



## Invasive pasture grasses in northern Australia – gamba grass, para grass, olive hymenachne, perennial mission grass and annual mission grass

This material has been developed based on the best available information at the time of development (September 2014).

To provide information updates please email: [weeds@environment.gov.au](mailto:weeds@environment.gov.au)

### Introduction

In 2009 a key threatening process (KTP) was listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): '[Ecosystem degradation, habitat loss and species decline due to invasion of northern Australia by introduced gamba grass \(\*Andropogon gayanus\*\), para grass \(\*Urochloa mutica\*\), olive hymenachne \(\*Hymenachne amplexicaulis\*\), mission grass \(\*Cenchrus polystachios\* syn. \*Pennisetum polystachion\*\) and annual mission grass \(\*Cenchrus pedicellatus\* syn. \*Pennisetum pedicellatum\*\)](#)'. Gamba and the two mission grasses are weeds of terrestrial habitats while para grass and olive hymenachne have invaded wetlands. All five species are weeds of northern Australia.

These five invasive pasture grasses were imported into northern Australia between the 1880s and the 1980s. Unfortunately, without careful management they can easily escape from pastoral areas into bushland or wetlands and affect the structure and function of environmental assets, including threatened species and ecological communities. By increasing fuel loads, they are capable of causing intense fires which endanger human and animal lives and destroy native vegetation. They can also alter nutrient and water availability for native plants. As a result, invasion of these grasses has led to ecosystem degradation, habitat loss and biodiversity decline.

The [Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses](#) was released in 2012 as a guiding document designed to minimise the adverse impacts of these five grasses on affected native species and ecological communities. Having a threat abatement plan encourages all relevant government agencies, landholders, industry and community groups to work together to prevent further damage to our environment.

As an extension to the plan, these web pages aim to bring together information to help prevent further damage by these invasive grasses. There are links to documents which provide ideas for practical on-ground abatement activities for local communities, natural resource management groups, landholders or other interested individuals. Also available are broader actions for government agencies, local councils, research organisations, industry bodies or non-government organisations that have been identified as important to minimising the impacts of these five grasses.

## Status of the five invasive grasses under state and territory legislation

Gamba grass (*Andropogon gayanus*) is listed as a Weed of National Significance and a declared weed under Western Australian, Northern Territory and Queensland legislation.

Para grass (*Urochloa mutica*) is not a declared weed under any legislation in any jurisdiction.

Olive hymenachne (*Hymenachne amplexicaulis*) is a Weed of National Significance and a declared weed under legislation in all Australian jurisdictions.

Perennial mission grass (*Cenchrus polystachios* syn. *Pennisetum polystachion*) is a declared weed under Northern Territory and Western Australian legislation.

Annual mission grass (*Cenchrus pedicellatus* syn. *Pennisetum pedicellatum*) is not a declared weed under any legislation in any jurisdiction.

Table 1: Status of the five invasive grasses under state and territory legislation

	<b>Gamba grass</b> ( <i>Andropogon gayanus</i> )	<b>Annual mission grass</b> ( <i>Cenchrus pedicellatus</i> )	<b>Perennial mission grass</b> ( <i>Cenchrus polystachios</i> )	<b>Olive hymenachne</b> ( <i>Hymenachne amplexicaulis</i> )	<b>Para grass</b> ( <i>Urochloa mutica</i> )
<b>Western Australia</b> <i>Biosecurity and Agriculture Management Act 2007</i>	Prohibited (s12) Control category C2 Eradication	Permitted (s11)	Prohibited (s12) Control category C1 Exclusion	Prohibited (s12) Control category C1 Exclusion	Permitted (s11)
<b>Northern Territory</b> <i>Weeds Management Act 2001</i>	Class A To be eradicated  Class B Growth and spread to be controlled	Not a declared weed	Class B Growth and spread to be controlled	Class B Growth and spread to be controlled	Not a declared weed
<b>Queensland</b> <i>Land Protection (Pest and Stock Route Management)</i>	Class 2 Landholders must try to keep their land free of this weed	Not a declared weed	Not a declared weed	Class 2 Landholders must try to keep their land free of this weed and	Not a declared weed

Act 2002	and it is an offence to possess, sell or release without a permit			it is an offence to possess, sell or release without a permit	
----------	---	--	--	---	--

### Status of the five invasive grasses under Commonwealth legislation

[‘Ecosystem degradation, habitat loss and species decline due to invasion of northern Australia by introduced gamba grass \(\*Andropogon gayanus\*\), para grass \(\*Urochloa mutica\*\), olive hymenachne \(\*Hymenachne amplexicaulis\*\), mission grass \(\*Pennisetum polystachion\*\) and annual mission grass \(\*Pennisetum pedicellatum\*\)’](#) is listed as a key threatening process (KTP) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This KTP meets the criteria stated in section 188(4)(a) and section 188(4)(c) of the EPBC Act and is eligible to be listed as a KTP because:

- it could cause the native species *Cycas armstrongii* (a cycad) to become eligible for listing as vulnerable under the EPBC Act
- it could adversely affect at least four species that are listed as endangered under the EPBC Act, primarily through altered local fire regimes, degradation of habitat and reduction of food sources. The examples presented in the KTP listing advice are: [Lucasium occultum](#) (*Diplodactylus occultus*, yellow-snouted gecko), [Erythrura gouldiae](#) (Gouldian finch), [Euploea alcatheae enastri](#) (Gove crow butterfly) and [Epthianura crocea tunneyi](#) (yellow chat – Alligator Rivers).

