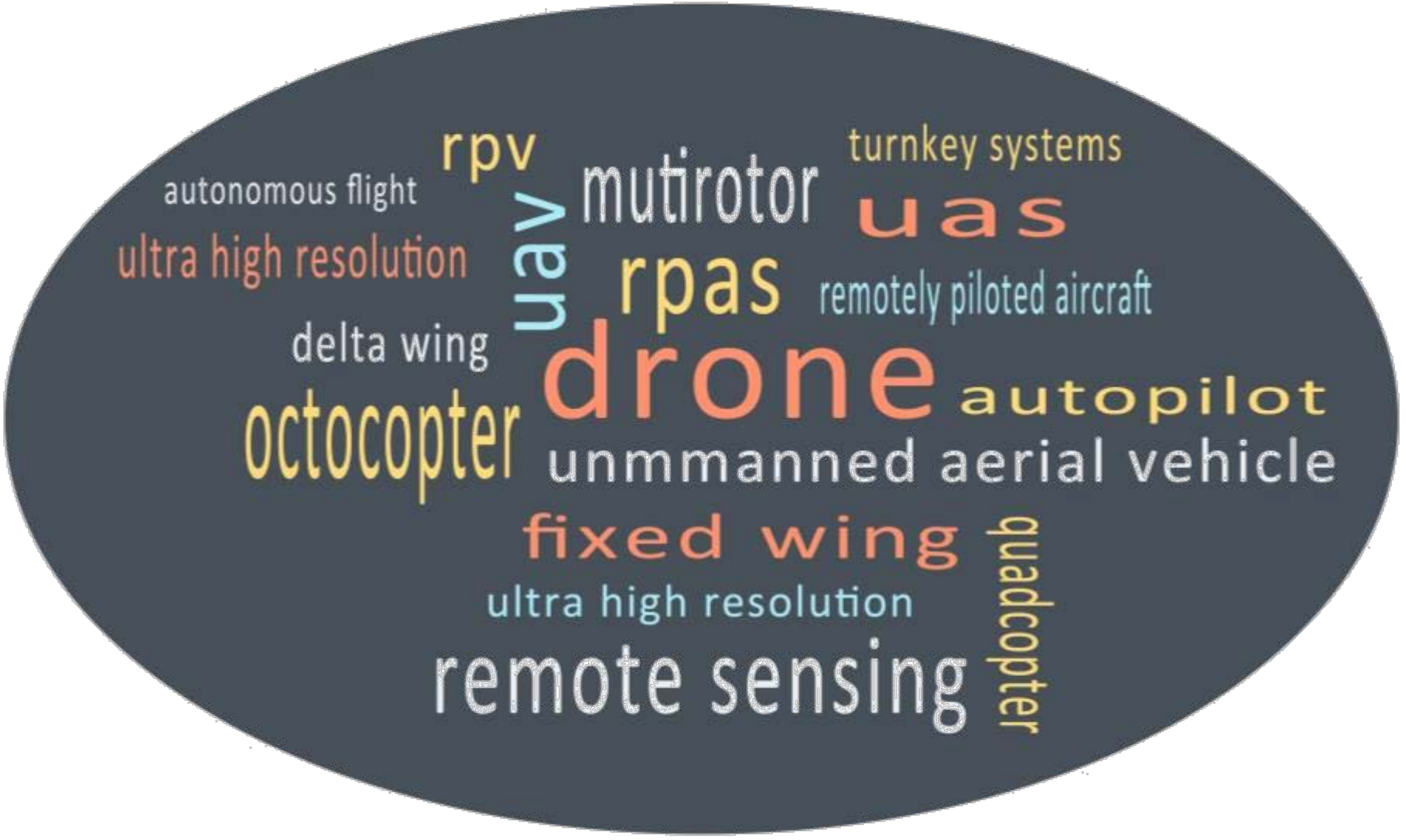
Australian Government
Department of the Environment
Supervising Scientist

RPAS for environmental monitoring in northern Australia

Renee Bartolo

What are RPAS/RPA?

