Department of **Agriculture and Fisheries**
Biosecurity Queensland

Invasive plant risk assessment

African lovegrass

Eragrostis curvula

Steve Csurhes, Catherine Leigh and Craig Walton

First published 2012
Updated 2016

Queensland Government

Front cover: *Rhizophora mangle*

Photo: Used with permission, Wikipedia, GNU Free Documentation License, ‹http://en.wikipedia.org/wiki/File:Red_mangrove-everglades_natl_park.jpg›

Contents

Summary 4

Introduction 5

Identity and taxonomy 5

Taxonomy 5

Description 6

Reproduction and dispersal 8

Origin and distribution 10

Status in Australia and Queensland 10

Preferred habitat 13

History as a pest elsewhere 14

Uses 15

Current and potential impacts in Queensland 16

References 18

Summary

African lovegrass (*Eragrostis curvula*) is a morphologically variable perennial plant native to semi-arid upland areas of subtropical southern and eastern Africa. There are at least six cultivars (forms) of the species, with significant differences in yield and invasiveness.

Since its introduction prior to 1900, African lovegrass has become widespread and abundant across southern Australia, including south-east Queensland. In most places it is restricted to roadsides and nearby open pastures and woodlands that have naturally sparse or disturbed ground cover. There is some evidence that prolonged or heavy grazing can favour dominance by African lovegrass. It almost always grows on sandy or otherwise light-textured (free-draining) soil types, including some red soils.

Reproduction is via small, light seeds that are dispersed by water, animals, earthwork machinery and vehicles, and as a contaminant of various materials such as grain, soil and fodder. Roadside slashing equipment is commonly blamed for spreading seeds. Seed longevity is unknown.

Naturalised African lovegrass is generally unpalatable to livestock for most of the year, although a more palatable cultivar 'consol' has been developed through selective breeding. Dense growth of unpalatable forms is accused of reducing pasture productivity, primarily on sandy soils. The species is generally not suited to clay soils.

In some places, African lovegrass is subject to control along roadsides, thereby imposing costs on local governments. While this study was unable to find any data on the economic impacts of African lovegrass in Queensland, there is anecdotal evidence that African lovegrass is having a negative impact on the grazing industry. Research is required to explore and quantify its economic impact. There is published evidence from the United States and Japan that African lovegrass can exclude locally native plant species, including endangered species. However, its environmental impact in Queensland is poorly studied and robust conclusions are difficult to make.

Climate modelling suggests that African lovegrass has already spread over most of its potential range. However, there is general agreement among landholders that it is becoming more abundant in some areas, perhaps in response to continued landscape disturbance and a general loss of more palatable grasses caused by prolonged grazing pressure.

Excluding African lovegrass from un-infested areas, via property-level quarantine and early detection, is perhaps the best control method for African lovegrass. For large infestations reasonable control can be achieved using herbicides, but effective long-term management generally involves some form of pasture renovation involving ploughing and re-sowing better quality pasture species.

Introduction

Identity and taxonomy

Species identity: *Eragrostis curvula* (Schrad.) Nees

Synonyms: *Poa curvula* Schrad. (1821) (Stanley and Ross 1989; PNP 1999), *E. chloromelas* Stuedel (1854), *E. jeffreysii* Hack. (1908) (Randall 2002)

Common names: African lovegrass, blue lovegrass, weeping lovegrass, Ermelo lovegrass, weeping grass, wire grass, pasto llorón (Peru), Boer lovegrass (Conferta type), oulandsgras (Africa), fyngras (South Africa)

Taxonomy

Eragrostis curvula (Schrad.) Nees (1841) is a member of the Poaceae family. Closely related genera include *Cynodon*, *Sporobolus* and *Spartina*. There are approximately 300 recognised species of *Eragrostis* worldwide, mainly in tropical and subtropical regions (Stanley and Ross 1989; Harden 1993). There are 69 species of *Eragrostis* in Australia, with 52 of these native and the remainder introduced (Harden 1993). There are 60 species in Queensland, with 22 of these found in south-east Queensland (Stanley and Ross 1989), 7 of which are introduced (Hnatinuk 1990).

E. curvula is often referred to as a species 'complex' as there are several 'agronomic types' evident within the species, each with slightly different morphological features (Leigh and Davidson 1968). Such genetic variation has caused considerable taxonomic uncertainty and confusion (for further discussion, refer to Leigh and Davidson 1968; Jacobs 1982; Johnston et al. 1984; Poverene and Voigt 1997). Adding to the confusion is the existence of several closely related species. For example, *E. lehmanniana* was, at one stage, considered as a possible candidate for inclusion within the *E. curvula* complex (Johnston et al. 1984). However, subsequent genetic work by Poverene and Voigt (1997) did not support this inclusion and the two species remained separate. Similarly, another very closely related species, *E. compotonii*, was formally described by De Winter in 1990. This species was collected from Swaziland and there are indications that it hybridises with members of the *E. curvula* complex, since intermediates between the two species have been collected. *E. paniculmis* also appears to hybridise with members of the complex, but this species is not yet recorded in Australia.

Genetic studies using seed isozyme analysis suggest the existence of specific genetic groups within the *E. curvula* complex, based on ploidy level, modes of reproduction and isozyme bands (Poverene and Voigt 1997). The taxonomic types (forms) within *E. curvula* have been named 'curvula', 'robusta green', 'tall chloromelas', 'short chloromelas', 'robusta blue', 'robusta intermediate' (Leigh and Davidson 1968) and 'conferta' (Jacobs 1982). The first four forms are naturalised in Australia (Parsons and Cuthbertson 2001). The types differ in their invasiveness, with different tolerances to environmental conditions and control methods.

Description

The following description is based on a combination of field observations and descriptions in the literature, including Stanley and Ross (1989), Harden (1993), Lazarides (1997), Lamp et al. (2001), Muyt (2001), and Parsons and Cuthbertson (2001).