The [Threat abatement plan to reduce the impacts on northern Australia’s biodiversity by the five listed grasses](#) was developed in 2012 to address this KTP. This plan provides guidance to minimise the adverse impacts of the five listed grasses on affected native species and ecological communities. The Australian Government environment minister must review the plan before December 2017.

### Resources

PLANS AND GUIDES RELEVANT TO ALL SPECIES (resources specific to gamba grass, para grass, hymenachne and mission grasses are available on the species pages)			
Title or description	Author	Date	Details
<a href="#">The Australian Weeds Strategy – A national strategy for weed</a>	Natural Resource Management	2007	A framework to establish consistent guidance and identify

<a href="#">management in Australia</a>	Ministerial Council		priorities for weed management across Australia
<a href="#">Commonwealth listing advice on invasion of northern Australia by gamba grass and other introduced grasses</a>	Threatened Species Scientific Committee	2009	Advice to the Minister from the Threatened Species Scientific Committee
<a href="#">Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Priority actions to manage the five species of invasive grasses
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Information on each of the five species of invasive grasses
<a href="#">Kakadu National Park management plan (2007–2014)</a>	Director of National Parks	2007	The 6 <sup>th</sup> Kakadu Management Plan is being finalised and will be released for public comment in December 2014.

#### GENERAL RESEARCH

<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">It was no accident: deliberate plant introductions by Australian government agencies during the 20<sup>th</sup> century</a>	Cook GD and Dias L	2006	Turner Review no. 12, <i>Australian Journal of Botany</i> , vol. 54, pp. 601–625
<a href="#">Exotic grass invasion in the tropical savanna of northern Australia: ecosystem consequences</a>	Rossiter N, Setterfield S, Douglas M, Hutley L and Cook G	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 168–

			171
<a href="#">How well are we currently dealing with contentious plants?</a>	Friedel MH, Grice AC, Clarkson JR, Ferdinands K and Setterfield SA	2010	Zydenbos SM (ed), Proceedings of the 17 <sup>th</sup> Australasian Weeds Conference, pp. 470–473, New Zealand Plant Protection Society, Christchurch, New Zealand
<a href="#">The role of legislation and policy in dealing with contentious plants</a>	Clarkson JR, Grice AC, Friedel MH, Setterfield, SA and Ferdinands K	2010	Zydenbos SM (ed), Proceedings of the 17 <sup>th</sup> Australasian Weeds Conference, pp. 474–7, New Zealand Plant Protection Society, Christchurch, New Zealand

#### GENERAL WEB RESOURCES

<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">INFFER (Investment Framework For Environmental Resources)</a>	INFFER		Asset identification and prioritisation tool
<a href="#">Species of National Environmental Significance</a>	Australian Government Department of the Environment		The Species of National Environmental Significance Database contains map summaries which provide general information on the distribution of species related to the <i>Environment Protection and Biodiversity Conservation Act 1999</i> . Species covered by the database include threatened and migratory species.
<a href="#">Species Profile and Threats (SPRAT)</a>	Australian Government Department of the		Recovery plans adopted under the <i>Environment Protection</i>

<a href="#">Database</a>	Environment		<i>and Biodiversity Conservation Act 1999</i>
<a href="#">Threatened species and ecological communities – publications</a>	Australian Government Department of the Environment		

## **Gamba grass (*Andropogon gayanus*)**

Gamba grass was first introduced to the Northern Territory in 1931 for testing as a pasture grass. In 1942, it was introduced to Queensland, but large-scale planting only began around 1983. It has naturalised in the east Kimberley region of Western Australia, in the northern parts of the Northern Territory, and in coastal and sub-coastal areas of North Queensland.

### **Gamba grass under state and territory legislation**

Gamba grass is a Weed of National Significance and it is also a declared weed throughout northern Australia.

Under Western Australia's [Biosecurity and Agriculture Management Act 2007](#), it is a prohibited plant under section 12. It has been placed in the C2 control category. It must be eradicated if it is in low enough numbers or in sufficiently limited areas that eradication is still feasible.

Under the Northern Territory's [Weeds Management Act 2001](#), further introductions of the species into the Northern Territory are prohibited and populations must be managed according to the declaration zone in which they occur. Areas which have isolated and low density gamba grass populations have been classified as the Class A/C Zone. In these areas the species is to be eradicated in all areas of the Northern Territory except where it is classified as Class B. Widely distributed and dense gamba grass infestations are within the Class B/C Zone. In these areas land managers must control its growth and prevent spread as detailed in the weed management plan for gamba grass.

Under Queensland's [Land Protection \(Pest and Stock Route Management\) Act 2002](#), gamba grass is a declared Class 2 pest – land managers must take reasonable steps to keep land free of the species and it is an offence to introduce, keep or supply the species without a permit.

