Department of Planning and Environment

Abating the threat of exotic perennial grasses in native grassy communities in eastern NSW

Section 3: NSW Northern Tablelands and Slopes

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Cover photo: New England Peppermint Grassy Woodland. Peter Richards/DPE

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[1] Centre for Sustainable Ecosystem Solutions, School of Earth, Atmospheric and Life Sciences, University of Wollongong, Wollongong NSW

[2] NSW Department of Planning and Environment, Sydney NSW.

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Environment and Heritage Group
Department of Planning and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and Heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
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Acknowledgments

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Thank you to the participants of the survey who took time out of their busy schedules to provide important information and feedback.

This report is in 5 sections. Each is available as a separate document for download:

1. Overview
2. NSW North Coast
3. **NSW Northern Tablelands and Slopes (this document)**
4. NSW Southern Tablelands and Slopes
5. NSW South Coast

Introduction

Straddling the Great Dividing Range, the Northern Tablelands and Slopes region is situated in northern inland New South Wales and covers a range of local government areas including Tenterfield, Walcha, Inverell, Armidale, Moree Plains and Liverpool Plains (LLS no date a, b). The region experiences a temperate climate with mild summers and cold frosty winters, with occasional snow at higher elevations (LLS no date a). Annual rainfall averages 500 mm in the west to 800 mm in the east (Murphy and McCormick 2014).

Agricultural production occurs in 68% of the region, with cropping occurring in the region's north-west (BOM & CSIRO 2019). The high livestock production landscape and associated movement of agricultural products in and out of the region increases the risk of introduction of invasive weed species (LLS 2017).

Three threatened grassy communities were surveyed in this region, although the land managers surveyed as part of this research manage other communities in the region (Figure 1).

Following the principles outlined in Section 1: Overview (see 'Four-step approach to managing native communities' below), we use field and land manager surveys to identify exotic perennial grasses (EPGs) in the region. We then combine this information with the risk assessment tool (see Section 1: Overview) to suggest which EPG species to prioritise for the grassy communities we surveyed.

The risk assessment tool identifies the species most at risk of invading native communities, based on plant characteristics (Rayment and French 2021, Overview).

Lastly, we provide resources to help identify advantages and disadvantages of control techniques available for the species identified as high priority. We hope this information facilitates the management of these communities and other native communities in the region. If there are other communities of interest, similar approaches could be taken.

Four-step approach to managing native communities

1 Identify

A quantitative survey of the area will identify the EPGs and their levels of invasion. *Monitoring Manual for Invasive and Native Flora* (Watson et al. 2021) sets out methods to do this in a rigorous manner. Training may be important to ensure grass identification is accurate.

2 Prioritise species for management

Based on the field surveys, identify the species with greatest invasion risk using the risk assessment tool (Section 1). Use other resources such as regional or national priorities to help prioritise your control. Some species might be rare in your community but have a high-risk score, leading to the need to prioritise the removal of the species from sites and an increase in the prioritisation score.

3 Control

Key to this action is the development of a management plan. Preventative weed control is a key tool in preventing EPG invasion. The NSW Department of Planning and Environment has developed hygiene guidelines to reduce the risks of introducing invasive plants.

Management options and resources are included in this document, but thinking about the biology of the species you are managing may help you to consider other control options too. The risk assessment tool provides information on the biology of species. The use of multiple control techniques (integrated weed management [IWM]) will be important in conserving these native communities. IWM is particularly useful to avoid plants adapting or improving their resilience to any single control method. Collaboration with a pooling of resources across land managers will be more effective, aiming to control a common area of land or common plant. Weed control is rarely short term: native regeneration is slow and EPG control is required continuously.

4 Monitor

Monitoring is critical to assess the success of control and identify new emerging threats, and will improve our understanding of management efficacy and native recovery. It also provides capacity to alter control strategies for long-term success. We recommend using the *Monitoring Manual for Invasive and Native Flora* (Watson et al. 2021) and implementing monitoring as a key requirement of managing EPGs.

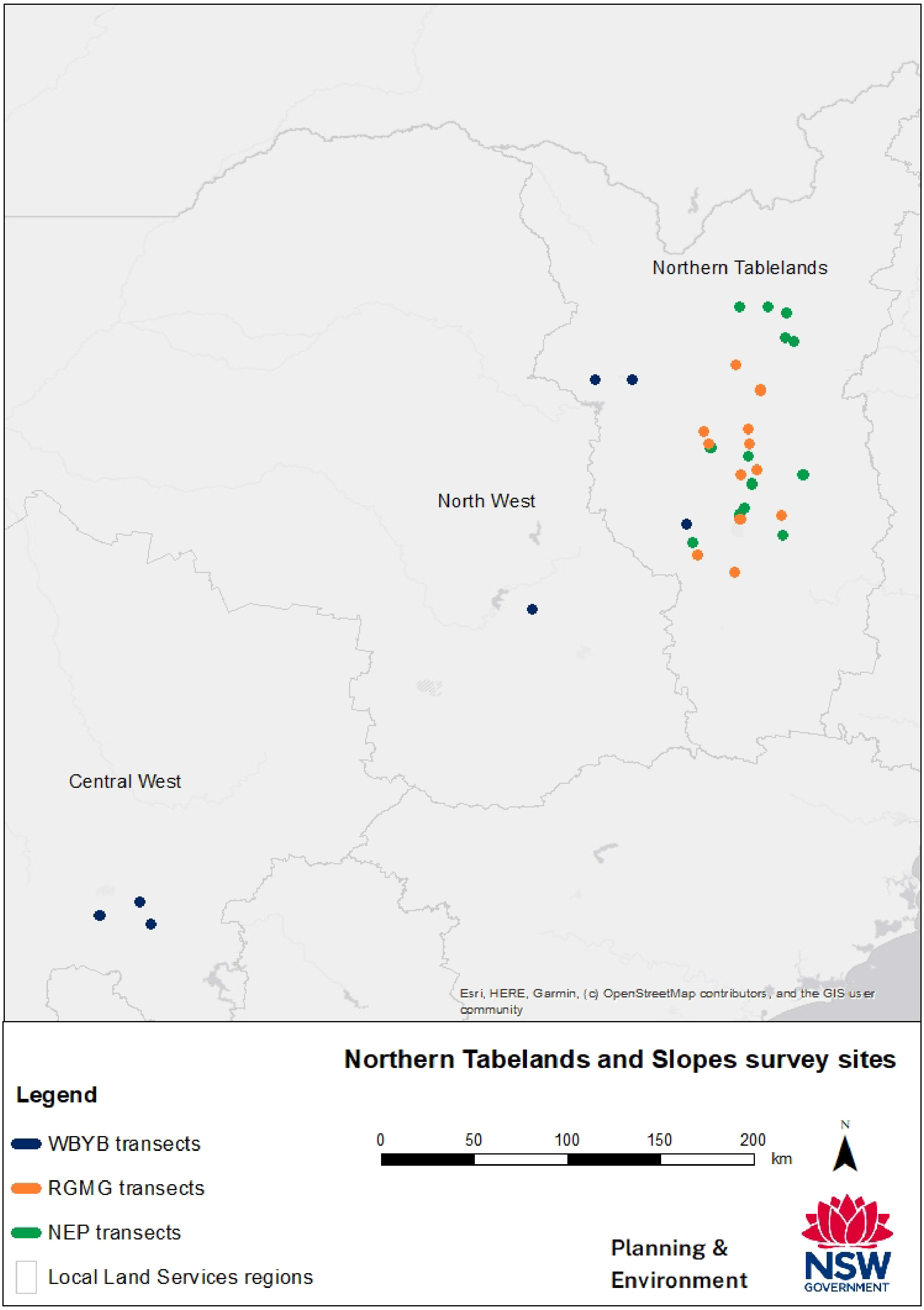

Figure 1 Northern Tablelands and Slopes field survey sites for the 3 threatened grassy communities

NEP: New England Peppermint Woodland, RGMG: Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland, WBYB: White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland

1. Identify: grassy community field surveys

In the Northern Tablelands and Slopes region, field surveys were conducted across 3 threatened ecological communities (TECs). Field surveys identified 18 EPGs in the 3 TECs (Figures 3 to 7) while land manager surveys of the region added a further 5 species as being present and of concern (Table 1). African lovegrass (*Eragrostis curvula*) was present in 16 of the 23 sites from the field surveys. Three trade-off species, Phalaris (*Phalaris aquatica*), cocksfoot (*Dactylis glomerata*) and Rhodes grass (*Chloris gayana*), were prevalent in field surveys.