African lovegrass is a densely tufted, perrenial grass (Wand et al. 2001). Its growth habit varies from erect to prostate, reaching a height of 30–120 cm (Johnston and Cregan 1979; Parsons and Cuthbertson 2001). It is often referred to as a 'bunchgrass' especially in the American literature. Stems can be slender or robust, with green to purple nodes, usually erect but sometimes bent at lower nodes. Leaves are dark green to blue-green. Basal leaf sheaths are keeled, strongly striate, usually hairless but sometimes silky hairy below and are typically straw-coloured or purplish. Ligules have a hairy ciliate rim. Leaf blades are 25–30 cm long, 3 mm wide and are narrow, linear, usually rolled or filiform, and scabrous (rough to the touch) running down towards the base. They arch as they lengthen, tapering towards the tips, which are usually bleached and curled (Muyt 2001). This leaf arching gives the grass its 'weeping' appearance.

Figure 1. Leaves and inflorescence of African lovegrass (photo: Biosecurity Queensland)

African lovegrass has a paniculate inflorescence (the main axis gives rise to branches bearing the spikelets). Young seed heads appear dark in colour, and mature to a paler green. The variable inflorescence is loose or compact, spreading and between 6 cm and 30 cm long. Panicle branches are slightly ascending, with the lower branches sometimes in whorls with hairs in the axils. Solitary spikelets are grey-green, linear-oblong or linear-elliptic, 3–10 mm long and 1–1.5 mm wide, with 4–13 florets. Glumes are 1.5–2.5 mm long, acute and glabrous. Lemmas are keeled, usually scabrous and 2–2.5 mm long. The palea is subequal to the lemma. Seeds are 0.3–0.7 mm long, ellipsoid, creamy to dark orange or brown. A kilogram of seeds contains 3.3–5.5 million seeds.

The fibrous roots are found mainly in the upper 50 cm of soil. African lovegrass displays the hollow crown phenomenon, also known as the central dieback process. This is a morphological characteristic of perennial tussock grasses in which a dead centre will develop over time (Dahl and Cotter 1984, in Wan and Sosebee 2000). Clumps thicken and become more fibrous with age (J Garton 2003, pers. comm., February).

As stated earlier, African lovegrass is morphologically variable. However, several authors (De Winter 1990; Prendergast et al. 1986; Lazarides 1997; Muyt 2001; Eurobodalla Shire Council 2002) have noted a number of distinguishing characters including:

- the absence of short, knotty rhizomes, the presence of which is relatively rare in the genus *Eragrostis*
- the absence of micro hairs on lower leaf surfaces
- black colouration on young seed heads
- prominent nodes on flowering stems
- the hollow crown phenomenon
- sericeous (covered with soft silky hairs) cataphylls (early form of leaves) and basal sheaths
- filiform-capillary blades
- a scaberulous, weakly flexuose rachilla
- a dividing palea
- unequal glumes
- partly naked panicle branches.

The drooping or weeping leaves are said to be a well-known and easily recognised feature of this grass. However, this feature is sometimes less apparent in smaller specimens that tend to have sparse or thin leaf blades. The sericeous basal sheaths and scabrous leaf blades are easy characteristics to identify in the field, by respectively separating the leaf blades gently at their bases and running the fingers along the leaf blades in a downwards direction.

Distinguishing between the numerous agronomic types of African lovegrass can be very difficult (Csurhes and Edwards 1998). The differences between these types are based on leaf colour and size, plant height, stalkiness, habit, inflorescence characteristics, chromosome number (Campbell 1983) and palatability (Muyt 2001). In a survey of 123 New South Wales shires, the only types of African lovegrass that were identified with any confidence were the 'curvula' and the 'short chloromelas' types (Campbell 1983).

Two similar Australian native grasses, *Poa labillardieri* (poa or silver tussock) and *E. parviflora* (a lovegrass), may be confused with African lovegrass (Eurobodalla Shire Council 2002).

Poa tussock has purplish rather than black young seed heads, and tends to be more upright and less weeping. *Eragrostis parviflora* tends to be a smaller plant with long, black to leaden-grey coloured seed heads that are less spreading or more linear than those of African lovegrass. Depending on the botanical experience of the observer, the confusion between these two species and African lovegrass sometimes extends to the entire native Australian *Poa* (tussock grasses) and *Eragrostis* species (Muyt 2001), including the native *E. setifolia* (neverfail), *E. parviflora* (weeping lovegrass) and *E. microcarpa* (dainty lovegrass); and the introduced *E. cilianensis* (stinkgrass), *E. minor* (small stinkgrass), *E. pilosa* (soft lovegrass) and *E. mexicana* (Mexican lovegrass) (Walsh 1994, in NRE 1998, Sharp and Simon 2002, Henry et al. 1995).

African lovegrass is generally not as tall or robust looking as *Sporobolus* spp. (giant rat's tail grass) or *Sorghum halepense* (Johnson grass), and blades tend to be paler and narrower than the wide, green blades of *Panicum maximum* var. *trichoglume* (green panic), which also tends to have rounder, bigger seeds than African lovegrass. Panicle branches of giant rat's tail grass tend to be more upright and less open than those of African lovegrass, panicle height can be up to double that of African lovegrass and panicles are dark when open rather than when young and closed, as in the case of African lovegrass.

Reproduction and dispersal

Unlike many plants, flowering is not triggered by changes in day length (Evans et al. 1964, in FAO 2003). While many references state that flowering generally occurs in summer, Silcock (2005) noted that flowering and seed production can occur at any time after rain, provided temperatures are high enough.

