Department of **Agriculture and Fisheries**
Biosecurity Queensland

Firethorn

Pyracantha species

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Contents

Summary

Pyracantha comprises about 10 species of thorny shrubs native to south China, Asia Minor and Europe. Originally introduced and planted as garden ornamentals, seven species have naturalised in Australia: *Pyracantha angustifolia*, *P. coccinea*, *P. crenulata*, *P. crenatoserrata*, *P. fortuneana*, *P. rogersiana* and *P. koidzumii*. Additional species are likely to naturalise if they are introduced and planted. In Queensland, four species have naturalised: *P. angustifolia*, *P. crenulata*, *P. koidzumii* and *P. rogersiana*. The most widespread and problematic species in Queensland and south-east Australia is *P. angustifolia*, which is locally abundant in parts of New South Wales, the Australian Capital Territory (ACT) and Victoria. In Queensland, *P. angustifolia* currently exists as relatively small populations and isolated garden specimens scattered across the Warwick–Stanthorpe region. Full delimitation has not been undertaken.

When growing in favourable habitat, especially riparian areas running through dry sclerophyll forest and woodland, *Pyracantha* can form dense thickets that compete with native vegetation and impede the movement of animals and people. Dispersal is via bird-dispersed berries. Several species have histories as weeds in the United States, Argentina, New Zealand and South Africa. *P. angustifolia* and *P. fortuneana* are declared weeds in the ACT.

Pyracantha species appear climatically suited to warm temperate upland areas of South East Queensland (mainly in the Warwick, Stanthorpe and Toowoomba region). Within this climate type, they have the potential to become abundant weeds in disturbed areas, open grasslands and pastures and open woodlands (mainly riparian habitats). Remaining areas of the state are predicted to be too hot.

This assessment concludes that, based on available evidence, it seems reasonable to treat all species of *Pyracantha* as potentially high-risk weeds, but only within upland areas of subcoastal South East Queensland.

Introduction

Identity and taxonomy

The *Pyracantha* genus is in the Rosaceae family. There appears to be about 10 species in the genus. However, the exact number of species is unclear as there are many synonyms used inconsistently in the literature (Table 1). To make the taxonomy more confusing, multiple ornamental cultivars have been developed for some species, making field identification difficult.

Table 1. Species, synonyms, varieties and common names of *Pyracantha* species (USDA 2010; eFloras.org 2003).

Species	Synonyms	Varieties	Common names
P. angustifolia	*Cotoneaster angustifolius*	NA	Orange firethorn (Australia) Yellow firethorn (England) Geelbranddoring (Africa) Zhai ye huo ji (China)
P. atalantioides	*Sportella atalantioides, Crataegus pyracantha, Mespilus loureiroi, Pyracantha discolour, P. gibbsii, P. loureiroi*	NA	
P. coccinea	*Cotoneaster pyracantha* *Crataegus pyracantha* *Mespilus pyracantha* *P. coccinea* var. *lalandei*	NA	Scarlet firethorn Firethorn (England) Pyracanth (England) Espinheiro-ardente (Portugal) Sarça-ardente (Portugal) Sarça-de-moisés (Portugal) Espino de fuego (Spain)
P. crenatoserrata	*P. fortuneana* *Photinia crenatoserrata* *P. crenulata* var. *yunnanensis* *P. gibbsii* var. *yunnanensis* *P. yunnanensis*	NA	Huo ji (China)

Species	Synonyms	Varieties	Common names
P. crenulata	*Mespilus crenulata* *Cotoneaster crenulatus* *Crataegus crenulata* *Crataegus pyracantha* var. *crenulata* *P. chinensis*	*P. crenulata* var. *crenulata* *P. crenulata* var. *kansuensis* *P. crenulata* var. *rogersiana*	Himalayan firethorn (England) Nepal firethorn (Australia, England) Nepalese firethorn (England) Rooivuurdoring (Africa) Xi ye xi yuan chi huo ji (China) Xi yuan chi huo ji (China) Xi yuan chi huo ji (China)
P. densiflora			
P. fortuneana	Possible syn. *P. crenatoserrata*		Broadleaf firethorn (Australia)
P. inermis			
P. koidzumii	*Cotoneaster formosanus* *Cotoneaster koidzumii* *Cotoneaster taitoensis* *P. formosana* *P. koidzumii* var. *taitoensis*	NA	Tan wan huo ji (China) Formosa pyracantha (England) Santa Cruz pyracantha (England) Red berry firethorn (England) Formosa firethorn (England)
P. mekongensis			
P. rogersiana		NA	Asian firethorn (Australia)

Description

The following descriptions were adapted mostly from eFloras.org (2003).

P. angustifolia (orange firethorn)

A dense shrub up to 4 m tall, often with thorny branches (Figure 1). Leaf blade narrowly oblong to oblanceolate-oblong, 15–50 mm long and 4–8 mm wide. White flowers, each 8 mm in diameter, produced in rather dense corymbs of 2–4 cm diameter. Produces masses of orange/red berries (Figure 2), 5–8 mm in diameter, containing five seeds per berry (Weber 2003); sepals persistent and erect (eFloras.org 2003). Various cultivars have been developed for sale as garden ornamentals, including the cultivar 'Orange Charmer' which has masses of decorative orange berries.

Figure 1. *P. angustifolia* growing at the base of a eucalypt tree (Photo by Craig Hunter, Biosecurity Queensland)

Figure 2. Berries of *P. angustifolia* (Photo by Craig Hunter, Biosecurity Queensland)

P. atalantioides

Shrubs or small trees to 6 m tall. Thorny branches. Leaf blade elliptic or oblong, rarely oblong-obovate, 1.5–4 long and 1–1.6 cm wide, margin usually entire. Compound corymb; many flowered. Flowers 8–10 mm in diameter. Berries bright red, 4–5 mm diameter.

P. coccinea (scarlet firethorn)

An upright, open, thorny shrub up to 5 m tall. Twigs slender, initially pubescent, later glaborous, red-brown. Leaves alternate, simple, oblong to lanceolate, serrated margin, 25–50 mm long, evergreen, shiny, dark green above, paler and pubescent below. Flowers creamy white, arranged in tight clusters appearing in late spring to early summer. Berries bright orange-red, arranged in tight clusters; ripen in late summer and persist through winter (VirginiaTech 2010).

