Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendments to the List of Key Threatening Processes under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

1. Name and description of the threatening process

1.1 Title of the process

Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

1.2 Name Changes

The original title of the nomination was 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants'. The Committee changed the name of the nomination to 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' to reflect that the threatening process is not restricted to the terrestrial environment.

1.3 Description of the process

The homogenisation of the global flora and fauna through the mass movement of species is creating one of the greatest environmental challenges facing the planet (Wilson, 1992). In natural ecosystems, invasive plants impact negatively on the biodiversity of many Australian vegetation types ranging from tropical wetlands to arid riverine vegetation. Leigh and Briggs (1992) identified weed competition as the primary cause for the extinction of at least four native plant species, and estimated that another 57 species were threatened or would become so in the future through competition of weeds. These figures almost certainly underestimate the contemporary problem by a large margin.

The gardening industry is by far the largest importer of introduced plant species, being the source for the introduction of 25 360 or 94% of non-native plant species into Australia (Virtue et al., 2004). Garden plant introductions are also the dominant source of new naturalised plants and weeds in Australia. Of the 2779 introduced plant species now known to be established in the Australian environment, 1831 (or 66%) are escaped garden plant species (Groves et al., 2005; Beeton et al., 2006). Furthermore, invasive garden plant species – both introduced and native species outside their natural range – are by far the largest source of environmental weeds (weeds which impact on natural biodiversity), comprising 72% of the 1765 listed environmental weeds (Groves et al., 2005).

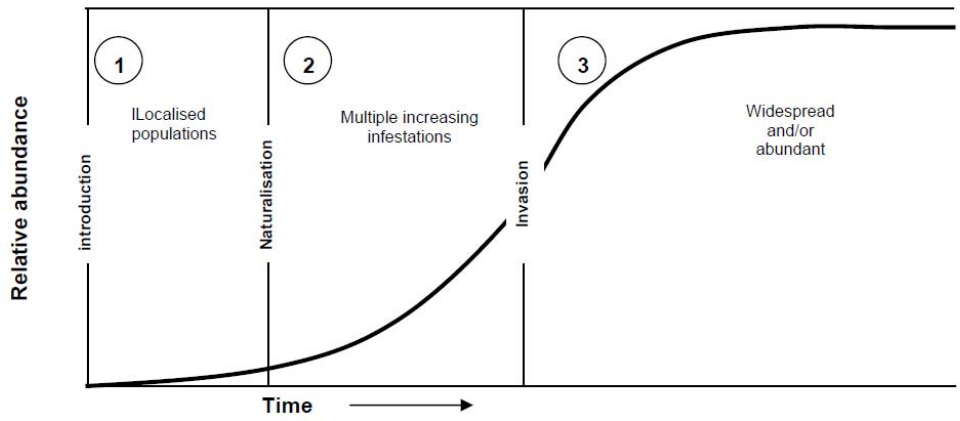
Furthermore, it is anticipated that introduced garden plants will comprise an even greater portion of all naturalised species in the future (Groves et al., 2005). Of great concern is that many serious environmental weeds continue to be imported into Australia by the garden and nursery sector and, in the case of aquatic plants, the aquarium industry. In addition to this, an increasing number of Australian native plants are invading beyond their natural indigenous range, with their spread facilitated by the nursery and garden industry and enthusiastic gardeners (Blood, 2006).

Invasive garden plants can be defined as plants that are currently or were historically used in gardens, primarily for ornament or utility, which have escaped or threaten to invade natural and other areas (Randall, 2001; Blood, 2006). Whilst in most cases species categorised as invasive garden plants are those that were initially introduced for ornamental horticultural purposes, this is not always the case. For example, some environmental weeds such as Blackberry (*Rubus fruticosus* aggregate) and Radiata Pine (*Pinus radiata*), have been grown in gardens and may therefore be classified as invasive garden plants even though their introduction was originally for agricultural and plantation purposes, respectively (Randall and Kessal, 2004; Groves et al., 2005).

In terms of the general invasion process and their ultimate impact on native biodiversity, invasive garden plants are indistinguishable from other types of environmental weeds. Plant invasion is a continuous process, depicted in Figure 1 below, which comprises at least three stages:

1. An introduction stage commencing with the arrival of a 'new' species to a region.
2. A naturalisation stage whereby those introduced plant species are reproducing naturally without human intervention or cultivation.
3. An invasive stage where the naturalised plant species becomes widespread and/or abundant (and ultimately impacts adversely on native indigenous species).

Figure 1: The three stages in weed development (Barker et al., 2006)



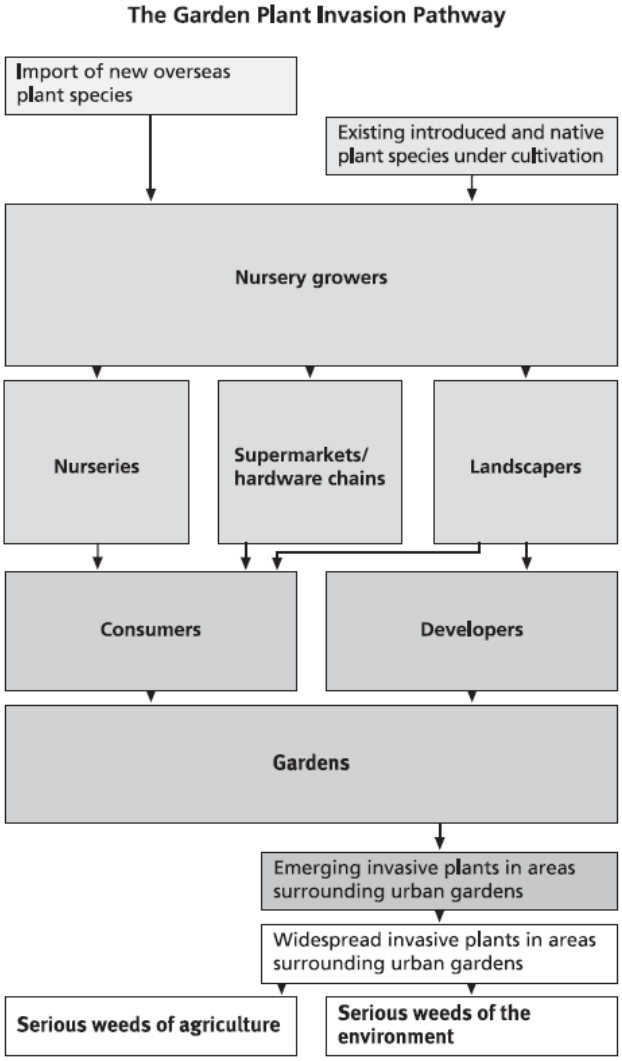
Garden plants may escape the confines of a garden and enter native bushland via natural dispersal vectors such as wind, water, insects, birds and other animals, however, humans are by far the most effective and efficient vector of plants (Coutts-Smith and Downey, 2006; Randall, 2007). For example, humans facilitate the direct introduction of escaped garden plants by inappropriate dumping of garden waste and, in the case of aquatic garden plant escapees such as Salvinia (*Salvinia molesta*) and Cabomba (*Cabomba caroliniana*), emptying of aquariums and backyard ponds and deliberate planting to allow wild cultivation for the aquarium trade (Blood, 2006; DAFF and DEW, undated).

The likelihood of invasion success and the time required for a plant to become naturalised after introduction, or subsequently become invasive, is variable and depends, in part, on introduction effort or propagule pressure (Groves et al., 2005; Lockwood et al., 2005; Rejmanek et al., 2005).

Propagule pressure is a measure of the number of individuals released into a region to which they are not native. It incorporates estimates of the absolute number of individuals involved in any one release event (propagule size) and the number of discrete release events (propagule number). As the number of releases and/or the number of individuals released increases, propagule pressure also increases (Mulvaney, 2001; Lockwood et al., 2005). Propagule pressure, together with the ecological attributes or life history traits of the escaped garden plant itself and the condition of the receiving environment, are important factors for determining the strength and severity of this threatening process (Lockwood et al., 2005; Rejmanek et al., 2005).

In the context of invasive garden plants, propagule pressure largely reflects human preferences for particular non-native species, extent of commercial trade between countries and regions, and the effort that humans expend in importing, distributing and releasing large numbers of non-native and non-indigenous individuals (Sullivan et al., 2004; Lockwood et al., 2005). Figure 2 illustrates the garden plant invasion pathway, with arrows representing propagule flow by human vectors and, to a lesser extent, natural vectors.

Figure 2: The Garden Plant Invasion Pathway (Adapted from Glanznig, 2006)



The temporal nature of the threatening process results in a phenomenon whereby the past sale and distribution of garden plant species (which may or may not be currently available for sale) is responsible for the naturalisation and invasion of environmental weeds that is evident in the landscape today. The seriousness of the threat that invasive garden plants pose, given time, is demonstrated by fact that ten of the 20 Weeds of National Significance (WoNS) are weeds of horticultural origin and 16 in total have been cultivated for ornamental horticulture (Groves et al., 2005). Table 1 outlines these 16 WoNS, including their current availability for sale. Similarly, the negative ecological effects of potentially invasive garden plants currently available for sale may not be apparent for decades because, as yet, they have not been planted in large enough numbers, or over a long enough period, or in susceptible habitats, to have had an opportunity to realise their invasive potential (Mulvaney, 2001).

According to Groves et al. (2005) the ten most serious invasive garden plants being sold currently by Australian nurseries are Asparagus Fern (*Asparagus scandens*), Broom (*Genista* spp.), Fountain Grass (*Pennisetum setaceum*), Gazania (*Gazania linearis*), Glory Lily (*Gloriosa superba*), Hybrid Mother of Millions (*Bryophyllum daigremontianum* x *B. tubiflorum* = *Bryophyllum daigremontianum* x *B. delagoense* cv. 'Houghtonii'), Japanese Honeysuckle (*Lonicera japonica*), Pepper tree (*Schinus areira)*, Periwinkle (*Vinca major*) and Sweet Pittosporum (*Pittosporum undulatum*).

Table 1: Invasive Garden Plants that are now recognised as Weeds of National Significance (Adapted from Glanznig et al., 2004)

Scientific name	Common name	Naturalised where?[1]	Potential to Naturalise[2]	Available for sale?
Alternanthera philoxeroides	Alligator Weed	Qld[3], NSW, ACT, Vic, WA, NT	SA, Tas	No
Annona glabra	Pond Apple	Qld	NSW, WA, NT	Yes – NSW
Asparagus asparagoides	Bridal Creeper	Vic, SA, NSW, Tas, WA	Qld, ACT	Yes – NSW**
Cabomba caroliniana	Cabomba	Vic, NSW, Qld, NT, ACT	WA, SA, Tas, ACT	Yes – SA*
Chrysanthemoides monilifera subsp. *monilifera* subsp. *rotundata*	Bone Seed Bitou Bush	Vic, SA, NSW, Qld, Tas, WA Vic, SA, NSW, Qld		No
Cryptostegia grandiflora	Rubber Vine	Qld, NT, WA	NSW	No
Lantana camara	Lantana	NSW, Qld, NT, WA, Vic, SA	Vic, SA, Tas	Yes – NT*, WA, Vic
Mimosa pigra	Mimosa	NT, Qld	WA, Qld	No
Nassella trichotoma	Serrated tussock	Vic, ACT, NSW, Tas	WA, SA, Qld	No
Parkinsonia aculeata	Parkinsonia	SA, NSW, Qld, NT, WA	Vic, SA	No
Prosopis spp.	Mesquite	Qld, NSW, WA		No

Rubus fruticosus aggregate	Blackberry	Vic, SA, NSW, Qld, Tas, WA, ACT		No
Salix spp.	Willows		SA, Tas	Yes –
Salix alba		Vic, ACT		Qld*
Salix alba subsp. *vitellina*		NSW, Vic		NSW
Salix cinerea		Vic, ACT		Vic
Salix purpurea		NSW, ACT, Vic		Vic
Salix × *sepulcralis* var. *chrysocoma*		NSW, ACT, Vic		NSW*
Salvinia molesta	Salvinia	Vic, NSW, Qld, NT, WA, ACT	Tas	No
Tamarix aphylla	Athel Pine	Qld, NSW, SA, NT, WA		Yes – WA
Ulex europaeus	Gorse	Vic, SA, NSW, Tas, WA, ACT, Qld		No

[1] The sources for reporting which states and territories invasive garden plants have naturalised are Randall 2001 and Groves et al 2003.