Seeds usually germinate whenever sufficient soil moisture is available (Parsons and Cuthbertson 2001). During the first three weeks of growth, seedlings consist of a single stranded 'seed root' with just a few small branchlets and are highly susceptible to disturbance (Shoop and McIlvain 1970). The permanent 'crown root' starts to develop after this, the seed root disappearing by about the eighth week of growth (Shoop and McIlvain 1970).

Seedlings reach varying degrees of maturity during their first year of growth, with flowers produced in the first or second year depending on conditions (Shoop and McIlvain 1970).

Seeds germinate over a wide range of temperature and soil moisture regimes (Maze et al.1993). Germination is poor on clay soils compared to sandy soils (Leigh and Davidson 1968). In experimental conditions, seeds required two days of high soil moisture (with at least 10 mm of water available over this time) for seedlings to emerge in previously dry sandy soil at temperatures of 24–30 °C (Wester et al. 1986). There was no emergence at 38 °C. Growth is strongly temperature-dependent, with germination occurring any time when temperatures exceed 10 °C, and stem and seed production continuous in warmer zones (Parsons and Cuthbertson 2001). A study by Johnston and Shoemark (1997) demonstrated that two cultivars of *E. curvula*, 'consol' and 'accession 4660', had an ability to delay establishment until conditions became favourable for germination.

Dispersal and general population development seems to be accelerated by disturbance and loss of competitive plant species, especially when land is overgrazed during drought (Anon 1999).

African lovegrass can develop a large soil seed bank (Department of Primary Industries 2001), but seeds appear short-lived, perhaps due to a weak seed coat (Garton 2001). In soils of the Grand Canyon National Park, seeds have been reported to remain viable for one to five years (United States Geological Survey 2002).

Some forms of African lovegrass show low levels of sexual reproduction (i.e. some diploid and tetraploid strains). However, most forms are polyploids that reproduce primarily using a process called apomixis, which does not involve fertilisation and/or meiosis (Voigt 1971, Voigt and Bashaw 1972, 1976). Hence, there is no genetic exchange involved, although flowers and pollen are still produced in the usual way (Johnston et al. 1984) and pollination appears necessary for seed formation (Leigh and Davidson 1968). This means that most forms of African lovegrass tend to breed true to seed, unless cross-fertilisation occurs by some rare chance (Leigh and Davidson 1968). Apomixis conserves extreme genotypes, normally lost during meiosis, and by allowing these extreme genotypes to remain fertile allows greater genetic variation to be passed on within cell lines, resulting in increased physiological plasticity (e.g. the ability to withstand extremes of climate (Voigt and Tischler 1994)) and the preservation of morphological variation.

This study was unable to find published data on seed production rates.

The seeds are small and light and can be dispersed by wind, water, animals, vehicles, equipment and transported soil (Muyt 2001; Panetta and Hopkins 1991; Parsons and Cuthbertson 2001; Animal and Plant Control Commission 2001). Sinclair (2003) found that 47% of seeds consumed by cattle pass through the animal and remain viable. Roadside mowing equipment is often blamed for spreading seeds, although no empirical studies have tested this assumption.

Origin and distribution

African lovegrass is native to East Africa, from Tanzania to Capetown (Silcock 2005)—a range that includes Botswana, Kenya, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, extending into sub-Saharan Africa (Scott and Delfosse 1992). Over its natural range, it is abundant on recently disturbed sites (such as fallowed lands) and in the temperate highlands, and is rarely found in tropical regions (Leigh and Davidson 1968) although it has been introduced through the African tropics mainly as a fodder grass (Gibbs Russell et al. 1991). In South Africa, African lovegrass can be found in all provinces (Fynbos, Savanna, Grassland, Nama-Karoo and Succulent Karoo biomes) (Gibbs Russell et al. 1991).

African lovegrass was probably first introduced into Australia accidentally, possibly as a contaminant of imported pasture seeds, prior to 1900 (Parsons and Cuthbertson 2001). Several deliberate imports were made over the years, including for use as a productive sown pasture plant and for soil stabilisation (Lazarides 1997; South Australian Animal and Plant Control Commission 2001; Muyt 2001; Parsons and Cuthbertson 2001). Imported seeds were sourced from several places. Seeds from collections in Oklahoma, United States, were transported and established in south-eastern Australia (Lloyd et al. 1983; Watt 1983, in Cox et al.1987) in 1947 and 1953. This material was originally collected in north-central Tanzania in 1927 (Crider 1945, in Cox et al. 1987) growing in black, sun-cracked soil at elevations between 1300 m and 1800 m. Original seeds for the 'consol' cultivar came from South Africa, and have been primarily selected for their palatability to sheep (Lamp et al. 2001). 'Consol' was officially released for commercial use in Australia in 1982.

African lovegrass was first collected in Queensland in 1928 from Ballandean (Queensland Rural Land Protection Board 1993).

African lovegrass has naturalised in several countries, including Argentina, Bolivia, Burma, Columbia, India, Japan, Madagascar, Mexico, New Zealand, Papua New Guinea, Peru, Spain and the United States (Cox 1984; Holm et al. 1991; Lazarides 1997; Missouri Botanic Gardens 2003). In the United States, its range includes Arizona (Bock et al. 1986); California (CalFlora 2002); the southern High Plains of Texas (McFarland and Mitchell 2000); the Brevard, Gadsden, Hillsborough, Jefferson, Lake, Leon, Polk and Washington counties of Florida (ISB 2002); Missouri; New Mexico (Missouri Botanic Gardens 2003); Piedmont and Shenandoah Valley of Virginia; and along embankments as far north as New Jersey (DCR 1999).

Status in Australia and Queensland

Naturalised populations of African lovegrass, including four of its agronomic varieties (*viz.* 'curvula', 'robusta green', 'short chloromelas' and 'tall chloromelas'), are found across much of southern Australia, from south-eastern Queensland across New South Wales, the Australian Capital Territory, South Australia, Victoria, Tasmania and Western Australia (Australia's Virtual Herbarium 2009)—see Figure 2.

