The Weed Impact to Native Species (WINS) assessment tool – results from a trial for bridal creeper (*Asparagus asparagoides* (L.) Druce) and ground asparagus (*Asparagus aethiopicus* L.) in southern New South Wales

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Abstract

The threat of plant invasions on biodiversity, while apparent, is rarely quantified in terms of the number of native species at risk, or lists of such species. While broad assumptions can be made as to what is at risk from plant invasions, the lack of specific information on individual species at risk hampers our ability to deliver weed management strategies with biodiversity conservation outcomes. A detailed examination of the biodiversity threatened by one weed, bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata* (DC.) T. Norl.), in New South Wales established a process or assessment tool for identifying the native species potentially at risk from plant invasions. The Weed Impact to Native Species (WINS) assessment tool involves four stages, being: 1) a review of the literature, 2) collation and assessment of the knowledge from land managers and botanists with specific involvement, either in managing the weed species, or the native species in weed infested areas, 3) rigorous evaluation and examination of an interim list of species potentially at risk, and 4) ranking the revised list using a model. Given the success of the WINS process in delivering a base-line of the species at risk from bitou bush, trials have been undertaken to determine if the WINS process can be adapted for other weed species. The results of one such trial, for bridal creeper (*Asparagus asparagoides*) and ground asparagus (*Asparagus aethiopicus*), conducted in southern New South Wales are presented here, based on stages 1, 2 and part of 3. The present trial suggests that the WINS assessment process or tool developed for bitou bush in New South Wales can be used/adopted more broadly for widespread established weeds. This trial also illustrated the level of knowledge available on weed impacts to biodiversity that is not presently recorded or assessed, as well as the deficiencies in our collective understanding of weed impacts. For example, the number of plant species identified here in an interim list as potentially threatened by bridal creeper and ground asparagus was 52 and 97, respectively. The results from this trial of the WINS process significantly increased the number of species thought to be at risk from both these asparagus weeds. Such information indicates the impact asparagus weeds have on biodiversity and the need to collect, assess and disseminate such knowledge more broadly. The value of this information cannot be underestimated from a policy perspective with respect to weed and/or biodiversity conservation.

Keywords: WINS, weed impacts to native species, bridal creeper, *Asparagus asparagoides*, ground asparagus, *Asparagus aethiopicus*, biodiversity, species at risk, threat abatement plan, bitou bush.

Introduction

Assessing the impact of weeds on biodiversity

Invasive alien species (weeds and pest animals) have been acknowledged as the greatest cause of biodiversity decline, behind habitat loss (see IUCN 2000, Coutts-Smith and Downey 2006). Despite the acknowledgement of invasive alien species as a major threat to biodiversity, information on the biodiversity at risk has not been forthcoming (Adair and Groves 1998, Downey submitted). This lack of knowledge has hampered the management of alien species with conservation outcomes (see Mahon 2000, Downey 2004, Downey *et al*. 2004, Downey and Cherry 2005), especially from an on-ground perspective (Mahon 2000, Downey 2003). Surprisingly, despite large numbers of alien introductions (e.g. 2800 naturalized plants in Australia – see Groves *et al*. 2003), and calls for information on the species at risk (see Adair and Groves 1998, Grice *et al*. 2004, Groves 2004) little has been done to collate such information for alien plants in Australia.

Historically, attempts to assess the biodiversity at risk from alien plant or weed invasions have either been through specific scientific investigation (e.g. Weiss and Noble 1984a,b, French and Zubovic 1997, Matarczyk 1999, Vranjic *et al.* 2000) or reviews of such studies (e.g. Grice *et al.* 2004, Vidler 2004). However, impacts can occur at, and thus be measured at a number of different levels (Adair and Groves 1998, Parker *et al*. 1999), for example at the genetic, individual, population, community and ecosystem level. In addition, the major constraint on determining any impacts is that there are few studies of native species diversity and abundance prior to and following invasion (Williamson 2001, Myers and Bazely 2003). While the information that is available provides specific information on individual species or collective assessments of these species, detailed information is not provided on the full extent of the biodiversity or the groups of species (e.g., orchids) most at risk from weed invasions (see Downey submitted). This is in part due to the fact that studies on the impacts of invasive plants have typically focused on processes, or linkages between organisms and their environment, and not on particular organisms (Walker and Smith 1997).

