Department of
Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Environmental weed risk assessment

Birdwood grass (*Cenchrus setiger*)

Family: Poaceae

Synonyms: *Cenchrus setigerus, C. ciliaris* var*. setiger*

Common names: Birdwood grass

Cultivars: None listed for Australia

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Assessment reviewed by: Bruce Cook, Greg Keighery

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Species summary:

Birdwood grass (*Cenchrus setiger*) is native to north Africa, India and Middle east. It arrived in Western Australia (WA) when seed was sent from India in the 1920s by Field Marshal Lord Birdwood to his son-in-law, a grazier, in northern WA (Petheram and Kok 1991). It is a tufted, perennial bunch grass with vegetative growth 30–60cm high and purplish or brownish seed heads with short stiff bristles which form a spike-like inflorescence to 9cm long (Petheram and Kok 1991; Cook et al. 2020). Birdwood grass is adapted to arid and semi-arid climates (annual rainfall (125–) 400–750 (–1,250) mm with a long dry season and responds quickly to light rains when temperatures are adequate for growth (Cook et al. 2020).

Birdwood grass is adapted to a wider range of soils and is more drought tolerant than buffel grass (*C. ciliaris*) (Biosecurity SA 2012).

Birdwood grass has been widely sown in the 1970s and 1980s in the Kimberley (McCartney 1991) and Pilbara, for rehabilitating degraded land and for increasing pastoral production. Birdwood grass has been commonly sown in both the east and west Kimberley for regenerating badly eroded and degraded landscapes (Hacker 1989), often with great success, e.g. 'Spectacular recovery in Ord River Catchment 2004' (Payne *et al*. 2004a). Initially these restored areas were dominated by the exotic grasses used in the re-vegetation process, however in the medium-term the native species are gradually re-colonising and displacing the exotic grasses.

Birdwood grass is highly valued by pastoralists as it substantially increases the carrying capacity compared with the native species. The contention between improved pastoral value and the potential risk of a species becoming an environmental weed is well illustrated by the following example – the carrying capacity of the Ashburton Catchment in the Pilbara was re-assessed (i.e. increased) at the request of pastoralists following the massive flood in 1997 which resulted in the spread of buffel and Birdwood grass over large areas of the catchment (Payne *et al*. 2004b). In the Ashburton Catchment a buffel–Birdwood grass dominant pasture in good condition is reported to have a carrying capacity of 9ha per cattle unit, compared with 15–120ha (280ha for hard spinifex hill country) per cattle unit for various native vegetation types in good condition (Payne *et al*. 2004b). Grazing trials in the west Kimberley indicate that stocking rates of one head per 5ha are sustainable on improved Birdwood grass pastures (McCartney 1991).

Western Australian Herbarium (1998–) describes Birdwood grass as alien to WA and reports its presence in the IBRA (Interim Biogeographical Regions of Australia) regions of Carnarvon,

Central Kimberley, Dampierland, Gascoyne, Geraldton Sandplains, Gibson Desert, Great Sandy Desert, Murchison, Northern Kimberley, Ord Victoria Plain, Pilbara and Victoria Bonaparte. FloraBase (Western Australian Herbarium (1998–) describes it as occupying sand dunes, rangelands, stony hillsides and floodplains.

Birdwood grass is established and has become naturalised in rangeland areas of several Australian states. It continues to be of interest as a pastoral species, particularly in low rainfall areas, although there is currently no commercial seed production.

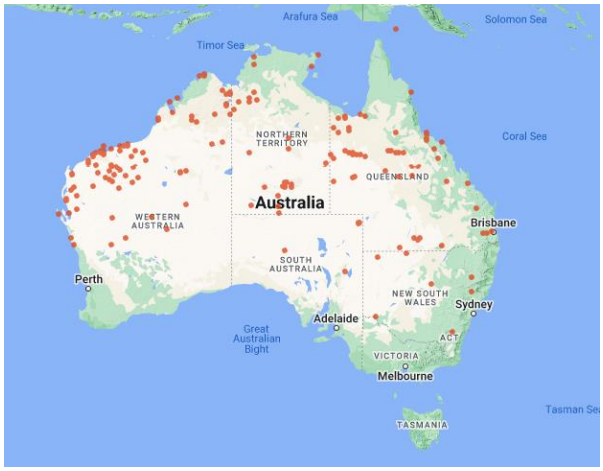


Figure 1. The distribution of Birdwood grass (*Cenchrus setiger*) in Australia from the Australasian Virtual Herbarium (https://avh.ala.org.au/)

