

The distribution and extent of declared weeds and invader plants in the macro channel of the Olifants River System, Mpumalanga

W.J. MYBURGH and G.J. BREDEKAMP

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The vegetation associated with the macro channel of the Olifants River System was investigated to distinguish plant communities at a spatial scale of 1:250 000. The floristic data were analysed in terms of the sectional and longitudinal distribution and extent of declared weeds and invaders recorded during the survey. The results gained using the PHYTOTAB PC-classification and mapping program package revealed eight Grassland Biome and nine Savanna Biome plant communities from its origin near the town of Breyten up to the border of the Kruger National Park. It was found that different invader species/weeds are associated with different biomes and habitats along the river system and that an alarming number of these species occur throughout the system.

Key words : Olifants River System, macro channel, declared weeds, invader plants, canopy cover, constancy.

W.J. Myburgh ✉, Department of Nature Conservation, Tshwane University of Technology, Pretoria, 0001 Republic of South Africa.; *G.J. Bredenkamp*; Department of Botany, University of Pretoria, Pretoria, 0002 Republic of South Africa

Introduction

Cronk & Fuller (1995), in their review of the worldwide threats posed by invasive alien plants to natural ecosystems, described several major categories of threats. These include the replacement of diverse ecosystems with single species stands and the alteration of soil chemistry, geomorphological processes, fire regimes and hydrology. Invasions could also lead to the extinction of different species and the destruction of riparian habitats. Ecosystems in South Africa which are most effected by invader species are probably those habitats associated with river systems (Henderson & Musil 1987).

The Olifants River, the second largest river in the former Transvaal (now Limpopo and Mpumalanga provinces) is one of the most polluted rivers in the region. The initiation of this project was *inter alia* an attempt to obtain a holistic perspective of the current state of the vegetation associated with the macro channel and to identify the impacts,

including alien vegetation, which could lead to the further degradation of the macro channel and the river system (Myburgh 2000; 2001).

This publication focuses on the distribution and extent of declared weeds and invader plants occurring in the macro channel of the Olifants River System. The plant communities found along the Olifants River System, associated with the Grassland and Savanna biomes (Fig. 1), were described by Myburgh & Bredenkamp (2004a, 2004b).

Study area

The macro channel of the Olifants River System, from its origin near the town Breyten to Mamba weir at the border of the Kruger National Park (south east of Phalaborwa) was investigated (Fig. 1). This section of the Olifants River intersects four Veld Types as described by Acocks (1988), namely: Bankenveld, Sourish Mixed Bushveld,

