An operational UAS program for the Kakadu region, northern Australia.

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Abstract:
The Supervising Scientist is a branch of the Science Division within the Department of the Environment. The core functions of the Supervising Scientist are: 1) working to protect the environment through environmental research and monitoring, environmental supervision, audit and inspection; and 2) ensuring the protection of the Alligator Rivers Region (ARR) from the effects of uranium mining and encouraging best practice in wetland conservation and management. Kakadu national park is contained within the Alligator Rivers Region. The primary focus of the Supervising Scientist currently is the rehabilitation and closure of the Ranger Uranium Mine, the only operational uranium mine in the ARR. Mining in Pit 3 at Ranger ceased in 2012 and the pit is currently being backfilled with processing of stockpiled ore expected to continue until 2021, when the current Ranger Authority expires. Other mine sites in the region that the Supervising Scientist has involvement in are: Jabiluka, Nabarlek and the South Alligator Valley mines. The Environmental Research Institute of the Supervising Scientist (ERISS) undertakes environmental monitoring and scientific research into the impact of uranium mining on the environment within the Alligator Rivers Region to support the role of the Supervising Scientist.

In 2014, ERISS acquired an unmanned aerial system (UAS) with a multispectral photogrammetric platform for the purpose of establishing a framework/methodologies/program to monitor landscape condition at a fine scale. This program includes monitoring the success of mine site rehabilitation. The UAV that was acquired is a Swampfox X5 delta wing (see Figure 1). The UAV has a 2.3m wingspan and is powered by an electric motor and controlled via telemetry from a mobile ground control station (GCS). The initial payload consists of two Sony Nex-5 cameras, one standard RGB (Red, Green, Blue) and the other converted to capture near infrared imagery (NIR, >720 nm).

The applications we are using UAS for are variable in terms of environmental conditions and spatial and temporal scales. It became apparent that different platforms and sensors would be required for different applications. Table 1 summarises the different components of UAS that we currently operate. We have found that redundancy is critical to ensuring that a UAS program is operational when required; therefore, where possible (and cost effective) we have two platforms or sensor kits. Figure 1 shows two different UAS configurations we typically use.

Figure 1. Left: X8 octocopter with MicaSense Red edge payload. Right: Swampfox X5 delta wing with Sony Nex5 cameras (R, G, B and modified NIR).

Platform and type	Sensor	Software
Swampfox X5 - delta wing * X8 – octocopter * IRIS – quadcopter *	Sony Nex-5 and A5000 (R,G,B and modified NIR) * Bayspec OCI 1000 Micasense Red edge Go Pro	Pix 4D Agisoft Photoscan Correlator 3D

Table 2. Components of the ERISS UAS environmental monitoring program.

** Indicates redundancy whereby there are two systems in the case of failure of one system in the field or downtime for repairs.*

The applications we have been using UAS for to date include:

- Monitoring of revegetation at Jabiluka mine site (12 hectares).
- Monitoring of rehabilitation (revegetation and erosion) at the South Alligator Valley containment (5 hectares).
- Monitoring suspended sediments in billabongs.
- Quantifying the impact of feral animals on floodplain environments (Yellow Waters).
- Quantifying structural attributes of savanna analogue sites.

Future applications include quantifying biomass on revegetated landforms to input into landform evolution models and Digital Elevation Model (DEM) generation on vegetated reconstructed landforms using LiDAR.

This paper will provide an overview of the UAS program with a focus on the requirements to ensure we can meet the research needs of our organisation.