Thermal sensors: use and application in monitoring/detecting Australian wildlife.

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ROYALTIES FOR REGIONS

PARKSAND WILDLIFE

GOVERNMENT OF WESTERN AUSTRALIA

Department of Agriculture and Food

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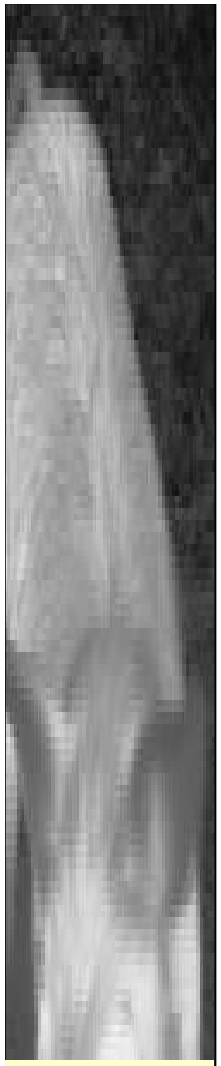

Thermal sensors

- Device that detects temperature/heat
- Thermal sensors ≠ night vision
- Night vision utilises image or low light intensification

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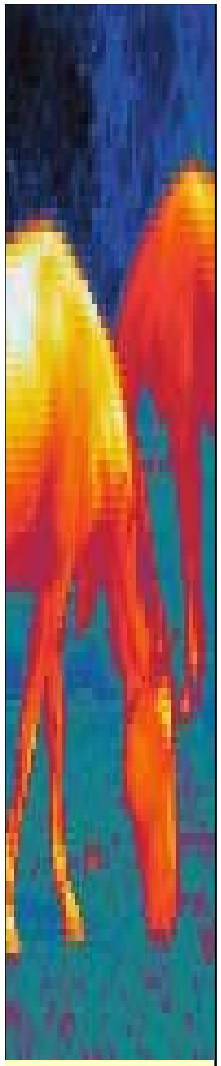

Thermal sensors

- Heat transfer occurs via 3 ways;
  - Convection
  - Conduction
  - IR radiation
- Thermal sensors detect infrared radiation
- Enables sensing and detection of IR emitting objects

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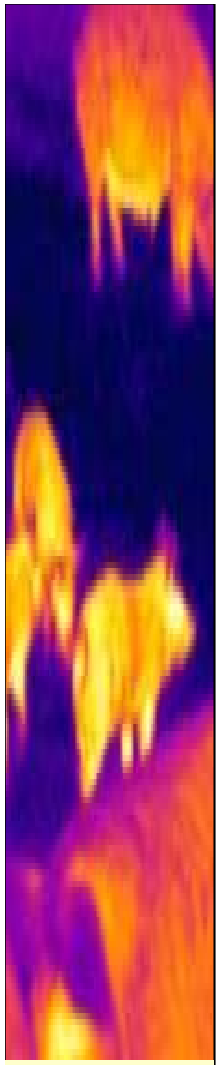
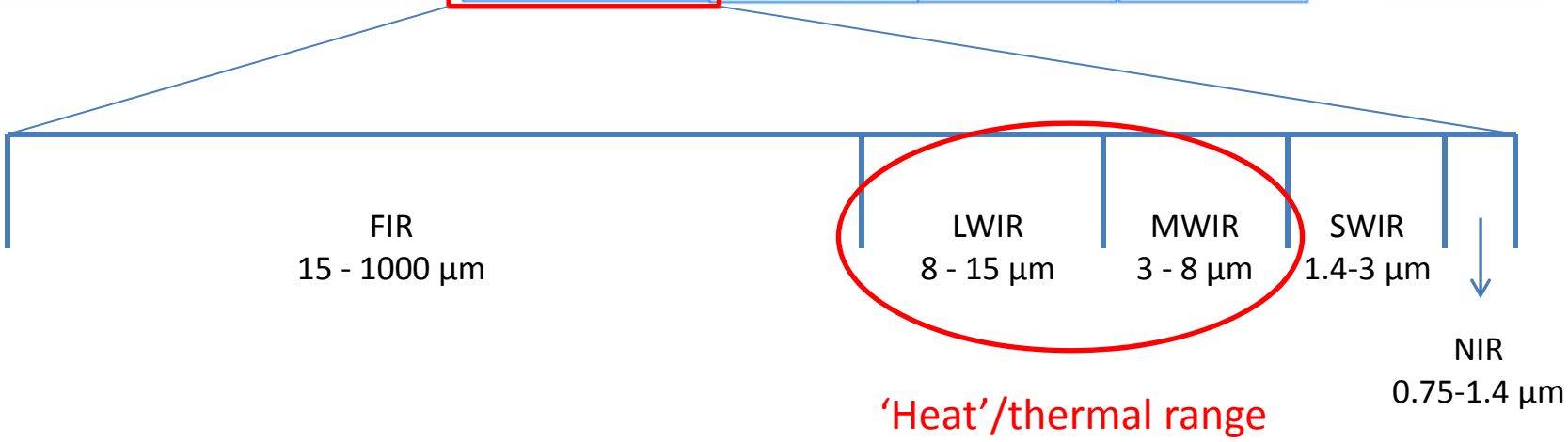