### **Priority actions/research (recent or underway)**

- As a result of the 2013 review of weed management operations for gamba grass in the Northern Territory, the government has increased the eradication zone (Class A/C) to include four large areas of land formerly in the management zone (Class B/C).
- Northern Territory Fire and Rescue Officers are conducting awareness and extension activities by advising land holders of the presence of gamba grass when undertaking 'permit to burn' inspections.
- The Northern Territory Government has developed a [gamba grass webpage](#).
- The Northern Territory Government periodically runs the [Gamba Grass Assistance Program](#) which includes equipment loans and free herbicide to control gamba grass.

## Gamba grass

- Kakadu National Park aims to keep free of new infestations of gamba grass and to eradicate some existing limited known infestations.
- Gamba grass was declared a Weed of National Significance (WoNS) in 2012. A WoNS coordinator for gamba grass was funded until the end of June 2013. The coordinator prepared the [Weeds of National Significance Gamba Grass \(\*Andropogon gayanus\*\) Strategic Plan 2012–2017](#).
- [Reducing the impact of tropical grassy weeds through effective risk management](#), S. Setterfield et al. (2011–12), RIRDC National Weeds and Productivity Research Program. This project focused on the Darwin/Daly region of the Northern Territory, which is a nationally significant area with high biodiversity and cultural values. It commenced development of a strategic planning framework to prioritise gamba grass management. This decision-making tool continued to be developed within the National Environmental Research Program (NERP), with application to multiple weeds and additional regions.
- [Gamba Grass Effects on Savanna Carbon and Fire](#), Setterfield S, Hutley L, Rossiter-Rachor N, Douglas M, Adams V, Richards A, National Environmental Research Program (NERP) North Australia Hub. The approach of this project will compare impacts of gamba grass invasion on carbon stocks, fire risk, biodiversity, and other assets, and integrate these results into a decision-support tool to determine the optimal control strategy to maintain savanna carbon stores and other assets.
- **Managing flammable high biomass grassy weeds**, Setterfield S, Hutley L, Rossiter-Rachor N, Meier S, Douglas M, Bushfires and Natural Hazards CRC (commencing 2015). This project will assess the likelihood and magnitude of risk of high biomass invasive grasses to fire regimes in the tropical savanna region and provide critical information for Government policy and planning, particularly prioritisation of weed risk for fire-regime changing species, and for fire management planning.
- [National Environmental Research Program](#) (NERP) researchers continue to work with Northern Territory and Queensland government agencies to improve understanding of the distribution, impacts and management of the five grasses. Current work includes developing decision support tools that better incorporate economic assessments of management costs and modelling the potential future spread of invasive grasses.

### Resources

GAMBA GRASS PLANS AND GUIDES			
Title or description	Author	Date	Details
<a href="#">Threat abatement plan to</a>	Australian Government	2012	Priority actions to

Gamba grass

<a href="#">reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Department of Sustainability, Environment, Water, Population and Communities		manage the five species of invasive grasses
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Information on each of the five species of invasive grasses
<a href="#">Weeds of National Significance Gamba Grass (<i>Andropogon gayanus</i>) Strategic Plan 2012–2017</a>	Australian Weeds Committee	2013	
<a href="#">Weed management plan for gamba grass (<i>Andropogon gayanus</i>) 2014</a>	Northern Territory Government Department of Land Resource Management	2014	
<a href="#">Gamba grass management guide</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Gamba grass weed management guide</a>	Queensland Government Department of Agriculture, Fisheries and Forestry	2011	
<b>GAMBA GRASS RESEARCH</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Exotic grass invasions: Applying a conceptual framework to the dynamics of degradation and restoration in Australia's tropical savannas</a>	Brooks KJ, Setterfield SA and Douglas MM	2010	<i>Restoration Ecology</i> , vol. 18, no. 2, pp. 188–197
<a href="#">Pest plant risk</a>	Csurhes S and	2008	Queensland

Gamba grass

<a href="#">assessment: Gamba grass <i>Andropogon gayanus</i></a>	Hannan-Jones M		Government Department of Primary Industries and Fisheries
<a href="#">Gamba grass in the NT: A summary of current knowledge</a>	Northern Territory Government Department of Natural Resources, Environment, The Arts and Sport	2008	
<a href="#">Africanising the tropical woodlands: Canopy loss and tree death following gamba grass <i>Andropogon gayanus</i> invasion</a>	Ferdinands K, Douglas MM, Setterfield SA and Barratt JL	2006	Preston C, Watts JH and Crossman ND (eds), Proceedings of the 15 <sup>th</sup> Australian Weeds Conference, Adelaide, South Australia, p. 296
<a href="#">Seedling recruitment of the exotic grass <i>Andropogon gayanus</i> (Poaceae) in northern Australia</a>	Flores TA, Setterfield SA and Douglas MM	2005	<i>Australian Journal of Botany</i> , vol. 53, no. 3, pp. 243–249
<a href="#">Pest or pasture? Introduced pasture grasses in the Northern Territory</a>	Grace BS, Gardener MR and Cameron AG	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 157–160
The extent of mission grasses and gamba grass in the Darwin region of Australia's Northern Territory	Kean L and Price O	2003	<i>Pacific Conservation Biology</i> , vol. 8, no. 4, pp. 281–290
Inferring habitat suitability and spread patterns from large-scale distributions of an exotic invasive pasture grass in north Australia	Petty AM, Setterfield S, Ferdinands K and Barrow P	2012	<i>Journal of Applied Ecology</i> , vol. 49, pp. 742–752
<a href="#">Exotic grass invasion in the tropical savanna of northern Australia:</a>	Rossiter N, Setterfield S, Douglas M, Hutley L	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup>

