ESCAPED GARDEN PLANTS AS A KEY THREATENING PROCESS

Submission in response to the nomination 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including cultivated and aquatic plants'.

Invasive Species Council

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1. Should escaped garden plants be listed as a key threatening process?

There is strong, if often poorly documented, evidence that escaped garden plants are having a major adverse impact on Australia's biodiversity, including those matters recognised as matters of national environmental significance such as threatened species. Such weeds cumulatively rank amongst the highest threats to biodiversity, and their threat is likely to increase into the future, particularly under climate change.

As documented by Coutts-Smith and Downey (2006)[1] — a study relied upon for the nomination of this KTP — 419 threatened species listed in NSW, 45 percent of those examined (some of which are federally listed) are threatened by weeds, of which about 65% are escaped garden plants. Weeds ranked second to land clearing as the most frequent single threatening factor. The same situation would apply to a lesser or stronger extent in other states and territories, but equivalent studies have not been done. Many listed ecological communities and nationally important conservation areas — World Heritage Areas, Ramsar wetlands, commonwealth reserves — are also under serious pressure from weedy garden plants and other weeds.

Although Australia has enacted substantial reforms to prevent new weeds being imported — 1997 quarantine reforms require risk assessment of proposals to import new plant species — the problem of invasive garden (and agricultural) plants will continue to grow.

Those garden plants already in the country represent an enormous pool of existing and potential weeds. An estimated 10 exotic plant species newly naturalise in Australia each year, the majority escaped garden plants. However, this is probably an underestimate as in Queensland an estimated 12 new species naturalise each year[2] and in Victoria an average 7.3 new plants naturalise each year (with the rate estimated to be increasing by 0.25 plants per year).[3] The problem will also increase as new genetic variants of existing or potential weed species continue to be imported[4], as they are not usually subject to quarantine risk assessment. Greater genetic diversity can greatly increase the invasion risks for existing or potential weeds, as was shown for the invasive garden tree *Pyrus calleryana* in the US (novel genetic rearrangements can expand

[1] Coutts-Smith, A.J. and Downey, P.O. (2006). Impact of weeds on threatened biodiversity in New South Wales. Technical Series no. 11, CRC for Australian Weed Management, Adelaide.
[2] Batianoff, G.N. & Butler, D.W. (2004) An overview of prioritization of invasive naturalized exotic plants in Queensland. See www.northcoastweeds.org.au/site-files/docs/forum04/seqldexotics-batianoff.pdf.
[3] Victoria's 2008 State of the Environment report, pest plants and animals section, see http://www.ces.vic.gov.au/ces/wcmn301.nsf/childdocs/-FCB9B8E076BEBA07CA2574F100040358-0B6E0C64F14232FBCA2574F1001F0220-6D729D2D2FEE8E47CA2574F1001F9B7A?open
[4] Wilson, J.R., Dormontt, E.E., Prentis, P.J. Lowe, A.J. and Richardson, D. (2009) Something in the way you move: dispersal pathways affect invasion success. Trends in Ecology & Evolution 24 (3): 136-144.
Prentis, P.J., Wilson, J.R., Dormontt, E.E. Richardson, D.M. and Lowe, A.J. (2008) Adaptive evolution in invasive species. Trends in Plant Science 13(6): 288-294.

ecological tolerances, increase genetic variance, alter epistatic interactions, mask or unload deleterious alleles, and transfer favorable genes).[5]

Although 'escaped garden plants' is a very large category of threats — consisting of thousands of individual species — it is an appropriate KTP category because it represents one major invasion pathway and because the impacts of different weeds are often very similar. Some individual weeds of garden origin are very significant threats in their own right and could be listed as individual KTPs — bridal creeper (*Myrsiphyllum asparagoides*), lantana (*Lantana camara*), rubbervine (*Cryptostegia grandiflora*), and mimosa (*Mimosa pigra*), for example. As well as the advantages of efficiency and synergies that derive from the category listing, there is that of facilitating a focus on emerging or potentially threatening garden species that would not yet qualify as individual KTPs. One of the strongest priorities in responding to this threat should be addressing these emerging threats.

Although gardening industries have a substantial economic output, and gardening is a very important activity for many people, there is not a fundamental conflict between gardening and protecting biodiversity from weed threats because there is a substantial pool of low-risk garden plant species. The nursery industry strongly resists regulatory restrictions because they want to protect as commercial options the widest possible choice of plants, but even if all weeds were restricted nurseries would still be economically productive and gardeners would still be able to maintain beautiful gardens.

2. Other examples of the key threatening process

ISC strongly recommends that DEWHA undertake a project to document the extent of the threat of escaped garden plants to listed threatened species and ecological communities, as well as other biodiversity values. The KTP nomination consisted mostly of threatened species identified in the NSW study by Coutts-Smith and Downey (2006), some version of which could be replicated at a national level.