Section 1: Invasiveness

1. Does the species have a documented environmental weed history?

a) Is an environmental weed in Australia

b) Is an environmental weed overseas

c) Species not known to be an environmental weed but there are environmental weed species in the genus

d) Genus has no known environmental weeds

Randall (2007) records that Birdwood grass in Australia has been found to be: naturalised, a weed of agriculture and a weed of the natural environment. By 2004 it had been recorded by van Klinken *et al.* (2004) in 33 IBRA regions and described as an environmental weed. Keighery and Longman (2004) list Birdwood grass as recorded in 11 IBRA regions within WA. Listed in 'Environmental weeds of Western Australia' as naturalised in national parks (Keighery 1991).

Birdwood grass has been established as a fodder plant in pastoral areas, has become naturalised over large areas and has become a widespread, serious weed of watercourses from the Kimberley to Geraldton (Hussey *et al.*1997). In northern WA it has colonised along the riverbanks, alluvial plains, coastal plains and landward coastal dunes of the Kimberley (Ryan *et al.* 2013). McKenzie *et al*. (2003) include Birdwood grass amongst a list of non-indigenous species that are a threat to the biodiversity of the Pilbara region.

> "Naturalised in many parts of northern and central Australia. It is scattered throughout Queensland, the Northern Territory, the northern parts of New South Wales and the north-eastern parts of South Australia. However, it is most common in the northern and north-western parts of Western Australia."

> "… often dominates grasslands and the understorey layer of savanna woodlands in northern Australia. During a recent survey, this introduced grass was listed as a priority environmental weed in one Natural Resource Management region."
>
> It is also common in coastal habitats and is ranked among the top ten environmental weeds in the coastal districts of the Kimberley and Pilbara regions of northern Western Australia" (Weeds of Australia website Fact sheet Index (lucidcentral.org)). It is not listed in Weeds of Australia (398 weed species) https://weeds.org.au/weeds-profiles/.

There are six non-indigenous species from this genus recorded in WA, several of which were introduced as pasture species but now have a weed history in the state. These include Buffel grass (*C. ciliaris*), a widespread weed of roadsides, creek lines, river edges and most vegetation types from Geraldton to the Pilbara, Kimberley and adjacent desert (Hussey *et al*. 1997) and burr grass, (*C. echinatus)* which is described by Petheram and Kok (1991) in 'Plants of the Kimberley region of Western Australia' as a common weed of yards and roadsides that should be eradicated wherever possible.

2. What is the ability of the species to successfully establish and compete with other plants, especially amongst intact native vegetation?

a) High - species can establish and displace intact native vegetation

b) Moderate - species can establish amongst intact native vegetation, but may not displace the native vegetation

c) Low - species can only establish where there is little or no competition or in areas where the native vegetation is in poor condition or has been disturbed

d) Very low - species can only successfully establish in vegetation which has been highly disturbed (e.g. roadsides, degraded or cleared areas)

e) Don't know

Birdwood grass usually spreads into native ecosystem, that are degraded by one or a combination of grazing, fire, erosion, flooding and/or natural events. However, Birdwood grass can also invade intact native vegetation in some circumstances.

Birdwood grass is considered with buffel grass (*Cenchrus ciliaris)* a threat to tropical savannahs in northern Australia (CRC Weed Management 2008). Hussey *et al.* (1997) describes Birdwood grass as 'a serious weed of watercourses in WA'.