Gamba grass

<a href="#">ecosystem consequences</a>	and Cook G		Australian Weeds Conference, Wagga Wagga, NSW, pp. 168–171
<i>Andropogon gayanus</i> (gamba grass) invasion increases fire-mediated nitrogen losses in the tropical savannas of northern Australia	Rossiter-Rachor NA, Setterfield SA, Douglas MM, Hutley LB and Cook GD	2008	<i>Ecosystems</i> , vol. 11, pp. 77–88
<a href="#">Seed bank dynamics of two exotic grass species in Australia's northern savannas</a>	Setterfield SA, Bellairs S, Douglas MM and Calnan T	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 555–557
<a href="#">Effects of canopy cover and ground disturbance on establishment of an invasive grass in an Australian savanna</a>	Setterfield SA, Douglas MM, Hutley LB and Welch MA	2005	<i>Biotropica</i> , vol. 37, no. 1, pp. 25–31
<a href="#">Turning up the heat: the impacts of <i>Andropogon gayanus</i> (gamba grass) invasion on fire behaviour in northern Australian savannas</a>	Setterfield SA, Rossiter-Rachor NA, Hutley LB, Douglas MM and Williams RJ	2010	<i>Diversity and Distributions</i> , vol. 16 pp. 854–861
Protecting new markets: quantifying the risks to new carbon markets from invasive species and prioritising areas for immediate action	Adams V and Setterfield SA	2014	19 <sup>th</sup> Australasian Weed Conference, Hobart, September 2014
The impacts of <i>Andropogon gayanus</i> (gamba grass) invasion on the fire danger index and fire management at a landscape scale	Setterfield SA, Rossiter-Rachor N, Douglas MM, McMaster D, Adams V and Ferdinands K	2014	19 <sup>th</sup> Australasian Weed Conference, Hobart, September 2014

Gamba grass

<a href="#">Adding fuel to the fire: the impacts of non-native grass invasion on fire management at a regional scale</a>	Setterfield SA, Rossiter-Rachor NA, Douglas MM, Wainger L, Petty A M, Barrow P, Shepherd IJ and Ferdinands KB	2013	<i>PLoS One</i> 8
<b>GAMBA GRASS WEB RESOURCES</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Further information about the biology, distribution and impacts of gamba grass</a>	Australian Government Department of the Environment	2013	Weeds in Australia website
<a href="#">Gamba grass management webpage</a>	Northern Territory Government Department of Land Resource Management	2014	Northern Territory Government website
<a href="#">Gamba grass identification resource</a>	Australian Weeds Committee		Weeds Australia website
<a href="#">Gamba grass Weeds of National Significance page</a>	Australian Weeds Committee		Weeds Australia website
<a href="#">Gamba grass declaration zones map</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Gamba grass weed note</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Gamba grass photo identification table</a>	Northern Territory Government Department of Land Resource Management	2013	
<a href="#">Declared plants of Queensland</a>	Queensland Government Department of	2013	

Gamba grass

	Agriculture, Fisheries and Forestry		
<a href="#">Gamba grass fact sheet</a>	Queensland Department of Agriculture, Fisheries and Forestry	2014	

### **Para grass (*Urochloa mutica*)**

Para grass was introduced to Queensland in 1884 to control riverbank erosion. In the 1880s it was growing in the Darwin Botanical Garden and was introduced to Arnhem Land in 1922. It has since been widely used as a pasture grass in northern Australia, including on ponded pastures in Queensland. Para grass is naturalised in Queensland, northern New South Wales, the Northern Territory and in the northern part of Western Australia. Para grass poses a major threat to the World Heritage-listed Kakadu National Park, where it is actively managed.

### **Para grass under state and territory legislation**

Para grass (*Urochloa mutica*) is not a declared weed under any legislation in Australia. Para grass is listed as a weed in at least 34 countries and recognised as a serious problem in Fiji, Thailand, Sri Lanka, Columbia, Hawaii, Jamaica, Malaysia, Peru, the Philippines, Puerto Rico and Trinidad.

### **Priority actions/research (recent or underway)**

[Seed banks of weed-invaded wetlands: implications for biodiversity and restoration](#) (Wearne L, Nicholas M, Perkins G, Australian Weeds Research Centre, 2011)

This project examines the impact of para grass on wetlands and the potential for recovery following its removal. The study concludes that the use of fire and grazing for the removal of para grass has resulted in a viable seed bank dominated by native species. In areas where para grass has been removed, species richness in the soil seed bank increases.

[Using Fire to Restore Australian Wetlands from Invasive Grasses](#) (Grice A, Nicholas M, 2011)

This project demonstrated that fire can be used as a reliable tool for reducing the prevalence of para grass in northern Australian wetlands.

