Testing the Potential of Synthetic Aperture Radar for Mass Detection of Snares and Gin Traps in Wildlife Landscapes

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Testing the Potential of Synthetic Aperture Radar for Mass Detection of Snares and Gin Traps in Wildlife Landscapes

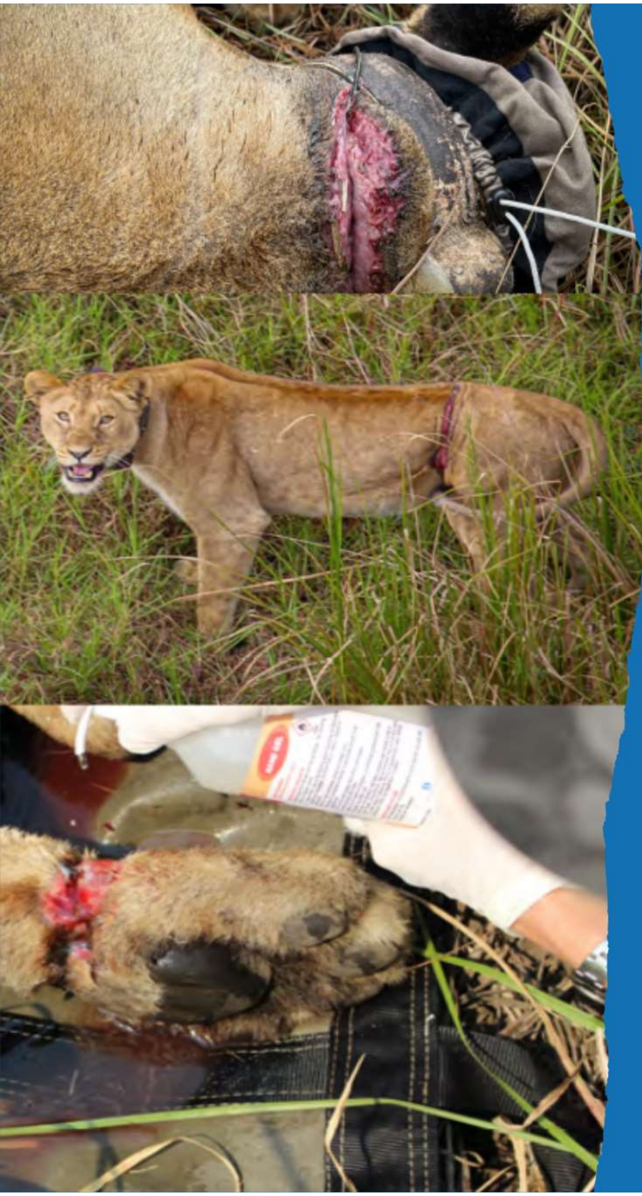
"Detecting snares and gin traps at scale from the air, would be a game changer in protecting the wildlife in the Zambezi Delta" – Mark Haldane **Zambeze Delta Conservation**

" Remotely locating snares at a large enough scale, allowing removal of snares by ground teams would be a revolutionary advance for conservation in Mozambique's wilderness areas." - Dr Joao Almeida **Mozambique Wildlife Alliance**

Scale of problem
Massive

12,3 million snares per year in protected areas in Southeast Asia (Belecky, M.& Gray, T.N.E, 2020)

- 1,000 snares in 32km^2 per year, 3,000 snares per 100km^2 Save Valley Conservancy, Zimbabwe (Karen Paolillo 2005)
- 2,314 snares 2018 -2021 - 771 snares per year Sengwa –Wildlife Area, Zimbabwe (Makhata, 2022)
- Snares removed has doubled in south African National Parks in 2022 doubled (SANP Annual Report 2021/2022)
- 5,879 in 2017, 1,975 in 2018, 969 in 2019, 678 in 2020 & 702 in 2021 Zambezi Delta, Mozambique (24 Lions – 5 year Report, 2023)