Infrared radiation



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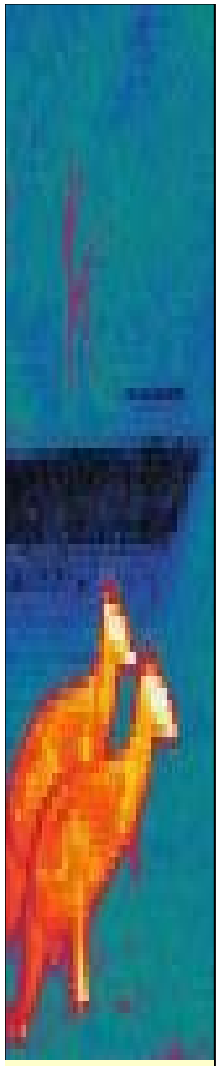
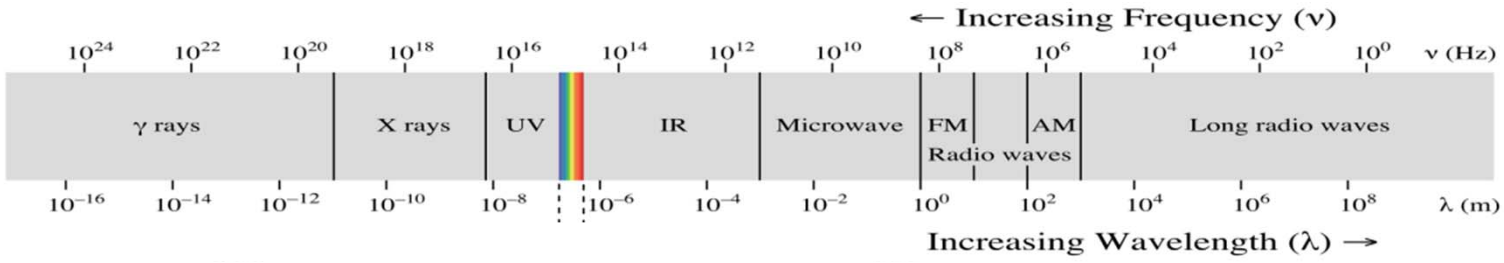


Why use thermal sensors?

- Electromagnetic (light) spectrum is wide



Philip Ronan, Wikipedia

- Visible light spectrum relatively narrow in comparison
- Anything above 5 Kelvin emits IR radiation

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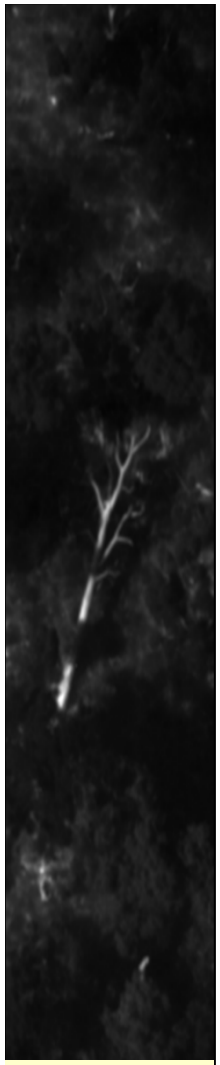

Emissivity coefficient - ε

- Proportion of infrared radiation emitted from a **'grey body'** compared to an ideal **'black body'** ($\varepsilon = 1$) *[Stefan-Boltzmann Law]*

Material	ε
Aluminium foil	0.04
Cement	0.54
Paint	0.96
Plastics	0.90 - 0.97
Soil	0.90 – 0.95

- For most biologicals, $\varepsilon = 0.95 – 0.98$

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Advantages

- Automated sensor(s) can remove human ‘inaccuracies’
  - Visual acuity
  - Memory
  - Concentration

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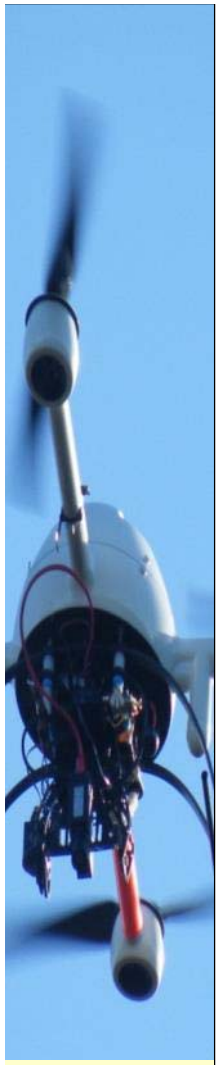

