Surveying salvinia (*Salvinia molesta*) and para grass (*Urochloa mutica*) on a floodplain system in Northern Australia

Daniel McIntyre
Energy Resources of Australia Ltd, GPO Box 2394, Darwin, NT 0800, Australia
(daniel.mcintyre@era.riotinto.com)

Summary Aquatic weeds are one of the biggest threats to the biodiversity, health and function of Kakadu National Park's Ramsar listed wetlands. Two prominent species that have successfully invaded large areas of floodplain environment in Kakadu are salvinia (*Salvinia molesta*) and para grass (*Urochloa mutica*). Up to date survey information on the density and extent of these weeds is important for effective management. In 2011–12 Energy Resources of Australia Ltd. (ERA) conducted airboat surveys of the Magela floodplain within the Jabiluka mining lease, and in an adjoining area of Kakadu National Park. The following paper presents the outcomes of the surveys, followed by an assessment of the advantages and disadvantages of the different survey methods.

Keywords *Urochloa mutica*, *Salvinia molesta*.

INTRODUCTION

Aquatic weeds are one of the biggest threats to the biodiversity, health and function of the Ramsar listed wetlands of Kakadu National Park in the Northern Territory (Walden and Bayliss 2003). Two prominent species that have successfully invaded large areas of floodplain environment in Kakadu are salvinia (*Salvinia molesta,* D.S. Mitchell) and para grass (*Urochloa mutica* Forssk. Stapf). Salvinia is a Weed of National Significance (WoNS) that forms dense mats over waterways, killing aquatic life and restricting traditional and recreational activities (Miller and Shultz 2004). Para grass is an introduced pasture grass that adversely alters fire regimes and out-competes native grasses and sedges (Douglas and O'Connor 2004).

Energy Resources of Australia Ltd. (ERA) is a mining company that operates on land surrounded by (but not part of) Kakadu National Park (KNP). The Magela floodplain comprises 1400 ha (19% by area) of ERA's Jabiluka mineral lease and the floodplain is identified as being highly susceptible to the negative impacts of aquatic weeds (Bayliss *et al*. 2012). Up to date survey information on the density and extent of salvinia and para grass on the Magela floodplain is an important pre-requisite for future management scenarios. In 2011–12, ERA conducted surveys of the Magela floodplain to address the deficiency of information on the location and density of para grass and salvinia. The field surveys consisted of three components: 1) random plots in Kakadu National Park that included both weeds and native flora species; 2) moving airboat transects of para grass and salvinia on the Jabiluka lease; and 3) the boundaries of para grass patches in proximity to a rehabilitation site (Djarr Djarr) on the margin of the floodplain on the Jabiluka lease were mapped.

METHODS

Plots The random plots were sampled on 12 and 13 April, 2011 in a part of KNP adjacent to Jabiluka (Figure 1, cross-hatched area). At each site, data were recorded from observations within four 25 × 25 m sub-plots located around the four corners of the airboat, for a total area of 0.25 ha. Within sub-plot the following data were recorded:

- dominant native wetland plant species with estimated percentage cover and height
- the presence of Salvinia and Para grass, with percentage cover and height
- an oblique digital photograph
- miscellaneous observations e.g. water depth and water cover.

Transects The fieldwork was conducted on 3 May 2011. Para grass and salvinia were sampled on the Jabiluka lease (Figure 1, right hatching) using the moving transect sampling strategy, where samples were taken at intervals of 5 seconds with a travel speed of *c*. 10–20 km h^{-1}. The sample area and density classes (Table 1) were adapted from the Guidelines for Weed Data Collection in the Northern Territory (NTG 2008), in which a semicircle of 20 m diameter (0.02 ha) was centred on the airboat. The semicircle was used rather than a full circle because of the limited visibility to the rear of the airboat whilst the vessel was in motion.

Table 1. Class and density values.

Class	Density
1	< 1%
2	1 – 10%
3	11 – 50%
4	> 50%

Para grass boundaries Para grass infestations in the vicinity of Djarr Djarr on the Jabiluka lease (Figure 1, black shaded area) were surveyed by airboat on 26 March, 2012. The purpose of the survey was to delineate patches of para grass to assist in selecting areas to use in proposed control trails in 2012–13. The perimeters of para grass infestations were traversed, and data recorded using a hand-held GPS and Personal Data Assistant (PDA).

RESULTS

Plots A total of 30 sites were sampled over the two days (Figure 2). Salvinia and para grass were recorded at 20 (67%) and 9 (30%) of the 30 plots, respectively, at an overall density between <1% and 100%.

Transects A total of 50 para grass samples were recorded (Figure 2), ranging in density from 2–4.

Of these samples, 38 (76%) were class 4, 8 (16%) class 3, and 4 (8%) class 2. A total of 383 salvinia samples were recorded, ranging in density from 1 to 4. Of these samples, 209 (55%) were class 4, 71 (18.5%) class 3, 37 (10%) class 2, and 66 (17%) class 1.

Para grass boundaries The extent of para grass is shown in Figure 2 (inset, shaded area). The area of para grass mapped was 59 ha. All of the mapped para grass patches had an estimated density of >50%.