Snaring biggest threat to carnivores in conserved areas

- Hunting of wildlife using wire snares is one of the severest threats in India – 113 cases, 59% mortality in 10 years in Karnataka, India (Gubbi et al. 2021)
- 27% lions caught at least once in snare in Gorogosa National Park, Mozambique (Boueley et al., 2013)
- Overall, 37% of lions and 22% of leopards been snared at some point in their lifetime(White & Valkenburgh 2022).
- Extirpation of wild dogs and main threat to lions and other carnivores in Lower Zambezi National Park, Zambia (Leigh, 2005; Pole, 1999)
- 20% of adult lions, and 67% wild dog packs were snared in Luangwa, Zambia (Bekker 2011)
- 1/3 of 24 founder lions were killed by snares, with a further 3 successful rescues (24 Lions – 5 year Report, 2023)

Tiny percentage of snares are located by patrols

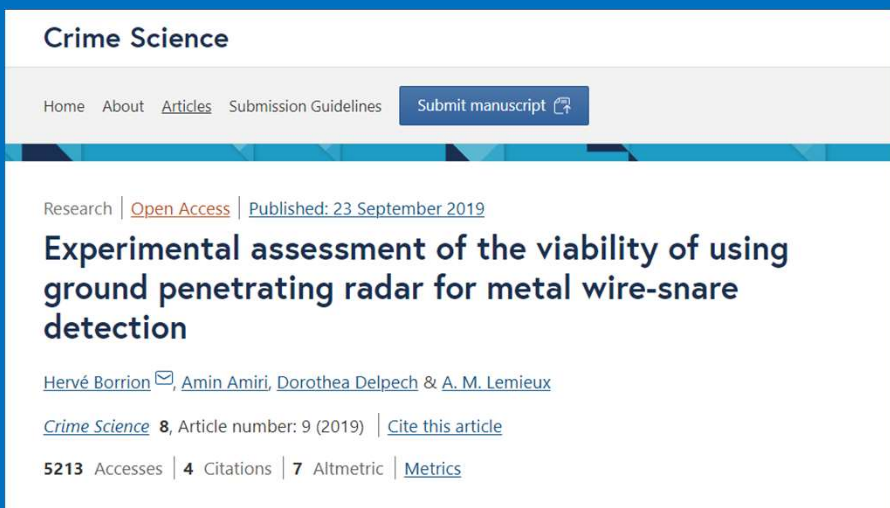
- Overall probability of detecting any given snares in a 0.25/km2 area, after 60 min of search effort is only 20% (Ibbett et. al., 2020)
- Diminishing returns, doubling effort only increased 20% detection rate by 10%
- These were well trained Rangers, searching and area where they knew there were snares and does not consider the patrol area compared to the total area
- Given this, managers need to consider whether intensive snare-removal efforts are the best use of limited resources(Ibbett et. al., 2020)
- Patrols cover only ¼ of area (Ibbett et. al., 2020) so we are looking at a 5% detection rate
- Only 23% found after 69 patrols in same area (Doormal et. al. 2022)

Clearly, we need to do something new to detect snares cost effectively at scale

Radar

- Suggested in in WILDLABS.NET conservation technology network (2017)
- WWF tests virtual radar-fence technology in South Africa –Doppler shift observation post for moving target identification
- Experimental assessment of the viability of using ground penetrating radar for metal wire snare detection (Borrion et. al., 2019) Crime Science

Experimental assessment of the viability of using ground penetrating radar for metal wire snare detection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Experimental assessment of the viability of using ground penetrating radar for metal wire-snare detection

