Department of **Agriculture, Fisheries and Forestry**
Biosecurity Queensland

Invasive species risk assessment

Para grass

Urochloa mutica

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Front cover: Para grass along Bulimba Creek, Brisbane

Photo: Courtesy of Sheldon Navie

Contents

Summary

Para grass (*Urochloa mutica*) is a semi-aquatic plant native to tropical Africa. It was introduced into Queensland around 1880 to reduce soil erosion along the banks of waterways. Since then, it has spread over most of its potential range, assisted by deliberate cultivation as a 'ponded pasture' grass.

Currently, para grass is abundant in freshwater wetland habitats throughout much of coastal and sub-coastal Queensland. However, there may be significant wetlands in Cape York that are still vulnerable to invasion.

Under favourable conditions, para grass can form pure stands, replacing native wetland plants and interfering with aquatic ecosystems. It is a significant pest in Kakadu National Park where it dominates substantial areas of tropical floodplain and affects native birdlife. In North Queensland, it blocks irrigation ditches designed to drain sugar cane crops and amplifies sedimentation problems in creeks.

Dispersal is generally via broken stem fragments, which are carried downstream, but to a lesser extent from seeds.

Para grass is listed as a weed in at least 34 countries and is recognised as a 'serious' problem in Fiji, Thailand, Sri Lanka, Colombia, Hawaii, Jamaica, Malaysia, Peru, the Philippines, Puerto Rico and Trinidad.

This assessment provides evidence that para grass has significant negative impacts in Queensland, despite its use as pasture.

Introduction

Identity and taxonomy

Species identity: *Urochloa mutica* (Forsk.) T.Q. Nguyen

Synonyms: *Brachiaria mutica* (Forsk.) Stapf, *B. purpurascens* (Raddi) Henr., *Panicum muticum* Forsk., *P. purpurascens* Raddi., *P. barbinode* Trin., *P. guadaloupense* Spreng. ex Steud., *P. spectabile* (name associated with an original introduction to Queensland from Kew)

Common names: Para grass (Africa, Australia, United States), Bancroft grass, buffalo grass, California grass, Dutch grass, giant couch, giant panicum, Mauritius signal grass (South Africa), Scotch grass, signal grass, African wonder grass.

Family: Poaceae

Para grass was first described as *Panicum muticum* by Forsskal in 1775. It was moved to *Brachiaria* in 1919 by Otto Stapf, keeper of the Kew Herbarium. The current combination *Urochloa mutica* was published in 1966.

Urochloa is a paleo-tropical genus comprising 12 species native mainly to the African savannas (Torres-Gonzalez and Morton 2005).

Several cultivars have been developed: 'TARS' in Australia; 'Sao Palo', 'Comum' and 'Fino' in Brazil; 'Medellin' in Columbia; 'Parana' and 'Aguada' in Cuba; and 'Lopori' in Zaire. A form from Rippon Falls is widely cultivated in Southern Zimbabwe under the name 'Tanner grass' (Cook et al. 2005).

Description

Para grass is a stoloniferous grass, generally around 1 m tall (see Figure 1). It can form pure stands in low-lying, seasonally-flooded wetlands (see Figure 2). When growing along the banks of deep waterways it has stems that float over the water surface (see Figure 3).

Figure 1: Para grass (photograph courtesy of Sheldon Navie)

Figure 2: Pure stand of para grass on a highly disturbed urban floodplain adjacent to Bulimba Creek, Brisbane (photograph courtesy of Sheldon Navie)

Figure 3: Para grass floating in deep water (stems are rooted to the bank) (photograph courtesy of Sheldon Navie)