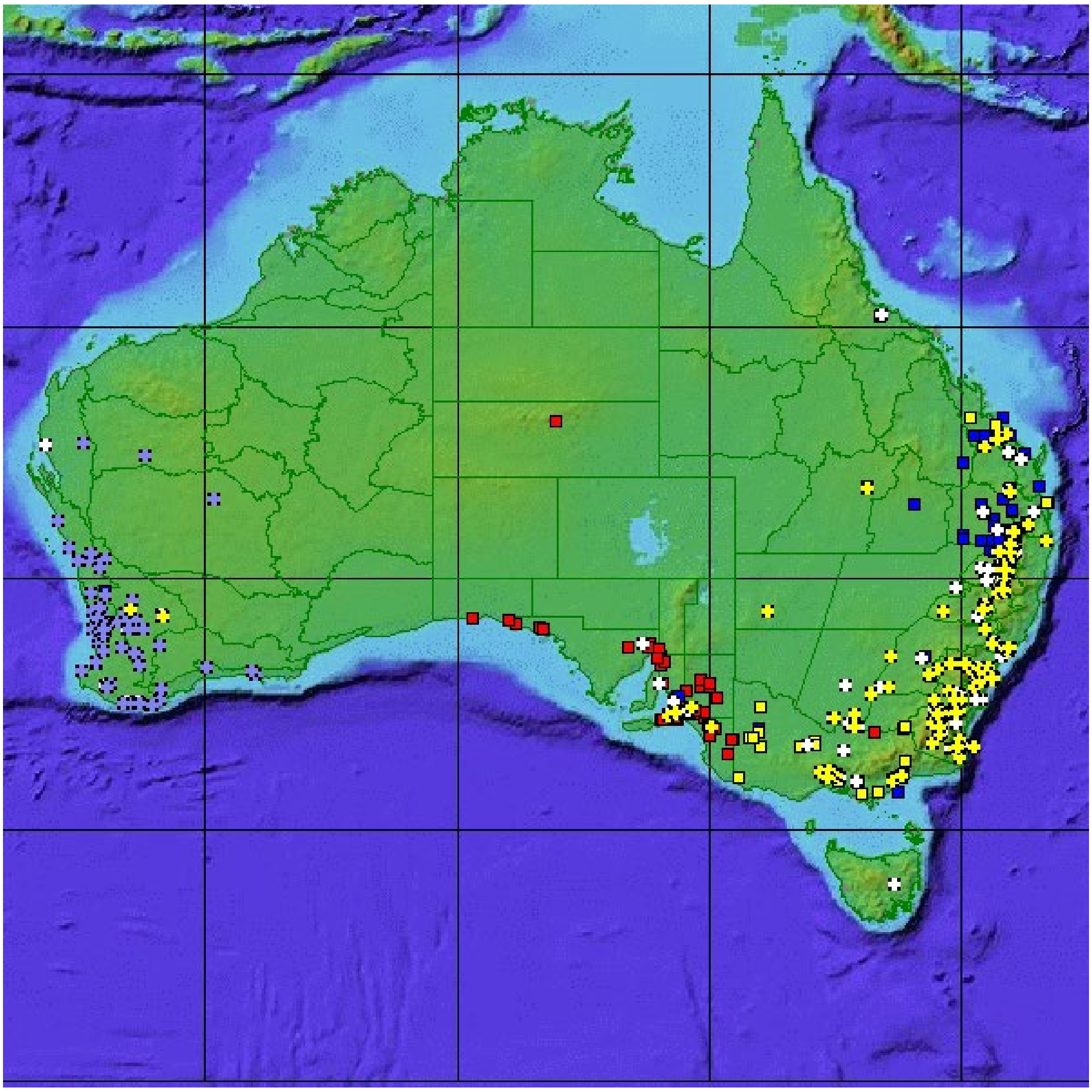

Figure 2. African lovegrass distribution in Australia (data: Australia's Virtual Herbarium 2009)

In Queensland, African lovegrass is widespread across the state's south-east. It is perhaps most abundant in the uplands of the Great Dividing Range south of Gayndah (Silcock 2005). It has been recorded in the Burnett, Darling Downs, Granite Belt, Moreton, Wide Bay, Leichhardt, Port Curtis, Maranoa and Warrego pastoral districts (Parsons and Cuthbertson 2001; Silcock 2005)—see Figure 3.

