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Project:	GNRBA Onion Weed
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Author:	Steve Ewings
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RPA Image: *Dam on Gunnadorah Station – Steve Ewings.*

Contents

Remotely Piloted Aircraft (RPA) Onion Weed Baseline Report

1. Preface

Onion weed (*Asphodelus fistulosus*) continues to grow unabated through areas of the Goldfields and Nullarbor. Onion weed infestations can reach high densities. The weed is unpalatable and can significantly reduce pasture carrying capacity.

Onion weed in Western Australia's southern rangelands is native to southern Europe, North Africa and eastwards to India. The plant usually grows as an annual herb but can be weakly perennial when soil moisture levels remain high. It has hollow onion-like basal leaves up to 25 cm in length and produces erect flower spikes, sequentially flowering six-petalled white or pinkish flowers up to 20 mm across.

Each petal has a conspicuous darker central nerve. The flower spike 'stems' are hollow and usually branched in their upper half. Seed production is usually prolific, with each flower forming a three-celled globular capsule. Each capsule carries three to six small black, triangular and wrinkled seeds easily dispersed by wind, machinery, water, animals, and clothing.

According to the Department of Agriculture (2002), an abundance of onion weed can be attributed to excessive grazing pressure or soil disturbance. Within holding paddocks, onion weed thrives under routine and heavy use conditions during winter. Spelling paddocks after use may not alleviate this situation, especially if high stock numbers early in the season impede the establishment of more desirable pasture species.

The Nullabor Onion weed infestation tenaciously holds in the depressions of Dongas. A 'Donga' on the Nullarbor Plain is a shallow depression, up to several metres deep and can be hundreds of metres across, with a flat day-loam floor and very gentle slopes. Donga groves provide a more valuable source of forage than the surrounding plains. The deterioration of donga groves and increased weed loads reduces the landscape's overall carrying capacity as it loses the ability to support herbivores during dry periods.

When the donga groves are in fair condition, there is a decline in the density of palatable species, often coinciding with an increase in Curara (*Acacia tetragonophylla*). Poor-condition dongas can be reduced to sparse stands of aged trees surrounded by undesirable annuals such as Ward's weed, Roly-poly, and declared weeds such as Bathurst burr, Doublegee, Saffron thistle, and recently onion weed.

2. Participants

Amanda Day – CEO Goldfields Nullabor Rangelands Biosecurity Association (GNRBA)
Sarah Jeffrey - Rangelands NRM Project Manager and RALF Officer
Steve Ewings – APC RPA survey design, Chief pilot, RPA Data analysis
Kanandah, Rawlinna, Gunnadorah, and Kinclaven – Station owners, managers, and overseers.

3. Introduction

Figure 1: *Onion weed in flower. Source Unknown*

This preliminary RPA baseline survey forms part of a greater onion weed assessment on the Nullabor being conducted by GNRBA. The report does not interpret the data, as the scope of works is to establish a baseline on a series of sites and provide basic Orthomosaic training to pastoralists.

The invasive plant, onion weed was first discovered growing along the Trans Line more than two decades ago.

The plant was believed to be brought to the area by trains along the railroad and vehicles that travelled along the parallel access road. The plant has since spread throughout the region and is known for its ability to outcompete native plants, and it can quickly take over entire Dongas and water-holding depressions. Despite efforts to control the spread of onion weed, it remains a persistent threat to the ecosystem in the area.

This report will provide the results of the RPA survey flights undertaken between 23-25 May 2023 and will feed into the ongoing GNRBA on-ground monitoring and surveillance. Our objective was to map specific areas to provide baseline monitoring data.

Additionally, two pastoralists were trained to create flight maps and conduct transect flights, process the imagery, and develop orthorectified maps to measure the spread of onion weed.

4. Nullabor Sites

The eleven identified Onion weed sites along the Trans Line begin just east of Zanthus and stretch 180 kilometres west of Forest. Onion weed is now also sighted over 100 km north of the Trans Line along the Connie Sue Highway (pers. Comm Daniel Hogg). There are likely to be many other sites that will be confirmed over time.

