

The identification and distribution of Western Cape form of bridal creeper (*Asparagus asparagoides* (L.) Druce) in the South East of South Australia and Western Victoria

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Summary

Two distinct forms of bridal creeper, *Asparagus asparagoides* (L.) Druce are now present in the South East of South Australia and the lower Western District of Victoria. The 'Western Cape' form has been recently recorded, whilst the common form is widespread in the region. The Western Cape form is restricted to the winter-rainfall region in South Africa and its known distribution in Australia has been mapped. Morphological features distinguishing it from common bridal creeper are described.

Introduction

Bridal creeper (*Asparagus asparagoides* (L.) Druce) is unusual amongst members of subgenus *Myrsiphyllum* in being both widespread and variable. At least two forms (eastern and western Cape) have been observed within the species (Obermeyer 1984), with Cooke and Robertson (1990) regarding the western form around Cape Town as an ecotype and the taxon most likely in South Australia. Kleinjan and Edwards (1999) reappraised these forms, mainly for southern Africa, finding a number of significant gross morphological differences (see Table 1), and also concluding that the predominant Australian form was in fact the one from the eastern Cape. The distribution of the Western Cape form (WC) in South Africa was found to be restricted to the area where <20% of the annual average rainfall occurs between the months of December to February (Kleinjan and Edwards 1999). In these areas the climate is described as having 'winter-rainfall'. In southern Australia the WC form has been located in areas of the South East of SA and the Western District of Victoria that match the 'winter-rainfall' region of 13% of the total from December to February (Australian Government Bureau of Meteorology 2005). The

distribution of the common bridal creeper (BC) in South Africa includes winter and summer rainfall regions (Kleinjan *et al.* 2004).

Amateur botanist Kath Alcock of Naracoorte first collected seeds of the WC form from Clarke's Point walk near Port McDonnell in June 2003. She illustrated the plant's habit in a number of watercolour illustrations. These include the flowers, fruits, and underground tuberous roots (see Figures 1 to 4). She also succeeded in cultivating the WC form from seed; a single plant took 2–3 years to mature and produce fruit.

Recent field observations and anecdotal evidence indicates that the WC form has probably been growing in the SE for at least 6–7 years. Both forms were probably introduced as ornamental plants and have spread to native bush habitats by birds feeding on the sticky red fruits; notably silver eyes (*Zosterops lateralis*), currawongs (*Strepera versicolor*), black birds (*Turdus merula*), wattle birds (*Anthochaera carunculata*) and emus (*Dromaius novaehollandiae*) (R. Johnson and T. Wynniat personal communication). Foxes and rabbits have also been recorded spreading the seeds (Willis 2000). WC invades native bush corridors, roadsides and nature reserves. New infestations occur under bird perching areas such as tall trees and fences lines. Occasionally, large numbers of seeds germinate beneath the climbing plants. In protected coastal dune systems, foxes eat ripe fruits and, by depositing seed in faeces along runs and walking paths, may also distribute the plant.

Puccinia myrsiphylli (Thuem.) Wint., a rust fungus of *A. asparagoides*, was isolated from plants in southern Africa and released in Australia in a biological control program by CSIRO (see Morin *et al.* 2006). Since its release, the rust has been

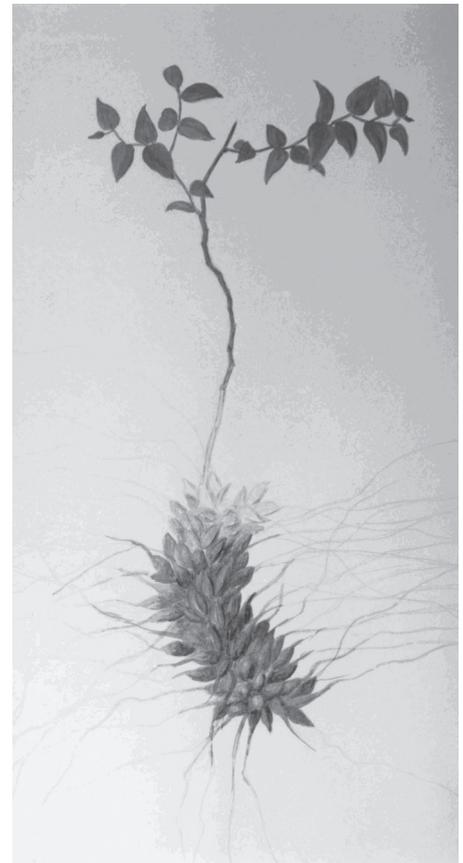


Figure 1. Common bridal creeper (illustration by Kath Alcock).