An important part of the assessment would be identifying the legal and commercial status of each of the threatening garden plants (a large proportion of the threatening weeds in the Coutts-Smith and Downey (2006) study were still available for sale in nurseries). It would also be important to identify the variety of ways in which the weeds adversely affect biodiversity, including by:

- competition for space and resources
- changing the micro-climate (eg. by shading out other plants)
- changing the soil (eg by nitrogen enrichment or allelopathy)
- changing fire regimes (eg. increasing flammability)
- altering hydrological conditions
- providing habitat and resources for other invasive species (eg. gorse harbours foxes that threaten pygmy possums.).

[5] Culley, T.M. and Hardiman, N.A. (2009) The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree Pyrus calleryana Biological Invasions 11:1107–1119.

- toxicity (eg. pink periwinkle (*Catharanthus roseus*) is poisonous for the Proserpine rock wallaby (*Petrogale persephone*), and has invaded its habitat on Gloucester Island.)

Downey (2006)[6] recommends using the Weed Impact to Native Species (WINS) assessment tool to assess the level of threat constituted by particular weeds, with the methodology involving literature review, collation and assessment of knowledge of land managers and botanists, evaluation of an interim list of species potentially at risk, and ranking of species at risk. Assessment of just a few weeds by this method have demonstrated that the impacts of weeds are generally underestimated, an assessment of lantana resulting in a three-fold increase in the species thought to be at risk (increasing from 53 to 160 species).

Rather than attempt to provide a comprehensive list of threatening garden weeds and threatened species or ecological communities (an exceedingly large task), we nominate a few more examples to illustrate the point that there are many more examples than were highlighted in the nomination (a forgone conclusion given its primary focus on NSW examples).

2.1 Norfolk Island

Exotic weeds are one of the worst threats to threatened species on Norfolk Island and Philiip Island.[7] The most significant of the weeds include eight escaped garden plants:

- Red Guava (*Psidium cattleianum var. cattleianum*);
- African Olive (*Olea europaea subsp. africana*);
- Broad leaf pepper tree! (*Schinus terebinthifolius*);
- Lantana (*Lantana camara*);
- Mist flower (*Ageratina riparia*);
- Formosan Lily (*Lilium formosanum*);
- Bleeding Heart (*Homolanthus populifolius*);
- Morning Glory (*Ipomoea cairica*)

There are 46 Norfolk Island plant species listed as threatened under the EPBC Act, 11 of which are critically endangered. According to the Director of National Parks (2008), woody weeds (guava, African olive and broad leaf pepper tree) dominate large parts of the national park and botanic gardens that harbour many of the threatened species, and "would destroy most Park and Botanic Garden values" if not controlled. African olive is taking over part of Phillip Island. Controlling weeds is the major demand on resources for management of the conservation areas.

Most of the threatened species are adversely affected by weeds; examples of EPBC-listed species in which the threat is explicitly acknowledged in the listing advice include:

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[6] Downey, P. (2006) 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. Plant Protection Quarterly 21(3): 109-17.

[7] Director of National Parks (2008) Norfolk Island National Park and Norfolk Island Botanic Garden Management Plan 2008–2018. See www.environment.gov.au/parks/publications/norfolk/pubs/management-plan.pdf.

- Norfolk Island euphorbia (*Euphorbia norfolkiana*), critically endangered[8]
- Norfolk Island abutilon (*Abutilon julianae*), critically endangered[9]
- Phillip Island hibiscus (*Hibiscus insularis*), critically endangered[10]

Threatened fauna is also adversely affected by degradation of habitat caused by invasion of escaped garden plants, including three bird and five snail species. The weeds can alter the leaf litter and fallen bark required by some snails for survival.

- Norfolk Island golden whistler (*Pachycephala pectoralis xanthoprocta*), vulnerable[11]
- Pacific robin (Norfolk Island) (*Petroica multicolor multicolor*), vulnerable[12]
- Norfolk Island green parrot (*Cyanoramphus novaezelandiae cookii*),
- Campbell's Helicarionid Land Snail (*Advena campbellii campbellii*), crtically endangered[13]
- Gray's Helicarionid Land Snail (*Mathewsoconcha grayi ms*), critically endangered[14]
- Phillip Island Helicarionid Land Snail (*Mathewsoconcha phillipii*), crtically endangered[15]
- a helicarionid land snail (*Mathewsoconcha suteri*), crtiically endangered[16]
- Stoddart's Helicarionid Land Snail (*Quintalia stoddartii*), critically endangered[17]

2.2 Kangaroo Island

Two of the five most serious and widespread weeds on Kangaroo Island roadsides are escaped garden plants:[18] bridal creeper (*Myrsiphyllum asparagoides*) and bridal veil (*Myrsiphyllum declinatum*). The Biodiversity Plan for Kangaroo Island notes that all five of the weeds "are capable of totally replacing native ground flora, and have already done so on many roadsides on the island."[19]

