

Using thermal imaging equipment in aerial shooting programs

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Aerial shooting

- Effective landscape control tool
- Many animals shot quickly
- Suited to remote terrain
- Animals difficult to detect
 - Low populations
 - Previously managed populations

Using thermal equipment

Pest animal monitoring

- Increase detections in complex habitat



Using thermal equipment

Pest animal monitoring

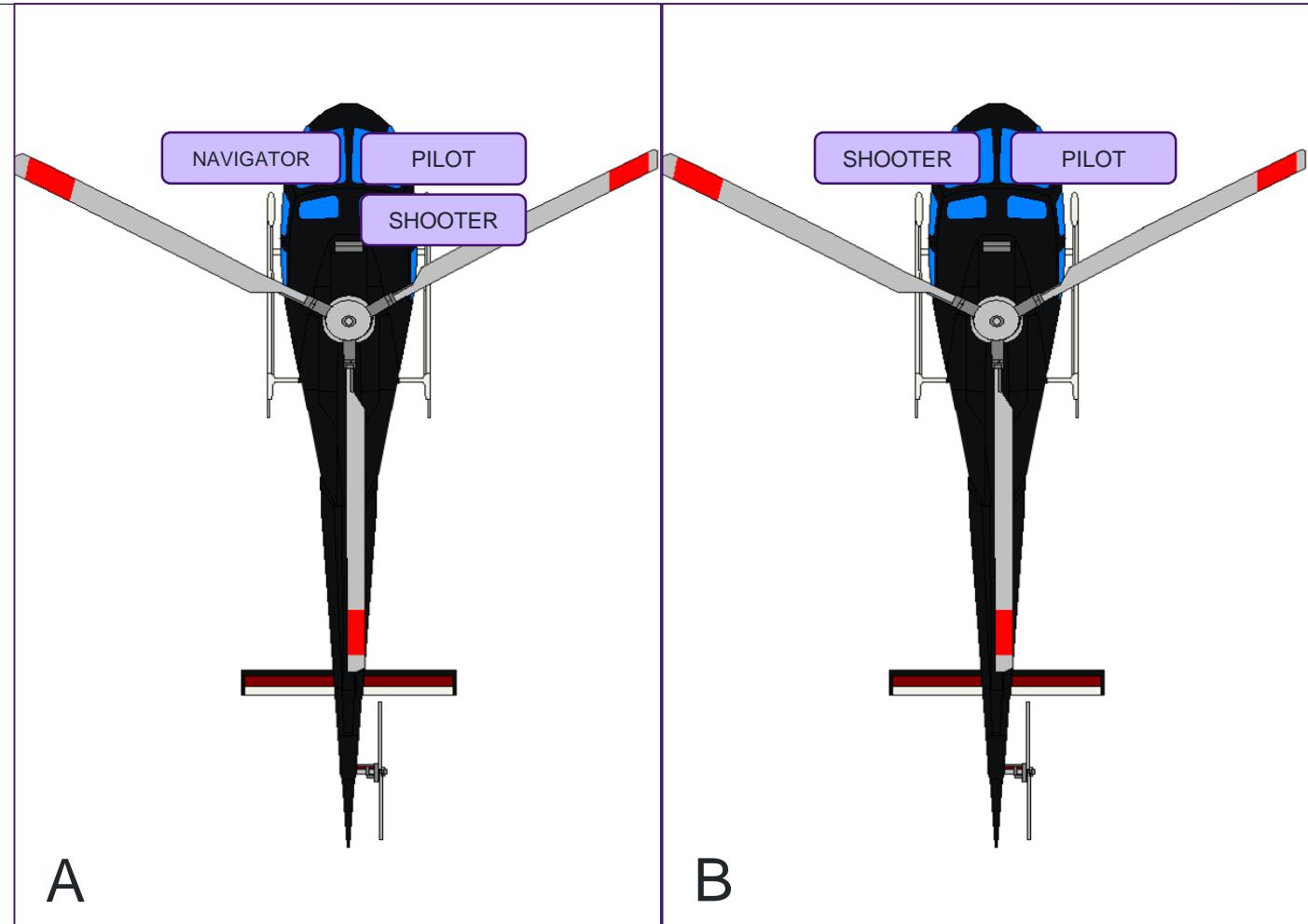
- Increase detections in complex habitat
- Improve detectability in open habitat