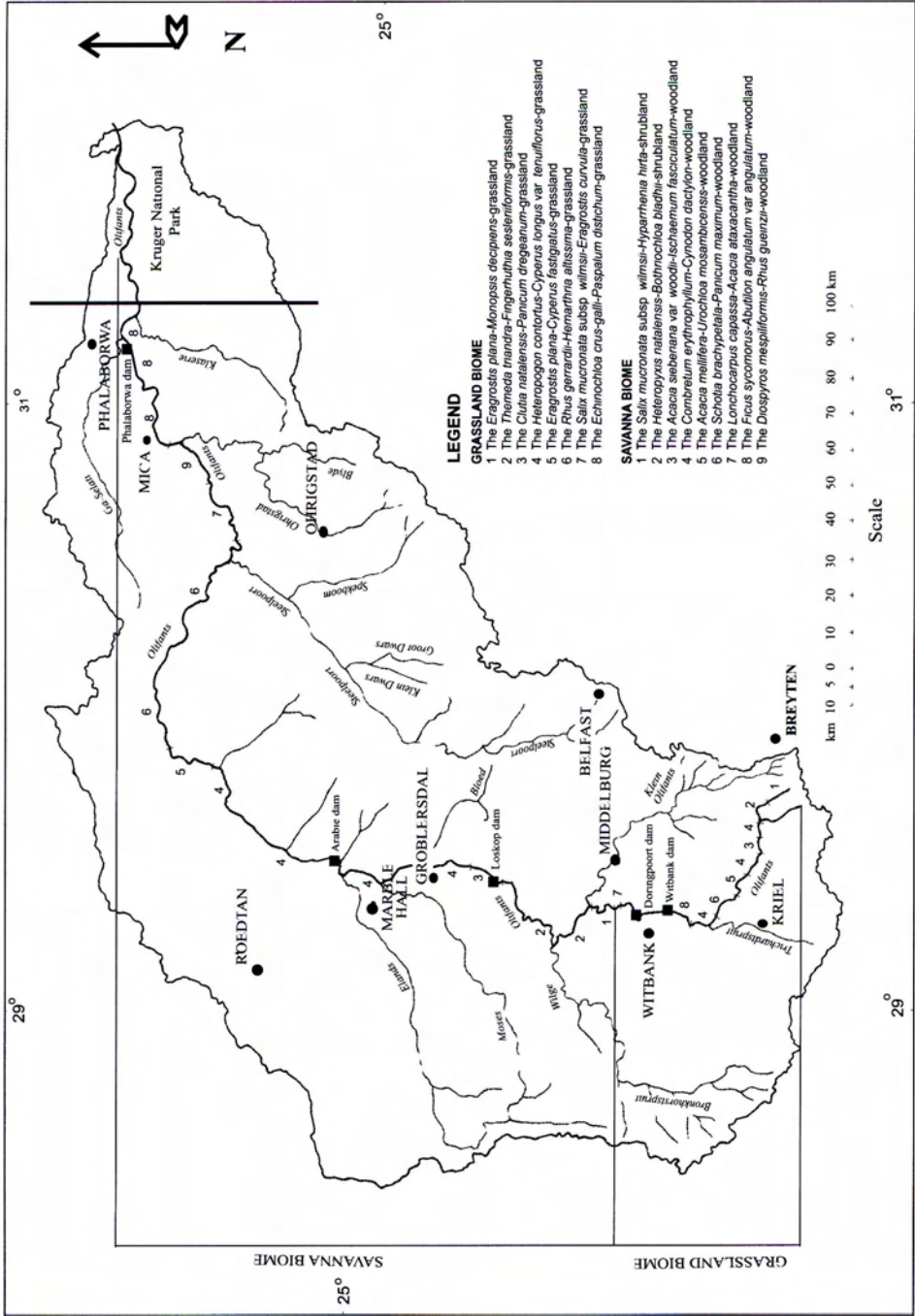


Fig. 1. Distribution of the plant communities associated with the macro channel of the Olifants River System.

Mixed Bushveld and Arid Lowveld and represents two biomes namely, Grassland and Savanna (Fig. 1)(Rutherford & Westfall 1986).

Methods

Various researchers (Vannote *et al.* 1980; Ward & Stanford 1987; Naiman *et al.* 1988; Townsend 1989) indicated that riparian vegetation changes from the origin of a river system downstream as the macro channel develops and changes. In order to include the largest possible section of the Olifants River System, from its origin up to the border of the Kruger National Park in this study, it was decided to use a spatial scale of 1:250 000. Geology was the most practical empirical data available at the mentioned scale and was used to stratify the macro channel of the Olifants River System.

Variable belt transects were placed out and floristic and habitat data were collected within these stratified units at 60 geo-referenced sample sites representing 119 relevés. The floristic data recorded at each of these relevés included species composition, growth forms and canopy cover using the Plant Number Scale (Westfall & Panagos 1988). The habitat data recorded at each sample site included the width of the macro channel, the slope and width of the macro channel bank, width of the active channel, the absence/presence of islands, former islands and seasonal channels and the percentage surface rock (on the banks, active and seasonal channels) (Myburgh 2000, 2001). Analyses of the floristic data, using the PHYTOTAB-PC computer program package (Westfall 1997), revealed that a large proportion of the species are alien with several of these species classified as weeds and/or invader species (Myburgh 2000, 2001; Myburgh & Bredenkamp 2004a, 2004b).