In the land manager survey, participants worked across 9 communities, ranging from woodlands to shrublands and wetlands, with Howell Shrublands and White Box – Yellow Box Grassy Woodland (WBYB) being the most commonly managed communities.

Parramatta grass (*Sporobolus africanus)* is one of several exotic *Sporobolus* species in Australia. Due to its genetic and morphological similarity to the other *Sporobolus* species, and their ability to hybridise readily, they are collectively referred as the weedy *Sporobolus* grasses.

Trade-off species

Some EPGs were intentionally introduced for use in pasture and garden plantings. Several species are still frequently used in agriculture today and are often referred to as 'trade-off' or contentious species. These species provide economic benefit but are detrimental in native communities and cause environmental losses. Issues arise in the management of these grasses as they may spread into areas of conservation more easily, and may be modified for improved use in pasture, which also improves their invasive ability. High propagule pressure and differences in the management of economically useful grass species greatly increases the likelihood of spread into native areas.

Grassy communities are often surrounded by areas of land where trade-off species are planted and can experience stock movement and grazing pressure.

1.1 White Box – Yellow Box Grassy Woodland

Figure 2 White Box – Yellow Box Grassy Woodland. Photo: Jackie Miles/DPE

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (WBYB) is a Commonwealth- and State-listed TEC. This woodland has been extensively cleared, with the remaining community highly fragmented. It ranges from Southern Queensland, through New South Wales and into Victoria (DPE 2022). There has been a focused effort on management and recovery plans for this community; a range of resources are available in the Resources section. Of the 8 surveys conducted in this region, no EPGs were recorded at 3 sites, and fewer EPGs were recorded compared to the other grassy communities in the region. Seven EPGs were recorded (Figure 3). Coolatai grass was recorded in the 5 invaded sites, occurring in, on average, 51% of quadrats at sites (Rayment et al. 2022). It was often observed to be prevalent in the surrounding landscape. African lovegrass was present in 3 WBYB sites and occurred in 41% of quadrats at sites.

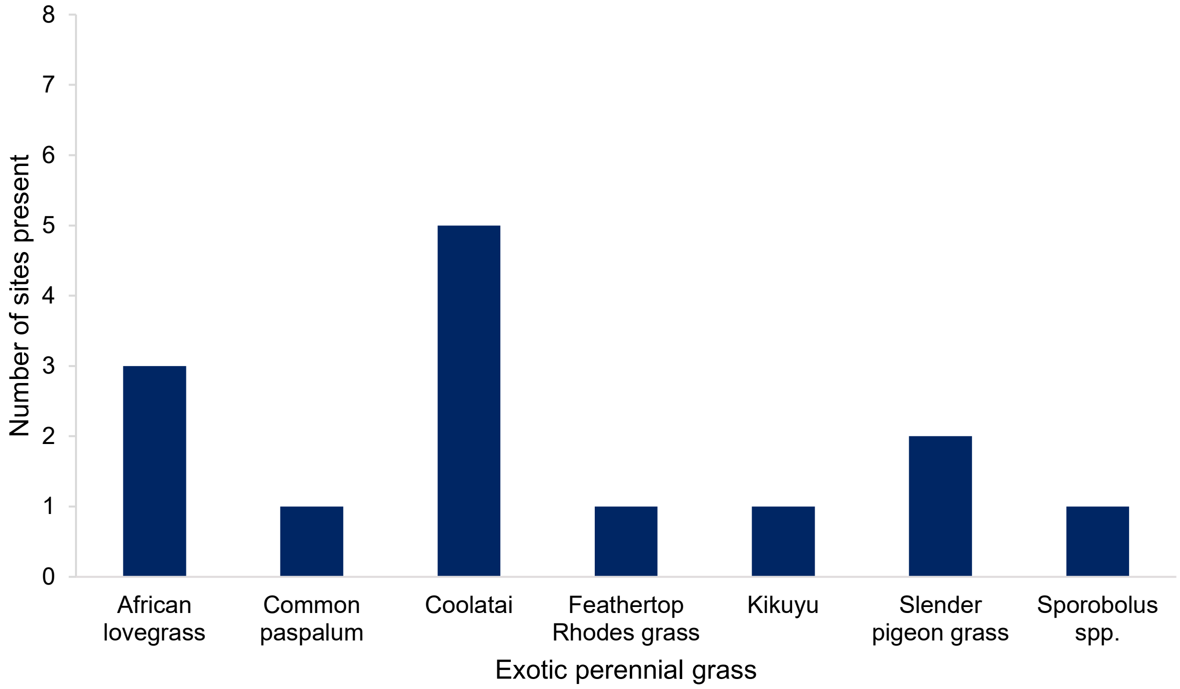

Figure 3 Number of sites where each EPG was recorded during field surveys of WBYB (n = 8)

1.2 New England Peppermint Woodland

Figure 4 New England Peppermint Woodland. Photo: Peter Richards/DPE

New England Peppermint (*Eucalyptus nova-anglica*) Woodland (NEP) occurs within national parks, reserves, travelling stock reserves (TSRs), and significant roadside environment areas. In this community, 12 EPGs were recorded across the 12 sites surveyed. African lovegrass and common paspalum were the most prevalent, occurring in 54% and 46% of sites respectively (Figure 5). Within sites, common paspalum occupied only 17% of quadrats, however, African lovegrass had invaded 56% of quadrats (Rayment et al. 2022). Weedy *Sporobolus* grasses occurred in 38% of sites and was invading 22% of quadrats in sites. Where Coolatai grass (2 sites) and Yorkshire fog (1 site) occurred, their invasions were quite dense, invading 52% of quadrats at sites (Rayment et al. 2022).