Wipff and Thompson (2006) provided the following botanical description: 'Plants perennial; stoloniferous, straggling. Culms to 5 m long, long-decumbent and rooting at the lower nodes (see Figure 4), vertical portion 90–200 (300) cm; nodes villous. Lower sheaths with papillose-based hairs (see Figure 5), these more dense distally, margins ciliate; collars pubescent; ligules 1–1.5 mm; blades 7.5–35 cm long, 4–20 mm wide, glabrous or sparsely pilose on both surfaces, margins scabrous. Panicles ('flowering spikes') 10–25 cm long, 5–10 cm wide (see Figure 6), pyramidal, with 10–30 spikelike branches in more than 2 ranks; primary branches 2.5–8 cm long, 0.4–0.9 mm wide, ascending to divergent, axils pubescent, axes flat, glabrous or with a few papillose-based hairs, secondary branches present or absent; pedicels shorter than the spikelets, scabrous, sometimes with hairs. Spikelets 2.6–3.5 mm long, 1–1.4 mm wide, mostly in pairs, in 2–4 rows, appressed to the branches, purplish to green. Glumes scarcely separate, rachilla internodes short not pronounced; lower glumes 0.6–1.1 mm, $1/5$–$1/3$ as long as the spikelets, glabrous, 0–1(3)-veined; upper glumes 2.6–3.5 mm, glabrous, 5–(7)-veined, without cross venation; lower florets staminate; lower lemmas 2.6–3.3 mm, glabrous, 5-veined, without cross venation; upper lemmas 2.3–2.8 mm long, 1–1.3 mm wide, apices rounded, mucronate; anthers 1–1.5 mm. Caryopses 1.8–2 mm.'

Figure 4: Roots emerging from stem-nodes (photograph courtesy of Sheldon Navie)

Figure 5: Hairy basal leaf sheath of para grass (photograph courtesy of Sheldon Navie)

Figure 6: Flowering para grass (photograph courtesy of Sheldon Navie)

Reproduction and dispersal

Para grass reproduces from seeds and from broken segments of stem (stolons) that can produce new roots at their nodes. It was actively planted (and dispersed) for use as a pasture grass within constructed pondage banks, since at least the 1930s in Queensland and the Northern Territory (Anning and Kernot 1991; Wildin and Chapman 1988). It was this promotion that led to the first broad-scale dispersal of this species in some areas.

As with other exotic ponded pasture species, para grass cannot be contained in ponded pasture systems and will inevitably escape, mainly during floods. Sometimes this species is intentionally planted into natural wetlands, where it is dispersed by flowing water, especially during floods. Dispersal may also occur through birds transporting material (Humphries et al. 1991). This species is mostly found in areas that experience seasonal flooding associated with summer rainfall.

Over most of its range, para grass can produce seeds. However, in northern New South Wales, reproduction is usually only vegetative (Humphries et al. 1991). Grof (1969) speculated that para grass may need humid tropical conditions to produce viable seeds. The degree to which seeds and/or vegetative propagation contribute to the establishment of stands of para grass in different areas of Queensland is unknown. However, Wesley-Smith (1973) observed that in the Northern Territory, para grass plants that were established did not produce viable seed and in order to produce viable seed, the plant needed to have been established from seed. If seed production does occur, seed yields are low but the percentage of viable seeds produced is high. There also appears to be no dormancy period for the seed to germinate (Bogdan 1977).

Seed production can be up to 31 kg/ha (FAO 2006). Since seed production is commonly apomictic, genetic variation is minimal. In North Queensland, flowering commences in March with flowers emerging progressively over three weeks.

Some authors state that there is no seed dormancy (Grof 1969). However, in the Northern Territory, a low germination rate recorded for fresh seeds was attributed to seed dormancy. Germination of that seed improved after 6–8 months storage (Cameron 2002). Germination rates after 2 months storage range from 51–57%. There may be two para grass ecotypes in the Northern Territory. A naturalised line, which was introduced in about 1910, does not produce viable seed and must be planted vegetatively.

Seed longevity is not known. However, a related species, liverseed grass (*Urochloa panicoides* P. Beauv.) has 1% seed viability after 2 years buried 0–2 cm deep, and 20% when buried 10 cm deep in a controlled, non-disturbed experiment (Walker et al. 2006).

Native range and global distribution

Para grass is native to tropical areas of western and northern Africa (Parsons 1972; Lazarides 1980). In the 1800s, there was confusion about its origin, with suggestions that it was native to South America. Smith (1979) noted that 'this grass was probably established in tropical America in the early days of trading' and was also 'described from Brazilian specimens' as *P. purpurascens* (in 1823) and *P.barbinode* (in 1829) (Stone 1970). Parsons (1972) claims it was introduced into Brazil before or during the 1820s and naturalised there. From Brazil, it spread to other parts of America (Parsons 1972).