Figure 2: *Spread of Onion weed along the Trans Line.*

5. Method

A list of Onion weed infestation sites with coordinates were provided by the Amanda Day, the CEO of GNRBA.

Table 1: Onion weed location and co-ordinates.

ONION WEED SITES AND CO-ORDINATES NULLARBOR WA DECEMBER 2022		
LOCATION	**CO-ORDINATES**	**DATE/TIME**
#1 East of Rawlinna	S31 0' 42.6204'' E125 31'45.72444''	07.12.2022 10.56am
#2 Kianga Gunnadorah	S30 57'4.33368'' E 126 9'39.00672"	07.12.2022 1.24pm
#3 Gunnadorah	S30 57'4.15944'' E 126 9'38.73708''	07.12.2022 1.27pm
#4 Fergies	S30 59'16. 37268'' E 125 57'9. 9522''	07.12.2022 3.02pm
#5 Well Paddock	S 31 0'16.38432'' E 125 49'35.57316 ''	07.12.2022 4.59pm
#6 Home Paddock	S 31 0'28.10376'' E 125 51'3.2724''	07.12.2022 5.12pm
#7 Trans Access Rd	S 31 0'21. 36024'' E 125 4'1.27164''	08.12.2022 9.11am
#8 Kanandah 1	S 30 55'14.84508'' E 124 51'31.14468''	08.12.2022 11.27am
#9 Kanandah2	S 30 56'21.2154'' E 124 51'58. 26132''	08.12.2022 11.43am
#10 Kanandah3	S 30 57'15.498'' E 124 51' 48. 1824''	08.12.2022 11.58am
#11 Kanandah4 West Dam	S 31 2'11. 68188'' E 124 18'7. 25292''	08.12.2022 1.09pm

For each site a Key Markup Language (KML) file was created in Google Earth Pro. Each KML file is centred over a co-ordinate and is 100x100m (one hectare) in extent.

An 'on the fly' site, #12 Gunnadorah Lat -30.9659903 Long 126.1570215 was added during the survey. This site is rectangular, covering 4.5ha and is 1.7km SSE of #2 Kianga Gunnadorah and #3 Gunnadorah which are located close to each other.

Figure 3: *An example of KML bounding box at Kanandah West Dam.*

The KML files were imported into DJI Smart Controller. *DroneLink* flight planning software on the Smart Controller used the KML bounding box to create the flight path. For consistency and species identification, flights were programmed at 40 meters above ground level (AGL). Camera was set to distance interval and overlap set at 75% forward and 80% side overlap. Consistently high winds required keeping flight transect speeds low, at 13-16kph.

With limited time window to fly flights and significant distances between sites the transects were flown irrespective of conditions. For example, on 24th May 2023 average wind speed was 37.8 kilometres per hour (kph), gusting to 45.72 kph (12.7 metres a second) for the #6 Home Paddock flight. Tree canopy movement generates artefacts and therefore obfuscates ground cover clarity.

A DJI Mavic 2 Pro was used to fly the transects, equipped with the standard 20MP, one-inch Hasselblad L1D-20c camera. A single battery was sufficient to fly each transect.

Flight data was uploaded to Maps Made Easy (MME) to create an orthorectified GeoTIFF, a full resolution JPG, and colourised DEM GeoTIFF. The GeoTIFF was imported into ArcGIS Pro to identify onion weed patches and perform area measurements.

All raw flight data and processed imagery are available to the GNRBA.

