Invasion of bridal creeper (*Asparagus asparagoides*) in a remnant vegetation patch: methodology and initial results

Kris Siderov¹ ² and Nigel Ainsworth¹ ³
¹ CRC for Australian Weed Management
² Geospatial Science, RMIT University, GPO Box 2476V, Melbourne, Victoria 3001, Australia
³ Department of Primary Industries, PO Box 48, Frankston, Victoria 3199, Australia

Summary The invasion process of *Asparagus asparagoides* (L.) W.Wight (bridal creeper) is described in relation to bird dispersal on Phillip Island, Victoria.

Cover and abundance were visually assessed and the data were presented in a geographic information system. This showed that the distribution of *A. asparagoides* within a remnant vegetation patch was not random. It appears to have entered the reserve from two boundaries, spreading toward the centre, which to date remains sparsely colonised despite the capacity of this weed to spread rapidly over long distances by birds. The initial dispersal appears to have been predominantly along the tracks within the reserve. Possible explanations of the inferred invasion history and the implications for weed management are discussed.

Keywords *Asparagus asparagoides*, bridal creeper, bird dispersed weed, heterogeneous landscapes, GIS.

INTRODUCTION

*Asparagus asparagoides* (L.) W.Wight, Asparagaceae is a climbing perennial. The plant reproduces from seeds contained in red fruits and vegetatively via an extensive mass of rhizomes with tubers attached. It has become well-established and is a serious environmental weed in the temperate regions of southern Australia, and has been declared a Weed of National Significance (Thorp and Lynch 2000).

Spread of *A. asparagoides* is largely dependent on the dispersal of its seeds to suitable sites by birds (Stansbury 2001). While most seeds dropped by foraging birds fall near the parent plants (Stansbury 1996), it is the infrequent long distance dispersal of seeds that will determine how far the plant spreads (Neubert and Caswell 2000). Once a seed is dispersed it must germinate and grow, thus post-dispersal success is important for establishment of a new population (Lavorel *et al.* 1999). While *A. asparagoides* has been observed growing in clumps under trees it is not known whether this is due to suitable microhabitat conditions or preferential seed deposition at such recruitment foci (Raymond 1999). Since *A. asparagoides* is primarily a bird-dispersed weed, both landscape elements that affect bird dispersal and vegetation types that affect seedling establishment may be important factors that limit or enhance its spread.

MATERIALS AND METHODS

Site selection The study site is on Phillip Island, approximately 100 kilometres south east of Melbourne. Phillip Island has an area of 100 km² and contains urban centres, cleared grazing land and small areas of remnant native vegetation. The site chosen for this study is the Oswin Roberts Koala Reserve and some adjacent pasture (hereafter referred to as the reserve), located in the northeast corner of Phillip Island (Figure 1).

The reserve is a managed remnant native vegetation patch and contains a number of heterogeneous landscape elements including public access tracks, bounding road elements, a variety of vegetation classes and edge effects induced by the adjoining agricultural elements of sheep and cattle grazed pastures. *Asparagus asparagoides* invasion of the reserve is a relatively recent phenomenon. Local landholders began to notice it near the reserve in 1997 and park management were definitely aware of *A. asparagoides* in the reserve by 1999.

Quadrat location and sampling The location of *A. asparagoides* together with a number of landscape attributes were recorded in the field using a Global Positioning System (GPS) receiver capable of sub-meter accuracy (Trimble 2001). The study site was systematically sampled using a regular grid of 20 m × 20 m quadrats spaced 125 m apart in the grazed

![Figure 1. Oswin Roberts Reserve, Phillip Island.](image-url)
land and 63.5 m in the actual reserve (Figure 2). In total, 410 quadrats were sampled. The fieldwork took place between July and November 2002. The spatial data were exported as shape files into the Arcview® 3.2a Geographic Information System (GIS) software package (ESRI 2000) for subsequent analysis.

A quadrat of 400 m² provided an extensive sampling strategy that was relatively quick and repeatable and enabled the use of the ‘site concept’ for the collection of a variety of associated landscape attributes (McDonald et al. 1990). Vegetation cover abundance was estimated by eye and recorded using the Braun-Blanquet cover abundance scale (Table 1) (Mueller-Dombois and Ellenberg 1974). Quadrats where A. asparagoides cover class was 1 or greater were defined as potential sources of seed for dispersal to a new location.

Based on the appearance of tubers retained on the rhizomes, it is possible to obtain an approximate age for A. asparagoides. Clumps of A. asparagoides may have arisen from one or several seedlings and their age cannot be determined precisely. Plants that germinated in the current year do not have a tuber. Year old tubers are white, and year two tubers are brown. Tubers older than three years generally appear dark and shrivelled. Given the known recent arrival of A. asparagoides at this site it is reasonable to assume that the plants in abundant sites are older. It is therefore possible to map the invasion process of A. asparagoides over time. This assumption only fails if cover remains low in some quadrats over an extended period due to herbivory or sub-optimal growth conditions. As a test of the assumed age/cover relationship, where cover was rated in the three lowest categories, plants were dug out and the tubers examined to determine approximate age.

RESULTS

Asparagus asparagoides was recorded in 143 of the 410 quadrats. Well established A. asparagoides infestations commonly cover the ground almost completely but in this study site quadrats with very abundant A. asparagoides were quite rare (Table 2). Quadrats with low levels of cover contained young plants, rather than older, suppressed plants.