Federally listed threatened species adversely affected include:

- small-flowered daisy bush (*Olearia microdisca*), endangered[20]
- Kangaroo Island phebalium (*Leionema equestre)*, endangered[21]
- Kangaroo Island turpentine bush (*Beyeria subtecta*), vulnerable[22]
- Kangaroo Island pomaderris (*Pomaderris halmaturina* ssp. *halmaturina*), vulnerable[23]

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[8] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=65887.
[9] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=27797
[10] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=30614
[11] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64444; incl. recovery plan
[12] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=26016; incl. recovery plan
[13] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82807; incl. recovery plan
[14] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81852
[15] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81252
[16] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81851
[17] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81253
[18] Davies, R (1996) Threatened Plant Species on Roadsides: Kangaroo Island, South Australia. Resource Management Branch, Department of Evironment and Natural Resources, South Australia.
[19] Willoughby, N., Oppermann, A., Inns, R.W. (2001) Biodiversity plan for Kangaroo Island, South Australia. Department for Environment and Heritage, South Australia, P111
[20] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21465.
[21] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64923
[22] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2076
[23] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21964

- MacGillavray spyridium (*Spyridium eriocephalum* var. *glabrisepalum*), vulnerable[24].

The biodiversity plan notes that with current rates of weed spread, and in the absence of control plants, invasion of the remaining habitat of the first two species noted could result in their total extinction within the next few decades. Another plant, not federally listed, that is also threatened by this process is beyeria bush-pea (*Pultenaea insularis)* – it would constitute a species that is likely to be listed should the threatening process not be addressed.

2.3 Southeast Queensland

Escaped garden plants are a very serious threat to biodiversity in southeast Queensland. The Queensland Herbarium lists the top 200 Invasive Naturalised Plants in SEQ, the vast majority of them garden escapees.[25] The top five invaders, according to their list, are all garden escapees:

- Lantana (*Lantana camara*)
- Groundsel bush (*Baccharis halimifolia*)
- Mother of millions (*Bryophyllum delagoense*)
- Cat's claw creeper (*Macfadyena unguis-cati*)
- Madeira vine (A*nredera cordifolia*)

Following are six examples of federally threatened plant species in SEQ adversely affected by invasion of escaped garden plants.

- Angle-stemmed Myrtle (*Gossia gonoclada*), endangered:[26] Weed invasion is one of the two key threats, a threat at 8 of 9 known sites for the species; numerous escaped garden plants make up the weed flora in these sites. Species specifically mentioned include the garden escapees larger broad-leaf pepper tree (*Schinus terebinthifolia*) and Chinese elm (*Celtis sinensis*), hiptage (*Hiptage benghalensis*), cats claw creeper (*Macfadyena unguis-cati*), balloon vine (*Cardiospermum grandiflorum*) and climbing asparagus (*Asparagus africanus*).

- Swamp lily (*Phaius tancarvilleae*), endangered:[27] Threatening invasive weeds include lantana (*Lantana camara*), umbrella tree (*Schefflera actinophylla*), *Baccharis sp.* and Brazilian cherry (*Eugenia uniflora*).

- Native jute (*Corchorus cunninghamii*) endangered:[28] Weed invasion by lantana and other weeds of the ecotonal habitat it occupies is a significant threat.

- Bristly bluegrass (*Dichanthium setosum*), vulnerable:[29] Weed invasion by lippia (*Phyla nodiflora*) and lantana are identified as threats.[30]

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[24] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=13771
[25] Batianoff, George N. and Butler, Don W. (2002). Assessment of Invasive naturalized plants in south-east Queensland. Appendix. ***Plant Protection Quarterly*** 17, 27-34.
[26] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=78866
[27] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=2104
[28] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=14659, including the recovery plan.

- Native thistle, Austral cornflower (*Rhaponticum australe*, formerly *Stemmacantha australis*), vulnerable:[31] Weed invasion is considered one of the main threats, including by lantana and mother of millions in SEQ.[32]

- Toadflax, thesium (*Thesium australe*), vulnerable:[33] Invasion by lantana and mother of millions is considered a threat in SEQ.[34]

Following are another 11 federally threatened or potentially threatened plant species in SEQ that were identified in a 1998 survey as adversely affected or potentially threatened by invasion of escaped garden plants. The survey was far from comprehensive, it is now a decade old, and it is clear that little was known about most of the threatening processes (most of the threats are discussed in terms of 'potential' threats). The information suffices here to exemplify weed invasion as a ubiquitous threatening process in SEQ, and to indicate candidates for further investigation. As well as lantana, the major garden-derived weed threats also include mist flower (*Ageratina riparia*) and crofton weed (*Ageratina adenophora*).

