

Abrus precatorius L.

FM: Leguminosae
LF: Evergreen climber
SN: *Abrus abrus* (L.) Wight, *Glycine abrus* L.
CU: Ornamental, medicines
CN: Rosary pea, precatory bean, coral bead plant

Invaded Habitats

Tropical hammocks, open forests, pine rockland, disturbed sites.

Description

A slender twining or trailing woody vine with herbaceous branches and stems to 9 m long or more. Leaves alternate, 5–13 cm long, pinnately compound, with 5–20 pairs of oval to oblong leaflets 7–27 mm long and 3–10 mm wide, ending in a short tip. Flowers white, yellowish, pink or purple, 10–15 mm long, borne in dense clusters in the axils of leaves. Fruits oblong pods, 2–5 cm long and 1–1.5 cm wide, splitting to release three to eight shiny oval seeds of 6–7 mm in length and 2–3 mm in diameter. Open fruits twisted and curled. Seeds two-coloured, bright scarlet with black bases (Langeland *et al.*, 2008; FOC, 2014; PIER, 2014).

Ecology and Impacts

This deep rooting plant has trailing and climbing shoots smothering native shrubs and small trees with a dense curtain of branches, impeding their growth and reproduction (Langeland *et al.*, 2008). Dense infestations displace native plant communities and reduce local biodiversity. The vine establishes well in disturbed sites, grows fast and spreads rapidly after fires. In Florida, rosary pea also invades undisturbed pinelands and hammocks, as well as pine rocklands. These habitats harbour a diverse hardwood and palm subcanopy and are of high conservation value. The vine is also a weed of pastures and non-cropland (Langeland *et al.*, 2008; PIER, 2014).

Seed production is prolific and seeds may be dispersed by birds although they are not fleshy. The seeds are extremely poisonous to livestock and humans due to the plant toxin abrin (Motooka *et al.*, 2003). Birds appear to be unaffected by this toxin.

Invasive plants in Australia belong to *Abrus precatorius* subsp. *africanus*, whereas *A. precatorius* subsp. *precatorius* is native to northern Australia (Weeds of Australia, 2014).

Control

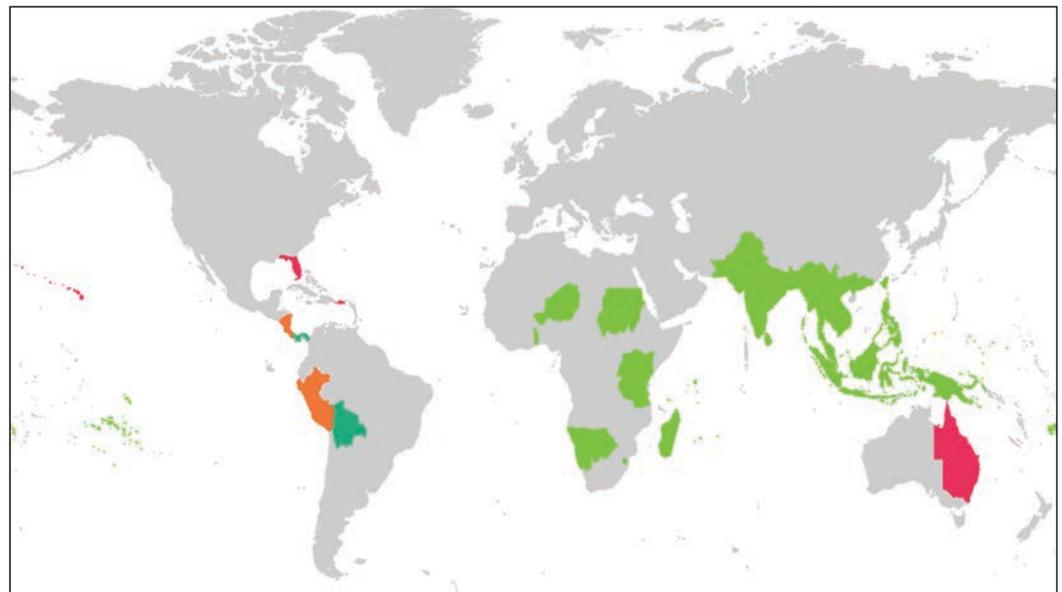
Further spread can be prevented by replacing rosary

pea plants in gardens by other ornamentals, e.g. *Clematis crispa* or *Gelsemium sempervirens*. Regular monitoring and removing young plants also prevents spread. Once established, the plant is difficult to control due to its deep roots. Hand-pulling and removal of entire plants, particularly the roots, is appropriate for small infestations. Repeated cutting weakens the plants, and larger infestations may be cut and stumps treated with herbicide. Cutting before fruit ripening prevents seed dispersal.

The best time for herbicide applications is autumn prior to seed set. Triclopyr is effective as a cut stump treatment. Triclopyr amine (3–5%) or glyphosate (1–3%) can be applied to the foliage. Good control is achieved by applying triclopyr ester at 10% in oil to basal bark or cut surfaces; or triclopyr amine at 50% in water applied to cut surfaces (Motooka *et al.*, 2003).



Abrus precatorius. With permission from Forest and Kim Starr



Acacia baileyana F. Muell.

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Racosperma baileyana* (F. Muell.) Pedley
 CU: Ornamental, erosion control, honey production
 CN: Bailey's acacia, Bailey's wattle

Invaded Habitats

Grasslands, riparian habitats, scrub, heath- and woodland.

Description

A small unarmed, erect or spreading tree or bush of 3–8 m in height, bark brown and smooth. Leaves greyish or silvery blue, bipinnately compound, 2–5 cm long, with two to six pairs of pinnae. Glands at the base of each pair of pinnae are common. Pinnae 1–2.5 cm long, consisting of 12–24 pairs of linear to oblong leaflets of 5–9 mm in length. Inflorescences 5–10 cm long, with 8–30 flowerheads, borne in leaf axils. Flowerheads globular, with 20–25 bright yellow flowers, on peduncles 4–7 mm long. Fruits greyish brown to black pods, straight to slightly curved, generally flat, 4–10 cm long and 8–12 mm wide. Each seed with a filiform aril at one end (Flora of Australia, 2014).