Para grass has been used as a pasture plant since at least 1849 (Cameron and Kelly 1970) and has been introduced into most tropical countries (see Figure 7). It provides considerable economic benefits in the South and Central American tropics and is cultivated on a large scale in Fiji, the Philippines, Puerto Rico, Cuba, humid West Africa and Zimbabwe (Bogdan 1977). Other places where it has naturalised include most parts of South-East Asia, India, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Republic of Palau, Christmas Island, Cook Islands, French Polynesia, Galapagos Islands, Hawaii, Kermadec Islands, New Caledonia, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu, Wallis and Futuna Islands, New Zealand, Taiwan, Thailand, Cambodia, Vietnam, Malaysia (PIER 2006), USA (McCann et al. 1996), Sri Lanka, Jamaica, Trinidad, Borneo and Mauritius (Holm et al. 1991).

Figure 7: Global distribution of para grass (GBIF 2011).

Current distribution and impact in Australia

Para grass is widespread and locally abundant in suitable freshwater wetland habitats throughout coastal and sub-coastal Queensland (see Figure 8).

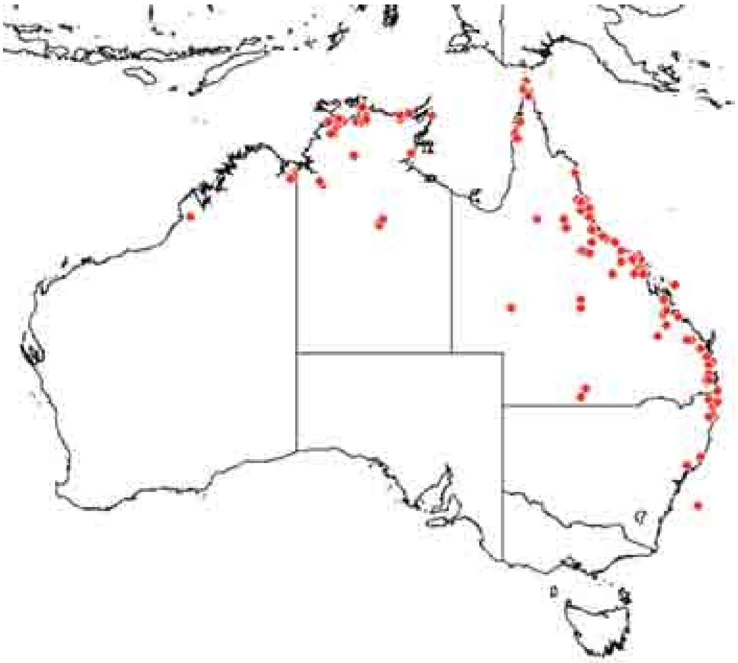

Figure 8: Australian distribution of para grass (specimen data reproduced from Australia's Virtual Herbarium (AVH 2011) with permission of the Council of Heads of Australasian Herbaria Inc.)

By 1995, some 26 000 ha in Queensland were being utilised as ponded pasture with most of this area containing para grass (Weier et al. 1995). By 1991, at least 21 800 ha of ponded pastures had been constructed in central Queensland, with most containing para grass as the dominant plant (Cummins 1991). Para grass is estimated to cover 100 000 ha of natural wetlands in Queensland (Walker and Weston 1990) and 40 000 ha in the Northern Territory (Low 1997). In some places it forms pure stands that have replaced other vegetation (see Figure 9).

Figure 9: Pure stand of para grass along the margin of a natural wetland in Brisbane (photograph courtesy of Sheldon Navie)

It is absent from a number of significant wetlands in remote areas where it has not been planted as fodder, such as national parks on Cape York Peninsula (J. Clarkson, Department of Environmental Resource Management (DERM), pers. comm. 2006).

In the Northern Territory, para grass is causing serious problems in Kakadu National Park, where it dominates extensive areas of shallow seasonal freshwater wetlands.

In Western Australia, para grass has been recorded along creeks and swamps at Yanchep, and in the Kimberley at Turkey Creek and the Ord River (Hussey et al. 1997).

Para grass chokes streams and wetlands, slowing water flow and causing increased sedimentation within the waterbody (Humphries et al. 1994; Arthington et al. 1983; Bunn et al. 1998). In North Queensland, Bunn et al. (1998) recorded a sediment load of 20 000 t/km in a stream choked with para grass and running through sugar cane crops. The latter study also estimated an 85% reduction in channel discharge capacity, as a consequence of para grass-related sedimentation. Such hydrological and morphological changes to streams, caused by para grass, have been blamed for causing increased flooding.