Figure 2. Western Cape form of bridal creeper (illustration by Kath Alcock).

detected on common BC in many areas of South Australia. However, the WC form appears to be less susceptible to the phylloclade-infesting disease and hence could possibly replace the common BC form (L. Morin personal communication).

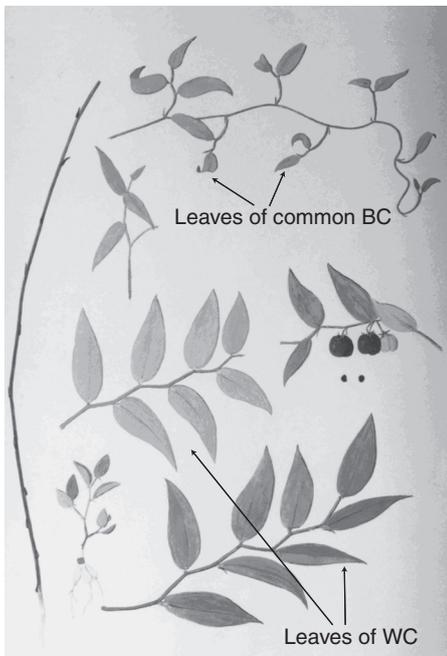


Figure 3. Leaves (phyllodes) of common and Western Cape form of bridal creeper (illustration by Kath Alcock).

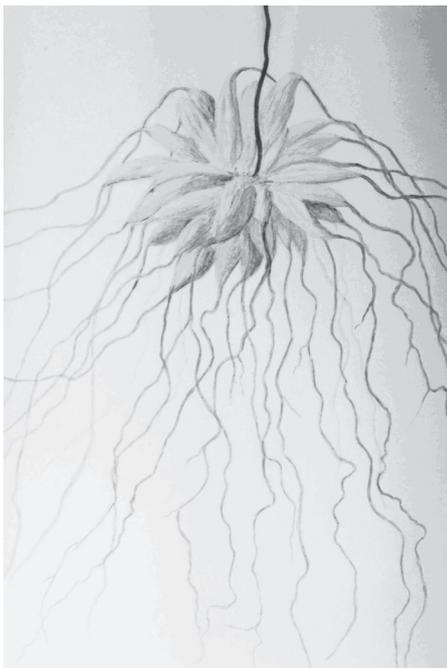


Figure 4. Tubers of Western Cape form of bridal creeper (illustration by Kath Alcock).

Differences between Western Cape and common forms of bridal creeper Kleinjan and Edwards (1999), although presenting means, standard deviations and sample sizes, did not analyse statistically the differences between the various forms of bridal creeper in South Africa or Australia. When these analyses are performed using ANOVA, tuber length and rhizome diameter are both significantly larger in the WC form ($P \leq 0.01$ to compensate for

Table 1. Differences between Western Cape and common bridal creeper.

Characteristic	Western Cape bridal creeper	Common bridal creeper
Tuber position ^A and size ^{AB} (mean \pm SD)	Elongated tubers near the soil surface, average diameter 43.2 \pm 13.6 mm, up to 73 mm long.	Smaller, elongate to spherical tubers, average diameter 22.5 \pm 2.6 mm, up to 42 mm long.
Tuber arrangement ^A and clustering ^A	All tubers continue as fine roots and lie parallel to the ground; closely packed in a shallowly sub-surface rosette round the rhizome (Figure 5).	Tubers not ending in a fine root, located deeper underground; arranged vertically in clusters along the rhizome (Figure 6).
Rhizome diameter ^{AB} (mean \pm SD)	Robust, 8.1 \pm 2.8 mm.	Slender, 5.4 \pm 1.7 mm.
Stems of lateral branchlets	Strongly longitudinally ridged.	Weakly longitudinally ridged.
Phylloclade arrangement on live plants	Semi-erect in several planes along lateral branchlets.	Largely horizontal, \pm in a single plane along lateral branchlets.
Phylloclade shape	Narrowly-cordate; basally lobed; apex acute-tapering.	Ovate-lanceolate; base rounded; apex broadly acute.
Phylloclade colour and texture on live plants	Thick-textured, dark blue-green, glaucous, waxy.	Thin-textured, pale to bright green, not glaucous. (Colour intensity can vary with growing conditions; waxiness does not.)
Phylloclade marginal cells in transverse section (TS)	Rounded dome-shaped to bullate.	Papillate.
Cuticle in TS ^B (mean \pm SD)	6.0 \pm 0.7 μ m thick with a smooth to slightly irregular surface (Figure 7).	6.9 \pm 0.8 μ m thick with a highly irregular, verrucate surface (Figure 8).
Cuticle periclinal surface	Finely rugulose, lacking obvious verrucae (Figure 9).	Not finely rugulose, with scattered verrucae (Figure 10).
Epidermal cells in TS ^B (mean \pm SD)	Isodiametric, 39.3 \pm 5.3 μ m wide, 39.2 \pm 2.9 μ m high (Figure 7).	Upright-rectangular 20.5 \pm 1.65 μ m wide, 26.0 \pm 1.55 μ m high (Figure 8).
Flowers per phylloclade axil	Mainly 2–3.	Mainly solitary or occasionally paired.
Fruit in TS	Conspicuously 3-lobed, lobes rounded (Figure 11).	Obscurely 6-lobed, lobes flattened to slightly rounded (Figure 12).