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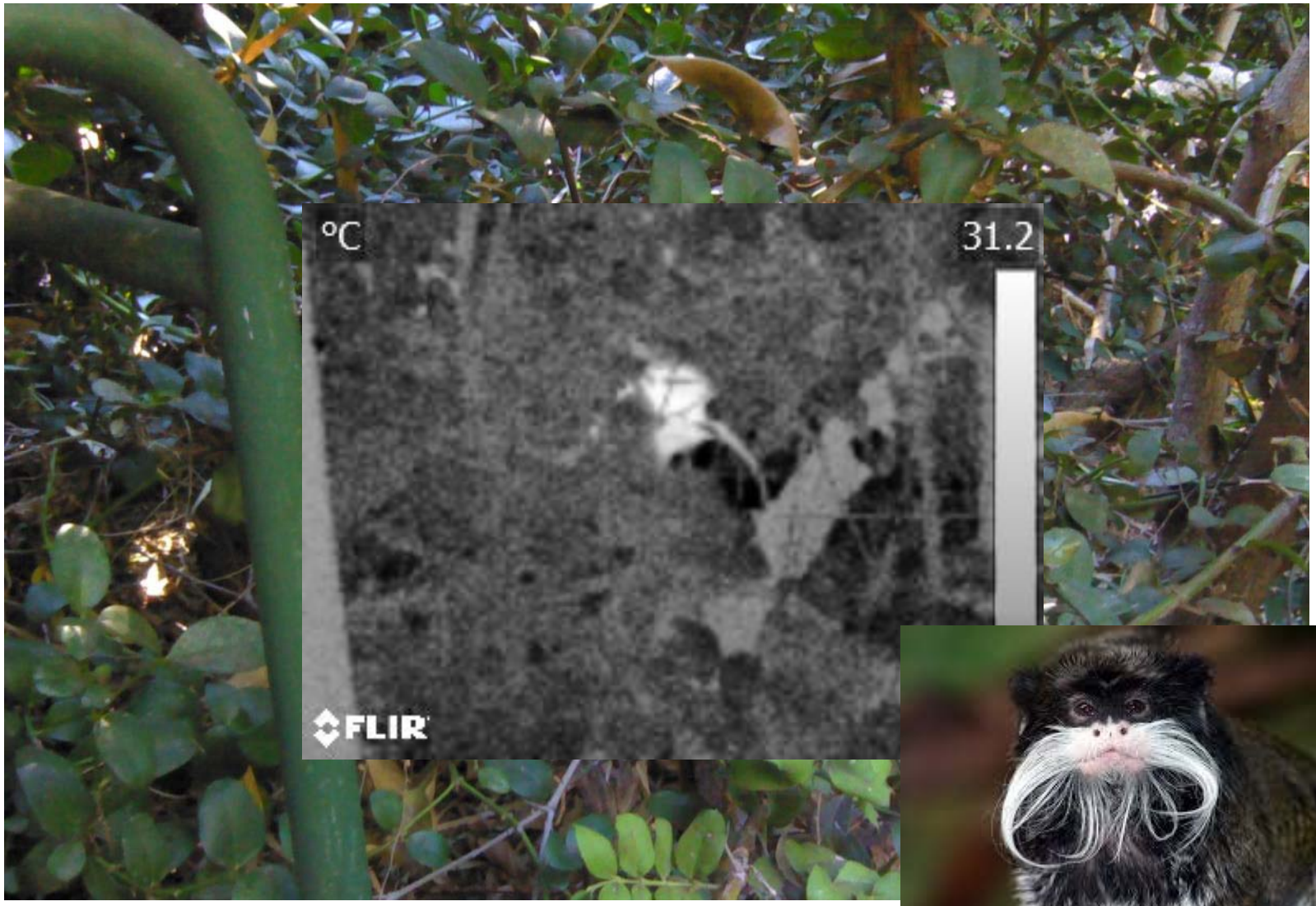
Overcome crypsis



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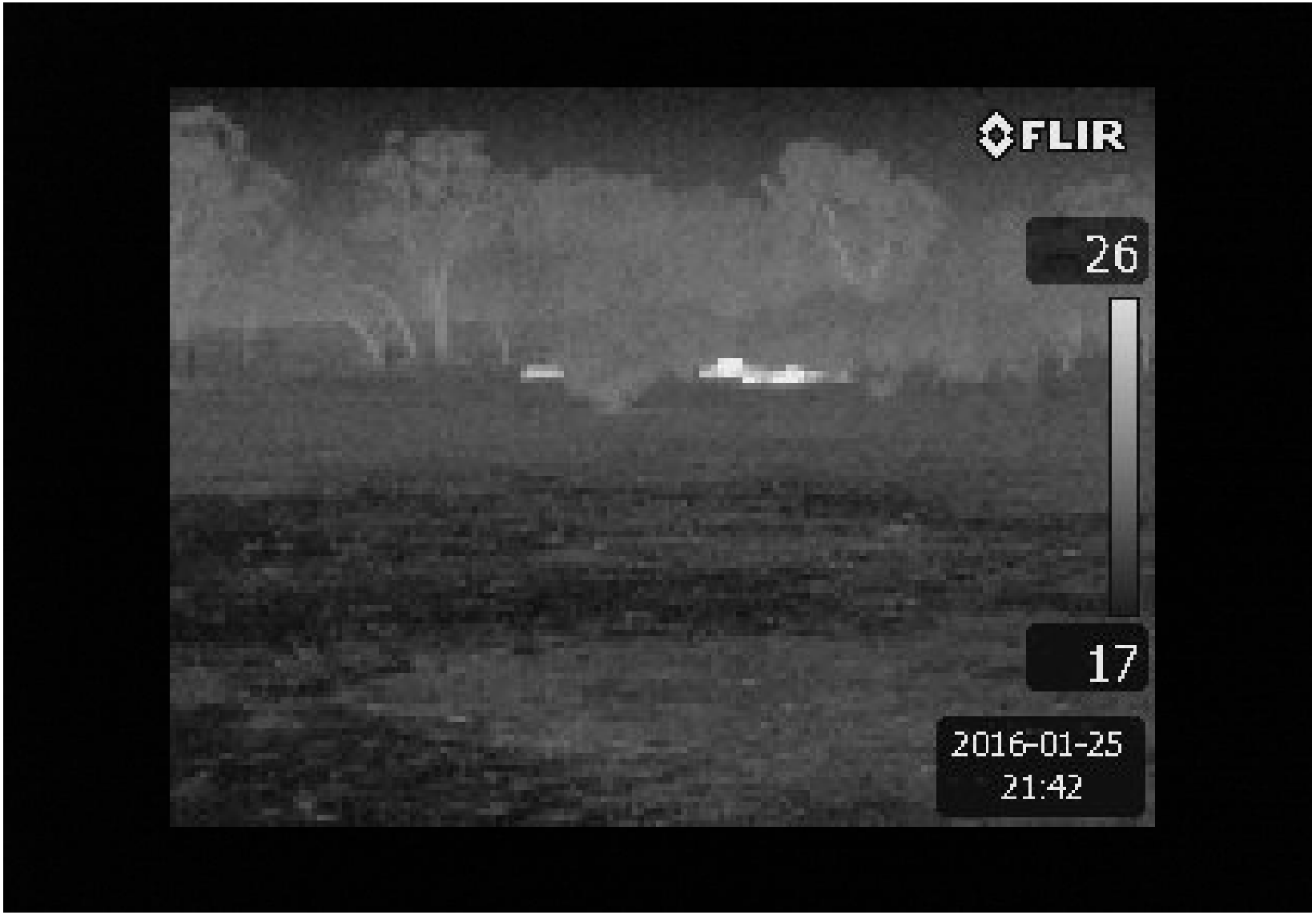
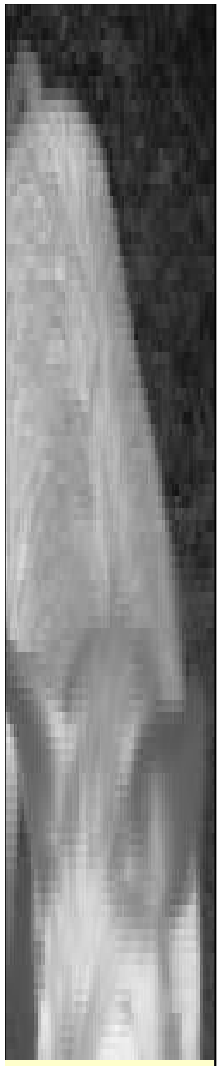
Advantages