Recently two different approaches have been developed that aim to provide a more comprehensive assessment of the biodiversity at risk from weed invasions. One focuses on an examination of threatened species databases (see Coutts-Smith and Downey 2006). The other is an assessment tool that focuses on a systematic review and consultation with stakeholders who have specific working knowledge of certain weed species and the native species that occur in invaded areas (DEC 2004 in press., Downey 2004), which has lead to the development the WINS (Weed Impact to Native Species) assessment tool. These two approaches have significantly increased the number of species considered to be at risk from weed invasion in New South Wales. For example, before these studies, a review of the species threatened by weeds in Australia found 41 species at risk (see Vidler 2004). Both of these two approaches found significantly more species at risk in New South Wales alone. The review of threatened species databases increased the number of species at risk by an order of magnitude, being 419 species (see Coutts-Smith and Downey 2006), while the WINS approach found 153 species at risk from the weed bitou bush (see DEC in press, Downey submitted).

By knowing the species at risk, appropriate policy, management strategies, priorities and specific actions can be developed. Unfortunately, due to the lack of information on the species at risk, many strategies for weeds have failed to account for impacts to biodiversity adequately (see Downey and Cherry 2005, Downey submitted), as decisions have to be made in the absence of comprehensive, quantitative data (Grice *et al*. 2004, Downey submitted). Following the collation of information on the impacts of weed species, weed management strategies can be developed that specifically focus weed control to areas where

biodiversity benefits are greatest (e.g., the Bitou Bush Threat Abatement Plan (Bitou TAP) – see Downey 2004, DEC 2004, in press for more details). The Bitou TAP provides a model that could be adopted for other weeds as suggested by Downey and Cherry (2005) and more broadly by Downey and Leys (2004). However, before the TAP approach can be adopted for any other weed species an assessment of the biodiversity at risk is required.

The impact of bridal creeper and ground asparagus on biodiversity

Although bridal creeper, *Asparagus asparagoides* (L.) Druce, is considered to be a serious threat to biodiversity, little quantitative data is available on its impact in southern Australia (Adair and Groves 1998). Despite Adair and Groves' (1998) comments, those of Humphries *et al*. (1991) in identifying bridal creeper as one the 18 worst environmental weeds in Australia, and the listing of bridal creeper as a Weed of National Significance (see Thorp and Lynch 1998), information on the species impacted upon has not been forthcoming. For example, the Bridal Creeper National Strategy (see ARMCANZ *et al*. 2001) identified only one species, the pink pimelea (*Pimelea spicata* R.Br.), and more generically orchids as being at risk from bridal creeper invasion. Given the distribution of bridal creeper in Australia (Batchelor and Scott 2006), the density of infestations, and the potential impact (i.e. Humphries *et al*. (1991) states that bridal creeper 'has the potential to eliminate most understorey species in the long term'), the number of species at risk must be greater than that outlined in the Bridal Creeper National Strategy. One reason for this lack of information may be associated with the fact that determining the species at risk by looking at post-control experiments may not be adequate as the recovery of invaded sites may take a long time following control (Turner and Virtue 2006).

A quick review of the literature revealed 14 additional plant species either currently or potentially at risk, all of which occur in South Australia; and a threatened butterfly and four endangered ecological communities, all of which occur in New South Wales (see Table 1).

There is additional information on species at risk, but they could not be determined, as unfortunately many authors discussed their observations, rather than documenting them. For example, Green (1993) states that the understorey beneath *Acacia rhetinocarpa* JM.Black is threatened by bridal creeper, and Littlely (1992) states that 'in some areas 85% of the native herbs are lost following bridal creeper invasion'. However, in both instances the species at risk were not described.

Whilst the Bridal Creeper National Strategy includes reference to all asparagus weeds in Australia, there is no mention of any species at risk from these other asparagus weeds (see ARMCANZ *et al*. 2001). Again a quick review of the literature revealed seven plant, three animal species and two ecological communities at risk from ground asparagus (which includes species referred to as *Asparagus densiflorus* (Kunth) Jessop and asparagus fern, *A. aethiopicus* L. – see Batchelor and Scott (2006) with regards to the confusion over the taxonomy of this group in Australia), bridal veil (*Asparagus declinatus* L.) and climbing asparagus (*Asparagus plumosus* Baker) invasions collectively (Table 1).

Based on this brief literature review, the total number of species and ecological communities potentially threatened by asparagus weeds was 22 and four, respectively. While this number is greater than that recorded in the National Strategy, it is not representative of the actual impacts. For example, impacts have only been recorded from South Australia and New South Wales (see Table 1), despite asparagus weeds being invasive elsewhere (e.g., bridal creeper is a problem in Western Australia, Tasmania and Victoria).