^AFeatures also found by Kleinjan and Edwards (1999) to differ between South African herbarium specimens of the two forms.

^BSignificantly different ($P \leq 0.01$).

unequal variances). Although Kleinjan and Edwards (1999) also concluded that phylloclade (= 'leaf') size was not useful in South African plants (based on herbarium material), there are in fact significant differences in phylloclade width ($P \leq 0.01$) between summer and even rainfall versus winter and WC collections (based on their published data). This does not necessarily help to distinguish the Australian collections, where there are thought to be plants of primarily winter rainfall and WC origin. Further study is required, especially in summer rainfall areas of coastal NSW where the species also occurs (Harden 1993).

Comparisons of living populations of the WC and BC forms from several localities in southern Australia grown under uniform conditions in Adelaide for 18 months found that there were a number of differences, at least between Australian populations (Table 1). In addition to tuber length and rhizome diameter, there were also differences between the forms in the numbers of flowers per phylloclade axil and the shape of developing fruit in transverse section. Examination of the phylloclade cuticular patterning and underlying cell anatomy also showed differences, allowing for a number of characters



Figure 5. Tubers of Western Cape form of bridal creeper.



Figure 6. Tubers of common form of bridal creeper.

whereby the taxa can be distinguished in southern Australia, both in the field and on herbarium sheets. The underground tubers are one of the most distinctive features for distinguishing the two forms, and these differences are statistically significant. Furthermore the differences are maintained under uniform growth conditions, indicating that they are neither phenotypic nor age/maturity-related factors. Another potential area for examination is seed micromorphology, which was found by Obermeyer (1984) to be useful in segregating South African species. Similarly, comparisons of the 'new' characters noted here for South African populations, as well as ongoing pollination studies and chromosomal compatibility studies may help to determine whether the taxa are capable of gene flow and thus represent different species. This is particularly important in view of their different response to rust infestation. Field assessments and infection trials have demonstrated that the WC form is less susceptible to the rust *P. myrsiphylli* (L. Morin personal communication) and has the potential to replace certain habitats of rust-infested BC (Kleinjan *et al.* 2004).

Mapping methods

Locations where the WC form was first identified by CSIRO in 2004 were revisited from July to December 2005. The extent of infestations were mapped along transects at intervals of 100 m to 1000 m using a Trimble Terra Sync GPS with settings: Datum Grid MGA 94, Zone 54, Projection UTM, CDI scale = ± 0.25 and Units metric. Infestations were recorded either as a point, line or polygon shape, using a buffer radius of 1 or more metres. Density cover was recorded as low (1–25%), medium (25–50%) or high (50–70%). Organisms affecting the plants were recorded as limiters, (e.g., rust, phylloclade hoppers, beetles or snails). The land use on which plants occurred (i.e., roadside, government reserve or grazing) and the