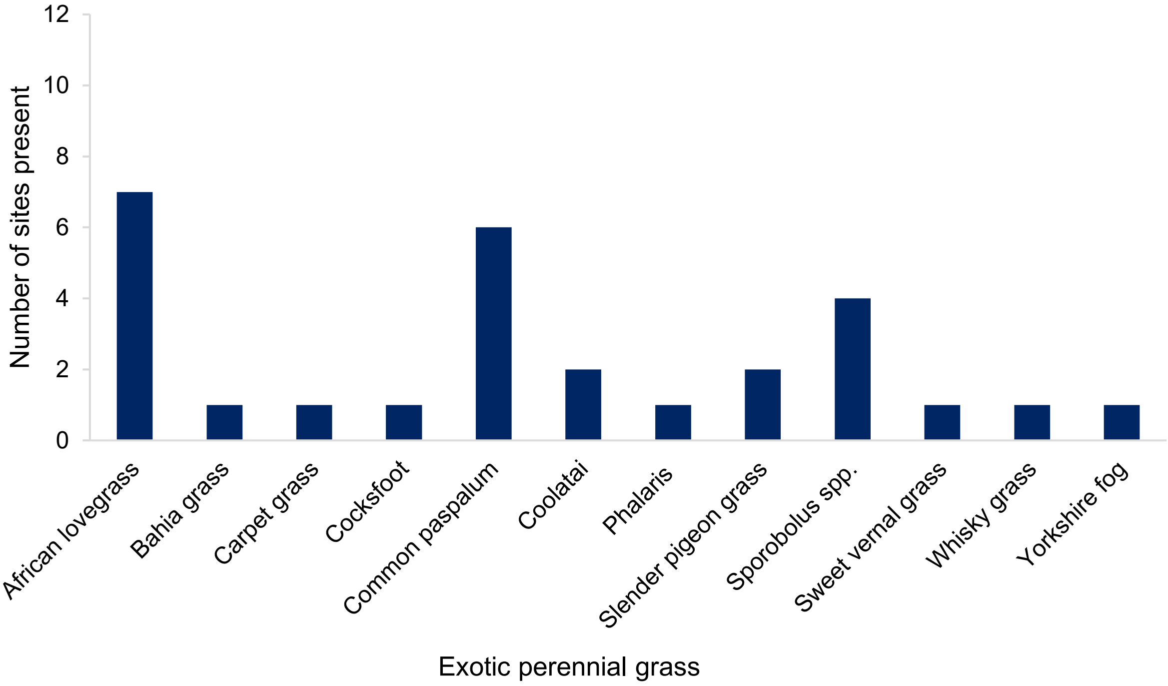

Figure 5 Number of sites where each EPG was recorded during field surveys of NEP (n = 12)

1.3 Ribbon Gum – Mountain Gum – Snow Gum Grassy Woodland

Figure 6 Ribbon Gum – Mountain Gum – Snow Gum Grassy Woodland. Photo Lachlan Copeland/DPE

Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland (RGMG) can co-occur with WBYB and often forms intermediate communities throughout the Northern Tablelands region. Remaining sites for the community are fragmented throughout reserves, TSRs and agricultural land as well as significant roadside areas and other Crown land. Of the 3 surveyed communities, RGMG had the highest level of EPG invasion, indicating a lower level of community resilience (Figure 7).

A total of 14 EPGs were recorded in the 15 surveyed sites, 5 of which were recorded in over 40% of these sites, and 4 of these being trade-off species. Common paspalum was the most frequently recorded (10 sites). Within sites, cocksfoot had the highest occurrence, occurring in 39% of quadrats, while the other 4 species occurred in 15–22% of quadrats in sites (Rayment et al. 2022).

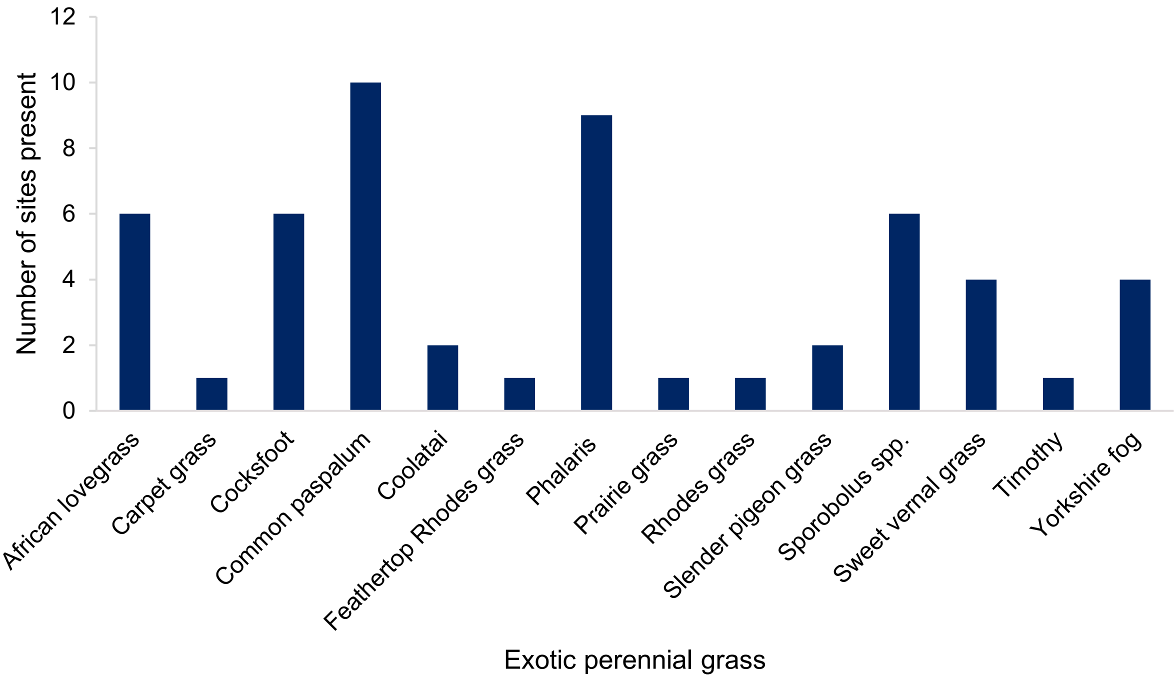

Figure 7 Number of sites where each EPG was recorded during field surveys of RGMG (n = 15)

1.4 Land manager survey results

Participants working across a range of communities in the Northern Tablelands and Slopes identified a different suite of EPG species as concerning compared to those identified in field surveys (Table 1). Of the 13 EPGs listed by participants, African lovegrass and Coolatai grass were of greatest concern. Both were recorded as prevalent in 6 of the 9 communities they manage. However, land manager surveys identified both Chilean needle grass and serrated tussock as important, although Chilean needle grass was not recorded in field surveys and there were only low levels of serrated tussock.

Low invasion in native communities by these species could be a result of either a whole community resilience to invasion or a region-wide reduction in the prevalence of this species associated with management, or as a result of the dry conditions at sites. In non-grassy communities, the land manager survey identified guinea grass, para grass, and common paspalum as highly damaging in wetland areas with 5 species considered important in Montane Peatlands and Swamps (MPS) (Table 1).

Survey participants overwhelmingly considered the presence of EPGs in the communities to have major negative impact, although minor impact was scored by some participants for African lovegrass, Chilean needle grass, serrated tussock, and whisky grass.

The differences between the species present in the field survey data and the concerns of land managers emphasises both the variable nature of invasions through time in response to rainfall, but also the focus on Weeds of National Significance (WoNS). Field surveys identified trade-off species as being significant invaders.

Trade-off species have the potential to invade beyond where they are intentionally planted and impact native communities. In the 3 surveyed threatened grassy communities, there were 4 widespread species that were trade-off species with significant invasions: common paspalum, African lovegrass, cocksfoot and phalaris.

Table 1 Results from the land manager survey in the Northern Tablelands and Slopes region

Land managers were asked to list **up to** 3 EPGs they consider most damaging in the community they manage. The number of participants per community is given at the bottom. Communities with more than one participant may have EPG counts greater than 1.

Community names are abbreviated: HS: Howell Shrublands, WBYB: White Box – Yellow Box Grassy Woodland, MPS: Montane Peatlands and Swamps, MSBOF: McKies Stringybark Open Forest, NEP: New England Peppermint Woodland, SEVT: Semi-evergreen Vine Thicket, FBW: Fuzzy Box Woodland. 'Northern Tablelands' represents a participant who likely works over multiple communities or areas or is involved with EPGs in another capacity in the region.

TEC	HS	WBYB	MPS	MSBOF	NEP	Northern Tablelands	SEVT	Wetland	FBW	Total
African lovegrass	2	3	1	1		1			1	9
Buffel grass						1				1
Chilean needle grass	2	1		1						4
Common paspalum								1	1	2
Coolatai	3	2	2	1	1		1			10
Guinea grass								1		1
Para grass								1		1
Rhodes grass		2							1	3
Serrated tussock	1	2	1							4
Sorghum		1								1
Sporobolus spp.						1				1
Whisky grass	1		1		1					3
Yorkshire fog			1							1
Number of participants	2	4	2	1	1	1	1	1	1	41

2. Prioritise: EPGs of concern in native communities in the Northern Tablelands and Slopes region

Using the field surveys in the 3 grassy threatened communities and land manager surveys who work across multiple native communities, we identified the following EPGs as of most concern to the region: African lovegrass, Coolatai grass, common paspalum, weedy *Sporobolus* grasses, phalaris, cocksfoot and Yorkshire fog. Survey participants were also concerned about Chilean needle grass and serrated tussock and, while management information is available in the best practice guidelines, for completeness we include some information in a later section on management. We refer to the Resources section for information on the biology of these species, and best practice management guides and other resources for these 2 EPGs.

