+Nomination Form for listing or delisting a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

To fill out this form you must refer to the attached Guidelines for threatening process nominations.

Threatening Process Details

Name of the threatening process:

Ecosystem degradation, habitat loss and species decline due to invasion of Top End NT by introduced gamba grass (*Andropogon gayanus*)

A description of the threatening process that distinguishes it from any other threatening process, by reference to:

(i) its biological and non-biological components.

Gamba is a vigorous, robust, highly productive introduced grass (weed) which forms tall (up to 4m) dense stands that increase fuel loads, cure later than native annual grasses of the Top End and promote intense, late Dry season fires which seriously damage, degrade and eventually destroy native habitat and ecosystems.

Gamba is clearly the most detrimental of the current crop of exotic grasses, being most likely to invade and irrevocably transform native environments.

Douglas and Setterfield (2005) state:

> In the NT, gamba grass currently occurs in the Darwin, Palmerston and Litchfield shires, the Coomalie Community Government, Mary River, Douglas River and Lower Daly River regions (S. Wingrave, pers. comm.). Roadsides and other disturbance corridors have been the major conduits for the spread of gamba grass in the NT (Barrow 1995; Kean and Price 2003). However, gamba grass is not restricted to these highly disturbed areas and is capable of invading long distances (> 500 m) from roadsides and pastoral properties into relatively undisturbed areas including parks managed for conservation (Whitehead and Wilson 2000; Price, unpublished data; Wilson and Panton, unpublished data). Soil or canopy disturbance are not essential for its establishment, but both of these factors will promote establishment and soil disturbance will increase survival in the first year (Setterfield *et al.* 2005). Gamba grass can establish across a range of habitats, from wetland margins through to upland savanna (Flores *et al.* 2005), and it is particularly common around riparian corridors (Kean and Price 2003). Its predicted potential distribution includes all savanna areas, wetland and rainforest margins north of Daly Waters (15 ^{o}S), this represents an area of approximately 380,000 km^2 (S. Wingrave, pers. comm.).
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> Compared with native grasses, gamba grass has higher photosynthetic rates under a range of conditions; it uses light more efficiently and produces more leaf area and biomass (Rossiter 2001). This higher grass layer biomass alters the ground layer microclimate characterised by significantly lower light levels and higher air temperature compared to native grass sites (Clifton 2004). This change in microclimate is likely to adversely affect native plant regeneration.
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> Compared with native grasses, gamba grass forms taller, denser stands that cure later in the dry season, resulting in substantial changes to the savanna fire regime (Rossiter *et al.* 2003). Native grass fuel loads are typically 3 to 5 tonnes/ha (Williams *et al.* 2003), whereas gamba grass fuel loads are typically 11 to 15 tonnes/ha (Rossiter *et al.* 2003) and may be as high as 30 tonnes/ha (Rossiter, unpublished data). The higher fuel loads of gamba grass support early dry season fires that are

approximately eight times more intense than those fuelled by native grasses (Rossiter *et al.* 2003). Even in the early dry season when the gamba grass fuels had only just started to cure, fire intensities were more than three times as high as those recorded in adjacent native grass savannas (Rossiter et al. 2004). Fire managers in the NT have reported that gamba fires are extremely difficult to manage and significantly more life threatening than native grass fires.

Flame heights of gamba grass fires are much higher than native grass fires and are typically higher than the tree canopy (Rossiter *et al.* 2003). Such fires have the potential to dramatically alter the structure of the native vegetation (Bowman 1999; Rossiter *et al.* 2003). This prediction is supported by predictions from the Flames simulation model (Liedloff and Cook, in prep) which suggest that gamba grass fires can kill most of the over storey tree layer within a century (Liedloff, unpublished data). However, in the worst case that we have observed, tree cover was halved within 5 years where gamba grass invasion was coupled with poor fire management i.e. annual late dry season fires (Setterfield *et al.*, unpublished data). In addition to causing the death of established canopy trees, gamba grass invasion reduces tree recruitment with seedling density 75% lower in invaded sites compared to native grass sites (Clifton *et al.* in prep.). The changes in fire regimes associated with gamba grass invasion could also be detrimental to rare plants such as cycads (Liddle, 2004).

