Shut the gate, alien weedy grasses have bolted and more are on the way

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Summary

Many introduced pasture grass species have invaded remnant native vegetation areas in South Australia with a subsequent negative impact on biodiversity. The fact that the process began through an understandable botanical cringe in Anglo-Europeans who sought to tame and conquer their newly-occupied lands does not excuse a continuance of that mind-set in us over 150 years later. A host of alien annuals and perennials that came to Australia, either deliberately or inadvertently, were escapees into the countryside well before 1900. The Federal Government still hasn't been persuaded to shut the gate. The develop-at-all-cost community still doesn't understand how the loss of native vegetation really affects biodiversity. There still isn't an aggressive strategy in place to cleverly use recently developed, grass-selective herbicides to hit those early-naturalized, invasive grasses to protect our native plant communities.

Introduction

Firstly, a few, light-hearted verses of what I believe is the theme song of the acclimatizers and collectors in agricultural research and the nursery trade. Apologies to 'My Bonnie lies over the ocean…'

> Preferred plants live over the ocean
> Preferred plants live over the sea
> Preferred plants live over the ocean
> Bring in those preferred plants to me
> Bring in
> Bring in
> Bring in those preferred plants to me,
> to me…

What a joke. Now isn't that the saddest song for an Aussie to sing. Yet 167 years after their ilk first coined it, the acclimatizers and collectors are still singing the song. They've never accepted that Australia is *Terra alienus* (i.e. a land belonging to other people, other organisms, other ecosystems). It's still *Terra nullus* to them.

We still graze and cultivate overly large tracts of the country into dustbowls and salt licks. Alien annual and perennial weedy plants are the first colonizers of severely disturbed sites. And, collectively, we don't give a damn about the loss of native habitats. What a hide we've got! We continue to deplete the Australian landscape's ability to be resilient in the face of rapid climate change due to the greenhouse effect.

This general attitude prevails despite early warnings. In 1928, the esteemed pasture researcher R.G. Stapledon, Professor of Agricultural Botany, Aberystwyth Research Centre, Wales, admitted the impact of domesticated stock on native Australian landscapes:

'*Their effect is four-fold; firstly, to kill and destroy plants that cannot stand heavy grazing, perhaps by preventing seed production, perhaps by continual and ravenous defoliation of markedly palatable plants; secondly by trampling and consolidation to alter the soil and water relationships in a direction favourable to introduced plants and unfavourable to endemics; thirdly to upset the floretic balance of the vegetation and by the very act of constant grazing to give a new direction to all the competitive influences at work; and fourthly, to help in the spread of the newly-introduced plants by carrying seed, and by their treading to assist young seedlings to establish themselves*' (Stapledon 1928).

Thirty-three years before, the visionary NSW botanist Fred Turner extolled the benefits of managing native grasses and herbaceous plants to protect the landscape and reported on the problems of trying to establish imported grasses (Turner 1895).

Early escapees

Most of the grassy weeds we're having trouble with today were escapees from pastures and gardens and were known to be a problem from at least 1900. South Australia's (SA's) J.M. Black published his list in 1909 with such familiar taxa as *Agrostis*, *Ammophila*, *Avena*, *Bromus*, *Briza*, *Chloris gayana* Kunth, *Dactylis*, *Ehrharta*, *Holcus*, *Hordeum*, *Lolium*, *Panicum*, *Paspalum*, *Pennisetum villosum* R.Br. ex. Fresen., *Phalaris*, *Piptatherum*, *Sorgum halepense* (L.) Pers. and *Stenotaphrum*. Many came as recommended pasture seed, in ships' ballast, as contaminants in seed consignments, in fodder for shipped stock, attached to stock, in packing materials and in bedding, and as seeds and plants for the gardens of the fashionable set. Kloot (1987) tracked the history of introduction and use of exotic grasses in SA (Appendix 1). It reveals that many of our problem grass weeds in SA were purposely introduced and spread.