P. crenatoserrata (syn. *P. fortuneana*)

Shrub 1–3 m tall (often to 1 m). Leaf blade obovate or obovate-oblong, 1.5–6 cm long and 0.5–2 cm wide, both surfaces glabrous, base cuneate, margin serrate with teeth incurved, apex obtuse or emarginate, sometimes shortly apiculate. Compound corymb rather loose, 34 mm in diameter. Flowers about 10 mm in diameter. Berry orange-red or dark red, subglobose, 5 mm diameter; fruiting pedicel 2.5 mm; sepals persistent and erect (eFloras.org 2003).

P. crenulata (Nepal firethorn)

Thorny shrub 2–5 m tall. Leaf blade oblong or oblanceolate, rarely ovate-lanceolate, 2–7 cm long and 0.8–1.8 cm wide, both surfaces glabrous, base broadly cuneate or slightly rounded, margin crenulate or sparsely so, apex acute or obtuse. Compound corymb 3.5 cm in diameter, comprised of many creamy white flowers. Berry orange-yellow or orange-red when mature, nearly globose, 3–8 mm in diameter; sepals persistent and erect (eFloras.org 2003).

P. densiflora

Thorny shrub. Thorns 1–2 cm long. Leaves dense, fasciculate on short branchlets; petiole short, not more than 2 mm, subglabrous; leaf blade obovate to obovate-elliptic, 1–1.8 cm × 6–9 mm, abaxially brown tomentose, glabrescent, adaxially lustrous, base cuneate, margin crenulate, apex obtuse or truncate. Inflorescences 1.5–2.5 cm; six- to ten-flowered. Flowers 0.8–1.2 cm in diameter. Fruit not seen.

P. koidzumii (Formosa firethorn)

Shrub to 5 m tall. Branchlets dark grey, often thornlike, initially pubescent, glabrous when old. Leaves usually three- to five-fascicled; petioles about 3 mm. Leaf blade narrowly elliptic to narrowly obovate, 3–4.5 cm long and 0.7–1.2 cm wide. Corymb 3–4 cm in diameter, white flowers. Flowers 8–10 mm in diameter (Figure 3). Berry orange-red, 4–5 mm (Figure 4) (eFloras.org 2003).

Figure 3. Flowers of *P. koidzumii* (Image by Forest Starr and Kim Starr, reproduced with permission under a Creative Commons Attribution 3.0 Licence)

Figure 4. Berries of *P. koidzumii* (Image by Forest Starr and Kim Starr, reproduced with permission under a Creative Commons Attribution 3.0 Licence)

P. inermis

Shrub to 1 m tall, usually unarmed with dense, short branches. Leaves fasciculate on short branches; petioles 4–9 mm, glabrous; leaf blade oblong to oblong-obovate, 3–4.5 × 1–1.3 cm. Corymb dense, terminal on short shoots, 2–3 cm in diameter, many flowered. Flowers 8–10 mm in diameter. Berry purplish brown, about 5 mm in diameter.

P. rogersiana (Asian firethorn)

Spiny shrub to 3 m high, young twigs white-pubescent when young but soon glabrous. Leaves oblanceolate, 2–4 cm long, 5–10 mm wide, thin textured, base narrow-cuneate tapering gradually into slender petiole; margins toothed, obscurely to rather coarsely or occasionally doubly toothed, the teeth prominent only close to apex; both surfaces glabrous. Berry 3–4 mm in diameter, yellow to orange-red (PlantNET, n.d.).

Reproduction and dispersal

Flowers generally appear in spring and summer and fruits develop from late summer, maturing in late autumn (Villalobos et al. 2010). Berries are produced in large numbers with up to 1000 seeds/m^2 of soil surface recorded (PIER 2007).

Pyracantha species generally reproduce from seeds (PIER 2007). Seeds are dispersed by animals (birds), water, gravity, soil movement and dumped vegetation (Auckland Regional Council 2008; Debussche and Isenmann 1994; Bass 1996). Birds are probably the most important dispersal vector. In New South Wales, pied currawongs are a major dispersal vector and actually prefer the fruit to those of other plant species. Bird dispersal assists escape of cultivated specimens from gardens to bushland (Bass 1996). Foxes have been suggested as a dispersal vector (Muyt 2001). In Southern California, the coyote (*Canis latrans*) disperses seeds of *Pyracantha* species (Silverstein 2005). In New Zealand, introduced black rats (*Rattus rattus*) and brushtail possums (*Trichosurus vulpecular*) have been recorded excreting whole seeds of *P. angustifolia* (Williams et al. 2000).

Origin and distribution

***P. angustifolia*:** Chinese provinces of Guizhou, Hubei, Sichuan, Xizang, Yunnan and Zhejiang (eFloras.org 2003).

***P. atalantioides*:** Southern China.

***P. coccinea*:** Parts of temperate Asia and Europe (Iran, Lebanon, Turkey, Armenia, Azerbaijan, Georgia, Ukraine, Albania, Bulgaria, Former Yugoslavia, Greece, France and Spain) (USDA 2010).

***P. crenatoserrata*:** Chinese provinces of Fujian, Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, Xizang, Yunnan and Zhejiang (eFloras.org 2003).

***P. crenulata*:** Native to temperate Himalaya (Weber 2003). Native range includes Chinese provinces of Gansu, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Xizang and Yunnan. Also native to Bhutan, India, Kashmir, Myanmar and Nepal (eFloras.org 2003).

***P. koidzumii*:** Taiwan (eFloras.org 2003).

***P. inermis*:** China.

***P. rogersiana*:** China.

Status in Australia

Seven species have naturalised in Australia: *P. angustifolia, P. coccinea, P. crenulata, P. crenatoserrata, P. fortuneana, P. rogersiana* and *P. koidzumii* (Figures 5–11). Of these, *P. angustifolia* is perhaps the most widespread and abundant, being naturalised in New South Wales, Queensland, ACT, Victoria, South Australia and Tasmania (AVH 2010) (Figure 5).