Results and discussion

During this study 527 plant species were recorded at 119 sample plots within the macro channel of the Olifants River, over a period of three years (1995-1997). Totals of 173 and 450 plant species were recorded in the Grassland and Savanna biomes respectively, while 96 species occurred in both biomes. The percentages of alien species recorded for the macro channel presented by

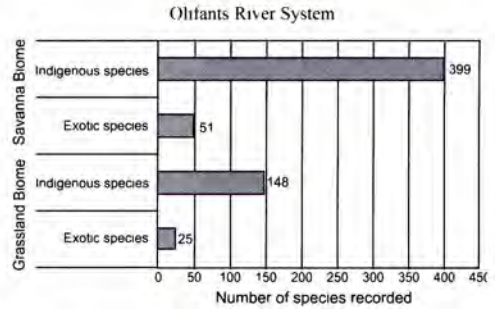


Fig. 2. Exotic plant species in relation to the total number of plant species recorded in the Grassland and Savanna biomes.

these two biomes were 14.5 % and 11.1 %, respectively (Fig. 2).

Agrestal weeds

Most of the alien species are opportunistic in nature and can be described as agrestal weeds, occurring mainly in disturbed areas. Hydrological events, varying flow regimes, water levels, and manmade structures and activities associated with the macro channels of river systems render a diverse degree of disturbance that produce habitats favoured by these species.

Annual weedy species such as *Tagetes minuta*, *Bidens pilosa*, *Gomphrena celosioides*, *Bidens formosa*, *Schkuhria pinnata*, *Conyza bonariensis*, *Zinnia peruviana* and *Richardia brasiliensis* were associated with disturbed open areas, either on the macro channel banks or in the channel bed. These species are typical examples of agrestal weeds, which are not thought to pose a serious threat to undisturbed natural areas.

Declared weeds and invaders

Only a small portion of alien plant species are able to invade natural or semi-natural habitats. These species are termed invasive aliens (Henderson 2001) or environmental weeds and could pose a serious threat to all

indigenous vegetation, if not effectively controlled. The Conservation of Agricultural Resources Act (Act 43 of 1983) amended in 2001, lists and categorises these environmental weeds as declared weeds and invader plants in South Africa. Seven of the plant species listed as declared weeds and invaders occur within the Grassland Biome section of the the Olifants River, while 19 aliens recorded within the Savanna Biome section of the macro channel are regarded as declared weeds and invaders (Table 1, Fig. 1).

The distribution and extent of these species are illustrated in terms of mean canopy cover and constancy within plant community boundaries (Tables 1 & 2). The canopy cover given is not site specific, but reflects a mean value for the species within a specific plant community, while the constancy indicates the number of times a specific species was recorded within a plant community and is expressed as a percentage.

Declared weed and invader species with widespread distributions or high mean canopy covers and/or constancies occurring in the macro channel of the Olifants River System include: *Acacia dealbata*, *Melia azedarach*, *Morus alba*, *Nicotiana glauca*, *Ricinus communis*, *Sesbania punicea*, *Cirsium vulgare*, *Datura stramonium* and *Xanthium strumarium*. These species are briefly discussed.

The invader species, *Acacia dealbata* is currently restricted to the transition between the Grassland and Savanna Biome sections of the macro channel of

Table 1
Distribution of declared weeds and invader plant species within the macro channel of the Olifants River System