- Hairy-joint Grass (*Arthraxon hispidus*), vulnerable:[35] The "main potential threat" is weed invasion including by mist flower, crofton weed and lantana along creeks. Weeds are also a potential threat in coastal habitats.

- Satin-top Grass (*Bothriochloa bunyensis*), vulnerable:[36] Kikuyu (*Pennisetum clandestinum*), which is commonly grown for lawns, is one of two grasses "considered to have potential to become a major problem in maintaining the natural flora of the Bunya Mountain grasslands". It has displaced native grasses in two grassland patches was recorded in another two patches. Other potential threats include moth vine (*Araujia sericifera*) and lantana.

- Stream Clematis (*Clematis fawcettii*), vulnerable:[37] Sites on rainforest margins may be susceptible to invasion of lantana. Mist flower and crofton weed may pose a threat along creeks and in canopy gaps. It is noted elsewhere as threatened by lantana, Madeira vine (*Anredera cordifolia*), coral berry (*Rivina humilis*), cat's claw creeper (*Macfadyena unguis-cati*) and asparagus fern (*Protasparagus spp.*).[38]

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[29] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=14159
[30] See EPBC conservation advice and the Biodiversity Recovery Plan for Gatton and Laidley Shires, Appendix B at bruceboyes.net/doc/Recovery_Plan_Appendix_B_Version_2.pdf.
[31] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=22647
[32] See EPBC conservation advice and the Biodiversity Recovery Plan for Gatton and Laidley Shires, Appendix B at bruceboyes.net/doc/Recovery_Plan_Appendix_B_Version_2.pdf.
[33] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=15202
[34] See the Biodiversity Recovery Plan for Gatton and Laidley Shires, Appendix B at bruceboyes.net/doc/Recovery_Plan_Appendix_B_Version_2.pdf.
[35] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=9338
[36] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=15961
[37] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=4311
[38] See Biodiversity Recovery Plan for Gatton and Laidley Shires, Appendix B at bruceboyes.net/doc/Recovery_Plan_Appendix_B_Version_2.pdf.

- *Haloragis exalata subsp. velutina*, vulnerable:[39] Populations on rainforest margins may be susceptible to invasion by lantana. Kikuyu threatens the population in the grassland community in the Bunya Mountains.

- *Medicosma elliptica*, vulnerable:[40] "The main potential threats to [its] continued existence ... in the wild" include the spread of lantana.

- *Notelaea lloydii*, vulnerable:[41] Populations on vine forest margins may be susceptible to the invasion of lantana. "It is suspected that lantana could modify the habitat by decreasing light intensities and increasing fire intensities to the extent that *N. lloydii* could not survive."

- *Oldenlandia sp.*, not listed, but is likely to be recognized as threatened as a result of weed invasion: It occupies an area of just 10 ha. The major threat to its remaining populations is modification of its habitat by the combination of fire and weed invasion. Large tracts of nearby vine forest were destroyed by fires and invaded by lantana. This provides high fuel loads which will support fires moving into the vine forest.

- *Plectranthus nitidus*, endangered:[42] A potential threat is invasion by lantana, mist flower and crofton weed.

- *Plectranthus omissus*, endangered:[43] It is threatened by weed infestation by lantana and blue billygoat weed (Ageratum houstonianum).

- *Rhodamnia* sp, not listed, but weed invasion could threaten its survival: only 19 individuals have been located in the wild. Large tracts of nearby vine forest was destroyed by fire and invaded by lantana. Two of the known plants are within 50 m of this area.

- *Sophora fraseri*, vulnerable:[44] Its habitat on rainforest margins is susceptible to invasion by lantana.

2.4 Listed ecological communities

The following 20 federal listed ecological communities are adversely affected by garden escapees, according to the (often sparse) information provided in the EPBC listing or conservation advice. A more thorough review is warranted.

[39] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16839
[40] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=12192
[41] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=15002
[42] See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=55742
[43] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=55729
[44] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=8836

- Alpine Sphagnum Bogs and Associated Fens, endangered:[45] Weeds "are one of the greatest threats", by species including soft rush (*Juncus effusus*) and musk money flower (*Mimulus moschatus*)

- Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain, endangered:[46] Budding club-rush (*Isolepis prolifera*) and other weeds are encroaching; "woody weeds may also impact the community in areas of influence by contributing to the drawdown of water from the spring area."

- Blue Gum High Forest of the Sydney Basin Bioregion, critically endangered:[47] Weed infestation is a major threat; it is "estimated that at least 50% of the remaining areas ... are subject to weed invasion."

- *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain, endangered:[48] Remaining patches are threatened by weed invasion.

- *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain, endangered:[49] Remaining patches are threatened by weed invasion. Quaking grass (*Briza maxima*) and onion grass (*Romulea rosea*) are common.