The Braun-Blanquet cover scale was modified (the two highest cover classes occurred in three quadrats) and the categories were mapped (Figure 3) as a means of estimating the change in distribution over time.

The map suggests that A. asparagoides has dispersed into the field site from two loci. The central core of the site has remained relatively free of A. asparagoides and implies there are two invasion fronts. During the early stages of establishment, A. asparagoides followed the tracks within the reserve.

Figure 2. Location of quadrats within the study site.

<table>
<thead>
<tr>
<th>Cover class</th>
<th>% Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>75–100</td>
</tr>
<tr>
<td>4</td>
<td>50–75</td>
</tr>
<tr>
<td>3</td>
<td>25–50</td>
</tr>
<tr>
<td>2 – very common</td>
<td>5–25</td>
</tr>
<tr>
<td>1 – common</td>
<td>1–5</td>
</tr>
<tr>
<td>f – few</td>
<td>&lt;1</td>
</tr>
<tr>
<td>r – rare</td>
<td>&lt;&lt;1</td>
</tr>
</tbody>
</table>

Table 1. Braun-Blanquet cover scale.

<table>
<thead>
<tr>
<th>Cover class</th>
<th>Number of quadrats</th>
<th>% of quadrats</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>2 – very common</td>
<td>51</td>
<td>35.7</td>
</tr>
<tr>
<td>1 – common</td>
<td>42</td>
<td>23.8</td>
</tr>
<tr>
<td>f – few</td>
<td>34</td>
<td>29.4</td>
</tr>
<tr>
<td>r – rare</td>
<td>13</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Table 2. Cover classes and number of quadrats containing A. asparagoides.

Within the last two years the plant has spread away from the tracks.

There are two quadrats within the pasture on the western side of the reserve in which A. asparagoides was recorded in cover classes ‘few’ and ‘rare’. These quadrats were located in sites that had been recently fenced off by the landowner as part of the Land for Wildlife program on Phillip Island. The nearest potential sources where seed production was occurring at the time of fencing off, were located from 360 to 380 metres away. None of the other quadrats in the pasture area contained any A. asparagoides.
DISCUSSION

In summary, *A. asparagoides* did not randomly enter the reserve. The cluster of points at the north and south of the reserve indicates the invasion originated from two loci. The initial stages of invasion follow the tracks before moving into the centre of the reserve. Finally, no *A. asparagoides* was recorded in areas where sheep and cattle grazed. The central part of the reserve, which at the time of sampling was sparsely colonised, has similar soils and topography to the more heavily populated adjoining areas. Therefore, *A. asparagoides* has the potential to invade the centre of the reserve.

The observation that *A. asparagoides* appears to have followed tracks and pathways is interesting since the tracks in this reserve, being narrow and lightly used, do not appear to have a large effect on the adjacent habitat. Further work is proceeding to investigate the role of tracks and other landscape elements.

One possible explanation for both preferential spread along tracks and surprisingly slow invasion of the centre is that a native herbivore may be affecting the success of *A. asparagoides* seedling establishment. The reserve supports a number of swamp wallabies that avoid the paths and boundaries, keeping more to the centre. *Asparagus asparagoides* is known to be palatable to macropods and there has been a previous report (Carr 1996) of it increasing dramatically at a site in Western Australia after exclusion of grazing by tammars (*Macropus eugenii*) (Desmarest 1817).

Total exclusion of *A. asparagoides* by livestock grazing is not unexpected as it confirms landowner observations that *A. asparagoides* is eaten by sheep and cattle. Rapid colonisation of areas several hundred metres away following exclusion of grazing demonstrates the potentially rapid dispersal of *A. asparagoides* at this site and accords with previous work showing that avian dispersal is likely to be highly effective (Stansbury 2001).

The final site of seed deposition will be the result of two interacting factors. Disperser behaviour will determine which sites are chosen for seed dispersal and landscape variability will modify disperser behaviour. Since each avian frugivore species has its own species specific dispersal behaviour (Jordano and Schupp 2000) any additional frugivore species may further complicate dispersal. Improvement of wildlife habitat may lead to introduction of different avian dispersers with their own particular behaviours, potentially accelerating spread.
In a largely cleared and grazed landscape, spread of *A. asparagoides* by avian frugivore dispersal vectors along roadsides and wildlife corridors has potentially large effects on the rate at which remnant native vegetation patches are invaded. By connecting disparate habitat, seed dispersal and establishment in widely separated vegetation remnants is no longer dependent upon rare long distance dispersal events.

A number of implications for management arise from these observations. If tracks within the reserve act as a conduit for invasion, control programs should prioritise these areas. Another approach could be to reduce the number of tracks within a reserve, particularly if it is ecologically sensitive and/or relatively small in area. A more controversial measure would be continuation of controlled grazing in areas that are currently being fenced off and revegetated. Grazing is a very effective control measure for *A. asparagoides* as seen from the pasture quadrats and may be more feasible for some land managers than ongoing searches and chemical control of new seedlings.

Understanding the influence of different landscape elements on the spread of *A. asparagoides* should ultimately allow the construction of a GIS model in which the implications of different land management options can be tested, thus allowing more informed decision making. A model of this sort could then in principle be extended to any bird-dispersed weed for which adequate data exist on disperser behaviour and weed habitat requirements.

**ACKNOWLEDGMENTS**

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**REFERENCES**


