Eyre Peninsula Landscape Board

PEST SPECIES REGIONAL MANAGEMENT PLAN

Cenchrus ciliaris and *Cenchrus pennisetiformis*

Buffel grass

This plan has a five year life period and will be reviewed in 2027.

INTRODUCTION

Synonyms

Cenchrus bulbosus Nomencl. Bot., ed. 2. 1: 317 (1840). Fresen. ex Steud., *Cenchrus longifolius* Hochst. ex Steud., Syn. Pl. Glumac. 1: 109 (1854). *Cenchrus melanostachyus* A.Camus, Bull. Soc. Bot. France 81: 594 (1934). *Pennisetum cenchroides* Rich., Syn. Pl. (Persoon) 1: 72 (1805). *Pennisetum polycladum* Chiov., Annuario Reale Ist. Bot. Roma 6: 167 (1896) *Pennisetum rufescens* (Desf.) Spreng., Syst. Veg. 1: 302 (1824). **[32]**

Cenchrus. pennisetiformis Hochst. & Steud, is a distinct species to *C. ciliaris*. **[32]**

For practical purposes the common name buffel grass, will refer to both *Cenchrus pennisetiformis* and *C. ciliaris* in this pest management plan.

Biology

Little is known about the ecological requirements of *Cenchrus pennisetiformis* which is morphologically and taxonomically similar to *Cenchrus ciliaris*. Until recently they were considered the same species **[32]**.

Buffel grass is an erect, deep-rooted, tussock forming, summer-growing perennial. The flowering heads appear from November to May or sporadically following rain **[2]**.

Key identifying features include:

- dense tussocks to 1 m high;
- leaves to 30 cm long and 1.3 cm wide;
- a ring of short hairs at the base of leaf blades;
- seed heads in a dense, hairy, cylindrical spike up to 15 cm long and 2 cm wide; growing in a spike-like raceme covered in clusters of bristles giving them a fluffy appearance **[1]**.
- seed heads have a purple appearance which fades to white as they age; and
- a 'zig-zag' shaped, rough-textured axis which becomes visible once the seeds drop **[9]**.

Buffel grass is bisexual and commonly reproduce by seed (produced with or without fertilisation) or vegetatively through rhizome or stolon production **[3]**. After shedding from the plant the seeds remain viable for 12 months or longer. Field experiments conducted near Alice Springs **[4]** found that a small portion of the seeds can remain viable for up to 4 years in the soil however only 10% were viable after two years. Generally at least 25.0 mm of rainfall is required for seed germination **[5]**. Emerging seedlings can grow and set seed in as little as three to five weeks with sufficient moisture and re-shooting mature plants can flower within 10 days after a rainfall event **[6]**.

Environmentally buffel grass is considered one of Australia's worst weeds **[8]**. The success of buffel grass as a pasture species and an environmental weed is due to its' ease of establishment, rapid growth rate, fast maturation, prolonged flowering periods, prolific seed production and high seed dispersal ability coupled with relatively long seed dormancy **[3]**. Buffel grass is tolerant of drought, fire and grazing. It easily naturalises in most climates and on a range of soil types and quickly forms self-sustaining populations **[3]**.

Wild fires may encourage germination as the ashes are reported to make good seedbeds **[7]**. Franks **[3]** suggests that buffel grass seeds are triggered to germinate through soil disturbance, including minor disturbances such as breaking of the soil surface by stock movement.

In central Australia buffel grass is spreading along river banks into other habitats where moisture is more persistent, forming dense monocultures, changing fire regimes, threatening key refugia and displacing native plants **[8]**.

Origin

Buffel grass is native to Africa, India and Indonesia. It is believed seeds were accidentally imported into the north-west coast of Western Australia in the 1870's on Afghan camel harnesses **[10]**. After the First World War, the Western Australian Department of Agriculture was active in distributing *Cenchrus* varieties sent from Afghanistan. These provided the seed source for the first buffel grass plantings in Queensland at Cloncurry in 1926 **[10]**. Trials of buffel grass from Pretoria were recorded in the early 1920s in NSW and a buffel grass specimen was identified in Alice Springs in 1930 **[10]**. Since the late 1950's, buffel grass has been a major pasture grass sown in northern Australia **[11]**.