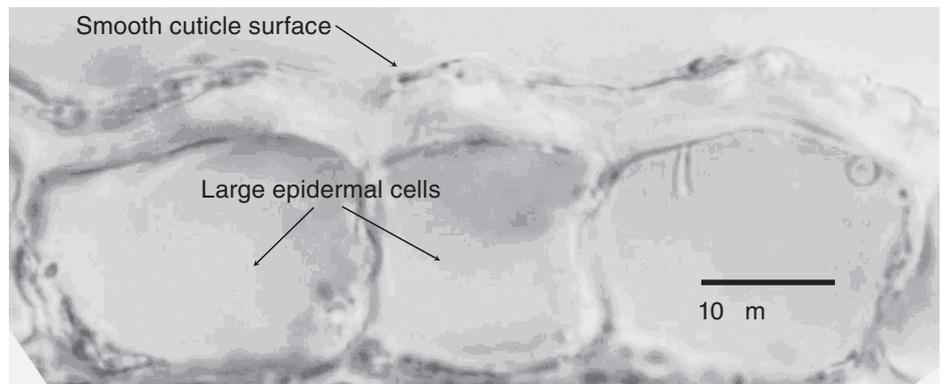


Figure 7. Cladode cuticle and epidermis in transverse section, Western Cape form of bridal creeper.

dominant overstorey (i.e. native, exotic or absent) were noted, as were reproductive features (i.e. flowering or fruits present). This data will be presented in a final report of the current mapping project. Mapping of the survey points was extended in a 1 km radius from any positive finds on an X,Y grid pattern, with negative findings also being recorded.

Distribution of Western Cape form including common bridal creeper form

WC bridal creeper was recorded during the recent mapping survey in the following South Australian Hundreds:

- Caroline (at Donovans, Glenelg River and Dry Creek, Wild Dog and Honey suckle Flats in SA Forest reserves)
- MacDonnell (near Port MacDonnell, Brown Bay, Mount Schank and Allendale East)
- Kongorong (near Forest reserves 598, 421 and Corattum)
- Mount Muirhead and Mayurra (near Millicent)

In Victoria the WC form was detected at Oxbow Lake, Nelson, east of Nelson at Millhouse Road and in a pine plantation 15 km SE of Nelson (Figure 13).

Discussion

There are clear, statistically significant, morphological and anatomical differences between WC and BC forms in South Australia and Victoria. However, many of these characters are not easily or directly visible to the naked eye on herbarium material, many of which lack tubers (a problem also noted by Obermeyer 1992 for South African collections). This makes the need to determine taxon boundaries based on living species in the field all the more important (Kleinjan and Edwards 1999). Extensive field surveys within South Australia and Victoria have supported Kleinjan and Edward's (1999) conclusion that the WC bridal creeper is a separate taxon from common BC within the *A. asparagoides* broad-phylloclade species complex (Obermeyer 1992, Fellingham and Meyer 1995). Nevertheless, this may reflect founder effects due to only some variants reaching Australia and spreading here. Both forms have consistently been found to have a number of morphological characters that distinguish them. Separation is clearly based on tuber size (WC robust, BC slender), the phylloclade cuticle periclinal surface (WC finely rugulose, BC smooth with irregular, scattered verrucae) and phylloclade marginal cell features (WC rounded

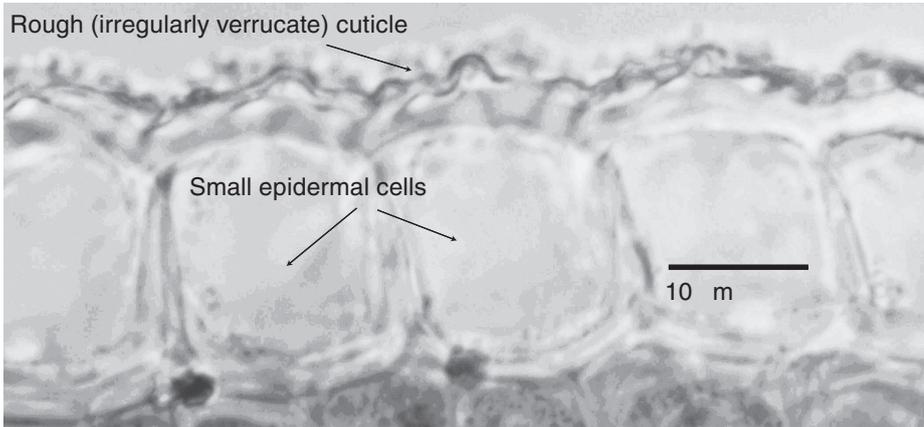


Figure 8. Cladode cuticle and epidermis in transverse section, common form of bridal creeper.