[2] Potential to naturalise information taken from www.deh.gov.au/biodiversity/invasive/weeds/alert-list.html and www.weeds.org.au.

[3] Alligator Weed is actively targetted for extermination in Queensland.

* Refers to those species in Aussie Plant Finder (2002) as available for sale that were subsequently prohibited for sale in the given state.

** Regional declarations prohibit the sale of bridal creeper in a number of regions in NSW.

1.4 Threats to native species

According to Groves et al. (2005), invasive garden plants represent 28 (57%) of the 49 naturalised non-native plant species that impact on rare or threatened native plant species. Groves et al. (2005) also outline 13 milestones on the road to extinction. Milestone 8 is recognised as "excessive competition from introduced species". This hierarchy of milestones acknowledges that weeds are not necessarily the primary cause of species decline. In many cases, land clearing resulting in habitat destruction, degradation and fragmentation has caused the initial reduction in species numbers and abundance. Environmental weeds then become a threat when invading remaining habitats, especially where these are already fragmented or degraded (Beeton et al., 2006).

Table 2, adapted from the 2006 State of the Environment Report (Beeton et al., 2006), lists native species that are believed to be under threat from various introduced plants. The primary source does not identify which of the weeds implicated can be considered escaped garden plants but other sources (Randall and Kessal, 2004; Groves et al., 2005) indicate that the weeds identified in Table 2 are recognised as naturalised invasive and potentially invasive garden plants.

The list of native species included in Table 2 that are adversely impacted by invasive garden plants is by no means exhaustive. For instance, a report by Coutts-Smith and Downey (2006) documented that invasive plants were a major threat impacting on 419 threatened species in New

South Wales. The main threat was attributed to 127 invasive plants, 82 of which were identified as plants that had escaped from parks, gardens and ornamental collections. The five weed species most commonly implicated as threatening biodiversity in New South Wales were Lantana, Bitou Bush, Blackberry, Kikuyu (*Pennisetum clandestinum*) and Scotch Broom (*Cytisus scoparius*), all of which are escaped garden plants. The study concluded that, collectively, garden escapees threaten at least 190 native species (and maybe as many as 300 native species) in New South Wales alone.

Table 2: Examples of native species believed to be under threat from invasive garden plants (Adapted from Beeton et al., 2006)

State and Territory	Threatened species	Invasive garden plants*
Tasmania	Tussock Skink (*Pseudemoia pagenstecheri*)[1]	Gorse (*Ulex europaeus*)
NSW	Zieria Prostrata (*Zieria prostrata*)[2] Austral Toad-flax (*Thesium australe*)[2]	Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*)
NSW	Cumberland Plain Woodland[2] Pink Pimelea (*Pimelea spicata*)[2]	Bridal Creeper (*Asparagus asparagoides*)
NSW	Hairy Quandong (*Elaeocarpus williamsianus*)[2]	Lantana (*Lantana camara*)
NSW and Victoria	Mountain Pygmy Possum (*Burramys parvus*)[2]	English Broom *(Cytisus scoparius* subsp. *scoparius)* Blackberry (*Rubus fruticosus* aggregate)
Victoria	Eltham Copper Butterfly (*Paralucia pyrodiscus lucida*)[1]	Cape Broom (*Genista monspessulana*) Radiata Pine (*Pinus radiata*) Quaking Grass (*Briza maxima*)
SA	Common White Spider Orchid (*Caladenia argocalla*)[2]	Topped Lavender (*Lavandula stoechas*) Soursobs (*Oxalis pescaprae*) St John's Wort (*Hypericum perforatum*) Gorse (*Ulex europaeus*) Hawthorn (*Crataegus monogyna*) Watsonia (*Watsonia meriana* var *bulbillifera*)
Qld and NSW	Richmond Birdwing Butterfly (*Troides richmondia*)[1]	Dutchman's Pipe (*Aristolochia elegans*)
Qld	Aponogeton Queenslandicus (*Aponogeton queenslandicus*)[1]	Para Grass (*Brachiaria mutica*)
Qld	Jabiru (*Ephippiorhynchus asiaticus australiensis*)[1]	Para Grass (*Brachiaria mutica*)
Qld	Brolga Park Zieria (*Zieria bifida* previously *Zieria* sp. "Brolga Park")[2]	Lantana (*Lantana camara*)
Qld	Proserpine Rock Wallaby (*Petrogale persephone*)[2]	Pink Periwinkle (*Catharanthus roseus*) Rubbervine (*Cryptostegia grandiflora*)

WA	Wing-fruited Lasiopetalum (*Lasiopetalum pterocarpum*)[2]	Watsonia (*Watsonia meriana* var *bulbillifera*) Blackberry (*Rubus fruticosus* aggregate) Gladioli (*Gladiolus undulatus*)
NT	Yellow Chat (Alligator Rivers) (*Epthianura crocea tunneyi*)[2]	Mimosa (*Mimosa pigra*)

[1] Listed as threatened only under state/territory legislation.
[2] Listed as threatened under both state/territory and national legislation.
[*] Naturalised invasive and potentially invasive garden plants (Randall and Kessal, 2004; Groves et al., 2005).

The Committee considers that escaped garden plants have had, and are continuing to have, adverse impacts on a number of threatened native species and ecological communities throughout Australia. For the purposes of this listing advice, the affected species examined in more detail are *Troides richmondia* (Richmond Birdwing Butterfly), *Pimelea spicata* (a shrub), *Pterostylis arenicola* (Sandhill Greenhood Orchid) and *Lasiopetalum pterocarpum* (Wing-fruited Lasiopetalum).

Additionally, the 'Cumberland Plains Woodlands', 'Blue Gum High Forest of the Sydney Basin Bioregion' and 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia' are examined as examples of ecological communities listed as threatened under the EPBC Act that are adversely impacted by this threatening process.

The impact of escaped garden plants is evident across the three levels of biological diversity: genetic diversity, species diversity and ecosystem diversity. Many escaped garden plants that become environmental weeds are capable of causing an impact at one or more of these levels, although the degree of impact is rarely quantitatively determined (Adair and Groves, 1998). Escaped garden plants can have an adverse impact through genetic effects, introduction of diseases, competition for resources, prevention of recruitment, alteration of ecosystem processes and changes to the abundance of indigenous fauna (Burgman and Lindenmayer, 1998; Csurches and Edwards, 1998).

1.4.1 Genetic effects

In instances where escaped garden plants become environmental weeds and cause a decline in the number of genetically distinct sub-populations that make up a native species, it is reasonable to conclude that an associated reduction in the genetic diversity of the affected species is likely to result. As intra-specific genetic variation is the basis for continuing evolution and also the ecological versatility of a species, a decline in genetic variation reduces a species' resilience and adaptability and increases a species' vulnerability in the face of change (Adair and Groves, 1998; Burgman and Lindenmayer, 1998).

The invasion of escaped garden plants may also affect the genetic diversity of native species through cross breeding or hybridisation, whereby foreign genes are introduced into local plant populations (Blood, 2001). Escaped garden plants can hybridise with closely related endemic native plant species, leading to reduced genetic fitness and hence viability of endemic native plant populations. For example, *Acacia baileyana* (Cootamundra Wattle), a native species that has become an environmental weed outside its natural range through cultivation as a garden plant, is capable of hybridising with indigenous species including *Acacia dealbata* (Silver

Wattle) and *Acacia pubescens* (Downy Wattle) (Brunskill, 2002; NGINA 2009). Similarly, in the Dandenong Ranges and South Gippsland in Victoria, another native garden plant which is considered a weed outside its natural range, *Pittosporum undulatum* (Sweet Pittosporum), is hybridising with the indigenous *Pittosporum bicolor* (Banyalla), threatening the survival of the local gene pool (Gleadow and Ashton, 1981; Parks Victoria, 2001).

1.4.2 Introduction of diseases

The introduction of exotic garden plants often results in the introduction of pathogens (fungi, nematodes, bacteria and viruses) that are associated with these plants in their natural range (ILDA, 2009). In their natural habitats and hosts, pathogens do little harm. In a novel environment, however, these pathogens can cause disease which adversely impacts on native vegetation (Pain, 2004).

The best known example of such a pathogen in Australia is *Phytophthora cinnamomi*. *P. cinnamomi* is a soil-borne microorganism which grows on the surface of plant roots and invades the cells of susceptible host plants, feeding on their root and basal stem tissue until the host plant is weakened or killed by a reduction or cessation in the movement of water and nutrients within the plant (WA CALM, 2003). While there has been some controversy concerning the origin of *P. cinnamomi* in Australia, it is believed that it is possibly of Asian origin and that it almost certainly entered Western Australia for the first time on soil around the roots of cultivated plants, shortly after European settlement (WA CALM, 2003; Cahill et al., 2008). Since this time it is speculated that there must have been innumerable introductions at many points of entry around Australia in association with the introduction of exotic garden plants (WA CALM, 2003; Pain, 2004).

Like terrestrial plants, aquarium and other aquatic plants carrying pathogens in their roots can adversely affect native plant and animal species, with fish being particularly susceptible to infection from aquatic plant-borne parasites (QLD EPA, 2008). Aquatic plants like Salvinia can also indirectly facilitate the spread of pathogens as they provide breeding habitat for other pest species such as disease-carrying mosquitoes (CRC AWM, 2003).

The introduction of pathogens caused by the mass movement of garden plants also creates opportunities for different species of pathogens to interact, pathogens which would not meet under natural conditions. This interaction is problematic as it may result in the evolution of new and potentially dangerous diseases (Pain, 2004).

1.4.3 Competition for resources

Competition between species is inevitable when more than one species occupy the same niche and have similar requirements for a limited resource (Cadotte, 2007). Escaped garden plants are known to compete with native plants for limited resources such as moisture, nutrients, sunlight, pollinators and space (Csurches and Edwards, 1998; Blood, 2001; Brunskill, 2002).

Many escaped garden plants in Australia become invasive because they are introduced in areas that do not contain their natural pests and predators which, under normal circumstances, would play a significant regulatory role. In the absence of natural pests and predators, growth of escaped garden plants can become extremely vigorous such that a competitive advantage over native

vegetation is gained. Blue Trumpet Vine (*Thunbergia grandiflora*) is an example of a garden escapee, spread primarily via the ornamental plant trade, that gained a competitive advantage in north Queensland owing to the absence of damaging insects and pathogens (Csurches and Edwards, 1998; QPIF, 2008; AWC, undated).