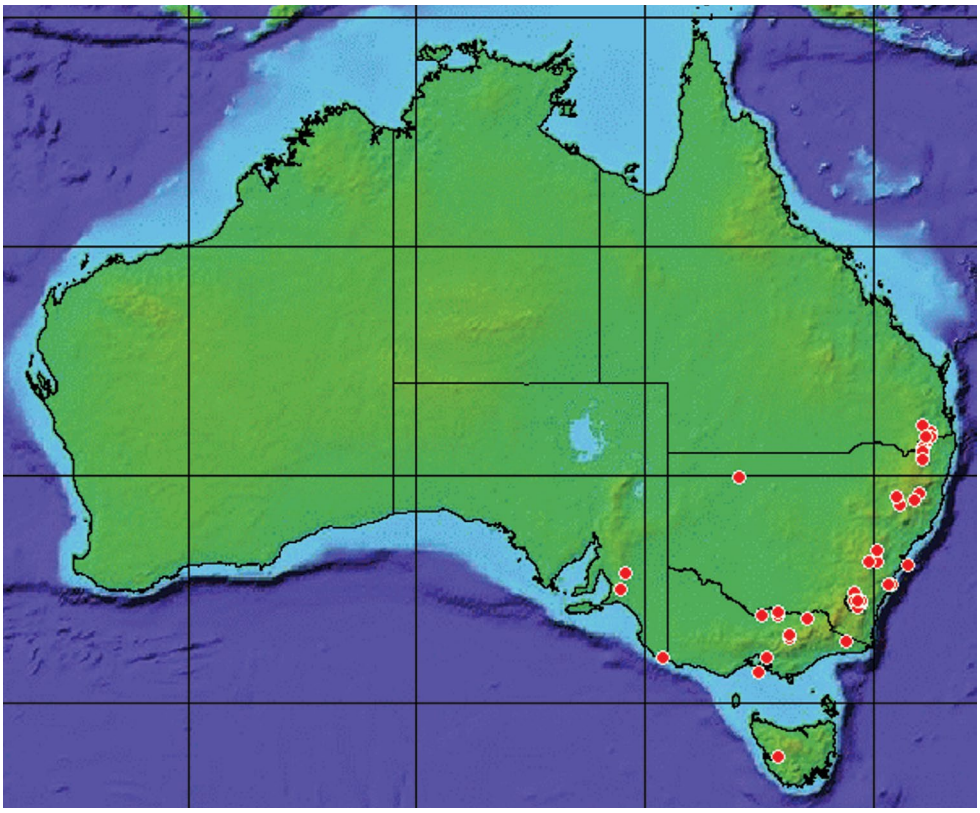

Figure 5. Distribution of *P. angustifolia* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

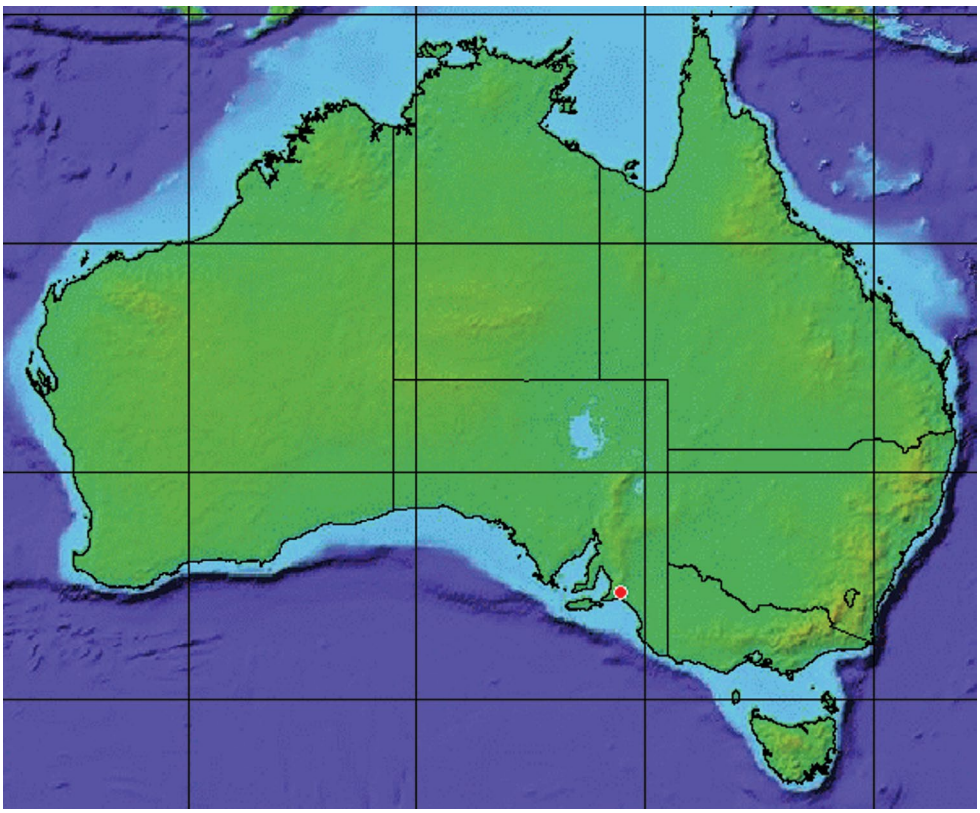

Figure 6. Distribution of *P. coccinea* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