Remotely Piloted Aircraft System



Multirotor and fixed wing platforms

SWAMPFOX UAS

Fixed wing aircraft

Autopilot - the brain of the system

GCS - ground control station

Payloads

2 x Sony NEX-5R cameras
Red, Green, Blue (RGB)
Near infrared (NIR)
Simultaneous capture

GoPro HERO 3
Record and livelink
Analogue livelink to the ground

SKYCAM UAV
UAV SYSTEM INTEGRATION AND OPERATIONS

Bungy launch

Parachute landing

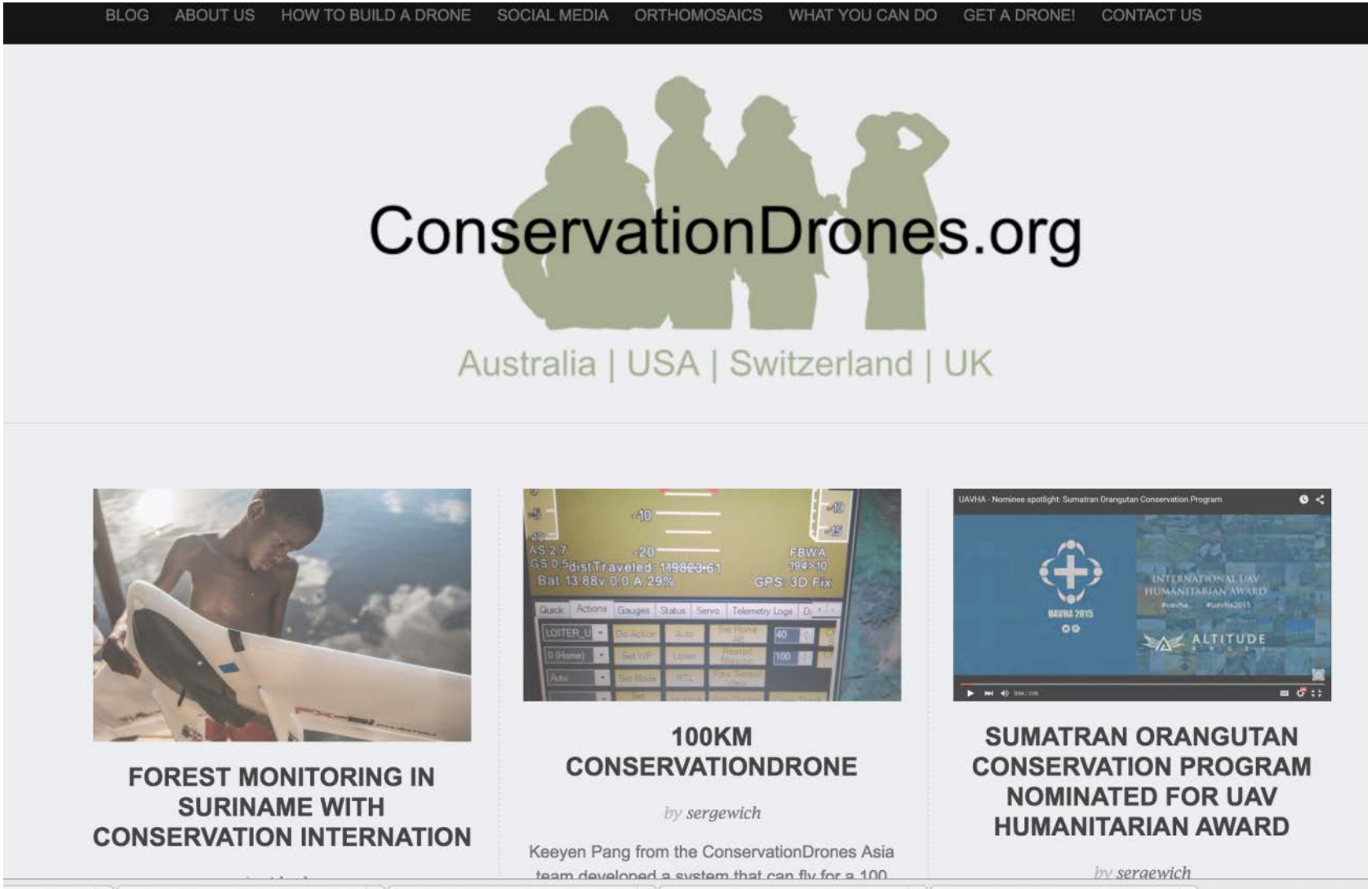
Specifications

Wingspan	2.7 m
Length	0.75 m
MAUW	4.8 kg (Maxiumum All Up Weight)
Range	45 km
Endurance	40-60 min (dependent on flying conditions)
Airspeeds	* 45 km/h minimum safe * 60 km/h cruise * 90 km/h dash (Differential Air-Speed Hold) * 110 km/h Vne (Never Exceed speed)
Propulsion	Outrunner Electric motor