Ecology and Impacts

This tree has a very limited natural distribution in southern New South Wales, Australia (Weeds of Australia, 2014), where it grows in open woodland (mallee communities), stony hills and in shrub communities, mainly on clay or clay loams (Flora of Australia, 2014).

Where invasive, the tree forms dense thickets competing for space, water and nutrients, thereby replacing native vegetation (Invasive Species South Africa, 2012). The fast-growing pioneer tree is nitrogen-fixing due to symbiotic rhizobia in root nodules and thus increases soil fertility. Reproduction is by seed, seeds are dispersed by birds and ants. They are long-lived, accumulate in the soil and germinate readily after fire or other disturbances (Blood, 2001; Muyt, 2001; Weeds of Australia, 2014). The tree grows fast and sets seeds by 2 years of age (Morgan *et al.*, 2002). A study reported that 2-year-old trees produce more than 300,000 flowers, resulting in more than 8000 seeds (Morgan *et al.*, 2002).

In Australia, Bailey's acacia hybridizes with native wattles, thereby diluting natural populations of these species with hybrids (Weeds of Australia, 2014). Naturalized plants in Australia stem from ornamental plantings (Morgan *et al.*, 2002).

Control

The tree is a widely used ornamental and further spread could be avoided by replacing it with other species, e.g. *Acacia karroo*, *Acacia caffra*, *Peltophorum africanum*, *Virgilia oroboides* (Invasive Species South Africa, 2012).

Seedlings and small plants can be hand-pulled or sprayed with herbicides. Older trees are best ring-barked or cut down, herbicide application to cut stumps is usually not necessary as the trees do not resprout. Fire is used to kill trees and stimulate seed germination. Seedlings are then treated with herbicides (Invasive Species South Africa, 2012).



Acacia baileyana. From KENPEI, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia cyclops A. Cunn. ex G. Don

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Acacia cyclops* Don
 CU: Ornamental, erosion control
 CN: Coastal wattle, redeye

Invaded Habitats

Grasslands, riparian habitats, coastal scrub and dunes.

Description

A dense, spreading large shrub or small tree 1.5–6 m tall, without spines, bark brownish and fissured. Instead of true leaves it has bright green phyllodes. Phyllodes leathery, 4–9 cm long and 6–12 mm wide, with three to five longitudinal veins and a small gland at the base. Flowers yellow, borne in globular flowerheads of 4–6 mm diameter that are arranged in short racemes. Fruits reddish brown pods 4–10 cm long and 8–12 mm wide, curved and becoming twisted when ripe. Fruits persist after seeds are shed. Seeds completely surrounded by an orange to red aril (Flora of Australia, 2014).

Ecology and Impacts

In the native range, this shrub or small tree grows mainly in coastal heath or dry scrubland communities and rarely forms dense stands (Flora of Australia, 2014).

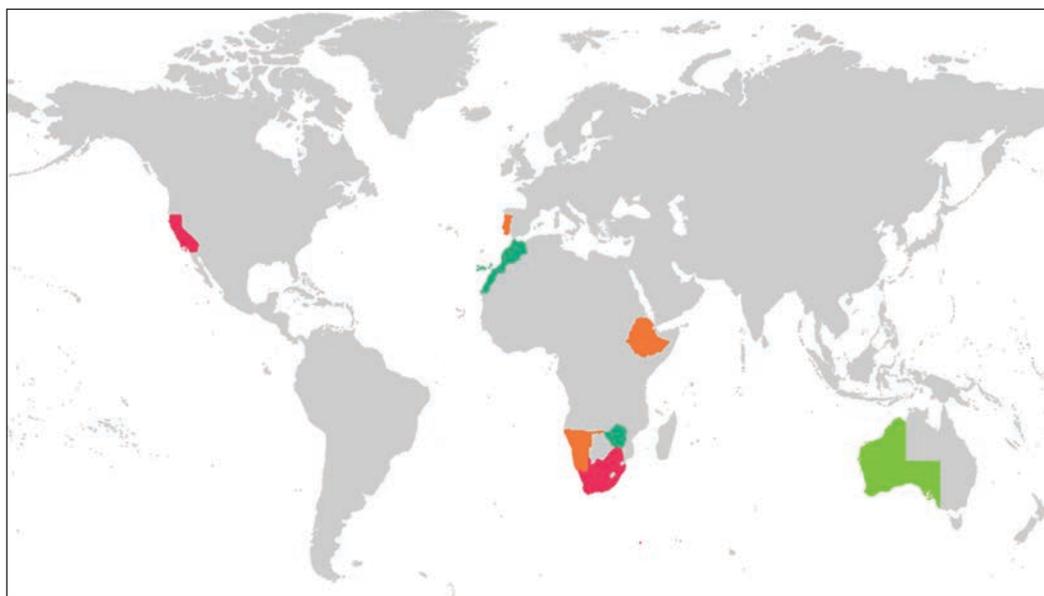
Where invasive, it forms dense and impenetrable thickets crowding out native vegetation and preventing establishment of native species. In South Africa, it forms a species-poor dune scrub, and invades fynbos and succulent karoo vegetation, both of which are extremely species-rich. Litter production is high, leading to increased soil nitrogen content (Witkowski, 1991). *Acacia cyclops* uses high volumes of water, and the loss of native plants to

thickets of coastal wattle is believed to leave the soil below canopies bare and vulnerable to wind and water erosion.

The tree reproduces by seeds, which are dispersed by birds, ants and small mammals (Glyphis *et al.*, 1981; Underhill and Hofmeyer, 2007). In Australia, seeds can remain viable in the soil for many years (Holmes, 1989). Germination is enhanced after fire; the seedlings are intolerant of shade. The tree rarely resprouts after fire damage or felling.