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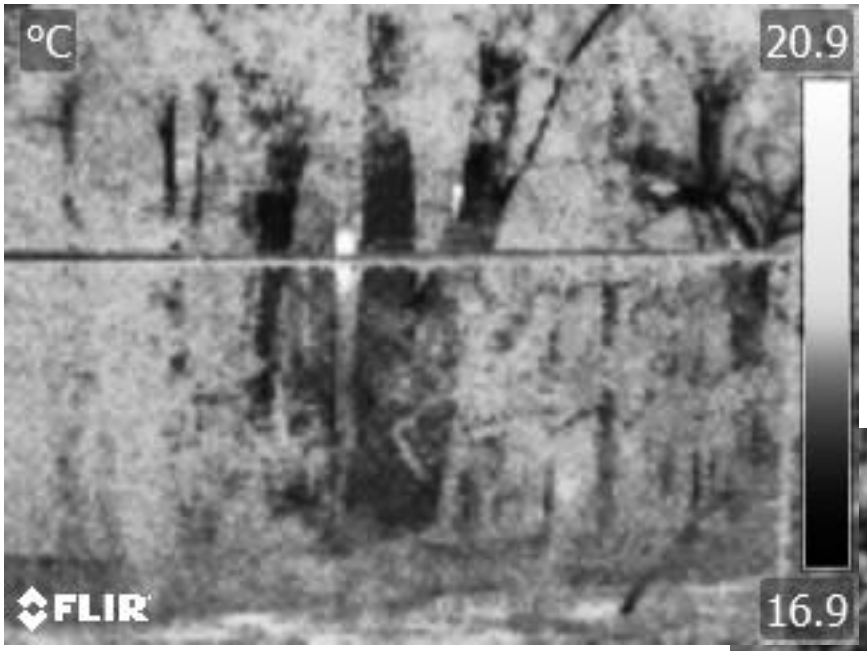
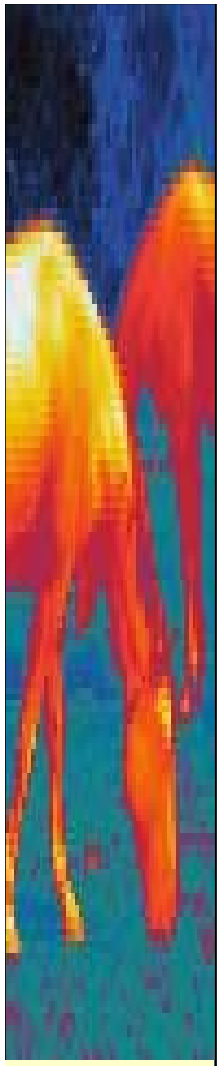
Visual Acuity





Limitations

- Sensitivity and accuracy highly dependent upon several factors;
  - Sensor
    - Sensitivity
    - Resolution
  - Target species/object
  - Environment

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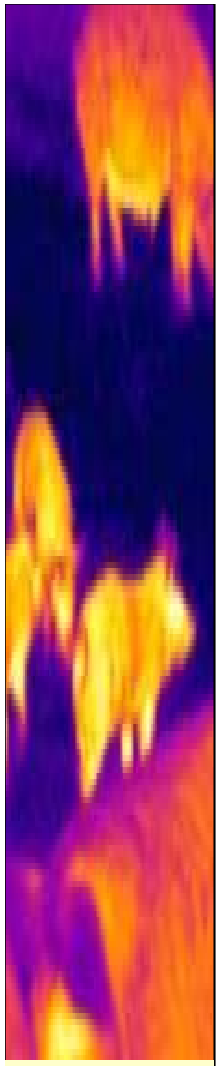

Sensors

- Sensitivity
  - Ability to detect variations in infrared radiation
  - ↑sensitivity requires active cooling of sensor
- Resolution
  - Increased pixels = improved visual image
  - Improved outline and identification
- Important for accurate detection or identification of target