Hervé Borrion, Amin Amiri, Dorothea Delpech & A. M. Lemieux

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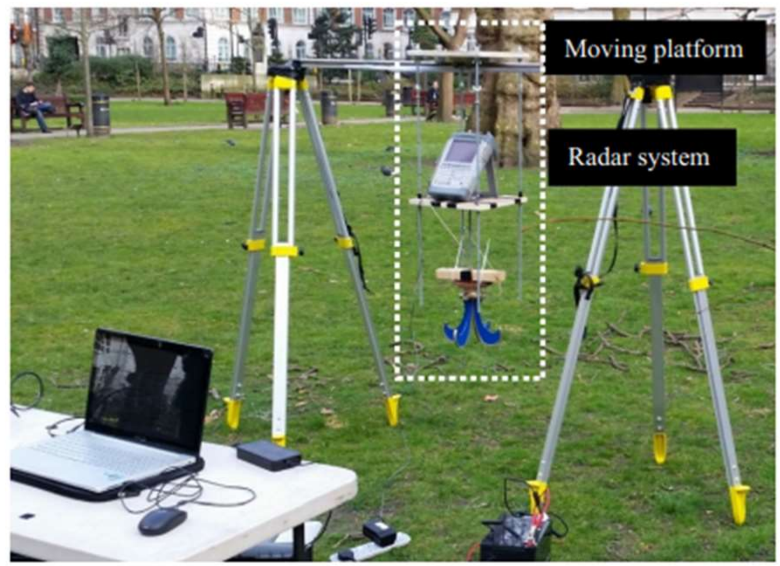


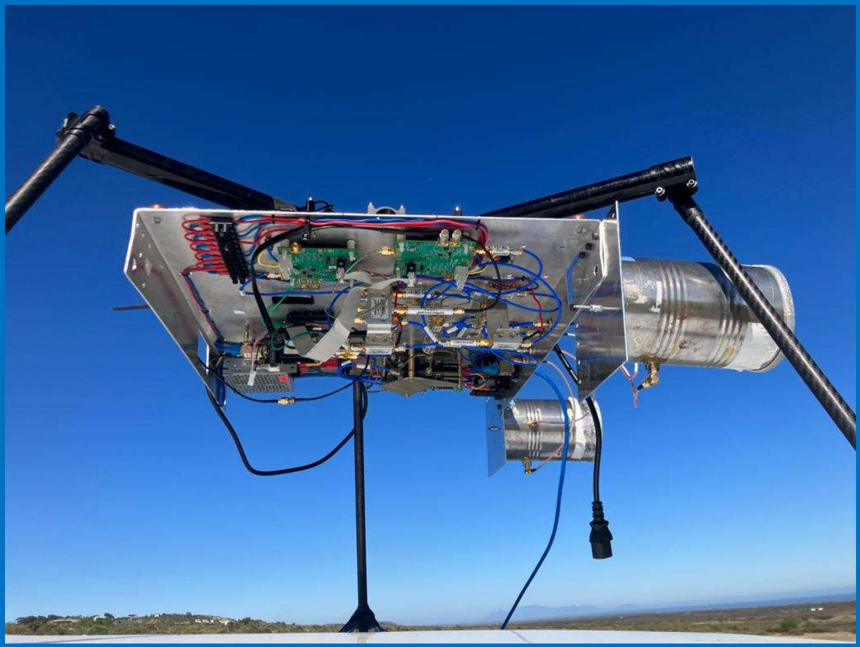
Fig. 4 Measurement setup with the radar (top) and the antenna (bottom) between the two tripods, Tavistock Square, London (UK)

Advantages of Aerial Synthetic Aperture Radar

- Long range – 1km search width @ 120m AGL @ 72km (20m/s)
- High resolution
- Can see through vegetation and canopy @ 2Ghz
- Can operate at night, poor light and in mist
- Is independent of road infrastructure
- Can cover 540 km^2 in a 8 hour mission (drone endurance 10 hr)
- Can generate GPS locations of snares to within 5m

