

African boxthorn (*Lycium ferocissimum*) and asset protection from a national perspective

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Summary African boxthorn (*Lycium ferocissimum* Miers), a Weed of National Significance, is widespread in southern Australia. Development of a national strategy, biological control feasibility assessment, and a national best practice manual for boxthorn led to the identification of key areas to guide investment.

With a weed as widespread as African boxthorn in Australia, asset protection is the priority for management, along with provision of additional tools for management of a widespread weed.

This paper outlines three key areas where management investment for African boxthorn in Australia might be made. These are: biodiversity-rich areas of Western Australia where boxthorn has significant invasive potential; horticultural regions susceptible to pest species hosted by boxthorn; and boxthorn biocontrol research.

Keywords African boxthorn, Weeds of National Significance, biodiversity, horticulture, biological control.

INTRODUCTION

African boxthorn has been present in Australia for more than 150 years and is one of Australia's most widespread weeds. It occurs across a diverse range of Australian landscapes from coastal to semi-arid inland habitats, and is present in many of Australia's most important environmental and agricultural asset areas.

In Australia, boxthorn impacts World Heritage listed places (e.g. Shark Bay in Western Australia and the Lord Howe Island Group in New South Wales), Ramsar-listed wetlands (e.g. Pitt Water – Orielton Lagoon in Tasmania and the Coorong in South Australia), internationally and nationally recognised biodiversity hotspots, and many of the nation's most significant offshore island environments.

African boxthorn hosts a range of pest animals including rabbits (*Oryctolagus cuniculus* Linnaeus), foxes (*Vulpes vulpes* Linnaeus), feral pigs (*Sus scrofa* Linnaeus), starlings (*Sturnus vulgaris* Linnaeus), fruit

fly (*Bactrocera tryoni* Froggatt), and potentially the tomato potato psyllid (*Bactericera cockerelli* Sulc) should it enter Australia. African boxthorn has a significant presence in southern Australia's agricultural areas.

In 2012, African boxthorn was declared a Weed of National Significance (WoNS). Following WoNS declaration, an *African boxthorn national strategic plan, feasibility of biological control of African boxthorn* initial assessment and *African boxthorn national best practice manual* have been produced. The strategic plan outlines national priorities for the strategic management of African boxthorn in Australia.

Widespread weeds like boxthorn can be difficult to direct expenditure toward, as priorities are often difficult to pinpoint. Using the biosecurity continuum (AWC 2013), asset protection and building management capability are logical investment approaches for African boxthorn in much of southern Australia.

This paper looks at three specific areas of importance for the national management of African boxthorn. These are the ongoing expansion and impact potential of African boxthorn in ecologically rich southern Western Australia, the potential of African boxthorn as a host for horticultural pests in areas with solanaceous crops, and the potential of classical biological control to provide an additional African boxthorn management tool.

WESTERN AUSTRALIAN LANDSCAPES

In Western Australia, unlike most other suitable parts of Australia, African boxthorn has not fully expanded throughout its potential range. This may be linked to the relationship between boxthorn and the starling (*Sturnus vulgaris*). Evidence from Bass Strait (Harris and McKenny 1999) and New Zealand (Taylor 1968) suggests that starlings boost boxthorn's capacity to invade natural environments, and in turn, boxthorn provides quality roosting and feeding habitat for starlings. The pest species' appear to have facilitative

interactions. The starling is so far absent (other than occasional incursions) from Western Australia.

The virtual absence of starlings in Western Australia permits greater potential for containment of boxthorn, so far preventing it from establishing a foothold throughout important natural assets, despite being present around them.

The establishment of starlings in Western Australia would almost certainly result in increased invasive capacity of boxthorn in natural ecosystems.

Western Australia has substantial environmental assets of national and global significance. In the southern half of the state, boxthorn poses a direct threat to some of these. For example, on the South Coast the Fitzgerald River Ravensthorpe region provides habitat for an extraordinary number of nationally listed threatened species (more than 40 species of fauna and over 100 flora species) (Gilfillan *et al.* 2009). The area holds a United Nations designation of 'Fitzgerald Biosphere', containing two internationally listed wetlands, and having immense overall species richness – making it a biodiversity hotspot.

The presence of African boxthorn on off-shore islands in Western Australia appears to be increasing. African boxthorn continues to threaten, for example, Australian sea lion (*Neophoca cinerea* Peron) and Australian fur seal (*Arctocephalus pusillus* Schreber) breeding habitats through displacing the native nitre bush (*Nitraria billardieri* DC.) that shelter sea lion and seal pups. Boxthorn does not provide the equivalent quality of nursery habitat to that provided by nitre bush, leaving pups more vulnerable to predation (Moritz and Kikkawa 1994).

In 2013 Western Australia's South Coast NRM completed a substantial African boxthorn management program. Other Western Australian initiatives have included the state's Department of Parks and Wildlife recent undertaking of African boxthorn management on the Beagle Islands south of Geraldton. These islands provide some of the most important sea lion breeding habitat on the Western Australian coastline.