African lovegrass. Photo: Harry Rose/flickr

Coolatai grass. Photo: Harry Rose/flickr

Common paspalum. Photo: Harry Rose/flickr

***Sporobolus* spp. Photo: Harry Rose/flickr**

Phalaris. Photo: Harry Rose/flickr

Cocksfoot. Photo: Julia Rayment/UOW

Yorkshire fog. Photo: Julia Rayment/UOW

Figure 8 Flower heads of the priority EPGs of the Northern Tablelands and Slopes

2.1 African lovegrass (*Eragrostis curvula*)

African lovegrass has the highest risk score of the 29 EPGs assessed in Section 1: Overview (28/32, Rayment & French 2021) and was very prevalent in the region both in grassy communities and in other communities as identified by survey participants. Information about its invasion characteristics is well-known.

Research priorities

An improved understanding of seed longevity might improve management. Research should continue to understand impact in invasion pathways of African lovegrass in native communities.

General biology and ecology

African lovegrass has plant traits that are indicative of a very successful invader, with traits that are well-suited to invasion and persistence. These include tolerance of a range of environmental conditions, good seed production, and high competitive ability for both resource competition and interference competition (allelopathy) (Campbell 1983; Csurhes et al. 2009; Firn 2009; Ghebrehiwot et al. 2014). African lovegrass can persist in infertile soils and is able to tolerate, and even preferentially spread, during stress and drought. African lovegrass can also increase growth in response to fire, indicating a strong ability to persist through extreme environmental conditions common throughout the region (Bock and Bock 1992; Milberg and Lamont 1995). African lovegrass can employ vegetative spread in response to disturbance through tiller production (Campbell 1983; Masters and Britton 1990 in Firn 2009).

Pasture

Once a trade-off species, 7 varieties of African lovegrass have been introduced across Australia and cultivated for use as erosion control and in pastures (Queensland Government 2016; Firn et al. 2018). Although now commonly recognised as economically and environmentally damaging, its legacy as a pasture species has played a key role in its spread throughout Australia.

Native communities

The presence of African lovegrass is negatively correlated with native species richness, and leads to ecosystem degradation (Bock and Bock 1992; Dorrough 2015; Godfree et al. 2017). Survey participants considered it has had a major negative impact in 4 communities and a minor negative impact in the other 3.

Survey participant perceptions of African lovegrass

‘Dominates ground cover and competes with native recruits’ (McKies Stringybark Open Forest)

‘[Causes] loss of biodiversity and takes over’ (Howell Shrublands)

‘Outcompetes’ (Montane Peatland and Swamps)

2.2 Coolatai grass (*Hyparrhenia hirta*)

Figure 9 Coolatai grass invasion. Photo: Barry Collier/DPE

While Coolatai scores low in the risk assessment (13/32, Rayment and French 2021) its invasion throughout the Northern Tablelands and Slopes region is significant.

General biology and ecology

Coolatai grass displays traits of a stress tolerator such as fast growth building high biomass and deep root systems (Fetene 2003). Once established, it forms dense monocultures that are difficult to control. Seed output was recently reported as around 3000 m^2, which is low compared to other grasses (Chejara et al. 2012; DPI 2018), but germination occurs over a wide range of conditions with rates of 66–80% (McWilliam et al. 1970). Coolatai grass can grow in both full sun and shade with deep roots providing a competitive advantage over native species, particularly during drought (McCormick et al. 1992 in Chejara et al. 2009). Coolatai grass rapidly regrows in response to burning or grazing, occupying free space and limiting recruitment of other species (D'Antonio and Vitousek 1992; McArdle et al. 2004; Reserve and Chejara 2007). While many EPGs in New South Wales spread in response to disturbance, Coolatai grass can invade undisturbed land, which is a particular concern for threatened communities (Chejara et al. 2009).

Pasture

Coolatai grass is a weed of agricultural areas. It can quickly dominate pastures, reducing productivity and competing with useful pasture species (DPI 2018).

Native communities

Coolatai grass can germinate and persist across a range of abiotic conditions (woodlands, swamps, rainforests and shrublands). Coolatai grass invasion causes a decline as high as 48% in native species richness (McArdle et al. 2004; Chejara et al. 2006). It is allelopathic, inhibiting germination and seedling emergence of other species (Chejara et al. 2009; Ghebrehiwot et al. 2014). Invasion of Coolatai grass in WBYB communities is associated with a reduction in plants, invertebrates and frog species (DPI 2018). All participants considered that Coolatai grass had major negative impact.

Survey participant perceptions of Coolatai grass

'Completely takes over … Loss of biodiversity' (Howell Shrublands)

'Dominant ground cover, competes with natives' (McKies Stringybark Open Forest)

'Potential to completely dominate … increased fire regimes and loss of species diversity' (Montane Peatlands and Swamp)

2.3 Common paspalum (*Paspalum dilatatum*)

Rayment and French (2021) classified common paspalum as having a very high risk of invasion and establishment (23.5/32). Common paspalum was found in all 3 TECs in the field survey and was more prevalent in NEP and RGMG communities.

Research priorities

Despite a high risk assessment score there is currently limited knowledge of its impact on native ecosystems, competitive ability and seed longevity, which limits management.

General biology and ecology

This species is adapted to intermittent flooding and drought conditions, with germination improved with water availability (Vasellati et al. 2001; Cornaglia et al. 2005; Mollard et al. 2008). With a high seed output and sticky seeds, paspalum can spread through transport on fur, machinery and humans (Weeds of Australia 2016b; Lawn Solutions Australia 2021). Paspalum prefers fertile soils and was described by one participant as 'able to dominate fertile alluvial soil in run-on zones'. Paspalum is said to be adapted to the wetter areas of the coast and inland slopes and plains, growing prolifically in the summer months (DPI no date b). This establishes important information regarding when to be vigilant for paspalum invasions, influencing monitoring plans. Once established, paspalum can spread vegetatively, improving its abundance at a site (Henry, Yelverton et al. 2007) and has been suggested to have allelopathic potential improving competitive ability (Hassan and Mohamed 2020).

Pasture

As a pasture species, common paspalum is tolerant to grazing and may outcompete less-competitive pasture species. With an ability to tolerate trampling, paspalum can persist in agricultural areas (Striker et al. 2006). Paspalum grows prolifically over summer and may spread from areas of intentional planting (DPI no date b).

Native communities

Paspalum will likely impact native recruitment and compete for resources such as space, light and nutrients. Its prevalence and dominance in many communities suggests it should be a focus of management: it can spread and invade without disturbance. Unpublished results from a greenhouse experiment have shown paspalum can smother native species recruitment and have deeper, larger root systems indicating effective competition for space, water and nutrients (J Rayment, personal observation). In both the Wetland and Fuzzy Box Woodland communities, paspalum was considered to have minor negative impact on the invaded environment.