[Managing threats to floodplain biodiversity and Indigenous values](#) (Setterfield S, Douglas M, Bayliss P, Jackson S, National Environmental Research Program (NERP) North Australia Hub, 2014). The NERP North Australia Hub continues to work with Northern Territory and Queensland government agencies to improve our understanding of the distribution, impacts and management of the five grasses. This project aims to improve the understanding of the spread of para grass and olive hymenachne in the tropical floodplains, and how spread patterns are related to hydrological regime, fire, and edaphic factors. The project will deliver maps of distribution of these weeds in Kakadu, models of areas of habitat suitable for invasion and predicted patterns of spread. It will also develop an improved decision-support tool to guide the implementation of cost-effective strategies to control aquatic invasive grasses.

## Resources

PARA GRASS PLANS AND GUIDES			
Title or description	Author	Date	Details
<a href="#">Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Priority actions to manage the five species of invasive grasses
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Information on each of the five species of invasive grasses
<a href="#">Fisheries guidelines for managing ponded pastures</a>	Challen S and Long P	2004	Queensland Department of Primary Industries and Fisheries
PARA GRASS RESEARCH			
Title or description	Author	Date	Details
Balancing wildlife conservation and pastoralism: An adaptive management case study on multiple land use, from Northern Australia's Mary River Region	Beggs K, Ferdinands K, Whitehead P and Woinarski J	2003	Proceedings of the 3 <sup>rd</sup> International Wildlife Management Congress, Christchurch, New Zealand
Ponded pastures: A threat to wetland biodiversity	Clarkson J	1995	Finlayson CM (ed), Wetland research in the wet-dry tropics of Australia, Supervising Scientist Report 101, Supervising Scientist, Canberra, pp. 206–211
<a href="#">Effects of para grass (<i>Urochloa mutica</i> (Forssk.) T.Q. Nguyen) invasion on terrestrial invertebrates of</a>	Douglas MM and O'Connor RA	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga

Para grass

<a href="#">a tropical floodplain</a>			Wagga, NSW, pp. 153–156
<a href="#">Weed invasion changes fuel characteristics: para grass (<i>Urochloa mutica</i> (Forssk.) T.Q. Nguyen) on a tropical floodplain</a>	Douglas MM and O'Connor RA	2004	<i>Ecological Management and Restoration</i> , vol. 5, pp. 143–145
<a href="#">Assessing the threat posed by an invasive African grass <i>Urochloa mutica</i> to biodiversity conservation in the Mary River Wetlands, Northern Territory</a>	Ferdinands K	2007	Institute of Advanced Studies, Charles Darwin University, Darwin (PhD thesis)
<a href="#">Biodiversity and invasive grass species: multiple use or monoculture?</a>	Ferdinands K, Beggs K and Whitehead P	2005	<i>Wildlife Research</i> , vol. 32, pp. 447–457
Controlling para grass in a tropical seasonal wetland	Gould SF	2001	<i>Ecological Management and Restoration</i> , vol. 2, no. 2, pp. 145–161
Pest or pasture? Introduced pasture grasses in the Northern Territory	Grace BS, Gardener MR and Cameron AG	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 157–160
<a href="#">Weed management in Kakadu National Park</a>	Hunter F, Ibbett M and Salau B	2010	Winderlich S (ed), <i>Kakadu National Park Landscape Symposia Series 2007–2009</i> , Symposium 2: Weeds management
<a href="#">Grassland community dynamics of a freshwater tropical floodplain: Invasion of <i>Brachiaria mutica</i> (Para grass) on the Magela floodplain, Kakadu National Park</a>	Knerr, NJA	1996	Department of Botany, University of New England, Armidale (thesis)

Para grass

<a href="#">Tropical pasture plants as weeds</a>	Low T	1997	<i>Tropical Grasslands</i> , vol. 31, pp. 337–343
Cattle grazing for Para Grass management in a mixed species wetland of north-eastern Australia	Williams PR, Collins EM and Grice AC	2005	<i>Ecological Management and Restoration</i> , vol. 6; no. 1; pp 75–78
Weeds of Protected Areas: Floodplain weeds in Australia's Kakadu National Park	Setterfield SA, Douglas MM, Petty AM, Bayliss P, Ferdinands KB and Winderlich S	2013	Foxcroft LC, Richardson DM, Pyšek P and Genovesi P (eds.), <i>Plant invasions in protected areas: patterns, problems and challenges</i> , Springer, ISBN 978-94-007-7750-7
<a href="#">Weed Management and the Biodiversity and Ecological Processes of Tropical Wetlands</a>	Douglas MM, Bunn SE, Pidgeon RJW, Davies PM, Barrow P, O'Connor RA and Winning M	2001	Environment Australia and Land and Water Resources Research and Development Corporation
Para grass management and costing trial within Kakadu National Park	McMaster D, Adams V, Setterfield SA, McIntyre D and Douglas MM	2014	19 <sup>th</sup> Australasian Weed Conference, Hobart, September 2014
<b>PARA GRASS WEB RESOURCES</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Further information about the biology, distribution and impacts of para grass</a>	Australian Government Department of the Environment	2013	Weeds in Australia website
<a href="#">Para grass weed note</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Para grass photo identification table</a>	Northern Territory Government Department of Land Resource Management	2012	