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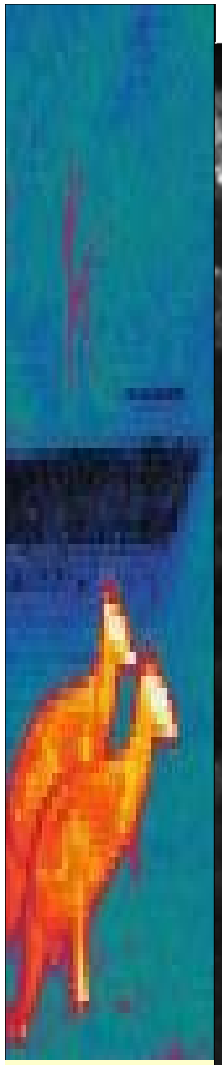

FLIR A65 @ 120mAGL

FLIR SC7500 @ 330mAGL

10m

25m

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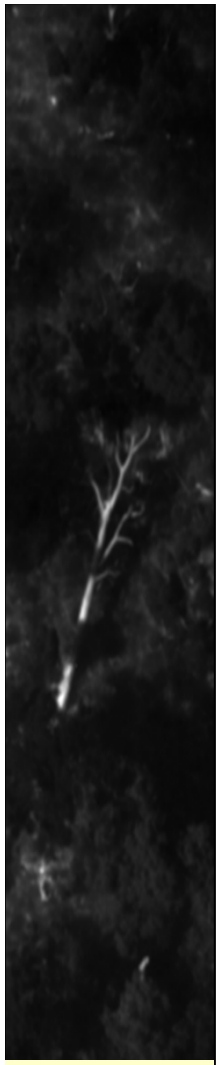

Target species/object

- Physiology
  - ΔT surface temperature and environment
- Size
  - Large animals = bigger target
- Behaviour