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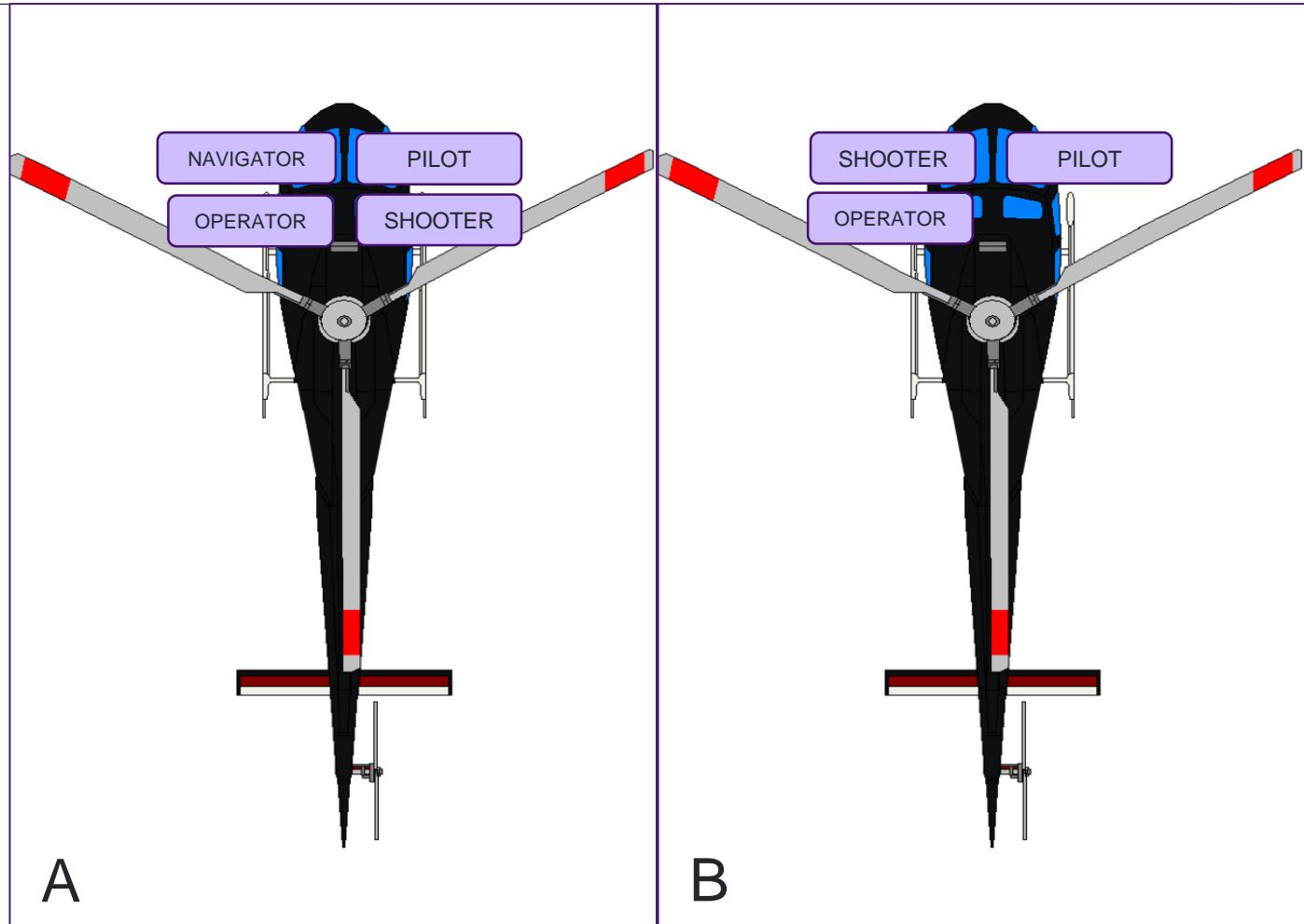
Thermal and aerial shooting

