

## Biodiversity threatened by weeds in New South Wales

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**Summary** Alien plants or weeds are acknowledged as a significant cause of global biodiversity decline. However, limited quantitative data is available on the biodiversity threatened by weeds. While there have been numerous studies of the impacts on individual native species, they do not allow for broad trends to be established across many taxonomic groups. One solution is to examine the biodiversity listed as threatened, for example the 970 listings under the NSW *Threatened Species Conservation Act 1995*. Threat information was compiled from a wide array of sources and condensed into distinct threat classes. Weeds posed a threat to 45% (n = 432) of listings, the majority of which were threatened plants. A total of 127 weed species were recorded as threatening biodiversity in NSW, although this number is likely to be much greater as approximately half of the weed threats described did not identify a specific weed species, and weed impacts are not confined to threatened species. Twenty weed species posed a threat to five or more threatened biodiversity listings, with eight threatening >10 listings. The three most recorded weeds were all Weeds of National Significance (WoNS), being lantana (*Lantana camara* L.) (99 listings), bitou bush (*Chrysanthemoides monilifera* (L.) T.Norl.) (48), and blackberry (*Rubus fruticosus* L. agg.) (21). Approximately 70% of weeds threatening biodiversity were deemed to be garden escapes, which collectively posed a threat to 190 listings. Unfortunately many of these weed species are still available for sale, highlighting the continual threat of weeds to biodiversity. The current study illustrates the impact of weeds on biodiversity and the implications for future weed management programs aimed at conservation, especially in NSW. Similar examination is needed nationally in order to quantify the weed problem in Australia.

**Keywords** Biodiversity at risk, weed impacts, Threatened Species, NSW *Threatened Species Conservation Act 1995*.

### INTRODUCTION

The major mechanisms of biodiversity loss have been identified as: (i) habitat loss and fragmentation, (ii) introduction of alien species, (iii) over-exploitation of flora and fauna, (iv) pollution, and (v) climate change (see WRI *et al.* 1992). Despite acknowledgement of

these major mechanisms of biodiversity loss, detailed information on the biodiversity threatened, and each threat's relative importance is lacking, irrespective of calls for such information (Grice *et al.* 2004, Groves 2004, P. Downey unpublished data), and significant progress towards understanding their impacts (i.e. since the seminal work of Elton 1958). One reason for this is that perceptions or beliefs have not been supported by data, especially with respect to broad patterns (Gurevitch and Padilla 2004).

Historically, attempts to assess the impacts of weeds on biodiversity have been through either scientific investigation of a specific alien species on a single native species (e.g. Weiss and Noble 1984, French and Zubovic 1997, Vranjic *et al.* 2000) or through reviews of such studies (Grice *et al.* 2004, Vidler 2004) and more recently, extensive systematic reviews using the Weed Impacts to Native Species (WINS) assessment tool (Downey 2006). However, impacts occur at a number of different levels (see Adair and Groves 1998), and the paucity of data derived from studies on the impacts of weeds on biodiversity make it difficult to determine broader impacts or trends (i.e. across diverse taxonomic groups of native species, or weed species). Given the urgent need for such information (see Grice *et al.* 2004) a new approach is needed.

Here we present an overview, and update of, a new approach to collating information on the biodiversity threatened by weeds in NSW (see Coutts-Smith and Downey 2006).

### IMPACT OF WEEDS ON THREATENED BIODIVERSITY IN NSW

**The dataset** The listings under the Schedules of the NSW *Threatened Species Conservation Act 1995* and the NSW *Fisheries Management Act 1994* (hereafter referred (collectively) to as the TSC Act for ease of reading), provided a list of threatened biodiversity in NSW, for which information on their threats could be compiled. The information on threats was compiled from a wide array of sources, which was then allocated into distinct threat classes. Coutts-Smith and Downey's (2006) study examined 945 listings under the TSC Act, however an additional 25 listings have been added since then. Examination of these additional listings is presented here along with their original results. The

biodiversity examined encompasses 578 plants, 276 animals, 37 threatened populations and 79 endangered ecological communities (Table 1).

