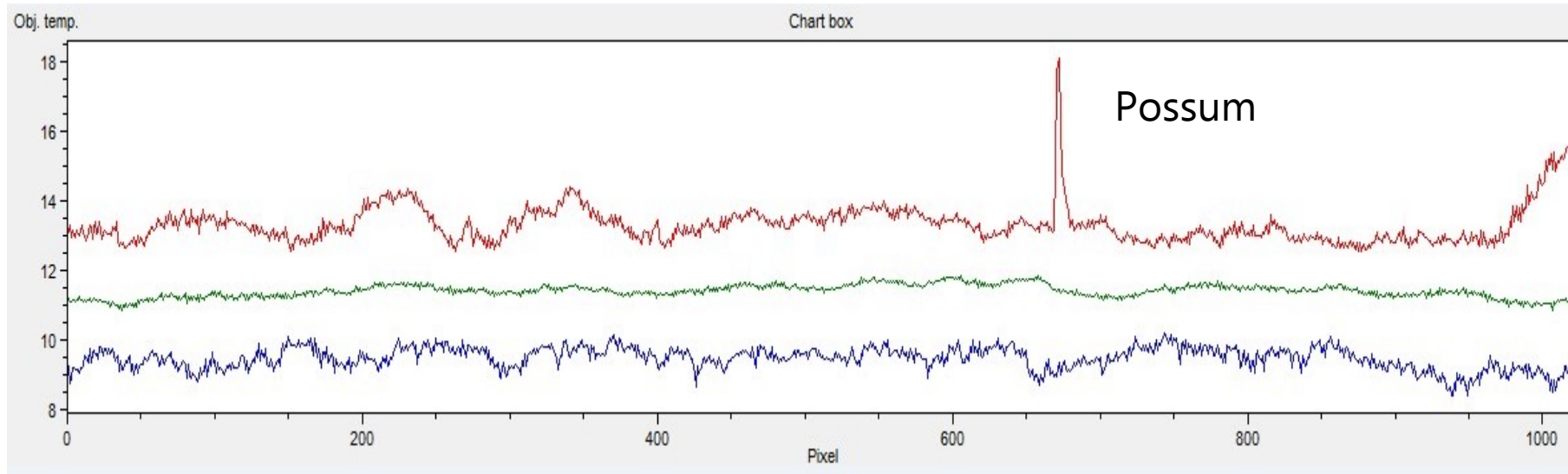
250m



Radio-metric cameras



Temperature is recorded for each pixel



Thermal cameras

Monitoring/hunting
(relative abundance)

Detection &
surveillance

Monitoring

	Monitoring Visual	Monitoring thermal
Seen	30	60

Thermal is twice as good as visual



Thermal cameras

Monitoring
(relative abundance)

Detection &
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Thermal is twice as good as visual