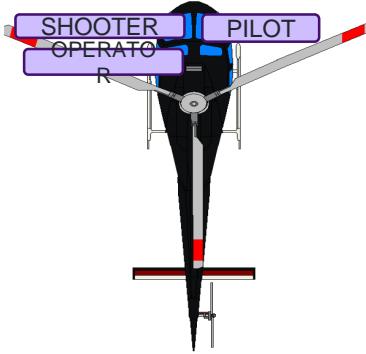
- Position of the shooter
 - Behind the pilot (A)
 - Beside the pilot (B)



Thermal and aerial shooting

- Position of the shooter
 - Behind the pilot (A)
 - Beside the pilot (B)
- Position of the thermal operator
 - FAAST configuration (A)
 - TAC configuration (B)





Features of TAC



- Thermal operator alongside the shooter
 - Provides essential support to shooter
 - Target monitoring and tracking
- Operator
 - Wide-angle, high frame rate sensor array
 - High-powered 1W laser
- Shooter
 - Thermal and red-dot scope options
 - Thermal binoculars
- Features
 - Active observers on both sides of aircraft
 - Wide field of view for all crew

Thermal and aerial shooting

- Position of the shooter
 - Behind the pilot (A)
 - Beside the pilot (B)
- Position of the thermal operator
 - FAAST configuration (A)
 - TAC configuration (B)
- Thermal for the shooter
 - Handheld only (A)
 - Handheld and rifle-mount (B)



Pulsar Accolade XP50
640 x 480 (2.5 x zoom)



A

Hicmicro Owl OH35
384 x 288



Pulsar Accolade XP50
640 x 480 (2.5 x zoom)



B

Pulsar Krypton FXG50 Clip-on
640 x 480

Thermal and aerial shooting

- Position of the shooter
 - Behind the pilot (A)
 - Beside the pilot (B)
- Position of the thermal operator
 - FAAST configuration (A)
 - TAC configuration (B)
- Thermal for the shooter
 - Handheld only (A)
 - Handheld and rifle-mount (B)
- Types of thermal sensor