The competitive advantage that many escaped garden plants possess is also a function of the ecological attributes or life history traits of the escaped garden plant itself. For example, Bitou Bush has a much greater reproductive output than the native *Acacia longifolia* (Sydney Golden Wattle), owing to the competitive advantage of Bitou Bush at the seedling stage. The competitive advantage of Bitou Bush is primarily derived from the species' comparatively greater root development, allowing better access to moisture, and its greater leaf area which results in a greater rate of photosynthesis. Both of these ecological characteristics enable Bitou Bush to outgrow and out-compete the Sydney Golden Wattle (Weiss and Noble, 1984).

1.4.4 Prevention of recruitment

Growth of invasive garden plants can be sufficiently vigorous to reduce or prevent the establishment of native plant species (Csurches and Edwards, 1998). For example, the establishment of Sweet Pittosporum results in the development of a low tree canopy of almost rainforest density, which intercepts light to the extent that only about ten percent of full daylight reaches the understorey (Gleadow and Ashton, 1981). The intensity of the shade cast by dense growth of Sweet Pittosporum may inhibit native plant seed germination; in dry sclerophyll forests east of Melbourne, for example, it resulted in a 90 percent decline in native plant species and in some cases caused the complete loss of the forest understorey (Gleadow and Ashton, 1981; Csurches and Edwards, 1998; Mullett, 2001).

1.4.5 Alteration of ecosystem processes

Invasive garden plants are also capable of altering various ecosystem processes such as geomorphological processes, hydrological cycles, nutrient dynamics and disturbance regimes (Csurches and Edwards, 1998). Alterations to ecosystem processes can potentially influence many if not all species within a community (Vranjic et al., 2000).

For example, with regard to geomorphological processes, the invasion of the exotic Marram Grass (*Ammophila arenaria*) is believed to have resulted in changes to the topography of sand dunes in Australia (Csurches and Edwards, 1998; Hilton et al., 2006). Additionally, the establishment of invasive garden plants, such as Willows, can indirectly increase soil erosion by shading out ground plants which would normally hold the soil together (Blood, 2001). Similarly, the presence of Lippia (*Phyla canescens*), a major invasive garden plant species in the Murray-Darling Basin, can also result in increased soil instability as Lippia's root system is less effective than that of native grasses in binding cracking clay soils (Groves et al., 2005).

Escaped garden plants may also influence hydrology. For example, the invasion of watercourses in central Australia by *Tamarix* spp. (Tamarisks) is likely to have resulted in a change in the hydrology of the Finke River and a lowering of the water table (Csurches and Edwards, 1998). Tamarisks are unable to actively regulate their transpiration such that, in dry conditions, they may desiccate watercourses in order to meet their moisture requirements (Griffin et al., 1989; Groves et al., 2005).

The nutrient dynamics of soil and litter substrates may also be altered by invasive garden plants. Cootamundra Wattle, for example, fixes nitrogen in the soil, thereby inhibiting the germination of many native plants (WBMB, undated). Bitou Bush, another example, can alter soil and litter properties substantially, and these changes negatively impact on the germination and seedling growth of indigenous plants such as *Acacia sophorae* (Coastal Wattle) (Vranjic et al., 2000). Similarly, Sweet Pittosporum produces leaf litter that is considerably different in terms of nutrient content to that of native eucalypts. Gleadow and Ashton (1981) found that, under laboratory conditions, the leaf litter of Sweet Pittosporum, which contains greater levels of calcium and magnesium, significantly inhibited, and may be allelopathic to, seed germination of several native eucalypt species. Invasive aquatic plants, such as Cord Grasses, are also capable of altering the nutrient dynamic of waterways as well as pre-existing pH, salinity and oxygen levels, all of which impact on native aquatic life (Hedge and Kriwoken, 2000).

Disturbance regimes, such as fire regimes, can also be altered by the invasion of escaped garden plants. Invasive garden plants can change intrinsic fuel properties (plant tissue moisture content and chemical composition) and extrinsic fuel properties (fuel load, continuity and packing ratio), which can in turn affect fire behaviour and, ultimately, alter fire regime characteristics such as frequency, intensity, extent, type, and seasonality (Brooks et al., 2004). Characteristics of many invasive garden plants that enable them to fuel very intense fires include abundant, highly flammable volatile leaf oils, very fine fuels (abundant small leaves and branches) and the formation of very dense thickets. Invasive garden plants often produce fuel loads that greatly exceed natural fuel loads, resulting in fires so intense that the soil is sterilised and all plants and soil-stored seed are destroyed. Escaped garden plants such as Blackberry, Gladioli (*Gladiolus undulatus*) and Watsonia (*Watsonia* sp.), for example, contribute to accumulated fuel loads and therefore increase the risk of fire (Stack and English, 2003). If the regime changes subsequently promote the dominance of the invaders, then a positive feedback loop or an invasive plant–fire regime cycle can be established (Brooks et al., 2004).

1.4.6 Changes to abundance of indigenous fauna

Escaped garden plants that become invasive can both directly and indirectly change the abundance of indigenous fauna. Fauna such as the Richmond Birdwing Butterfly and *Petrogale persephone* (Proserpine Rock Wallaby) are directly impacted by escaped garden plants, Dutchman's Pipe (*Aristolochia elegans*) and Pink Periwinkle (*Catharanthus roseus*), respectively, both of which are attractive as a food source and yet toxic to them when consumed (Watts and Vidler, 2006).

Indirectly, escaped garden plants impact indigenous fauna by altering the availability of suitable habitat, including food and shelter, and by creating habitats that harbour other pest species that can, in turn, have a detrimental affect. In the Northern Territory, for example, thickets of Mimosa (*Mimosa pigra*) were found to be unsuitable for *Anseranas semipalmata* (Magpie Goose), which relies on native sedges displaced by Mimosa for nesting and food, and to have lower overall bird and lizard abundances compared to native vegetation (Groves et al. 2005). Similarly, Blackberry is capable of out-competing native vegetation that *Burramys parvus* (Mountain Pygmy Possum) depends on for food and shelter, and it also provides food and shelter for introduced pests such as dogs and foxes which are known to prey on the possum (Mansergh et al., 1991; TSN, 2005).

1.5 Listing status under State and Territory legislation

Victoria

The following are listed as potentially threatening processes under the Victorian *Flora and Fauna Guarantee Act 1988*:

- 'Invasion of native vegetation by Blackberry *Rubus fruticosus* L. agg'
- 'Invasion of native vegetation by 'environmental weeds''
- 'Introduction and spread of *Spartina* to Victorian estuarine environments'
- 'Spread of *Pittosporum undulatum* in areas outside its natural distribution'

New South Wales

The following are listed as key threatening processes under the NSW *Threatened Species Conservation Act 1995*:

- 'Invasion and establishment of exotic vines and scramblers'
- 'Invasion and establishment of Scotch Broom'
- 'Invasion of native plant communities by bitou bush & boneseed'
- 'Invasion of native plant communities by exotic perennial grasses'
- 'Invasion, establishment and spread of *Lantana camara*'

In addition, the NSW Scientific Committee has made a preliminary determination to list the 'Invasion and establishment of escaped exotic garden plants' as a key threatening process.

Many weeds that originated as garden plants are also declared as noxious or prohibited under various state/territory legislation.

2. How judged by the Committee in relation to the EPBC Act criteria

Section 188(4) of the EPBC Act states:

A threatening process is eligible to be treated as a key threatening process if:

a) it could cause a native species or an ecological community to become eligible for listing in any category, other than conservation dependent; or

b) it could cause a listed threatened species or a listed threatened ecological community to become eligible to be listed in another category representing a higher degree of endangerment; or

c) it adversely affects 2 or more listed threatened species (other than conservation dependent species) or 2 or more listed threatened ecological communities.

A. Could the threatening process cause a native species or an ecological community to become eligible for listing as Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable?

There are a number of species not listed as threatened under the EPBC Act that are likely to be negatively impacted by escaped garden plants. However, there are currently insufficient quantitative data available to enable assessment of the impacts on most of these species against this criterion. There is however, evidence that the threatening process could cause *Troides richmondia* (Richmond Birdwing Butterfly) to become eligible for listing as threatened under the EPBC Act.

Richmond Birdwing Butterfly

This species' eligibility for listing under the EPBC Act can be assessed using relevant criteria set out in the Environment Protection and Biodiversity Conservation Regulations 2000. The species would be considered to be vulnerable if it met any one of the criteria set out in the regulations. The following criterion is relevant in the case of Richmond Birdwing Butterfly: 'It has undergone, is suspected to have undergone or is likely to undergo in the immediate future, a substantial reduction in numbers'.

The Richmond Birdwing Butterfly occurs only in subtropical northern New South Wales and south-east Queensland. The species was once reportedly very common in Brisbane and its natural range extended from Maryborough and Gympie in Queensland to Grafton in New South Wales (Gardening Australia, 2003; Vidler, 2004; Sands, 2008). Significant contraction in the species' distribution has occurred over the last century in response to extensive clearing of lowland rainforest for forestry and farming (Sands, 2008). Continuing declines in abundance and distribution of the butterfly and its native food plants have occurred over the last 20 years and it is estimated that less than two-thirds of the original population's range remains (Sands, 2008). The Committee considers that the past decline in the species' population size would be commensurate with this range contraction.

Escaped garden plants turned invasive weeds, including Morning Glory (*Ipomoea* spp.), Madeira Vine (*Anredera cordifolia*) and, in particular, Dutchman's Pipe (*Aristolochia elegans*) have been identified as significant threats that have contributed to the Richmond Birdwing Butterfly's decline over the last couple of decades (Sands, 2008). Dutchman's Pipe has been particularly problematic and its impact is two-fold. Firstly, it can have an indirect impact on the Richmond Birdwing Butterfly by competing with and displacing what remains of the species' native food plant vines, *Pararistolochia praevenosa* (Birdwing Butterfly Vine) and *Pararistolochia laheyana* (Mountain Aristolochia) (Sands, 2008). Secondly, in the absence of native food plants, butterflies are attracted to laying their eggs on the leaves of the related, but introduced, Dutchman's Pipe. Leaves of Dutchman's Pipe contain toxins that poison and kill the larvae of the Richmond Birdwing Butterfly when they hatch and commence feeding (Gardening Australia, 2003; Vidler, 2004; Biosecurity Queensland, 2007; Sands, 2008; Qld EPA, 2009). Dead larvae of the species have been observed everywhere the weed occurs, including in national parks (Sands, 2008).

Despite significant recovery effort to date which has involved nurseries and school groups undertaking cultivation and planting of the native food plant throughout Brisbane gardens, the Dutchman's Pipe continues to threaten the survival of the butterfly and it is considered that eventual eradication of the Dutchman's Pipe may not be feasible in some extensive habitats. Furthermore, it is anticipated that the threat posed by the Dutchman's Pipe will continue as future climate change is expected to favour the competitiveness and expand the range of this and other invasive weeds (Sands, 2008). The Committee therefore considers that the Richmond Birdwing Butterfly is likely to undergo a substantial reduction in numbers in the immediate future.