Drone SAR Snare Detection at Scale

droneSAR

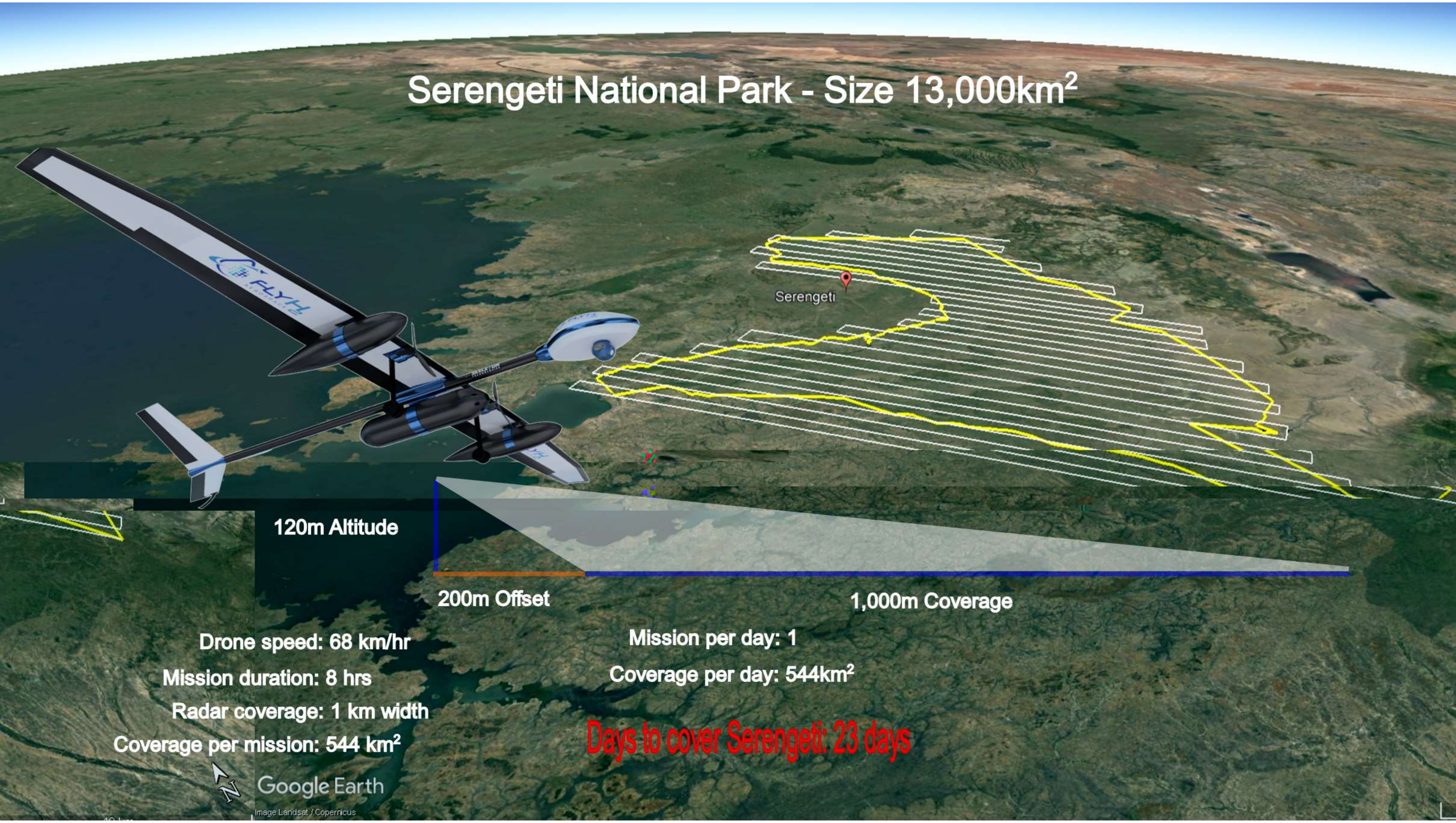


Specifications

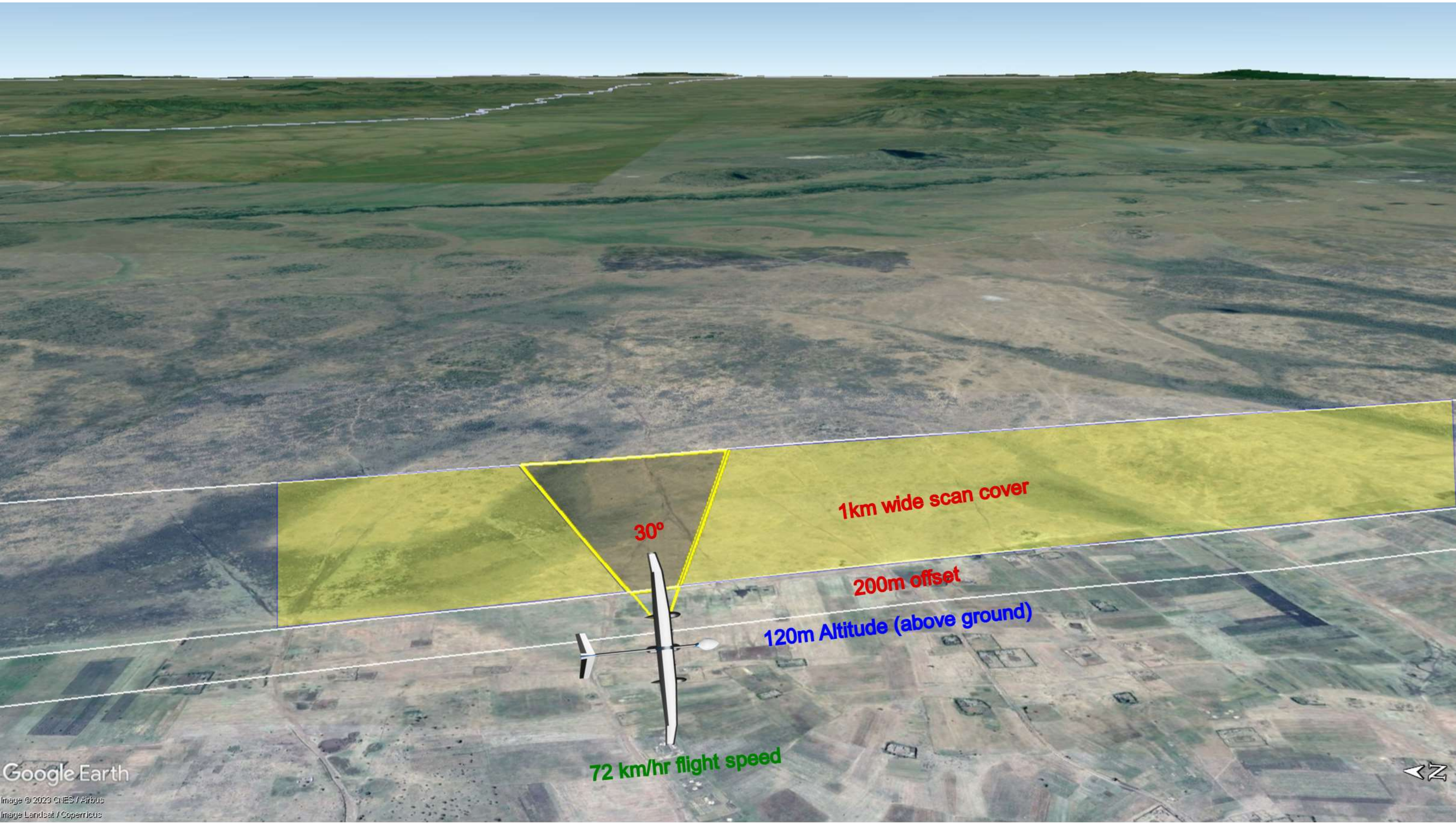
- Transmitter 5 mW
- 2400MHz range
- Linear Frequency Modulated Continuous Wave (LFMCW)
- Fully polarimetric
- 7W power consumption
- 3kg

Dragonfly V

- Fuel – Hydrogen fuel cell
- 2 Electric motors capable of 9.6kW burst power
- 126km/hr speed (68km/hr for SAR)
- 10 hrs endurance at payload (8hr mission → 544 km^2 SAR coverage)
- Top payload 20 +kg (SAR payload 3kg)
- Short Take Off and Landing - <100m