Battery	14.8V, 10 Ah LiPo

Environmental Operating Limits

Tempertaure range (recommended) -14 C to 45 C
Relative humidity 100% but not recommended for flight in rain
Wind speed (max recommended) 35-40 kph

How RPAS are being used worldwide for environmental monitoring



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science for a changing world

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National Unmanned Aircraft Systems (UAS) Project Office

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Sensor Imagery Examples

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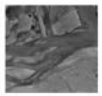
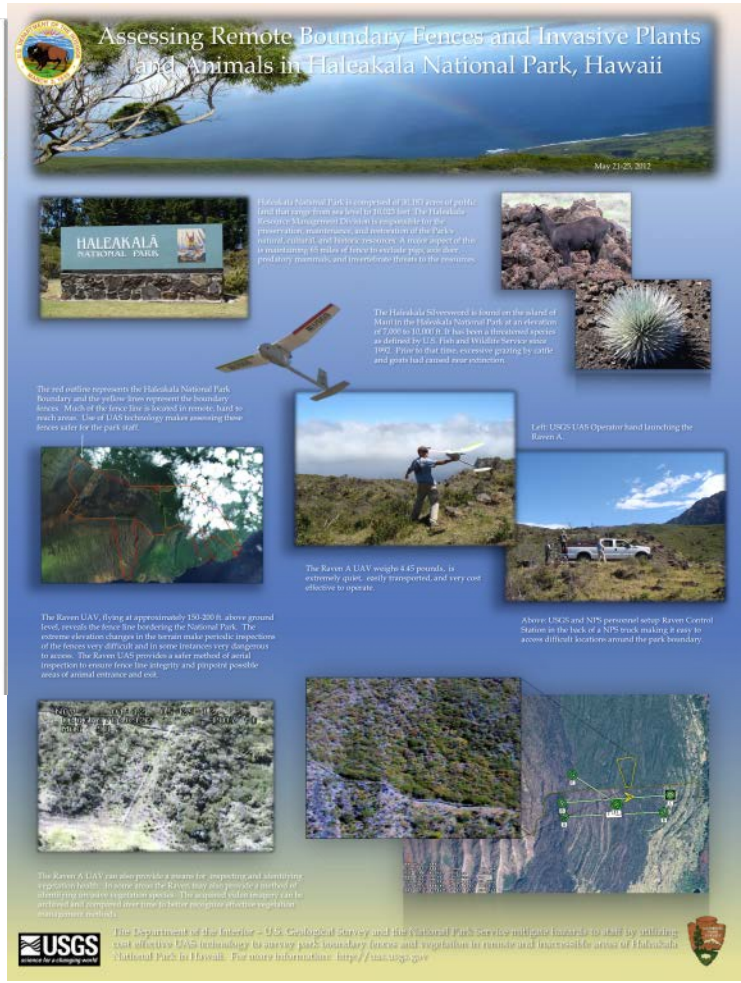
Hydrologic Monitoring

(Click on preview thumbnail to enlarge/download)