Summary of assessment: The Richmond Birdwing Butterfly was once reportedly very common in Brisbane and its natural range extended from Maryborough and Gympie in Queensland to Grafton in New South Wales. However, the species has been adversely affected by invasive garden plants, the impact of which is exacerbated in the context of past clearing and a highly fragmented habitat.

The Committee considers that the species has undergone a substantial reduction in numbers consistent with a substantial reduction in range. The species' distribution is dictated by the distribution of its native food plant and, in future, the latter will be largely dictated by the expansion of various invasive garden plants, including the Dutchman's Pipe. The survival of the butterflies that remain is also jeopardised by virtue of the fact that the leaves of the Dutchman's Pipe are poisonous to feeding Richmond Birdwing Butterfly larvae.

Further, the decline in population size and geographic distribution may continue if the threat of invasive garden plants continues. The level of this threat is not yet quantified but it is anticipated that future climate change will increase the competitive advantage of escaped garden plants such as the Dutchman's Pipe. The Committee considers that the Richmond Birdwing Butterfly is likely to undergo a substantial reduction in numbers in the immediate future.

The Committee judges that this threatening process could cause the Richmond Birdwing Butterfly to become eligible for listing under the EPBC Act.

Conclusion for Criterion A: The Committee considers that the threatening process is eligible under this criterion as the process could cause the Richmond Birdwing Butterfly to become eligible for listing as threatened under the EPBC Act.

B. Could the threatening process cause a listed threatened species or a listed threatened ecological community to become eligible to be listed in another category representing a higher degree of endangerment?

Escaped garden plants, along with other threatening processes, could cause the Cumberland Plain Woodlands ecological community, currently listed as endangered, to become eligible for listing as critically endangered under the EPBC Act.

The Cumberland Plain Woodlands ecological community supports a range of escaped garden plant species including:

- African Olive (*Olea europaea* subsp. *cuspidata*);
- Branched Centaury (*Centaurium tenuiflorum*)
- Bridal Creeper (*Asparagus asparagoides*);
- Cat's Ear (*Hypochaeris radicata*);
- Glandular Willow-herb (*Epilobium ciliatum*);
- Moth Vine (*Araujia sericifera*);
- Pimpernel (*Anagallis arvensis*);
- Spear Thistle (*Cirsium vulgare*);
- Square Cicendia (*Cicendia quadrangularis*);
- Yellow Wood Sorrel (*Oxalis corniculata*)

(NSW Scientific Committee, 2008b; DEWHA 2009b).

All of these escaped garden plant species compete for space and resources and, in doing so, may displace native species and contribute to a reduction in native plant and animal biodiversity. African Olive and Bridal Creeper have been identified as particularly significant weeds as they are highly competitive and appear able to suppress native understorey species (Benson, 1992; Tozer, 2003; TSSC, 2009). Bridal Creeper and Moth Vine are among a suite of exotic vines and scramblers that are listed as a threatening process in NSW which are also considered a specific threat to the ecological community (NSW Scientific Committee, 2006; TSSC, 2009).

African Olive has established as an aggressive environmental weed since its introduction into Australia in the mid-19th century as an ornamental and hedging plant and as a rootstock for the European Olive (*Olea europaea* subsp. *europaea*). It has an ability to permanently change the structure of the ecological community through dense mid-canopy formation and, like other weeds such as Bridal Creeper, can suppress native plant species in the understorey (Benson, 1992; Cuneo and Leishman, 2006; TSSC, 2009). The establishment of African Olive within a patch of the ecological community can also significantly alter the types of fauna using the patch (NSW DECC, 2007; TSSC, 2009).

Morris and Wood (2001) found that 14 of 57 identified species (11% of the total) that germinated from the soil seed bank of the Cumberland Plain Woodlands ecological community were exotic species. Similarly, Hill and French (2003) found that 11 of 68 species represented in the soil seed bank of the ecological community were weeds. However, the identification and origin of the weed species was not revealed by the authors of either study. Notwithstanding this, Hill and French (2003) reported that two of the ten species found to be unique to the soil seed-bank (not present in standing vegetation) were Glandular Willow-herb (*Epilobium ciliatum*) and Square Cicendia (*Cicendia quadrangularis*), both of which are invasive garden plants. The presence of Glandular Willow-herb and Square Cicendia seeds in the soil profile can reduce the seed-bank of native species and their regeneration capacity. The fact that these garden plant species are unique to the soil seed-bank suggests that their invasive potential is yet to be fully realised and these species may have an increasingly detrimental impact in the future (Hill and French, 2003). Furthermore, Hill and French (2003) reported that Yellow Wood Sorrel (*Oxalis corniculata*), another escaped garden plant, was the most abundant of 11 temperature-tolerant species to germinate from all soil samples collected from the ecological community.

The following criteria are relevant in determining the Cumberland Plain Woodland's eligibility for listing as critically endangered: 'Small geographic distribution coupled with demonstrable threat' and 'Reduction in community integrity'.

Small geographic distribution coupled with demonstrable threat

The Cumberland Plain Woodlands were formerly extensive and scattered across the entire Cumberland Plain, an area of about 2800 km^2 (NSW Scientific Committee, 2008b). As remnants of the ecological community continue to be scattered across the entire Cumberland Plain, this value approximates the extent of occurrence for the ecological community. Based on its extent of occurrence, the Cumberland Plain Woodlands has a limited geographic distribution, i.e. it lies well within the range of 1000 to 10 000 km^2 (TSSC, 2009).

The ecological community's area of occupancy has markedly contracted from about 130 900 ha to approximately 12 300 ha (Tozer, 2003; NSW Scientific Committee and Simpson, 2008) and there is a strong possibility of further decline. The area of occupancy for the Cumberland Plain Woodlands is, therefore, indicative of a restricted geographic distribution (TSSC, 2009).

Data on patch sizes for the ecological community indicates that about 87% of woodland remnants are under 10 hectares in size, with about 72% of remnants falling within the size range of 0.5 to 5 hectares. Large remnants of 100 ha or more in area are comparatively rare, accounting for less than 1% of the number of remnants. The distribution of patch size classes indicates that the present geographic distribution of the Cumberland Plain Woodlands is highly fragmented and can be considered to be very restricted (TSSC, 2009).

In addition to the threat of clearing for urban development and the subsequent fragmentation of the ecological community that ensues, the Cumberland Plain Woodlands ecological community is seriously threatened by invasion of escaped garden plants, particularly African Olive which has been mapped across about 985 hectares of the Cumberland Plains Woodlands (Cuneo et al., 2009). Given current urban expansion and infrastructure development plans, the threat of escaped garden plants will continue to intensify, rather than diminish (TSSC, 2009).

The Committee considers that the ecological community has a very restricted geographic distribution, based on the fragmentation of remnants into very small patch sizes, coupled with demonstrable ongoing threats that could cause it to be lost in the immediate future. Therefore, the ecological community is **eligible** for listing as **critically endangered** under this criterion (TSSC, 2009).

Reduction in community integrity

A number of the threats and disturbances that contribute to a reduction in the integrity of the Cumberland Plain Woodlands ecological community are common to temperate grassy ecosystems across south-eastern Australia. The major difference is that the entire distribution of this ecological community is within or in close proximity to the greater Sydney metropolitan area. This juxtaposition with an urban environment makes the Cumberland Plain Woodlands particularly susceptible to anthropogenic threats. Where the ecological community has not been outright cleared and irrecoverably lost, the integrity of remnants has declined over time in response to a number of threats including the invasion of escaped garden plants (TSSC, 2009).

The Cumberland Plain Woodlands ecological community is subject to extensive invasion by several weed species which originated as garden plants, most notably African Olive. African Olive can have transformative impacts upon remnants of the ecological community - it has the ability to permanently change ecosystem structure by forming a dense mid-canopy formation, blocking out the understorey plant species and preventing the regeneration of tree canopy species (Cuneo and Leishman, 2006; TSSC, 2009). Cuneo et al. (2009) used satellite imagery to determine that African Olive has infested 8.5% of the ecological community in the south of the Cumberland Plain. Fragmentation of the ecological community increases the threat of African Olive as the increased edge effects of remnants allows increased dispersal of weed propagules into remnants (Hobbs and Huenneke 1992).

Escaped garden plant species with the potential to aggressively invade the understorey, such as Bridal Creeper, are also present at some sites. Where Bridal Creeper is extensive, the tuber mat limits establishment sites for native ground layer species, whilst the climbing shoots can smother native vegetation into the small tree canopy. Effective control for these escaped garden plant species is likely to be problematic and difficult. Consequently, these garden plant species will continue to be a key factor contributing to the reduction in the integrity of many patches of the ecological community into the foreseeable future (TSSC, 2009).

The Committee considers that the change in integrity experienced by the ecological community, as indicated by invasion of escaped garden plants, is very severe. The nature of the changes in integrity of the ecological community are such that the regeneration of many patches is unlikely to occur within the immediate future, even with positive human intervention. Therefore, the ecological community is **eligible** for listing as **critically endangered** under this criterion (TSSC, 2009).

Conclusion for Criterion B: The Committee considers that the threatening process is eligible under this criterion as the process could cause the Cumberland Plain Woodlands to become eligible for listing as critically endangered, a category which represents a higher degree of endangerment, under the EPBC Act.

C. Does the threatening process adversely affect two or more listed threatened species (other than conservation dependent species) or two or more listed threatened ecological communities?

As discussed under ‘Threats to Native Species’ there are a number of species being impacted upon by this threatening process. The following species, listed as threatened under the EPBC Act, are examples that demonstrate the adverse impacts of escaped garden plants on threatened Australian native species. These species are being affected by escaped garden plants primarily through competition and habitat degradation.

- *Pimelea spicata* (a shrub)
- *Pterostylis arenicola* (Sandhill Greenhood Orchid)
- *Lasiopetalum pterocarpum* (Wing-fruited Lasiopetalum)

Additionally, the 'Blue Gum High Forest of the Sydney Basin Bioregion' and 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia' are examples of ecological communities listed as threatened under the EPBC Act that are adversely impacted by this threatening process.

Pimelea spicata

Pimelea spicata is endemic to New South Wales and is currently listed as endangered under the EPBC Act. *P. spicata* is a small shrub growing to about 50 cm that bears pink-white flowers from September to May. It reproduces mainly from seed but also possesses a thick tap root that enables re-sprouting after fire and other disturbances (Groves et al., 2005). Although once widespread in southeastern New South Wales, the species is now restricted to approximately 30 populations and has a relatively scattered distribution occurring in two disjunct areas - the Cumberland Plain Woodland (itself a nationally threatened ecological community) and Illawarra (Matarczyk et al., 2002; Vidler, 2004). The species' current distribution is largely a result of habitat fragmentation caused by clearing for rural and urban development (NSW DEC, 2004; NSW NPWS, 2004c).