Daily water use (in the wet season) is three times higher for gamba grass than native grasses (Rossiter *et al.* 2004). Preliminary data analysis shows that gamba grass invasion reduces the drainage of water through the soil profile and deep drainage was 20 to 50% lower in gamba invaded sites than in native grass sites (Rossiter *et al.* 2004). This will result in increased competition for soil moisture with woody species which will be particularly critical during the dry season when deep drainage provides a critical reserve of moisture sustaining evergreen tree canopies (Hutley *et al.* 2000). Extensive gamba grass infestation could also result in reduced or the earlier cessation of stream flows.

Recently published research in the NT has demonstrated that gamba grass is a significant weed that has negative environmental impacts (Kean and Price 2003; Rossiter *et al.* 2003; Rossiter *et al.* 2004; Flores *et al.* 2005; Setterfield *et al.* 2005) and forthcoming research looks certain to provide further evidence of its effects on biodiversity and ecosystem processes. There is also increasing public concern over the negative impacts of gamba grass on a range of non-pastoral savanna land users (Tideman, in prep.). Yet despite repeated recommendations for urgent action to manage gamba grass before it becomes a widespread problem (Childs 2000; Whitehead and Wilson 2000; Kean and Price 2003; Rossiter *et al.* 2003; Flores *et al.* 2005; Setterfield *et al.* 2005) it is still not a declared weed in the NT, and so there are no restrictions on its use and no requirements to limit its spread and establishment. Consequently, even though gamba grass is still at a relatively early phase of invasion and can be controlled using available techniques, its spread continues in the NT."

(*Impacts of Exotic Grasses: Lessons from Gamba grass in the Northern Territory*, Douglas M.M. and Setterfield S.A., Tropical Savannas Cooperative Research Centre, Darwin, 2005.)

Rossiter *et al* (2003) reports that, "Fire frequency may also increase because *A. gayanus* has the potential to support fire more than once a year. Due to its high tolerance of fire and ability to resprout soon after fire, [it] can produce sufficient biomass to support a second fire in the same season…With an increased continuous fuel load comes an increased probability of uniform fires over large areas. Such an intense, frequent and uniform fire regime is likely to drastically alter the vegetation structure and composition of communities…*A. gayanus* can clearly be described as an ecosystem 'transformer' with the potential to alter the community structure and the nutrient, water and carbon cycling processes over large areas of Australia's savanna ecosystems."

The end result of gamba infestation is the transformation of wildlife-rich woodland, wetland and riparian environments into biologically impoverished, pyrogenic monocultures of gamba grass carrying regular hot fires.

As the spread of gamba continues, it will increasingly place at risk a wide range of endangered and vulnerable species and communities across most of the Top End of the Northern Territory.

The long term consequences of continued and accelerating gamba grass spread are**:**

- incalculable loss to the natural environment of the NT**;**
- incalculable loss to those industries and economic activities in the NT which depend on a healthy natural environment and ecosystem services, e.g. tourism, pastoralism, fishing, etc**;**
- ever-increasing financial and opportunity costs to future NT and Commonwealth governments, and the community, through fire protection costs and losses, costs of environmental degradation (e.g. degradation of waterways and water resources) and massive programs of landscape restoration and biodiversity conservation.

Gamba is still at a relatively early stage of invasion, but if strong action is not taken in the next few years, the problem will be beyond control.

(ii) the processes by which those components interact (if known).

Gamba has been widely cultivated as a cattle pasture species on pastoral properties in the Top End since the late 1950's, and has subsequently colonised large areas of non-pastoral land, including conservation reserves.

The light and fluffy Gamba seed is dispersed from existing locations into new locations through any one of a number of dispersal methods including deliberate sowing, wind, animals, hay, road maintenance and other vehicles, and water movement. Gamba establishes vigorously in disturbed environments.