A trial of the WINS assessment tool

The WINS assessment process

The development of the Bitou TAP required a process to be established that would enable the identification of a comprehensive list of species potentially at risk without undertaking protracted detailed quantitative examinations. The solution lead to the development of the WINS assessment tool, which involves four stages, being 1) a review of the literature, 2) collation and assessment of the knowledge from land managers and botanists with specific involvement, either in managing the weed species, or the native species in weed infested areas, 3) rigorous evaluation and examination of an interim list of species potentially at risk, and 4) ranking the revised list using a model (i.e. DEC in press). Stage 1 does not differ from the current approach (see Grice *et al*. 2004, Vidler 2004), and while stage 4 is unique in terms of dealing with individual impacts from one weed species, models have been used widely to develop priorities (Groves *et al*. 2001). However, in a new approach for establishing weed impacts, stages 2 and 3 of WINS outline a process for rapidly collating information that would otherwise not be available, and evaluating the quality of that information in order to determine its integrity, respectively.

Stage 2 of the bitou bush WINS assessment involved a series of targeted workshops, where experts with first hand knowledge of bitou bush management, native species conservation or botany, specifically in areas affected by bitou bush or with specific knowledge of species impacted, were invited to attend. These workshops were confined to about 10 people and the workshop participants were asked to bring along any information on species impacted by bitou bush and lists of species they thought might be at risk, irrespective of whether this information was anecdotal, perceived or based on some form of assessment (i.e. observations from invaded and uninvaded areas). Participants were asked to provide such information and the group discussed each species or ecological community in turn [hereafter the use of 'species' will include 'ecological community' unless otherwise stated for ease of reading]. Only after there was group consensus that a species was at risk from bitou bush invasion was it added to an interim list of potentially at risk species. For each species considered to be at risk, notes were made as to how the group thought the species was at risk (e.g., not present in infested areas – see Table 2) along with notes of who made observations, so if needed the source of information could be retraced. This process resulted in an interim list of the species potentially at risk. The interim list was then widely circulated and feed-back was sought; stage 3 of the WINS process. Any species for which there was debate as to the impact were discarded or highlighted as considered to be at risk. The model used to assess the impacts from bitou bush invasions [stage 4] used four attributes, being a) habitat susceptibility – a measure of how susceptible the habitat is to invasion, b) distribution – the degree of overlap between the native species and the bitou bush, c) species susceptibility – a measure of how susceptible the species is to invasion, and d) persistence – two measures on the persistence of species, being propagule dispersal and dormancy (see DEC in press and Downey submitted for more details).

While the four stage WINS assessment tool is not a rigorous scientific assessment of the impacts, there have been no criticisms of the species identified as being at risk from bitou bush invasions, despite wide community consultation (i.e. public exhibition of the draft Bitou TAP). The value of the WINS assessment process is evident by our increased understanding of the biodiversity at risk. For example, there were only six plant species identified at risk in the National Bitou Bush Strategy (ARMCANZ *et al*. 2000) yet the final Bitou TAP identifies over 150 plant species, two plant populations and 24 ecological communities at risk (DEC in press).

A trial of the WINS assessment process for bridal creeper and ground asparagus

In October 2005, a trial of the WINS assessment tool was conducted to establish whether the process outlined above could be adopted for other weeds, in this instance bridal creeper and ground asparagus. The trial took place in Ulladulla, southern New

Table 1. Species identified to be at or potentially at risk from asparagus weed invasions in Australia, following a brief literature review.