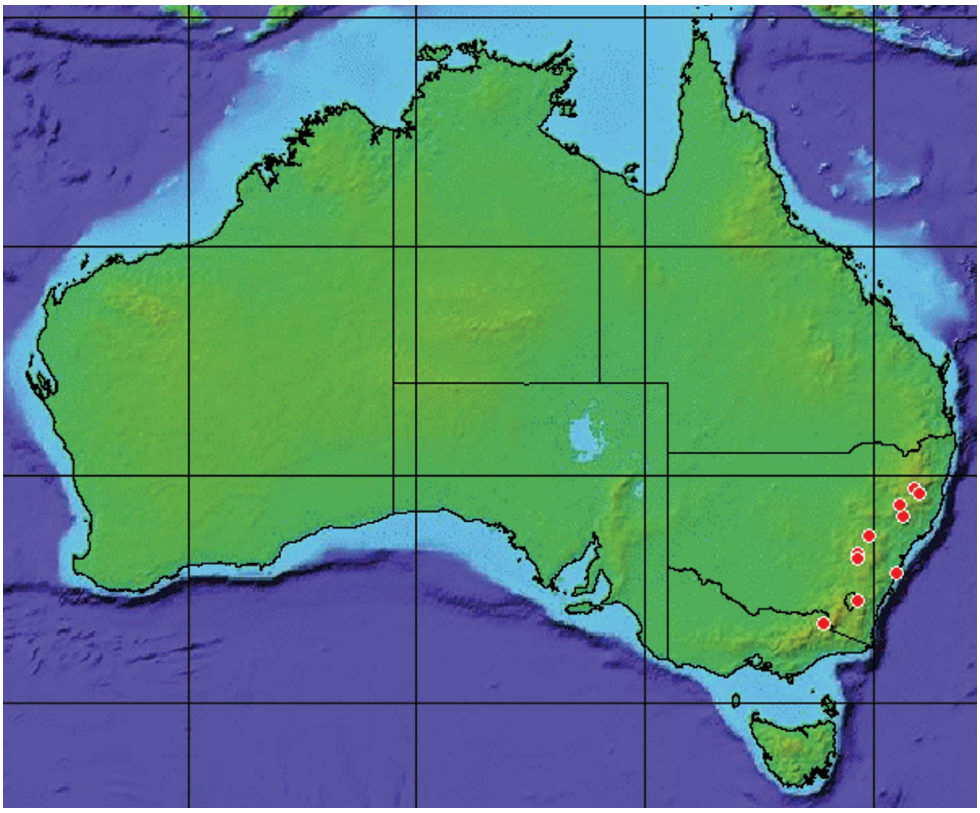

Figure 7. Distribution of *P. crenatoserrata* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

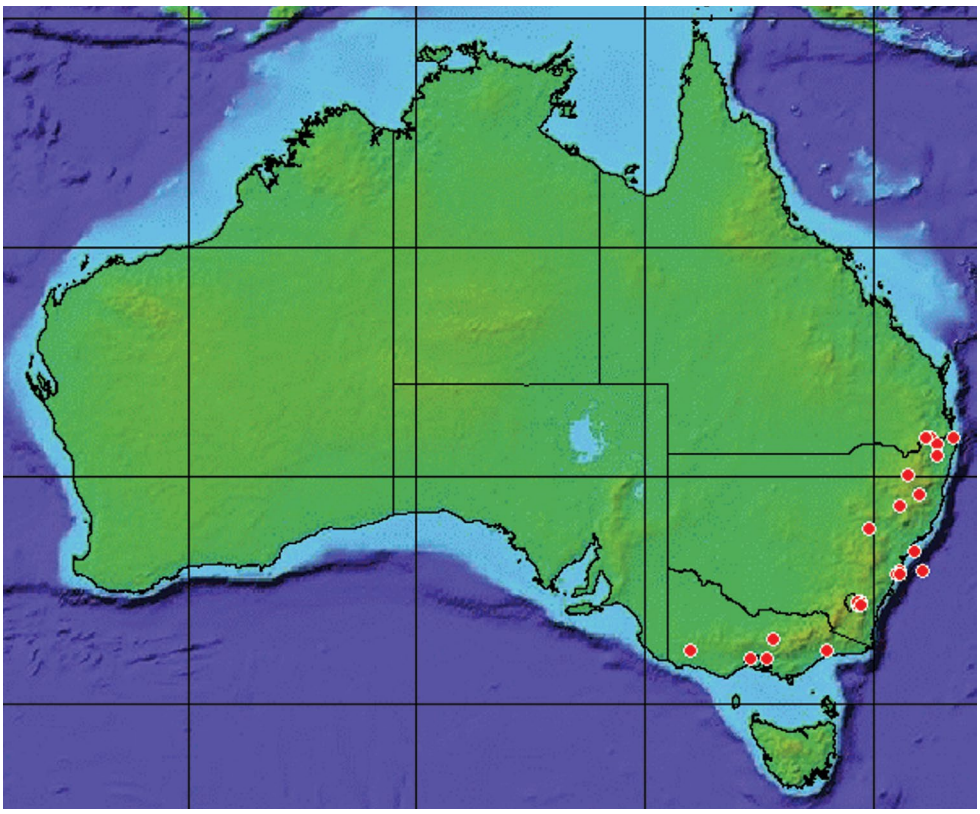

Figure 8. Distribution of *P. crenulata* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

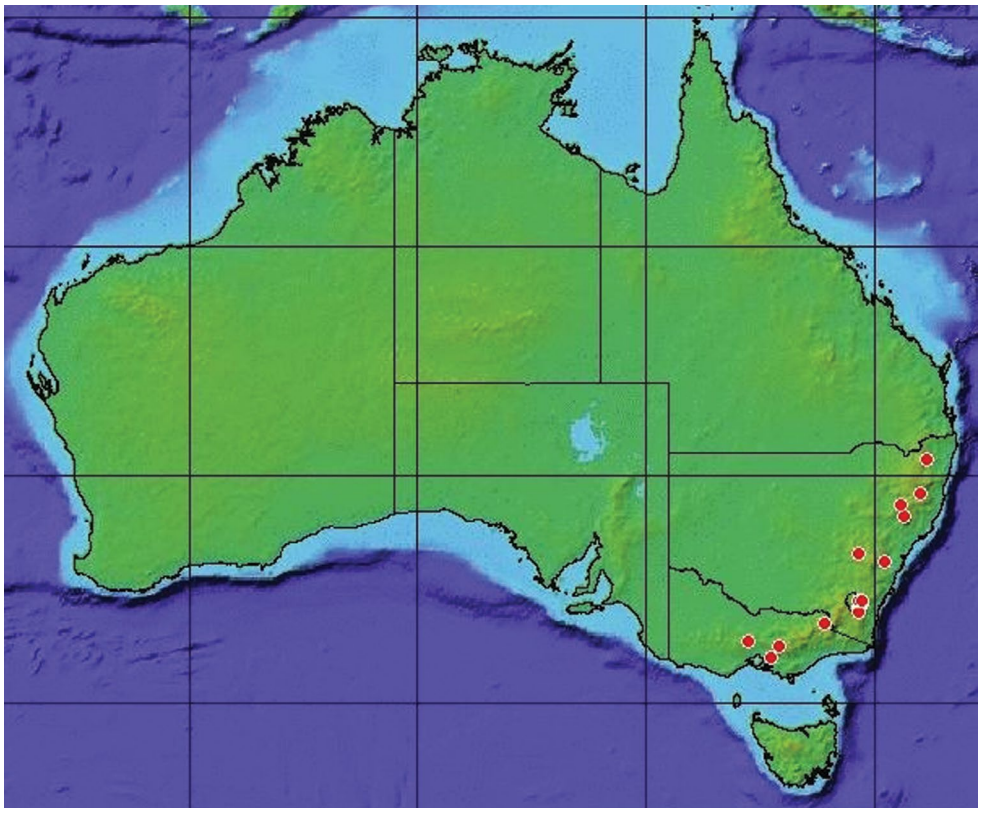

Figure 9. Distribution of *P. fortuneana* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