Bunn et al. (1997) suggest increased sedimentation of streams caused by para grass may have a smothering effect on benthic species by creating anaerobic conditions. Loss of benthic organisms can have significant negative effects on wetland food chains.

In natural wetlands, para grass can affect nesting habitat and reduce feeding areas for waterfowl such as magpie geese (*Anseranas semipalmata*) (Humphries et al. 1994), which has one of its last remaining dry-season refuges in Kakadu National Park. Para grass replaces *Oryza rufipogon* and *Eleocharis* species, which are preferred nesting sites and which provide stable food resources for magpie geese (Frith 1977; Cowie and Werner 1993; Douglas et al. 2001; Corbett and Hertog 1996). In the Townsville Town Common Conservation Park, para grass is displacing water chestnut (*Eleocharis dulcis*), a major food resource for magpie geese and brolgas (Low 1997).

The impacts of para grass on fish habitats has not been widely studied. In a study of ponded pastures in Central Queensland, Hyland (2002) found that barramundi were absent from shallow (<1 m) wetlands dominated by para grass but were present in para grass along the edge of deep water (>2 m).

There is a common belief that para grass can irreversibly destroy the structure and function of a natural wetland ecosystem (Humphries et al. 1990), even in the absence of large-scale disturbance (Cowie and Werner 1993). There is no doubt that, when conditions are suitable, para grass can form extensive pure stands, displacing a suite of native plant species. For example, a study in Taiwan found that para grass comprised 27–35% of total wetland vegetation 1 year after its introduction, 91–93% in 2 years and 100% soon after (Wang et al. 1969).

On the floodplains of the Northern Territory, Douglas et al. (2001) found that para grass invasion has significant negative effects on wet season terrestrial invertebrate biodiversity, but less impact on aquatic invertebrate or fish communities. Minimal impact on aquatic invertebrates and fish might be due to the reliance of such organisms on epiphytic algae, which grow equally well on para grass and native macrophytes. Douglas et al. (2001) state, however, that native bird and mammal species rely heavily on native grass seeds and are negatively impacted by para grass. The latter authors observed a significant negative effect of para grass on native vegetation of the Magela Creek Floodplain in Kakadu National Park. Compared with native rice (*Oryza meridionalis*) and native hymenachne (*Hymenachne acutigluma*) grass communities, para grass habitats had markedly different plant composition and significantly lower plant biodiversity, particularly during the dry season. On the Magela Creek Floodplain, para grass occupied a broad range of habitats from *Melaleuca* woodland fringing the floodplain to the edges of permanent billabongs within the floodplain. Para grass occurred across a wide range of water depths and therefore has the potential to spread widely, reducing habitat diversity (Douglas et al. 2001). If para grass reduces the abundance of waterbirds, such as magpie geese, and degrades the unique appearance and character of natural wetlands, it may have a negative impact on tourism, particularly in Kakadu National Park.

Para grass has very different fuel characteristics compared to the native grasses it has replaced on Magela Creek Floodplain in the Northern Territory (Douglas and O'Connor 2004). For example, para grass produces approximately twice the dry-season fuel load of annual wild rice (*Oryza meridionalis*). While para grass has a similar fuel load to the native perennial *hymenachne*, it tends to produce taller, drier fuel making it more likely to burn each dry season. This may facilitate the displacement of native *hymenachne*, which is fire sensitive. Increased flame height and intensity damages fire-sensitive woody vegetation including paperbark forest and rainforest. On the Magela floodplain, para grass surrounds stands of dead, deeply fire-scarred paperbark trees and is responsible for a reduction in the area of monsoon vine forest adjacent to the floodplain. More intense fires pose a threat to turtles (*Chelodina rugosa*) that aestivate in the floodplain soil during the dry season. Turtles have been found dead in para grass, presumably unable to dig through the dense fuel to the soil, or killed by fire even while buried.