Asparagus weed species	Native species at risk	State[A]	Threatened[B]	Reference
Bridal creeper				
Plants	beyeria bush-pea (*Pultenaea insularis* I.Holliday)	SA	EPBC	Taylor (2003)
	Kangaroo Island turpentine bush (*Beyeria subtecta* J.Black)	SA	EPBC	Taylor (2003)
	Kangaroo Island pomaderris (*Pomaderris halmaturina* subsp. *halmaturina* J.M.Black)	SA	EPBC	Davies (1986), Jusaitis (1993), Taylor (2003)
	MacGillavray spyridium (*Spyridium eriocephalum* var. *glabrisepalum* J.M.Black)	SA	EPBC	Taylor (2003)
	Kangaroo Island phebalium (*Leionema equestre* (D.A.Cooke) Paul G.Wilson)	SA	EPBC	Taylor (2003)
	pink pimelea or spiked rice-flower (*Pimelea spicata*)	NSW	TSC	Groves and Willis (1999), ARMCANZ *et al*. (2001), Coutts-Smith and Downey (2006)
	sandhill green-hood orchid (*Pterostylis arenicola* M.A.Clem. & J.Stewart)	SA	EPBC	Davies (1991), Jusaitis and Sorenson (1994), Sorenson and Jusaitis (1995), Davies (1995), Groves and Willis (1999)
	small-flowered daisy bush (*Olearia microdisca* J.M.Black)	SA	EPBC	Taylor (2003)
	pale leek-orchid (*Prasophyllum pallidum* Nicholls)	SA	EPBC	Davies (1995)
	west coast mintbush (*Prostanthera calycina* Benth.)	SA	EPBC	Davies (1995)
	metallic sun-orchid (*Thelymitra epipactoides* F.Muell.)	SA	EPBC	Davies (1995)
	blue range emubush (*Eremophila barbata* Chinnock)	SA	EPBC	Davies (1995)
	ironstone mulla mulla (*Ptilotus beckerianus* (F.Muell.) J.Black)	SA	EPBC	Davies (1995)
	Spyridium coactilifolium Reisseck	SA	EPBC	Davies (1986)
	fringed pseudanthus (*Pseudanthus micranthus* Benth.)	SA	ROTAP	Davies (1986)
Invertebrates	black grass-dart butterfly (*Ocybadistes knightorum*)	NSW	TSC	Coutts-Smith and Downey (2006)
Ecological communities	littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions	NSW	TSC	Coutts-Smith and Downey (2006)
	river-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin, and South East Corner bioregions	NSW	TSC	Coutts-Smith and Downey (2006)
	swamp-oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	NSW	TSC	Coutts-Smith and Downey (2006)
	sub-tropical Coastal floodplain forest of the NSW North Coast bioregion	NSW	TSC	Coutts-Smith and Downey (2006)
Ground asparagus				
Plants	crystal creek walnut (*Endiandra floydii* B.Hyland)	NSW	TSC	Coutts-Smith and Downey (2006)
	Nielsen Park she-oak (*Allocasurina portuensis* L.Johhson)	NSW	TSC	Matthes and Nash (2000)
	ripple-leaf Muttonwood (*Rapanea* sp. A Richmond River (J.H.Maiden & J.L.Boorman NSW 26751))	NSW	TSC	Coutts-Smith and Downey (2006)
	thorny pea (*Desmodium acanthocladum* F.Muell)	NSW	TSC	Coutts-Smith and Downey (2006)
Animals	black-winged petrel (*Pterodroma nigripennis*)	NSW	TSC	Coutts-Smith and Downey (2006)
	Coxen's double-eyed fig parrot (*Cyclopsitta diophthalma coxeni*)	NSW	TSC	Coutts-Smith and Downey (2006)
	little shearwater (*Puffinus assimilus*)	NSW	TSC	Coutts-Smith and Downey (2006)
Ecological communities	littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions	NSW	TSC	Coutts-Smith and Downey (2006)
Bridal veil				
Plants	beyeria bush-pea (*Pultenaea insularis*)	SA	EPBC	Taylor (2003)
	Kangaroo Island phebalium (*Leionema equestre*)	SA	EPBC	Taylor (2003)
	small-flowered daisy bush (*Olearia microdisca*)	SA	EPBC	Taylor (2003)
Climbing asparagus				
Ecological communities	sub-tropical Coastal floodplain forest of the NSW North Coast bioregion	NSW	TSC	Coutts-Smith and Downey (2006)

[A] State in which the impact was recorded/observed.

[B] Threatened as listed under EPBC = *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth), TSC = *Threatened Species Conservation Act 1995* (NSW) and/or ROTAP = Rare or Threatened Australian Plants.

Table 2. The five criteria used during the WINS process for assessing the risk to native species thought to be at potentially at risk from weed invasions.