Over 580 varieties of buffel grass have been brought into Australia from 35 countries **[12]** with new varieties continuing to be introduced **[13]**.

Distribution

Buffel grass is found across much of the Australian continent. In South Australia it is widely distributed across the northern regions as scattered populations (Figure 1). Extensive populations exist in the far north-west in the Alinytjara Wilurara Landscape region. With the exception of the far north-west, known non-roadside occurrences of buffel grass are scattered and sparse. Infestations are mostly small, however its' distribution along some rivers is likely to be more extensive **[1]**.

Buffel grass densities along the Stuart Highway, north of Marla, are high in the roadside verge and adjoining

landscapes; while south of Marla the density and distribution decline.

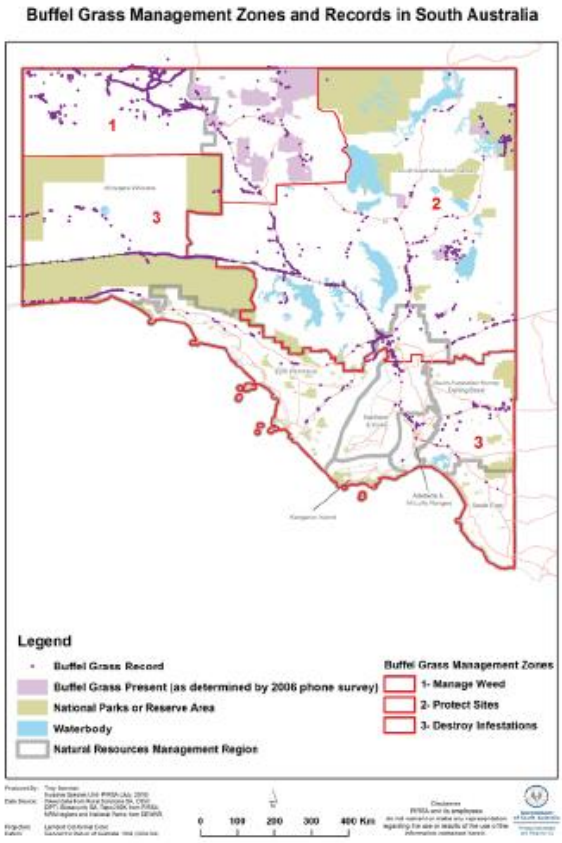

Figure 1. Current Distribution and Management Zones in South Australia [1].

Small and isolated patches are present on other roads and in towns throughout northern South Australia including the Oodnadatta Track, the William Creek Road (between Coober Pedy and William Creek), the Bore Field Track, Leigh Creek Road, and within townships including Marla, Oodnadatta, Cooper Pedy, Glendambo and Roxby Downs.

Buffel grass is mostly restricted to road verges along the main highways, within railway corridors and within some townships on Eyre Peninsula.

Potential distribution

CLIMAX climatic and soil modelling predicts 25% of Australia is potentially 'highly suitable' and 43% is identified as potentially 'suitable' for buffel grass spread. Arid to semi-arid areas are modelled as being potentially the most favoured for this species **[18]**.

BIOCLIM[1] **[14]** modelling of South Australia predicts that no part of the State's land area is unsuitable for establishment of buffel grass (Figure 2). The model also shows that the degree of suitability for establishment is variable across the State: 27.5% is 'very highly suitable', 41.9% 'highly suitable' and 30.5% is 'moderately suitable'. A relatively small proportion of the State (0.03% or 33,000 ha, confined to the SA Arid Lands and Alinytjara Wilurara Landscape regions) is predicted as 'extremely suitable'.

Inter-state horticultural programs are likely to result in the release of new forms of buffel grass with the potential to invade a wider range of habitats **[1]**.