Adverse effects on native vegetation

Surviving examples of threatened native grassy communities in SA are partially to heavily weed invaded. Even where surviving examples contain localized areas of high native species diversity, they are nearly always surrounded by vegetation consisting predominantly of exotic grasses and forbs, a source of weed propagules. Davies (1997) also stressed that, where remnants of these grassy habitats exist on roadsides, to ignore these would see us deserting a suite of native plants in various stages of a diminishing struggle against weeds. Though there appears to be public pressure on land managers such as District Councils, Government agencies and private landholders to control weeds in heavily invaded remnant vegetation areas, both for biodiversity reasons and minimization of fire risk, the evidence of control is either often hard to find (personal observations) or noticeable because of off-target effects on indigenous plants (Davies 1997).

Davies (1997) pushed for the use of selective grass herbicides in the fight to remove grassy weed competition in SA. He cited Hitchmough *et al.* (1994), whom had argued that when native grassy vegetation is converted by unchecked weed invasion to a sward of exotic grasses, the adverse consequences for many indigenous organisms are rather more clear-cut than the non-target uncertainties associated with herbicide use. However, we should always proceed with caution based on a formal botanical survey. Similar growth habits between native, C3, cool-season, perennial grasses and exotic species such as phalaris (*Phalaris aquatica* L.), perennial veldgrass (*Ehrharta calycina* Sm.), Yorkshire fog (*Holcus lanatus* L.), cocksfoot (*Dactylis glomerata* L.), rice millet (*Piptatherum miliaceum* (L.) Coss.) and tall wheatgrass (*Lophopyrum ponticum* (Podp.) Á.Löve) means that control risks damage to the natives. There is certainly a need for trials with some of the newer grass selective herbicides (following on from Davies 1997). In the eastern States of Australia, grassland and grassy woodland ecologists have extensively researched various herbicides to assist in grassy weed reduction programs.

Though perennial grassy weeds are this workshop's theme, the impact of annual grassy weeds on native vegetation should not be underestimated. They are able to out-compete natives over the cold winter period simply by mass of numbers. They certainly reduce the richness of native vegetation. A recent study in the Mid-North of SA (part-funded by the Native Grass Resources Group Inc.) found that:

'*…management changes or environmental conditions favouring the growth of annuals can result in increased competitive interactions and in litter build-up with negative*

effects on native perennial grasses as well as exotic, and presumably native, herbaceous annuals… these changes may have positive feedback on the grasses themselves… a short invasion window could allow annual grasses to persist and spread in a system" (Lenz *et al*. 2003).

Invasive grasses are a significant threat to SA's temperate grassy ecosystems, with Davies' (1997) list of most frequent and abundant weed species having 19 annual grasses (out of a total of 44 annuals) and four perennial grasses (out of 11 perennials). In my voluntary and continuous work, privately and publicly, on revegetation of watercourses and re-establishment and protection of native grass species since 1986, control of invasive grasses has been the most problematic issue I've had to deal with. Most revegetators and bushcarers would concur with this. Many landholders have just given up. It's hard to know where to turn or who to turn to in solving the invasive grasses crisis.

Acclimatization still goes on

The acclimatizers mentality of the past is still in full practice in the present. At a SA pasture field day last year, scientists spoke about doing worldwide searches for more useful plant species. Hence my little verse at the start of this paper. Preferred plants are still not Australian plants. In SA there are 271 species of native grasses from 73 genera, yet none have been researched and put into commercial cultivation for SA agriculture. This is an indictment on our plant research organizations. Only last year did Primary Industries and Resources SA become affiliated with salinity plant trials in the State's south-east which involves using native grass cultivars from NSW. Two years previously the Federal Department of Agriculture, Fisheries and Forestry funded a project in SA (and other states) to commercialize the known weedy, exotic grass from North America, saltgrass (*Distichlis spicata*).