- Cumberland Plain Woodlands, endangered:[50] threats include invasion by weeds including African olive and bridal veil creeper.[51]

- Eastern Suburbs Banksia Scrub of the Sydney Region, endangered:[52] Threats include weed invasion, including by lantana.[53]

- *Eucalyptus ovata* - *Callitris oblonga* Forest, vulnerable:[54] Weeds have degraded a large proportion of sites, with serious woody weeds including gorse (*Ulex europaeus*), hawthorn (*Crataegus monogyna*), willow (*Salix fragilis*), briar (*Rosa rubiginosa*) and blackberry (*Rubus fruticosus*).

[45] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=29&status=Endangered
[46] http://www.environment.gov.au/biodiversity/threatened/communities/tumulus-mounds.html#reasons
[47] http://www.environment.gov.au/biodiversity/threatened/communities/sydney-blue-gum.html#judged
[48] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=17&status=Endangered
[49] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=18&status=Endangered
[50] http://www.environment.gov.au/biodiversity/threatened/communities/cumberland-plains.html
[51] See www.environment.nsw.gov.au/resources/nature/EECinfoCumberlandPlainWoodland.pdf
[52] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=2&status=Endangered
[53] See recovery plan at http://www.environment.gov.au/biodiversity/threatened/publications/recovery/esbs/index.html
[54] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=40&status=Vulnerable

- Gippsland Red Gum (Eucalyptus tereticornis subsp. mediana) Grassy Woodland and Associated Native Grassland, critically endangered:[55] "The change in integrity ... through fragmentation, weed invasion ... is very severe." Threats include bridal creeper.

- Iron-grass Natural Temperate Grassland of South Australia, crticially endangered:[56] Key threats include weed invasion; many areas are dominated by weeds, with common ones including Saffron Thistle (*Carthamus lanatus*) and Salvation Jane/Patterson's Curse (*Echium plantagineum*).[57]

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia, critically endangered:[58] "Transformer weeds are currently detrimentally affecting the integrity and viability of the ecological community in multiple ways." In the Marlo Estuary, Victoria, weed invasion alone "destroyed a third of the littoral rainforest stand" and the remainder is in severe decline. In northern NSW, remnant stands have been invaded by exotic vines. Weeds are well established in many patches along the eastern coastline. Garden escapees having adverse effects include blue periwinkle (*Vinca major*), cape ivy (*Delairea odorata*), wandering jew (*Tradescantia albiflora*), cat's claw vine (*Macfadyena unguis-cati*), madeira vine (*Anredera cordifolia*), asparagus fern *(Asparagus aethiopicus*) and lantana.

- Mabi Forest (Complex Notophyll Vine Forest 5b), critically endangered:[59] "Almost 80 weed species, comprising 14% of vascular species recorded, have been recorded in Mabi Forest on the Atherton Tableland." Garden escapees are smothering remnants. The most serious include madeira vine, Dutchman's pipe (*Aristolochia elegans*), cat's claw vine, turbina vine (*Turbina corymbosa*) and coral berry (*Rivina humilis*).

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland, critically endangered:[60] One of the serious weed species is lippia (*Phyla nodiflora*).

- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia, critically endangered:[61] Major threats include weed invasion - weeds accounted for 8 to 57% of the species composition - with the most serious one being Salvation Jane/Patterson's Curse.

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[55] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=73&status=Critically%20Endangered
[56] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=37&status=Critically%20Endangered
[57] see recovery plan at http://www.environment.gov.au/epbc/publications/peppermint-box-iron-grass-policy.html
[58] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=76&status=Critically%20Endangered, including listing advice.
[59] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=30&status=Critically%20Endangered, including listing advice.
[60] http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=88&status=Critically%20Endangered
[61] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=36&status=Critically%20Endangered

- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions , endangered:[62] The most serious threats include lantana and rubber vine (*Cryptostegia grandiflora*). Others include velvet tree pear (*Opuntia tomentosa*), Brazilian nightshade (*Solanum seaforthianum*) and coral berry.[63]

- Shale/Sandstone Transition Forest, endangered:[64] Weed invasion is a threat, including by bridal creeper.

- Shrublands and Woodlands of the eastern Swan Coastal Plain, endangered:[65] Remnants are threatened by weed invasion, with common weeds including *Gladiolus caryophyllaceus*.

- Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain, endangered:[66] The major threats include weed invasion, including by watsonia (species not identified).

- Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland, critically endangered:[67] >40 weed species are known to have established; weeds of particular concern include lantana and creeping lantana (*Lantana montevidensis*). Other common weed species include mother of millions and prickly pear (*Opuntia stricta*).

- Swamps of the Fleurieu Peninsula, critically endangered:[68] Continued invasion of exotic species is altering the structural composition of the understorey; blackberry is a particular threat.