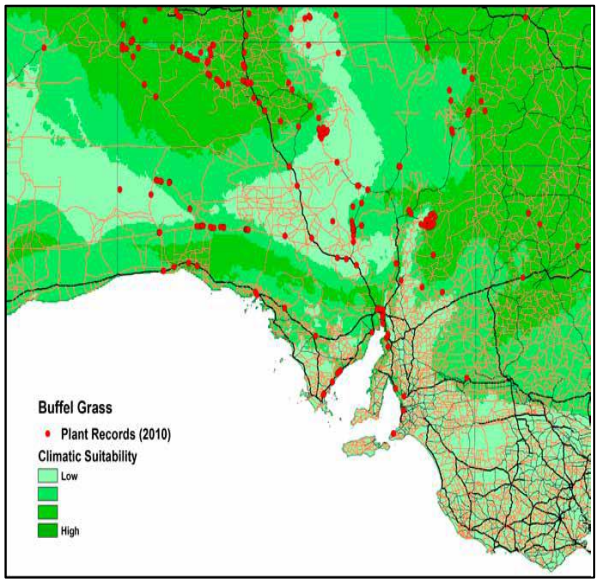

Figure 2. Potential distribution of buffel grass in South Australia. Potential distribution is based on BIOCLIM analysis.

RISK ASSESSMENT

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a national framework for environmental management (including the recognition of nationally threatened species and ecological communities), thereby directing resources towards the delivery of improved environmental protection. The EPBC Act applies where declared pest species threaten any

[1] *BIOCLIM is a species distribution model that generates climate estimates based on meteorological data and topographical information. User input of the distribution of taxa is used to create climatic profiles, which can subsequently allow predictions of further distributions of these taxa (Busby 1991). BIOCLIM requires precipitation and temperature information, but does not take substrate into account.*

listed species or ecological community or where its control may have adverse effects on matters of national environmental significance on Commonwealth land.

South Australian weed risk assessment process

The Primary Industries and Regions SA (PIRSA) Biosecurity SA division, in cooperation with then Natural Resources Management Boards (now LandscapeSA) developed the Biosecurity SA Weed Risk Management System **[31]** to rank the importance of pest plants, standardise the prioritising of these plants for control programs and to assess weed species for declaration.

The Biosecurity SA Weed Risk Management System uses a series of questions to determine weed risk and feasibility of control for a species within a specific land use type. The result of the assessment is used to determine and prioritise weed management actions within each land use type.

Weed risk characteristics assessed include; invasiveness (i.e. its rate of spread); economic, environmental and social impacts, and potential distribution (total area) of the weed.

Appropriate management objectives are determined and can be prioritised using a risk matrix which compares weed risk scores against feasibility of control scores. Pest plants that have both high weed risk and are feasible to control have higher priority management objectives e.g. eradication. Conversely, species that are not feasible to control will not rank as a high priority, monitoring or limited management action may be the most appropriate management objective.

The risk matrix categorises each weed species into one of nine risk categories for regional management:

1. ALERT: to prevent species which pose a significant threat arriving and establishing in a management area.
2. ERADICATE: remove from a management area.
3. DESTROY INFESTATIONS: significantly reduce the extent in a management area.
4. CONTAIN SPREAD: prevent the ongoing spread in a management area.
5. PROTECT SITES: prevent spread to key sites/assets of high economic, environmental and/or social value.
6. MANAGE WEED: reduce the overall economic, environmental and/or social impacts through targeted management.
7. MANAGE SITES: maintain the overall economic, environmental and/or social value of key sites/assets through improved general weed management.
8. MONITOR: detect any significant changes in the species' weed risk.
9. LIMITED ACTION: species would only be targeted for coordinated control if its presence makes it likely to spread to land uses where it ranks as a higher priority.

Pest risk

Buffel Grass;

- forms dense monocultures that displace native vegetation and cause habitat loss;
- competes with other plants for water and nutrients;
- forms a continuous, flammable ground layer that can carry hot fires, affecting native flora and fauna, and threatening infrastructure and public safety; and
- is drought and fire resistant, and can withstand heavy grazing.