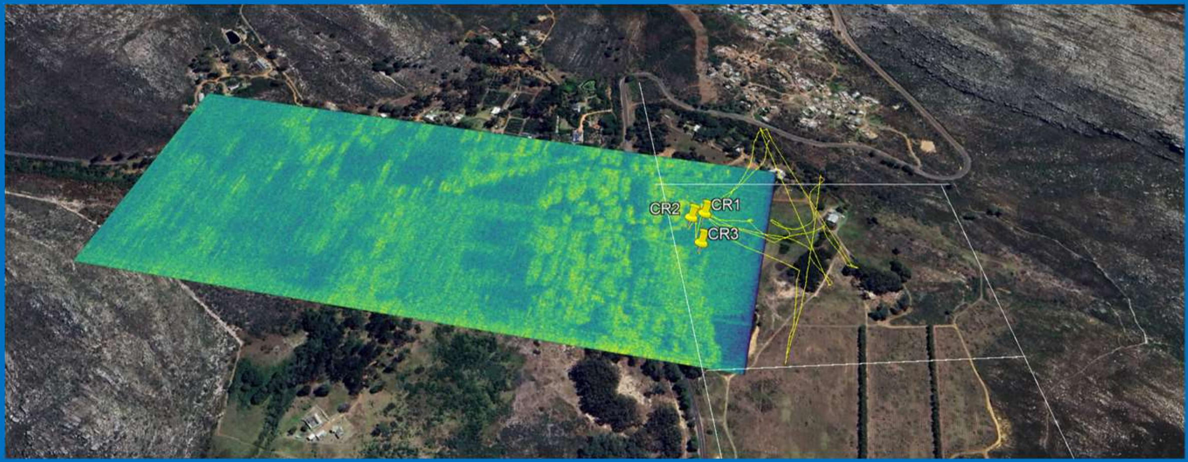


Serengeti National Park - Size 13,000km2
Serengeti
120m Altitude
200m Offset
1,000m Coverage
Drone speed: 68 km/hr
Mission duration: 8 hrs
Radar coverage: 1 km width
Coverage per mission: 544 km2
Mission per day: 1
Coverage per day: 544km2
Days to cover Serengeti: 23 days
Google Earth
Image Landsat / Copernicus