Survey participant perceptions of common paspalum

'Displaces native plants and is resilient to grazing and disturbance. Frequently seen as roadside vegetation' (Fuzzy Box Woodland)

2.4 Weedy Sporobolus grasses (*Sporobolus africanus*, *Sporobolus fertilis* and others)

Sporobolus fertilis **(giant Parramatta grass) flower head (top) and growth. Photos: Harry Rose**

Sporbolus africanus **(Parramatta grass) flower head (top) and growth. Photos: Harry Rose**

Figure 10 Comparisons of 2 common *Sporobolus* species found in the Northern Tablelands and Slopes region

The *Sporobolus* grasses are typically grouped together and referred to as 'weedy *Sporobolus* grasses' (WSG). Five exotic *Sporobolus* species are present in New South Wales and are grouped into one complex due to their genetic and morphological similarity. Information on their ecology and biology has been reviewed in Rayment and French (2021) (supplementary material) and a revised risk score of 15/32 was considered in Rayment et al. 2022. *Sporobolus* species, particularly Parramatta grass, was present across all 3 TECs with higher presence in RGMG woodlands. In the land manager survey, it was identified by one participant as highly damaging.

Research priorities

There is low certainty relating to impact on native ecosystems. Increased research on resource competition and environmental tolerance in native communities is needed.

General biology and ecology

In surveys, giant Parramatta grass (*S. fertilis)* was less prevalent than Parramatta grass but identification among the suite of invasive species in this genus is difficult especially when coupled with some hybridisation. According to mapping by NSW Department of Primary Industries (DPI 2017), *Sporobolus* grasses are more abundant in the tablelands towards the border of New South Wales and Queensland. The most invasive characteristics of *Sporobolus* spp. are their ability to inhabit a wide range of soil and climate types (Bray and Officer 2007; Ghasempour and Kianian 2007; Rana et al. 2012), coupled with highly prolific seed production (85,000 seeds/m^2: DAF 2018) and small seed size allowing good dispersal (Vogler and Bahnisch 2006). As seeds can remain viable for up to 10 years, control of WSG will require long-term investment to deplete the seed bank (Bray and Officer 2007). WSG establish best on disturbed ground and are more commonly found along roadsides or ecosystem edges. They are prolific seeders, germinating year-round and quickly developing tough root systems to persist through stressful environmental conditions (Witt and McConnachie 2004; Bray and Officer 2007; Padilla et al. 2013). WSG appear to be better adapted to survive prolonged periods of drought than native counterparts. Yobo et al. (2009) describes *Sporobolus* spp. as opportunistic invaders, with the ability to spread when competition is low from drought.

Pasture

WSG are serious pastoral weeds (Bray and Officer 2007; DPI 2017) with survey participants noting they 'spread [into] adjacent grazing land' and cause 'reduced productivity'. Unpalatable weedy *Sporobolus* grasses in pasture leads to overgrazing of more desirable species, creating a cycle that allows these grasses to increase in size and establish.

Native communities

WSG outcompete native species for space and resources. As with many invasive grasses, they germinate quickly, developing tough root systems in 5 weeks (Bray and Officer 2007) and have been observed to produce seed within 6 months of germinating (J Rayment, personal communication). Impact on native communities is not well-quantified, but evidence from impact on agricultural areas, and these surveys, indicates an ability to cause negative impact where WSG establishes.

2.5 Yorkshire fog (*Holcus lanatus*)

Figure 11 Yorkshire fog flowering. Photo: Julia Rayment/UOW

Yorkshire fog ranked eighth in the risk assessment (Section 1: Overview), with information reviewed in Rayment and French (2021). Characteristics that are important in invasion are well-understood for native ecosystems. It was recorded in both NEP and RGMG woodlands.

General biology and ecology

Yorkshire fog has high seed production (177,000 seeds per plant) (Watt 1976; Thompson and Turkington 1988) with seeds viable for 5 years and able to germinate over a range of conditions (Thompson et al. 1993; Robert 2013). Yorkshire fog can also spread through stolons and can tolerate drought and low soil nutrients (Thompson and Turkington 1988).

Pasture

There is limited information on the invasion or impact of Yorkshire fog in agricultural communities beyond its status as a weed of pastures. Information suggests it is not very palatable and requires heavy grazing pressure to be productive (Herbiguide no date).

Native communities

Yorkshire fog has an aggressive growth habit that affects natives through both direct competition and indirect changes to the soil community (allelopathy), which continue to hinder the growth and establishment of other species even after removal (Newman and Rovira 1975; Thompson and Turkington 1988; Bennett et al. 2011). Yorkshire fog has been recognised for its risk to threatened communities and plants in the Southern Tablelands (Weeds of Australia 2016a) and the survey results indicate it is also a threat to the health of communities in the Northern Tablelands.

2.6 Phalaris (*Phalaris aquatica*)

Phalaris is a trade-off species with a risk score for invasion into native communities of 19.5/32, however, there is a paucity of knowledge (45% uncertainty; see Section 1: Overview) (Rayment and French 2021). In the Northern Tablelands, phalaris was a significant invader in RGMG woodlands and, to a lesser extent, NEP woodlands.

Research priorities

Low confidence in the risk score is attributed to a focus in the literature on productivity and stocking rates for pasture, with little to no information regarding competitive ability against native species and impact to native ecosystems. There is also little information on seed biology and longevity. As a pasture species, information on seed biology for phalaris is only available on yields, hindering our understanding of seed dispersal. Research could determine seed output and seed longevity in natural conditions to improve the risk assessment.

General biology and ecology

Phalaris is particularly problematic in wetter, more fertile areas of invaded communities such as along creek flats. Phalaris can accumulate biomass if unmanaged. This can limit surrounding recruitment and produce higher fuel loads, which can be 3 times higher than native kangaroo grass (Stoner et al. 2004). Oram et al. (2009) describe phalaris as drought tolerant with an ability to resprout through reproductive tillers.

Pasture

Exotic pasture species improvement has given rise to grazing-tolerant and disturbance-adapted exotics that influence ecosystem functioning even after pastureland is retired (Low 1997; Keith 2017). In most cases these grasses have been modified to improve their use in production systems, increasing their potential for major negative impact in threatened native communities and increasing their likelihood of establishing and persisting. Several studies have clearly shown that weed invasion is more prevalent in fragments that have been grazed by livestock (Scougall et al. 1993; Abensperg-Traun et al. 1998, in Hobbs 2001).

Native communities

For phalaris, one of the biggest risks and complexities is its intentional planting in agricultural areas. This leads to increases in seed available in the region, enhancing invasion in nearby native communities. Participants with invasions of phalaris frequently attribute its impact to an ability to outcompete and smother native grasses and forbs. Phalaris has been observed to germinate faster, and colonise and accumulate biomass faster than native counterparts, which may hinder native biodiversity recovery and persistence (J Rayment, personal observation). Phalaris appears to be of main concern in areas where it has been intentionally planted and left unmanaged, particularly in areas of high fertility and moisture such as creek and drainage lines.

2.7 Cocksfoot (*Dactylis glomerata*)

Figure 12 Cocksfoot flower head and growth habit. Photos: Harry Rose/flickr

Cocksfoot is a trade-off species with a risk score of 20.5/32, scoring in the top 10 for the risk assessment (Section 1: Overview). Several studies have clearly shown that weed invasion is more prevalent in fragments that have been grazed by livestock (Scougall et al. 1993; Abensperg-Traun et al. 1998, in Hobbs 2001).

Research priorities

There are some knowledge gaps concerning seed biology and the ability of cocksfoot to compete with native species, with an uncertainty score of 22.5%. As a pasture species we recommend research to determine competitive ability and impact on native communities for improved management.

General biology and ecology

As a trade-off species, new cultivars in Australia have improved drought tolerance and adaptation to Australian climate (Lolicato and Rumball 1994). Volaire and Lelièvre (2001) found low mortality of cocksfoot under drought with dehydration tolerance and an ability to extract water. This tolerance provides opportunity for it to outcompete less-tolerant native and non-native counterparts. Williamson and Harrison (2002) recorded cocksfoot spreading into two adjoining ecosystems with spread limited by disturbance and seed supply. Increased invasion is seen on fertile soils. The invasion of cocksfoot was negatively correlated with species richness indicating ability to compete for resources (Williamson and Harrison 2002).