Plant species	Community number		Mean canopy cover (%)	Constancy (%)
	Grassland	Savanna		
Trees:				
<i>Acacia dealbata</i>		1	6	80
		2	<1	64
	7.2		12	75
	8		4	25
<i>Gleditsia triacanthos</i>		4	<1	4
<i>Melia azedarach</i>		3	2	50
		4	2	54
		5	<1	33
		6	<1	20
		7	<1	33
		8	<1	36
		9	<1	70
		8	<1	50
<i>Morus alba</i>		3	<1	25
		4	<1	21
<i>Populus canescens</i>		8	<1	25
		3	<1	13
<i>Salix babylonica</i>		6	<1	33
Shrubs:				
<i>Lantana camara</i>		3	<1	13
		4	<1	18
		8	<1	50
<i>Nicotiana glauca</i>		6	2	90
		7	<1	100
		8	5	100
		9	1	100
<i>Prosopis velutina</i>		4	<1	4
<i>Ricinus communis</i>		2	<1	7
		4	<1	21
		5	<1	33
		6	<1	73
		7	<1	67
		8	2	79
		9	<1	90
<i>Rubus cuneifolius</i>		4	<1	7
<i>Rubus fruticosus</i>		4	<1	14
<i>Sesbania punicea</i>		7.2	2	100
		2	<1	13
		4	<1	25
		5	<1	33
		7	<1	17
<i>Solanum mauritanum</i>		4	<1	7
		8	<1	14
<i>Tamarix chinensis</i>		4	<1	7
Forbs:				
<i>Cirsium vulgare</i>		2	<1	25
		3	<1	50
		5	<1	60
		8	<1	75
		1	<1	20
	4	<1	4	

Table 1 (continued)

<i>Datura stramonium</i>	2	<1	7
	3	<1	25
	4	<1	18
	5	<1	67
	6	<1	57
	7	<1	67
	8	<1	50
	9	<1	50
	<i>Rivima humilis</i>	4	1
5		<1	67
<i>Solanum seaforthianum</i>	4	<1	25
<i>Xanthium spinosum</i>	6	<1	23
	9	<1	20
<i>Xanthium strumarium</i>	4	<1	11
	5	1	100
	6	6	97
	7	5	100
	8	3	100
	9	2	80

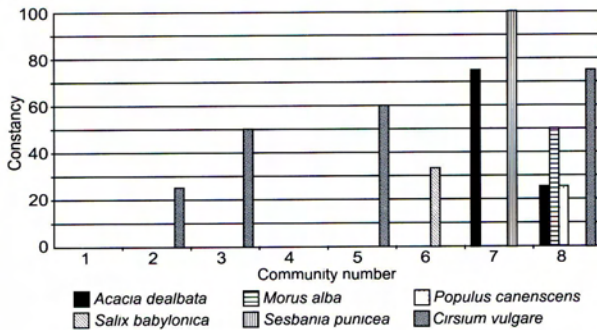


Fig. 3. The extent and distribution of declared weeds and invaders in the Grassland Biome section of the macro channel of the Olifants River System.

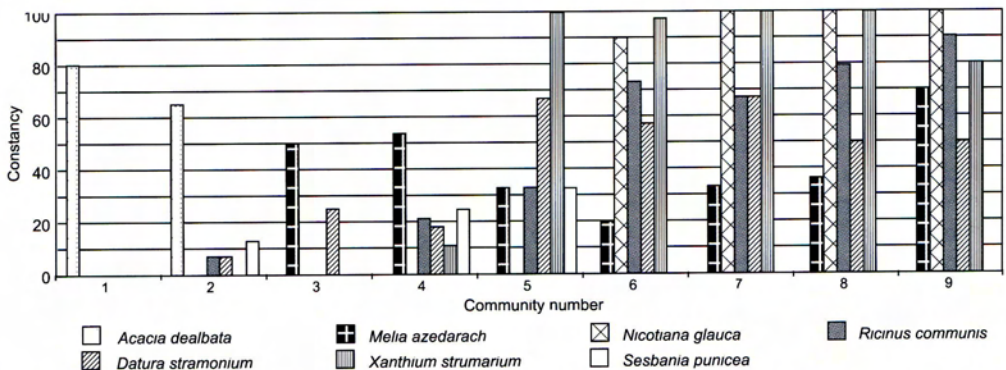


Fig. 4. The extent and distribution of declared weeds and invaders in the Savanna Biome section of the macro channel of the Olifants River System.