### RESULTS

As the compilation of threat information included all threats, analysis of the impact of weeds relative to other threats revealed that weeds are a significant cause of biodiversity decline in NSW, being the major group of invasive species, and comparable to major threatening processes like land clearing. Weeds alone posed a threat to almost half of the biodiversity examined (i.e. 45% or 432 listings).

The greatest impact of weeds was to plants, with almost 50% (n = 283) of the plants listed being threatened by weeds, and 66% of all listings threatened by weeds were plants. Weed competition was identified as the greatest threat action, affecting over 80% of listings threatened by weeds, while the control of weeds was identified as affecting approximately 7%. However,

most species listed were threatened by more than one threat and identifying which was the main threat was not possible.

In addition, 127 different weed species (representing over 120 genera) posed a threat to biodiversity in NSW. Given that approximately half of the weed threats identified did not specify a specific species (i.e. the threat was simply described as competition from weeds), the number of weed species posing a threat is likely to be considerably higher. Of the weeds posing a threat, perennial grasses, vines/climbers, and legumes comprised the major groups. The three most recorded weed threats were all WoNS, being lantana, bitou bush and blackberry.

Approximately 70% of the weed species identified were considered to be garden escapes (as identified in Randall 2002). These garden escapes threatened at least 190 listings, or 44% of the listings threatened by weeds. This percentage is significantly increased, from 44 to 93%, when examined against the listings that

**Table 1.** The biodiversity listed on Schedules of the *Threatened Species Conservation Act 1995* (NSW) and *Fisheries Management Act 1994* (NSW), on the 1st January 2006 (after Coutts-Smith and Downey 2006).

Threatened biodiversity	Number listed as Endangered <sup>A</sup>	Number listed as Vulnerable <sup>A</sup>	Total listings	Number threatened by weeds
Plants	349	229	578	283
Aquatic plants	(3)	(1)	(4)	(0)
Algae, mosses and lichens	(1)	(0)	(1)	(0)
Fungi	(5)	(4)	(9)	(9)
Ferns and allies	(14)	(2)	(16)	(6)
Gymnosperms	(5)	(1)	(6)	(4)
Monocotyledons	(51)	(33)	(84)	(45)
Dicotyledons	(270)	(188)	(458)	(219)
Animals	97	179	276	63
Invertebrates	(15)	(2)	(17)	(11)
Fish	(7)	(5)	(12)	(1)
Amphibians	(13)	(14)	(27)	(7)
Reptiles	(16)	(26)	(42)	(10)
Marine mammals	(2)	(5)	(7)	(0)
Mammals	(17)	(40)	(57)	(8)
Birds	(27)	(87)	(114)	(26)
Plant populations	19	0 <sup>B</sup>	19	13
Animal populations	18	0 <sup>B</sup>	18	2
Ecological communities	79	n/a <sup>B</sup>	79	71
Total	562	408	970	432

<sup>A</sup>The descriptions of Endangered and Vulnerable are based on definitions outlined in the Red Book (see IUCN 2004).

<sup>B</sup>The listing of populations as Vulnerable followed an amendment to the TSC Act in 2004, and ecological communities can only be listed as Endangered.

did identify a specific weed species posing the threat. Fifty-five weed species were still available for sale nationally, of which 35 were available in NSW.

#### DISCUSSION

While the role of weeds in biodiversity decline has been widely acknowledged (WRI *et al.* 1992) there has been limited assessment of the actual impacts in Australia (P. Downey, unpublished), despite calls for such information (see Grice *et al.* 2004, Groves 2004). What is needed to influence management and policy initiatives is a broad assessment across many taxonomic groups (P. Downey, unpublished). The report by Coutts-Smith and Downey (2006), together with the revised information presented here, aims to rectify this problem by quantifying the biodiversity threatened by weeds.