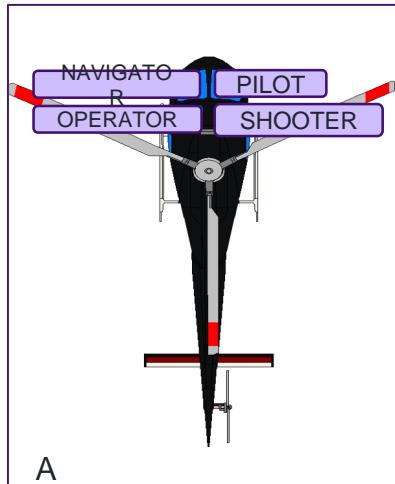


A

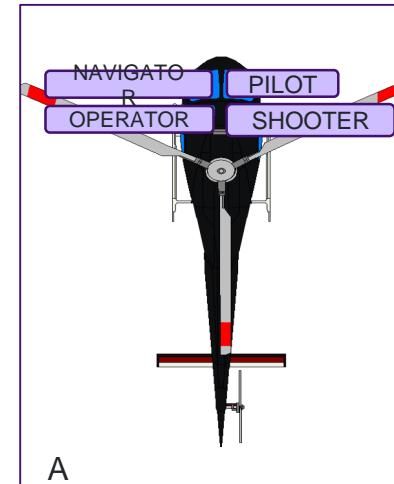
B

Shooting programs

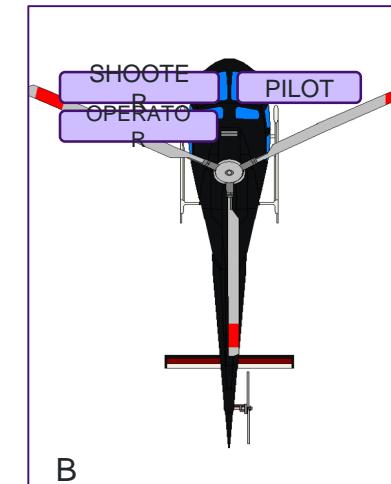
2021 Hay Plains
Pigs and Deer
FAAST configuration



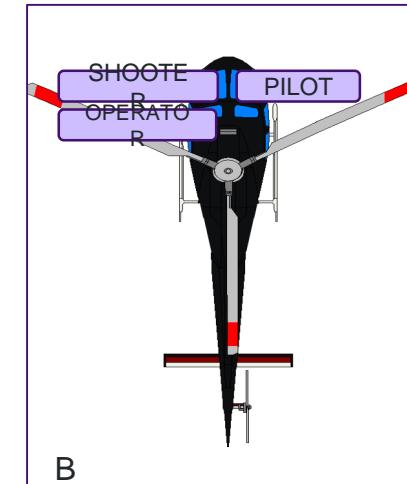
2022 Hay Plains
Pigs and Deer
FAAST configuration



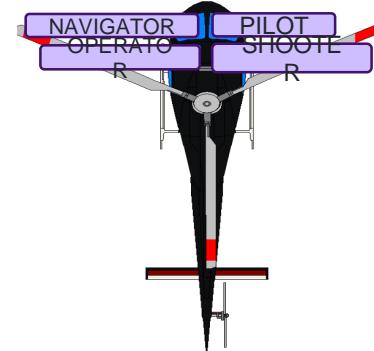
2021 Limestone Coast
Deer
TAC configuration



2021 Kangaroo Island
Pigs
TAC configuration



- No thermal for shooter
- 1920 x 1200 array
- Shooter with thermal monocular/binoculars
- 640 x 480 array
- Shooter with thermal scope and binoculars
- 1920 x 1200 array
- Shooter with thermal scope and binoculars
- 1920 x 1200 array

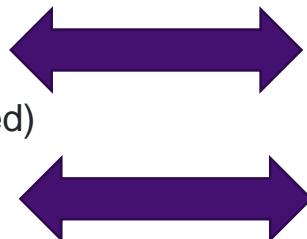


Results

(thermal video and visual shoot audio only)

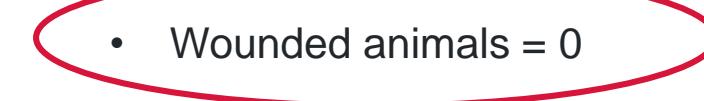
2021 Hay Plains FAAST configuration

- 240 detections (n=835)
 - thermal – 140 (n=533)
 - visual – 100 (n=302)
 - $z=2.08$, $P=0.02$
- 89.7% animals shot
- Animals lost - 11% (758 pursued)
 - thermal – 77.6% (n=66)
 - Visual – 22.4% (n=19)
 - $z=2.36$, $P<0.001$
- Wounded animals = 5



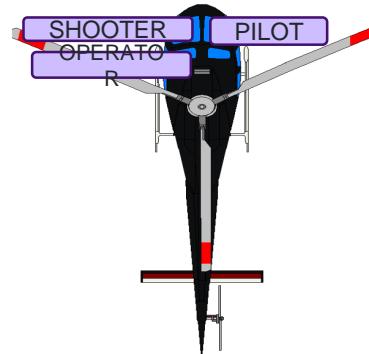
2022 Hay Plains FAAST configuration

- 187 detections (n=744)
 - thermal – 85 (n=376)
 - (66 operator, 19 shooter)
 - visual – 104 (n=368)
- 96.7% animals shot
- Animals lost – 6.7% (404 pursuits recorded)
 - thermal – 55.5% (n=15)
 - Visual – 44.5% (n=12)
- Wounded animals = 0