the Olifants River System, mainly occurring down stream of the Doornpoort Dam (Figs. 3 & 4). The mean canopy cover of this woody species, predominantly occurring on macro-channel banks (Fig. 5), range from < 1 % up to 12 % with a constancy of up to 80 % (Table 1). The 12 % canopy cover calculated for this invader species altered the appearance and structure of grassland plant community 7.2, being the only tree species recorded in this community. The tree canopy covers of 4 % and 6 % of the total tree canopy cover of 9 %, indicated for grassland community 8 and savanna community 1 respectively, are contributed by *Acacia dealbata* (Table 2).

The aggressive invader, *Melica azedarach*, although restricted to the Savanna Biome section of the macro channel, has a wide distribution within this section and occurs from directly down stream of Loskop Dam, through the Drakensberg Mountains up to Mamba bordering the Kruger National Park (Fig. 1 & 4). The mean canopy cover of this tree species can be described as low

varying from <1 % to 2 % (Table 1). *Melia azedarach* contributes 2 % to the mean canopy covers of the tree layers in both savanna plant communities 3 and 4 (Table 2). These individuals, which predominantly occur on the macro channel banks (Fig. 5), are however able to produce vast quantities of seeds, available for distribution down stream. The constancy of this invader species, varying from 20 % up to 70 % (Table 1), together with its wide distribution (occurring in a number of communities), indicate that it is well established on the macro channel banks and islands (Fig. 5) of the Olifants River System.

The small section of the macro channel of the river down stream of Doornpoort Dam near Witbank represents Community 8 within the Grassland Biome (Fig. 1). *Morus alba* is restricted to this localised area, and although this species has a constancy of 50 % within this section, the mean canopy cover is

<1 % (Table 1). This invader species, predominantly occurring on macro channel banks and islands (Fig. 5), is also present in low densities and constancies in Communities 3 and 4 of the Savanna Biome section of the macro channel (Fig. 1).

The invader species, *Nicotiana glauca*, although restricted to the Savanna Biome section of the macro channel, is widely distributed and occurs in Plant Communities 6, 7, 8 and 9 (Figs. 1 & 4). This species contributes a mean canopy cover of 5% to the mean total canopy cover of 12%, calculated for the shrub layer of Savanna Plant Community 8 (Table 2). This species predominantly occurs on channel bars, seasonal channels and ephemeral channels, with the exception of a few recordings on lower

Table 2
The contribution of the declared weeds and invaders plants in terms of mean canopy cover (M.C.C.) in the Grassland and Savanna Biome sections of the macro channel of the Olifants River System

Plant community number	M.C.C. (%) of plant community	M.C.C. (%) of various growth forms recorded in the plant communities					M.C.C. (%) of weeds/invaders
		Trees	Shrubs	Dwarf shrubs	Grasses	Forbs	
Grassland Biome							
1	33	-	-	-	30	3	-
2	42	-	-	-	32	10<1	-
3	37	-	-	7	26	4	<1
4	56	-	-	1	50	5	<1
5	39	-	-	1	33	5	<1
6	38	-	4	2	23	9	<1
7 1	48	-	2	1	39	6	-
7 2	68	12	9	2	24	21	14
8	62	4	-	-	46	12	6
Savanna Biome							
1	55	9	14	2	16	14	7
2	43	7	13	1	17	4	2
3	74	9	5	3	42	15	4
4	65	12	9	4	23	17	8
5	47	12	9	2	12	12	4
6	52	18	11	2	10	11	10
7	43	16	7	1	9	10	8
8	63	27	12	2	15	7	12
9	56	28	10	1	7	10	5

macro channel banks (Fig. 5). *Nicotiana glauca* has a very high constancy within its distribution range, varying from 90 % up to 100 % (Table 1).