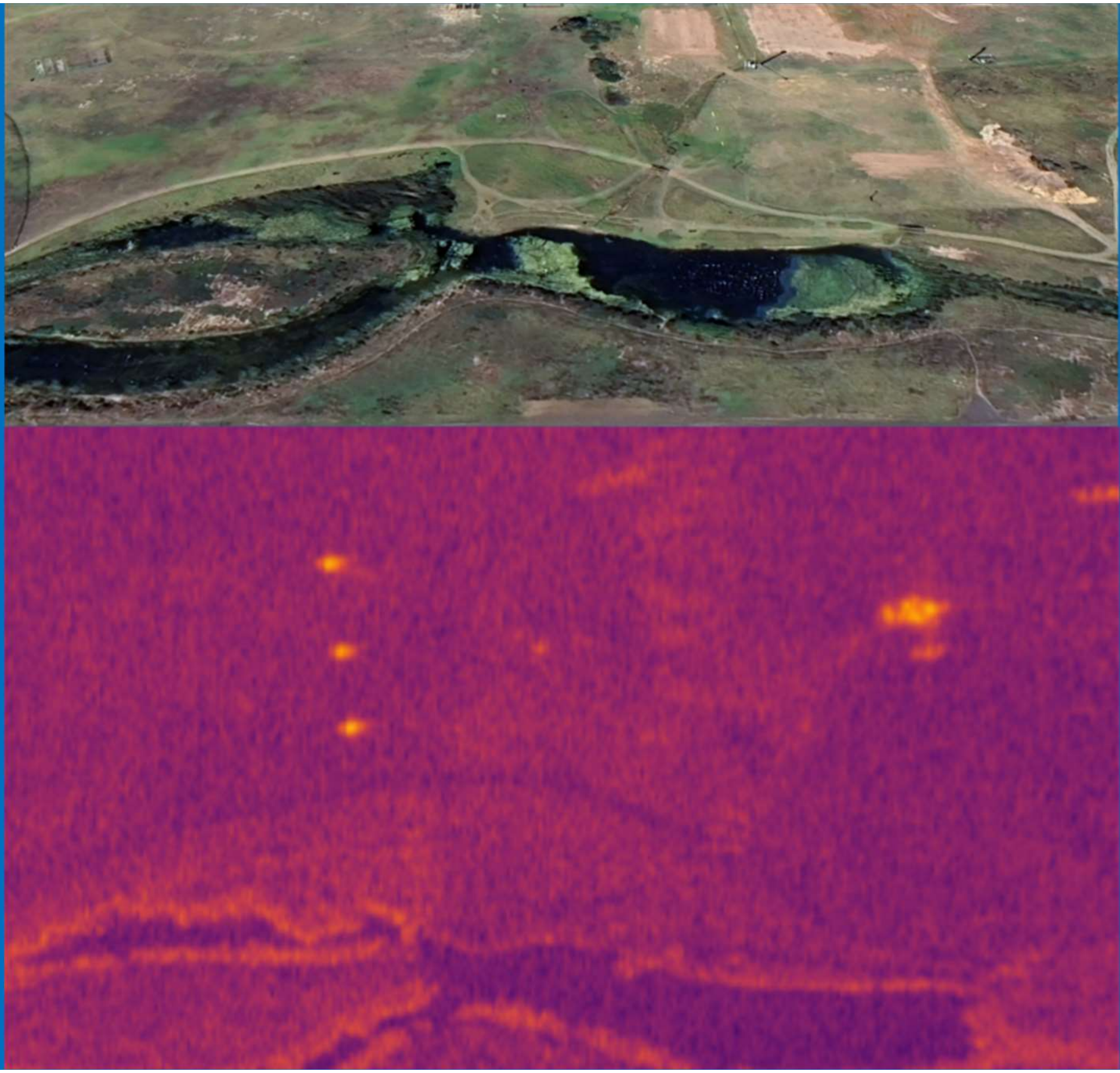

1km wide scan cover
30º
200m offset
120m Altitude (above ground)
72 km/hr flight speed
Google Earth
Image © 2023 CNES / Airbus
Image Landsat / Copernicus