Once established, gamba spreads more or less rapidly through the surrounding environment, aided by any form of disturbance.

As the extent and density of gamba increases, fuel loads increase and the fire regime alters, in turn further accelerating gamba's spread and facilitating the process of transforming healthy native ecosystems to biologically impoverished, pyrogenic monocultures of gamba grass.

Gamba grass can impact on the ecology of native ecosystems in a number of ways by:
- Replacing native vegetation
- Reducing native plant and animal diversity
- Changing the structure of plant communities
- Increasing the fire risk as a result of increased fuel loads
- Changing nitrogen cycling through plant communities
- Changing water cycling in native ecosystems

Name any species or ecological communities listed as threatened under the EPBC Act that are considered to be adversely affected by the threatening process:

Darwin palm; *Ptychosperma bleeseri (macarthurii):* endangered

Eastern partridge pigeon; *Geophaps smithii smithii*: vulnerable

Gouldian finch; *Erythrura gouldiae*: endangered

Northern quoll; *Dasyurus hallucatus*: endangered

Yellow-snouted gecko; *Diplodactylus occultus:* case under consideration

Name any species or ecological community, other than those that are listed under the EPBC Act, that could become eligible for listing in one of those categories because of the threatening process:

Cycad; *Cycas armstrongii*: listed a vulnerable under NT legislation

Cycad; *Cycas canalis*: listed a vulnerable under NT legislation

Christmas holly grevillea; *Grevillea longicuspis*: listed a vulnerable under NT legislation

Yellow-snouted gecko; *Diplodactylus occultus*: listed a vulnerable under NT legislation

Northern grassdart butterfly; *Taractrocera ilia ilia*: listed a vulnerable under NT legislation

Yellow chat; *Epthianura crocea tunney:* listed as endangered under NT legislation

Northern hopping mouse; *Notomys aquilo*: listed as vulnerable under NT legislation

Brush-tailed phascogale; *Phascogale tapoatafa pirata*: listed as vulnerable under NT legislation

Northern nail-tail wallaby; *Onychogalea unguifer*: listed as near threatened under NT legislation

Rainforest patches containing a huge richness and diversity of flora and fauna can be expected to suffer extensive decline.

Whole suites of plant and animal species typical of the tropical savannas can be expected to suffer extensive decline.

Justification for this nomination

Provide justification for listing the threatening process as a key threatening process under the EPBC Act, with particular reference to:

[Note that although there are three criteria for listing, meeting any ONE of the criteria means a threatening process is eligible for listing as a key threatening process]

(a) evidence that the threatening process could cause a native species or ecological community to become eligible for listing in any category, other than conservation dependant:

With many Top End fauna species already in decline, as has been widely documented in the scientific literature (e.g. Franklin 1999; Woinarski *et al*, 2001; Whitehead *et al*, 2003), widespread invasion by gamba and consequent altered and increased frequency and intensity of wild fire is likely to push many indigenous species further along the continuum towards threatened status or extinction. For example, hollow dependent bird and mammal species and granivorous birds, several of which are already listed under NT or Commonwealth legislation, are likely to undergo further major population declines as gamba invades their habitat and removes their breeding and feeding resources.

Rossiter *et al* (2003) report that, "*A. gayanus* can clearly be described as an ecosystem 'transformer' with the potential to alter the community structure and the nutrient, water and carbon cycling processes over large areas of Australia's savanna ecosystems."

Woinarski (pers comm., 2005) states, "A series of recent studies have shown that many native animal species benefit from a fire regime that is infrequent, fine-scale and relatively cool, and that detriment to native animals is greatest when fires are relatively homogenous, frequent, extensive and intense (Woinarski *et al*. 2004; Woinarski in press; Andersen *et al*. in press)."

The case of ***Cycas armstrongii*** (NT vulnerable):

"Potential threats: Land clearing and inappropriate fire regimes, particularly arising from increased fuel load due to invasion of exotic grasses, are major threats. Mortality in excess of 50% of adult stems per fire event has been recorded when subject to fuel loads of 20 tonnes per hectare (Liddle submitted). The exotic pasture species gamba grass *Andropogon gayanus* supports fuel loads up to 20 tonnes per hectare and the exotic perennial mission grass *Pennisetum polystachyon* supports fuel loads up to 27 tonnes per hectare. Both of these exotic species are spreading rapidly and have the potential to extend over the full range of *C. armstrongii*.