Note: the following is a late addition to the submission

The extent of the threat to ecological communities by escaped garden plants is not comprehensively covered in the listing or conservation advices, and often not in published literature at all. For example, we were provided with unpublished information about the impact of escaped garden plants on NSW remnants of the critically endangered White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands ecological community[69] by a bushland regenerator working in this community (Kate Boyd, personal communication). The listing advice for the community notes only the threat of escaped exotic pasture grasses. This

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[62] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=24&status=Endangered
[63] See Qld EPA overview at http://www.epa.qld.gov.au/publications?id=2186
[64] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=25&status=Endangered
[65] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=20&status=Endangered
[66] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=21&status=Endangered, including interim recovery plan.
[67] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=33&status=Critically%20Endangered
[68] See http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=31&status=Critically%20Endangered
[69] http://www.environment.gov.au/biodiversity/threatened/communities/box-gum.html

example demonstrates the need for a thorough review of the threat of escaped garden plants that involves interviews with those working on restoration of listed ecological communities.

The information is pertinent to remnants of the listed ecological community near Armidale NSW, as well as remnants of Ribbon Gum – Snow Gum grassy woodland that are listed under NSW legislation as an endangered ecological community.

Garden escapees are “a major threat” to these remnants, established in the woodlands due to residents in the area dumping garden waste or by birds and foxes spreading berry seeds. Some of the best remnants are in or near towns because they often had long periods without regular stock grazing (e.g. cemeteries, land set aside or purchased for future purposes). These near-urban remnants may be threatened as much or more by garden plants than agricultural. Weed species that have originated from gardens include:

- periwinkle (*Vinca major*)
- monpellier broom (*Genista monspessulana*)
- fire thorn (*Pyracantha sp.)*
- privets (*Ligustrum spp.*)
- *Cotoneaster* sp.
- *Pistacia chinensis*
- hawthorn (*Craetagus monogyna*)
- *Prunus* sp.
- Jasmine (*Jasminum polyanthum*)
- honeysuckle *(Lonicera japonica*)
- ivy (*Hedera helix*)
- *Watsonia* spp.
- oxeye daisy (*Leucanthemum vulgare*)
- kikuyu (*Pennisetum clandestinum*)
- St John’s wort (*Hypericum perforatum*)
- Chinese wormwood (*Artemisia verlotiorum*)

Monpellier broom may have arrived in dumped green waste or soil or on earth-moving equipment used on the edges of bushland. It spreads by throwing its seed several meters when pods split on hot days, or perhaps by seeds being washed downslope. It forms such thick scrub that most of the grasses and forbs die. It is easily killed or uprooted but keeps coming up for decades from the seed bank. Where bush regenerators have killed all the broom, native groundcover is returning, but in some areas there are lots of other weeds as well.

Hawthorn is a major weed in some remnants outside towns as well as in or near towns – it was planted long ago both in towns and on many rural properties around houses and as hedges in garden extensions along driveways and fences. It has had time to be spread widely by birds – several generations of seedlings have become mature plants far from the original plantings. It is abundant in many remnants as well as in paddocks and weedy roadsides. Privet is a similar though less common problem. Firethorn has been planted more recently in gardens of rural properties and as hedgerows and has started to spread in the same way as Hawthorn. New

England Weeds Authority has obtained and spent grant funds killing these species along rural roads and encouraged landholders to kill plants of these species if they do not want to keep them, but there are still large numbers of plants from which more are being spread, sometimes into remnant woodlands. Oxeye daisy is a very widespread problem, and the dominant forb in some remnants of Ribbon Gum woodland.

2.5 Flammable native garden plants as part of the threatening process

Note: this is a late addition to the submission

One aspect of the nominated threatening process that should be considered is the increased risk of fire due to escape of native (not indigenous) garden plants, as described by Victorian botanist Geoff Carr for the Coastal Shire region in Victoria. We haven't nominated particular threatened species, but the Shire hosts many that would be threatened by the increased flammability described here.

In recent decades a large proportion of fuel buildup along the Surf Coast and hinterland has been brought about by unrestricted proliferation of woody environmental weeds. The problem of weed invasion locally and regionally is well known and well documented. In summary, weed invasions constitute the greatest threat to flora and fauna, landscape heritage and amenity values in the Shire, values which are of national and international significance, as well as incalculable economic significance. On current trends over the next few decades, invading weeds will destroy or greatly (and irrevocably) compromise many of these values because weed control efforts fall so far short of those required.

The greater proportion of these invading trees, shrubs and woody vines are Australian native plants – scores of species that have escaped from cultivation, particularly along the coast from Anglesea to Lorne. They include over 60 species of wattles, including Sallow Wattle and Coast Wattle (*Acacia*), paperbarks/honey-myrtles (*Melaleuca*), Sweet Pittosporum, Hakea, eucalypts, Coast Tea-tree, Cape Wattle (*Albizzia*), Kunzea, Bluebell Creeper and many others (see list below). These plants look as though they belong but they do not. The introduced species will destroy most of the unique local flora and fauna habitats.