Preview	Description	Sensor	Resolution	Format
	River Sediment Monitoring, Platte River, NE Download Imagery	Canon SX230	200 ft AGL GSD 0.87 inch	geotiff (zipped)
	River Sediment Monitoring, Platte River, NE Download Imagery	Canon SX230	300 ft AGL GSD 01.18 inch	geotiff (zipped)
	River Sediment Monitoring, Olympic National Park, WA Download Imagery	GoPro 2 (4mm)	400 ft AGL GSD 1.94 inch	jpg



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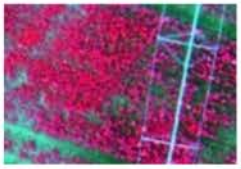
Applications

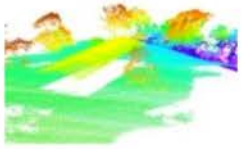
Applications

UAV-MVS (Multi-view stereopsis) point clouds for coastal monitoring

UAV mapping of Antarctic moss vigour under climate change



UAS for crop monitoring, precision agriculture and viticulture



UAV-borne LiDAR for forest management

UAS remote sensing for salt marsh monitoring

Supervising Scientist Environmental Monitoring

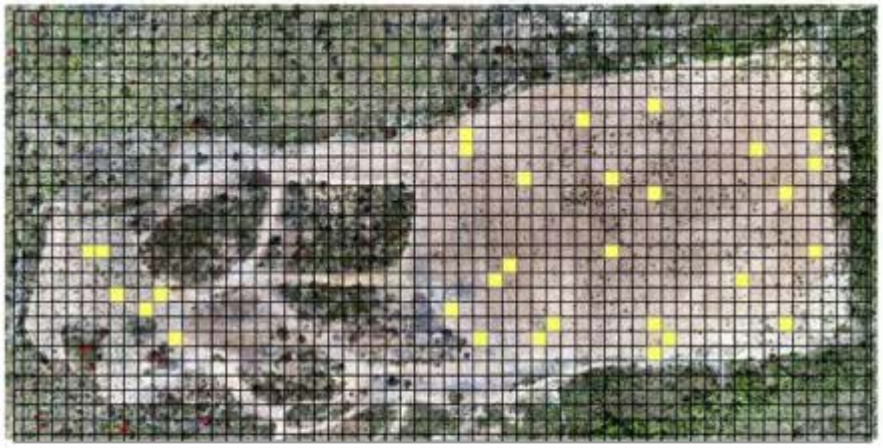
Rehabilitation monitoring

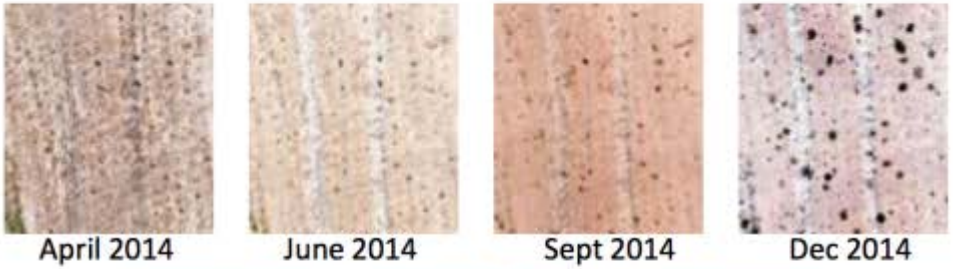
Monitoring billabong turbidity

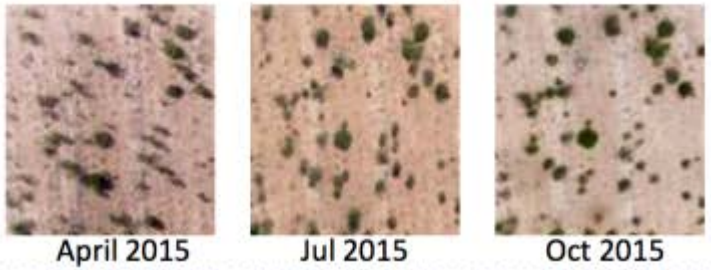
Jabiluka Billabong
December 2014

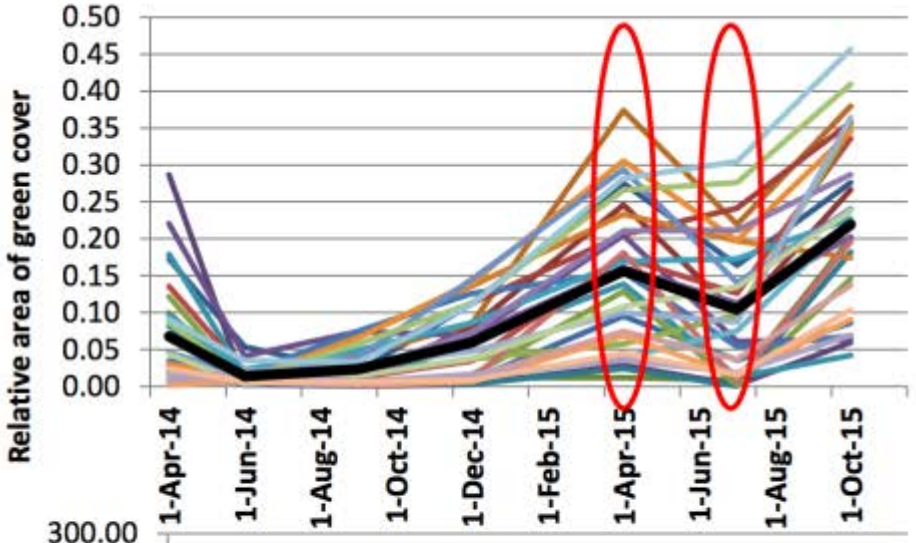
Djarr Djarr/Kelly's Billabong
October 2013
December 2014