Control

Seedlings can be hand-pulled when the soil is moist. Smaller bushes are best ring-barked or cut below the surface. Larger plants can be cut close to the ground and stumps treated with herbicide. Clearing and burning stands of coastal wattle are used to deplete the soil seed bank. Any control measures require follow-up controls to remove newly emerging seedlings. In South Africa, the gall midge *Dasineura dielsi* (Diptera: Cecidomyiidae) and the seed-feeding weevil *Melanterius servulus* (Coleoptera: Curculionidae) have been released as biocontrol agents (Impson *et al.*, 2004; Adair, 2005; Kotze *et al.*, 2010; Post *et al.*, 2010). The latter destroyed up to 95% of seeds at release sites in the Cape Province (Impson *et al.*, 2004). *D. dielsi* reduces fruit set but appears not to severely limit vegetative growth of *A. cyclops* (Moseley *et al.*, 2009).



Acacia dealbata Link

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Acacia decurrens* var. *dealbata* (Link) F. Muell., *Racosperma dealbatum* (Link) Pedley
 CU: Ornamental, erosion control, honey production, shade/shelter, fuelwood
 CN: Silver wattle, mimosa

Invaded Habitats

Grasslands, riparian habitats, open forests, disturbed sites.

Description

Shrub or tree 2–10 m tall, occasionally >25 m, without spines. Bark greyish green to black, usually smooth. Branchlets slightly ribbed

and pubescent. Leaves bipinnately compound, 4–10 cm long, with 8–20 pairs of pinnae, each consisting of 20–40 pairs of leaflets. Leaflets linear-oblong, 2–5 mm long. A raised gland is present at each junction of pinnae pairs. Inflorescences large racemes or panicles. Flowers bright yellow, in globular flowerheads of 5–7 mm diameter, each having 25–35 flowers. Fruits greyish to brown pods, glabrous, usually flat, 5–9 cm long and 6–12 mm wide, slightly constricted between seeds. Seeds elliptical, flat (Flora of Australia, 2014; FOC, 2014).

Ecology and Impacts

In its native range, this plant grows as a tall tree in mountain forests, along watercourses and in dry sclerophyll forests, remaining shrubby under dry conditions (Flora of Australia, 2014). The tree is a significant component of fragmented vegetation remnants, and it has been suggested to augment its populations in Australia in order to increase landscape connectivity (Broadhurst and Young, 2006).

Where invasive, silver wattle forms dense thickets suppressing native vegetation, disrupting water flow and increasing soil erosion along stream banks (Fuentes-Ramirez *et al.*, 2011). It vigorously resprouts from stumps and is a prolific seed producer. The plant is nitrogen-fixing and increases soil fertility through its litter.

In Spain silver wattle invades disturbed *Quercus robur* forests, increasing total soil nitrogen, decreasing soil pH and modifying soil seed bank composition (Lorenzo *et al.*, 2010; Gonzalez-Munoz *et al.*, 2012). Species richness is reduced in invaded areas, the percentage of Compositae and exotic species is higher compared to uninvaded areas in Chile (Fuentes-Ramirez *et al.*, 2010). The species also exhibits allelopathic interferences on native species (Lorenzo *et al.*, 2011, 2012).

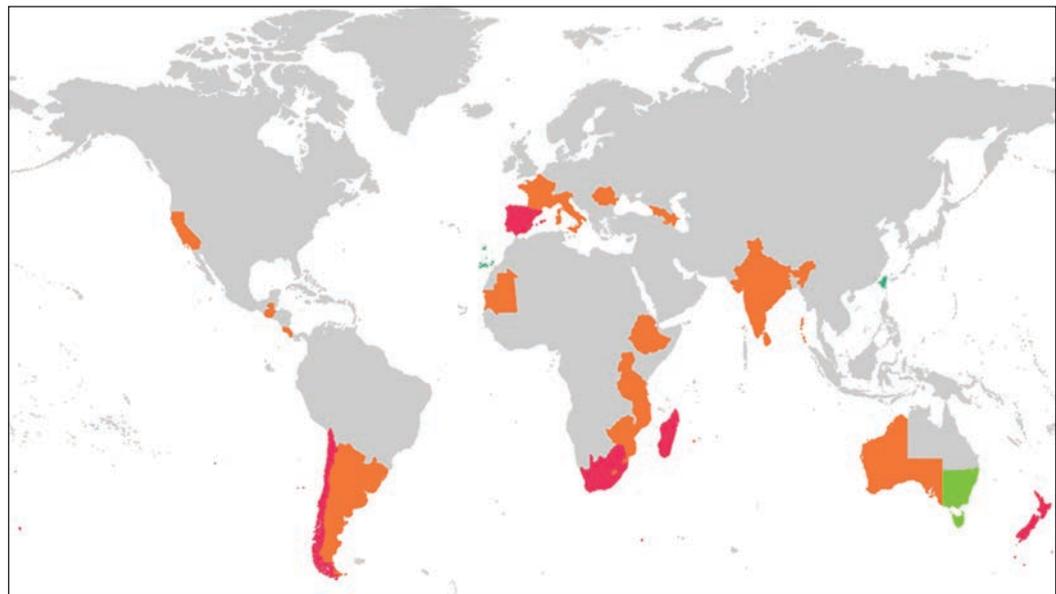
In native grasslands of South Africa, expansion of silver wattle strongly reduces assemblages of beetles (Coleoptera); it causes decline especially in larger and less abundant species (Coetzee *et al.*, 2007). In Madagascar, this wattle is considered to be invasive but also offers a renewable resource for peasant farmers (Tassin *et al.*, 2009a).

Control

Seedlings and small plants can be hand-pulled or dug out. Larger plants can be ring-barked. Chemical control includes basal stem treatments, stump treatments or foliar spray with herbicides. After clearing large infestations, a follow-up programme is necessary to remove emerging seedlings and to prevent coppice regrowth. Stumps need to be treated with herbicides in order to prevent re-sprouting, and it is recommended to keep stumps lower than 15 cm.



Acacia dealbata. From Strobilomyces, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia longifolia (Andrews) Willd.

