Flood induced recruitment of lippia (*Phyla canescens*).

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Introduction

Lippia (*Phyla canescens*) is an invasive herbaceous ground-cover of floodplain pastures and wetlands, particularly in the northern catchments of the Murray Darling Basin. It is estimated to cost the grazing industry $38 million annually, primarily in lost production, through the displacement of more valuable species (Earl 2003). Little is known of the recruitment biology of lippia but it may increase substantially in range and abundance after floods. This paper describes recruitment after a single flood event.

Methods

A moderate flood event occurred between 30 June and 3 July 2005 at 'Glen Arvon' (30°11'20"S 149°31'30"E), 10 km east of Wee Waa, northern NSW. On 6 September 2005, three 28 m transects were randomly placed across a 150 m length of a billabong on the Namoi River floodplain. Each transect ran perpendicular to the edge of the billabong, and was divided into three zones (Table 1). The lower edge of zone 1 (0 m elevation) was the water level at the time of sampling. The boundary between zones 1 and 2 (0.16 m) was the upper extent of spike-sedge (*Eleocharis plana*). The flood strand-line was located at the boundary between zones 2 and 3 (0.42 m). A square 25 cm quadrat was placed at 1 m intervals along each transect, the first quadrat being located randomly within the first metre of each transect. The number of individuals of lippia per quadrat were recorded and categorised as: seedlings (small erect plants with cotyledons), fragments (small horizontal pieces of stem, rooting into the substrate) or adults (well established individuals, apparently present prior to the recent flood event). The site was being grazed by sheep at the time. Frequency data for each plant type were subjected to chi square tests.

Results

From 81 quadrats, 217 recruits were recorded, of which 147 were seedlings and 70 were vegetative fragments. Mean density was highest for seedlings in zone 1, at 45.6 per square metre (Table 1). With the exception of just three seedlings, all recruits were recorded below the flood strand-line. Of these three exceptions, two occurred in quadrats within 1 m horizontally and 50 mm vertically of the strand-line. Thirteen seeds were found to have germinated directly from sheep faeces.

Within plant types, no significant differences in frequency (number of quadrats in which plant type was present) were evident for comparisons between zones 1 and 2 for seedlings ($P = 0.4142$) and for fragments ($P = 0.0561$), and between zones 2 and 3 for adults ($P = 0.3794$). All other comparisons represent significant differences (for all, $P \leq 0.0055$, accounting for Bonferroni adjustment for multiple comparisons).

Between plant types, frequency of adults was significantly different from both seedlings ($P < 0.0001$) and fragments ($P < 0.0001$), but only in

Table 1 Mean density per square metre (number/m^2) and percentage frequency in quadrats (% of quadrats occupied) by plant type for each zone.

Zone	Relative elevation (m)	Dominant vegetation	Seedlings		Fragments		Adults		Number of quadrats
			Density (no./m^2)	Frequency (%)	Density (no./m^2)	Frequency (%)	Density (no./m^2)	Frequency (%)	
1	0-0.16	Spike-sedge	45.6	44.4	7.7	40.7	3.0	11.1	27
2	0.16-0.42	Bare mud, lippia	39.7	55.5	33.8	66.7	32.6	74.1	27
3	0.42-1.07	Medic, lippia	1.8	11.1	0.0	0.0	18.4	63.0	27
		Mean	29.0	37.0	13.8	35.8	18.0	49.4	81

zone 3. All other comparisons between plant types within zones were not significant.

Discussion

In this study, seedlings and fragments both made substantial contributions to overall recruitment and both appear highly dependent on flooding, as indicated by their almost complete absence above the strand-line. This is also the first record of lippia germinating from material that has survived gut-passage (sheep faeces), which may be an important but manageable dispersal mechanism. Fragment dispersal by flood was limited by the height of the strand-line.

Adult plants were less frequent in zone 1, suggesting a restricted ability of lippia to persist in this zone. Without 'before' data we cannot suggest if this pattern was due to mortality from prolonged inundation (McCosker 1994) during recent or earlier flood events, competition from other species such as spike-sedge or other factors.

It remains untested whether the recruitment pattern described here holds for floods in other seasons, or for rarer and larger floods. The survivorship of the recruits in this study is not known, but results from another study (Macdonald unpublished data) suggest high mortality occurs with the onset of dry conditions. Given that recruitment in this species appears highly flood dependent, management interventions immediately following such an event may be important for the sustainable management of this species in perennial pastures and wetlands.

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