Description	Code used
• The native species is not present in infested areas which contain that species' typical vegetation community. This can be determined from both infested and un-infested sites as well as anecdotal or observation data about declines following invasion.	NP
• There is clear evidence that the weed displaces the native species. For example, the native occurs at lower than 'normal' levels in invaded sites, but is not out-competed.	D
• The weed species is thought to out-compete and/or suppresses the native species.	OCS
• The density of an infestation is such that recruitment of native species is prevented. The prevention of recruitment could affect a wide range of native species from annuals or trees.	RP
• The native species is considered at risk, but more information is needed to determine the level of risk.	CAR

South Wales, as both asparagus weeds were present in the area and thus were potentially posing a threat to biodiversity. Eight people, spanning both government and the community participated in the one-day workshop. The workshop was started with a short presentation on the Bitou TAP and how the list of species at risk was developed, followed by discussions on the impacts of bridal creeper and ground asparagus. Notes were made using the five criteria (see Table 2) on the likely impact for each species to support their consideration as being potentially at risk. The interim list of species potentially at risk from this workshop was then circulated to a wider group of people who were asked to comment on the inclusion of any species. This resulted in the addition of several additional species.

Given that this workshop investigated two weed species, there was only sufficient time to investigate the impacts to plant species and ecological communities.

Results of the WINS trial

Bridal creeper

The number of species identified in the trial as potentially at risk from bridal creeper invasion in southern New South Wales was 52. Two of these species are listed under the *Threatened Species Conservation Act 1995* (NSW: TSC Act). None of the 52 were recorded during the literature review (stage 1). In addition, 11 ecological communities were identified as potentially at risk by bridal creeper, six of which are listed under the TSC Act (see Appendix 1 for a complete list). The majority of the species (50%) did not occur in infested areas (NP), while only 11.5% were considered to be at risk (CAR - Table 3).

Ground asparagus

The number of species identified in the trial as potentially at risk from ground asparagus invasion was 97, none of which were recorded during the initial literature review. Two of these species are listed under the TSC Act. Forty-eight of these species were also identified as being threatened by bridal creeper. In addition, seven ecological communities were identified as potentially threatened by ground asparagus, one of which are listed under the TSC Act (see Appendix 1 for a complete list) and one of which was recorded during the literature review. The majority of the species (34%) were assessed as being impacted through the prevention of recruitment (RP), and a further 30% did not occur in infested areas (NP - Table 3).

Table 3. The way in which bridal creeper and ground asparagus posed a threat to the native species identified as being potentially at risk from the trial of WINS.

	Number of native species potentially at risk	
Reasons for decline	Bridal creeper	Ground asparagus
NP – not present in infested areas	26	29
D – displaced by weed	6	7
OCS – out-competed and/or suppressed	7	21
RP – recruitment prevented	6	33
CAR – considered to be at risk	7	7
Total number of species potentially at risk	52	97

Discussion

The current trial of an assessment tool for determining the biodiversity at risk from weed invasions, using bridal creeper and ground asparagus, showed that this process works for weed species other than bitou bush; a finding supported by a separate trials on lantana (P. Downey and A. Clark unpublished data) and boneseed (P. Downey and H. Cherry unpublished data). In all four instances [bitou bush, bridal creeper/ground asparagus, lantana and boneseed] the number of species identified as being at risk during this process significantly eclipsed the prior available knowledge on impacts, suggesting that vast amounts of information on weed impacts are not documented, but can be readily collated and assessed. For example, the lantana trial resulted in a three-fold increase in the species thought to be at risk (increasing from 53 to 160 species), which is similar to the 4.5-fold increase for bridal creeper as presented here (increasing from 15 to 67 species), while the increase for boneseed was 11-fold (increasing from 12 to 130 species). However, the increase for ground asparagus was 24-fold (increasing from 4 to 97 species, suggesting that its impacts have been greatly overlooked, and is similar to the 25-fold increase observed for bitou bush (increasing from 6 to 153 species). Similar increases were also observed for the number of ecological communities at risk from each weed. It must be noted however, that the assessment undertaken for bitou bush involved several workshops, extensive consultation and review throughout the distribution of bitou bush within New South Wales, over a 12–18 month period, which greatly refined the list of species at risk (see Downey 2004 in press) and using all four stages of the WINS assessment tool. Therefore, the numbers observed from these trials on bridal creeper/ground asparagus, lantana and boneseed will change once extensive examination is undertaken, like that for bitou bush, as the combination of all four stages of the process will lead to refinement and better justification of the species identified.

It should also be noted that by identifying a species as being at risk, does not mean that the species is at risk from the weed species throughout its distribution. This is accounted for by the **distribution attribute** in the Bitou TAP model (see above and DEC in press); highlighting the value of stage four in the assessment process.