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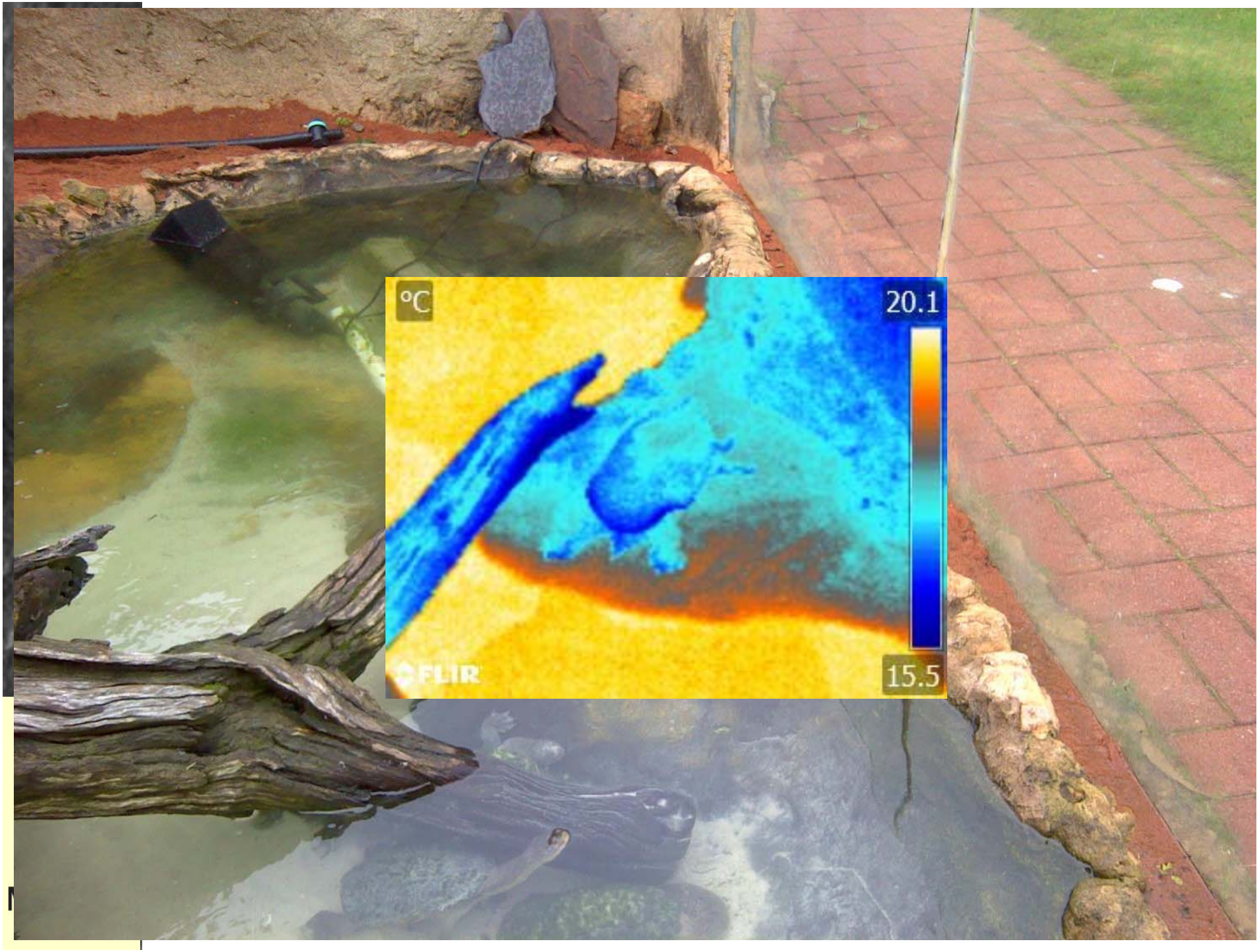
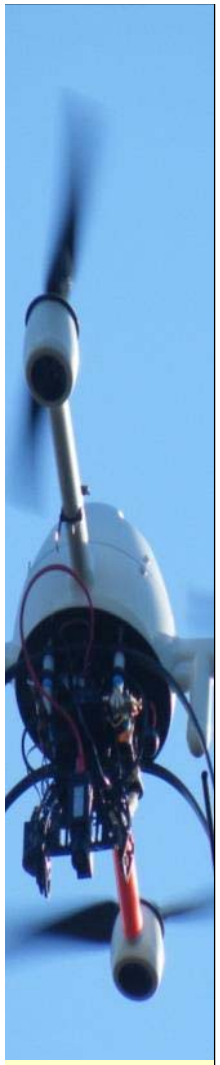
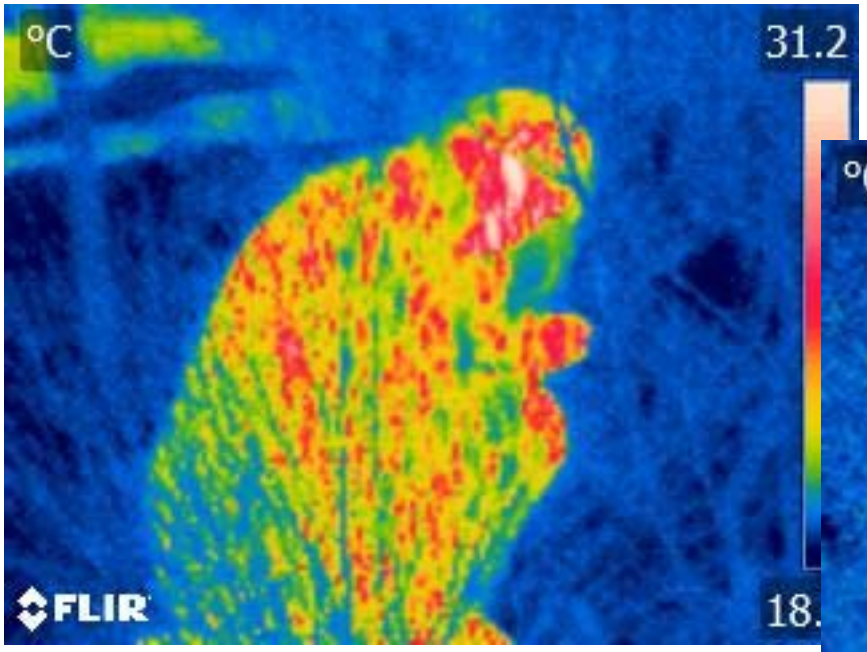
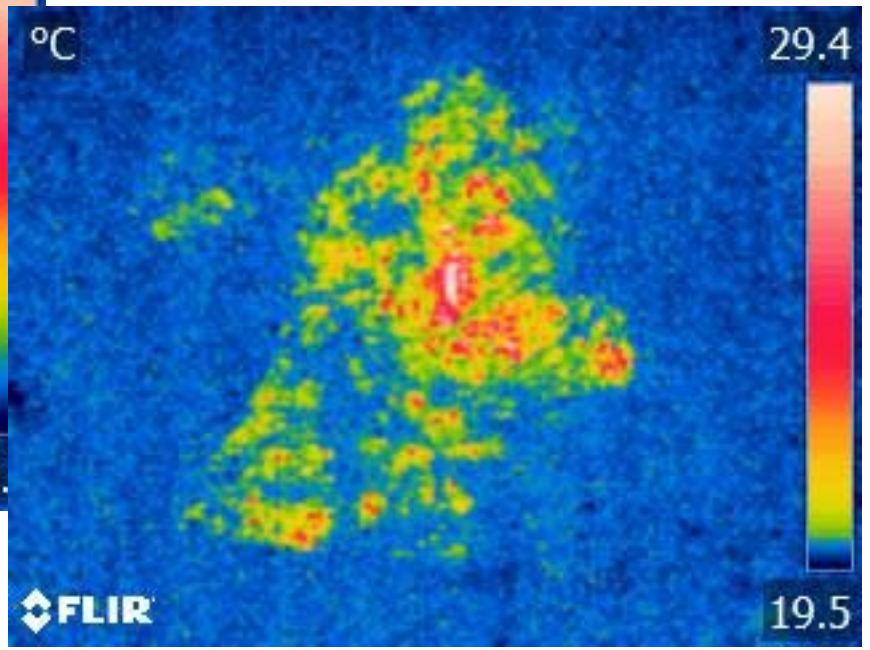