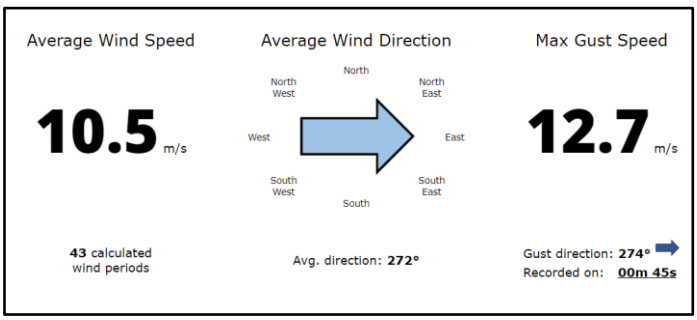

Figure 4: Wind conditions on 24/5/2023 at 11:57 AM.

8. Results

This section does not offer analysis of the onion weed incursion on the Nullabor. The scope was to provide baseline data and train pastoralists with RPAs to conduct further missions to map the extent of onion weed on their properties.

Seven sites were flown over two days 24-25th May 2023 (Appendix 1). Some sites had low density of onion weed, however it occupied half (52.4%) of the site area (Site #4 Fergies). Other sites had three times the density (Figure 5) and the infestation covered 28% of the site.

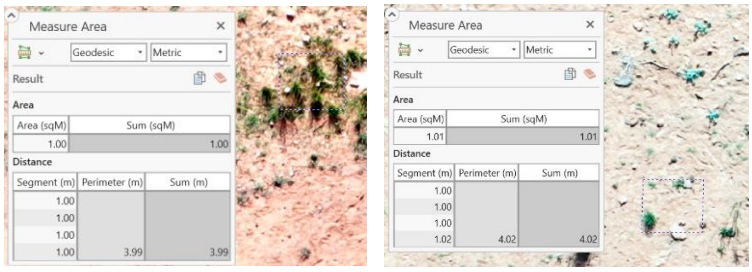

Figure 5: Density of Onion weed ranges from 3 (#4 Fergies) to 9 (#5 Well) plants m^2

All flights were at 40m AGL and with little rain in the preceding months, the more mature onion weed clumps were clear in the Orthomosaic maps. Smaller, individual plants are not as easily identified, particularly if flights with lengthened shadows occur later in the day. Future flights under similar conditions may benefit by reducing AGL to 30m. This would extend flight time for each site by 2-3 minutes, and increased resolution is seen to be a reasonable trade-off.

Table 2: Flight metrics and results

Site Number	Description	Aerial Area ha	Weed Coverage ha	Weed Cover %	Date & Time of Flight
2 - 3	Gunnadorah	1.49	0.060	4.00	24/5/2023 8:28 am
4	Fergies	1.57	0.824	52.41	24/5/2023 10:38 am
5	Well Paddock	1.56	0.443	28.29	24/5/2023 11:33 am
6	Home Paddock	1.58	0.150	9.81	24/5/2023 11:58 am
8	Kanandah 1	1.50	0.116	7.72	23/5/2023 3:20 pm
11	Kanandah Dam	1.65	0.107	6.48	23/5/2023 11:23 am
12	Gunnadorah (new)	2.94	0.387	13.15	24/5/2023 9:10 am

9. Training

Training in the production of orthomosiac mapping was provided to Cameron and Faith Day at Gunnadorah Station and Craig Chandler at Rawlinna Station. Gunnadorah has a DJI Phantom 4, and Craig uses a DJI Air 2S; both are suitable for creating basic mapping products.

Both parties have some experience in flying drones, so the focus was to impart the knowledge and tools necessary to undertake mapping for the onion weed project.

However, from conversations with pastoralists and station staff, it was apparent that most could do with a brush-up on CASA RPA regulations and standard operating procedures. Rangelands NRM has an online course hosted by the Drone Institute of Technology that

would be beneficial to RPA pilots on the Nullabor. The training was informal, although thorough and sequential, covering the following:

- Viewing hard copy outputs of Orthomosaic maps
- Setting up an account with DroneLink flight planning software
- Downloading and installing the Dronelink app to a remote controller or phone
- Explaining AGL, transects, camera overlap, aircraft speed, site plan buffering, and other flight parameters to generate quality maps.
- Creating flight plans on a laptop using DroneLink online.
- Syncing flight plans to phone or controller.
- Connecting the controller with aircraft and executing a flight
- Removing the SD card and downloading data to laptop.
- Creating an account with Maps Made Easy (MME)
- Explaining steps and process to upload data to MME
- Uploading images to MME and processing.
- Viewing MME online finalised maps
- Checking Overlap Report, verifying map quality
- Downloading processed GeoTIFF, DEM files.