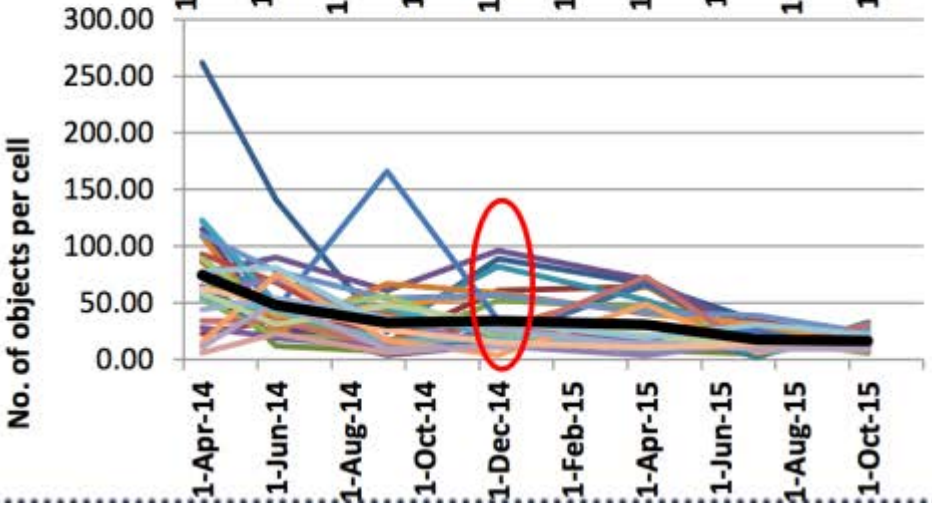
Wirnmyurr Billabong
December 2014

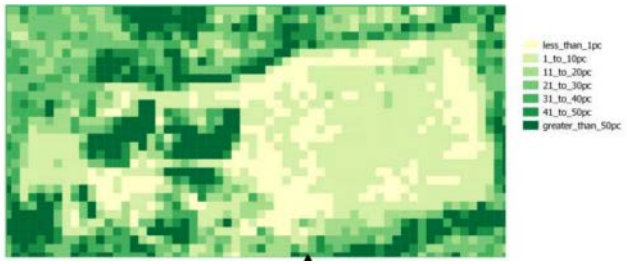


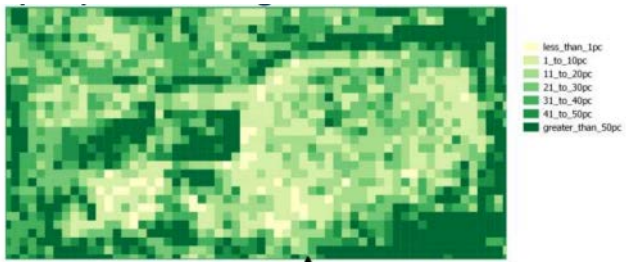

April 2014
June 2014
Sept 2014
Dec 2014

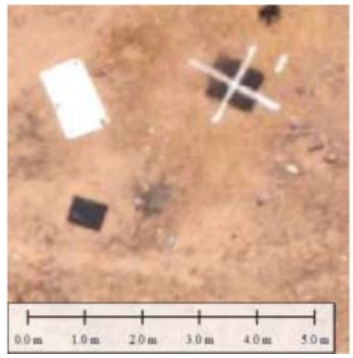

April 2015
Jul 2015
Oct 2015


Relative area of green cover
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1-Apr-14
1-Jun-14
1-Aug-14
1-Oct-14
1-Dec-14
1-Feb-15
1-Apr-15
1-Jun-15
1-Aug-15
1-Oct-15