Invasive weeds that are able to out-compete *P. spicata* for resources have severely degraded the species' habitat, thereby threatening the viability of remnant *P. spicata* populations (NSW DEC, 2004; Watts and Vidler, 2006). Indeed, according to Matarczyk et al. (2002), if current rates of habitat loss and weed invasion continue unchecked, the species is at risk of disappearing from the wild within the next 10-20 years. The major weeds adversely impacting *P. spicata* include Bridal Creeper (*Asparagus asparagoides*), Bitou Bush, Blackberry, St John's Wort (*Hypericum perforatum*), Kikuyu, Lantana, African Olive (*Olea africana* subsp. *africana*) and Broad-leaved Privet (*Ligustrum lucidum*) (Vidler, 2004; Watts and Vidler, 2006). The invasion of these weeds, most of which are escaped garden plants, is likely to detrimentally affect *P. spicata* by reducing the reproductive capacity of adult plants and their ability to resprout following disturbance, and by inhibiting seedling recruitment (NSW DEC, 2004).

P. spicata is particularly susceptible to displacement by environmental weeds due to its herb-like habit, and is especially vulnerable to competition from weeds that can form a dense ground cover such as Kikuyu and Bridal Creeper. Kikuyu is known to compete with *P. spicata* at the majority of sites and is likely to cause the local extinction of the species at a number of sites in the absence of effective control measures (NSW DEC, 2004). For example, Kikuyu along with Bitou Bush and Lantana are invading coastal populations and having a major impact on the recruitment of *P. spicata* from the seedbank (DEWHA, 2009d).

The adverse impact of Bridal Creeper on the native shrub is particularly evident at one of the largest *P. spicata* populations near Camden which comprises about one-quarter of all remaining individuals. At this site, Bridal Creeper is known to co-occur at varying densities with about 60 per cent of *P. spicata* adults (Groves et al., 2005). Bridal Creeper is capable of competing with *P. spicata* both above and below ground (Vidler, 2004). Preliminary evidence suggests that the latter form of competition is relatively more intense as the presence of Bridal Creeper roots, irrespective of shoots, can limit the germination of *P. spicata.* This has negative implications for the early life history stages of *P. spicata* (Groves et al., 2005).

While the removal of Bridal Creeper may lead to localised increases in *P. spicata* populations, the species' habitat will always be predisposed to further weed invasion because the vegetation type in which *P. spicata* occurs is highly fragmented (Groves et al., 2005).

Summary of assessment: Escaped garden plants are very likely to be a cause of decline in the population size and distribution of *Pimelea spicata*, with local extinctions likely in the absence of effective weed control measures. In particular, the invasion of Kikuyu and Bridal Creeper is likely to have had an adverse impact on the species through direct competition.

The Committee judges that this threatening process is adversely affecting *Pimelea spicata*.

Sandhill Greenhood Orchid

The Sandhill Greenhood Orchid is endemic to South Australia and is currently listed as vulnerable under the EPBC Act. This seasonal terrestrial orchid emerges from subterranean tubers in June, flowers in September and October, and dies back during November-December (Sorensen and Jusaitis, 1995; SA DEH, 2005). In the early 1990s, the species' distribution was restricted to three well known small populations, totalling an estimated 330 plants, and a fourth newly discovered population (Groves et al., 2005; DEWHA, 2009e). Two of these populations occur within a State Reserve at Tailem Bend and the third and fourth populations are located on a golf course in the Adelaide Metropolitan area and in the Coorong National Park, respectively (Groves et al., 2005; DEWHA, 2009e).

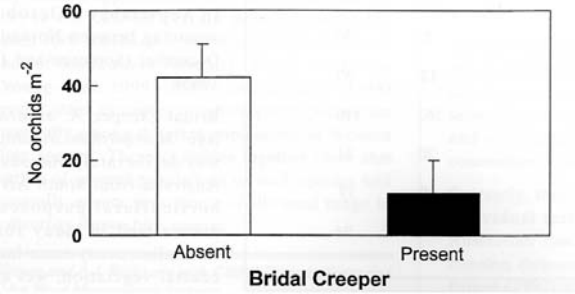
The invasion of escaped garden plants has been identified as a threat at each of these populations. Bridal Creeper and *Avena* spp. are the main weed species at Tailem Bend and Coorong National Park and Soursob (*Oxalis pes-caprae*) is the prominent weed species at the golf course (DEWHA, 2009e). These weed species negatively impact on Sandhill Greenhood Orchid by directly competing for light, water, nutrients and space.

Sorensen and Jusaitis (1995) quantified the impact of Bridal Creeper on Sandhill Greenhood Orchid numbers through analysis of quadrats at Tailem Bend. As depicted in Figure 3, in July 1994, an average of more than 40 orchids per m^2 were recorded in the absence of Bridal Creeper, and this plant density reduced to just over ten orchids per m^2 when Bridal Creeper was present. The adverse impact of Bridal Creeper was also apparent temporally. For instance, in Bridal Creeper-infested areas, the weed's coverage almost doubled during the September flowering period, at the expense of the Sandhill Greenhood Orchid which declined in density to about 2.5 orchids per m^2. Sorensen and Jusaitis (1995) attribute the strong adverse impact on the Sandhill Greenhood Orchid to the close congruence in phenology of weed and orchid – both species grow from a tuberous root stock over autumn and winter and both also fruit and die back during spring and summer.

Summary of assessment: Escaped garden plants are very likely to be a cause of decline in the population size and distribution of the Sandhill Greenhood Orchid. The invasion of Bridal Creeper, in particular, has had an adverse impact on the species through direct competition.

The Committee judges that this threatening process is adversely affecting the Sandhill Greenhood Orchid.

Figure 3: Numbers of Sandhill Greenhood Orchid (*Pterostylis arenicola*) with and without Bridal Creeper (*Asparagus asparagoides*) at Tailem Bend, SA (Sorensen and Jusaitis, 1995).



Wing-fruited Lasiopetalum

The Wing-fruited Lasiopetalum is a shrub endemic to the Serpentine National Park of Western Australia near Perth. The species is currently listed as endangered under the EPBC Act.

The species is known from one natural location and two translocated locations and is estimated to comprise 555 mature individuals (excluding 102 translocated plants that have not yet been proved viable) (DEWHA, 2009c). Invasive garden plants including Blackberry, Gladioli (*Gladiolus undulatus*) and Watsonia (*Watsonia* sp.) pose the most immediate threat to the species and its habitat by suppressing both the growth of adult plants and recruitment through competition for soil moisture, nutrients and light (Stack and English, 2003; DEWHA, 2009c). The presence of these weed species also potentially threatens the survival of the Wing-fruited Lasiopetalum by contributing to fuel loadings and thereby increasing the risk of fire (Stack and English, 2003).

Despite weed control that has been undertaken in accordance with the species' recovery plan, invasive garden plants are still present within the species' distribution and propagules are continually introduced from infestations upstream of the natural location (Stack and English, 2003).

Summary of assessment: Escaped garden plants are very likely to be a cause of decline in the population size and distribution of the Wing-fruited Lasiopetalum. The invasion of Blackberry, Gladioli and Watsonia, in particular, has had an adverse impact on the species through direct competition.

The Committee judges that this threatening process is adversely affecting the Wing-fruited Lasiopetalum.

Blue Gum High Forest of the Sydney Basin Bioregion

The Blue Gum High Forest of the Sydney Basin Bioregion ('Blue Gum High Forest') is currently listed as a critically endangered ecological community under the EPBC Act. The Blue Gum High Forest is a tall forest that has several vegetation layers in its undisturbed state (DEH, 2005). The common components of the dominant tree layer of this ecological community are Blackbutt (*Eucalyptus pilularis*), Sydney Blue Gum (*Eucalyptus saligna*) and Smooth-barked Apple (*Angophora costata*) (DEWHA, 2009a).

The Blue Gum High Forest once covered the Sydney region, however, following European settlement and extensive vegetation clearing, this ecological community is now restricted to small bushland remnants nestled amongst the northern suburbs of Sydney. These remnants constitute less than 5 percent of the original forest area (DEH, 2005).

Many of the threats to the Blue Gum High Forest relate to the juxtaposition of the remnants with intensively disturbed urban areas. For instance, remnants with a high perimeter to area ratio are subject to edge effects and are highly susceptible to invasion by weed species, many of which are escaped garden plants (TSSC, 2005; DEWHA, 2009a). It is estimated that at least 50 percent of the remaining areas containing the Blue Gum High Forest are subject to weed invasion (TSSC, 2005).

Problematic escaped garden plants that are commonly associated with Blue Gum High Forest and threaten its condition include:

- Bridal Creeper (*Asparagus asparagoides*);
- Camphor Laurel (*Cinnamomum camphora*);
- Lantana;
- Large-leaved Privet (*Ligustrum lucidum*);
- Small-leaved Privet (*Ligustrum sinense*);
- Ochna (*Ochna serrulata*);
- Kikuyu;
- Blackberry;
- Cassia (*Senna pendula* var. *glabrata*); and
- Wandering Jew (*Tradescantia albiflora* and *T. fluminensis*)

(NSW Scientific Committee, 2008a; DEWHA, 2009a).

Camphor Laurel, Lantana, Privet, Ochna and Blackberry are of most concern, as these species are often present even in the least disturbed parts of high quality Blue Gum High Forest remnants (DEWHA, 2009a). A number of remnants have highly modified understories, in which the native woody component has been largely replaced by various garden escapees through direct competition. In addition to altering the native floristic structure and composition of the ecological community, the reduction of understorey complexity that results from the invasion of escaped garden plants also leads to the degradation of habitat for a range of native bird and mammal species. Moreover, the invasion of escaped garden plants contributes to a reduction in the overall natural ecological function of the community (NSW Scientific Committee, 2008a).

Although weed infestations have been managed to some extent in some areas, the current level of work is not enough to significantly reduce the continued invasion of escaped garden plants from neighbouring private properties and public land (NSW NPWS, 2004a; DEH, 2005).

Summary of assessment: The Blue Gum High Forest is restricted to small bushland remnants nestled amongst the northern suburbs of Sydney which constitute less than 5 percent of the original forest area. The fragmented state of the ecological community makes it highly susceptible to invasion by weed species, many of which are escaped garden plants. Invasive species such as Camphor Laurel, Lantana, Privet, Ochna and Blackberry which occur in at least 50 percent of remnant areas have replaced the native woody component, altering the native floristic structure and composition of the ecological community and also degrading habitat for a range of native bird and mammal species. Existing remnants of the Blue Gum High Forest continue to be threatened by weed invasion.

The Committee judges that this threatening process is adversely affecting the Blue Gum High Forest of the Sydney Basin Bioregion.

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia

The Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ('Littoral Rainforest') is currently listed as a critically endangered ecological community under the EPBC Act. As its name suggests, the ecological community represents a complex of rainforest and coastal vine thickets on the east coast of Australia. Typically, the ecological community occurs within two kilometres of the coast or adjacent to a large salt water body, such as an estuary and, thus, is influenced by the sea. The structure of the ecological community is typically a closed canopy of trees that can be interspersed with canopy gaps that are common in exposed situations or with storm events. The Littoral Rainforest contains a range of plant life forms including trees, shrubs, vines, herbs, ferns and epiphytes (TSSC, 2008).

The Littoral Rainforest, originally an almost continuous archipelago of patches along the eastern coast of Australia, has undergone a reduction in extent and fragmentation primarily as a result of coastal development, sandmining and agriculture (Bradley and Merrilyn, 1992). This fragmentation and reduction in patch size have increased the ecological community's vulnerability to other threats including invasion of escaped garden plants. Whether the ecological community is protected in reserves or not, the risk of escaped garden plant invasion increases where patches of the ecological community are located near human habitation and/or are subject to visitor disturbance (TSSC, 2008). A study by Peel (in prep.) found that the majority of weeds recorded were incidentally introduced through human activities, including domestic gardens and associated refuse dumping. Escaped garden plants that invade littoral rainforest, notably Lantana, Bitou Bush and Rubber Vine, are now recognised as Weeds of National Significance (WoNS).