Detection

	Monitoring Visual	Monitoring thermal
Seen	30	60
# present	100	100

Thermal detection probability 0.6



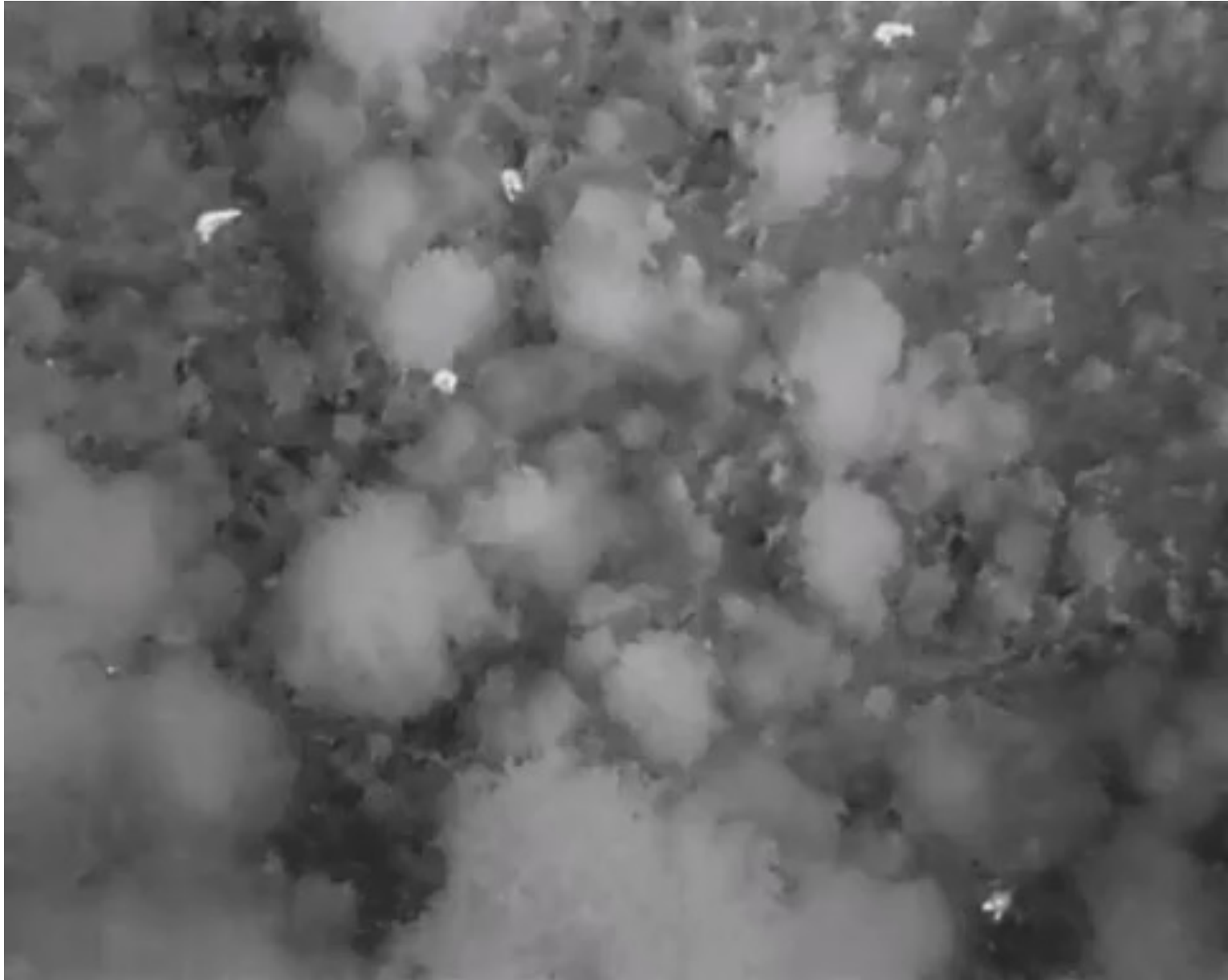
False positives, false negatives and scale

We classified
animals as:

- Definites
- Probables
- Possibles

Did not use
possibles





Integrating thermal and night vision

Using thermal to locate an animal

Then:

Using night vision to zoom in and identify it (using IR black light)



Images from Interpine NZ

UAVs and helicopters

Commercial UAV operators have to operate under a CAA Part 101 and/or Part 102

If night flying they need to operate under a Part 102 (this might require two operators)



UAVs and Helicopters



Pros

UAV:

- Flight is totally autonomous
- No pilot risk
- Low carbon emission
- Camera and UAV integrated

Helicopter:

- Not restricted by line of sight or altitude
- Could be cheaper (model dependent)
- Can change locations easily
- Faster, so can capitalise on weather windows
- Longer endurance (more lines)

UAVs and Helicopters



Pros

UAV:

- Flight is totally autonomous
- No pilot risk – excellent for night missions
- Low carbon emission
- Camera and UAV integrated

Helicopter:

- Not restricted by line of sight or altitude
- Could be cheaper (model dependent)
- Can change locations easily
- Faster, so can capitalise on weather windows
- Longer endurance (more lines)

Cons

UAV:

- Visual line of sight (need to get close to start of every survey line)
- DJI UAVs have a max altitude gain of 500m
- Each mission is pre-programmed (no flexibility in field)
- Can be expensive

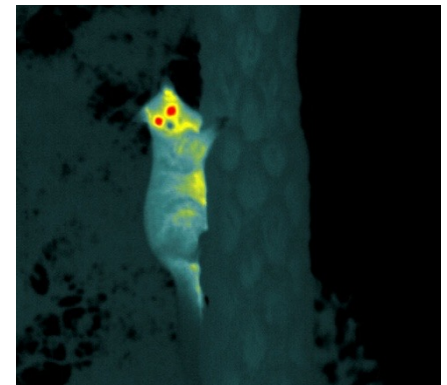
Helicopter:

- Not easy or cheap for night flying
- Certification challenges
- High carbon emissions
- Camera and helicopter not integrated

Conclusions



- Thermal cameras increase detections and can be used to obtain a relative measure of abundance
- Unknown number of false negatives (i.e. missing animals)
- When using thermal for monitoring and hunting the detection probability is unknown (i.e. given there is one animal present what is the probability that it is detected?)
- UAVs are a useful platform for small areas (current regulations restrict their utility)
- UAVs probably cheapest option for night work
- But UAVs not necessarily the cheapest option depending on job





Acknowledgements

- Brent Glentworth - Environment Canterbury
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