These introduced Australian plants are mostly exemplary fire-adapted plants that have evolved over millions of years to flourish and reproduce in the face of fire. They survive by resprouting after fire, or if killed they release masses of seed stored in the soil (e.g. wattles) or in the canopy (e.g. Melaleuca, Hakea) to provide another generation of young recruits. A few mother plants can produce thousands, even millions, of recruits in this way. Characteristics (in many species) that enable them to fuel very intense fires include abundant, highly flammable volatile leaf oils (as in eucalypts), very fine fuels (abundant small leaves and branches) and the formation of very dense thickets. Stands of these species (e.g. Coast Tea-tree and Coast Wattle) often produce fuel loads greatly exceeding (perhaps by several orders of magnitude) the natural fuel loads in the invaded dunes, cliffs, heathlands, heathy woodlands or forests of the Surf Coast.

Such massive fuel loads often produce fires so intense that the soil is sterilised, killing all plants and soil-stored seeds such that vegetation must recover from seeds dispersed from off-site, many

of which may also be weeds. In the intervening period these sterilised soils are highly vulnerable to erosion, with risks to water quality of streams and estuaries.

In many respects Ash Wednesday 1983 was a turning point for these weedy invaders. They were (and are) very widely planted in Torquay, Anglesea, Aireys Inlet, Lorne and elsewhere. Those catastrophic fires stimulated massive regeneration and recruitment of these Australian plants. Now, 25 years later, there are vast accumulated fuel loads. In the event of a wildfire the intensity and rate of spread and propagation of the fire are likely to be greatly exacerbated.

Weedy Australian plant species naturalised (as garden escapees) in the Surf Coast Shire (Torquay to Lorne), Victoria

(G. Carr unpubl. data)
Sources of data: Moysey, E.D., Carr G.W., Kershaw, J.S. and Quin, D.G (2006). Environment and Land Management Plan – Volume 2: Natural Values. Report prepared for Great Ocean Road Coast Committee. Ecology Australia Pty Ltd, Fairfield, Victoria.

Species in **bold** are extremely serious environmental weeds

Scientific Name	Common Name
Acacia baileyana	Cootamundra Wattle
Acacia decurrens	Early Black-wattle
Acacia elata	Cedar Wattle
Acacia floribunda	White Sallow-wattle
Acacia longifolia* subsp. *longifolia	Sallow Wattle
Acacia longifolia* subsp. *sophorae	Coast Wattle
Acacia provincialis	Wirilda
Acacia saligna	Golden Wreath Wattle
Acacia schinoides	Frosty Wattle
Acmena smithii	Lilly-pilly
Agonis flexuosa	Willow Myrtle
Agonis juniperina	Juniper Myrtle
Agonis parviceps	Agonis
Angophora costata subsp. *costata*	Smooth-barked Apple
Astartea heteranthera	Astartea
Banksia integrifolia subsp. *integrifolia*	Coast Banksia
Billardiera heterophylla	Bluebell Creeper
Callistachys lanceolata	Greenbush
Callistemon hybrid	Bottlebrush
Callistemon rigidus	Bottlebrush
Callistemon rugulosus	Scarlet Bottlebrush
Casuarina glauca	Swamp Oak
Correa alba var. *alba*	White Correa
Corymbia calophylla	Marri
Corymbia ficifolia	Red-flowering Gum
Corymbia maculata	Spotted Gum
Eucalyptus botryoides	Southern Mahogany
Eucalyptus camaldulensis	River Red Gum
Eucalyptus cladocalyx	Sugar Gum
Eucalyptus conferruminata	Bushy Yate
Eucalyptus cornuta	Yate
Eucalyptus crenulata	Buxton Gum
Eucalyptus diversifolia ssp. *megacarpa*	Soap Mallee

Eucalyptus globulus subsp. *globulus*	Southern Blue-gum
Eucalyptus gomphocephala	Tuart
Eucalyptus kitsoniana	Bog Gum
Eucalyptus leucoxylon ssp. *megalocarpa*	Coast Yellow-gum
Eucalyptus sideroxylon	Red Ironbark
Eucalyptus verrucata	Mt Abrupt Stringybark
Eucalyptus viminalis ssp. *Viminalis*	Manna Gum
Grevillea rosmarinifolia	Rosemary Grevillea
Hakea drupacea	Sweet Hakea
Hakea laurina	Pincushion Hakea
Hakea petiolaris	Sea-urchin Hakea
Hakea salicifolia subsp. *salicifolia*	Willow-leaf Hakea
Hardenbergia violacea	Purple Coral-pea
Kennedia nigricans	Black Coral-pea
Kennedia rubicunda	Dusky Coral-pea
Kunzea ambigua	White Kunzea
Kunzea baxteri	Red Kunzea
Kunzea ericoides s.l.	Burgan
Leptospermum laevigatum	Coast Tea-tree
Melaleuca armillaris* subsp. *armillaris	Giant Honey-myrtle
Melaleuca decussata	Totem-poles
Melaleuca diosmifolia	Green Honey-myrtle
Melaleuca halmaturorum	Salt Paperbark
Melaleuca hypericifolia	Hillock Bush
Melaleuca incana subsp. *incana*	Grey Honey-myrtle
Melaleuca nesophila	Showy Honey-myrtle
Melaleuca parvistaminea	Rough-barked Honey-myrtle
Pandorea pandorana	Wonga Vine
Paraserianthes lophantha subsp. *lophantha*	Cape Wattle
Pittosporum undulatum	Sweet Pittosporum
Syzygium paniculatum	Lilly Pilly
Westringia fruticosa	Coast Rosemary