Para grass

<a href="#">Invasive species risk assessment: Para grass <i>Urochloa mutica</i></a>	<p>Hannan-Jones M and Csurhes S, Biosecurity Queensland</p> <p>Queensland Department of Agriculture, Fisheries and Forestry</p>	<p>2012</p>	
<a href="#">Managing weeds for wildlife conservation</a>	<p>Northern Land Manager</p>		
<a href="#">Links to Ramsar sites, directory of important wetlands in Australia, communications materials and other valuable wetlands information</a>	<p>Australian Government Department of the Environment</p>		<p>Wetlands web pages</p>
<a href="#">Map and description of Ramsar sites in Australia</a>	<p>Australian Government Department of the Environment</p>		<p>Australian Wetlands Database</p>
<a href="#">Wise use of wetlands in Australia</a>	<p>Australian Government Department of Sustainability, Environment, Water, Population and Communities</p>	<p>2012</p>	<p>Fact sheet</p>

### **Olive hymenachne (*Hymenachne amplexicaulis*)**

Hymenachne was imported into northern Queensland in the 1970s to use in ponded pastures. It escaped cultivation a few years after its release in 1988. It is spreading throughout the tropical wetlands of northern Australia and is most common in the coastal wetlands of northern Queensland and the Northern Territory. Olive hymenachne also grows in northern New South Wales. It has not established in Western Australia, although the Kimberley region is at high risk of invasion.

### **Olive hymenachne under state and territory legislation**

Olive hymenachne (*Hymenachne amplexicaulis*) is a Weed of National Significance and it is also a declared weed throughout Australia.

Under Western Australia's [Biosecurity and Agriculture Management Act 2007](#) it is prohibited under section 12. It has been placed in the C1 control category (exclusion – not established in Western Australia and control measures are to be taken, including border checks, to prevent them entering and establishing in the state).

Under the Northern Territory's [Weeds Management Act 2001](#), olive hymenachne is classified as a Class B/C weed (further introductions of the species into the Northern Territory are prohibited and land managers must control its growth and prevent spread).

Under Queensland's [Land Protection \(Pest and Stock Route Management\) Act 2002](#), olive hymenachne is a declared Class 2 pest (land managers must take reasonable steps to keep land free of the species and it is an offence to introduce, keep or supply the species without a permit).

Under New South Wales' [Noxious Weeds Act 1993](#), olive hymenachne is declared a Class 1 weed state wide (it must be eradicated from the land and the land must be kept free of the plant).

Under the Australian Capital Territory's [Pest Plants and Animals Act 2005](#), olive hymenachne is a prohibited pest plant (propagation and supply is prohibited).

Under Victoria's [Catchment and Land Protection Act 1994](#), olive hymenachne is classified as a restricted weed state-wide – it has or may have the potential to become a serious threat to primary production, Crown land, the environment or community health in Victoria or in another State or a Territory of the Commonwealth. It cannot be sold or traded as it poses an unacceptable risk of spread.

Under South Australia's [Natural Resources Management Act 2004](#) olive hymenachne is a declared weed. A person must not sell it or sell anything that carries it (i.e. contaminated by it).

Under Tasmania's [Weed Management Act 1999](#) olive hymenachne is a declared weed (importation, sale and distribution are prohibited).

**Priority actions/research (recent or underway)**

Olive hymenachne is a Weed of National Significance (WoNS) under state and territory management. The 2012 review of the Hymenachne National Strategic Plan lists the following key achievements for hymenachne management since its declaration as a WoNS in 1999:

- [Guideline for the containment of olive hymenachne \(\*Hymenachne amplexicaulis\*\) to genuine grazing systems](#). AgForce Queensland and the Northern Territory Cattleman’s Association endorsed this document in 2011.
- Extension and awareness activities and materials such as attendance of field days and conducting forums, preparation and delivery of resource kits, signage for recreational waterholes, banners for field days, television and newspaper coverage.
- In June 2001 the Queensland Government released its ‘Policy for development and use of ponded pastures’, recommending against the use of hymenachne and para grass.
- [Hymenachne control methods and case studies manual](#) (2006) includes:
  - a comprehensive range of control and management tools for combating hymenachne
  - case studies demonstrating landholder approaches and experiences.

[Managing threats to floodplain biodiversity and Indigenous values](#) (Setterfield S, Douglas M, Bayliss P, Jackson S, National Environmental Research Program (NERP) North Australia Hub, 2014). The NERP North Australia Hub continues to work with Northern Territory and Queensland government agencies to improve our understanding of the distribution, impacts and management of the five grasses. This project aims to improve the understanding of the spread of para grass and olive hymenachne in the tropical floodplains, and how spread patterns are related to hydrological regime, fire, and edaphic factors. The project will deliver maps of distribution of these weeds in Kakadu, models of areas of habitat suitable for invasion and predicted patterns of spread. It will also develop an improved decision-support tool to guide the implementation of cost-effective strategies to control aquatic invasive grasses.