Pasture

Cocksfoot is intentionally planted across New South Wales and has been selectively bred to establish in areas with minimal rainfall. This may improve its ability to persist in native communities in drier regions or during periods of drought (DPI no date a).

Native communities

Although its invasion throughout the Northern Tablelands is concerning, there is little information regarding the impact of cocksfoot as an invasive species in native communities. What is available suggests it can confer competitive advantage due to potential for drought tolerance with suggestions of outcompeting native species (Muyt 2001; Volaire and Lelièvre 2001).

Table 2 Triage system for the risk and prioritisation of EPGs in the Northern Tablelands and Slopes region

Red (HC) = highest concern, high priority for weed control (frequent, high risk); orange (MC) = moderate concern (e.g. high threat with moderate occurrence / high uncertainty in information); blue (N) = notable species (e.g. trade-off species, high risk with low occurrence)

EPG	Risk score	Prevalence at sites (%)	Risk factors for invasion	Areas for concern	Other considerations
HC – African lovegrass	28	Total: 44% WBYB: 38% NEP: 54% RGMG: 40%	Highly competitive. Adapted to drought, fire, and unfavourable conditions.	Multiple cultivars. Evidence of herbicide resistance.	Canopy cover linked with reduced abundance. Research into biocontrol. Management guides for pasture available.
HC – Coolatai grass	13	Total: 25% WBYB: 63% NEP: 15% RGMG: 13%	Spreads in response to fire and grazing. High germination.	Herbicide resistant. Invades without disturbance. Forms dense monocultures.	Revegetation important. Reduce seed bank. Do not rely on herbicide. Weed management guide available.
HC – Common paspalum	23.5	Total: 47% WBYB: 13% NEP: 46% RGMG: 67%	Tolerant of drought and flooding. Rainfall promotes growth and seed spread.	Grazing and mowing promote growth. Evidence of allelopathy.	Information needed for impact on natives and control.
HC – Phalaris	19.5	Total: 28% WBYB: 0 NEP: 8% RGMG: 60%	Trade-off species. Drought tolerant. Invades where soil moisture is high.	Information skewed towards productivity. Alters fire regime. High biomass accumulation.	More research into phalaris as an invasive species needed. Weed hygiene to prevent spread from pastures important.
MC – *Sporobolus* spp.	15	Total: 31% WBYB: 13% NEP: 38% RGMG: 40%	High seed output. Resistant to competition. Tolerant of harsh environmental conditions.	Invades disturbed areas. Long-lived seed bank.	Control before seed set. Best practice manual available for pasture.
MC – Cocksfoot	20.5	Total: 19% WBYB: 0 NEP: 8% RGMG: 40%	Trade-off species. Drought tolerant. Competitive.	Reduces native species richness. Limited information on impact in Australia.	Limit seed bank – no seed dormancy. Research into impact in New South Wales.
MC – Yorkshire fog	22	Total: 14% WBYB: 0 NEP: 8% RGMG: 25%	Aggressive growth and competition. Drought tolerant.	Changes soil condition, impacting natives even after removal. Highly competitive.	Management may require soil improvement. Research needed into impacts and control in Australia.
N – *Nassella* spp. (WoNS)	17–21		Environmental tolerance. High propagule pressure. Competitive dominance.	Potential for major negative impact where present. Economically damaging.	Control according to WoNS best practice management guides.

3. Control: managing EPGs in the Northern Tablelands and Slopes region

3.1 General management of EPGs

This document focuses on the grassy communities for which we have information from field and land manager surveys. Here we present a range of options for the management of the prioritised species that we consider might be important across the whole region. However, prioritisation decisions in other communities and at smaller scales may result in a different set of priority species. Despite this, the principles of the 4-step approach can still be applied, and information on management provided in this document can be used.

Managing trade-off species

Many sites in the region offer both agricultural and conservation benefits. A concerted and continued effort needs to be made to actively improve the native ground cover of threatened communities to increase resilience to invasion from trade-off species and weeds more generally. This may involve retiring, replanning, or limiting grazing of TSRs and other native communities while actively promoting native regeneration with the aim of creating communities able to resist invasion and, in the future, provide intermittent grazing benefits (Baer et al. 2009). While many primary producers employ weed hygiene and farm biosecurity to prevent unwanted weeds, pests or diseases entering their farm, these measures can also be used to prevent trade-off species spreading beyond the farm. Abating the threat of EPGs in these communities requires acknowledging, and changing, the relationship between agriculture and the decline of threatened communities.

Current control strategies

Control of EPG species should, where possible, involve community-wide coordination to facilitate the most impactful management and education. The Northern Tablelands and Slopes region has a range of community organisations that facilitate community weed management and transdisciplinary management. This includes organisations such as Local Land Services, NSW Department of Primary Industries, NSW Department of Planning and Environment and NSW National Parks and Wildlife Service, New England Weeds Authority (NEWA), North West Weeds, and Local Landcare. Annual spray programs, including the control of several EPG species, can be found online for NEWA and North West Weeds.

Klori TSR – example of coordinated EPG control

Klori TSR, 40 km from Tamworth, contains grassy box woodland community and is at threat from overgrazing, damage from roadworks, and invasion from Coolatai grass (TRLA 2017). Klori TSR is managed and cared for by the landcare group Friends of Klori TSR, which works to improve the health of the threatened community. With assistance from a grant, the local group continues to manage Coolatai grass and educate nearby schools and residents on the value of the area (TRLA 2017).

Figure 13 Klori TSR
Signage explaining the significance of Klori TSR (left), and monoculture invasion of Coolatai grass further up the road at Klori Common (right). Photo: Julia Rayment/UOW.

Efforts to control EPGs by land managers were recorded in the land manager survey. Survey responses frequently stated control led to a lowered abundance of the weed and improved ground cover. One participant with Chilean needle grass observed no change in abundance or surrounding ground cover in response to control. No change in abundance or surrounding ground cover were also recorded for land managers trying to control African lovegrass, Coolatai grass and serrated tussock.

For some of the EPG species, limited information and resources are available on what control methods and herbicide regimes are appropriate. The ability to understand the effectiveness of the outcome of control is sometimes lacking, indicating that a monitoring program to inform management in native communities is a high priority. We advise following the methods set out in *Monitoring Manual for Invasive and Native Flora* (Watson et al. 2021) as an integral part of weed management.

While setting up a robust monitoring design is essential, monitoring should also include the type of weed, the type of control, the level of infestation, who undertook the activities and where it was done. This information provides valuable data to determine efficacy and the scale of problem, and the free availability of such information will influence other activities in the region.

Several survey participants commented on the costs of control, both financially and time wise. Weed control can be an exhausting process, particularly for land managers. Engagement with community and organisations can help with sharing the load associated with weed control, helping to implement a more efficient regional approach.

Best practice manuals are available for weedy *Sporobolus*, and weed management guides are available for African lovegrass and Coolatai grass (Resources section).

In Table 2, we outline suggested strategies for the EPGs of concern in the region. These were current at the time of publication, but as new research is undertaken, best practice management may change over time. Following this we provide further information for each species.

Table 3 Management options for the main EPG species of concern in the Northern Tablelands and Slopes region

Note: best practice management uses more than one control strategy. Grazing strategies should be considered only in native pasture communities where allowed. N/A: not available.