In coastal North Queensland, poor drainage (excessive waterlogging) can reduce yields of sugar cane by up to $100 000 per property per annum. Cane growers invest heavily in the construction and maintenance of drainage ditches and para grass often dominates such infrastructure, requiring constant removal. In the Babinda area alone, an estimated $23 000 is spent each year on herbicide to control para grass (Fisk 1991). Over the entire sugar cane growing area of North Queensland, control costs are likely to be several hundred thousand dollars per annum.

Para grass is an alternative host for a number of agriculturally important pests and diseases, including *Cassytha filiformis* (a parasitic plant), *Helminthosporium* sp., *Piricularia oryzae* (blast of rice), *Pythium arrhenomanes* (root rot of sugarcane), *Pythium artotrogus* (root rot of sugarcane), *Pythium rostratum* (root rot of sugarcane), *Sclerospora graminicola* (pearl millet downy mildew), *Chirothrips mexicanus* (grass seed-feeding thrips) and *Thaia oryzipvora* (rice leafhopper) (Holm et al. 1991).

The benefits of programs to remove important weeds such as *Mimosa pigra* in northern Australia may be jeopardised if areas formerly occupied by *M. pigra* are subsequently invaded by para grass (Douglas et al. 2001).

In Brazil, para grass is one of several aquatic plant species that has caused significant damage to infrastructure associated with hydroelectric dams (Costa et al. 2006).

Preferred habitat and climate

Para grass prefers naturally open, shallow, tropical freshwater wetlands and associated floodplains, including the margins of rivers, creeks and lakes. While disturbance does not appear to be a prerequisite for invasion in tropical floodplains, para grass does tend to favour creek and river banks where the original cover of native riparian trees has been cleared or damaged. It tends to be absent from riparian areas that have retained a thick cover of trees or other vegetation tall enough to produce shade.

Para grass is well adapted to withstand waterlogging and long-term flooding and has evolved hollow stems and large aerenchyma in its roots, which allows the roots to develop under low soil oxygen levels. Many authors state that para grass cannot survive in permanent water deeper than 0.3 m–0.6 m (Anning and Hyde 1987; Clarkson 1991; Low 1997). However, it can tolerate prolonged periods in deeper water and has been observed in water up to 2.2 m deep on the Magela floodplain in the Northern Territory (Douglas et al. 2001). This is presumably an adaptation to seasonal flooding.

Para grass has been recorded at elevations ranging from sea level to 1500 m (FAO 2006; Henty 1969), but always in wet sites. In Hawaii, para grass is 'naturalised and common at elevations between sea level and 1060 m' (Wagner et al. 1999), but can persist at elevations up to 1200 m (Smith 1985). In Fiji, it is 'widespread from sea level to about 800 m' (Smith 1979).

In subtropical South East Queensland, para grass is most often seen along the banks of creeks and rivers, in cleared, flood-prone lowlands and in low-lying roadside drains (see Figure 10).

Figure 10: Para grass in a roadside drain in the Gold Coast hinterland, South East Queensland (photograph courtesy of Sheldon Navie)

Preferred soil types are wet or seasonally flooded alluvial (hydromorphic) soils. According to O'Brien et al. (1973), it forms dense stands on alluvial soils, montmorillonitic and kaolinitic clays rich in organic matter, iron and aluminium. Preferred soil pH ranges from 4.4 to 5.5 (O'Brien et al. 1973). It can grow on deep loamy soils overlying saline clays and along the margins of saline (marine) floodplains.

Para grass is adapted to high-rainfall tropical and subtropical conditions, but in protected areas it can persist with rainfall as low as 900 mm per year (FAO 2006). There are varying opinions as to the required level of annual rainfall with O'Brien et al. (1973) stating that it prefers 900–1300 mm per annum and Lazier (1980, 1981a, 1981b) stating that it requires 1500 mm. NewCROP (1997) states it can tolerate an annual rainfall of 4100 mm. Para grass does not persist on dry land in arid or semi-arid areas (Bogdan 1977). While preferring wet areas para grass can withstand dry periods (NewCROP 1997; Cameron 2003), but there is little growth during dry weather (Lazier 1981; NewCROP 1997).

According to NewCROP (1997), para grass prefers an annual temperature range of 18.7 °C to 27.4 °C. A mean annual temperature of 21 °C is optimal for growth (Russell & Webb, 1976). Allen & Cowdry (1961) claim that para grass growth does not occur until the daily minimum temperature exceeds about 15.5 °C. Para grass is badly damaged by frost but can regrow after (NewCROP 1997). It does not tolerate temperatures below 8 °C (Wheeler 1950).