Drone Trials
1.Redhill
2.!Kwha Thu!
3.Fish Hoek

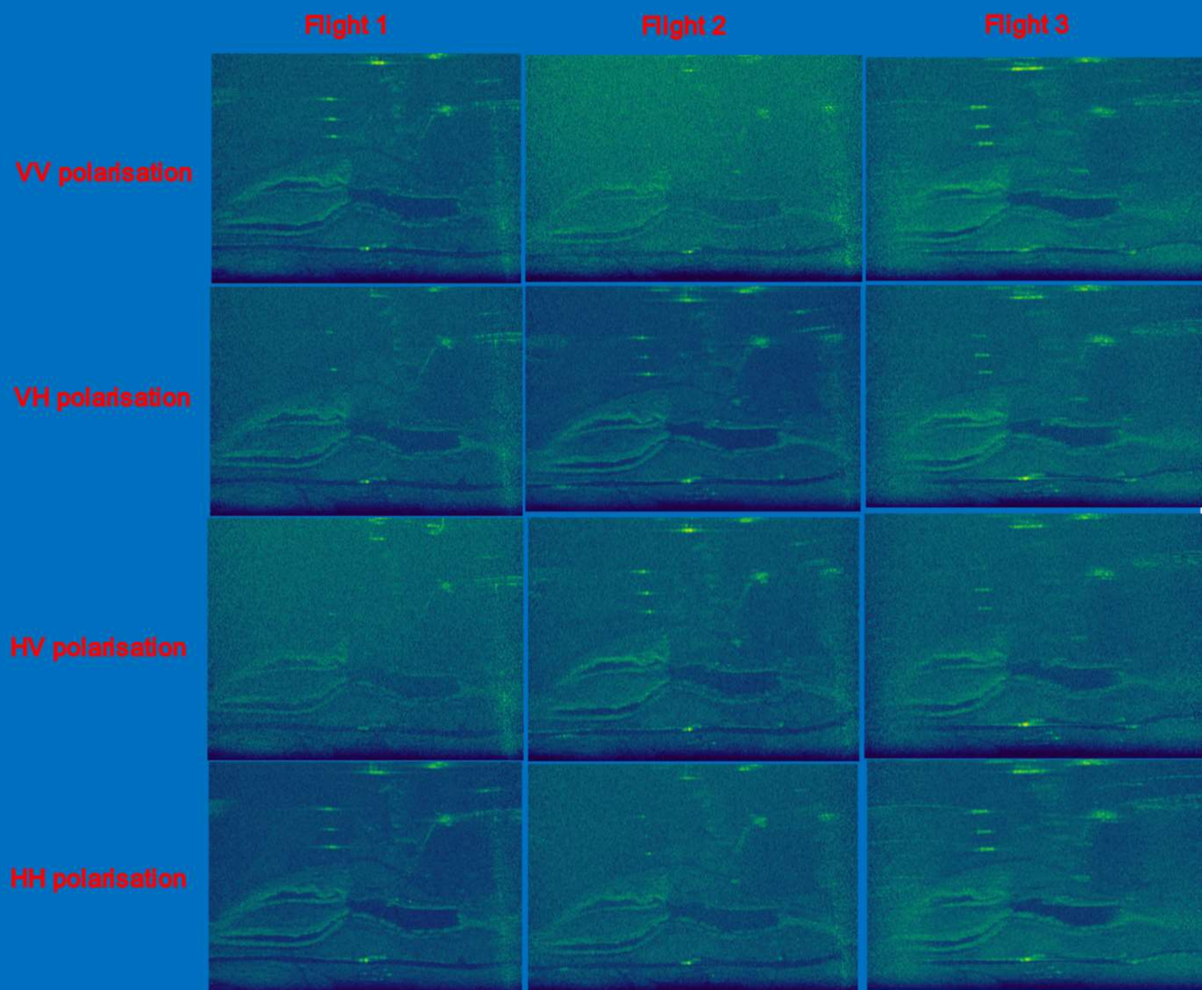
Field Trial – Results 1

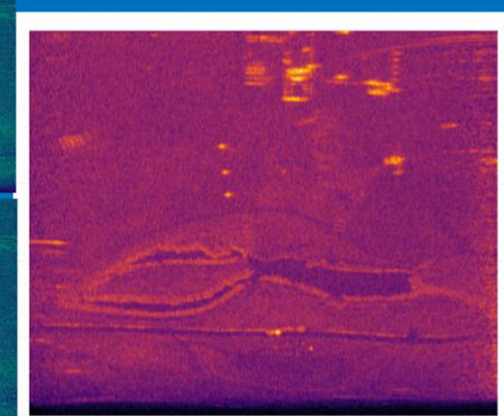


Field Trial – Results 2



Field Trial – Results 3





Where do we stand after 3 trials?

Early Days
New Technology

- We have not detected snares with standard SAR imaging on first pass
- Drone mounted SAR working and detecting aluminum radar reflectors
- Our results are replicable for different flights
- Our results are replicable in different habitats
- Currently working on developing the software to carry out image registration to allow us to use differential processing for target detection
- Intend to look at polarization differences between man-made traps and natural dielectric targets
- Quality of images achieved thus far bode well for target extraction during differential processing
- We intend to look into using AI to help us detect signals from a single pass.

Our Hope for Drone SAR Snare Detection

- Change the economics of snaring by timely detection and removal of > 70% of snares in conservation areas
- Save millions of animal's lives
- Remove the greatest threat to carnivore populations in protected areas
- Avoid costly punitive responses to poaching
- Couple these efforts with creating other opportunities for livelihoods, and ensuring food security in a local conservation economy
- As a single conservation intervention, developing a way to locate snares at scale has one of the biggest conservation paybacks

Thank You

Questions ?

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