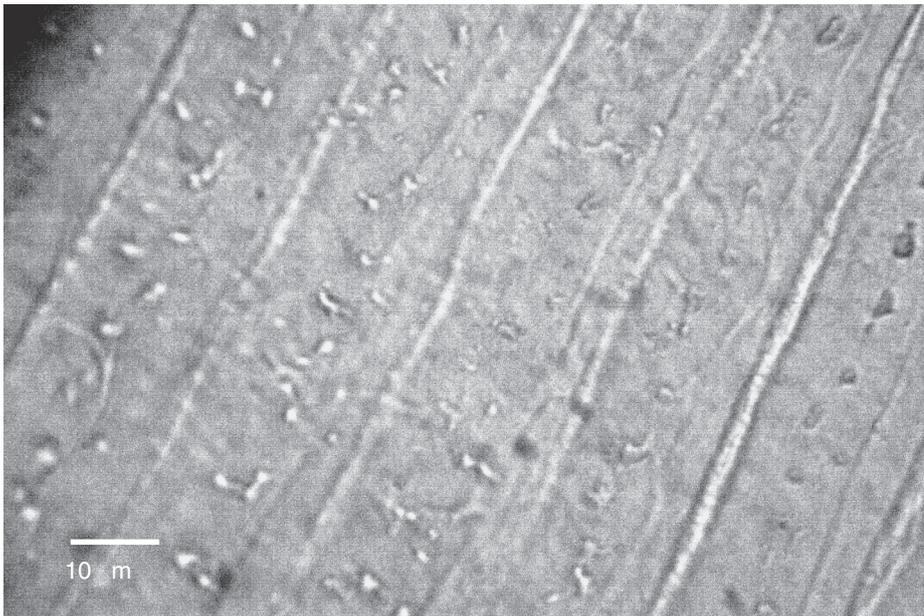


Figure 10. Common form of bridal creeper, cuticle of cladode upper surface not rugulose but finely ramulose.

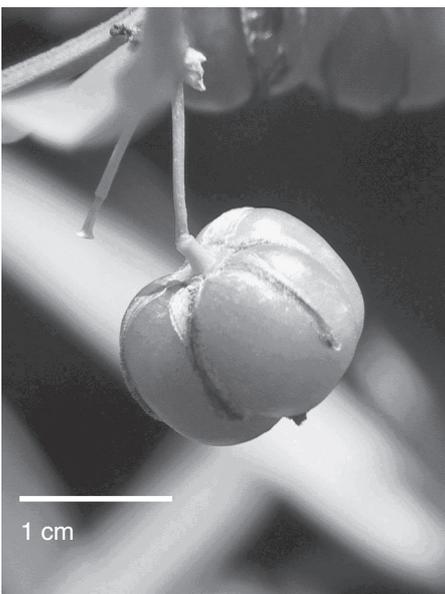


Figure 11. Fruit of Western Cape form of bridal creeper.



Figure 12. Fruit of common form of bridal creeper.



Figure 9. Western Cape form of bridal creeper, smooth cuticle of cladode lower surface finely rugulose, with stoma.

dome-shaped to bullate, BC papillate). In addition, the flowers per phylloclade axil are 2-3 for WC and mainly solitary (sometimes paired) for BC. Developing fruits in transverse section are conspicuously 3-lobed and rounded for WC, but obscurely 6-lobed with the lobes flattened to only slightly rounded in BC.

Molecular studies in *Asparagus* have also found possible markers at the species level that might be useful for determining relationships between the different forms (Štajner *et al.* 2002, Fukuda *et al.* 2005), and there are already known to be differences in ITS sequences between the *A. asparagoides* forms (L. Morin personal communication).

The WC form has been located in areas of South East of SA and Western Victoria that match the 'winter-rainfall' region of its native range in South Africa. The distribution of WC bridal creeper was found to be within 15 km from the coast, similar also to its native distribution.

The WC bridal creeper is less susceptible to the bridal creeper rust fungus than the common form. At a site near Millicent, rust infestation measurements were made on plants estimated to be greater than three years old in September 2005. *P. myrsiphylli* pustules on the WC form showed 22% of phylloclades infested with an area cover of 3.4%, whilst the BC form had 96% of phylloclades infested and an area cover of 9.2%. Molecular studies on both WC and BC forms may also help to determine whether WC was an early, suppressed introduction, which is now spreading as biocontrol of the BC form takes effect, or whether the former represents a recent incursion. Amateur botanists have observed new WC infestations becoming established near Millicent in areas where the rust had been introduced to control BC. Further studies could determine whether *P. myrsiphylli* is influencing the establishment of WC form in locations where both WC and BC occur in close proximity. Studies are also needed on the WC bridal creeper to assess the effectiveness of the beetle and leafhopper species previously introduced to control BC (Morin *et al.* 2006).