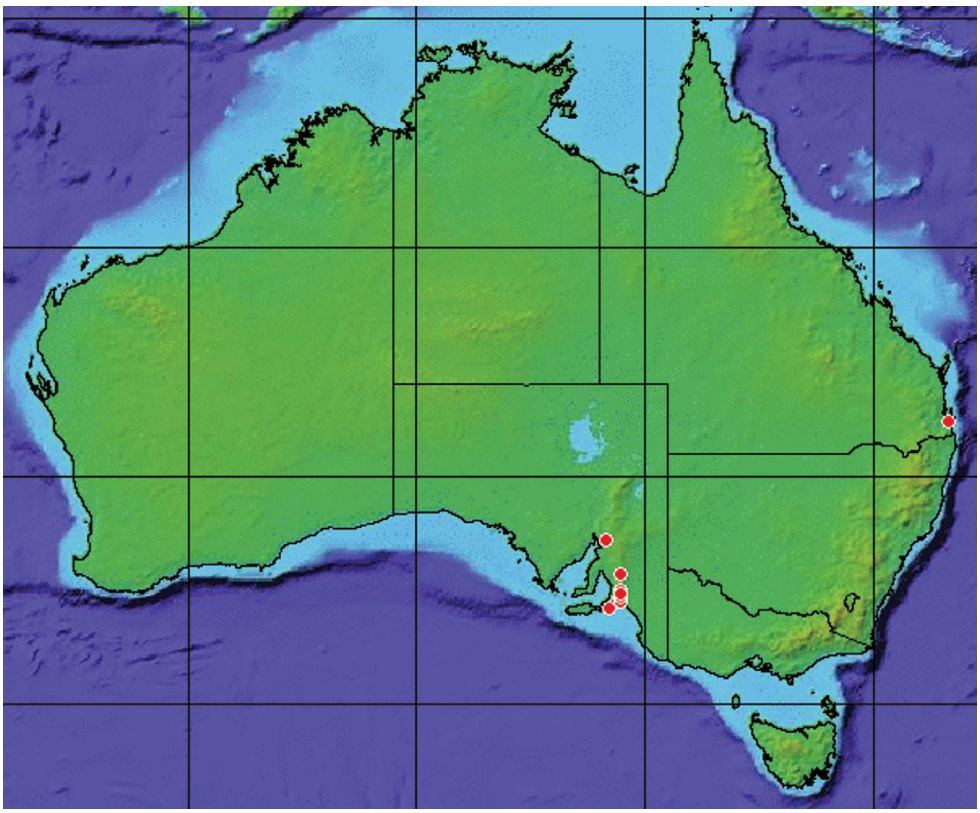

Figure 10. Distribution of *P. koidzumii* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

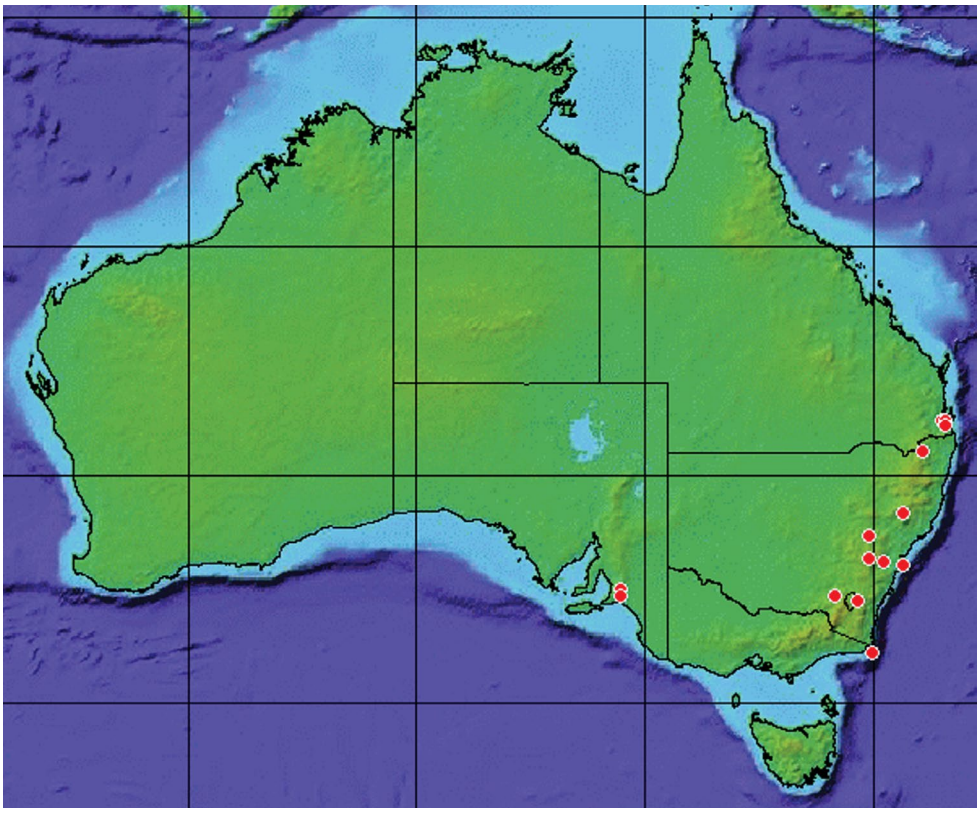

Figure 11. Distribution of *P. rogersiana* in Australia (specimen data reproduced from Australia's Virtual Herbarium (2010) with permission of the Council of Heads of Australasian Herbaria Inc.)

Status in Queensland

This study was unable to determine when *Pyracantha* species were first introduced into Queensland. However, there is evidence that a species known only as *Crataegus pyracantha* (a synonym of *Pyracantha*) was available from Queensland nurseries as early as 1867 (*The Queenslander* 6 April 1867).