This approach identified 432 biodiversity listings at risk from weed invasions in NSW alone, which is an order of magnitude more than Vidler's (2004) assessment for the whole of Australia (e.g. 41 nationally). While the current study provides a baseline assessment across many taxonomic groups, it has limitations in that the data is not based on an assessment of weed impacts, but rather on threatened species listings. Thus it is important that the study of individual weed species is maintained to determine the full extent of the weed problem and the nature of the impacts. For example, the only thorough examination of a single weed species to date, revealed 158 plant species, three populations and 26 ecological communities at risk from bitou bush invasion (Bitou Bush Threat Abatement Plan (TAP), DEC 2006), using the WINS assessment tool; a four stage process developed to collate information on weed impacts to native species (see Downey 2006 for further information). Again the number of species at risk identified far exceeded that reported previously for bitou bush, being six (see ARCANZ *et al.* 2000). This highlights the deficiencies in our knowledge and the need for dedicated assessments like that presented here or those using the WINS assessment tool. The WINS assessment examines all flora at risk (both those listed as threatened (i.e. under the TSC Act) and those not). For example, of the 158 species examined during the bitou bush assessment only 55 were listed under the TSC Act. This more thorough examination provides a greater understanding of the impacts, as well as enabling management directed for conservation purposes (e.g. DEC 2006).

In addition to determining the biodiversity at risk, the current study also provides information on the weed species posing the threat. Information on the weed species threatening biodiversity have not been previously compiled, despite them being published

as part of broader studies. Vidler (2004) outlines over 43 weed species, plus the generic collective threat of introduced grasses (both perennial and annual) threatening biodiversity, while Grice *et al.* (2004) outlines another seven weed species for a total of 50 weed species nationally. Thirteen of these weeds are Weeds of National Significance. The present study identifies 127 weed species, however this is only an interim list as: i) at least half of the threats did not identify a specific weed species, and; ii) the present study only examined threatened species and not all native species at risk. Given that there are 1386 naturalised plants in NSW (Coutts-Smith and Downey 2006), there are likely to be many more as only 10% were identified here.

A recent review found that 66% of the weed species in Australia originated from garden plants (Groves *et al.* 2005). The current study found that a similar percentage of the weeds threatening biodiversity in NSW originated from gardens. Unfortunately Groves *et al.* (2005) were not able to demonstrate the impact of these 'garden escapes' on biodiversity, thereby limiting the impetus for change (i.e. to legislation, policy and attitude: Coutts-Smith and Downey 2006). It is anticipated that identifying those species threatened by 'garden escapes' will be the driver for a policy change on garden escapes (e.g. banning such species from sale). The 35 weed species identified here that are still for sale in NSW should be immediately banned for sale. It should be noted that seven of these species were identified in a list of the 10 most serious invasive garden plants that were still available for sale in NSW (Groves *et al.* 2005).

Since the completion of the report by Coutts-Smith and Downey (2006) new data have become available: (i) 25 new listings under the TSC Act, which were incorporated here; 50% of which were threatened by weeds, (ii) a trial of the WINS system for two asparagus species identified an additional 95 species that were deemed to be potentially at risk (Downey 2006), and (iii) the development of the final Bitou TAP identified an additional 96 species, one population and 15 ecological communities as being at risk, between the draft (DEC 2004) and the final plan (DEC 2006). Not all of these newly identified species are listed as Threatened under the TSC Act. Irrespective, these additions further highlight the need for detailed assessments and their value in determining the threat weeds pose to biodiversity.

The approach developed by Coutts-Smith and Downey (2006) has attempted, for the first time in Australia, to quantify the impact of weeds on biodiversity. The results illustrate the extent of the weed problem in terms of the biodiversity threatened and the continual nature of the threat (i.e. from garden

escapes). While the data have some limitations (i.e. derived from a range of sources of different quality, the information presented here provides a long overdue baseline from which informed management and policy decisions can be made. It is hoped that the information presented here will stimulate robust discussions on the management of weed impacts to biodiversity. Finally, while the data presented here illustrates the weed problem for NSW at a specific point in time, what is ideally required is a national analysis, with regular revisions or updates.

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