McCartney (1991) reports that Birdwood and buffel grass were successfully established into areas of spinifex in the west Kimberley which had been burnt, however the spinifex (*Triodia pungens*) gradually re-established and smothered the exotic grasses. Successful establishment of Birdwood grass into the Pindan vegetation in the west Kimberley requires land clearing, fertiliser application and on-going weed control (McCartney 1991, Dolling 1983).

Van Vreeswyk *et al*. (2004) report that:

> "buffel grass (*Cenchrus ciliaris*) and Birdwood grass (*Cenchrus setigerus*) have displaced native grasses and low shrubs on some coastal plains. They have also colonised previously severely degraded floodplains and levees of many of the major river systems in the survey area."

3. Grazing tolerance and palatability

a) Unpalatable (or toxic), rarely grazed

b) Will persist under heavy continuous grazing due to plant structure or has limited palatability

c) Tolerant of grazing as, in general, only young growth (annuals) or young re-growth (perennials) is grazed or plants are only occasionally browsed

d) Readily grazed during the wet season with some preferential grazing, during the dry season

e) Preferentially grazed at all growth stages; or has low tolerance to grazing and plants are easily killed. Plant numbers decline over successive years.

f) Don't know

Birdwood grass is 'moderately palatable and readily accepted by stock' (Cook et al. 2020). It responds rapidly to light rains producing a high value feed during the pre-flowering stage, but the feed quality declines as it dries off and becomes less palatable (McCartney 1991, Petheram and Kok 1991). Once established, plants can withstand heavy grazing, even by sheep, however it should be allowed to set seed every two to three years to thicken the stand (Cook et al. 2020).

Birdwood grass is preferentially grazed by cattle and native animals (e.g. wallabies), especially fresh growth. The ability of the plants to persist under heavy grazing depends on the grazing intensity and nutritional status of the soil. Continued selective grazing on infertile soils can result in a substantial decline in the density of Birdwood grass (G. Moore personal communication).

4. What is the species' ability to persist as a long-term sward or stand without management?

a) Plant numbers increase substantially with successive reproductive cycles to form a near monoculture over a significant area

b) Plant numbers remain at a steady level, persisting as a significant component of a mixed sward/stand

c) Plant numbers decline slowly over successive years so that it becomes a minor component of the vegetation

d) Plant numbers decline rapidly over successive years so that only occasional plants can be found

e) Don't know

Birdwood grass is more drought tolerant than buffel grass surviving in regions with an annual rainfall as low as 200mm and persisting through long dry seasons (Biosecurity SA 2012, Cook et al. 2020). Plants can rapidly respond to light rainfall if the temperature is suitable for growth even after prolonged dry periods (Cook et al. 2020). Birdwood grass can survive and become naturalised in arid and semi-arid environments without management and is tolerant of grazing once established.

A site on red-brown sand ('Pindan' vegetation) near Derby in the west Kimberley with cleared paddocks and Birdwood grass dominant pastures was abandoned in the 1980s. There has been no spread from the unmanaged Birdwood grass paddocks into the surrounding native vegetation after more than 25 years. The unmanaged Birdwood grass pastures have largely reverted back to native vegetation with a dense wattle over-storey and an under-storey with a low density of Birdwood and buffel grass. At Birdwood Downs Station near Derby the density of Birdwood grass pastures has markedly declined due to continued selective grazing by cattle and wallabies and low soil fertility (G. Moore personal communication). However, where they are not overgrazed Birdwood grass pastures can remain productive for many years (Cook et al. 2020).

5. Is the plant likely to spread or rapidly colonise a site?

a) High risk – plants with a history of spreading rapidly with many plants successfully establishing under favourable conditions

b) Medium risk – some plants will spread outside the planted area and successfully establish under favourable conditions

c) Low – No or minimal spread of sown species outside the planted area a few plants will spread and successfully establish within 100m of the planted area under favourable conditions.

d) No spread of sown species more than 1m outside the planted area

e) Don't know

Birdwood grass is spread by seed and needs incorporation into the soil by animal treading for establishment (Cook et al. 2020). It is described as 'a serious weed of watercourses in WA' (Biosecurity SA 2012) and can spread quickly and easily along such environments. The carrying capacity of the Ashburton Catchment in the Pilbara was re-assessed following the massive flood in 1997 which resulted in the spread of buffel and Birdwood grass over large areas of the catchment (Payne *et al*. 2004b). At two sites near Derby there was no spread from cleared fertilised paddocks of Birdwood grass pastures into the surrounding native vegetation (i.e. unfertilised soils) after more than 25 years (G. Moore personal communication).