Four species of *Pyracantha* (*P. angustifolia*, *P. crenulata*, *P. koidzumii* and *P. rogersiana*) have naturalised in Queensland, with 30 herbarium records all in the Moreton and Darling Downs regions (South East Queensland). The most widespread *Pyracantha* in Queensland is *P. angustifolia* with 19 herbarium records. This species is perhaps most common near Warwick and Stanthorpe, especially along riparian areas in the Goomburra Valley, near Warwick, and along roadsides near towns. At some sites in the Goomburra Valley, *P. angustifolia* has invaded open pastures on alluvial flats. Preliminary mapping work has recorded more than 415 specimens in the Warwick–Stanthorpe area, presumably *P. angustifolia*. Further mapping is required to fully delimit the species' distribution and abundance in Queensland and to confirm or delimit the three congeners known to exist in Queensland.

Preferred habitat

Pyracantha species grow in a variety of soil types although most references indicate a preference for soils with high calcium content (Roche et al. 1998). In central Yunnan (China), *P. crenatoserrata* grows in a variety of soils, mostly red or brown earths, that are seasonally dry, infertile and with a pH of 5.5–7.0 (Xiwen and Walker 1986). In France, *P. coccinea* grows on calcium rich, moist, colluvial soils while in south-western China, *Pyracantha* species readily grow on karst formations (Roche et al. 1998; Xiuzhen et al. 1998). In the Cape Peninsula, South Africa, *P. angustifolia* is invading areas of degraded native forest with deep, high clay content, slightly acidic soils (Alston and Richardson 2006).

Pyracantha species prefer warm temperate (Mediterranean) to cool, subtropical climates, with many species preferring cool subtropical climates (Xiwen and Walker 1986; Wang et al. 2006; Liu et al. 2010). Within the central Yunnan region of China, the climate varies from areas with small seasonal temperature differences, wet summer and autumn with dry winter and spring to some very dry subtropical areas (Xiwen and Walker 1986). In the Huachuca Mountains of Arizona, *Pyracantha* species grow in an area with a summer dominated annual rainfall of 371 mm with about 10 per cent of winter precipitation (45 mm) falling as short-lasting snow. This area has a January average temperature of 7.9 ˚C and an average July temperature of 25.3 ˚C (Bowers and McLaughlin 1996). In the Montpellier region of France, *P. coccinea* grows in a Mediterranean type climate that is subhumid to humid with cool to cold winters. Annual precipitation varies between 950 mm and 1350 mm. Average temperature in the coldest month varies between –1.5 ˚C and 0.5 ˚C and in the warmest between 26 ˚C and 30 ˚C (Villalobos et al. 2010).

In central Yunnan, *P. crenatoserrata* grows in forest communities dominated by *Pinus yunnanensis* over an altitudinal range of 1500–2800 m above sea level, *Coriaria nepalensis* dominated shrubland on desolate subtropical slopes at 600–1000 m altitude and *Sophora viciifolia* shrubland that regrows following forest destruction in the very dry habitats of the plateau and river valleys (Xiwen and Walker 1986). In south-western China, where *Pyracantha* species are found in karst landscapes, they are resistant to short droughts during the cooler months and even during the wet season (May to August) when most rainfall (1300 mm) occurs. This habitat features high soil porosity and evaporation rates (Liu et al. 2010).

On the north-eastern Tibetan Plateau, *P. crenatoserrata* is one of a few shrub species that dominate areas between 3300 m and 3400 m above sea level (Wang et al. 2006). In central Himalayan forests, *P. crenulata* flourishes along the open banks of streams, in wastelands, chir pine forests (1580–1800 m altitude) and banj oak forests (1800–2100 m altitude). This species prefers a fertile, well-drained, moisture retentive loamy soil and sunny position (Shah et al. 2006).

P. angustifolia invades degraded shrublands and grasslands in the Cordoba Mountains, central Argentina, where the mean annual rainfall is 850 mm (concentrated in summer) and a mean annual temperature of 14 ˚C (Tecco et al. 2007; Giantomasi et al. 2008). In North America, *Pyracantha* species are weedy colonisers of habitats with high light intensity such as those found along streams, forest margins or areas that have suffered from recent disturbance (Dickinson and Campbell 1991).

In Hawaii, *Pyracantha* species invade moist and wet forests and open areas between 3000 and 5000 feet above sea level. They form dense thickets that exclude other plants and their thorns make access difficult (PIER 2007).

Pyracantha species in California are commonly found in disturbed sites, along roadsides and in coastal scrub, prairie and riparian areas. However, successful new introductions are limited, especially in areas that do not have a cool, moist climate (Cal-IPC 2006).

Villalobos et al. (2010) found that soil disturbance and removal of vegetation cover promoted the establishment of *P. coccinea* in the Montpellier region. Despite high propagule pressure and high germination rates, Villalobos et al. (2010) hypothesised that *P. coccinea* had failed to become abundant in the Mediterranean ecosystems of the area due to its inability to avoid germination just before or during the long, dry summer. Most other native woody species in the area have adapted to the dry summers by evolving seeds that remain dormant over summer.

According to the eFloras.org (2003), *P. crenatoserrata* forms thickets along stream sides and roadsides at altitudes of 500–2800 m. *P. koidzumii* grows in rocky valley areas and seashores among other shrubs. *P. crenulata* grows on slopes, roadsides, stream sides, among shrubs, grassy places and valleys at altitudes of 700–2500 m. *P. angustifolia* forms thickets on slopes and along roadsides at altitudes of 1600–3000 m. *P. densiflora* grows in thickets at elevations around 1000 m in north-west Guangxi (Longlin Gezu Zizhixian). *P. inermis* prefers sandy riverbanks.

In Victoria, Australia, *P. angustifolia* has invaded lowland grassland and grassy woodland, dry and damp sclerophyll forests and riparian vegetation (Carr et al. 1992). In the ACT, *P. angustifolia* and several congeners persist in a range of habitats, from riparian areas to open pasture and into adjacent areas of woodland and forest (mainly on southern slopes, but including some seasonally dry habitats).

In South East Queensland, *P. angustifolia* seems to prefer alluvial soils along the banks of creeks in relatively cool (warm temperate) upland areas around Warwick and Stanthorpe. These habitats have either been cleared or are heavily disturbed by grazing cattle, but in places are probably naturally open. The plant is rare (but still present) in adjacent state forest (i.e. Goomburra Valley near Warwick), where there has been less disturbance. The genus is generally absent from warmer subtropical lowland areas of Queensland and absent from tropical areas (at least at low elevations).

The effect of fire on *Pyracantha* abundance and persistence is not known. However, observations by the authors near Canberra suggest bushfires can reduce the abundance of *Pyracantha* species in forest areas (but not eliminate them).

