The ecology of bridal veil (*Asparagus declinatus* L.) in South Australia

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Summary

Bridal veil (*Asparagus declinatus* L.) was introduced to Australia for ornamental purposes from its native home of South Africa. It has since emerged as a highly invasive and aggressive environmental weed. Bridal veil is yet to receive the same research and public attention as its close relative bridal creeper, yet it has a similar lifecycle, habit and environmental impact. This paper draws from research conducted in South Australia to outline the biology, ecology and dispersal vectors of bridal veil.

Introduction

Bridal veil (*Asparagus declinatus* L.), a native to the Western Cape region of South Africa, was brought to Australia for ornamental purposes (Jessop and Toelken 1986) and was first recorded as a garden plant in 1870 (Pheloung and Scott 1996). Escaping from gardens, it has invaded native vegetation and occupies similar environments to its close relative bridal creeper (*A. asparagoides* (L.) Druce). As is the case with bridal creeper, bridal veil is a highly invasive and aggressive weed that can successfully out-compete and displace native plants. Leah (2001), for example, found that the establishment of bridal veil led to a decline in bare ground and other ground cover, a reduction of species diversity (up to 71% Shannon-Weaver Index) and a fall in the recruitment of native woody species with 69% less seedlings recorded at invaded sites. Control of bridal veil has also proven particularly difficult (Winkler and Taylor 2006).

Bridal veil has a scattered distribution across temperate Australia. In South Australia, infestations occur on Eyre, Yorke and Fleurieu Peninsulas, the Barossa Valley and also on Kangaroo Island where it is a serious problem (Bass and Lawrie 2003). In Western Australia infestations occur in Perth (Kings Park and Botanic Gardens), Bunbury (Keighery 1996) and near Albany (K. Batchelor personal communication). Bridal veil has also been found near Horsham in western Victoria, where it has been eradicated. The significance of bridal veil as an environmental weed is confirmed by distribution modelling with CLIMEX, which identifies a wide potential range including south-west Western Australia, coastal South Australia, Victoria and eastern Tasmania (Pheloung and Scott 1996). With little published on bridal veil in Australia, this paper introduces the biology, ecology and dispersal vectors of bridal veil, drawing from research conducted on the Fleurieu Peninsula and Kangaroo Island, South Australia.

Morphology and life cycle

Bridal veil is a fern-like, creeping, perennial plant with blue–green, needle-like leaves (cladodes) that are 3–9 mm long (Clifford and Conran 1987). It produces scrambling and weakly climbing, annual shoots of 2–3 m in length that grow from tuber-bearing rhizomes. Shoots emerge after the first autumn rains, usually during April or May, and scramble across the ground, climbing to a lesser extent than bridal creeper shoots. Greenish-white, nectariferous flowers of 5–8 mm in diameter (Clifford and Conran 1987) are produced during July-August. Green, ovoid berries begin to form during August-September and as they mature they turn a translucent, white colour. Bridal veil seeds are black, globose and 2.5–3.5 mm in diameter (Clifford and Conran 1987). Seed viability is not known, though bridal creeper seeds remain viable for up to three years (Raymond 1999). Above-ground plant matter begins to senesce when temperatures rise, usually during November-December, though drying fruit has been observed to stay on the plant through to January. Over the hot summer months bridal veil is present only as an underground, tuberous root mat.

Underground (occasionally surface) growth of bridal veil forms an extensive root system consisting of branching rhizomes, which bear numerous bulb-like, tuberous storage organs. This attribute ensures that during periods of unfavourable conditions (such as during a dry season) the plant can draw on nutrients and moisture contained within the storage organs (Pate and Dixon 1982). This is a highly advantageous trait as nutrients left over in the storage organ from the previous growing season can be made available for use in growing the next generation of roots, stems and leaves (Pate and Dixon 1982). Furthermore, tubers enable the plant to regenerate vegetatively, providing an additional dispersal mode. In mature bridal veil plants the root mass can account for 85% of the total mass of the plant (Leah 2001). The tuberous root mass generally occupies the top 15 cm of soil, though in sandy areas tubers have been found up to one metre below the surface (R. Taylor personal communication).

Ecology and dynamics of fruit/seed production

Bridal veil has been observed to grow in a wide array of environments from exposed rocky outcrops to pine forests to coastal sandy areas. Bridal veil can grow well in a range of soil types, including neutral-alkaline sands and acid ironstone clays. It also grows in a wide climatic range. In South Australia, bridal veil grows well in dry areas that receive average rainfall of 495 mm year^{-1} (e.g., Milang and Finniss districts) to wetter regions that receive around 630 mm year^{-1} (e.g., central Kangaroo Island). When established, bridal veil's scrambling habit and dense underground tuberous root mass inhibits germination and recruitment of native plants (Weidenbach 1994, Leah 2001). In South Australia, bridal veil is often located under particular tree species such as native cherry (*Exocarpos cupressiformis* Labill.) on the Fleurieu Peninsula and soap mallee (*Eucalyptus diversifolia* Bonpl.) on Kangaroo Island, which are trees favoured by frugivorous birds as perching sites. It is also associated with other sites including fence lines and overhead wires, around dams and watercourses and in cemeteries and rubbish dumps.