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Racosperma longifolium* (Andr.) Martius, *Mimosa longifolia* Andrews
 CU: Ornamental, erosion control
 CN: Coastal wattle, longleaf wattle

Invaded Habitats

Riparian habitats, woodland, grasslands, coastal dunes and scrub.

Description

Shrub or small tree, 2–10 m tall, with a spreading crown, without spines. Bark smooth, grey. Instead of true leaves bright green, flat phyllodes. Phyllodes linear-lanceolate to obovate, 8–20 cm long, 1–2.5 cm wide, margins smooth, with two to five prominent longitudinal veins and a gland at the base. Flowers bright yellow to lemon yellow, in axillary, cylindrical inflorescences 2–5 cm long and *c.* 7 mm wide. Fruits pale brown pods, 5–15 cm long, 3–6 mm wide, more or less straight and cylindrical, constricted between seeds, with six to eight seeds. Seeds elliptical, shiny, 4–6 mm long, with thick aril (Flora of Australia, 2014).

Ecology and Impacts

In the native range, this nitrogen-fixing tree is common in coastal forests. Two subspecies are recognized: *A. longifolia* subsp. *sophorae* occurs mainly along the coastal strip and subsp. *longifolia* more towards the hinterland (Flora of Australia, 2014).

Where invasive, this wattle forms dense thickets that reduce native invertebrate and plant species richness; the latter may be reduced by 50% compared to uninvaded areas (Rascher *et al.*, 2011b). The high water consumption of longleaf wattle may lead to long-term changes in invaded communities by replacing drought tolerant native species (Rascher *et al.*, 2011a). The plant produces large amounts of litter, increasing nitrogen and phosphorus content of the soil. It accumulates large quantities of seeds in the soil that may remain dormant for many years. Annual seed rain under canopies may reach 12,000 seeds/m² (Marchante *et al.*, 2010). In South Africa, fires usually stimulate only a small proportion of seeds in the soil to germinate; seeds buried in deeper soil layers survive the fire and remain dormant.

In Portugal, *Acacia longifolia* alters natural dune communities and dune forests dominated by *Pinus pinaster*. Thickets of the shrub reduce species richness, favour other exotic plants, alter soil nutrient dynamics and also soil microbial communities (Marchante *et al.*, 2008). The tree has been proved to cope better with salinity stress in coastal dunes than gorse (*Ulex europaeus*), although growth is reduced (Morais *et al.*, 2012).

Control

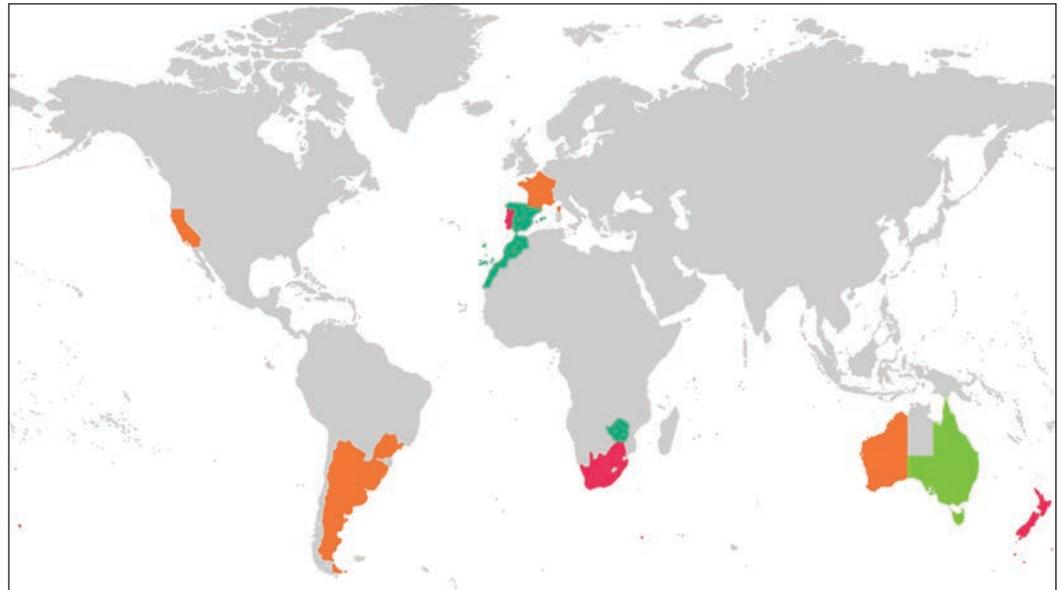
Since the tree does not sprout after cutting, control of large plants might be feasible. If only a moderate number of seedlings emerge after fires, these can be

removed by weeding or with herbicides. Seedling removal is best combined with re-establishment of native plants to reduce soil erosion problems. Follow-up programmes for several years after clearance are necessary to remove new seedlings. Clearing infestations is best combined with removal of the thick litter layers because they limit establishment of native species (Marchante *et al.*, 2011a).

In South Africa, the bud-galling wasp *Trichilogaster acaciaelongifoliae* (Hymenoptera: Pteromalidae) and the seed-feeding weevil *Melanterius ventralis* (Coleoptera: Curculionidae) have been released as biocontrol agents (Donnelly and Hoffmann, 2004; Marchante *et al.*, 2011b).



Acacia longifolia. From Fritz Geller-Grimm, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia mangium Willd.

FM: Leguminosae
 LF: Evergreen tree
 SN: *Racosperma mangium* (Willd.) Pedley
 CU: Fuelwood, soil improver, forage
 CN: Black wattle, hickory wattle, broadleaf salwood

Invaded Habitats

Tropical forests and forest edges, secondary forests, disturbed sites.

Description

Tree, 7–30 m tall, with branches spreading from near ground or with bole to 4.5 m high. Branchlets glabrous. Instead of true leaves the tree has dark green phyllodes 5–10 cm broad and two to four times as long as broad, with three to four main veins. Inflorescences loose spikes, 5–12 cm long, solitary or in pairs in the axils of leaves. Flowers white to cream-coloured, corolla 1.8–2 mm long. Fruits glabrous pods, linear, 7–8 cm long and 3–5 mm wide when green, becoming coiled and brackish brown when ripe, depressed between the seeds. Seeds black, ellipsoid, ovate or oblong, 3.5–5 mm long and *c.* 2.5 mm wide, funicle bright orange, forming a fleshy aril (Flora of Australia, 2014).