The weed, *Ricinus communis*, although not recorded in the section of the macro channel of the Olifants River from its origin up to the confluence with the Klein Olifants River, is widely distributed in the Savanna Biome section of the macro channel. This species is not restricted to channel bars and seasonal channels only, but also occurs on the macro channel banks (Fig. 5). The mean canopy cover recorded for *Ricinus communis* throughout the macro channel is low (<1 %). There is however a gradual increase in constancy of this species, ranging from 7 % up to 90% in the lowveld (Table 1; Fig. 4).

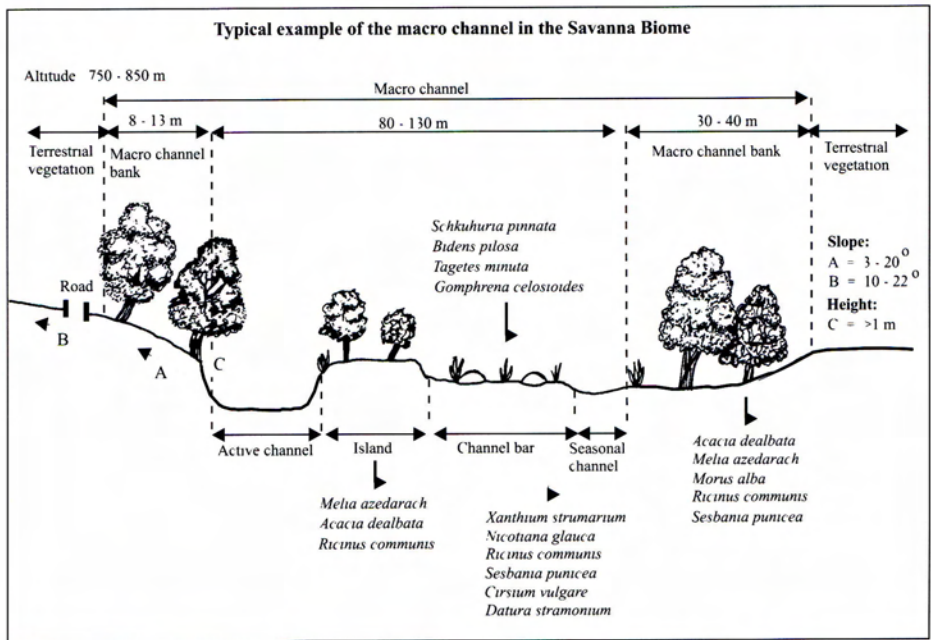
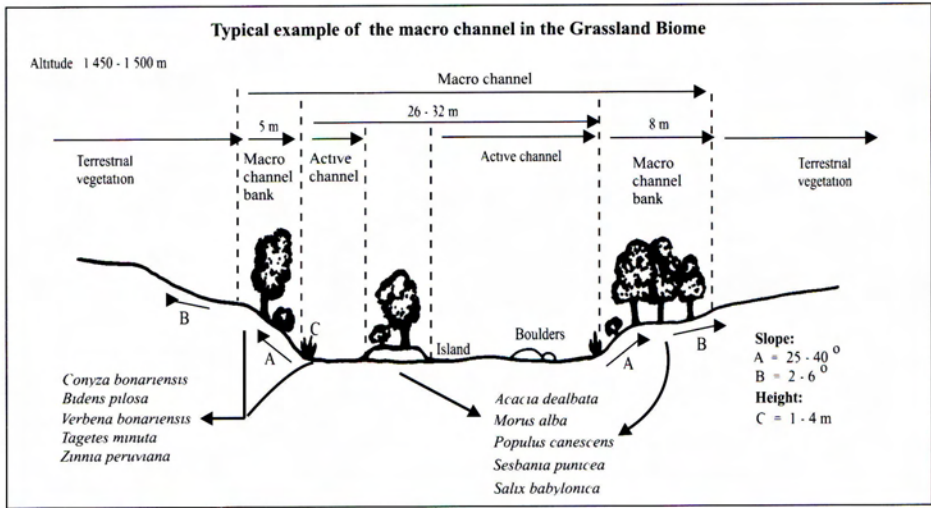


Fig. 5. Two typical examples of cross sections of the macro channel of the Olifants River indicating the preferred habitat of certain declared weeds and invaders.