History as a weed overseas

There is ample evidence that para grass is a significant weed overseas. Holm et al. (1991) listed para grass as a weed in 34 countries and as a 'serious' weed in Fiji, Thailand, Sri Lanka, Colombia, Hawaii, Jamaica, Malaysia, Peru, the Philippines, Puerto Rico and Trinidad. In South East Asia, para grass is a troublesome weed of coconut plantations, nurseries and rice (Lazarides 1980; Khan et al. 1996). In Florida, it is a weed of drainage lines and agricultural fields (McCann et al. 1996). Floods can dislodge large rafts of para grass, which float downstream to the sea and interfere with marine navigation. In many tropical countries, para grass forms pure stands in wetlands that displace native plants and destroy bird habitats.

History of introduction into Queensland

There is evidence that para grass was originally introduced into Australia on at least three occasions in the 1880s and early 1900s. Planting material was sourced from Indonesia, Fiji and Kew Gardens (England). Its arrival in Queensland was recounted by Middleton (1991):

'*The first introduction to Queensland in about 1880 was credited to Dr Joseph Bancroft who received seed from Baron von Mueller at Kew (Bailey 1902; 1908). It was commonly called Bancroft grass in the early years. A second introduction of para grass to Queensland and the first recorded commercial planting took place in 1884. The Colonial Sugar Refining Co introduced it from its Fiji plantations and planted it on the banks of the Herbert River to control soil erosion (Cameron and Kelly 1970). After its initial introduction it was extensively planted in the early 1900s on swampy country in northern New South Wales and south-eastern Queensland (Barnard 1969). By the mid 1930s, "it was grown in scattered areas right along the eastern seaboard with heavy rainfall, and to a lesser extent in frost free areas up to 100 miles inland" (Winders 1937). Evidence suggests it had already colonised the cleared areas to which it was naturally adapted. Para grass was ideally suited to the tropical lowlands of North Queensland and its expanded use after 1930 closely parallels the developing beef industry in that area. Small-scale development for beef had commenced on the tropical lowlands in the latter part of the 19th century (Marriott 1960; Bolton 1972). However, several factors collectively limited a viable beef industry prior to the late 1930s. These included the dominance of sugarcane, the decimation of cattle herds by ticks between 1894 and 1902 (Jones 1961; Bolton, 1972) and the lack of effective carcass chilling methods until the early 1930s (Seddon and Mulhearn 1939; Jones 1961). From mid 1930 active development of lowland areas in the wet belt commenced. Prominent among the pioneers was Bruce Henry of "Riversdale" Tully who established extensive areas with the artificial grasses, para grass and Guinea grass (Jones 1961).*'

The earliest specimen at the Queensland Herbarium was collected by Dr Joseph Bancroft in April 1895 near Burpengary in South East Queensland.

The arrival of para grass in the Northern Territory is also believed to have occurred twice, once before 1890 and again between 1905 and 1910. In the 1891 South Australian Parliamentary Papers, Maurice Holtze wrote, ‘I have to thank Sir Ferd. Baron von Muller, Government Botanist of Victoria, for … the true Panicum spectabile or coapim grass.’ The description of this ‘coapim grass’ is consistent with that of para grass (Wesley-Smith 1973). Wesley-Smith (1973) attributed the second introduction to Judge Charles E. Herbert, the Government Resident in Darwin. Judge Herbert is believed to have visited the Indonesian region during his term of office and brought back cuttings of two grasses *P. muticum* and *P. barbinode* (both now treated as synonyms of *U. mutica*) as runners, which were planted on the properties ‘Koolpinyah’ and ‘Oenpelli’. This grass was known locally as ‘Kopang grass’ (Wesley-Smith 1973). This ’local’ Northern Territory para grass, that does not produce seed, is still known from Oenpelli Mission, Stapleton Station and the wet and low-lying areas around Darwin including The Narrows, Winnellie and the Botanic Gardens (Cameron 2002).

Para grass has been actively promoted over the past 40 years to sectors of the agricultural community as a ponded pasture grass (Humphries et al. 1994). This promotion led to its rapid dispersal in Western Australia, the Northern Territory, Queensland and New South Wales (Lazarides et al. 1997; Humphries et al. 1994).