To conclude, this assessment suggests that, based on the available literature, the genus is best suited to temperate climates, but can extend into cool (upland) subtropical areas (i.e. the latter can be considered marginal habitat). The genus is not suited to hot tropical areas. The various species of *Pyracantha* occupy areas where annual rainfall is generally 350–1350 mm, perhaps with an optimum around 700–800 mm (speculative). This seems to be consistent with visual observations in south-east Australia, where *Pyracantha* appear to grow best in subcoastal (annual rainfall 700–900 mm), warm temperate to cool subtropical climates. In Queensland, such areas are restricted to upland areas around Warwick and Stanthorpe, extending north to around Toowoomba. It seems reasonable to conclude that preferred habitats include generally open sites, particularly riparian habitats and grassland (pasture), but extending into drier forest and woodland habitats. The genus seems capable of surviving on a wide range of soils.

History as a weed elsewhere

P. koidzumii has naturalised in parts of North America (Alabama, Florida, Georgia, Arkansas, Louisiana, Mississippi, Oklahoma, South Carolina, Texas and Arizona) and Hawaii (Nesom 2010). In Hawaii, *P. koidzumii* has formed localised thickets along roadsides, creek banks and within open habitats on hillsides (Figure 12).

Figure 12. *P. koidzumii* growing in open habitat on a hillside in Hawaii (Image by Forest Starr and Kim Starr, reproduced with permission under a Creative Commons Attribution 3.0 Licence)

P. angustifolia has naturalised in the Newlands Forest on the eastern slopes of Table Mountain, South Africa (Alston and Richardson 2006) and also invades high-elevation grasslands elsewhere in South Africa (van Wilgen et al. 2008, Weber 2003). Wells et al. (1986) listed *P. angustifolia* as a problem plant in southern Africa and stated that it replaces native vegetation and pasture (grass), contaminates seeds and blocks access. *P. angustifolia* has also naturalised in central Argentina (Tecco et al. 2007; Giantomasi et al. 2008), Hawaii, Netherlands, New Zealand (Wester 1992; PIER 2007), Japan (Auld et al. 2003) and California (Silverstein 2005). In Argentina, *P. angustifolia* interferes with recruitment of native woody species and enhances recruitment of other invasive plant species (Giantomasi et al. 2008).

P. coccinea has naturalised in Norway, Japan, Hungary, Britain, Costa Rica, Austria, South Africa, the United States (California, District of Columbia, Georgia, Mississippi, North Carolina, New Mexico, New York, Ohio, Oregon, Pennsylvania, South Carolina, Utah, Alabama, Louisiana, Oklahoma, Tennessee, Virginia, Missouri and Texas) and Canada (Catling and Oldham 2010; Nesom 2010; USDA 2010). Wells et al. (1986) listed *P. coccinea* as a problem plant in southern Africa and stated that it replaces native vegetation and pasture (grass), contaminates seeds and blocks access.

P. crenatoserrata has naturalised in New Zealand and the United States (Alabama, South Carolina, Texas, California, Florida and Hawaii) (Nesom 2010; Randall 2002).

P. crenulata has naturalised in Japan, South Africa (noxious weed), Britain, New Zealand and the United States (Randall 2002; Weber 2003). It invades grassland and riparian habitats, including high-altitude grasslands in southern Africa, where it forms dense thorny thickets that crowd out native vegetation (Weber 2003).

Uses

Most species of *Pyracantha* have been used in some way as garden ornamentals in Australia and overseas (Bass 1996). The stems are used to make walking sticks in India and the fruit of some species are consumed by people (Shah et al. 2006). The plant is used as bonsai in Japan (Burger et al. 1985).

Pest potential in Queensland

Current impact in Australia and Queensland

P. angustifolia, P. crenulata, and *P. crenatoserrata (*syn. *P. fortuneana*), are significant environmental weeds in the ACT, New South Wales and Victoria (Burnett and Roush 1999). *P. angustifolia* and *P. fortuneana* are listed as prohibited weeds in the ACT (DECCEW 2009). Muyt (2001) commented that in parts of south-east Australia, *P. angustifolia* 'alters the composition of bushland by shading out ground-flora and seriously impeding the growth and regeneration of overstorey plants'. In addition, the plant's spines and habit of forming dense thickets can impede the movement of animals and people (Figure 13).

Figure 13. Thorns of *P. koidzumii* (Image by Forest Starr and Kim Starr, reproduced with permission under a Creative Commons Attribution 3.0 Licence)

Swarbrick and Skarratt (1994) listed *P. angustifolia*, *P. coccinea*, *P. crenulata*, *P. fortuneana* and *P. rogersiana* as environmental weeds in parts of New South Wales, Victoria and the ACT, and listed invaded habitats as riparian areas and grassy woodlands.

In Queensland, the most problematic species appears to be *P. angustifolia*, which has established relatively small thickets, mainly along creek banks, but also out onto adjacent pastures, in the Warwick–Stanthorpe region (especially in the Goomburra Valley). *P. angustifolia* is declared under local law in the former Warwick Shire.

Currently, the impact of *Pyracantha* in Queensland is localised and minor, relative to a range of other weed species.

Potential distribution and impact in Queensland

Over the long term, most (if not all) *Pyracantha* species have the potential to form locally significant thorny thickets in cool upland areas of subcoastal South East Queensland. In areas where climate is suitable, they have the potential to occupy riparian habitats and also nearby pastures, perhaps reducing productivity and impeding the movement of grazing animals and people. Hence, the species' impacts, while generally environmental in nature, could include economic and social impacts. It is difficult to predict whether *Pyracantha* species pose a significant risk to non-riparian habitats in drier forests and woodlands in upland areas of South East Queensland. However, similar (albeit cooler) habitat types have been invaded to varying degrees in southern states (especially the ACT). It is relevant to note that several species of *Pyracantha* form dense thickets on open hillsides in upland areas in Hawaii and South Africa, as well as open hillsides within their native ranges in China. As such, the risk of spread away from riparian habitats in cool, high-elevation areas of Queensland is difficult to dismiss.

While only four species of *Pyracantha* are currently naturalised in Queensland, remaining species within the genus seem to share very similar biological attributes. As such, the entire genus is considered to pose a weed risk.