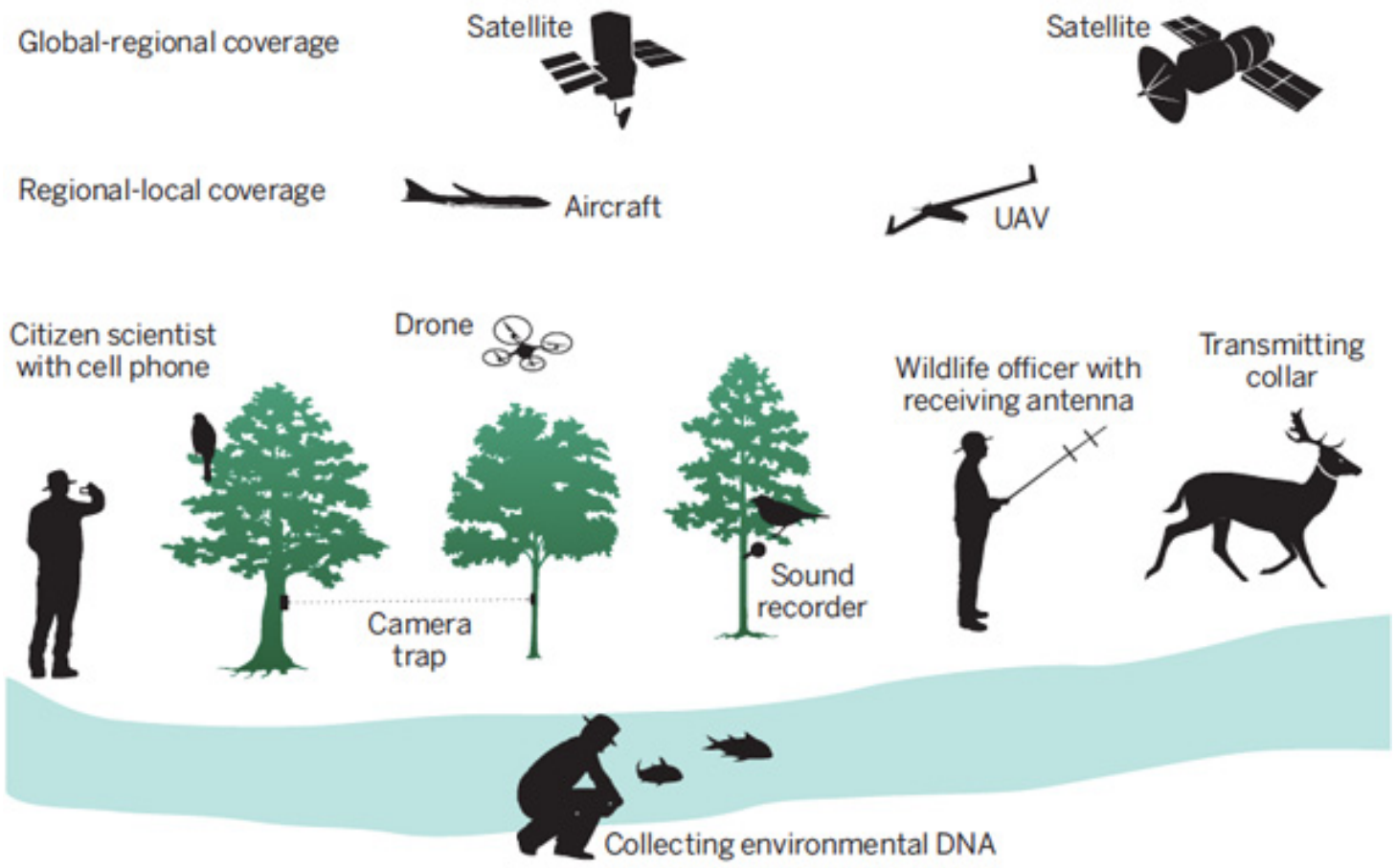

No. of objects per cell
300.00
250.00
200.00
150.00
100.00
50.00
0.00
1-Apr-14
1-Jun-14
1-Aug-14
1-Oct-14
1-Dec-14
1-Feb-15
1-Apr-15
1-Jun-15
1-Aug-15
1-Oct-15


less_than_1pc
1_to_10pc
11_to_20pc
21_to_30pc
31_to_40pc
41_to_50pc
greater_than_50pc


less_than_1pc
1_to_10pc
11_to_20pc
21_to_30pc
31_to_40pc
41_to_50pc