Ecology and Impacts

In the native range, *Acacia mangium* grows often in grasslands and on margins of lowland rainforests (ISSG, 2014).

This fast-growing and drought resistant tree develops an extensive root system, especially on low fertility soils. Stands of this tree increase turnover rate of nitrogen in the topsoil and thus increase nitrogen availability (Voigtlaender *et al.*, 2012), also by its nutrient-rich leaf litter (Pellens and Garay, 1999). These properties have led to extensive use of *Acacia mangium* for the rehabilitation of waste dumps and mining areas in the tropics. The tree grows well on burned sites, on degraded lateritic soils (L. Yang *et al.*, 2009). It also colonizes slopes invaded by *Eupatorium* sp. or *Imperata cylindrica*.

The tree produces large amounts of seeds, which are dispersed by birds. Seedlings and saplings can reach high abundances and outcompete native woody plants (Barthelat, pers. comm.). Pure stands of this tree alter the composition of soil macrofauna (Tsukamoto and Sabang, 2005). A comparison of *Acacia mangium* plantations with a nearby primary rainforest revealed that total abundance of soil macroinvertebrates was similar, but that in *Acacia mangium* an

earthworm species was the single dominant species (Tsukamoto and Sabang, 2005).

Control

No specific control methods have been developed for this tree. Large trees can be girdled, seedlings hand-pulled (PIER, 2014).



Acacia mangium. From Forest and Kim Starr, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia mearnsii De Wild.

- FM: Leguminosae
 LF: Evergreen tree
 SN: *Acacia decurrens* var. *mollis* Lindl., *Racosperma mearnsii* (De Wild.) Pedley
 CU: Ornamental, erosion control, honey production, shade/shelter, fuelwood
 CN: Black wattle, green wattle, tan wattle

Invaded Habitats

Riparian habitats, coastal scrub, grasslands, dry forests, woodland.

Description

Spreading shrub or erect tree 5–20 m tall, without spines, with densely pubescent branchlets. Bark smooth, blackish to dark grey. Leaves dark green and glossy above, bipinnately compound with 9–20 pairs of pinnae, each pinna having 20–60 pairs of leaflets 1.5–4 mm long. Numerous nectar glands present along the main axis of the leaves. Flowers pale yellow, in globose flowerheads of *c.* 5 mm in diameter, arranged in large irregularly formed leafy panicles. Fruits dark brown pods, 6–15 cm long and 5–9 mm wide, constricted between seeds. Seeds elliptical, flat, 4–7 mm long and 3–6 mm wide (Flora of Australia, 2014).

Ecology and Impacts

In the native range, the tree often forms the understorey vegetation of eucalypt forests. Other habitats include tussock grassland, gullies and hillsides, mostly in sandy or gravelly clay soils.

Where invasive, this drought tolerant wattle forms dense impenetrable thickets that displace native vegetation and reduce species richness (Crous *et al.*, 2012). The tree replaces seasonally dormant grasslands and fynbos (Dye and Jarman, 2004). Allelopathy is suspected to be part of the mechanism of preventing native species getting established, even after removal of *Acacia mearnsii* (Tassin *et al.*, 2009b). The tree is fast-growing, nitrogen-fixing and its high litter production leads to increased soil nitrogen levels. It is a prolific seed producer, and seeds are dispersed by small mammals, birds and water. The seed bank may contain up to 20,000 seeds/m². Fire stimulates germination and basal resprouting. The high water consumption of *Acacia mearnsii* contributes to its ability to expand at the expense of native plants.

Black wattle maintains a high proportion of green leaf area throughout the year and has high evaporation rates; it has the potential to reduce catchment water yields (Dye and Jarman, 2004).

In South African plantations, seedlings of black wattle are attacked by a high number of herbivorous insects, including whitegrubs (larvae of Coleoptera), cutworms (larvae of Lepidop-

tera), grasshoppers, termites and others (Govender, 2007). The pathogen *Ceratocystis albifundus* has been observed to infect black wattle in South Africa, causing wilt diseases (Heath *et al.*, 2010).

Control

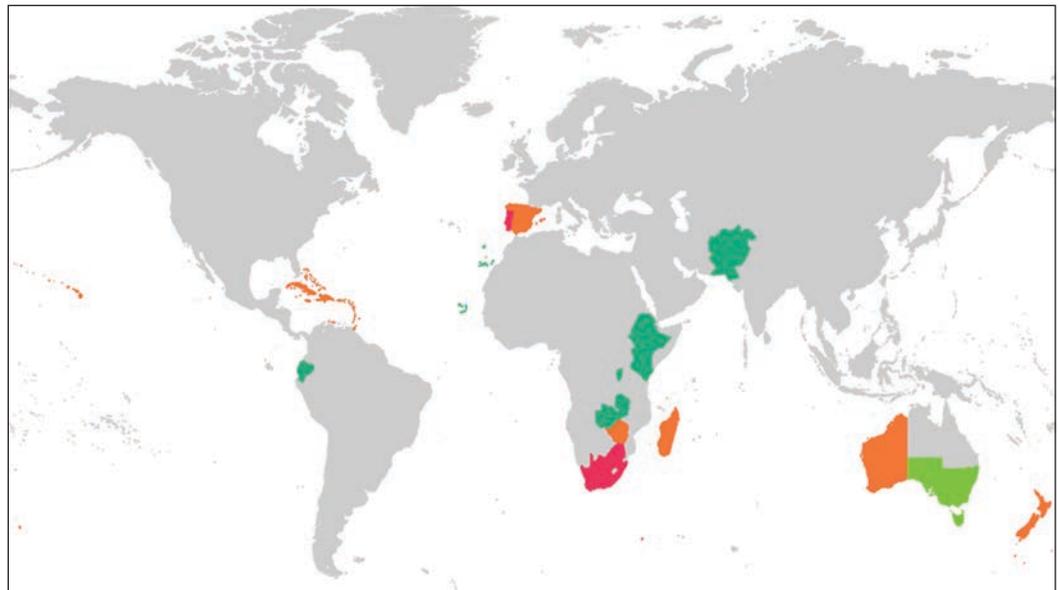
Mechanical control includes removal of roots or cutting the stems as low as possible (Campbell, 2000). Chemical control methods include spraying seedlings and saplings with glyphosate, and cutting larger trees followed by treating the stumps with herbicide. Older trees do not usually coppice from stumps.