6. Will the species establish and reproduce in low-nutrient Australian soils without the addition of fertiliser or inoculant?

a) Establishment, growth and reproduction uninhibited in low-nutrient soils

b) Establishment, growth and reproduction reduced in low-nutrient soils

b) Establishment, growth and reproduction severely diminished in low-nutrient soils

c) Establishment, growth and reproduction unlikely in low-nutrient soils without soil additives

d) Don't know

Birdwood grass is adapted to a wide range of soils (e.g. brown sands, red loams, sand dunes, stony soils, floodplain soils), but in northern WA is best suited to medium and coarse-textured soils including calcareous sands (Biosecurity SA 2012, Petheram and Kok 1991; Ryan *et al*. 2013). It is well adapted to arid and semi-arid climates with a long dry season, as found in the northern Australian rangelands of the Kimberley and Pilbara and can develop self-sustaining populations and become naturalised.

Birdwood grass can be responsive to nitrogen and phosphorous application (Norman 1965). The recommended fertiliser application for establishing an improved pasture based on Birdwood grass in the west Kimberley is 50kg/ha of double superphosphate and 50kg/ha of urea in the establishment year with regular applications of P every second year (McCartney 1991). At Birdwood Downs Station near Derby the density of Birdwood grass pastures has markedly declined due to continued selective grazing by cattle and wallabies and low soil fertility (G. Moore personal communication). At two sites near Derby there was no spread from cleared fertilised paddocks of Birdwood grass pastures into the surrounding native vegetation (i.e. unfertilised soils) after more than 25 years.

7.1 How likely is long-distance dispersal (>100m) by flying animals (birds, bats)?

a) Common

b) Occasional

c) Unlikely

d) Don't know

No information found. Seed is formed in spiny or toothed burrs (floral fascicles) which are unlikely to adhere to feathers. It is possible but improbable that some seed could be eaten by seed eating birds as the seed is contained in a burr fascicle.

7.2 How likely is long-distance dispersal (>100m) by stock, native and/or feral animals?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Seed is formed in spiny or toothed burrs which may be able to adhere to hair of fur of grazers. Seeds may be incorporated into soil and be carried on feet or hooves.

7.3 How likely is long-distance dispersal (>100m) to by water?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Birdwood grass is known to grow and spread along creeks, drainage lines and waterways and is also found on floodplains. It is considered a serious weed of watercourses in WA (Hussey *et al*. 1997). Seed is formed in spiny or toothed burrs and although the mature plants are not tolerant of waterlogging the seed can be spread by overland flow, or by rivers in flood. Birdwood grass spread in the Ashburton Catchment following a massive flood in 1997 (Payne *et al*. 2004b).

7.4 How likely is long-distance dispersal (>100m) by wind?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Birdwood grass can seed heavily and the seed is small and relatively light (180,000-350,000 seed units/kg, Cook et al. 2020), however the seed has no structures to aid in wind dispersal and is contained within a toothed burr. Any dispersal by wind is generally likely to be over short distances (<10m).

8.1 How likely is long-distance dispersal (>100m) accidentally by people and vehicles?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Birdwood seed can be spread by people (G. Keighery* personal communication). The plants seed heavily (Cook et al. 2020) and the small and light seed (180,000-350,000 seed units/kg; Cook et al. 2020) contained in a toothed burr could attach to footwear, vehicles and machinery under certain conditions.

*(Keighery G. – Botanist and weed specialist, formerly WA Department of Parks and Wildlife).