A conversation was had at Kananda Station with some interest about potential involvement in weed mapping, which would require the acquisition of an RPA. Daniel Hogg from Kinclaven Station owns a Splash drone that cannot be programmed by flight planning software. A workaround was discussed, where the aircraft could be flown and a single image captured. The Splash drone camera is a wide-angle lens with considerable distortion; ground calibration might provide a rough estimation of weed incursion. Photographs cannot be imported into GIS software to perform any measurements.

In summary, due to the training, the Gunnadorah pastoralists and the Rawlinna Station overseer are well-positioned to provide useful data for input into the onion weed project.

10. References

Daniel Hogg, *Spread of Onion weed north of Trans Line*, 25th May 2023, Personal Communication.

Department of Agriculture, (2002) Farmnote 56, *Onion weed. What threat to the arid rangeland in Western Australia?* https://futurebeef.com.au/wp-content/uploads/2011/09/Onion_weed.pdf

DPIRD, (2022) *Nullarbor pastures in the southern rangelands of Western Australia*, https://www.agric.wa.gov.au/rangelands/nullarbor-pastures-southern-rangelands-western-australia

Appendix 1 Orthomosaic maps and onion weed areas.

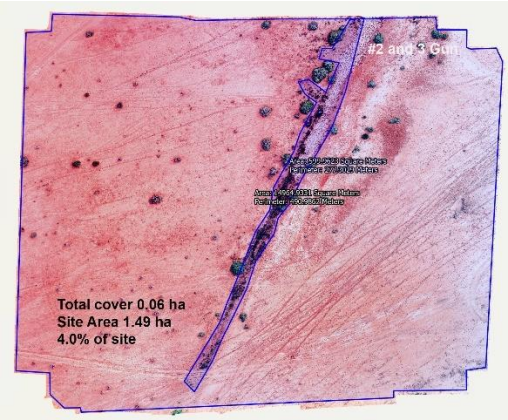

Figure 6: Sites #2 and #3 Gunnadorah.

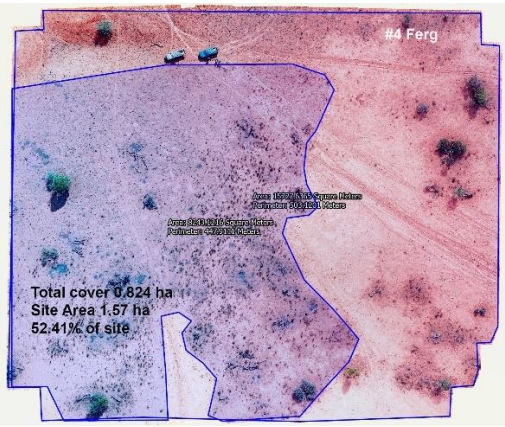

Figure 7: Site #4 Fergies.

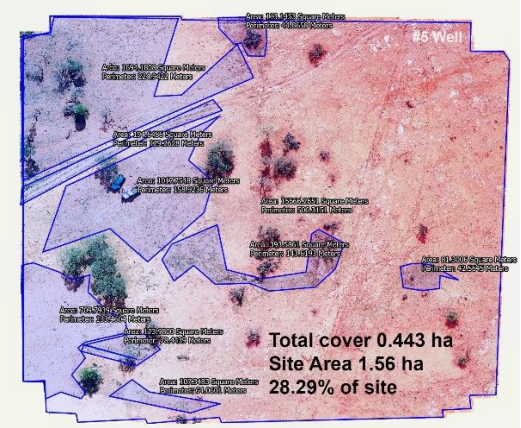

Figure 8: Site #5 Well Paddock.