In South Africa, the flower-galling midge *Dasineura rubiformis* (Diptera: Cecidomyiidae) has been released as a biocontrol agent (Impson *et al.*, 2008).

Alternatives for using black wattle as an ornamental are weeping wattle (*Peltophorum africanum*), hook thorn acacia (*Acacia caffra*), karee (*Rhus lancea*) or mountain karee (*Rhus leptodactyla*) (Invasive Species South Africa, 2014).



Acacia mearnsii. From B.navez, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia melanoxylon R. Br.

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Racosperma melanoxylon* (R. Br.) Mart.
 CU: Ornamental, erosion control, wood
 CN: Australian blackwood, black wattle, sally wattle, blackwood

Invaded Habitats

Forest edges and gaps, grasslands, heathland, woodland, riparian habitats.

Description

Tree 8–30 m tall, sometimes a shrub, with a pyramidal crown, without spines. Bark dark grey, furrowed. Instead of true leaves dark green phyllodes, straight or slightly curved, smooth, oblong lanceolate, 4–13 cm long and 7–25 mm wide, with a gland close to the base. True leaves often persist on young plants. Flowers pale yellow to creamy, borne in globular flowerheads of 8–10 mm diameter, arranged in branched racemes 6–40 mm long. Fruits reddish brown pods, 3–12 cm long and 5–10 mm wide, slightly constricted between seeds, becoming twisted. Seeds broadly elliptical, black, 3–5 mm long and 1.5–3 mm wide, surrounded by pink to deep red aril (Flora of Australia, 2014).

Ecology and Impacts

In the native range, the plant grows as a shrub or tree in wet sclerophyll forest and cooler rainforest; in Tasmania it grows as a tall dominant tree in forested seasonal swamps. It tolerates seasonal waterlogging and hypoxic conditions (Pryor *et al.*, 2006), drought, salt air, and grows both in sun and shade (ISSG, 2014). The tree is considerably variable, especially in phyllode size and shape.

Where invasive, the tree forms dense thickets, competing for water and light and replacing native vegetation. It replaces naturally treeless grass- and scrubland, and completely transforms these habitats by building up a tall shrub layer. These favour the establishment of other forest species (Geldenhuys, 2002).

Flowers and phyllodes contain allelopathic compounds reducing germination and growth of native species (Hussain *et al.*, 2011a, 2011b). The large amounts of litter produced increase the soil nitrogen content (Milton, 1981). The species vigorously regenerates from the soil seed bank after

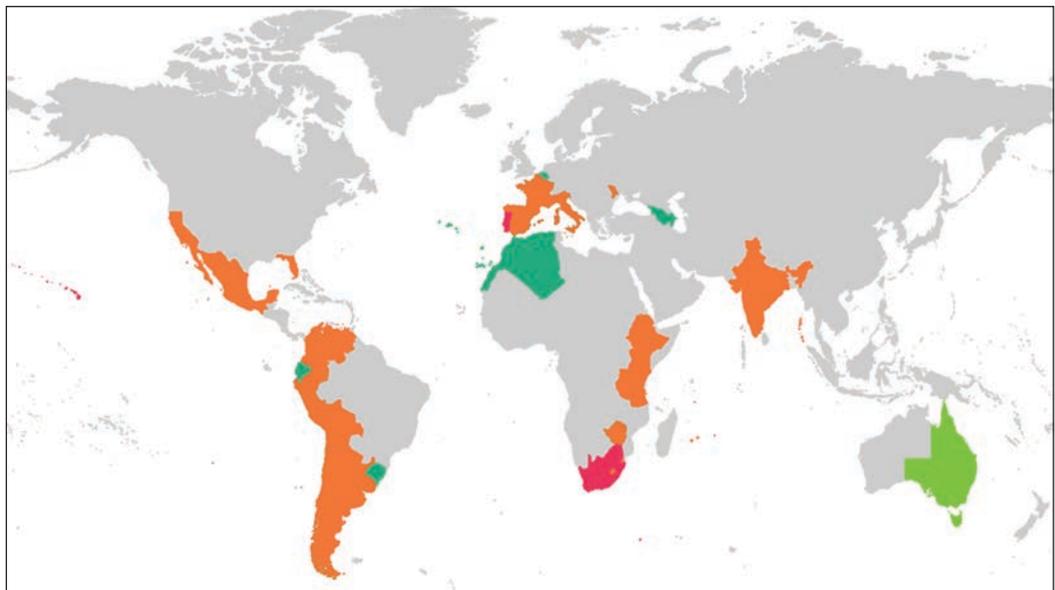
clearing or burning; fire stimulates germination of the seeds in the soil, and copious seedling recruitment contributes to its invasiveness. The tree coppices after damage and frequently suckers from roots.

Control

Seedlings and small plants can be hand-pulled or dug out; roots should be removed as completely as possible. Larger plants can be cut and stumps treated with herbicide to prevent regrowth. Trees should be removed before they flower and produce seed (ISSG, 2014).



Acacia melanoxylon. From Júlio Reis, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia pycnantha Benth.

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN:
 CU: Erosion control, ornamental
 CN: Australian golden wattle, broadleaf wattle

Invaded Habitats

Heath- and shrubland, forests, river banks, disturbed sites.