Follow-up of initial boxthorn control measures is essential to successful management. It is very important that ongoing investment be made to continue and extend this strategically important work in Western Australia.

IMPLICATIONS FOR HORTICULTURE

Boxthorn hosts a range of agricultural pests including the fruit fly (*Bactrocera tryoni*) and the tomato potato psyllid (TPP) (*Bactericera cockerelli*). The latter is a North America species that has spread to Central America (Davidson *et al.* 2008). It has not been found in Australia yet, but there is a very high risk of it

reaching Australia in the near future. In North America, its overwintering host plants are several native *Lycium* species (Butler and Trumble 2012). The TPP is a major pest of solanaceous crops such as tomatoes, potatoes, capsicum, egg plants and tamarillos because it is the vector of the plant bacteria, *Candidatus Liberibacter solanacearum* Jagoueix *et al.*, the causative agent of the so-called zebra chip disease.

The TPP is reputed to have over 40 host plant species, primarily in the Solanaceae family (Biosecurity Australia 2009). It was recently found to use African boxthorn as an overwintering host plant (Fowler 2013), and is able to breed on that host species (J. Dohmen, pers. comm. 2013). TPP populations build up on their overwintering hosts, and they colonise commercial crops in spring. The sizes of TPP populations can be reduced if access to overwintering host plant species is reduced; hence the importance of controlling African boxthorn near susceptible horticultural crops. Another danger is the possible transfer of *Candidatus Liberibacter solanacearum* to native Australian plant species by any native Australian psyllids that may feed on plants with this disease. *Acizzia solanicola* Kent & Taylor is a native Australian psyllid that has switched from its native solanaceous plant species to egg plants (Taylor and Kent 2013).

BIOLOGICAL CONTROL

African boxthorn is difficult to suppress using mechanical and chemical control methods due to a persistent seed bank, strong re-colonisation capacity and expense. Although African boxthorn has been suggested as a target for biological control (Julien 2006), Australia is the only region where this approach is being considered. In 2013, the potential for biological control was formally evaluated and considered to be feasible (Adair 2013).

In Australia, a low diversity and abundance of natural enemies from African boxthorn are known. In a recent survey, only 12 species of arthropod and pathogen were recorded from south-eastern Australia, but it is likely additional taxa could be recorded with more extensive searches.

Similarly, in southern Africa, only five arthropods and one pathogen are recorded from *L. ferocissimum*, but a richer assemblage is known from other *Lycium* species elsewhere indicating that the low diversity is perhaps an artefact of limited survey and collection effort in the region of origin. Biological surveys on other large, woody African shrubs (e.g. boneseed *Chrysanthemoides monilifera* subsp. *monilifera* (L.) Norlindh and myrtle-leaf milkwort *Polygala myrtifolia* L.), show a richer assemblage of phytophagous arthropods. Further survey effort in both Australia

and southern Africa is required on African boxthorn to fully evaluate its phytophagous biota (Adair 2013).

Despite these limitations, four of the species recorded from *L. ferocissimum* in South Africa appear to be monophagous and have potential as classical biological control agents for African boxthorn. These are the tortoise beetles *Cassida lycii* Borowiec & Switajanska, *C. ditinguenda* Spaeth, *C. melanophthalma* Boheman, and the pathogen *Puccinia rapipes* R.Berndt and E.Uhlmann.

Puccinia rapipes (boxthorn rust) has considerable potential as a biological control in Australia as most rusts have highly restricted host ranges, can be highly damaging to their hosts and are generally easy to collect and establish in the laboratory or field. It is highly likely other damaging pathogens also occur on African boxthorn in southern Africa, but remain unrecorded due to the absence of systematic survey effort (Adair 2013).

Although *Lycium* is taxonomically isolated from the majority of other Solanaceae in Australia, the native shrub *L. australe* F.Muell. is closely related and is a key species for consideration in future host specificity evaluation, should it occur.

DISCUSSION

The 2012 Weeds of National Significance declaration and Australian Government coordination investment allowed a first national overview of African boxthorn in Australia. Coming from that overview were several key national management priorities that have been elaborated upon here.

From a natural environment perspective, a strategically important expenditure on African boxthorn management is Western Australia's high value environmental assets (e.g. the Fitzgerald River biosphere and offshore islands). Should starlings establish in Western Australia, boxthorn infestations will extend into natural areas where they have not yet achieved a foothold.

There is a strong potential for tomato potato psyllid (*Bactericera cockerelli*) to arrive in Australia, and use of boxthorn by it for overwintering. An assessment of solanaceous cropping areas and comparison of boxthorn infestation areas is recommended. This would assist biosecurity staff, industry and others to determine priorities and undertake strategic action.

From a broader perspective, investment in development of an African boxthorn biological control agent is strongly warranted, having the potential to reduce the weed's impact across its existing range. Initial research (Adair 2013) has indicated strong potential for boxthorn biocontrols. The potential of the rust species *Puccinia rapipes* particularly stands out. The next

step though requires research funding to progress the assessment of this rust for introduction into Australia.

These three areas represent priority environmental and agricultural asset protection and improved management capability investment opportunities for African boxthorn management in Australia.

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