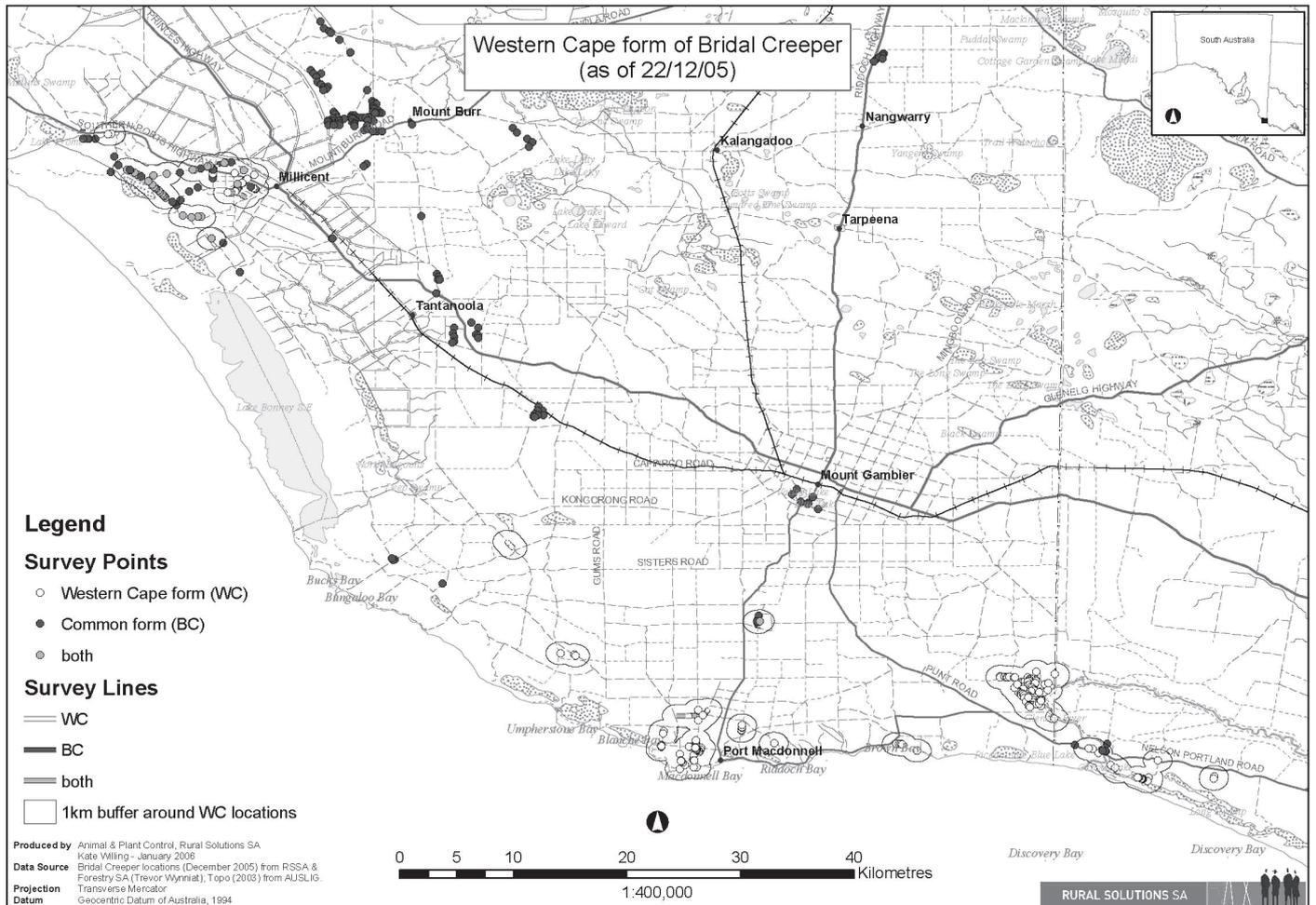


Figure 13. Distribution of infestations of Western Cape bridal creeper, *Asparagus asparagoides*, in South Australia and Victoria with 1 km buffer zones, November 2005.

Acknowledgments

We thank Forestry SA, SA Animal and Plant Control Boards, SA Department for Environment and Heritage and the Victorian Department of Primary Industries for site co-ordinates, producing maps, and information for locating both forms of bridal creeper. Special thanks is given to Kath Alcock for allowing her paintings to be reproduced and information of the first recordings of the WC form near Port Mac Donnell.

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