Description

Shrub or small tree, 3–8 m tall. Bark smooth or finely fissured, dark brown to greyish. Branchlets glabrous. Instead of true leaves phyllodes, 6–20 cm long and 5–30 mm wide, often hanging, with conspicuous midvein and one or two glands along the margins. Flowers golden yellow, in flowerheads with 30–70 flowers each. Flowerheads arranged on extended axillary inflorescences 2.5–9 cm long. Fruits brown pods, glabrous, more or less straight, flat, 5–14 cm long and 5–8 mm wide, slightly constricted between seeds. Seeds 5–6 mm long, narrowly elliptical, shiny black, with aril (Flora of Australia, 2014).

Ecology and Impacts

Within the native range, this plant grows in a wide range of habitats including *Eucalyptus* forests, woodland, open scrub and heathland on sandy or stony soils. The tree is fast-growing, rather short-lived and somewhat frost-sensitive (Flora of Australia, 2014).

Golden wattle invades South African coastal and mountain fynbos, where it forms extensive and dense stands crowding out native vegetation and preventing the regeneration of native shrubs and trees (Hoffmann *et al.*, 2002). It is nitrogen-fixing and thus increases soil fertility levels with its nitrogen-rich litter.

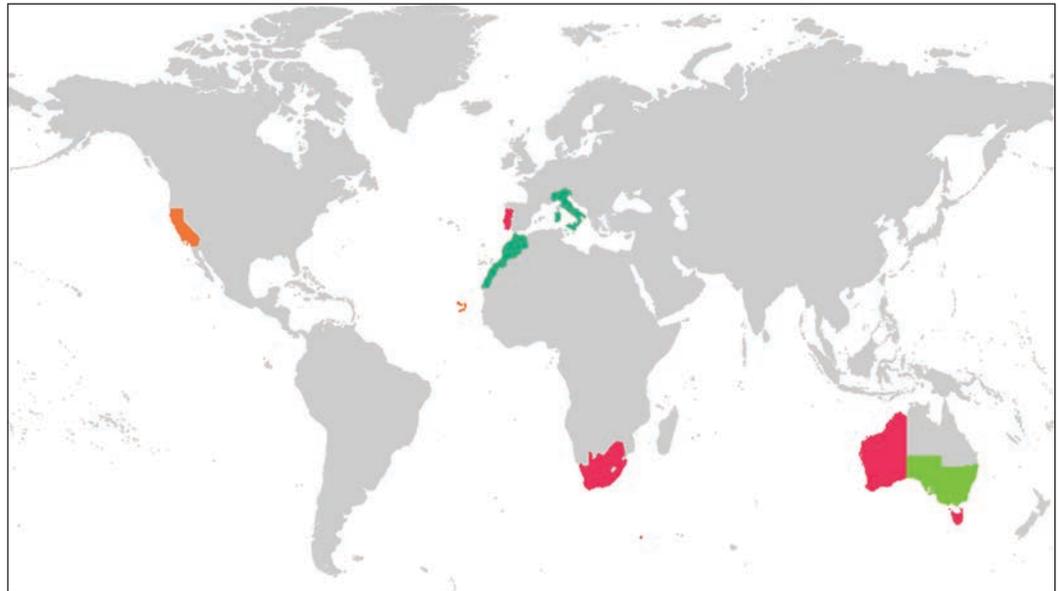
Control

No specific control methods have been established. Seedlings and small plants may be hand-pulled or dug out. Larger individuals are cut and the cut stumps treated with herbicide.

In South Africa, a gall wasp *Trichilogaster* sp. (Hymenoptera: Pteromalidae) has been released as a biocontrol agent (Hoffmann *et al.*, 2002). The mycoherbicide Stumpout® is being used for treating cut stumps (Lennox *et al.*, 2001).



Acacia pycnantha. From Melburnian, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)



Acacia saligna (Labill.) H.L. Wendl.

FM: Leguminosae
 LF: Evergreen shrub, tree
 SN: *Acacia cyanophylla* Lindl., *Racosperma salignum* (Labill.) Pedley

CU: Erosion control, revegetator, fuelwood
 CN: Blue-leafed wattle, golden wreath wattle, orange wattle, silver wattle, weeping wattle

Invaded Habitats

Grasslands, heathland, coastal beaches and scrub, woodland.

Description

Bushy shrub or small tree, 2–6 m tall, branchlets often hanging. Bark smooth, becoming fissured with age, grey. Instead of true leaves phyllodes, glabrous, flat, linear to lanceolate, dark green, 8–25 cm long and 3–30 mm wide, with conspicuous midrib. Flowerheads globular, stalked, 5–10 mm in diameter, each containing 25–65 bright yellow flowers. Flowerheads in irregularly shaped axillary racemes 2–5 cm long. Fruits linear pods, 8–12 cm long and 4–6 mm wide, slightly constricted between seeds, glabrous. Seeds shiny, dark brown to black, oblong, 5–6 mm long, with aril (Flora of Australia, 2014).



Acacia saligna. From Alvesgaspar, published under a creative commons license (<http://creativecommons.org/licenses/by/3.0/>)

