Botanical diversity within two saline ecosystems in southwestern Australia

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Abstract

Species composition within two typical saline paddocks in southwestern Australia was assessed in the spring and autumn. Plant diversity within the paddocks was much higher than the diversity that is often found in non-saline pastures in these areas. The Meckering paddock contained 31 plant species, and the Tammin paddock contained 24 plant species. It is expected that high levels of plant diversity within paddocks are maintained by niche differentiation; i.e. no one species can dominate in all of the functional niches within the paddock. In light of the inherent variation within saline areas, it is unlikely that monocultures of sown species will be optimal when revegetating saline land.

Key Words

Salinity, halophyte, ecology, saltbush.

Introduction

In southwestern Australia, 10 % or 1.8 million ha of the farmed area is affected by dryland salinity and a further 6 million ha are threatened (1). One option for farmers is to plant salt-tolerant grasses, trees and shrubs in saline areas. These plants improve the visual amenity of saline land, provide feed for livestock, may reduce the spread of salinity and probably increase the biodiversity value of saline land. However, vegetation on saline land tends to remain patchy and there are few planting options available to farmers. The aim of this study was to assess botanical diversity within two paddocks that were once cropped and were subsequently sown with salt-tolerant species in the early 1980's after becoming saline. It was predicted that botanical diversity would be low due to salinity, waterlogging and past farming practice.

Methods

The paddocks that were studied in 2001 are situated near Meckering (130 km east of Perth) and Tammin (180 km east of Perth). Soil samples were collected across paddocks in March 2001 to measure electrical conductivity and peizometers were used to monitor the water table. Botanical composition was assessed in autumn and spring using the dry-weight rank method of Mannetje and Haydock (2). Briefly, the paddocks were crossed by five transects in both autumn and spring, with botanical assessments made every 15 m along transects. For each assessment, the three herbaceous plant species that appeared to contribute most biomass were ranked in descending order from 1-3. Rankings were totalled and multiplied by a weighting factor to give a percentage of biomass/species.

Results

The Meckering paddock (19 ha) was the more saline and waterlogged site as 20% of the area had become a bare salt scald. On average the soil was highly saline (EC_e 48 dSm^{-1}) and the saline water table (EC_w 27 dSm^{-1}) was 66 cm below the soil surface in March. The soils in the Tammin paddock (12 ha) were on average highly saline (EC_e 25 dSm^{-1}) and the groundwater (164 cm below the soil surface in March) was highly saline (EC_w 56 dSm^{-1}). The topography of both paddocks was undulating.

Table 1 summarises the results. The Meckering paddock contained 31 herbaceous plant species, of which five were sown (early 1980's) and 26 were volunteers. Only 23 % of the species were native to Australia. The most common species at the site in autumn were the grass *Puccinellia ciliata* and the halophytes *Atriplex undulata, A. lentiformis, A. semibaccata* and *Halosarcia* spp. In spring, the annual herbs *Mesembryanthemum nodiflorum* and *Cotula coronopifolia* formed 16.5 % of the botanical

composition. The Tammin paddock contained 24 plant species of which five were sown and 19 had volunteered. One third of the recorded species were native to Australia. The most common species were *Maireana brevifolia, Halosarcia* spp. and *Lolium rigidum*.

Table 1. Botanical composition (%) in autumn and spring of two salt-affected paddocks.

Species	Common name	Status	Origin	Tammin		Meckering	
				autumn	spring	autumn	spring
			Halophytes				
Atriplex amnicola	river saltbush	sown	Australia }			2.7	< 1.0
Atriplex nummularia	oldman saltbush	sown	Australia }	6.9	4.1	-	-
Atriplex semibaccata	creeping saltbush	sown	Australia }			4.2	1.0
Atriplex undulata	wavy-leaf saltbush	sown	Argentina }			19.2	6.5
Atriplex lentiformis	Quailbrush	sown	USA	-	-	6.1	7.5
Haloscaria spp.	Samphire	volunteer	Australia	21.2	27.9	9.5	8.4
Maireana brevifolia	small-leaved bluebush	volunteer	Australia	32.1	20.4	1.5	2.3
			Grasses				
Avena fatua	wild oat	volunteer	Mediterranean	< 1.0	< 1.0	< 1.0	< 1.0
Chloris virgata	windmill grass	sown	Australia	< 1.0	< 1.0	-	-
Eragostis curvula	African lovegrass	volunteer	South Africa	-	-	< 1.0	< 1.0
Eragostis dielsii	prostrate lovegrass	volunteer	Australia	10.5	3.6	7.1	3.3