Buffel grass has been listed among species of 'extensive continental distribution' that are 'capable of destroying' Australian ecosystems **[8]**. Buffel grass is arguably the single greatest invasive species threat to biodiversity **[2]** across the entire Australian arid zone. Within arid zones in particular, buffel grass limits the quantity of available native seed and foraging opportunities for native granivores. Where buffel has been eradicated, richer and more diverse vegetation and seed banks exist for annual and perennial forbs and annual grasses [34]. The species also directly or indirectly alters the soil microbiome including mycorrhizal fungi and nitrifiers, thus potentially facilitating rapid biomass accumulation by the weed (33). Without active management it will continue to invade a wide range of native habitats to the extent that it would replace many native species in those habitats **[1]**.

The apparent dependence of buffel grass establishment on disturbed soil surfaces makes its ecological label as an 'invader 'controversial. Overall, there is consensus in the literature that disturbance facilitates the establishment of buffel grass and humans are a frequent cause of disturbances. However, there is little evidence from the literature that suggest human disturbances are necessary to facilitate spread at broad scales and once established, anecdotal evidence indicates that the species can often invade into adjacent areas unaided **[15]**.

Arid and semi-arid environments are particularly prone to buffel grass invasion and do not tolerate the increased frequency and intensity of bushfires that accompany the increased grass biomass. Buffel grass fuelled fires are believed to be responsible for declining numbers of characteristic arid zone plants, the Saguaro Cactus (Arizona, USA) and River Red Gum (Australia). Arid landscapes worldwide stand out as requiring urgent control of buffel grass **[15]**.

Buffel grass disperses by burrs containing seeds, which are carried by wind, water, people (pasture sowing and leisure

activities), machinery (vehicles, tractors), livestock, birds and other wild animals **[16]**. It has spread from planting for pasture, mine rehabilitation and erosion control across much of northern and inland Australia.

Feasibility of control

Control initiated during early stages of buffel grass invasion gives the greatest likelihood of successful removal **[26]**.

Increasing public and community awareness of buffel grass, its' impacts and the benefits of control is essential to build a community's willingness and capacity to prevent new buffel grass occurrences **[27]**.

Prioritizing control areas to maximise the effectiveness of limited resources is essential for managing the scattered distribution and extensively infested sites in northern South Australia and Eyre Peninsula.

Considerations to prioritise areas for control may include:

- assets at risk (priority assets).
- high risk source infestations,
- high risk invasion pathways, and
- isolated outlier infestations **[1]**

A buffel grass prioritisation tool has been developed to assist Landscape regions and other agencies in prioritising buffel grass infestations for control **[28]**. The tool uses a multi-criteria analysis shell that has the ability to feed in variables thought to influence prioritisation. The tool uses a buffel grass geodatabase containing both roadside survey and other buffel grass distribution data. It also incorporates habitat suitability and landscape susceptibility with feasibility of control assessments, and the assets to be protected (e.g. conservation reserves, occurrence of threatened species). **[28]**.

Weightings are applied to each of the input layers and the tool produces an output layer of priorities for control which can be exported into Google Maps or ARC GIS software and analysed further (or used to create maps of the priority sites) **[28]**.

The prioritisation tool could be applied to assist buffel grass control on Eyre Peninsula.

A number of factors present considerable challenges in controlling buffel grass, including:

- the physiological and ecological characteristics of buffel grass;
- extensive distribution;
- presence in remote areas;
- land use, particularly pastoral; and,
- the low level of community awareness regarding impacts of this species **[25]**.

In addition, the effects of wind and water potentially move buffel seed large distances very quickly.

Integrated pest management combines prevention and control methods to achieve long term control objectives for many pest species **[30]** and is widely recommended as an effective tactic for long-term control of buffel grass. A variety of preventative and control methods are available that can prohibit and reverse buffel grass incursion when strategically combined **[30]**. Control methods can be combined and tailored to manage environmental and social variables in different infestations.