(*Draft Management Program for Cycads in the Northern Territory*, Parks and Wildlife Service of the Northern Territory, 2003. See also: *A guide to threatened, near threatened and data deficient plants in the Litchfield Shire of the Northern Territory*, WWF *et al*, 2005)

(b) evidence that the threatening process could cause a listed threatened species or ecological community to become eligible for listing in another category representing a higher degree of endangerment:

(c) evidence that the threatening process adversely affects two or more listed threatened species (other than conservation dependant species) or two or more listed threatened ecological communities:

The restricted threatened species Darwin palm; *Ptychosperma bleeseri (macarthurii): EPBC* endangered, and Yellow-snouted gecko; *Diplodactylus occultus: EPBC* case under consideration, are both highly susceptible to the impacts of the spread of gamba and associated changes to fire regimes.

Darwin palm

"The Darwin Palm is only found in eight small rainforest patches east of Darwin, within the Adelaide and Howard River system. It occurs over an area 30 kilometres long by 20 kilometres wide. Three of the eight rainforest patches occur within the Black Jungle Conservation Reserve, with the remainder occurring on freehold or pastoral lease land.

"Threats include invasion by weeds, habitat degradation by feral animals and changes in water quantity and quality as a result of changing land use in the catchment…Intense fires also threaten regeneration as they kill adult plants. Frequent fires prevent seedlings and young palms from growing while also allowing weeds to become established."

From**:** *Darwin Palm: **Threatened Species Day Fact Sheet,*** Department of the Environment and Heritage, 2003.

Yellow-snouted gecko

"The yellow-snouted gecko is endemic to the Northern Territory and is known from only a few locations. Until the recent discovery of this species on Wildman Reserve, previous records were limited to only three specimens, all from the northwest of Kakadu National Park (King *et al.* 1982)… This species appears to be restricted to lowland open forests in the adjoining Mary, Wildman and West Alligator catchments. Fire regimes in this environment and this region have been the subject of a series of recent studies. These have concluded that the current regime is different to the historic regime, and is now characterised by an increased extent of fires and more intensive fires because of a higher frequency of fires in the late dry season (e.g. Andersen *et al*. 1998, 2003, in press). The current fire regime is regarded as being too frequent for biodiversity conservation (Pardon *et al*. 2003; Woinarski *et al*. 2004; Woinarski in press; Andersen *et al*. in press). Compounding this change, the Wildman and Mary River catchments have been extensively invaded by exotic pasture grasses, particularly gamba and mission grass. These grasses are also increasing within Kakadu NP. Studies of these exotic grasses in open forests in Wildman River reserve suggest that fuel loads are increased 3-5 times and fire intensities eight-fold relative to comparable open forests with native grasses (Rossiter *et al*. 2003). Such hotter fires are likely to increase the mortality of terrestrial geckoes and their eggs, to reduce the leaf litter in which they shelter, and to increase predation risks."

From: DEH Nomination for listing as threatened species, accessed at: http://www.deh.gov.au/biodiversity/threatened/nominations/pubs/yellow-snouted-gecko.pdf

Additional Information on a Threat Abatement Plan (not compulsory):

A threat abatement plan is needed and should address such factors as:

- constraints/bans on sale or movement of Gamba;
- strategic approaches to elimination;
- assessment of efficacy of different control mechanisms;
- monitoring and reporting invasions/control measures;
- incentives for removal;
- options for pastoralists for less harmful alternatives.

Reference and reading list

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Rossiter, N.A., Setterfield, S.A., Douglas, M.M. and Hutley, L.B. (2003). Testing the grass-fire cycle: exotic grass invasion in the tropical savannas of northern Australia. *Diversity and Distributions* 9: 169-176.

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