It is important to note the four *Pyracantha* species naturalised in Queensland appear to be in their relatively early stages of population development (visual observation over the past 20 years suggests they are spreading). Despite being cultivated as garden ornamentals for many decades, spread into bushland and farmland appears to have been slow, relative to many other invasive plant species. Spread rate might increase as the population develops (a common feature of plant invasions generally). While the species' current impacts are currently minor and very localised, failure to control expected population development might result in the development of a significant problem. This prediction is based on the fact that several species, *P. angustifolia* in particular, are currently listed as significant weeds in the ACT, New South Wales and Victoria. Carr et al. (1992) stated that *P. angustifolia* 'posed a very serious threat to one or more vegetation formations in Victoria'. Moreover, eFloras.org (2003) noted that *P. angustifolia* forms thickets on slopes and along roadsides within its native range in China (Guizhou, Hubei, Sichuan, Xizang, Yunnan, Zhejiang). Highly invasive plant species are often problematic within their native range.

Application of Climatch modelling software (BRS 2009) suggests that cool (warm temperate) upland areas of South East Queensland are most suitable for *P. angustifolia* (Figure 14). Within this climatic envelope, the species is predicted to occupy mainly riparian habitats running through forests and woodlands.

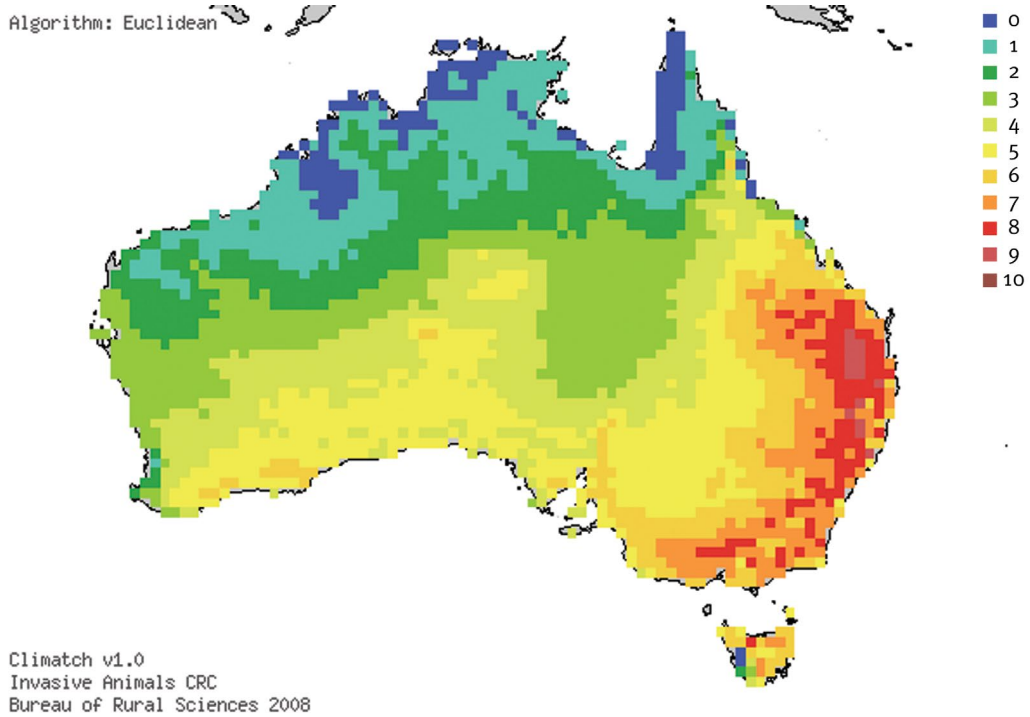

Figure 14. Areas of Australia where climate appears suitable for *P. Angustifolia*. Red and dark orange indicate areas that are suitable, light orange and yellow are marginal, and green and blue are unsuitable. Map produced using Climatch computer software (BRS 2009)

Pyracantha is a host for bacterial fireblight, a serious disease of apples and pears with no single effective treatment (Miles n.d.). If an incursion of fireblight were ever detected in Queensland, eradication could be confounded once the disease became established in wild firethorn. Queensland's apple crops are grown around Stanthorpe, in close proximity to *Pyracantha*. The expected value of Queensland's apple crop in 2009–10 was $40 million (DEEDI 2010). The berries of firethorn may also allow fruit fly to overwinter.

Cost of eradication

Using WeedSearch, a predictive model developed by Cacho and Pheloung (2007), we assessed the cost of eradication for *P. angustifolia*, based on the following assumptions (input parameters):

Area		
Total search area (A) in hectares (total search area not just area infested)	5188 ha This area was calculated to include a total of 415 sites where *P. angustifolia* has been recorded, with each site surrounded by a search buffer (radius) of 200 m. This buffer is included since it is reasonable to expect that birds can carry propagules over at least this distance	
Average number of mature plants per hectare	10 (estimate)	
Biological attributes		
B1. Pre-reproductive period (how old is the plant when it first produces seeds)	3 years (estimate)	
B2. Maximum seed longevity	10 years (estimate)	
B3. Seeds per square metre of soil surface	50 (estimate)	
B4. Mortality of first year juveniles (%)	90 (estimate)	
B5. Perennial or annual	P	
B6. Size of mature plant (average in m^2)	4	
B7. Plant longevity (average)	20 (estimate)	
B8. Population growth rate	1.2 (estimate)	
Economics		
Discount	6	
Administration	5000	
Transport	200	
Labour	47	0.002
Chemical	25	0.0001
Machinery	15	0

Management	
Search mode	parallel
Searches per year	1
Search time (hrs/ha)	2
Effective sweep width (adult)	20 (estimate)
Effective sweep width (juvenile) relative	0.5 (50% of adult) (estimate)
Search speed (m/hr)	1000 (estimate)
Control effectiveness (% kill)	95 (estimate)

It is important to note that most of the parameters are crude estimates, due to a lack of data. Delimitation is required to properly assess total search area and number of plants per hectare, as is research to collect biological data such as seed longevity, mortality of seedlings, etc.

The model suggests that eradication is feasible over a 14-year period at a total cost of $5 165 800 (or $368 986 per annum), but only if the search parameters are met. In other words, eradication is predicted to be feasible if a total of 145 236 hours of searching is invested over a 14-year period (and the entire 5188 ha search area is methodically searched each year). The required search effort is roughly equivalent to six full-time positions (assuming each person works for 8 hours/day for 220 days/year).

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