greater_than_50pc


0.0 m
1.0 m
2.0 m
3.0 m
4.0 m
5.0 m

Measuring environmental drivers, pressures, stressors, responses in northern Australia



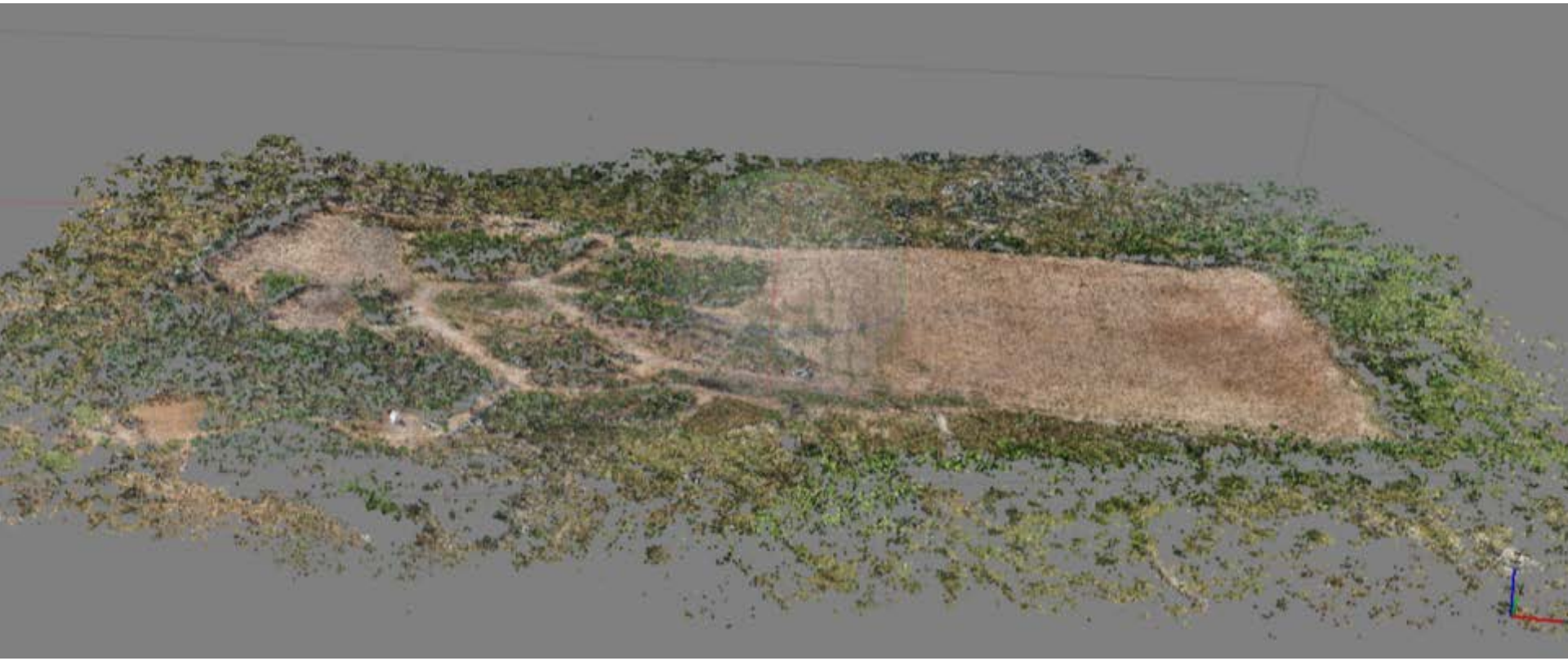
Sensor power. Networking satellite and airborne remote sensing with in situ sensing will allow changes in many elements of biodiversity to be tracked over time.