In a 1996–97 survey of northern Australian beef producers, 20% of respondents in the Central Queensland coastal region, 20% in the central highlands, 7% in the Maranoa southwest, 23% in North Queensland, 26% in the Northern Territory and 8% in Western Australia said they had planted para grass in pasture improvement programmes (Bortolussi et al. 2005).

The negative impacts of para grass were first recognised in Australia at least 70 years ago. Winders (1937) noted, ‘para grass has come to be looked upon with disfavour in certain areas (particularly on the Upper Tweed River in New South Wales), because of its habit of invading irrigation channels and small streams and impeding the flow of water. The grass may also assume pest proportions.’

Letts (1960, cited in Cowie and Werner 1993) noted that para grass had invaded several thousand hectares of the East Alligator River floodplain in the Northern Territory, over a period of 60 years.

Uses

Para grass has been used as pasture in Australia since its introduction in 1849. It is currently used extensively for grazing and cut fodder in most tropical and subtropical countries that have sufficient rainfall (Cameron & Kelly 1970). It can also be useful for stream bank and stream erosion control and on steep slopes where rainfall and soil allows vigorous growth.

Pests and diseases

Para grass in Australia has three main insect pests in Queensland. The most important is the pasture leafhopper (*Toya* sp.), which can cause severe damage that leads to the observed 'leafhopper burns' in wet winters. The other two pests, which cause leaf damage, are the caterpillars of the common armyworm (*Mythimna convecta*) and dayfeeding armyworm (*Spodoptera exempta*) (Elder & O'Brien 1996).

There is also a coccid bug that attacks para grass with an associated sooty mould fungus (*Capnodium* sp.) that causes damage to young leaf shoots (Cameron & Kelly 1970).

There is a recent report from Columbia that para grass is a host for the sugarcane rootstock weevil *Apinocis subnudus*.

Potential distribution and impact in Queensland

Walker and Weston (1990) suggest para grass has the potential to spread over an additional 100 000 ha in Queensland. However, Middleton (1991) argues that since para grass has existed in Queensland for over 100 years it has had ample time to fill its entire potential range.

While a range of habitat factors, such as water depth, period of inundation, soil moisture, percentage shade, salinity and soil-water nutrient status will influence the potential distribution and abundance of para grass in Queensland, temperature is a particularly influential factor. As such, the climate-modelling software, Climex (Skarratt et al. 1995), was applied to predict the total area where temperature alone appears suitable (see Figure 11).

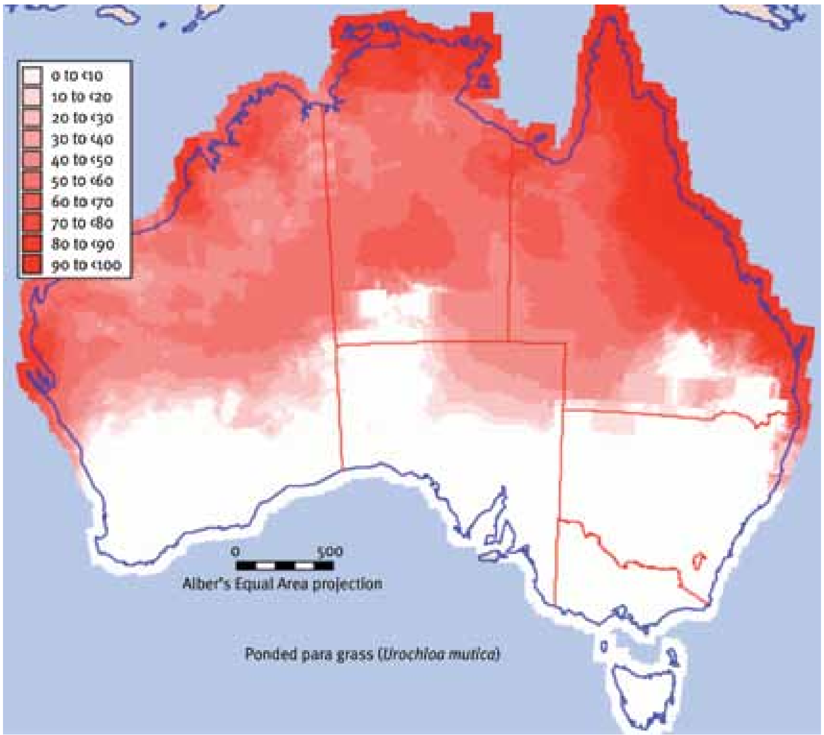

Figure 11: Areas of Australia where temperature appears suitable for para grass (map generated using Climex), based on the assumptions that temperature will determine broad distribution and that there will be suitable wetland habitats anywhere within this range.