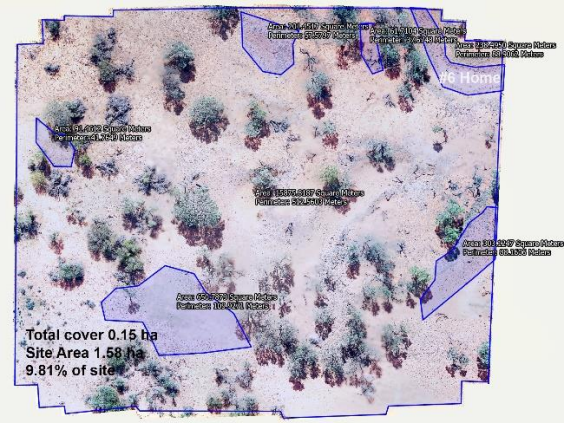

Figure 9: Site #6 Home Paddock.

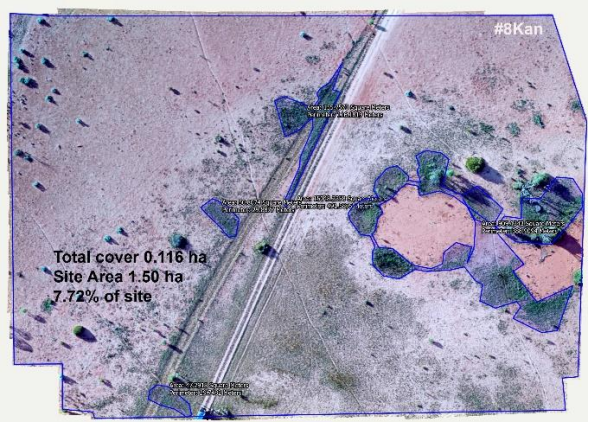

Figure 10: Site #8 Kanandah 1.

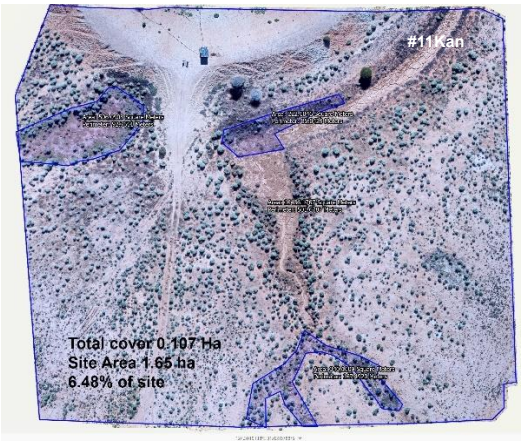

Figure 11: Site #11 Kanandah West Dam.

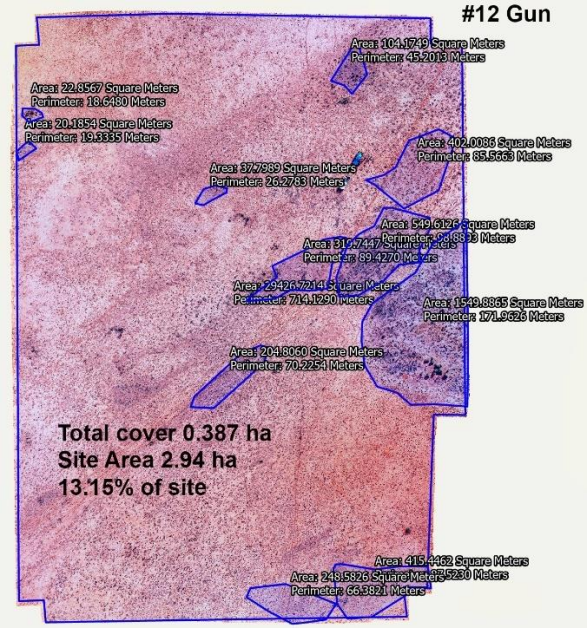

Figure 12: Site #12 Gunnadorah (new).