8.2 How likely is long-distance dispersal (>100m) accidentally through the movement of produce or materials for infrastructure?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Birdwood grass is not usually cut for hay, so spread through produce is unlikely. However, Birdwood grass is commonly found in disturbed areas such as roadsides and also along creek-lines and water-courses (Biosecurity SA 2012). Its seeds can be spread in the movement of soil by earthmoving equipment and other vehicles.

9.1 What is the species' minimum generation time?

a) <1 year

b) 2-3 years

c) >3 years to never

d) Don't know

Birdwood grass has good seedling vigour and the plants can establish and set seed in less than a year. Under stressful environmental conditions Birdwood grass can establish and mature very quickly. Flowers can be initiated within 11 days of germination and seed produced within a month, but more often 6-8 weeks (Cook et al. 2020). Under these circumstances Birdwood grass can behave quite similar to the ephemeral annual grasses. Under good growing conditions plants put most of their energy into vegetative growth and develop a large crown before flowering in response to short days.

9.2 What is the species' average seed set in a favourable season?

a) High

b) Low

c) None

d) Don't know

Birdwood grass 'seeds heavily' producing copious small seed (180,000-350,000 seed units/kg, Cook et al. 2020). Seed yields of 276 to 293 kg/ha were recorded over 3 years in an arid sub-humid environment where the annual rainfall varied from 220 to 420mm (Rajora *et al.* 2009).

9.3 What is the species' seed persistence in the soil seedbank?

a) >5 years

b) 2-5 years

c) <2 years

d) Don't know

Freshly harvested Birdwood grass seed has low germination due to post-harvest seed dormancy and as a result germination can improve for up to 2 years after harvest (Cook et al. 2020).

9.4 Can the species' reproduce vegetatively?

a) Yes – rapid

b) Yes – slow

c) No

d) Don't know

Spread is only by seed.

Section 2: Impacts

1. Could the species reduce the biodiversity value of a natural ecosystem, either by reducing the amount of biodiversity present (diversity and abundance of native species), or degrading the visual appearance?

a) The species could significantly reduce biodiversity such that areas infested become low priorities for nature conservation and/or nature-based tourism

b) The species could have some effect on biodiversity and reduce its value for conservation and/or tourism

c) The species would have marginal effects on biodiversity but is visually obvious and could degrade the natural appearance of the landscape

d) The species would not or would have little effect on the affect biodiversity or the appearance of natural ecosystems

e) Don't know

In the north of WA Birdwood grass "has become a widespread, serious weed of watercourses from the Kimberley to Geraldton" (Hussey *et al.* 1997). McKenzie *et al*. (2003) includes Birdwood grass amongst a list of non-indigenous species that are a threat to the biodiversity of the Pilbara region of WA. Keighery (2010) includes Birdwood grass in a list of naturalised taxa and major weeds of the Pilbara affecting riverine, alluvial and disturbed habitats.

2. Does the species have a history of, or potential to reduce the establishment of other plant species?

a) The species can significantly inhibit the establishment of other plants (e.g. regenerating native vegetation) by preventing germination and/or out-competing seedlings, and/or the species forms a monoculture over a large area

b) The species can inhibit the establishment of other plants and may become dominant.

c) The species can cause some minor displacement by inhibiting establishment, but will not become dominant.

d) The species does not inhibit the establishment of other plants.

e) Don't know

Birdwood grass is reported as naturalised in many rangeland environments in Australia and as a weed affecting the biodiversity of habitats in WA. Keighery (2010) lists Birdwood grass a landscape scale weed which may alter habitats by affecting soil chemistry or fire regime and as an increasing widespread weed of the Pilbara region of WA. Its presence as self-sustaining populations will increase competition with the native flora, reducing biodiversity and may affect the native fauna.

3. Could the species alter the structure of native ecosystems at risk of invasion from this species by adding a new strata level?

a) Will add a new strata level, and could reach medium to high density

b) Will add a new strata level, but at low density

c) Will not add a new strata level

d) Don't know

Birdwood grass is unlikely to add a new strata to any native ecosystem that are at risk of invasion, as it mainly establishes in low rainfall areas where there is already a grass under-storey. In low to medium rainfall environments Birdwood grass has a low growth habit.