There is a degree of subjectivity associated with assessing peoples' thoughts on species at risk from weed invasions. To account for this subjectivity, two

mechanisms were used in stage 2 of the assessment process; 1) an initial assessment based on the majority of the participants at the workshops, and 2) the use of written justifications using the words in Table 2, as to how the species is thought or perceived to be at risk. When followed up with stage 3 of the process – evaluation and assessment of the lists through wide consultation, and stage 4 – modelling, any subjectivity is reduced. Any subjectivity is further reduced if high priority species, as determined by the model, are used in the first instance as the species at risk.

Given the species presented here (see Appendix 1) are only an interim list of those species deemed to be at risk from bridal creeper and ground asparagus invasions based on stages 2 and part of stage 3 of the four stage assessment process, caution should be employed when using these species to document impacts (either from the weed to a native species, or collectively for a weed) or determining species actually at risk, especially given the above discussion. Further evaluation and assessment is needed and the publication of the interim list here can form part of this process. It is anticipated that any feed-back, discussion, further justification, additions or removals of species on the interim list be directed to the author, in the first instance [contact details above]. While publishing this interim list [here] will contribute to the stage 3, stage 4 is the definitive stage, as the modelling and ranking process narrows the focus to those species for which impacts are likely in the absence of empirical data. Thus, the species presented here should only be cited as potentially at risk, pending further evaluation and assessment.

Irrespective, by making some assessment of the likely impacts (i.e. using Table 2), a degree of confidence can be placed upon their validity. For example, observations that certain native species are not present in infested areas could be considered to be a greater justification of the impact, than those species that are identified as being potentially (or considered to be) at risk. In addition, the lists presented here can provide researchers with the identity of species for which to test the actual impacts upon through the collection of empirical data.

The WINS assessment process is an evolving approach, developed following a need to assess the biodiversity at risk from plant invasions quickly and in the absence of empirical data on actual impacts. There may be other ways of assessing impacts and the process may change once it is used more widely, but any changes to the WINS methodology are likely to be driven by the same need or aim, and will be the result of debate and discussion on assessing weed impacts, which is long overdue (Downey submitted).

Impact of asparagus weeds on biodiversity

The results of the brief literature review (see above) and the trial of the WINS assessment process highlight the range and diversity of species that are potentially threatened by asparagus weeds. In addition, the results of stages 1, 2 and part of 3 illustrate that information is available, but collating and assessing it requires effort and a process. The dissemination of such information on impacts is crucial in gaining the appropriate support for developing policy and managing the biodiversity impacted from bridal creeper and asparagus weeds in Australia.

Expanding the WINS trial

The interim lists of species identified as 'potentially at risk' from this and other trials needs to be widely circulated and assessed. Ideally, prior to any assessment the results of these trials should be supported by additional trials/workshops from throughout the distributions of the respective weed species. Lastly, the revised lists from stage 3 need to be modelled (stage 4) (i.e. in a similar fashion to that used in the Bitou TAP to determine the species most at risk (see DEC in press)).

Managing the impacts of bridal creeper / asparagus weeds on biodiversity

A key action in the National Bridal Creeper Strategy is to list bridal creeper as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (KTP – see ARMCANZ *et al*. 2001); or under the TSC Act. Despite this, such a listing has not yet occurred, in part due to the limited information that was available on the species at risk and the need for such information in order to make a nomination (see Downey and Leys 2004 for details on listing weeds as KTPs). However, the present trial provides clear evidence of the likely impact of asparagus weeds to biodiversity, which is sufficient to satisfy the KTP listing process. Following a KTP listing (i.e. under the TSC Act), a Threat Abatement Plan (TAP) for managing bridal creeper in New South Wales could be prepared based on the model developed for the Bitou TAP (see DEC in press), as suggested by Downey and Cherry (2005). If the Bitou TAP model were to be used then the current trial would need to be expanded to cover the entire distribution of bridal creeper and all four stages of the WINS process completed (see above).

Given number of species identified here as potentially at risk from ground asparagus invasions, it maybe appropriate to develop a plan that deals with asparagus weeds as a whole, which may include a generic nomination to have asparagus weeds listed as a KTP.

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Appendix 1. An interim list of species thought to be at risk from bridal creeper and ground asparagus invasions from southern New South Wales, based on the outcome of a workshop aimed at trialling the assessment process developed for bitou bush. This interim list does not contain the results of the literature review presented in the text. Given that this interim list only represents the results of stages 2 and part of 3 in a four stage assessment process, caution should be used in using these species to document impacts (either from the bridal creeper or ground asparagus to a native species, or collectively for either weed) or determining species actually at risk. Thus, the species presented here should only be cited as potentially at risk, pending further evaluation and assessment. The completion of stage 3 involves evaluation of this list. Hence, any feed-back, discussion, further justification, additions or removals of species on the interim list should be directed to the author, in the first instance (contact details above).