Turner, W. (2014) Sensing Biodiversity. *Science*, 346: 301-302

Benefits of using RPAS in northern Australia

- Ubiquitous cloud in the wet season & smoke from active fires in the dry season impact data captures for quantitative studies from satellite and traditional airborne acquisitions
- RPAS enable flexible data capture under cloud during the wet season- new opportunities for studying wet season dynamics.
- SCALE- Fills a gap particularly for ecological studies.
  - Ultra high resolution data across multiple scales (sub-1m → <10km)
  - Map and quantify, monitor, assess dynamics, understand pattern, link pattern to process, model and predict.
- DATA RICH:
  - Multi sensor (Hyperspectral, LiDAR, magnetics, fluorescence, etc)
  - Hyperspatial, hypertemporal, hyperspectral.

Digital Surface Model (DSM)



Sparse point cloud

Dense point cloud

3D

Nabarlek

230 ha 45 mins flight time 1013 photographs <5cm resolution

Constraints

- Environmental conditions push sensors to their operational limits
- The required specialists at this stage in the R&D:
  - In the least require a remote sensing expert preferably with photogrammetry experience.
  - Electrical engineer/systems integration
  - Data scientist
- HUMUNGOUS data!
  - Processing capability
  - Storage and retrieval
- CASA regulations
  - Unless you can operate a system <2kgs, research will require a RePL and ReOC.
  - For small RPA there are still regulations to comply with and you can not apply for further exemptions. You will need to check with insurer if you require RePL and ReOC to obtain insurance.

Key researchers and research users in northern Australia

Key Researchers

- **ERISS**
- **Karen Joyce (JCU)**
- **Stefan Maier (maitec)**

(External to NESP-NAER)

Research Users

- **ERISS**
- **Parks Australia**
- **Natural resource management groups**
- **NTG - Weeds Branch**
- **NTG – Flora and Fauna**
- **Land owners**

Example priority research question

Can an operational turnkey RPAS be developed to survey and monitor weeds in northern Australia?

- Suitable platform and sensor(s)
- On board processing of data to end user product
- Data calibration

Further recommendations on:

- Cost-benefit-analysis of using long range RPA in the near future
- Aerial application of control measures.

Other remote monitoring technologies