Distribution and potential impact of *Opuntia aurantiaca* (tiger pear) along Little River, Victoria

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Summary

Tiger pear *Opuntia aurantiaca* is a sterile species which is dispersed vegetatively along water courses. It is a major pest in New South Wales and Queensland, but is recorded from only five locations in Victoria. The main infestation is along Little River between Ripley Bridge and the River outlet into Port Phillip Bay. The potential for significant spread of tiger pear downstream is of concern because of the Ramsar wetlands. Tiger pear infestation is more frequent on the westerly side of Little River (64%) compared with the easterly side of the river (36%). The upstream sections of Little River are more severely infested than the downstream sections, and vegetation loss and soil degradation are more severe. Along the downstream sections, tiger pear is restricted to the major river bends, but is beginning secondary spread. It is likely tiger pear will spread to other watercourses. Small populations, mostly single plants, have already dispersed into swamps near the mouth of Little River.

Introduction

The history of *Opuntia aurantiaca* Lindley (tiger pear or jointed cactus) in Australia is uncertain. The species was first noted in New South Wales in 1883, and by 1911 tiger pear's potential as a weed in New South Wales and Queensland was well recognized. It was estimated to cover a total of 181 000 ha on 2100 properties (Parsons and Cuthbertson 1992). In Queensland, control has been achieved using the cochineal insect (*Dactylopius austrinus* De Lotto), however tiger pear remains the main cactus pest in New South Wales (Hosking *et al.* 1988). Within Victoria there are five recorded infestations of tiger pear (Flora Information System, DNRE, Victoria), with the largest found along Little River (Figure 1).

Tiger pear is a low-growing succulent shrub characterized by jointed stems bearing extremely sharp spines. Dense clumps of the cactus often have an orange/scarlet appearance. It is thought to be a sterile hybrid between the South American species *Opuntia salmiana* Parm. and *Opuntia discolor* Br. & R. (Hosking and Deighton 1979), although Moran and Zimmermann (1991) consider that its hybrid origin is unresolved. Tiger pear is dispersed when segments (cladodes) are transported by water-flow, particularly during floods (Auld *et al.* 1982), or by attaching to animals or to vehicles (Gibbs 1999a). Tuberous roots are formed once the dispersed cladodes are partially covered with soil (Parsons and Cuthbertson 1992). Infestations generally follow watercourses (Parsons and Cuthbertson 1992), and flood events in NSW have played a major role in long-distance dispersal (Hosking and Deighton 1979). However, tiger pear does not appear to be limited to areas adjacent to rivers, and in South Africa it is reported to have 'infilled' areas between rivers (Auld *et al.* 1982). Along Little River, Victoria, the main dispersal vector is floodwater, with animals and humans facilitating secondary dispersal of segments of tiger pear away from the river (David Dance personal observation).

All *Opuntia* species are drought resistant, and can grow in climates with 150 mm annual rainfall at the dry extreme, to areas that have 800 mm annual rainfall (Parsons and Cuthbertson 1992). Like all cacti *Opuntia* species use crassulacean acid metabolism (CAM), an important water conservation strategy (Hosking *et al.* 1988), and detached segments can survive for several years (Parsons and Cuthbertson 1992). Given its drought and climatic tolerances, it is most unlikely that tiger pear has reached its potential distribution in Victoria, and its status as a sleeper weed is cause for considerable concern. Access to infestations is frequently difficult, making herbicide application and mechanical control extremely costly. Biological control is being attempted at Little River with the release of cochineal insect (*Dactylopius austrinus*) in 1999 (F. Mahr personal communication).