°C
20.1
15.5
FLIR



Environment

- Does not penetrate vegetation or other visual barriers





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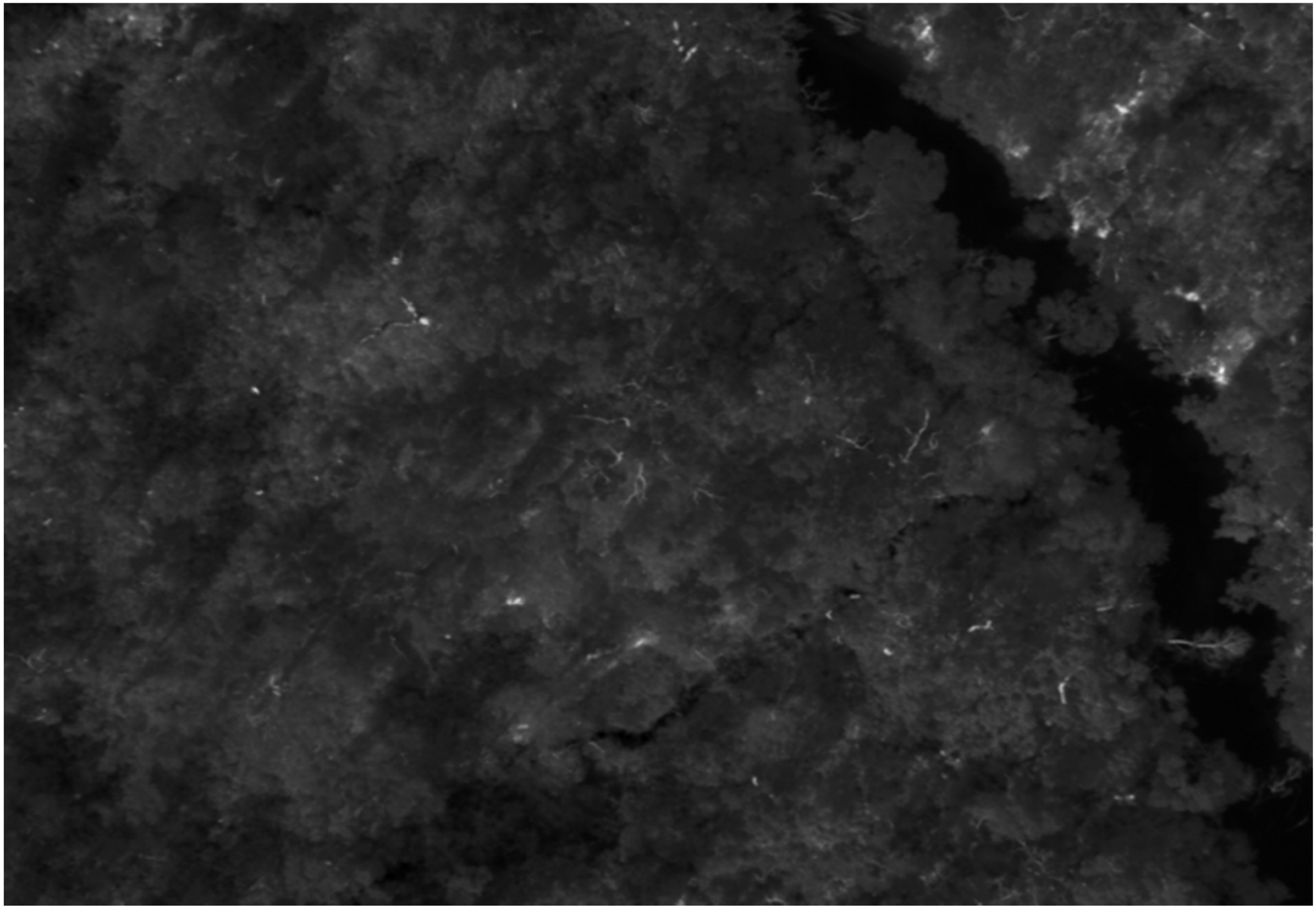
Background temperature



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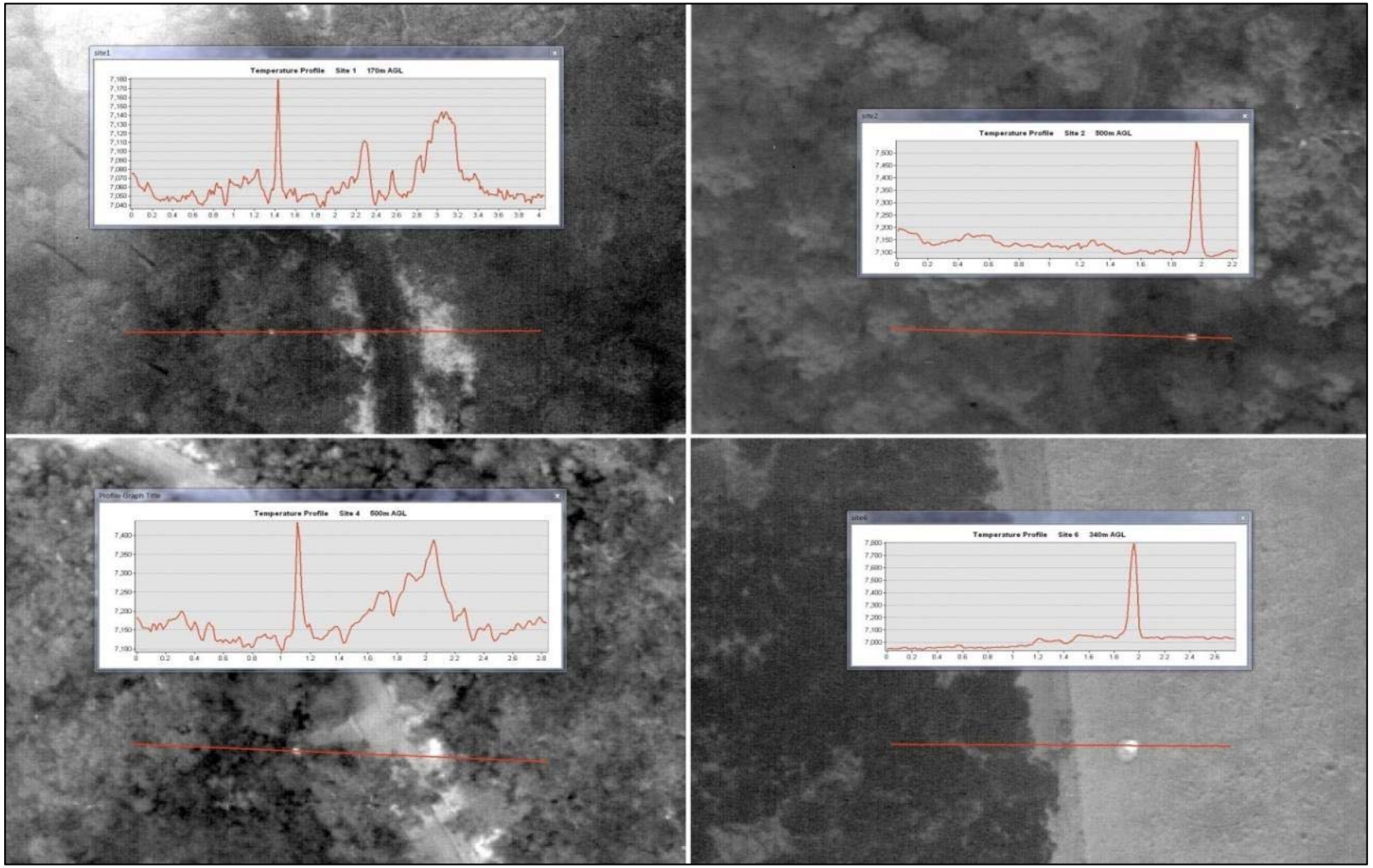
Thermal ‘noise’