	Manual	Mechanical	Chemical	Fire	Biocontrol	Grazing
General rules	**Weed hygiene** **Bag seed heads** **Work from most to least invaded areas**	**Weed hygiene**	**Avoid herbicide resistance** **Use DPI handbook**	**Best as integrated weed management (IWM)**	**Use where available**	**Consider stock movement, competitive pasture planting, use of native pasture species. Restrict use in native communities.**
African lovegrass	Suitable for small infestations. Tough root system	High capacity for regrowth	Suitable but herbicide resistance possible	Can withstand and resprout after fire	N/A	Graze heavily when young, weed hygiene important. Competitive pastures
Coolatai	Suitable for small infestations	Effective means to reduce seed production	Evidence of herbicide resistance, avoid where possible	Fire tolerant, tussocks withstand burns	N/A	Competitive ground cover important. Weed hygiene important if grazing
Common paspalum	Suitable for small infestations	Regrowth in response to mowing, however, this may help through limiting seed production	Follow Queensland guides and seek advice. Information needed for New South Wales	Role of fire in management unknown	N/A	Trade-off species. Avoid spread into new areas. Weed hygiene important
Sporobolus spp.	Suitable for small infestations	Suitable for IWM, weed hygiene important	Susceptible to herbicide	Fire will reduce biomass	Currently being researched	Unpalatable. Pasture competition recommended. Weed hygiene important
Yorkshire fog	Suitable for small infestations	Suitable but avoid if in seed	Suitable, follow-up spray required	Suitable to suppress growth	N/A	Unpalatable. Competitive pastures and weed hygiene important
Phalaris	Suitable but requires follow-up throughout year	Regular mowing limits spread	Suitable but limited information	Suppresses growth but higher fuel loads compared with natives	N/A	Trade-off species. Avoid spread into new areas. Weed hygiene important
Cocksfoot	Suitable but ensure crown is removed	Suitable to limit seed set	Suitable but will require follow-up treatments	Limited information. Unaffected by fire in US	N/A	Trade-off species. Avoid spread into new areas. Weed hygiene important

The following provides current information to help you make educated decisions for management in native communities.

3.2 African lovegrass (*Eragrostis curvula)*

Figure 14 African lovegrass flower head and invasion. Photos: Harry Rose/flickr

Strategies for African lovegrass management in relation to grazing and agricultural practices for the region are available in the Resources section. As the goals for control in native communities are different, control strategies are also different to those in agricultural plans.

In native communities, active regeneration of shrub and tree cover may be necessary, as invasion is reduced under canopy cover (Firn et al. 2018). Native resilience is possible but a threshold abundance of least 33% is required (Firn et al. 2018). Enclosure fences to promote native recovery where kangaroo or other faunal grazing is high may be one way to protect palatable native species and encourage grazing of less palatable African lovegrass (Lindsay and Cunningham 2011).

Manual removal may be suitable for small infestations of African lovegrass, and be useful in preventative control, but may be difficult due to its tough root system. Hand pulling is difficult, and chipping and grubbing tools should be used. With a high capacity for regrowth after mowing, mechanical removal needs to be employed with other control methods. African lovegrass can regrow quickly in response to fire (Milberg and Lamont 1995; Csurhes et al. 2009). Fire may be more useful in IWM where it can reduce biomass before secondary control, or to limit seed set. As African lovegrass has a higher fuel load than natives, careful planning is required. Successful use of fire as part of IWM has been recorded in the Cumberland Plains in Sydney (Sanders and Chapple 2016).

One participant in the Northern Tablelands and Slopes identified no change in the abundance of African lovegrass or surrounding ground cover in response to herbicide control, but noted control was undertaken in an inconsistent manner. Inconsistent herbicide control can lead to herbicide resistance (Michael 2021) and is unlikely to result in positive long-term control. Herbicide resistance has been identified in African lovegrass in the Southern Tablelands (Michael 2021). IWM is the best way to limit development of herbicide resistance in EPGs.

Control of African lovegrass requires diligent control, using several techniques to improve likelihood of success. With high capacity for regrowth, multiple control efforts throughout the year, and for several years, will be necessary. While eradication is not possible, we can prevent its invasion into areas of conservation significance and limit its impact in areas where it is currently invasive.

3.3 Coolatai grass (*Hyparrhenia hirta*)

As Coolatai grass does not spread vegetatively, reducing seed bank size and having a competitive native ground cover is integral to effective control. Weed management guides commonly focus on agricultural land, discussing grazing strategies, manual removal, weed hygiene and chemical control. We suggest monitoring control efforts to improve understanding of best practice management options for native communities. As Coolatai grass is one of few EPGs that do not depend on disturbance to spread, maintaining native ground cover is paramount.

Manual removal is suitable for small infestations but should be avoided if grass is in seed. Physical removal of small infestations of Coolatai grass was employed by 3 participants, with one using tarpaulins to prevent reinfestations once removed.

Local government sources and scientific research promote the use of mechanical control as an effective strategy to reduce seed set and minimise spread (Reserve and Chejara 2007; Chejara et al. 2012). Chejara et al. (2012) found herbicide and mowing led to seed bank declines of 74% and 76% respectively compared to control.

While disturbance associated with mechanical control can promote growth of Coolatai, evidence suggests it will be useful as part of IWM to reduce biomass and seed set. Evidence from management of Klori TSR suggests overgrazing promotes spread, therefore control strategies may involve limiting livestock grazing and promoting native regeneration.

Coolatai can survive and regrow in response to fire, so fire is not recommended as a management tool (McArdle et al. 2004; DPI 2018).

Herbicide resistance has been identified in Coolatai grass, and use of herbicide as a primary control strategy is not recommended (McArdle et al. 2004; DPI 2018).

3.4 Common paspalum (*Paspalum dilatatum*)

Figure 15 Common paspalum flower head and invasion. Photo: Harry Rose/ flickr

Research priority

Limited information is available on how paspalum will respond to control techniques as it has not been a focus to date, despite a considerable invasion across the region. We recommend monitoring response of paspalum if subject to fire to improve our understanding of fire as a management tool.

In native communities, management should focus on limiting lateral spread of paspalum to prevent crowding out native germination. To minimise off-target damage, timing of control and control techniques that promote native regeneration is important.

> One participant controlling paspalum described chipping as time-consuming but leading to considerable reduction in collateral damage risk.

Mechanical removal has mixed reports, with reductions in lateral spread achieved through close mowing (Henry, Burton et al. 2007), while defoliation has been shown to promote establishment of paspalum species (Cornaglia et al. 2005). While no chemical rates are available for paspalum, chemical control is suggested throughout Australia (PIPWE 2019; DAF 2020). Vigilance is recommended after periods of high rainfall or drought as paspalum is adapted to intermittent flooding and drought. It may increase its spread, flower, or simply persist during extreme conditions of drought and flooding. Available information suggests paspalum can recover after fire from rootstock if conditions are favourable (Tropical Forages 2020).

3.5 Weedy Sporobolus grasses (*Sporobolus africanus*, *Sporobolus fertilis* and others)

Due to the impact weedy *Sporobolus* grasses have been causing in northern New South Wales and Queensland, several resources are available for the best practice management of these grasses. These can be found in the Resources section, and we recommend consulting these to aid management. However, these manuals have a focus on agricultural land, and actions may not be applicable to native communities.

Management of WSG infestations in native areas should focus on limiting seed set, preventing or removing seeds from the seed bank, and encouraging competitive native ground cover to increase resilience. In native ecosystems this may involve focusing on preventing seed set and using weed cleaning stations, educational signs and farm biosecurity to limit spread. Small infestations may be removed through manual control (Bray and Officer 2007). Padilla et al. 2013 investigated strategies for reducing grassland degradation by WSG invasion: actively sowing native species to promote recolonisation led to infestation reduction from 52% to 5% with cover of desired species increasing from 20% to 89%. Although intensive, active management can overcome issues of slow native recovery and reinvasion from weeds in response to control. Plant choice should prioritise native species able to compete against Sporobolus spp. and species adapted to the area (Bray and Officer 2007).

While burning of plants was suggested as unlikely to kill the plant, it may reduce the seed bank and, if used alongside herbicide, can be an effective management strategy (Bray and Officer 2007). Research is underway for biocontrol options for weedy *Sporobolus* grasses (Sutton et al. 2019).

3.6 Yorkshire fog (*Holcus lanatus*)

Research priority

Effective management of Yorskhire fog is currently restricted due to limited information on control strategies. Improved understanding of the impact of Yorkshire fog in native communities, and control techniques, is needed.