The shrub *Sesbania punicea* is currently confined to a small area within the Grassland Biome section of the macro channel, on a diabase intrusion (Plant Community 7; variant 7.2) north of Witbank. This species, how-

ever, does also occur in the macro channel from the Klein Olifants/Olifants confluence up to the Burgersford/Polokwane National Road, with constancies varying from 13 % to 33 % (Table 1 & Fig. 1). *Sesbania punicea*,

although also occurring on the macro channel banks, predominantly establish on channel bars, seasonal channels and the active channel bed close to the water edge (Fig. 5).

The highest constancies of the weed, *Cirsium vulgare*, were recorded within the Grassland Biome section of the macro channel of the Olifants River. Although the mean canopy cover of this species never exceeded 1 %, constancies varied from 25 % to 75 % (Table 1). *Datura stramonium* is widely distributed through the macro channel of the Olifants River representing the Savanna Biome and was recorded in all the plant communities, except community 1 (Fig. 4). Constancies of 50 % or more were calculated in plant communities 5, 6, 7, 8 and 9 (Table 1).

The weed, *Xanthium strumarium*, is not as widely distributed as *Datura stramonium* and occurs in the macro channel down stream of Loskop Dam through the lowveld up to Mamba near Palaborwa (Fig. 1 & 4). This species generally dominates all the channel bars and seasonal channels (Fig. 5) in this section of the macro channel of the river system. The high densities of occurrence of this species are reflected in mean canopy covers of up to 6 % (Table 1). This species was recorded at almost every site surveyed down stream of the Burgersford/Polokwane national road, with constancies varying from 80 % to 100 % in the lowveld section of the macro channel.

Conclusion

Various declared weeds and invader plants characterise the macro channel of the Olifants River System, from its origin up to the border of the Kruger National Park at Mamba weir. There is a definite distinction between the occurrences of herbaceous weeds and woody invaders with regards to habitat selection. The herbaceous species primarily establish themselves on the lower lying fluvial landforms (depositional bars and channel bars) and seasonal and ephemeral channels, with minimum impact on the

indigenous woody species that mainly occur on the channel banks and islands. Most of the woody invader species are predominantly associated with the macro channel banks and islands and directly compete for resource space with the indigenous woody species. The time scales involved in altering the low-lying habitats (depositional bars, channel bars and channel bed) differ radically from those impacting on the higher lying areas (macro channel banks, islands and former islands) due to the frequency of flooding. The herbaceous plants have shorter life cycles, favouring the more regular changes in habitat.

Although many of the weed and invader species occur throughout the river system, certain species are restricted to either the Grassland or Savanna Biome sections of the macro channel. The climatic differences between these two biomes probably influence the distribution of these species. The woody invaders *Populus canescens* and *Acacia dealbata* are primarily restricted to the Grassland Biome including the transitional area between the two biomes. *Melia azedarach* and *Morus alba* tend to establish in the transitional area between the two biomes in a down stream direction, representing the Savanna Biome.

The intensity and extent of declared weeds and invader plants in the macro channel of the Olifants River System were alarming. Although the individual contribution to the mean total canopy cover of most of these species, with the exception of *Acacia dealbata*, *Nicotiana glauca* and *Xanthium strumarium*, seems to be low, the collective contribution of a number of these species may cause alterations in vegetation structure and species composition in the long term. Certain plant communities in the grassland section of the macro channel are already structurally altered by invader species, causing changes in the microhabitats of the indigenous vegetation. The eradication and/or control of these invader plant species should be a high priority in order to effectively manage and conserve biodiversity within this longitudinal ecosystem.

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