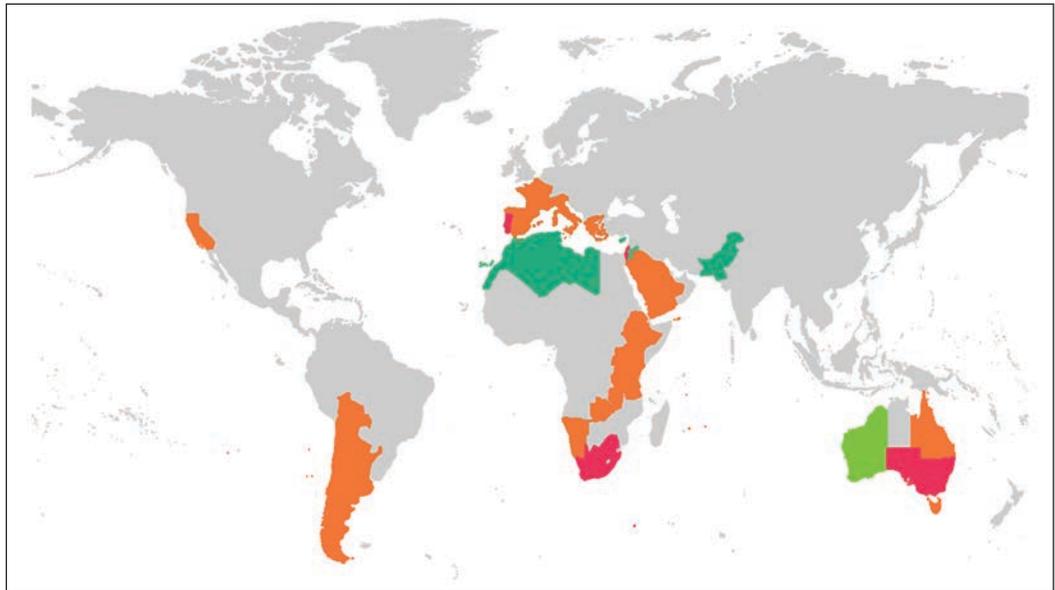
Ecology and Impacts

In the native range, this freely suckering tree grows often along watercourses and in coastal dune systems, where it forms dense thickets between sand hills. The species tolerates poor sandy soils but grows also at the base of granite boulders in the wheatbelt.

Where invasive, the species spreads rapidly and forms large and impenetrable thickets completely replacing native vegetation and threatening endangered plant species (Bar *et al.*, 2004; Odat *et al.*, 2011). In South Africa, the tree is considered to be one of the most damaging invaders of coastal lowlands (Strydom *et al.*, 2012).

The copious litter production and the ability to fix nitrogen increase soil nitrogen content, and the tree's high water consumption promotes dry conditions (Yelenik *et al.*, 2004; Jovanovic *et al.*, 2009). An increase in soil fertility as a result of invasion by *A. saligna* favours other nitrophilous weedy species, such as *Ehrharta calycina*, even after clearing this tree (Yelenik, 2004).

Seeds are dispersed by birds and water, are long-lived and germinate rapidly after fire. The shrub accumulates a large seed bank and easily resprouts if cut or burnt. The largest portion of the seed bank is situated in the upper 10 cm of the soil (Strydom *et al.*, 2012). Disturbances or fire may trigger germination and lead to mass regeneration of saplings (Wood, 2012).



Control

In gardens, the species can be replaced by less harmful species (i.e. *Buddleja saligna*, *Peltophorum africanum*). Control methods include cutting trees and treating the stumps with herbicides to prevent regrowth. Prescribed fires after clearing are used to stimulate seed germination; seedlings are then hand-pulled, chemically treated or killed by repeated burning. Soil solarization treatments caused an almost complete eradication of buried seeds of *Acacia saligna* in a study (Cohen *et al.*, 2008).

In South Africa, the gall rust fungus *Uromycladium tepperianum* has been highly successful as a biocontrol agent (Wood, 2007, 2012; Strydom *et al.*, 2012).

To restore native fynbos vegetation, Yelenik *et al.* (2004) suggest the use of controlled burns, the addition of mulch and the addition of fynbos seed after clearing to lower the levels of available nitrogen in the soil and initiate the return of native species.

Acer negundo L.

FM: Aceraceae
 LF: Deciduous tree
 SN: *Acer californicum* D. Dietr., *Acer interius* Britton, *Negundo californicum* Torr. & A. Gray
 CU: Ornamental, revegetator, shade/shelter, wood
 CN: Ash-leaf maple, box elder, three-leaf maple

Invaded Habitats

Riparian habitats, forests, woodland, wasteland.

Description

Tree 3–20 m height, trunk usually dividing near the ground into several limbs, with a broad irregular crown. Bark light grey to grey-brown, smooth at first becoming fissured with age. Leaves bright green, 20–30 cm long, pinnately compound with three to five ovate to elliptical leaflets, each 5–10 cm long and 5–8 cm wide. Margins coarsely toothed. Trees either with male or female flowers. Female flowers without petals, in pendulous inflorescences. Male flowers with long, purplish stamens, mostly in clusters of four flowers. Flowers appear prior to leaf growth. Fruits composed of two fused brownish yellow samaras, wing including nutlet 3–3.5 cm long and 8–10 mm wide, wings acute-angled to obtuse-angled (Overton, 1990; FOC, 2014).

Ecology and Impacts

Box elder is a fast-growing pioneer tree with a short life-span of *c.* 75 years. Growth is rapid when young, shoots may extend 60 cm or more in a year. In the native range, the tree is primarily found in riparian forests and floodplains (De Wine and Cooper, 2007). At least seven varieties have been recognized. It grows well in full sun and in shade (Saccone *et al.*, 2010a), tolerates short periods of flooding, and frost. Mature trees are to some extent drought tolerant. The tree easily resprouts after damage and forms root suckers. It produces large amounts of seeds (>20,000 per female tree), which are dispersed mainly by wind, occasionally by birds and squirrels (Overton, 1990).

Box elder invades softwood riparian forests and quickly builds up dense growth, displacing native shrubs and trees and preventing their regeneration. The tree establishes well in gaps of disturbed forests. Invaded areas are species-poor, mostly free of herbs and may expand at the expense of other trees (Saccone *et al.*, 2010b). Since seedlings tolerate shade, they establish well under canopies of *Acer negundo* (Saccone *et al.*, 2010b). The tree has been observed to increasingly colonize drier habitats such as industrial wasteland and other ruderal sites in Europe (Medrzycki and Pabjanek, 2001; Erfmeier *et al.*, 2011).

Sediment deposition in an *A. negundo* stand was greater than in native vegetation after a major flood event (Saccone *et al.*, 2010a).

Control

Little effort has been undertaken so far to control this tree and no specific control methods are available. Cutting trees at ground level and treating stumps with herbicides as in other tree species may prove effective. Seedlings and saplings can be hand-pulled or dug out. 2,4-D is a very effective herbicide to control this tree. Planting male trees in gardens and amenity areas would prevent seed production and reduce further spread.



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