Hygiene protocols: promoting and implementation of good hygiene protocols can significantly limit the spread of buffel grass into un-infested regions.

Manual removal: involves hand grubbing individual plants, and exposing the roots to dry out **[30]**. Manual removal is feasible for small numbers of plants at a local scale. Plants with flowers and/or seed heads need to be burnt on site or securely contained and transported to a suitable location for destruction **[30]**.

Manually removing plants causes ground disturbance. Sites treated using this method will need to be frequently monitored to treat regrowth.

Mulching; covering areas with materials such as plastic sheeting, woodchips, straw etc. where mature buffel grass plants have been removed can prohibit regrowth and movement of residual seeds. Mulching is not suitable for large infestations **[30].**

Competitive exclusion: Buffel grass is intolerant of shade, tree and shrub canopies can limit buffel grass density (L. Williams, personal communication). However, planting shrubs into a buffel dominated grassland is risky, as buffel grasslands pose a high fire danger risk **[19]**. Therefore, habitat restoration on sites dominated by buffel grass should not rely on competitive exclusion by itself as a dependable technique **[19]**.

Fire; with correct authority and under appropriate environmental conditions, fire can be used to prepare infested areas for follow-up control treatments **[30]**.

Fire removes surface biomass, including seed and stimulates growth of buffel grass tussocks and sub-surface seed germination.

Fire can be effective when preparing large infestations for foliar herbicide treatment. The timing for post-fire application is critical and is most effective when soil conditions are suitable to promote active growth and sufficient live biomass to maximise chemical uptake.

Chemical control; Chemical control is the most widely used method for control of large infestations of buffel grass.

Two recommended herbicides, currently registered under the minor use APVMA permit PER9792, are glyphosate and flupropanate **[1]**. These can be used independently or combined into the same mix.

Glyphosate: – is a non-selective herbicide. Buffel grass must be actively growing for effective uptake of herbicides. Foliar application to young plants or regrowth following rain or a fire event provides the best opportunity for success **[1]**.

Timing is critical for effective use of foliar herbicides. Re-sprouting plants can flower within a week after rain and new germinations can set seed within three to five weeks **[6]**. Thus, chemical control programs require flexibility and responsiveness around rainfall events, with monitoring and follow up control required for many years to achieve eradication **[1]**.

Liquid flupropanate: - is a residual herbicide killing the plants predominantly through the root system and can remain in the soil for up to two years. Activated by rainfall the residual chemical removes subsequent regrowth.

Combined herbicide use: - A mixture of a broad-spectrum herbicide (glyphosate), and a residual herbicide (flupropanate), will provide a longer period of effective control.

Benefits of using in a combined mix include;

- Glyphosate rapidly kills any actively growing plants, killing top growth, reducing the risk of further seed set.
- Flupropanate kills regrowth at a later time once it has reached the root system, and any seedlings after subsequent rain or fire events.
- Ideal for remote/isolated locations where follow-up treatment may be delayed.
- Reduces the risk of herbicide resistance.

Even though a mixture of glyphosate and liquid Flupropanate may provide effective, longer term control, repeated follow up application is needed to achieve eradication.

A project conducted at the Alice Springs Desert Park between 1997 and 2007, provides an insight to the costs associated with chemical control of buffel grass. Labour and material costs ranged from almost $10,000/ha in the initial stages, to $50/ha once the infestation was largely controlled. Over the project period (1997-2007), the average cost was $5500/ha **[13]**.

Biological control: no biological control agents are registered for use on buffel grass in Australia currently.

Management calendar

	J	F	M	A	M	J	J	A	S	O	N	D
Germination												
Flowering and seed formation												
Treat with Granular Flupropanate												
Spray Flupropanate + Glyphosate												
Spray with BioWeed												

Legend: Regularly Occasionally

Note: The timing of different growth stages can vary significantly depending on seasonal conditions.