DISCUSSION

Survey A summary of the advantages and disadvantages of the different survey methods for para grass and salvinia is shown in Table 2. In addition to the ground based methods–two other survey methods–helicopter and remote sensing are also included. The moving transect method was most effective for mapping salvinia because the species had a spatially continuous

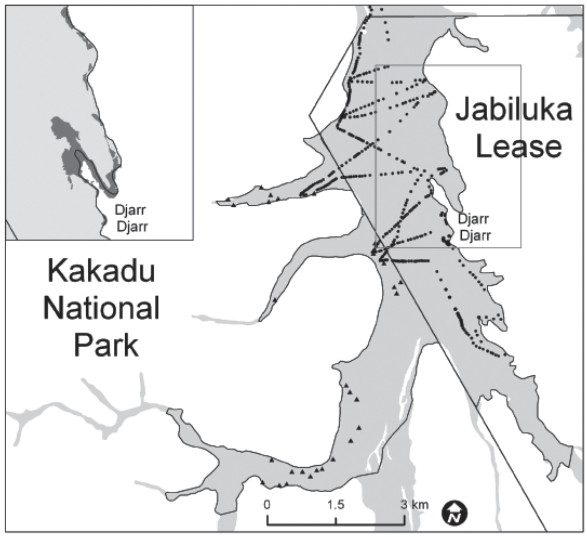

Figure 2. Location of para grass and salvinia from the 2011–12 surveys. Triangles represent random plot sites in KNP; circles represent Jabiluka transects; inset shows para grass patches mapped at Djarr Djarr.

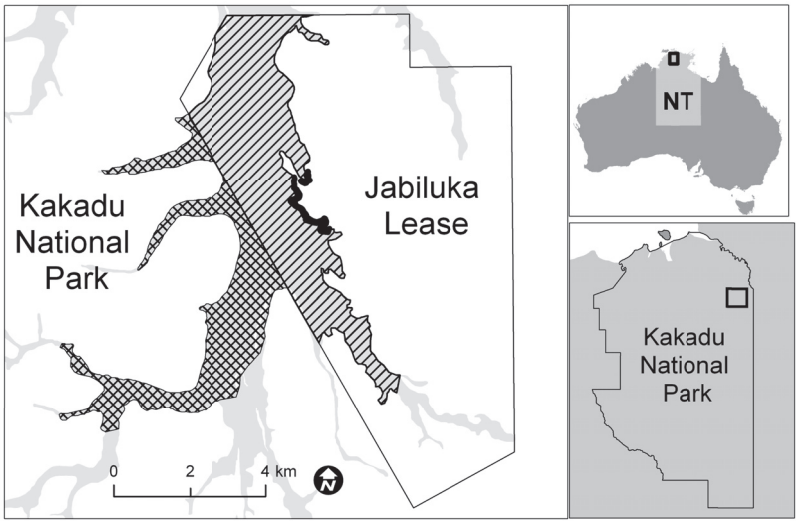

Figure 1. Locality map of surveys in Kakadu National Park and Jabiluka lease.

Table 2. Advantages and disadvantages of the different survey methods for aquatic weeds.

Method	Sample type	Advantages	Disadvantages
Plots	4 × 25 m plots	• High level of detail on floodplain flora species abundance • Compatible with scientific research objectives	• Time consuming • Under-sampling for map/remote sensing validation • Requires specialist knowledge of floodplain flora
Moving transects	Semi-circle of 20 m diameter	• Large areas can be surveyed rapidly • Ideal for surveying species with a continuous distribution (e.g. Salvinia)	• Positional error due to moving airboat • Limited value for patchily distributed species like Para grass
Polygon (boundary)	Polygon around perimeter	• Best represents contiguous patches of Para grass • Area of and extent of infestations can be calculated and compared over time	• Access to some areas of Para grass may be limited when water levels lower • Navigation around perimeter impeded by obstacles (e.g. trees) • Time consuming
Helicopter	Variable	• No access issues (e.g. water levels) • Large areas mapped in timely manner	• Familiarisation with ground conditions essential • Expensive • Positional accuracy reduced
Remote Sensing	Pixel (variable)	• Synoptic view • Large area coverage • (Potentially) repeatable and consistent coverage	• Meteorological conditions (e.g. clouds) can obscure imagery • Cost of high resolution data • Specialist skills may be required

distribution. In contrast, the method was not optimal for para grass, which formed discrete patches and was more suitable for the polygon method. Salvinia is a difficult weed to survey due to the large difference in temporal dynamics between years. Para grass is more amenable to survey and monitoring due to it being a perennial weed. The location of para grass infestations can be more reliably tracked and assessed. The polygon mapping method, can be time consuming if large areas of para grass are to be mapped, and may require that selected areas are prioritised for survey, rather than an entire floodplain area.

ACKNOWLEDGMENTS

We thank Parks Australia for administrative and logistical support, and the Traditional Owners of the Magela floodplain for their consent to conduct the surveys. The project was supported by Kakadu Research Permit RK762.

REFERENCES

Bayliss, P., van Dam, R.A. and Bartolo, R.E. (2012). Quantitative Ecological Risk Assessment of the Magela Creek Floodplain in Kakadu National Park, Australia: Comparing Point Source Risks from the Ranger Uranium Mine to Diffuse Landscape-Scale Risks. *Human and Ecological Risk Assessment: An International Journal* 18 (1), 115-151.

Department of Natural Resources, Environment and the Arts (2008). 'Guidelines for Weed Data Collection in the Northern Territory'. Northern Territory Government of Australia, Darwin.

Douglas, M.M. and O'Connor, R.A. (2004). Weed invasion changes fuel characteristics: Para Grass (Urochloa mutica (Forssk.) T.Q. Nguyen) on a tropical floodplain. *Ecological Management & Restoration* 5, 143-145.

Miller, I.L. and Shultz, G.C. (2004). Agnote 462: Salvinia. Weed Management Branch, Northern Territory.

Walden, D. and Bayliss, P. (2003). 'An ecological risk assessment of the major weeds on the Magela Creek floodplain, Kakadu National Park'. Internal Report 439, Supervising Scientist, Darwin NT.