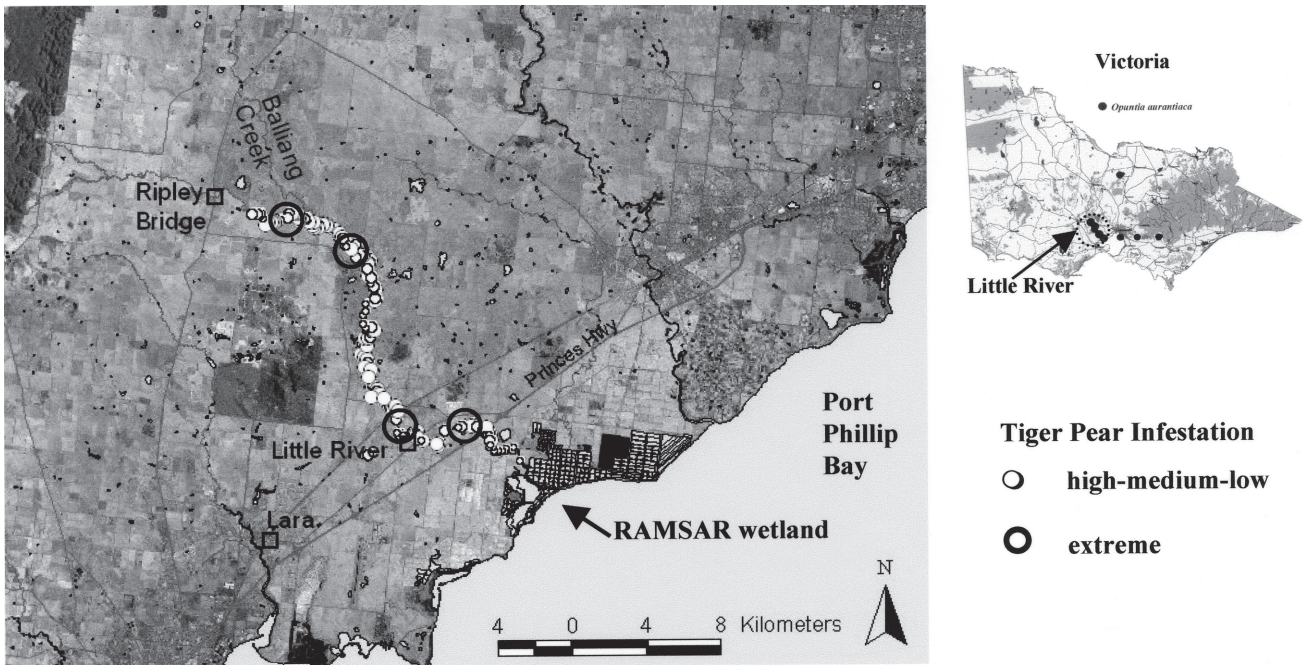

Figure 1. Distribution of tiger pear in Victoria, and infestation levels along Little River, Victoria.

The apparent spread of tiger pear downstream along Little River is of concern because of the potential for environmental degradation in sensitive sites for bird conservation, such as Lake Borrie, part of the Ramsar wetlands (Ramsar No. 5AU018 Port Phillip Bay and Bellarine Peninsula) within the land managed by Melbourne Water (Gibbs 1999b). The primary aim of this field survey was to map in detail the distribution of tiger pear along Little River, so that the pattern of weed infestation and spread could be used for planning strategic control by the municipalities involved.

Methods

Little River forms the boundary between the City of Greater Geelong and the City of Wyndham, and the survey area covered the stretch of Little River from Ripley Bridge to the river outlet into Port Phillip Bay. The survey covered approximately 20 m either side of Little River, and included the riparian strip characterized by extensive rocky outcrops, mature *Eucalyptus camaldulensis*, (river red gum), and a mix of grasslands, pasture, and cropland. Grassy weeds and *Lycium ferocissimum* (boxthorn) were common along the whole riparian strip.

The river was surveyed on foot between November 1999 and August 2000, in 100 m segments and each 100 m × 20 m (0.2 ha) quadrat was scored as high, medium or low infestation level. The level of infestation was determined by a visual estimate of the percentage cover over the quadrat. Infestations recorded as 'high' covered at least half the quadrat; 'medium' infestations covered 10–50%; 'low' infestations covered approximately 1–10% of the quadrat.

The high infestations were subsequently divided into two categories, 'high' and 'extreme'. The first category comprised high infestations which were relatively isolated from other high infestations, and therefore not continuous over a large area. These isolated high infestations were more commonly associated with large rocky outcrops, and fence lines within 20–30 metres of the river banks. The second category of 'extreme' infestation comprised infestations which were contiguous and which covered large stretches of the riverbank.

The location of each infestation was recorded using a Magellan 3000 GPS, and later mapped using Arc View 3.2. Each point on the map represents the total 100 m in which the infestation falls.

To gain a general impression of the environmental context of tiger pear, the habitat of the infestation (bare earth, introduced vegetation, rockiness, etc.), size of individuals, clump pattern, position on the slope of the flood-river channel, and potential vectors of dispersal (vehicles, rabbits, stock) were also noted.

Results

Tiger pear is found along both banks of Little River but is not evenly distributed. High and extreme infestations were more frequent and generally more severe in upstream sections of the River compared with downstream sections approaching the Ramsar wetlands within Melbourne Water's sewage treatment facility (Figure 1).