Hordeum leporinum	barley grass	volunteer	Mediterranean	< 1.0	< 1.0	< 1.0	< 1.0
Hordeum marinum	sea barley grass	volunteer	Southern Europe	8.8	3.9	2.3	3.7
Lolium rigidum	annual ryegrass	volunteer	Mediterranean	8.3	17.7	6.4	3.5
Parapholis incurva	coast barbgrass	volunteer	Mediterranean	< 1.0	< 1.0	-	-
Paspalum vaginatum	saltwater couch	volunteer	America	< 1.0	< 1.0	1.1	< 1.0
Puccinellia ciliata	Puccinellia	sown	Turkey	-	-	34.0	30.8
Vulpia spp.	silver grass	volunteer	Mediterranean	10	2.8	< 1.0	3.4
			Other				
Arctotheca calendula	Capeweed	volunteer	South Africa	< 1.0	< 1.0	< 1.0	3.6
Conyza spp.	Fleabane	volunteer	America	-	-	< 1.0	< 1.0
Cotula coronopifolia	Cotula	volunteer	Australia	< 1.0	9.7	< 1.0	7.7
Heliotropium curassavicum	Heliotrope	volunteer	cosmopolitan	-	-	< 1.0	< 1.0
Hypochaeris radicata	Flatweed	volunteer	Europe	< 1.0	3.4	< 1.0	< 1.0
Juncus bufonius	Toadrush	volunteer	cosmopolitan	< 1.0	< 1.0	< 1.0	< 1.0
Juncus acutus	sharp rush	volunteer	Europe	-	-	< 1.0	2.7
Mesembryanthemum nodiflorum	Iceplant	volunteer	South Africa	-	-	< 1.0	8.6
Plantago coronopus	Buckshorn plaintain	volunteer	Europe	-	-	< 1.0	< 1.0
Ploygonum aviculare	wire weed	volunteer	Europe	-	-	< 1.0	< 1.0

Ptilotus polystachyus	mulla mulla	volunteer	Australia	-	-	< 1.0	< 1.0
Romulea rosea	onion grass	volunteer	South Africa	-	-	< 1.0	3.8
Rumex acetosella	Sorrel	volunteer	Europe & Asia	< 1.0	< 1.0	-	-
Trifolium arvense	haresfoot clover	volunteer	Mediterranean	< 1.0	< 1.0	1.9	< 1.0
Trifolium glomeratum	cluster clover	volunteer	Mediterranean	< 1.0	< 1.0	< 1.0	< 1.0
Trifolium subterraneum	Subterranean clover	volunteer	Mediterranean	< 1.0	< 1.0	< 1.0	< 1.0
Trifolium tomentosum	woolly clover	volunteer	Mediterranean	< 1.0	< 1.0	< 1.0	< 1.0

Conclusion

Plant diversity within the paddocks was as high or higher than the diversity generally found in non-saline pastures in the same areas. The presence of so many species suggests that there is either little competitive exclusion, little agronomic exclusion or the paddocks are divided into botanical niches. It is likely that high levels of plant diversity within paddocks are maintained by niche differentiation; i.e. no one species can dominate (or perhaps even survive) in all of the functional niches within the paddock. The suggestion of niche differentiation was supported by successional changes in species composition across salinity and waterlogging gradients at both sites (data not presented). This diversity should be considered when evaluating options for revegetating saline land.

References

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