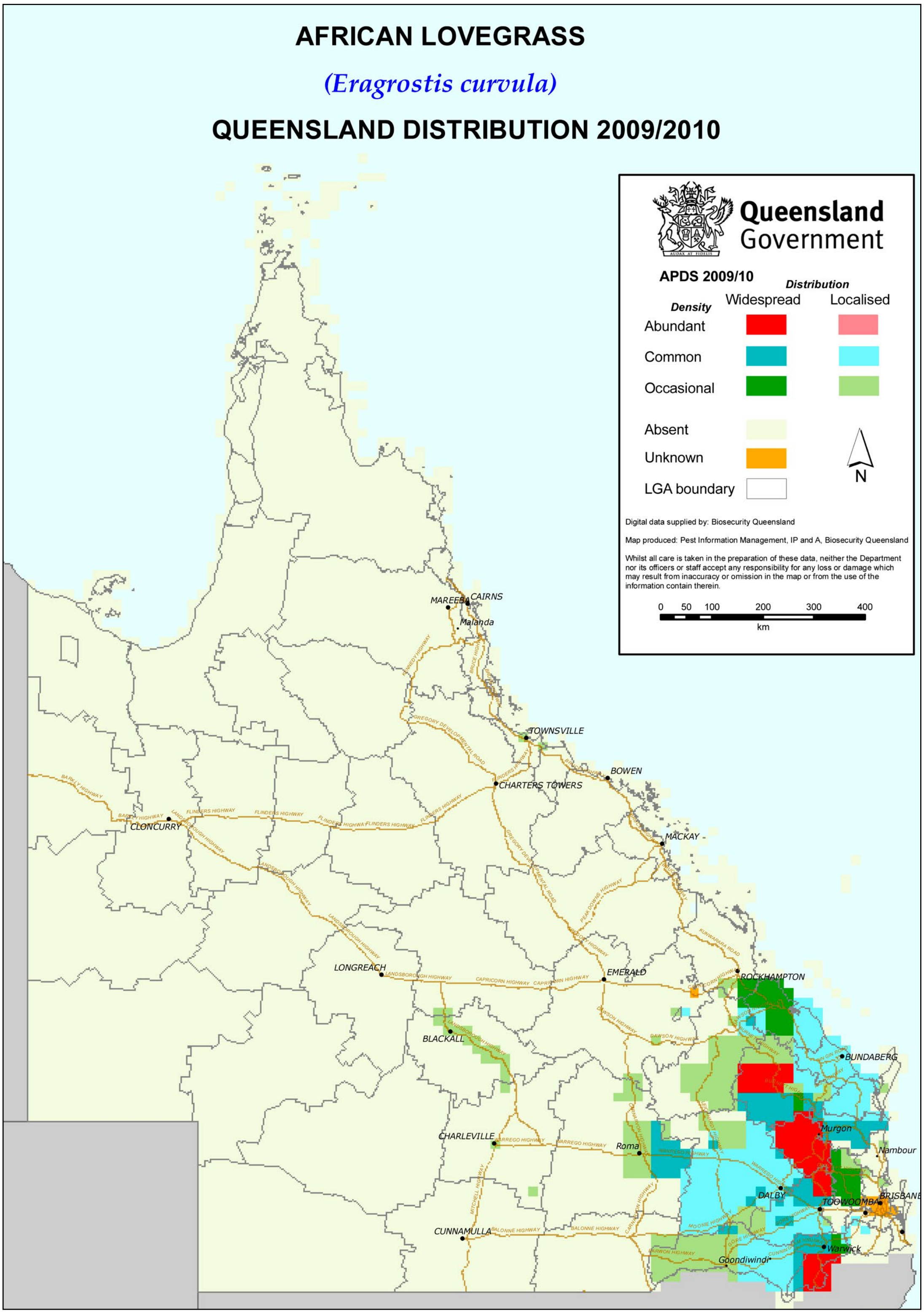

Figure 3. Distribution of African lovegrass in Queensland in 2009/10 (data: Biosecurity Queensland)

In 2008, African lovegrass was a declared pest in four local government areas (Duaringa, Tara, Eidsvold and Bungil) and was listed in 48 local government pest management plans.

Preferred habitat

Within its native range, African lovegrass inhabits semi-arid subtropical grasslands and open scrublands, mainly on low-fertility, acidic sands and light-textured sandy loams, and particularly areas with significant elevation (Parsons and Cuthbertson 2001; Silcock 2005). Although it can become dominant when subject to heavy grazing pressure on disturbed land, it is otherwise uncommon in southern African grasslands (Leigh and Davidson 1968). It tends not to colonise bare soil in Africa, but is preceded by a range of early succession species ('pioneer' species) and couch grass (*Cynodon dactylon*). Under heavy grazing, it often becomes co-dominant with the latter species (Leigh and Davidson 1968). Long-term persistence of African lovegrass in southern Africa is normally limited to deep sandy soils (Rethman and de Witt 1984, in Cox et al. 1987) and it is often associated with disturbed or badly managed areas (Gibbs Russell et al. 1991).

In other parts of the world, African lovegrass generally grows in areas where annual summer rainfall is 400–1000 mm and mean minimum and maximum temperatures are between 0 °C and 30 °C respectively (Cox et al. 1987). Growth rates tend to decline when competing with other plants. African lovegrass often suffers from fungal infections, mites and nematodes in areas where summer rainfall exceeds 700 mm (Cox et al. 1987).

The 'conferta' variety is found on depleted desert grassland ranges in Arizona where it appears well adapted to neutral soils with annual rainfall of around 325 mm (University of Arizona 1997). In Texas, Florida and Arizona it is reported to be 'very drought tolerant', growing strongly in hot, dry conditions; full sun; and a range of well-drained soil types such as sands and sandy loams (Department of Conservation Recreation 1999; Dahl and Cotter 1984, in McFarland and Mitchell 2000).

Grasses that produce numerous tillers, such as African lovegrass, are well adapted to withstand heavy grazing and frequent fire (McFarland and Mitchell 2000). However, African lovegrass is said to have poor tolerance to flooding and standing water (Rogers and Bailey 1963, in FAO 2003).

In Australia, African lovegrass appears to prefer disturbed sites, especially roadsides and pastures that have been grazed for some time. It is generally associated with light textured (sandy) soil types, especially granitic sands, and is often abundant along sandy riverbanks and beach dunes (Lazarides 1997). In some places, it grows on fertile, acidic red soils. It often becomes abundant where there is a lack of competition from other pasture plants (Campbell 1983), and its range extends across subtropical and temperate areas where annual rainfall is 400–1000 mm.

Leigh and Davidson (1968) concluded that African lovegrass performs as well as, or better than, other introduced species (especially under drought conditions) in areas where annual rainfall is between 500 and 750 mm. African lovegrass established easily and persisted at most places where it was tested as a pasture species in Australia, even under drought conditions (Leigh and Davidson 1968). The exceptions were Alice Springs (average annual rainfall of 280 mm) and Deniliquin (average annual rainfall of 375 mm) in south-western New South Wales (where it was planted into a clay soil).

In the Western Australian wheat-belt, Farrington (1973) commented that African lovegrass could only persist in deep sandy soils where the watertable was no greater than 150 cm below the soil surface.