As such, any areas of suitable wetland habitat within the bright red areas in Figure 11 are predicted to be highly suitable for para grass. Parameters used to define this area included a minimum temperature of growth of 15.5 ˚C (Allen & Cowdry 1961) and frost sensitivity below 8 ˚C (Wheeler, 1950). An assumption was also made that plants growing in water will be somewhat protected from frosts.

If it is accepted that the distribution will be determined by rainfall as well as temperature, the predicted range is more limited to areas closer to the coast (see Figure 12).

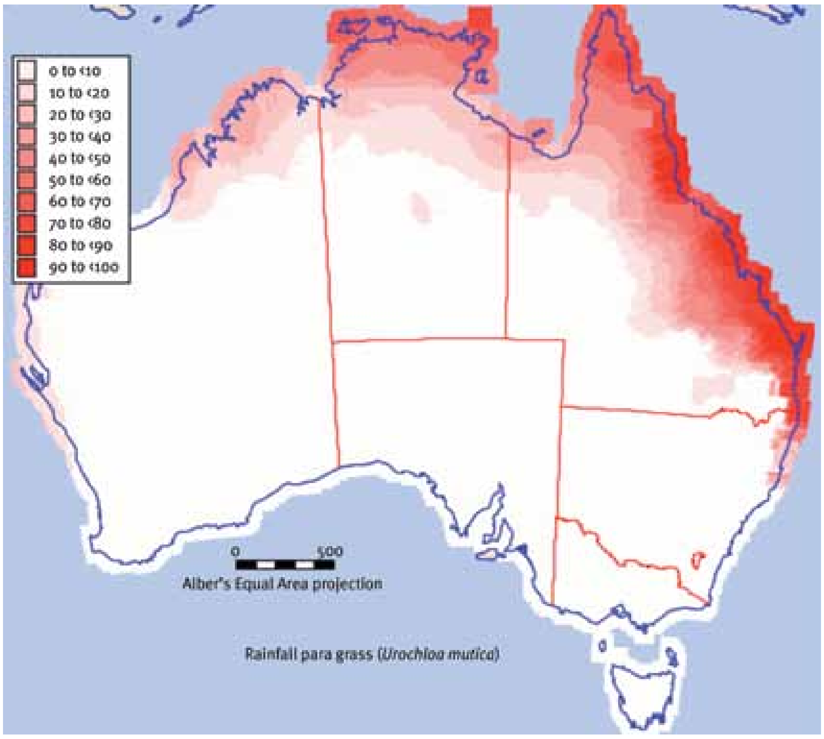

Figure 12: Areas of Australia where temperature and rainfall are suitable for para grass (map generated using Climex).

While para grass has probably spread over much of its potential range, there may be potential for it to become more abundant in certain areas. Two important areas at risk appear to be Cape York, where substantial areas of wetlands are still free of para grass and perhaps some other wetlands in North Queensland. The northern region of the Queensland Parks and Wildlife Service (QPWS) considers that para grass, Aleman grass and hymenachne pose significant threats to the biodiversity of tropical wetlands (Paul Williams, QPWS, pers. comm. 2006). Para grass is a threat to wetlands in a large proportion of northern region protected areas, including the Bowling Green Bay wetlands, listed under the international Ramsar Convention on Wetlands agreement.

Experience in the Townsville Town Common Conservation Park, shows that para grass can smother hundreds of hectares of wetlands and is almost impossible to remove, even when grazed and burnt (Williams et al. 2005). QPWS believes intensive burning and/or grazing treatments cannot be broadly used across the protected area estate.

The impact of para grass on sugar cane drainage ditches in north Queensland may increase marginally over time. Similarly, it may increase in abundance elsewhere in the state, particularly wherever native riparian vegetation is destroyed or damaged, and wherever the water quality within our creeks and rivers becomes degraded.

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