The establishment of transformer weeds, many of which are escaped garden plants, in littoral rainforest patches can have a significantly detrimental effect (TSSC, 2008). Transformer weeds are highly invasive taxa with the potential to seriously alter the structure and function of the ecological community. Whilst it is accepted that the ecological community can tolerate a significant amount of weed cover due to its relative resilience, if left unchecked, such weeds will eventually take over and destroy the affected patch (TSSC, 2008). Peel (in prep.) observed the

impact of escaped garden plants in 2002-03 in the Marlo Estuary, Victoria, where weed invasion alone (i.e. without any other disturbance) had destroyed a third of the littoral rainforest stand and left the remaining two thirds in a state of severe decline. The escaped garden plant species that caused this degradation included Blue Periwinkle (*Vinca major*), Cape Ivy (*Delairea odorata*) and Wandering Jew (*Tradescantia albiflora*). Peel (in prep.) concluded that the ecological community, in this area, could disappear in the next five to ten years without proper intervention. Given the aggressive nature of transformer weeds, it can generally be deduced that seriously infested patches of the ecological community will be lost in the short to medium term in the absence of effective control of escaped garden plants (TSSC, 2008).

In New South Wales, many coastal habitats, including Littoral Rainforest, have been invaded by Bitou Bush which can smother canopy species and may form dense growth around the edge of the ecological community (Adam, 1992). The NSW Threat Abatement Plan for Bitou Bush recognises that this escaped garden plant poses a serious threat to littoral rainforest in northern NSW by invading the rainforest margins and canopy gaps, thereby disrupting recruitment processes (NSW DEC, 2006).

In northern New South Wales, remnant stands of the ecological community have been invaded by escaped garden plants such as Cat's Claw Vine *(Macfadyena unguis-cati)* and Madeira Vine *(Anredera cordifolia)* (Adam, 1992). Along the eastern coastline, Asparagus Fern *(Asparagus aethiopicus)* and Lantana are well established in many patches of the ecological community where they pose a serious threat to littoral rainforest species through their habit of climbing and smothering (TSSC, 2008). Not only are established trees killed by these weeds, but germination and recruitment of seedlings are severely hindered if not inhibited (Bradley and Merrilyn, 1992).

The presence of various escaped garden plants typically of the warm temperate climate zone of south-eastern Australia, such as Cape Ivy, Bitou Bush, Lantana and Madeira Vine, in the sub-tropical zone of northern NSW (Williams, 1993; Peel, in prep) demonstrates that certain escaped garden plants have the capacity to significantly expand their range on the eastern coastline to the detriment of the Littoral Rainforest ecological community.

Summary of assessment: The Littoral Rainforest ecological community has undergone a reduction in extent and fragmentation primarily as a result of coastal development, sandmining and agriculture. This fragmentation and reduction in patch size have increased the ecological community's vulnerability to other threats including invasion of escaped garden plants (TSSC, 2008). Invasive garden plant species such as Lantana, Bitou Bush, Rubber Vine, Blue Periwinkle, Cape Ivy, Wandering Jew**,** Cat's Claw Vine and Madeira Vine compete with native vegetation, altering the native floristic structure and composition of the ecological community. Existing remnants of the Littoral Rainforest are likely to continue to be threatened by escaped garden plants as these invasive species expand their range on the eastern coastline (TSSC, 2008).

The Committee judges that this threatening process is adversely affecting the Littoral Rainforest and Vine Thickets of Eastern Australia.

Conclusion for Criterion C: The Committee considers that the threatening process is **eligible** under this criterion as the process is adversely affecting population numbers and geographic distribution of at least three listed threatened species and two listed threatened ecological communities, primarily through competition and habitat degradation.

CONCLUSION: The threatening process meets s188(4)(a), s188(4)(b) and s188(4)(c) of the EPBC Act, and is therefore **eligible** to be listed as a key threatening process.

3. Threat Abatement Plan

3.1 Degree of threat

The continuing sale, and hence wide distribution, of invasive and potentially invasive garden plants in Australia presents a significant risk to Australia's environment. The invasion of escaped garden plants has resulted in adverse impacts on a number of native species from a variety of taxa, including many listed as threatened under the EPBC Act. Native plant species, such as *P. spicata*, Sandhill Greenhood Orchid and the Wing-fruited Lasiopetalum, are adversely impacted by escaped garden plants which are strong competitors for resources including light, moisture and space. Other species, such as the Richmond Birdwing Butterfly, are detrimentally affected by invasive garden plants which displace native plants that form part of the species' preferred habitat. Threatened ecological communities, including the Cumberland Plain Woodlands, Blue Gum High Forest and the Littoral Rainforest, are also adversely impacted by the threatening process.

3.2 Potential of threatened species and ecosystems to recover

The threats posed by invasive garden plants can be controlled by preventing further spread into new habitats, eradicating weeds and rehabilitating the ecosystems where these weeds occur. Many of the invasive garden plant species identified as part of this threatening process are already very well established in the Australian landscape, to the extent that they are recognised as WoNS. For these species, the goal of management is containment, rather than eradication which is no longer feasible in many cases. As a result, the ecosystem changes induced by these already widely distributed invasive garden plants may be largely irreversible.

Although not specifically identified in this advice as they are yet to become invasive and their effect on native species at the national level is not yet definitively known or documented, potentially invasive garden plants are an important part of this threatening process. These plants may still be in the early stages of introduction or naturalisation and it is towards these potentially invasive garden plants that additional management effort should be directed. In these instances where invasive garden plants can be locally eradicated, threatened species have the ability to recover from the impacts of the threatening process.

3.3 Current threat abatement actions

There are a number of national and state-based initiatives in place to address this threatening process; the below examples are instructive when considering the need for a national Threat Abatement Plan.

National Initiatives

- The EPBC Act and the *Quarantine Act 1908* regulate the import of live plants and animals into Australia. Under the EPBC Act, the importation of live plants, excluding CITES listed plant specimens, is unregulated provided it is in accordance with the Quarantine Act. Under the Quarantine Act, plant imports are regulated taking into consideration their pest potential. The Australian Quarantine and Inspection Service (AQIS) administers the Quarantine Act and Biosecurity Australia undertakes the import risk assessments. Biosecurity Australia uses the Weed Risk Assessment (WRA) system as the agreed pre-entry screening method for new plant imports and this is applied to all proposals to import new plant species (seeds, nursery stock or tissue culture) which are not on the permitted list. The WRA system assesses whether the plant proposed for import possesses certain attributes which could increase the likelihood of it becoming a weed in Australia. Plants that are already present in Australia still require assessment before importation if they are not on the permitted list.

- Biosecurity Australia also develops and reviews quarantine policies to protect the environment from exotic pests (including weeds) and diseases. On request, Biosecurity Australia provides advice to AQIS regarding these policies.

- AusBIOSEC is a policy framework that provides for national collaboration on biosecurity issues. This includes managing pests (including weeds) and diseases in terrestrial, freshwater and marine environments. It aims to provide a coordinated national approach to prevention, emergency response to new incursions and management of established invasive species. AusBIOSEC builds on existing strategies including the Australian Weeds Strategy 2007.

- *Australia's Biodiversity Conservation Strategy 2010-2020 (draft)* aims to ensure that biodiversity is healthy, resilient to climate change and valued for its essential contribution to human existence. It recognises invasive species as one of six main threats to biodiversity and provides a broad framework for the implementation of other national strategies outlined below.

- *The National Framework for the Management and Monitoring of Australia's Vegetation* sets out a national approach to the management and monitoring of Australia's native vegetation and provides a process through which Commonwealth, State and Territory commitments can be implemented to improve the quality and extent of Australia's native vegetation cover.

- *The Australian Weeds Strategy 2007* provides guidance to all stakeholders involved in weed management and identifies priorities for weed management across Australia. The goals of the strategy are: preventing new weed problems; reducing the impact of existing priority weed problems; and enhancing Australia's capacity and commitment to solve weed problems. Under the strategy, priority is given to control and management of 20 plant species identified as Weeds of National Significance (WoNS). A national strategy and a Weeds Management Guide has been produced for each WoNS. The Australian Weeds Committee, which reports to the Natural Resource Management Ministerial Council, supports the implementation of the Australian Weeds Strategy by facilitating and coordinating consistent national action on weed tasks.

- The following national draft action plans, both currently undergoing significant revision, sit beneath the strategy:
    - *The National Weeds Awareness Action Plan* focuses on improving awareness as a prerequisite to achieving acceptable long-term management of weeds. The key outcome of the plan is a weeds awareness program that increases whole-of-community and government understanding of the invasive plant crisis. 'Nursery and Landscape' is one of the target groups highlighted in the plan and key stakeholders identified in the plan that would play an important role in abating the key threatening process include Australian National Botanic Gardens, Greening Australia, Horticulture Australia and Nursery & Garden Industry Australia. Investment under the action plan over the last decade has contributed to heightened awareness and increased capacity to manage weed issues, primarily through community group participation in the Weedbuster campaign and the development of awareness products.
    - *The National Weed Spread Prevention Action Plan* establishes a framework to prevent weed spread. The draft objectives include: to identify and address all pathways for weed spread, achieve national consistency in weed spread prevention and minimise the spread of weeds by human agency. The action plan acknowledges that one form of human-induced spread is the direct movement of weeds by people through planting invasive ornamental species close to native vegetation.

- The Natural Resource Management Ministerial Council's National Cost-Sharing Eradication Programs currently apply to six target species, three of which are considered escaped garden plants (Koster's Curse *Clidemia hirta*, Limnocharis *Limnocharis flava*, and Miconia *Miconia calvescens*). These programs identify infested areas, through mapping and monitoring, and coordinate or undertake activities to eradicate the species from Australia.

- The National Weeds Research and Productivity Program aims to reduce the impact of invasive plants on farm and forestry productivity and also on biodiversity. The Australian Weeds Research Centre is the centrepiece of the program and will build on the work of the CRC for Australian Weed Management which completed its term on 30 June 2008. The Australian Government has committed $15.3 million over four years, from 2008/09 to 2011/12, to the program and thus far, funds totaling $2.5 million have been allocated to 28 weeds research projects.

<u>State and Territory Initiatives</u>

- Victorian Pest Management: Weed Management Strategy, including Weed Alert Plan;
- New South Wales Weed Strategy, NSW Bitou Bush TAP, Lantana Strategy (in prep.);
- Queensland Weeds Strategy, Queensland Weed Spread Prevention Strategy;
- Northern Territory Weed Management Strategy;
- A Weed Plan for Western Australia, Western Australia Environmental Weed Strategy;
- Weed Strategy for South Australia;
- Tasmanian Weed Management Strategy;
- Australian Capital Territory Weeds Strategy; and
- State and Territory legislative noxious/prohibited weeds lists.