African lovegrass tolerates drought, infertile soils and low soil pH (Johnston and Cregan 1979). It is generally considered to be quite frost-resistant, although it does suffer some damage (Garton 2001; Campbell et al. 1987).

History as a pest elsewhere

African lovegrass has been listed as a weed in Chile, South Africa, Lebanon, Columbia, parts of the United States, New Zealand, Hawaii and Japan (Holm et al. 1991; Randall 2002; Matsumoto et al. 2000; Calflora 2002; HEAR 2007).

Figure 4. African lovegrass growing wild in Hawaii (photo: Forest and Kim Starr, licensed under a Creative Commons Attribution 3.0 License, permitting sharing and adaptation with attribution, http://commons.wikimedia.org/wiki/File:Starr_050208-3899_Eragrostis_curvula.jpg).

While African lovegrass has naturalised in many more countries, it is considered to be a useful pasture plant rather than a weed. This study was unable to find detailed information or data on the species' negative economic impacts overseas. Evidence of the species' negative impact on native plant communities is also limited. Bock et al. (1986) investigated the species' negative impact on native grasslands in Arizona. Experimental sites planted with *E. curvula var. conferta* and *E. lehmanniana* supported fewer indigenous plants and animals than sites dominated by native perennial grasses. Similarly, an endangered herbaceous plant (*Aster kantoensis*), growing on gravelly floodplain habitat in eastern central Japan, was found to be negatively affected by shading from African lovegrass (Matsumoto et al. 2000). While certain native plant species might be affected by African lovegrass in specific habitat types, it is difficult to draw a robust conclusion on the degree to which African lovegrass poses a threat to native plant species. Clouding the issue is the fact that, in general, African lovegrass tends to be restricted to highly disturbed habitats—habitats that are prone to invasion by many other plant species.

African lovegrass is a target for enforced control across southern Australia. It is a declared weed in 23 council areas of New South Wales, the Australian Capital Territory, parts of Victoria, South Australia (except var. 'consol'), Tasmania and one shire (Denmark) in Western Australia (Parsons and Cuthbertson 2001). Campbell (1983) reported that African lovegrass infested an estimated 45 000 hectares in New South Wales, mainly on the coast and tablelands, and was the most important weed on the south coast of New South Wales. Again, no data appear to have been published on the species' negative economic impacts.

Uses

African lovegrass is palatable to cattle and sheep when young but it quickly runs to seed and forms a tough unpalatable closed tussock, especially when left ungrazed. It is grown as pasture in some less fertile, arid areas of Africa, south-central United States and Argentina (Silcock 2005). Under intense management, it has increased stocking rates 10-fold in west Texas (Cotter et al. 1983, in Campbell et al. 1985) and improved animal production in Argentina, where it is the most extensively cultivated warm season perennial grass (Vera et al. 1972, in Campbell et al. 1985; Di Renzo et al. 2003).

The cultivar 'consol' is the most useful variety. In Australia, it has been promoted and used to prevent soil erosion, as a palatable sown pasture plant and as a nematode break to protect maize crops (Silcock 2005). It is reported to have low weed potential compared to other forms of the species, and can even be used to suppress certain weed species (Johnston et al. 1984; Robinson and Whalley 1991; Chan et al. 2001; Parsons and Cuthbertson 2001; Johnston 1989).

There is a body of evidence that African lovegrass can provide useful pasture in sandy soil types and certain climates, provided it is carefully managed. In a summary of Australian pasture evaluation trials conducted prior to 1968, Leigh and Davidson (1968) concluded that African lovegrass was equal or superior to a range of other introduced pasture species where rainfall is between 500 mm and 750 mm, especially under drought conditions. More recently, Johnston et al. (2005) concluded that palatable varieties are useful summer-active perennial pastures in southern Australia. Some landholders value African lovegrass for its ability to provide stockfeed during drought (Johnston and Cregan 1979). However, its slow growth rate in winter can allow winter growing weeds to invade, and its low nutrient concentrations in warmer months can reduce its value (Farrington 1973).

African lovegrass is no longer recommended as a pasture species in Queensland (Silcock 2005).

Current and potential impacts in Queensland

With the exception of the ‘consol’ variety, African lovegrass is commonly regarded as an undesirable weed of grazing land in Australia. Most naturalised forms of the species have low palatability, low crude protein content and can replace more productive native and introduced pastures. African lovegrass becomes unpalatable due to increased lignification and reduced digestibility as the plant ages (Friend and Kemp 2000).

There is some evidence that grazing eliminates more palatable types of African lovegrass, leaving the less palatable types to proliferate. Over time, a paddock can become dominated by unpalatable forms (Johnston et al. 1984). African lovegrass can have a protein content of no more than 3%, which is too low for successful animal production (Garton 2001).

African lovegrass was included in a list of 200 environmental weeds of south-east Queensland (Batianoff and Butler 2002). There is anecdotal evidence that it can invade natural grasslands, especially on sandy soil types, and compete with native ground cover plants. Milberg and Lamont (1995) found that regrowth and establishment of native plant species in parts of Western Australia was reduced by African lovegrass.

This study was unable to find data on the total economic costs of African lovegrass in Queensland. However, there is considerable anecdotal evidence that naturalised African lovegrass is having a negative impact on the grazing industry (cattle and sheep).

Based on the species’ native distribution in Africa, a map of potential distribution was modelled using CLIMEX computer software (Skarratt et al. 1995)—see Figure 5.