Native biodiversity thought to be at risk from invasion	Bridal creeper	Threat code (see Table 2)	Ground asparagus	Threat code (see Table 2)	Listed as threatened[A]
Species					
Acacia maidenii F.Muell.			Yes	RP	
Acacia sophorae (Labill.) R.Br.	yes	D	Yes	D	
Acmena smithii (Poir.) Merr. & L.M.Perry			Yes	RP	
Acianthus fornicatus R.Br.			Yes	NP	
Acronychia oblongifolia (A.Cunn. ex Hook.) Endl. ex Heynh.			yes	RP	
Alyxia buxifolia R.Br.	yes	D	yes	D	
Adriana tomentosa Gaudich.	yes	OCS	yes	OCS	
Angophora hispida (Sm.) Blaxell			yes	RP	
Aphanopetalum resinosum Endl.	yes	CAR	yes	CAR	
Banksia integrifolia L.f.	yes	RP	yes	RP	
Billardiera scandens Sm.	yes	OCS	yes	OCS	
Bossiaea ensata DC.	yes	D	yes	D	
Breynia oblongifolia (Mull.Arg.) Mull.Arg.	yes	OCS	yes	NP	
Caleana major R.Br.	yes	NP	yes	NP	
Carpobrotus glaucescens (Haw.) Schwantes			yes	OCS	
Cassine australis (Vent.) Kuntze			yes	RP	
Casuarina glauca Sieber ex Spreng.	yes	RP	yes	RP	
Cissus antarctica Vent.			yes	RP	
Cissus rhombifolia Vahl			yes	RP	
Clerodendrum tomentosum (Vent.) R.Br.			yes	RP	
Claoxylon australe Baill.			yes	RP	
Commelina cyanea R.Br.	yes	NP	yes	OCS	
Correa reflexa (Labill.) Vent.	yes	NP	yes	NP	
Cynanchum elegans (Benth.) Domin	yes	CAR	yes	CAR	TSC Act
Dendrobium teretifolium R.Br.	yes	CAR	yes	CAR	
Dianella caerulea Sims			yes	OCS	
Dianella congesta R.Br.			yes	OCS	
Dianella longifolia R.Br.			yes	OCS	
Dianella tasmanica Hook.f.	yes	NP	yes	NP	
Dichondra repens J.R.Forst. & G.Forst.			yes	RP	
Dipodium punctatum (Sm.) R.Br.			yes	NP	
Dipodium variegatum M.A.Clem. & D.L.Jones			yes	NP	
Diuris punctata Sm.			yes	NP	
Diuris sulphurea R.Br.			yes	NP	
Doodia aspera R.Br.			yes	OCS	
Eucalyptus botryoides Sm.	yes	RP	yes	OCS	
Eucalyptus gummifera (Gaertn.) Hochr.			yes	OCS	
Eucalyptus melliodora A.Cunn. ex Schauer	yes	RP			
Eucalyptus pilularis Sm.			yes	RP	
Eucalyptus robusta Sm.			yes	RP	
Eucalyptus tereticornis Sm.	yes	RP			
Eustrephus latifolius R.Br. ex Ker Gawl.	yes	OCS			
Ficus coronata Spin & Colla			yes	RP	
Geitonoplesium cymosum (R.Br.) A.Cunn. ex R.Br.	yes	D	yes	D	
Glycine clandestina J.C.Wendl.	yes	NP	yes	NP	
Gonocarpus teucrioides DC.	yes	NP	yes	NP	
Guioa semiglauca (F.Muell.) Radlk.			yes	RP	
Haloragis exalata F.Muell.	yes	CAR	yes	CAR	
Hardenbergia violacea (Schneev.) Stearn			yes	RP	
Helichrysum elatum DC.	yes	NP	yes	NP	
Hibbertia dentata DC.	yes	D	yes	D	
Hibbertia obtusifolia DC.	yes	NP	yes	NP	