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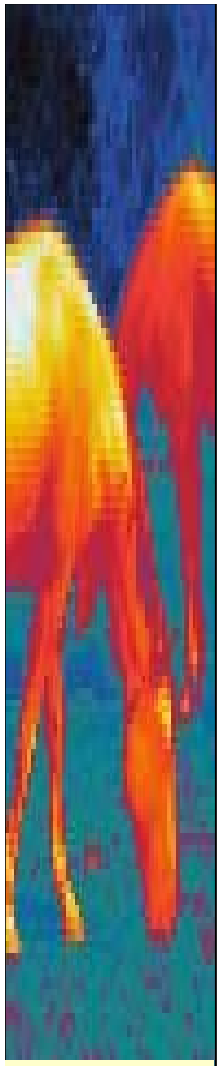

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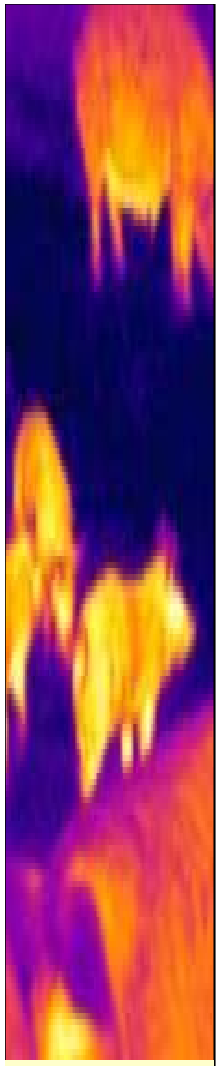

Hand-held sensors

- FLIR E series
  - 160 x 120 pixels
  - AU$7,000 - $10,000

- FLIR T400 series
  - 320 x 240 pixels
  - AU$20,000 – $30,000

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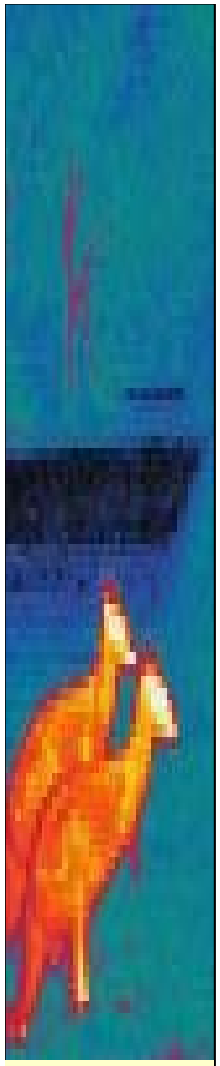

Mounted sensors

- FLIR Axx series
  - 640 x 512 pixels
  - AU$20,000 – $40,000

- FLIR SC7000 series
  - Internal cooling
  - AU$200,000+

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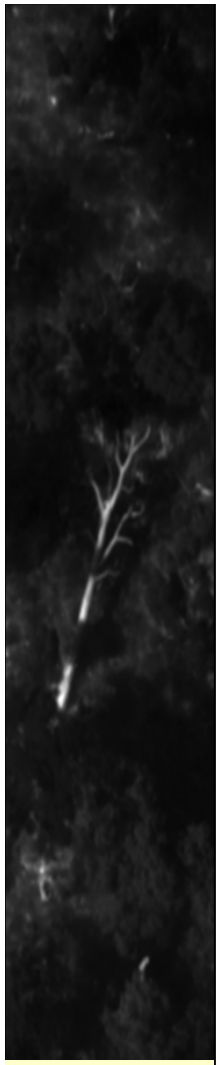

Summary

- Increase detectability of target species
  - Dependent upon physiological and environmental attributes
- Need to be aware of the limitations
- Real-time and post-data collection analysis
- Aerial and ground based applications
- Expensive

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Acknowledgements

- DPaW
  - Vertebrate pest control project
- DAFWA
  - Boosting Biosecurity Defences project, supported by Royalties for Regions

Questions?

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