Scientists in the field of agronomy, though cognizant of the host of introduced annuals and perennial grasses that have caused considerable problems in grain crops, 'disturbed' areas and roadsides, have continued to breed and release grasses with a known potential for invasion. These include kikuyu (*Pennisetum clandestinum* Hochst. ex Chiov.), *P. aquatica*, *E. calycina*, *L. ponticum*, African lovegrass (*Eragrostis curvula* (Schrad.) Nees) and puccinellia (*Puccinellia ciliata* Bor) (Oram 1990). The latter is a pioneering species that likes wet, salty areas and is thought to be of relatively low environmental impact (Virtue and Melland 2003), but many native species also like these areas. State and Federal Governments, through Departments of Agriculture/Primary Industries, research institutes, soil conservation agencies and industry promotion groups continue to fund these farm 'innovations'!

The more our paddocks, reserves and roadsides look like a pastiche of the Northern Hemisphere, the more we're indicating that we're part of an insidious native species extinction process.

Conclusion

So how do I pull all this together? From my point of view:

- To shut the continent gate and padlock it. If you like, you could call it 'The Right Australia Policy for the Conservation and Use of Native Plants'.
- To stand up for the ecological integrity of our Aussie landscapes, which also means excluding the acclimatizers and collectors from any further position of influence.
- To bring the current crop of acclimatizers and their backers to legal account.
- To persuade the owners/'guardians' of grassy weed infested land, where native vegetation is being out competed, to adopt eradication, revegetation and ongoing management strategies. The cost would be borne by those government departments that promoted the grass weeds in the first place.

From the point of view of eminent palaeobotanist Mary White it was time to act many years ago:

'*Australia's capacity to control environmental weeds is limited. The prognosis for their spread on a continental scale is grim. Economically and even technically the problems are too large, and there is a political element arising from a conflict between conservation and agriculture or horticulture which also constrains. Government agencies continue to promote environmentally unacceptable pasture species; there is a lack of controls on the import of ornamental plants and the continuing maintenance of grazing on marginal lands predisposes them to weed invasion. Prevention of further non-essential introductions should be given top priority and the plant import legislation has to be updated to prevent further ecological and economic disaster*' (White 1997).

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Appendix 1. List of introduced grass species and their use as fodder in South Australia (from Kloot 1987, which provides specific references for the dated events).

Alopecurus pratensis L. (meadow foxtail)
1913 – recommended for sandy country at Monteith.
1947 – still recommended in pasture mixes.

Anthoxanthum odoratum L. (sweet vernal grass)
1925 – recommended, *inter alia*, for higher rainfall areas.

Arrhenatherum elatius (L.) J. & C.Presl var. *elatius* (false oatgrass)
1909 – in pasture plots at Saddleworth.

Arundo donax L. (giant reed)
1897 – useful for fodder and windbreak.
1941 – recommended, *inter alia*, for feed.

Avena fatua L. (wild oat)
1891 – so well adapted as a fodder plant that no other species is necessary in Maitland area.
1892 – seed distributed in the Mundoora area from supply sent from Stansbury.
– Fertilized at Nairne with guano.

Bromus madritensis L. (Madrid brome)
1912 – seen to be thriving in (Adelaide) suburban garden, seeds collected and scattered over newly cleared Mallee country at Nunkeri.

Bromus unioloides Kunth (prairie grass)
1857 – seed introduced and bulked up. Seed freely available by summer 1858.

Chloris gayana Kunth (Rhodes grass)
1907 – recommended for fodder.
1911 – sown as fodder at Millicent.

Cynodon dactylon (L.) Pers. (couch)
1928 – *inter alia*, sown in pastures at Yurgo.

Cynosurus echinatus L. (crested dogstail)
1927 – *Inter alia*, trial for pasture at Jamestown.

Dactylis glomerata L. (cocksfoot)
1859 – highly recommended as a fodder grass.