**Resources**

OLIVE HYMENACHNE PLANS AND GUIDES			
Title or description	Author	Date	Details
<a href="#">Threat abatement plan to reduce the impacts on northern Australia’s biodiversity by the five</a>	Australian Government Department of Sustainability, Environment, Water, Population and	2012	Priority actions to manage the five species of invasive grasses

Hymenachne

<a href="#">listed grasses</a>	Communities		
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Information on each of the five species of invasive grasses
<a href="#">Olive hymenachne (<i>Hymenachne amplexicaulis</i> (Rudge) Nees) strategic plan 2012–17</a>	Australian Weeds Committee	2012	Weeds of National Significance, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra
<a href="#">Hymenachne National Strategic Plan progress review (2008–2009)</a>	Cobon R	2009	National Hymenachne Management Group
<a href="#">Fisheries guidelines for managing ponded pastures</a>	Challen S and Long P	2004	Queensland Department of Primary Industries and Fisheries
<b>OLIVE HYMENACHNE RESEARCH</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
Pest or pasture? Introduced pasture grasses in the Northern Territory	Grace BS, Gardener MR and Cameron AG	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 157–160
<a href="#">Geographic differentiation of management objectives for invasive species: a case study of <i>Hymenachne amplexicaulis</i> in Australia</a>	Grice AC, Clarkson JR and Calvert M	2011	<i>Environmental Science and Policy</i> vol. 14, pp. 1205–1218
<a href="#">Tropical pasture plants as weeds</a>	Low T	1997	<i>Tropical Grasslands</i> , vol. 31, pp. 337–343
<a href="#">Rapid response to the discovery of olive hymenachne</a>	Clarkson J Grice T and Still LA	2012	Proceedings of the 18 <sup>th</sup> Australasian Weeds Conference, Melbourne

Hymenachne

<a href="#">(<i>Hymenachne amplexicaulis</i> (Rudge) Nees) on Rinyirru (Lakefield) National Park</a>			Vic
Potential distribution of an invasive plant species and risk assessment: a case study of <i>Hymenachne amplexicaulis</i> in Australia	Wearne LJ, Ko D, Hannan-Jones M and Calvert M	2011	Human and Ecological Risk Assessment
The biology of Australian weeds 56 <i>Hymenachne amplexicaulis</i> (Rudge) Nees	Wearne LJ, Clarkson JR and Vitelli JS	2010	<i>Plant Protection Quarterly</i> 25:146–161
Geographic differentiation of management objectives for invasive species: a case study of <i>Hymenachne amplexicaulis</i> in Australia	Grice AC, Clarkson JR and Calvert M	2011	<i>Environmental Science and Policy</i> Volume 14, Issue 8, December 2011, Pages 986–997
<b>OLIVE HYMENACHNE WEB RESOURCES</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Further information about the biology, distribution and impacts of olive hymenachne</a>	Australian Government Department of the Environment	2013	Weeds in Australia website
<a href="#">Olive hymenachne weed note</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Olive hymenachne photo identification table</a>	Northern Territory Government Department of Land Resource Management	2013	
<a href="#">Links to Ramsar sites, directory of important wetlands in Australia, communications materials and other valuable</a>	Australian Government Department of the Environment		Wetlands webpages

Hymenachne

<a href="#">wetlands information</a>			
<a href="#">Map and description of Ramsar sites in Australia</a>	Australian Government Department of the Environment		Australian Wetlands Database
<a href="#">Hymenachne (<i>Hymenachne amplexicaulis</i>) in Queensland</a>	Csurhes SM, Mackey AP, Fitzsimmons L	1999	Queensland Government Pest status review series – land protection
<a href="#">Wise use of wetlands in Australia</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Fact sheet

## **Perennial mission grass (*Cenchrus polystachios* syn. *Pennisetum polystachion*)**

Perennial mission grass was introduced into Australia in the 1940s and 1950s for testing as a pasture grass. It was well established as a weed in the Darwin area by 1970. Since then it has spread to Katherine, Arnhem Land, the Daly River and the Tiwi Islands. Perennial mission grass is also widely naturalised Queensland, although it has not established in Western Australia.

### **Perennial mission grass under state and territory legislation**

Perennial mission grass is a declared weed in the Northern Territory and Western Australia.

Under the Northern Territory's [Weeds Management Act 2001](#) it is declared a Class B/C weed (landholders must control its growth and prevent spread – further introductions of the species into the Northern Territory are prohibited).

Under Western Australia's [Biosecurity and Agriculture Management Act 2007](#) it is prohibited under section 12. It has been placed in the C1 control category (exclusion – not established in Western Australia and control measures are to be taken, including border checks, to prevent them entering and establishing in the state).

### **Priority actions/research**

Increase public/stakeholder awareness of the risks posed by perennial mission grass and the need for management in key areas (perennial mission grass is not particularly valuable as a pasture species and there is some community awareness/concern about its impacts).

Collect any new information generated by research/ongoing management and incorporate it into weed risk management systems.