Status

The Eyre Peninsula Landscape Board risk management assessment (Table 1) rates buffel grass as **'eradicate'** across all land use systems on Eyre Peninsula.

Table 1: Regional Assessment

Land Use	Pest Risk	Feasibility of Control	Management Action
Northern Perennial Pasture	Very High	Very High	Eradicate
Southern Perennial Pasture	Very High	Very High	Eradicate

REGIONAL RESPONSE

Special considerations/Board position

The South Australia Buffel Grass Strategic Plan 2019-2024 divides the state into management zones for strategic application of management objectives (Figure 1). Eyre Peninsula lies within Zone 3 where destruction of infestations is the principle management objective **[1]**.

The Eyre Peninsula Landscape regional buffel grass management plan objectives are consistent with Zone 3 management zones objectives.

Outcomes

To prevent the establishment of new buffel grass infestations and eradicate existing infestations.

Objectives

1. Refine the mapping of buffel grass infestations;
2. Destroy all existing infestations;
3. Prevent new infestations establishing; and
4. Gain cooperation of stakeholders and other agencies to improve control.

Area/s to be protected

All areas

Actions

Land managers to:

1. survey and control all infestations annually and supply survey and control information on request to Landscape Board staff;
2. prevent the spread of buffel grass by searching annually for outlier infestations near known infestations; and
3. monitor areas of previous control works and undertake follow-up control works as required.

Landscape Board staff to:

4. facilitate, encourage, compel (develop action plans) control on private land;
5. facilitate, encourage, compel or undertake control on public land, including roadsides (costs may be recovered from land managers);
6. Develop localised annual action plans to achieve the objectives and actions of this management plan
7. undertake systematic data collection (control and survey numbers, location and date information) and storage in a central spatial database;
8. provide education on control methods and encourage wider control.
9. Identify modes of potential spread and promote the benefits of good hygiene practices;
10. facilitate cooperative action with land managers, neighbouring Landscape regions and other agencies; and
11. keep abreast of trials, including bio-agents, to determine more effective means of control.

Evaluation

Evaluation of success will be based on:

- annual analysis in November of monitoring and control data to evaluate the success of pest plan actions (including the update of spatial layers);
- identify any gaps in delivery and action as soon as possible; and
- review of this pest management plan every five years

Declarations

Buffel grass (*Cenchrus ciliaris* and *C. pennisetiformis*) is declared in Category 2, under the *Landscape South Australia Act 2019* for the purpose of setting maximum penalties and for other purposes. Any permit to allow its movement or sale can only be issued by the Chief Executive pursuant to section 197. Under the Landscape South Australia (General) Regulations 2020, Regulation 27 specifies the conditions under which a person is exempt from the operation of section 186 and may transport wool, grain or other produce or goods carrying buffel grass on public roads, or bring them into the State. Regulation 28 specifies conditions under which a person is exempt from the operation of section 188(2) and may sell wool, grain or other produce or goods carrying buffel grass.

Table two outlines the sections of the Landscape South Australia Act 2019 that apply to buffel grass throughout the Eyre Peninsula region:

Table 2: Relevant sections of the *Landscape South Australia Act 2019* for provisions for buffel grass.

Section	How the section applies
186 (1) (2)	Prohibited to bring the plant into South Australia Prohibiting movement on public roads
188 (1) (2)	Prohibiting the sale of plants Prohibiting sale of contaminated goods
192 (1)	Land owner must destroy plants on their land
194	The Landscape Board authority may recover costs from land owners for control of plants on adjoining road reserves

More information

Contact your local Eyre Peninsula Landscape Board office

www.landscape.gov.au/ep/contact-us

Ph: 8688 3200

E: EPLBAdmin@sa.gov.au

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Useful links

Information on buffel grass, can be found on the Biosecurity SA website:

http://www.pir.sa.gov.au/biosecurity/weeds_and_pest_animals/weeds_in_sa/weed_id/plant_id_notes/buffel_grass