Other Initiatives

- The Nursery & Garden Industry Australia Invasive Plants Policy Position;
- The Nursery & Garden Industry Australia's 'Grow Me Instead' program;
- The Bushland Friendly Nursery Scheme, an initiative of the NSW North Coast Weeds Advisory Committee;
- Sustainable Gardening Australia;
- Weed Spotters, a weed detection and alert model developed by the CRC for Australian Weed Management, with networks operational in Queensland and Victoria;
- Weedbusters, a national awareness program;
- 'What does your garden grow?' Workshops, a CRC for Australian Weed Management training program;
- Traveller's guide to Australian interstate quarantine; and
- Various regional weed strategies.

CONCLUSION: The existing measures in place at national and state and territory level provide a framework for a broad range of actions for border protection and weed management and control. They also provide for coordination and leadership in the event of new incursions. Given these measures, the development of a national Threat Abatement Plan is not considered to be the most efficient and effective way to address this threatening process.

It is recommended that abatement actions for this key threatening process continue to be developed and implemented under the Australian Weeds Strategy 2007.

In the event that the Minister agrees with the Committee's advice and in accordance with the legislative requirement for the review of a no-Threat Abatement Plan decision, the Committee will examine the effectiveness of this approach in five years.

4. Recommendations

A. The Committee recommends that the list referred to in section 183 of the EPBC Act be amended by **including** in the list of **key threatening processes**: **"Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants."**

B. The Committee recommends that a Threat Abatement Plan is not considered a feasible, efficient or effective way to abate the process at this time.

C. The Committee recommends that abatement actions for this key threatening process continue to be developed and implemented under the Australian Weeds Strategy 2007.

Associate Professor Robert J.S. Beeton *AM FEIANZ*
Chair
Threatened Species Scientific Committee

References cited in the advice

Adair RJ and Groves RH (1998). National Weeds Program: Impact of Environmental Weeds on Biodiversity: A Review and Development of a Methodology. Environment Australia Biodiversity Group. Canberra.

Adam P (1992). Australian Rainforests, Oxford Monographs on Biogeography No. 6, Oxford Science Publications.

Australian Weeds Committee (AWC) (undated). Weed Identification – *Thunbergia grandiflora*. Viewed: 1 May 2009
Available on the Internet at:
http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tpl&ibra=all&card=V10

Barker J, Randall RP and Grice T (CRC for Australian Weed Management) (2006). Weeds of the future? Threats to Australia's grazing industries by garden plants. Meat & Livestock Australia Limited. North Sydney.
Available on the Internet at:
http://www.mla.com.au/NR/rdonlyres/075176BC-1E50-4D6D-BD9A-C3EE0091F132/0/WEEDSofSIGNIFNBP35720060720FinalReport.pdf

Beeton RJS (Bob), Buckley KI, Jones GJ, Morgan D, Reichelt RE and Trewin D (2006 Australian State of the Environment Committee) (2006). Australia State of the Environment 2006. Independent report to the Australian Government Minister for the Environment and Heritage. Department of the Environment and Heritage. Canberra.
Available on the Internet at:
http://www.environment.gov.au/soe/2006/publications/report/index.html

Benson DH (1992). The natural vegetation of the Penrith 1:100 000 map sheet. Cunninghamia 2(4): 541–596.

Biosecurity Queensland (2007). Fact Sheet – Invasive Plants and Animals: Dutchman's Pipe (*Aristolochia elegans*). Queensland Department of Primary Industries and Fisheries.
Available on the Internet at:
http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Dutchmans-Pipe-PP78.pdf

Blood K (2001). Environmental Weeds in the Goulburn Broken Catchment. In: Revegetation Guide for the Goulburn Broken Catchment (eds G Earl, F Stelling, M Titcumb and S Berwick). Department of Natural Resources and Environment. Victoria.
Available on the Internet at:
http://www.gbcma.vic.gov.au/revegetation/chapters/pdf/ch4.PDF

Blood K (2006). What is an invasive garden plant? In: Proceedings of Weeds in the Media 2006. CRC for Australian Weed Management. Adelaide.
Available on the Internet at:
http://www.weedscrc.org.au/documents/weeds_in_the_media_proceedings.pdf

Bradley L and Merrilyn L (1992). Rainforests by the Sea *in* Australian Natural History, Spring 1992.

Brooks ML, D'Antonio CM, Richardson DM, Grace JB, Keeley JE, Ditomaso JM, Hobbs RJ, Pellant M and Pyke D (2004). Effects of Invasive Alien Plants on Fire Regimes. BioScience. 54(7): 677-688.

Brunskill S (2002). Environmental Weeds. In: Native Vegetation Guide for the Riverina – Vegetation Management Review Articles (eds K Kent, G Earl, B Mullins, I Lunt and R Webster). Charles Sturt University.
Available on the Internet at:
http://www.csu.edu.au/herbarium/riverina/chapters/chapter11.pdf

Burgman MA and Lindenmayer DB (1998). Conservation Biology for the Australian Environment. Surrey Beatty & Sons Pty Limited. Chipping Norton.

Cadotte MW (2007). Concurrent niche and neutral processes in the competition-colonization model of species coexistence. Proceedings of the Royal Society of Biological Sciences. 274: 2739-2744.

Cahill DM, Rookes JE, Wilson BA, Gibson L and McDougall KL (2008). Turner Review No. 17. *Phytophthora cinnamomi* and Australia's biodiversity: impacts, predictions and progress towards control. Australian Journal of Botany. 56: 279-310.
Available on the Internet at:
http://www.publish.csiro.au/?act=view_file&file_id=BT07159.pdf

Coutts-Smith AJ and Downey PO (2006). Impact of weeds on threatened biodiversity in New South Wales. Technical Series no. 11. CRC for Australian Weed Management. Adelaide.
Available on the Internet at:
http://www.weedscrc.org.au/documents/tech_series_11.pdf

CRC for Australian Weed Management (CRC AWM) (2003). Salvinia (*Salvinia molesta*) Weed Management Guide. Department of the Environment and Heritage. Canberra.
Available on the Internet at:
http://www.weeds.gov.au/publications/guidelines/wons/pubs/s-molesta.pdf

Csurches S and Edwards R (1998). National Weeds Program: Potential Environmental Weeds in Australia: Candidate Species for Preventative Control. Environment Australia Biodiversity Group. Canberra.

Cuneo P, Jacobson C and Leishman MR (2009). Landscape-scale detection and mapping of invasive African Olive (Olea europaea L. subsp. cuspidata (Wall ex G. Don Ciferri) in SW Sydney, Australia using remote sensing, Australia. Applied Vegetation Science. 12: 145–154.

Cuneo P and Leishman MR (2006). African Olive (Olea europaea subsp. cuspidata) as an environmental weed in eastern Australia: a review. Cunninghamia 9(4): 545–577.

Department of Agriculture, Fisheries and Forestry and Department of Environment and Water Resources (DAFF and DEW) (undated). *Cabomba caroliniana*.
Viewed: 5 March 2009
Available on the Internet at:
http://www.weeds.gov.au/cgi-bin/weeddetails.pl?taxon_id=5171

Department of the Environment and Hertiage (DEH) (2005). EPBC Act Information Sheet - Nationally threatened species and ecological communities: Blue Gum High Forest of the Sydney Basin Bioregion.
Available on the Internet at:
http://www.environment.gov.au/biodiversity/threatened/publications/pubs/sydney-blue-gum.pdf

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a). Species Profile and Threats (SPRAT) Database: Blue Gum High Forest of the Sydney Basin Bioregion.
Available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=47

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). Species Profile and Threats (SPRAT) Database: Cumberland Plain Woodlands.
Available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=1&status=Endangered

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009c). Species Profile and Threats (SPRAT) Database: *Lasiopetalum pterocarpum* – Wing-fruited Lasiopetalum.
Available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82047

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009d). Species Profile and Threats (SPRAT) Database: *Pimelea spicata*.
Available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=20834

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009e). Species Profile and Threats (SPRAT) Database: *Pterostylis arenicola* - Sandhill Greenhood Orchid.
Available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=17919

Gardening Australia (2003). Fact Sheet: Richmond Birdwing Butterfly.
Viewed: 1 April 2009
Available on the Internet at:
http://www.abc.net.au/gardening/stories/s938771.htm

Glanznig A (2006). Weed proofing Australia: a way forward on invasive garden plants. In: Proceedings of Weeds in the Media 2006. CRC for Australian Weed Management. Adelaide.
Available on the Internet at:
http://www.weedscrc.org.au/documents/weeds_in_the_media_proceedings.pdf

Glanznig A, McLachlan K and Kessal O (2004). Garden Plants that are Invasive Plants of National Importance: an overview of their legal status, commercial availability and risk status. WWF-Australia. Sydney.
Available on the Internet at:
http://www.wwf.org.au/publications/IPNIGardenPlants.pdf

Gleadow RM and Ashton DH (1981). Invasion by Pittosporum undulatum of the Forests of Central Victoria. I Invasion Patterns and Plant Morphology. Australian Journal of Botany. 29: 705-720.
Available on the Internet at:
http://www.publish.csiro.au/?act=view_file&file_id=BT9810705.pdf

Griffin GF, Stafford Smith DM, Morton SR, Allan GE, Masters KA and Preece N (1989). Status and Implications of the Invasion of Tamarisk (*Tamarix aphylla*) on the Finke River, Northern Territory, Australia. Journal of Environmental Management. 29: 297-315.

Groves RH, Boden R and Lonsdale WM (2005). Jumping the Garden Fence: Invasive Garden Plants in Australia and their environmental and agricultural impacts. CSIRO report prepared for WWF-Australia. WWF-Australia. Sydney.
Available on the Internet at:
http://www.wwf.org.au/publications/jumping_the_garden_fence.pdf

Groves RH, Hosking JR, Batianoff GN, Cooke DA, Cowie ID, Johnson RW, Keighery GJ, Lepschi B, Mitchell AA, Moerkerk M, Randall RP, Rozefelds AC, Walsh NG and Waterhouse BM (2003). Weed Categories for Natural and Agricultural Ecosystem Management. Bureau of Rural Sciences. Canberra.
Available on the Internet at:
http://www.affashop.gov.au/PdfFiles/PC12781.pdf

Hedge P and Kriwoken LK (2000). Evidence for effects of *Spartina anglica* invasion on benthic macrofauna in Little Swanport estuary, Tasmania. Austral Ecology. 25: 150-159.

Hibbert M (2002). The Aussie Plant Finder 2002/2003. Florilegium. Glebe.

Hill SJ and French K (2003). Response of the soil seed-bank of Cumberland Plain Woodland to heating. Austral Ecology 28(1): 14–22.

Hilton M, Harvey N, Hart A, James K and Arbuckle C (2006). The Impact of Exotic Dune Grass Species on Foredune Development in Australia and New Zealand: a case study of *Ammophila arenaria* and *Thinopyrum junceiforme*. Australian Geographer. 37(3): 313-334.

Hobbs RJ and Huenneke LF (1992). Disturbance, diversity, and invasion: implications for conservation. Conservation Biology 6: 324–337.

Indigenous Landscape Design Australia (ILDA) (undated). Environmental Weeds.
Viewed: 30 April 2009
Available on the Internet at:
http://www.ilda.com.au/page/weeds.html

Leigh JH and Briggs JD (eds) (1992). Threatened Australian Plants: Overview and Case Studies. Australian National Parks and Wildlife Service. Canberra.

Lockwood JL, Cassey P and Blackburn T (2005). The role of propagule pressure in explaining species invasions. Trends in Ecology and Evolution. 20(5): 223-228.