- No thermal for shooter
- 1920 x 1200 array

- Shooter with thermal monocular/binoculars
- 640 x 480 array



Results

(thermal and RGB video)

2021 Kangaroo Island TAC configuration

- 67 detections (n=138), 88% (n=122) shot
- Median times:
 - First impact shot → incapacitation
 - 11.5 s (SD = 42.7, mean = 24.2)
 - Shot at
 - 3 (SD = 3)
 - Number impact shots
 - 2.5 (SD = 1.3, mean = 2.7)
- Animals lost – 9.6%*
- Culling rate:
 - visual = 1.2 h^{-1} , thermal = 3.4 h^{-1}

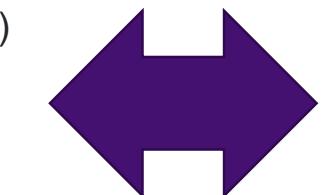
• Wounded animals = 0

- Shooter with thermal scope and binoculars
- 1920 x 1210 array

2022 Limestone Coast TAC configuration

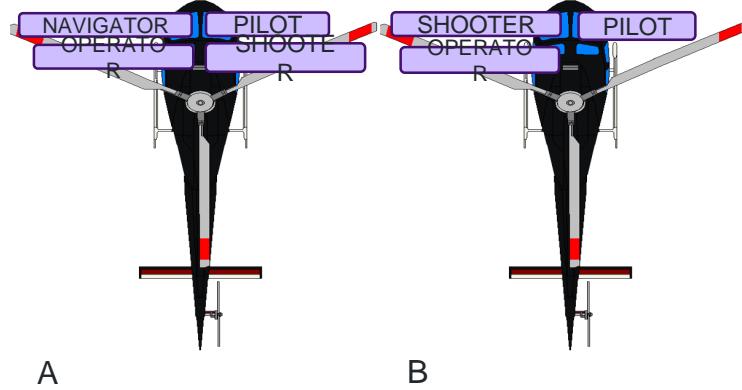
- 126 detections (n=246), 76.4% (n=188) shot
- Median times:
 - First impact shot → incapacitation
 - 11.0 s (SD = 33.2, mean = 21.9)
 - Shot at
 - 5 (SD = 3.7)
 - Number impact shots
 - 2 (SD = 1.2, mean = 2.2)
- Animals lost – 17.7%*
- Culling rate:
 - visual 6.8 h^{-1} , thermal 12.1 h^{-1}

• Wounded animals = 0



Results

Animals found with thermal



FAAST configuration

85% of animals found in dense or sparse habitat

- Pigs - 50% dense habitat (lignum/tall timber)
- Deer - 45% dense habitat (tall timber)

TAC configuration

Pigs

- 99% detected in dense habitat (tall timber/bracken/epicormic growth)
- 95% shot in dense habitat
- 1 pig shot in open habitat

Deer

- 91% detected in dense and sparse habitat (tea tree and eucalypt woodland)
- 51% shot in dense habitat
- 5.6 % shot in open habitat