### **Resources**

<b>PERENNIAL MISSION GRASS PLANS AND GUIDES</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Priority actions to manage the five species of invasive grasses
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by</a>	Australian Government Department of Sustainability, Environment, Water, Population and	2012	Information on each of the five species of invasive grasses

Perennial mission grass

<a href="#">the five listed grasses</a>	Communities		
PERENNIAL MISSION GRASS RESEARCH			
Title or description	Author	Date	Details
<a href="#">Exotic grass invasions: Applying a conceptual framework to the dynamics of degradation and restoration in Australia's tropical savannas</a>	Brooks KJ, Setterfield SA and Douglas MM	2010	<i>Restoration Ecology</i> , vol. 18, no. 2, pp. 188–197
<a href="#">It was no accident: deliberate plant introductions by Australian government agencies during the 20<sup>th</sup> century</a>	Cook GD and Dias L	2006	Turner Review no. 12, <i>Australian Journal of Botany</i> , vol. 54, pp. 601–625
<a href="#">Effects of mission grass (<i>Pennisetum polystachion</i> (L.) Schult.) invasion on fuel loads and nitrogen availability in a northern Australia tropical savanna</a>	Douglas MM, Setterfield SA, Rossiter N, Barratt J and Hutley LB	2004	Sindel BM and Johnson SB (eds), Proceedings of the 14 <sup>th</sup> Australian Weeds Conference, Wagga Wagga, NSW, pp. 179–181
The extent of mission grasses and gamba grass in the Darwin region of Australia's Northern Territory	Kean L and Price O	2003	<i>Pacific Conservation Biology</i> , vol. 8, no. 4, pp. 281–290
<a href="#">Tropical pasture plants as weeds</a>	Low T	1997	<i>Tropical Grasslands</i> , vol. 31, pp. 337–343
<a href="#">Management of mission grass (<i>Pennisetum polystachion</i>)</a>	Miller I	2006	Department of Primary Industry, Fisheries and Mines, Northern Territory Government, Darwin
PERENNIAL MISSION GRASS WEB RESOURCES			
Title or description	Author	Date	Details
<a href="#">Further information about the biology, distribution and impacts of perennial</a>	Australian Government Department of the	2013	Weeds in Australia website

Perennial mission grass

<a href="#">mission grass</a>	Environment		
<a href="#">Mission and gamba grass</a>	Northern Territory Fire and Rescue Service		
<a href="#">Managing weeds for wildlife conservation</a>	Northern Land Manager		
<a href="#">Perennial mission grass technical factsheet</a>	Plantwise		Plantwise Knowledge Bank
<a href="#">Weed identification tool</a>	Australian Weeds Committee		Weeds Australia
<a href="#">Perennial mission grass weed note</a>	Northern Territory Government Department of Land Resource Management		
<a href="#">Perennial mission grass photo identification table</a>	Northern Territory Government Department of Land Resource Management	2013	

**Annual mission grass (*Cenchrus pedicellatus* syn. *Pennisetum pedicellatum*)**

Annual mission grass was probably first introduced to Australia in the 1940s for testing as a pasture grass. In the 1950s it had spread from trial sites. By 1970, it had already spread over large parts of northern Australia. It is now found in Western Australia, the Northern Territory and Queensland. A weed risk assessment has found that it has a potentially high impact in Western Australia's Kimberley region. It grows in shady areas that are unsuitable for natives, helping to fuel fires beneath sensitive trees and shrubs that wouldn't otherwise burn so easily.

**Annual mission grass under state and territory legislation**

Annual mission grass is not a declared weed under any legislation in Australia and there are no formal management strategies in place to control the spread of this invasive plant.

**Priority actions/research**

Increase public/stakeholder awareness of the risks posed by annual mission grass and the need for management in key areas (annual mission grass is not a valuable pasture grass and there is low community awareness of its impacts).

Collect any new information generated by research/ongoing management and incorporate it into weed risk management systems.

**Resources**

<b>ANNUAL MISSION GRASS PLANS AND GUIDES</b>			
<b>Title or description</b>	<b>Author</b>	<b>Date</b>	<b>Details</b>
<a href="#">Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Priority actions to manage the five species of invasive grasses
<a href="#">Background: Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses</a>	Australian Government Department of Sustainability, Environment, Water, Population and Communities	2012	Information on each of the five species of invasive grasses
<a href="#">Annual mission grass photo identification table</a>	Northern Territory Government Department of Land Resource	2013	

	Management		
ANNUAL MISSION GRASS RESEARCH			
Title or description	Author	Date	Details
<a href="#">It was no accident: deliberate plant introductions by Australian government agencies during the 20<sup>th</sup> century</a>	Cook GD and Dias L	2006	Turner Review no. 12, <i>Australian Journal of Botany</i> , vol. 54, pp. 601–625
The extent of mission grasses and gamba grass in the Darwin region of Australia's Northern Territory	Kean L and Price O	2003	<i>Pacific Conservation Biology</i> , vol. 8, no. 4, pp. 281–290
<a href="#">Reproductive phenology of <i>Pennisetum pedicellatum</i></a>	Setterfield SA, Douglas MM, Barratt JL and Brooks KJ	2006	Preston C, Watts JH and Crossman ND (eds), Proceedings of the 15 <sup>th</sup> Australian Weeds Conference, Adelaide, South Australia, pp. 272–274
ANNUAL MISSION GRASS WEB RESOURCES			
Title or description	Author	Date	Details
<a href="#">Further information about the biology, distribution and impacts of annual mission grass</a>	Australian Government Department of the Environment	2013	Weeds in Australia website