3. Should a Threat Abatement Plan be prepared?

Federal coordination and leadership is required

The Invasive Species Council strongly recommends the development of a threat abatement plan. There would be little point in making the listing unless there is federal government leadership, coordination, and prioritisation guided by an abatement plan. The national significance of the threats warrants this.

Should the KTP nomination be accepted and a threat abatement plan developed, we would be keen to have input into the contents of the plan.

Identifying gaps

There are many gaps in current state and territory-focused approaches, which underline the need for federal coordination and intervention, and improved state and territory approaches.

There are many disparate activities that are either exacerbating the threats of escaped garden plants or mitigating them that need to be identified and assessed as part of an abatement plan. Some of the threatening weeds are regulated by the states or territories, many are not. Despite their threat to biodiversity many are still being sold by nurseries – a substantial proportion of the weeds listed in Coutts-Smith and Downey (2006) as adversely affecting threatened species listed under the NSW Threatened Species Conservation Act 1995 were still available for sale in nurseries. Some of the threatening weeds are being managed in some environmentally significant areas, most are not.

Identifying priorities

One of the most important processes of an abatement plan would be to determine priorities from a national perspective for control/eradication, regulatory controls on trade and use, biological control research, education and other. Priorities should be determined by a transparent, justifiable process that includes assessment of the magnitude of the impact of the weed and the potential for averting or mitigating the threat.

The method used to generate rankings should accord high priority to such as:

- ✦potentially threatening species at an early stage of invasion, as this is the most effective and cost-effective approach;
- ✦potential threats that can be averted at low cost – the benefits of eradicating threatening or potentially threatening invasive species entirely, even when they are considered minor, are high in part because there is a high level of uncertainty associated with predictions, and because minor impacts in the short-term are likely to become substantial impacts over centuries; and
- ✦potentially catastrophic invasive species even when the potential to successfully avert or mitigate so is not considered high – sometimes there is too much to lose.

Addressing emerging threats and trends

High priority should be granted to actions to prevent emerging and future threats, as prevention and early intervention is much more effective and cost-effective than addressing entrenched threats.

There should also be a strong focus on action to prevent existing weeds being introduced to new areas or new genetic material being introduced that would increase the invasive potential of existing threats.

A threat abatement plan should also address the implications of climate change for weedy garden plants, as it will exacerbate the threat in numerous ways - eg. with extreme events providing opportunity for invasion and changed weather patterns increasing the range and impacts of many weeds. Climate change could also exacerbate the threats by motivating new trends in gardening, such as the use of hardier and more drought-tolerant varieties that may constitute new or worse weeds. There should be a strong focus on particular regions vulnerable to the combined threats of climate change and invasive garden plants: the Wet Tropics and the alpine areas, for example. Potentially serious invasive species are grown in gardens in both these regions, and changing climate (warming or extreme events) are likely to precipitate their invasion.

Identifying appropriate interventions

The proposed threat abatement plan should identify the most effective (including cost-effective) options to address the existing and emerging or potential threats of escaped garden plants. This should include use of the potential under section 301 of the EPBC Act to regulate actions (such as sale or planting) of threatening garden plants. This would be a much more efficient approach than encouraging each state or territory government to do so, and reduce the risk of permissive approaches in one state undermining the actions in another. Quarantine reforms will be required to address the threats of new genetic material increasing the invasive potential of existing weeds (requiring that new variants of permitted weedy species be assessed before being permitted entry into the country).

Much of the focus to date has been on voluntary reforms by the nursery industry, eg. by labelling of plants and providing information to consumers about native alternatives to weedy species. However, these reforms have had limited uptake and effectiveness, and are not sufficient to address nationally significant threats. A threat abatement plan should ensure that proposed actions do not rely on voluntary restraint by the nursery industry that conflict with common practice or commercial interests.

There would also need to be a strong educational focus on gardeners, who are often unaware that they harbour high-risk invasive species in their gardens.