Echinochloa crus-galli (L.) P.Beauv. (barnyard grass)
1893 – being sown at Naracoorte.
1909 – best fodder on saline areas of reclaimed swamps.

Ehrharta calycina Sm. (perennial veldgrass)
1908 – 'cuttings' (sic.? rhizomes) obtained from South Africa and planted at Kalangadoo.
1928 – well established at Reeves Plains and Minda Home.

Ehrharta longiflora Sm. (annual veldgrass)
1930 – included in pasture mixes at Keitb.

Elymus repens (L.) Gould (quackgrass)
1897 – sown as a potential fodder at Crystal Brook.

Festuca arundinacea Screb. (tall fescue)
1900 – growing well on Messrs. Williams' property at Millicent and promises to be the best grass to grow on reclaimed swampland.

Festuca pratensis Huds. (meadow fescue)
1907 – recommended for fodder.

Festuca rubra L. (red fescue)
1894 – sown at Warrow.

Holcus lanatus L. (Yorkshire fog)
1875 – seed distributed and sown throughout State from German supply labelled *Dactylis caespifosa* in error.
1931 – still being sown as fodder at Longwood.

Hordeum leporinum Link or *glaucum* Steud. ? (barley grass)
1901 – being deliberately sown for fodder at Craddock.
1912 – seen to be thriving in (Adelaide) suburban garden, seed collected and scattered over newly cleared Mallee country at Nunkeri.
1919 – recommended to be sown at Coonalpyn.

Lolium multiflorum Lam. (Italian ryegrass)
1906 – recommended for fodder.

Lolium perenne L. (perennial ryegrass)
1906 – recommended for fodder.

Lolium rigidum Gaudin (Wimmera rye)
1919 – recommended to be sown at Coonalpyn.
1922 – combined with sub clover is good pasture for the SE
1927 – recommended that wheat should be undersown with it.

Paspalum dilatatum Poir. (paspalum)
1876 – introduced to Adelaide Botanic Gardens as a potential fodder grass.
1897 – being grown at Lucindale from seeds provided by Botanic Gardens.

Paspalum vaginatum Sw. (saltwater couch)
1951 – introduced as a salt-tolerant fodder grass, doing well by 1973.

Pennisetum clandestinum Hochst. ex Chiov.(Kikuyu grass)
1926 – introduced from Natal and sown as a fodder crop at Mt. Remarkable.
1929 – sown on Kybybolite.

Pennisetum villosum R.Br. ex Fresen (feathertop)
1892 – potentially valuable fodder grass at Tatiara.

Phalaris aquatica L. (phalaris)
1889 – potential fodder plant growing in Adelaide Botanic Gardens.
1905 – first sown commercially in SA.

Phleum pratense L.(Timothy grass)
1904 – growing at Longwood.
1907 – recommended for fodder.

Piptatherum miliaceum (L.) Coss. (rice millet)
1908 – sown at Kanmantoo.
1913 – recommended for sandy country at Monteith.
1914 – for pasture at Geranium.

Poa annua L. (winter grass)
1912 – 'A very hardy grass, affording an early sweet herbage greatly relished by stock. It is a good thing to mix a few pounds of it with other grasses for pasture' (Hackett 1912 – see Kloot 1987).

Poa pratensis L. (Kentucky bluegrass)
1907 – recommended for fodder.

Secale cereale L. (rye)
1899 – being sown at Strathalbyn.

Sorghum halepense (L.) Pers. (Johnson grass)
1875 – doing well at Yankalilla.
1899 – sown as fodder at Riverton.
1924 – being sown at Nantawarra.

Sorghum bicolor (L.) Moench (forage sorghum)
1858 – highly recommended since that year in SA.
1870 – fresh seed obtained from Sydney for Botanic Gardens.

Stenotaphrum secundatum (Walter) Kuntze (buffalo grass)
1928 – *inter alia* sown in pastures at Yurgo.