Bridal veil fruits have 5–8 seeds per fruit but can range from 2–14 seeds per fruit. Fruit production ranges from 100–800 fruit m^{-2} with a possible seed load reaching up to approximately 4800 seeds m^{-2}. Research conducted on the Fleurieu Peninsula and Kangaroo Island also indicates that higher rainfall regions (Kangaroo Island infestations) have larger fruit with more seeds than areas that receive lower rainfall (Milang/Finniss infestations). On Kangaroo Island, bridal veil fruits can reach on average 11.3 mm in length and 8.2 mm in width and contain an average of eight seeds. In contrast, fruits taken from the Milang/Finniss area had an average of 9.6 mm in length and 7.0 mm in width, with an average of six seeds. Fruit size also varies depending on the season. In a warmer than average year with reduced rainfall, bridal veil fruits have been found to be smaller with less seeds.

Dispersal processes

Initial seed dispersal observations of bridal veil in South Australia indicate that the main dispersers are medium to large gregarious birds such as the grey currawong (*Strepera versicolor*), Australian magpie

(*Gymnorhina tibicen*), red wattlebird (*Anthochaera carunculata*) and brush wattlebird (*Anthochaera chrysoptera*) (Bass and Lawrie 2003). All have been recorded as seed dispersers elsewhere (Loyn and French 1991). Other likely bird dispersers are the common blackbird (*Turdus merula*), Australian raven (*Corvus coronoides*), common bronzewing (*Phaps chalcoptera*), grey-backed silvereye (*Zosterops lateralis*) and honeyeaters (Family Meliphagidae). The attractiveness of bridal veil fruit to dispersal agents has also been confirmed through monitoring fruit removal. The author's research has found that 69–80% of tagged fruit were removed during the months of October and November, similar removal rates to what has been observed for bridal creeper (Raymond 1996).

Dispersal distance for bridal veil is likely to be greater than that of bridal creeper. The fruit of bridal veil is substantially larger (nearly double) than that of bridal creeper and thus has a stronger dispersal association with larger birds due to the relationship between bird gape width and fruit diameter (Bass and Lawrie 2003). Larger birds, such as currawongs, are able to consume large fruit sizes in large quantities and can disperse these seed loads considerable distances. For example, based on seed dispersal research in NSW (Bass 1995, 1996) and observations in South Australia (Bass and Lawrie 2003; A. Maguire personal communication) currawongs have the potential to ingest up to 15 bridal veil fruit and fly up to 10 km before regurgitating seeds. If the fruit consumed averaged six seeds per fruit, such a dispersal event would equate to 90 seeds (Bass and Lawrie 2003). In contrast, smaller birds such as silvereyes and honeyeaters are likely to consume far less fruit, with each dispersal event comprising a lesser number of seeds. Furthermore, given behavioural ecology and shorter gut passage rates, dispersal by smaller birds is also likely to be more localized (Stansbury 1999, French 1992), perhaps ranging up to 100 m. This short distance dispersal is important in the infilling process of plant invasions, resulting in higher plant densities.

Other potential dispersers of bridal veil include common brush-tailed (*Trichosurus caninus*) and ringtail (*Pseudocheirus peregrinus*) possums, foxes (*Vulpes vulpes*) and small rodents. Damage to bridal veil fruit, possibly made by bush rats (*Rattus fuscipes*), has been observed on the Fleurieu Peninsula whereby the seeds and most of the pulp are scooped out with only the shell remaining. There is also the potential for lizards (e.g., sleepy lizards, *Tiliqua rugosa*) to disperse bridal veil, as white or pale coloured fruit is associated with frugivory by lizards (Lord and Marshall 2001).

Conclusions

Bridal veil is an aggressive and highly invasive environmental weed that is well suited to southern Australia, which has a similar climate to its native home range of south-west South Africa. Since its introduction as an ornamental plant, bridal veil has flourished and spread into a variety of scattered environments across southern Australia. With a thick underground tuberous root mass and a scrambling habit, its impacts are similar to that of bridal creeper. The recruitment and regeneration of native species is hindered through the additional competition for nutrients, moisture, light and space. Bridal veil has proven to have high fecundity in a variety of environments through its annual cycle, which sees it senesce over the summer months and grow rapidly during autumn and winter. With fruit production reaching up to 800 fruit m^{-2} and with 5–8 seeds per fruit, seed loads can reach approximately 4800 seeds m^{-2}. Exacerbating management efforts has been the dispersal of bridal veil by a number of agents including larger birds such as Currawongs, which can fly up to 10 km before regurgitating viable seeds. With such biological and ecological characteristics, the potential significance of bridal veil as a major environmental weed is unequivocal.

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