Native biodiversity thought to be at risk from invasion	Bridal creeper	Threat code (see Table 2)	Ground asparagus	Threat code (see Table 2)	Listed as threatened[A]
Hibbertia scandens (Willd.) Dryand.	yes	D	yes	NP	
Indigofera australis Willd.	yes	OCS	yes	OCS	
Isolepis nodosa (Rottb.) R.Br.	yes	NP	yes	NP	
Kennedia prostrata R.Br.	yes	OCS	yes	OCS	
Kennedia rubicunda Vent.	yes	NP	yes	NP	
Lepidosperma concavum R.Br.	yes	NP	yes	NP	
Leucopogon parviflorus (Andrews) Lindl.	yes	NP	yes	NP	
Marsdenia rostrata R.Br.	yes	NP	yes	NP	
Microlaena stipoides (Labill.) R.Br.	yes	OCS	yes	OCS	
Monotoca elliptica (Sm.) R.Br.	yes	RP	yes	RP	
Myoporum acuminatum R.Br.			yes	RP	
Myoporum acuminatum R.Br.			yes	RP	
Notelaea longifolia Vent.			yes	RP	
Olearia axillaris (DC.) Benth.	yes	NP	yes	NP	
*Omalanthus popu*lifolius Graham			yes	RP	
Opercularia aspera Gaertn.	yes	NP	yes	NP	
*Oplismenus aemul*us (R.Br.) Roem. & Schult.			yes	OCS	
Oplismenus imbecillis (R.Br.) Roem. & Schult.	yes	NP	yes	OCS	
Oxalis rubens Haw.	yes	NP	yes	NP	
Parsonsia straminea (R.Br.) F.Muell.	yes	NP	yes	CAR	
Pellaea falcata (R.Br.) Fee			yes	OCS	
Persoonia levis (Cav.) Domin			yes	RP	
Persoonia linearis Andrews			yes	RP	
Pittosporum revolutum Dryand. ex W.T.Aiton	yes	NP	yes	RP	
Plectranthus parviflorus Willd.			yes	RP	
Poa poiformis (Labill.) Druce	yes	NP	yes	NP	
Podocarpus elatus R.Br. ex Endl.			yes	RP	
Podocarpus spinulosus (Sm.) R.Br. ex Mirb.			yes	RP	
Poranthera microphylla Brongn.	yes	NP	yes	NP	
Pterostylis nutans R.Br.	yes	NP	yes	NP	
Rapanea howittiana (F.Muell.) Mez			yes	RP	
Rapanea variabilis (R.Br.) Mez			yes	RP	
Rubus parvifolius L.			yes	OCS	
Scaevola calendulacea (Andrews) Druce			yes	OCS	
Schelhammera undulata R.Br.			yes	OCS	
*Senecio lautu*s subsp. *maritimus* Ali	yes	NP	yes	NP	
Senecio linearifolius A.Rich.	yes	NP	yes	NP	
Solanum stelligerum Sm.	yes	NP	yes	NP	
Stackhousia spathulata Sieber ex Spreng.			yes	OCS	
Stephania japonica (Thunb.) Miers	yes	NP	yes	NP	
Syncarpia glomulifera (Sm.) Nied.			yes	RP	
Synoum glandulosum (Sm.) A.Juss.			yes	RP	
Tetragonia tetragonioides (Pall.) Kuntze			yes	OCS	
Themeda australis (R.Br.) Stapf			yes	D	
Typhonium eliosurum (Benth.) O.D.Evans	yes	CAR	yes	CAR	ROTAP
Viola hederacea Labill.	yes	CAR	yes	CAR	
Westringia fruticosa (Willd.) Druce			yes	RP	
Terrestrial ground orchids	yes	NP	yes	NP	
Ecological communities					
Banksia sand forest			yes	RP	
Bangalay banksia coastal scrub	yes	OCS	yes	OCS	
Bega dry grass forest	yes	RP			
Candelo dry woodland grass forest	yes	RP			
Casuarina forest			yes	RP	
Coastal dune scrub	yes	CAR	yes	CAR	
Coastal swamp forest complex			yes	CAR	
Coastal swamp oak forest (flooded)	yes	CAR			
Coastal themeda grasslands			yes	OCS	
Grassy woodlands	yes	CAR			
Milton-Ulladulla subtropical rainforest	yes	OCS			
Mount Gibraltar tall open forest community	yes	RP			
Littoral rainforest	yes	CAR	yes	OCS	TSC
Shale-sandstone transitional forest	yes	OCS			
Sydney coastal estuarine freshwater complex	yes	CAR			TSC

[A] Listed as threatened under TSC Act = the *Threatened Species Conservation Act 1995* (NSW) and/or ROTAP = Rare or Threatened Plants of Australia (see Briggs and Leigh 1996).