4. Could or does the species restrict the physical movement of people, animals, and/or water?

a) Species infestations could become impenetrable throughout the year, preventing the physical movement of people, animals and/or water

b) Species infestations could significantly slow the physical movement of people, animals and/or water throughout the year

c) Species infestations could slow the physical movement of people, animals and/or water at certain times of the year or provide a minor obstruction throughout the year.

d) Species infestations have no effect on physical movement

e) Don't know

Birdwood grass is considered a serious weed of watercourses in WA (Hussey *et al.* 1997). However, it is a tussock grass growing to 30–60cm in height and mainly establishes in grasslands in low rainfall areas and would not impede physical movement.

5. Does the species have, or show the potential to have, a major effect on fire regime?

a) Major effect on frequency and/or fire intensity

b) Moderate effect on frequency or fire intensity

c) No effect

d) Don't know

Keighery (2010) lists Birdwood grass as a landscape scale weed which may alter habitats by affecting soil chemistry or fire regime and as an increasing widespread weed of the Pilbara region of WA. It is able to grow in low rainfall areas and can produce more palatable biomass than the native species which could increase the intensity of wild fires. Birdwood grass recovers rapidly after fire (Cook et al. 2020) and also responds quickly after small amounts of rain which may increase the fuel load and fire frequency.

6.1 Is the species toxic to animals, have spines or burrs, or host other pests or diseases that could impact on native fauna and flora?

a) Yes - plant poisonous or other adverse factors present

b) No – plant is not poisonous, does not produce burrs or spines or harbour pests or diseases

No toxicity reported (Skerman and Riveros 1990). Birdwood grass has low to moderate levels of oxalates (Jones and Ford 1972), and has adequate levels of sodium (Playne 1970), which can be deficient in some grasses in northern Australia.

6.2 Could the species provide food or shelter for pest animals?

a) Yes – more than the native vegetation provides

b) No – similar or less shelter than the native vegetation

c) Don't know

Birdwood grass is able to grow in low rainfall areas producing more biomass than the native species and providing additional food for both native and feral grazers. It is selectively grazed by wallabies. In the east Kimberley, Schoknecht and Grose (1996) note that Kori bustards (bush turkey) were common in the study area, foraging among the introduced Birdwood grass.

7.1 Does the species have, or show the potential to have, a major effect on nutrient levels in intact native vegetation?

a) Will significantly increase soil nutrient levels

b) Will significantly decrease soil nutrient levels

c) Will have minimal effect on soil nutrient levels

d) Don't know

Birdwood grass responds to nitrogen and phosphorous (Norman 1965; McCartney 1991). Birdwood grass pastures can remain productive for many years unless overgrazed (Cook et al. 2020) and being a Panicoid species it is likely to tie up or strip nutrients from the soil as buffel grass does.

7.2 Could the species reduce water quality or cause silting of waterways?

a) Could significantly reduce water quality or cause silting or alteration of flow of waterways

b) May have some effect on water quality or silting of waterways in some ecosystems

c) Minor or no effect on water quality

d) Don't know

Birdwood grass has been described as a significant weed of creeklines, waterways and floodplains in northern Australia but no information was found indicating a detrimental effect on water quality or movement.

7.3 Does the species have, or show the potential to have, a major effect on the soil water table below intact native vegetation?