The contiguous pattern and severity of infestations in the upstream section of Little River suggests that this area was colonized by tiger pear earlier than the downstream section. Within the downstream sections of Little River the infestations are further apart, and are clustered around the sharp bends in the River. Infestations were observed more frequently amongst rocky outcrops or fences that provided physical 'traps' for segments, and shelter after flood events. However, the extreme infestations were generally in areas devoid of large rocky outcrops. These infestations covered areas of rabbit-disturbed soils dominated by introduced grasses and *Lycium ferocissimum* (boxthorn). The association and abundance of tiger pear among rabbit warrens, along livestock tracks, fence lines and access tracks, suggests that the secondary vectors (rabbits 63%, livestock 29%, vehicles 8%) disperse tiger pear segments quite effectively and regularly (Figure 2). The abundance of shotgun cartridges throughout the area surveyed suggests that people are also probable dispersal vectors.

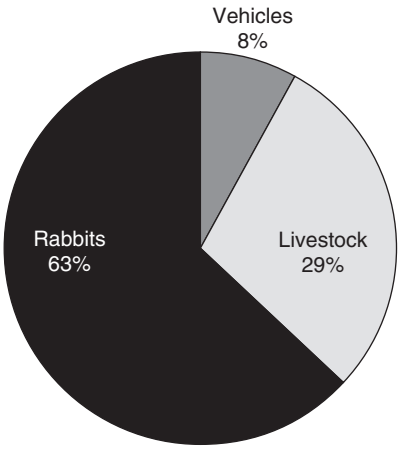

Figure 2. Proportions of the tiger pear infestations on Little River associated with potential vectors.

Tiger pear infestation was more frequent and infested a larger area on the City of Greater Geelong side of Little River (n = 137, approx. 11.5 ha) compared with the City of Wyndham side of the river (n = 78, approx. 4.9 ha) (Table 1). Two thirds of all the high infestations, and all of the infestations classed as extreme, occurred on the City of Greater Geelong side. The City of Wyndham side had lower tiger pear infestation levels in all categories, and contained no extreme infestations. This pattern may reflect the level of landowner awareness and action along the River.

Discussion

Tiger pear infestation appears to start between Ripley Bridge and Balliang Creek (Figure 1), and the upstream sections of Little River are more severely infested than the downstream sections. The distribution pattern confirms that dispersal occurs initially through the long-distance movement of segments by floodwaters (Hosking and Deighton 1979), and suggests that the segments tend to accumulate in the sharp bends of the river – the most likely areas to act as tiger pear-segment 'traps'. The secondary spread of tiger pear segments involves transport vectors such as rabbits, livestock, vehicles and humans. There was no directional trend associated with this secondary dispersal, but it is likely that segments will be spread to other watercourses in the area, such as Lollipop Creek, Skeleton Creek and the Werribee River, and that infill between watercourses is also likely (Auld *et al*. 1982).

The upstream section represented a more advanced stage of tiger pear colonization, where the infestation clumps were less distinct, and secondary spread had resulted in infilling between the initial clumps to form extreme infestations. Upstream, infestations are associated with significant environmental degradation. Tiger pear appears to displace both pasture and native vegetation, and the severe soil degradation associated with rabbit warrens may facilitate infilling.

The downstream sections of Little River appear to be in a 'pioneering' stage of tiger pear colonization, where separate clumps of tiger pear are restricted to the major

Table 1. Distribution (per cent) of tiger pear infestations on either bank of the Little River, Victoria.

Infestation Level (n=215)	City of Greater Geelong (western bank) (n=137)	City of Wyndham (eastern bank) (n=78)
High	27%	10%
Medium	19%	10%
Low	18%	16%
Total infested sites	64%	36%

river bends, and the process of secondary spread is beginning. Small populations, mostly single plants, have already dispersed into Melbourne Water land along Little River, and tiger pear is recorded from at least one swamp within the land managed by Melbourne Water (F. Mahr personal communication).

At present tiger pear is mainly confined to the banks of Little River, secondary dispersal through rabbits and livestock could further spread segments into more environmentally sensitive areas. However, the potential for floodwaters to spread large numbers of segments into the Ramsar wetlands owned by Melbourne Water is high, and increases as infestations spread downstream.

Cochineal insect releases were made in December 1999 (F. Mahr personal communication) into two areas of high infestation. Cochineal insects disperse by wind, but dispersal is not effective in areas with isolated clumps of tiger pear (Moran and Annecke 1979). Dispersal distance is about 2.5 m from the source, and tiger pear densities less than 1 plant m^{-2} result in poor colonization (Moran and Zimmermann 1991). Successful control by cochineal insect requires its release into infestations which will facilitate natural colonization, and the sections of Little River with high and extreme infestations, which should be suitable as future release sites, have now been located (Figure 1).

Mechanical removal or chemical treatment of small infestations, in conjunction with biological control of the larger ones, and continued landowner education and assistance, could provide an effective and co-ordinated approach to tiger pear control for both Municipalities along Little River.

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