The information on control strategies below is gathered from the few available resources. Strategies to prevent seed set are important in native areas. As its ability to hinder germination of surrounding species can continue after the plant has been removed, considerations for soil regeneration, particularly through soil microbial communities, or active planting of native species should be considered.

Manual removal of small infestations is suitable (Brown and Bettink 2019b). Regular slashing can reduce vigour but is advised against if in seed (Brown and Bettink 2019b). The integration of mechanical removal and herbicide is suggested as a good management strategy (Brown and Bettink 2019b). Controlled burning is said to be useful for suppression and is therefore likely to be useful in IWM as well (Brown and Bettink 2019b). Chemical spray with follow-up can provide control but should be used as part of IWM (Herbiguide no date c). Seek advice from your local weeds officer if unsure of appropriate herbicide rates.

3.7 Phalaris (*Phalaris aquatica*)

Figure 16 Phalaris flower head and growth form. Photos: Harry Rose/flickr

Described as the most persistent and productive pasture species to sow in the region, there is a resulting complete lack of information regarding the control of phalaris in areas where it grows unmanaged. Phalaris appears tolerant to herbicides when controlling other EPGs in a phalaris pasture, but limited information is available on control where phalaris is invasive (Campbell and Ridings 1988). Any techniques that reduce growth and limit seed spread should be employed to prevent phalaris from invading native areas. Monitoring and early control may be necessary in native areas that are close to pastures, such as roadsides. As with the other EPG species, manual control is suitable for small infestations of phalaris. There is limited information on the response of phalaris to mechanical control, but as a pasture plant it is likely to survive defoliation and mowing. Information from the United States suggests mowing phalaris is an effective way to reduce vigour biomass for improved efficacy when sprayed with herbicide (DiTomaso and Kyser 2013). Burning may suppress growth, and when used before herbicide, can improve the efficacy of herbicide control (Popay 2015b).

Research from Department of Environment, Land, Water and Planning (DELWP) Victoria, on an annual herbicide program in a native grassland, shows control of phalaris was achieved with annual application, but emphasises the process takes many years as native grasslands are slow to recover and regenerate. Suggestions for herbicide rates and application timing are available online (HerbiGuide no date b).

Techniques that reduce growth and limit seed spread should be employed to prevent phalaris from invading native areas. Monitoring is necessary in native areas that offer agricultural relief (e.g. TSRs, roadsides and waterways) where phalaris may establish. Monitoring control activities is also vital, as there is so little available information, to determine which control strategies work and to educate others controlling phalaris.

As a trade-off species, weed hygiene is needed to prevent the spread of phalaris into surrounding native communities, and planting phalaris near bushland is not recommended (HerbiGuide no date b).

3.8 Cocksfoot (*Dactylis glomerata*)

As a pasture plant, with limited recognition of its negative environmental impact, information on control strategies for cocksfoot is limited. A greater understanding of the impact of cocksfoot on native environments, and how to control it, is a high priority. Information provided for cocksfoot uses internet resources of unknown or mixed reliability. Monitoring of native areas near roads or agricultural areas is important, as is early eradication, as propagule pressure is high. Where cocksfoot is established, reducing competitive ability and promoting native establishment is recommended.

Cocksfoot plants can be removed via manual control, but regrowth is possible so the entire crown must be removed (Muyt 2001; Popay 2015a). Information suggests mechanical control such as slashing can be employed to limit seed production, and that close mowing can eliminate the grass (Muyt 2001; Popay 2015a). Close mowing may not be relevant for conservation sites but may be useful on roadside infestations.

As a trade-off species, weed hygiene in native pastures to prevent its spread into surrounding areas is important. Information from North America suggests cocksfoot will be unaffected or increase in response to fire (FEIS no date). Chemical control is said to be effective but requires follow-up treatments (HerbiGuide no date a; Muyt 2001; Popay 2015a). Some sources consider IWM strategies, including a slash, burn, herbicide regime (Brown and Bettink 2019a).

4. Monitor

Monitoring is critical to assess success of control, identify new emerging threats, and to improve our understanding of management efficacy and native recovery. It also provides an opportunity to reflect on current control strategies and how we might alter future control for long-term success. Monitoring is also necessary to provide clear information on outcomes of management programs. Using standard monitoring practices supports consistent data collection and improves transdisciplinary communication and integration.

We recommend using the *Monitoring Manual for Invasive and Native Flora* (Watson et al. 2021) and implementing monitoring as a key requirement of EPG management.

Resources

General

North Coast Regional Strategic Weed Management Plan 2017–2022, Version 2 – North Coast LLS

Weed Management Guide for the North West & Northern Tablelands – Northern Tablelands and North West LLS Regional Weed Committees

Native Revegetation Establishment Guidelines – Northern Tablelands LLS

Travelling Stock Reserves: Best environmental management practice – LLS

Managing native vegetation on a rural property – LLS

Weed Control Management Plans – New England Weeds Authority

North West Weeds: Weeds Index – North West Weeds

White Box – Yellow Box management

Jewels in the Landscape: Managing very high conservation value ground-layers in Box-Gum Grassy Woodlands – CSIRO Land and Water

National Recovery Plan: White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Department of Environment, Climate Change and Water NSW (DECCW)

A Guide to Managing Box Gum Grassy Woodlands – Department of the Environment, Water, Heritage and the Arts (DEWHA)

Chilean needle grass

Chilean needle grass – 3D weed management

Integrated control of Chilean needle grass – Meat & Livestock Australia (MLA)

Developing whole farm Integrated Management programs for Unpalatable grasses – (including Chilean needle grass and serrated tussock) – MLA and DPI Victoria

Chilean needle grass case studies (Farmers managing Chilean needle grass in grazing systems) – 3D weed management

Nassella neesiana (Trin. & Rupr.), Chilean needle grass – Weeds Australia – Profiles

Weed Management Guide: Chilean needle grass (Nassella neesiana) – Natural Heritage Trust

Serrated tussock

NSW WeedWise: Serrated tussock (Nassella trichotoma) – DPI

Serrated Tussock Management and Control in NSW and ACT – DPI

National Best Practice Management Manual: Serrated Tussock – National Serrated Tussock Management Group

Regional Local Weed Management Plan: Serrated tussock – Central Tablelands and Central West LLS

Serrated tussock – 3D weed management

Integrated Management Strategies for the Control of Serrated Tussock in Inaccessible Native Pastures – MLA

African lovegrass

NSW WeedWise: African lovegrass (Eragrostis curvula) – DPI

African lovegrass Invasive plant risk assessment – Queensland Government

African lovegrass – 3D weed management

Using fire to manage priority weeds in Cumberland Plain vegetation: African lovegrass – Nature Conservation Council (NCC)

Coolatai

Weed Management Guide: Coolatai grass (Hyparrhenia hirta) – CRC for Australian Weed Management

NSW WeedWise: Coolatai grass (Hyparrhenia hirta) – DPI

North West Weeds: Coolatai grass (Hyparrhenia hirta) – North West Weeds

Weed Sheet: Coolatai Grass – Government of South Australia

Weeds of the Blue Mountains: Coolatai grass – Blue Mountains City Council

Sporobolus

Giant rat's tail grass (Sporobolus pyramidalis) – NSW WeedWise, DPI

Giant Parramatta grass (Sporobolus fertilis) – NSW WeedWise, DPI

Strategic management of weedy Sporobolus grasses – MLA

Weed Management Guide – Weedy Sporobolus Grasses, Technical Report 2011 – Australian Government Department of Agriculture and Fisheries

Weedy Sporobolus grasses: Best practice manual – Queensland Department of Primary Industries and Fisheries

More information

- Hygiene guidelines
- Monitoring Manual for Invasive and Native Flora
- New England Weeds Authority: NEWA Control Program
- North West Weeds

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