Mansergh I, Kelly P and Johnson G (1991). Flora & Fauna Guarantee Action Statement: Mountain Pygmy-possum *Burramys parvus*. Victorian Department of Sustainability and Environment. Melbourne.
Available on the Internet at:
http://www.dse.vic.gov.au/CA256F310024B628/0/82941BC1F618645FCA2570440018F452/$File/002+Mountain+Pygmy-possum+1991.pdf

Matarczyk JA, Willis AJ, Vranjic JA and Ash JE (2002). Herbicides, weeds and endangered species: management of bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*) with glyphosate and impacts on the endangered shrub, *Pimelea spicata*. Biological Conservation. 108: 133-141.

Morris EC and Wood PD (2001). Soil seed bank of Cumberland Plain Woodland, poster at Ecological Society of Australia meeting, Wollongong, 26-28 September
Viewed: 9 May 2009
Available on the Internet at:
http://www.uow.edu.au/science/biol/esa/posters/morris_w.pdf

Mullett TL (2001). Effects of the native environmental weed *Pittosporum undulatum* Vent. (sweet pittosporum) on plant biodiversity. Plant Protection Quarterly. 16(3): 117-121.

Mulvaney M (2001). The Effect of Introduction Pressure on the Naturalization of Ornamental Woody Plants in South-Eastern Australia. In: Weed Risk Assessment (eds RH Groves, FD Panetta and JG Virtue). CSIRO Publishing. Collingwood.

NSW DECC (New South Wales Department of Environment and Climate Change) (2007). Threatened and Pest Animals of Greater Southern Sydney. Volume 2: Terrestrial vertebrate fauna of the Greater Southern Sydney Region. Fauna of conservation concern and priority pest species.

NSW Department of Environment and Conservation (NSW DEC) (2004). Draft NSW and National Recovery Plan for *Pimelea spicata*. NSW Department of Environment and Conservation. Hurtsville.
Viewed: 31 March 2009
Available on the Internet at:
http://www.environment.nsw.gov.au/resources/nature/RecoveryPlanDraftPimeleaSpicata.pdf

NSW Department of Environment and Conservation (NSW DEC) (2006). NSW Threat Abatement Plan – Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed). Department of Environment and Conservation (NSW), Hurstville.

NSW National Parks and Wildlife Service (NSW NPWS) (2004a). Dalrymple-Hay Nature Reserve Plan of Management.
Available on the Internet at:
http://www.environment.nsw.gov.au/resources/parks/PoMDalrymple-HayNR.pdf

NSW National Parks and Wildlife Service (NSW NPWS) (2004b). Endangered Ecological Community Information: Blue Gum High Forest.
Available on the Internet at:
http://www.environment.nsw.gov.au/resources/nature/EECinfoBlueGumHighForest.pdf

NSW National Parks and Wildlife Service (NSW NPWS) (2004c). Threatened Species Information: *Pimelea spicata*.
Available on the Internet at:
http://www.environment.nsw.gov.au/resources/nature/TSprofilePimeleaSpicata.pdf

NSW Scientific Committee (New South Wales Scientific Committee) (2006). Exotic vines and scramblers - key threatening process declaration - final determination, New South Wales National Parks and Wildlife Service
Viewed: 4 May 2009
Available on the Internet at:
http://www.environment.nsw.gov.au/determinations/ExoticVinesKtp.htm

NSW Scientific Committee (New South Wales Scientific Committee) (2008a). Blue Gum High Forest in the Sydney Basin Bioregion – critically endangered ecological community listing. Final Determination
Available on the Internet at:
http://www.environment.nsw.gov.au/determinations/BlueGumHighForestEndSpListing.htm

NSW Scientific Committee (New South Wales Scientific Committee) (2008b). Cumberland Plain Woodland in the Sydney Basin Bioregion – proposed critically endangered ecological community listing. Preliminary Determination.
Viewed: 4 May 2009
Available on the Internet at:
http://www.environment.nsw.gov.au/determinations/cumberlandplainpd.htm

NSW Scientific Committee and Simpson (New South Wales Scientific Committee and Simpson CC) (2008). Change in the distribution of Cumberland Plain Woodland.

Nursery & Garden Industry NSW & ACT (NGINA) (undated). Grow Me Instead! A guide for gardeners in the Greater Sydney District. NGINA. Rouse Hill.
Viewed: 30 April 2009
Available on the Internet at:
www.weeds.org.au/docs/GrowMeInstead.pdf

Pain S (2004). Felled by fungus. New Scientist. 182(2450): 40-43.

Parks Victoria (2001). Environmental Weeds in the Dandenong Ranges.
Viewed: 30 April 2009
Available on the Internet at:
http://www.parkweb.vic.gov.au/resources/mresources/publications/03_weeds_pests.pdf

Peel B (in prep.). Rainforest Restoration Manual for South-Eastern Australia, CSIRO.

Queensland Environmental Protection Agency (Qld EPA) (2008). Threats to Wildlife: Invasive plants and animals.
Viewed: 5 March 2009
Available on the Internet at:
http://www.epa.qld.gov.au/nature_conservation/wildlife/threats_to_wildlife/

Queensland Environmental Protection Agency (Qld EPA) (2009). Richmond birdwing butterfly.
Viewed: 20 April 2009
Available on the Internet at:
http://www.epa.qld.gov.au/nature_conservation/wildlife/threatened_plants_and_animals/vulnerable/richmond_birdwing_butterfly/

Queensland Primary Industries and Fisheries (QPIF) (2008). Environmental Weeds.
Viewed: 30 April 2009
Available on the Internet at:
http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/4790_7029_ENA_HTML.htm

Randall RP (2001). Garden Thugs, a national list of invasive and potential invasive garden plants. Plant Protection Quarterly. 16(4): 138-171.

Randall RP (2007). The introduced flora of Australia and its weed status. CRC for Australian Weed Management. Adelaide.
Available on the Internet at:
http://www.weedscrc.org.au/documents/intro_flora_australia.pdf

Randall RP and Kessal O (2004). National List of Invasive and Potentially Invasive Garden Plants. WWF-Australia. Sydney.
Available on the Internet at:
http://www.wwf.org.au/publications/ListInvasivePlants.pdf

Rejmanek M, Richardson DM, Higgins SI, Pitcairn MJ and Grotkopp E (2005). Ecology of Invasive Plants: State of the Art. In: Invasive Alien Species: a new synthesis (eds HA Mooney et al.). Island Press. Washington.

Sands D (2008). Conserving the Richmond Birdwing Butterfly over two decades: Where to next? Ecological Management and Restoration. 9(1): 4-16.
Available on the Internet at:
http://www3.interscience.wiley.com/cgi-bin/fulltext/119419236/PDFSTART

Sorensen B and Jusaitis M (1995). The Impact of Bridal Creeper on an Endangered Orchid. In: Weeds of Conservation Concern: Seminar and Workshop Papers (eds D Cooke and J Choate). South Australia Department of Environment and Natural Resources & Animal and Plant Control Commission. Adelaide.

South Australian Department for Environment and Heritage (SA DEH) (2005). Threatened Flora of the South Australian Murray Darling Basin: Sandhill Greenhood Orchid Pterostylis arenicola.
Available on the Internet at:
http://www.environment.sa.gov.au/biodiversity/pdfs/sandhill_greenhood_orchid.pdf

Stack G and English V (2003). Wing-fruited Lasiopetalum (*Lasiopetalum pterocarpum*) Interim Recovery Plan 2003-2008. Department of Conservation and Land Management. Perth.
Available on the Internet at:
http://www.environment.gov.au/biodiversity/threatened/publications/recovery/l-pterocarpum/pubs/l-pterocarpum.pdf

Sullivan JJ, Williams PA, Cameron EK and Timmins SM (2004). People and Time Explain the Distribution of Naturalized Plants in New Zealand. Invasive Weed Symposium. Weed Technology. 18: 1330-1333.

Threatened Species Network (TSN) (2005). Mountain Pygmy-possum (*Burramys parvus*) Threatened Species Day fact sheet. Department of the Environment and Heritage. Canberra.
Available on the Internet at:
http://www.environment.gov.au/biodiversity/threatened/publications/pubs/tsd05mountain-pygmy-possum.pdf

Threatened Species Scientific Committee (TSSC) (2005). Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): Blue Gum High Forest of the Sydney Basin Bioregion.
Available on the Internet at:
http://www.environment.gov.au/biodiversity/threatened/communities/sydney-blue-gum.html

Threatened Species Scientific Committee (TSSC) (2008). Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.
Available on the Internet at:
http://www.environment.gov.au/biodiversity/threatened/communities/pubs/76-listing-advice.pdf

Threatened Species Scientific Committee (TSSC) (2009). Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): Cumberland Plain Woodlands.

Tozer M (2003). The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. Cunninghamia 8(1): 1-75.

Vidler SJ (2004). Using your cute and furries: the role of threatened species in weed awareness. Proceedings of the 14th Australian Weeds Conference (eds B Sindel and S Johnson). pp. 652-658. Weed Society of New South Wales. Sydney.

Virtue JG, Bennett SJ and Randall RP (2004). Plant introductions in Australia: How can we resolve “weedy” conflicts of interest? In: Proceedings of 14th Australian Weeds Conference (eds B Sindel and S Johnson). pp. 42-48. Weed Society of New South Wales. Sydney.

Vranjic JA, Woods MJ and Barnard J (2000). Soil-mediated effects on germination and seedling growth of coastal wattle (*Acacia sophorae*) by the environmental weed, bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*). Austral ecology. 25: 445-453.

Watts J and Vidler S (2006). Factsheet – Under Pressure: Australian flora and fauna threatened by invasive plants. CRC for Australian Weed Management. Glen Osmond.
Available on the Internet at:
http://www.weedscrc.org.au/documents/fs44_threatened_species.pdf

Weeds of Blue Mountains Bushland (WBMB) (undated). Cootamundra Wattle – Bush Invader. Viewed: 27 April 2009
Available on the Internet at:
http://www.weedsbluemountains.org.au/cootamundra_wattle.asp

Weiss PW and Noble IR (1984). Interactions between seedlings of *Chrysanthemoides monilifera* and *Acacia longifolia*. Australian Journal of Ecology. 9: 107-115.

Western Australian Department of Conservation and Land Management (WA CALM) (2003). *Phytophthora cinnamomi* and disease caused by it. Volume I – Management Guidelines. Available on the Internet at:
http://www.dec.wa.gov.au/component/option,com_docman/Itemid,1/gid,3152/task,doc_download

Williams G (1993). Hidden Rainforests - Subtropical Rainforests and Their Invertebrate Biodiversity. NSW University Press.

Wilson EO (1992). The Diversity of Life. Penguin Books. London

Terminology used in the advice

Terms used throughout this advice are defined as follows.

Garden plants	Plants that are currently or were historically used in gardens in Australia, primarily for ornament or utility.
Introduction	The movement, by human agency, of a species outside its natural geographic distribution. This movement can be either within a country or between countries.
Native species	As defined under Section 528 of the EPBC Act.
Indigenous species	A species in its natural geographic range.
Non-native species	A species that is not indigenous to Australia or an external Territory.
Natural Geographic Distribution	The distribution in which a species can be reliably inferred to be present prior to the year 1400 AD.