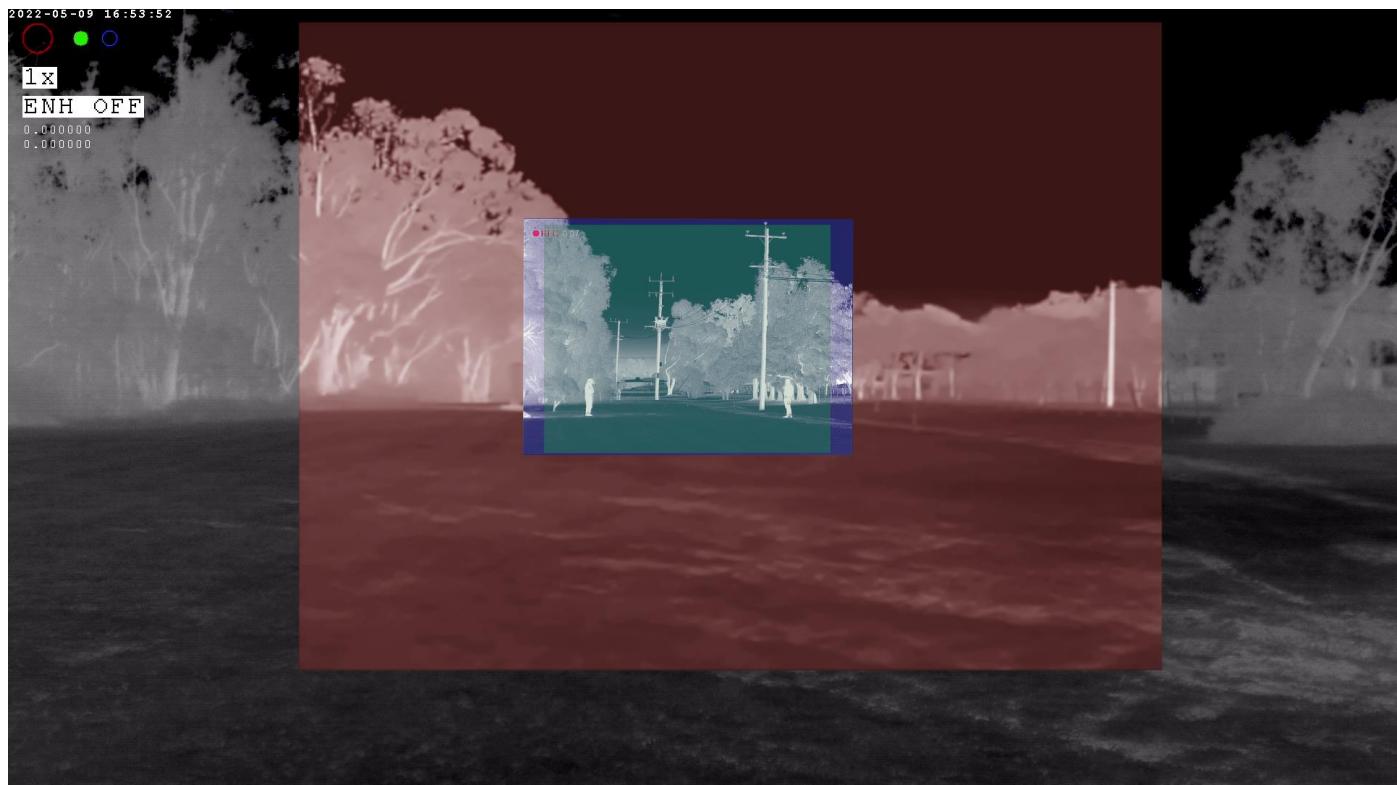
Results – sensor size

Grey – Vayu HD – 1920 x 1200

Red – BW640-A – 640 x 480

Blue – Pulsar Accolade – 640 x 480*

Green – Hicmicro Owl – 384 x 288



Bigger is better

Conclusions

- Any thermal in the helicopter improves detection rates
- Provisioning the shooter with thermal in the FAAST configuration reduces lost animals, loss of wounded animals and increases percentage of animals culled
- HD and wider field of view provides greater opportunity for detection
- TAC configuration ideal for target acquisition and dispatch in complex habitat

Cox et al (2023) Thermal aerial culling for the control of vertebrate pest populations *Scientific Reports* 13, Article number: 10063



Acknowledgements

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