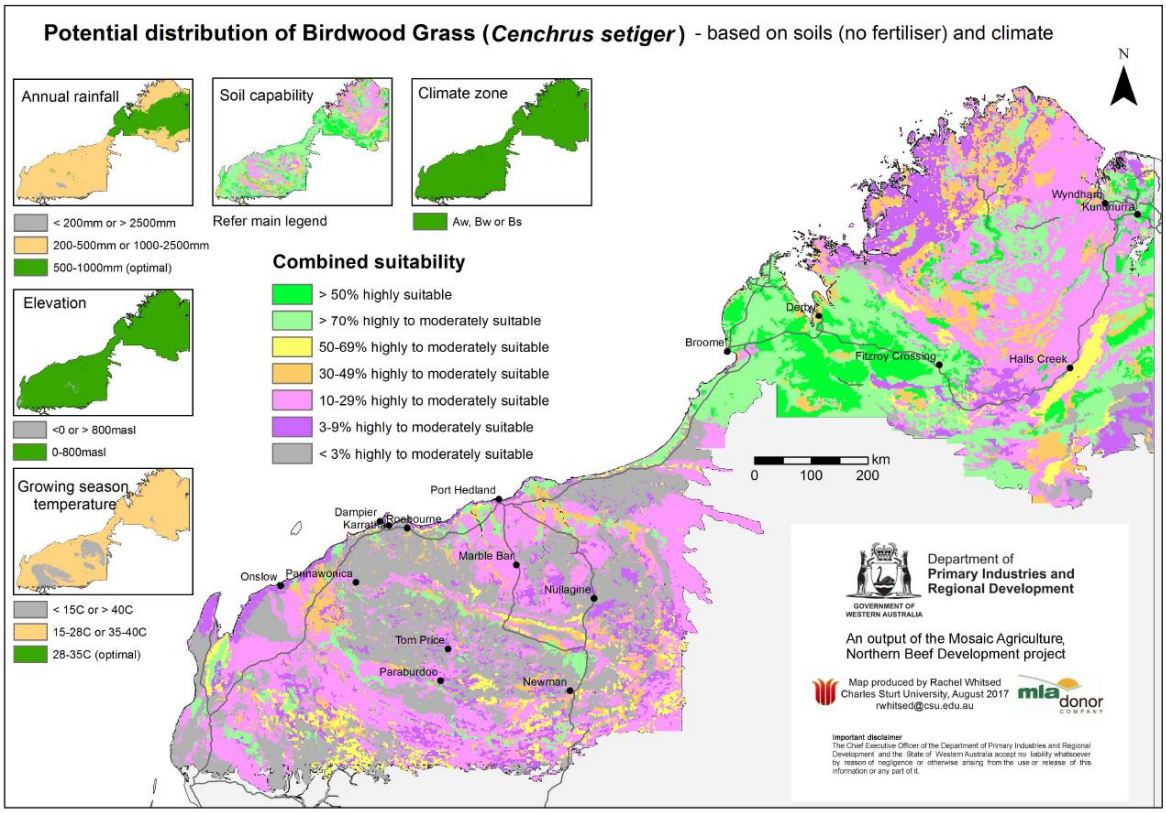
a) Yes – can significantly lower the watertable and/or reduce groundwater recharge to the watertable

b) No - will have little or no impact on hydrology

c) Don't know

Birdwood grass has been described as a significant weed of creeklines, waterways and floodplains in northern Australia and can form self-sustaining populations (naturalised) in some areas increasing the amount of palatable biomass produced. However, it is unlikely to reduce the watertable, relative to the native vegetation in the arid and semi -arid areas where it can be found.

Potential distribution



Region	Area of suitable soils and climate (Mha)	Potential distribution score
Kimberley	14.5	8.0
Pilbara	3.6	6.0
Gascoyne – Goldfields (>200mm AAR)	TBA	
Gascoyne – Goldfields (<200mm AAR)	0	0.5

Overall weed risk assessment

The overall weed risk assessment (WRA) is calculated from Equation 1.

Equation1: Invasiveness (0-10) x Impacts (0-10) x Potential Distribution (0-10) = Weed risk score (0-1000)

Region	WRA calculation*	Overall score	WRA rating
Kimberley	6.8 x 3.5 x 8.0	**190.4**	**High**
Pilbara	6.8 x 3.5 x 6.0	**142.8**	**High**
Gascoyne – Goldfields (>200mm AAR)	6.8 x 3.5 x ?.?	**TBD**	**TBD**
Gascoyne – Goldfields (<200mm AAR)	6.8 x 3.5 x 0.5	**11.9**	**Negligible to low**

***** Invasiveness (0-10) x Impacts (0-10) x Potential Distribution (0-10) = Weed risk score (0-1000)

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Important disclaimer