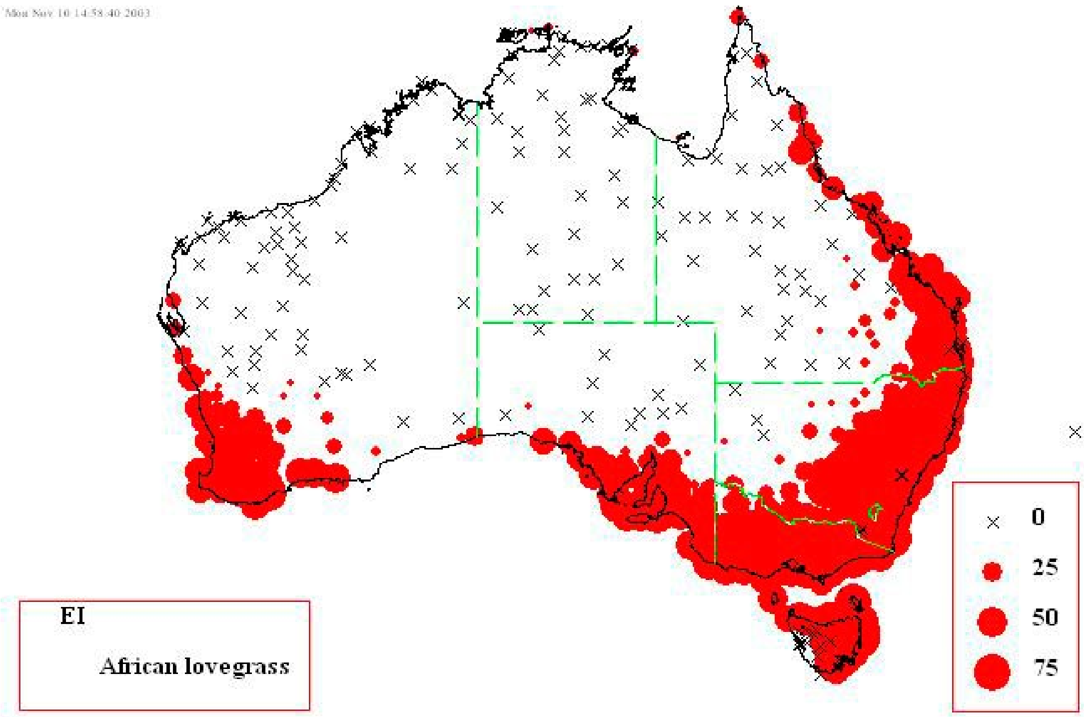

Figure 5. Potential distribution of African lovegrass in Australia (map produced using CLIMEX climate-matching computer program)—the red circles indicate the area where our climate is similar to climate

experienced across the species' native range in Africa, with the degree of similarity increasing with the size of the circles

This prediction can be compared to maps of the species' current distribution (figures 2 and 3) and suggests that African lovegrass has already spread over much of its potential range, although Tasmania is still at risk.

Since the current economic and environmental impacts of African lovegrass are poorly studied in Queensland, it is difficult to make robust predictions about the species' long-term impacts. While there is a growing perception among landholders that African lovegrass is a significant weed threat, due perhaps to its increasing conspicuousness in the landscape, there is still a chance that its real impact is negligible and limited to roadsides and nearby unhealthy pastures in infertile sandy soils. This question cannot be resolved without research designed to quantify the impacts.

References

Animal and Plant Control Commission (2001). African Lovegrass Identification Note. Primary Industries and Resources South Australia.
www.pir.sa.gov.au/pages/sus_res/animal_plant/public/african_lovegrass.pdf
Viewed 5 December 2002.

Anon. (1999). Notes on the African Lovegrass Information for Strategy Launch, February 1999. Gippsland Region, Victoria.

Australian Pesticides and Veterinary Medicines Authority (2003). National Registration Authority for Agricultural and Veterinary Chemicals: Permits Search.
www.apvma.gov.au/permits/permits.shtml
Viewed 10 March 2003.

Australia's Virtual Herbarium (2009).
www.anbg.gov.au/avh/cgi-bin/avh.cgi

Australia's Virtual Herbarium (2006). African Lovegrass (*Eragrostis curvula*).
www.anbg.gov.au/avh/
Viewed 22 January 2007.

Batianoff, GN, and Butler, DW. (2002) Assessment of invasive naturalised plants in south-east Queensland. *Plant Protection Quarterly* 17, 27–34.

Berg, WA (1986). Effect of 20 years of low N rate pasture fertilization on soil acidity. *Journal of Range Management* 39 (2): 122–124.

Biosecurity Queensland (2007). African lovegrass fact sheet.
www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-African-Lovegrass-PP63.pdf

Bock, CE, Bock, JH, Jepson, KL, and Ortega, JC (1986). Ecological effects of planting African love-grasses in Arizona. *National Geographic Research* 2(4): 456–463.

Bredenkamp, GJ, Granger, E. and van Rooyen, N. (1996) North-eastern mountain grassland. In Low, AB and Rebelo, AG (eds) Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

CalFlora (2002). The CalFora Database: Information on California plants for education, research and conservation.
www.calflora.org/cgi/calflora_query?one
Viewed 5 December 2002.

Campbell, MH (1983). Area, distribution and weed potential of *Eragrostis curvula* (Schrad.) Nees in New South Wales. *Australian Weeds* 2(3): 107–112.

Campbell, MH, Dellow, JJ, Keys, MJ, and Gilmour, AR (1985). Use of herbicides for selective removal of *Eragrostis curvula* (Schrad.) Nees from a Phalaris aquatica pasture. *Australian Journal of Experimental Agriculture* 25(3): 665–671.

Campbell, MH, Kemp, HW, Murison, RD, Dellow, JJ, Keys, MJ, and Gilmour, AR (1987). Agfacts: African lovegrass control. P7.6.37. Department of Agriculture, New South Wales.

Carr, GW, Yugovic, JV, and Robinson, KE (1992). Environmental weed invasions in Victoria: conservation and management implications. Department of Conservation and Environment, East Melbourne, and Ecological Horticulture Pty Ltd, Clifton Hill, Victoria.

Chan, KY, Bowman, AM, Smith, W, and Ashley, R (2001). Restoring soil fertility of degraded hardsetting soils in semi-arid areas with different pastures. *Australian Journal of Experimental Agriculture* 41: 507–514.

Cox, JR (1984). Temperature, timing of precipitation and soil texture effects on germination, emergence and seedling survival of South African lovegrasses. *Journal of South African Botany* 50 (2): 159–170.

Cox, JR, Martin-R, MH, Ibarra-F, FA, Fourie, JH, Rethman, NFG, and Wilcox, DG (1987). Effects of climate and soils on the distribution of four African grasses. In Proceedings of Symposium 'Seed and seedbed ecology of rangeland plants', 21–23 April 1987, Tuscon, Arizona, pp. 225–240.

Csurhes, S, and Edwards, R (1998). Potential Environmental Weeds in Australia. Environment Australia, Canberra.

Department of Conservation and Recreation. (1999). Invasive alien plant species of Virginia: Weeping lovegrass (*Eragrostis curvula* (Schrader) Ness).
www.state.va.us/~dcr/vaher.html

Department of Horticulture, Landscape and Architecture. (1996). Eragrostis curvula (Schrad.) Nees. Purdue University, West Lafayette, Illinois.
www.hort.purdue.edu/newcrop/duke_energy/Eragrostis_curvula.html
Viewed 27 November 2002.

Department of Natural Resources and Mines. (2002). Weed and pest animal research: 2001–2002. Technical highlights. Department of Natural Resources and Mines, Queensland.

Department of Primary Industries (1996). Beeftalk: African lovegrass—increasing concerns.
www.dpi.qld.gov.au/beef/1996.html
Viewed 11 December 2002.

Department of Primary Industries (2001). DPI News: African lovegrass field day.
www.dpi.qld.gov.au/news/NewsReleases/3162.html
Viewed 11 December 2002.

Di Renzo, MA, Ibanez, MA, Bonamico, NC, Faricelli, ME, Poverene, MM and Echenique, CV (2003). Effect of three environments on the efficiency of indirect selection in *Eragrostis curvula* (lovegrass) genotypes, *Journal of Agricultural Science* 140: 427–433.

De Winter, B (1990). A new species of *Eragrostis* (Chlorideae) in the *E. curvula* alliance. *Bothalia* 20 (2): 208–209.

Elliot, H (2001a). Southern Queensland priority weed survey—Local Government results. Internal Report, Department of Natural Resources and Mines, Queensland.

Elliot, H (2001b). Southern Queensland priority weed survey—community and stakeholder results. Internal Report, Department of Natural Resources and Mines, Queensland.

Eurobodalla Shire Council (2002). African lovegrass (*Eragrostis curvula*).
www.esc.nsw.gov.au/Weeds/Sheets/grasses/G%20African%20lovegrass.htm

FAO (2003). Grassland Index. Species description: *Eragrostis curvula* (Schrad.) Nees. www.fao.org/ag/agp/agpc/doc/gbase/Default.htm

Farrington, P (1973). The seasonal growth of lovegrass (*Eragrostis curvula*) on deep sandy soils in a semi-arid environment. *Australian Journal of Experimental Agriculture and Animal Husbandry* 13(63): 383–388.

Fensham, RJ (1998). The grassy vegetation of the Darling Downs, south-eastern Queensland, Australia. Floristics and grazing effects. *Biological Conservation* 84 (3): 301–310.

Friend, DA, and Kemp, DR (2000). Grazing Management Methods. In B.M. Sindel, (ed.) Australian weed management systems. R.G. and F.J. Richardson, Meredith, Victoria, pp.134–160.

Garton, J (2001). Notes on the North Burnett District Pest Management Meeting. Eidsvold, November 2001.

Gibbs Russell, GE, Watson, L, Koekemoer, M, Smook, L, Barker, NP, Anderson, HM, and Dallwitz, MJ (1991). Grasses of Southern Africa. National Botanical Gardens and Botanical Research Institute, South Africa.

Harden, GJ (ed.) (1993). Flora of New South Wales. Vol. 4. University Press, Kensington, Australia.

HEAR (2007). Hawaiian Ecosystems at Risk website, list of references. www.hear.org/gcw/species/eragrostis_curvula/

Henry, DR, Hall, TJ, Jordan, DJ, Milson, JA, Schefe, CM and Silcock, RG (1995) Pasture plants of Southern Inland Queensland. Department of Primary Industries, Queensland.

Hnatinuk, RJ (1990). Census of Australian vascular plants: Australian flora and fauna series number 11. Bureau of Flora and Fauna, Australian Government Publishing Service, Canberra.

Holm, LG, Pancho, JV, Herberger, JP, and Plucknett, DL (1991). A geographical atlas of world weeds. Krieger Publishing Company, Malabar, Florida.

Hussey, BMJ, Keighery, GJ, Cousens, RD, Dodd, J, and Lloyd, SG (1997). Western weeds: a guide to the weeds of Western Australia. The Plant Protection Society of Western Australia, Victoria Park, Western Australia.

Institute for Systematic Botany (ISB) (2002). ISB: Atlas of Florida vascular plants. http://131.247.163.200/website/plantatlas/maps.asp?plantID=1644

Jacobs, SWL (1982). Classification of the *Eragrostis curvula* complex. *Australia Plant Introduction Review* (CSIRO Australia) 15(1): 5–14.

Johnston, WH (1989). Consol lovegrass (*Eragrostis curvula* complex) controls spiny burrgrass (*Cenchrus* spp.) in south-western New South Wales. *Australian Journal of Experimental Agriculture* 29(1): 37–42.

Johnston, WH, Aveyard, JM, and Legge, K (1984). Selection and testing of Consol Lovegrass for soil conservation and pastoral use. *Journal of Soil Conservation* 40 (1): 38–45.