Macro-channel riparian vegetation of the Olifants River System in the Grassland Biome, Mpumalanga

W.J. Myburgh and G.J. Bredenkamp

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The vegetation associated with the macro-channel of the Olifants River System was investigated to identify plant communities mappable at a spatial scale of 1:250 000. The results obtained by using the PHYTOTAB PC-classification and mapping program package, revealed eight distinct plant communities associated with the macro-channel of this river system that occurs within the Grassland Biome.

Key words: macro-channel, Olifants River System, plant communities, riparian vegetation.

W.J. Myburgh ✉, Private Bag X680, Department of Nature Conservation, Tshwane University of Technogoly, Pretoria, 0001 Republic of South Africa; G.J. Bredenkamp, Department of Botany, University of Pretoria, Pretoria, 0002 Republic of South Africa.

Introduction

The Olifants River, the second largest river in the former Transvaal (now the Limpopo Province and Mpumalanga), is one of the most severely polluted rivers in the region (Olifants River Forum 1995). This project was initiated, *inter alia*, to obtain a holistic perspective of the current state of the vegetation associated with the macro-channel, including the extent and distribution of exotic vegetation within the macro channel of the river system (Myburgh 2000, 2001).

In the study, which was conducted over a period of four years, the vegetation was monitored prior to and after flooding events. This report focuses on the species composition and structure of the plant communities associated with the macro-channel of the Olifants River System within the Grassland Biome.

Study area

The Grassland Biome section of the Olifants River (Fig. 1) stretches downstream from the river's origin in the vicinity of the town Breyten, to the Witbank Dam (Rutherford & Westfall 1986). The vegetation of this area is broadly referred to as Bankenveld (Veld Type 61) (Acocks 1988).

The width of the macro-channel varies from only a few metres (< 5 m), with no distinct riparian vegetation zone on the river banks, to 32 m wide with a well-developed riparian zone quite distinct from the adjacent zonal grassland. This section of the Olifants River flows through a landscape that may, in general, be described as flat to rolling plains dominated by grassland, with woody plant species restricted to the rocky river banks. The catchment area surrounding the macro-channel is mainly used for agricultural and industrial purposes, with mining activities being the most prominent.

Methods

Various researchers (Vannote *et al*. 1980; Ward & Stanford 1983; Naiman *et al*. 1988; Townsend 1989) indicated that riparian vegetation changes downstream from the origin of a river system, as the macro-channel develops and changes. In this study, it was decided to use a spatial scale of 1:250 000, in order to include the Olifants River System from its origin to the western border of the Kruger National Park. Geological data were the most practical empirical data set available at this particular scale and were

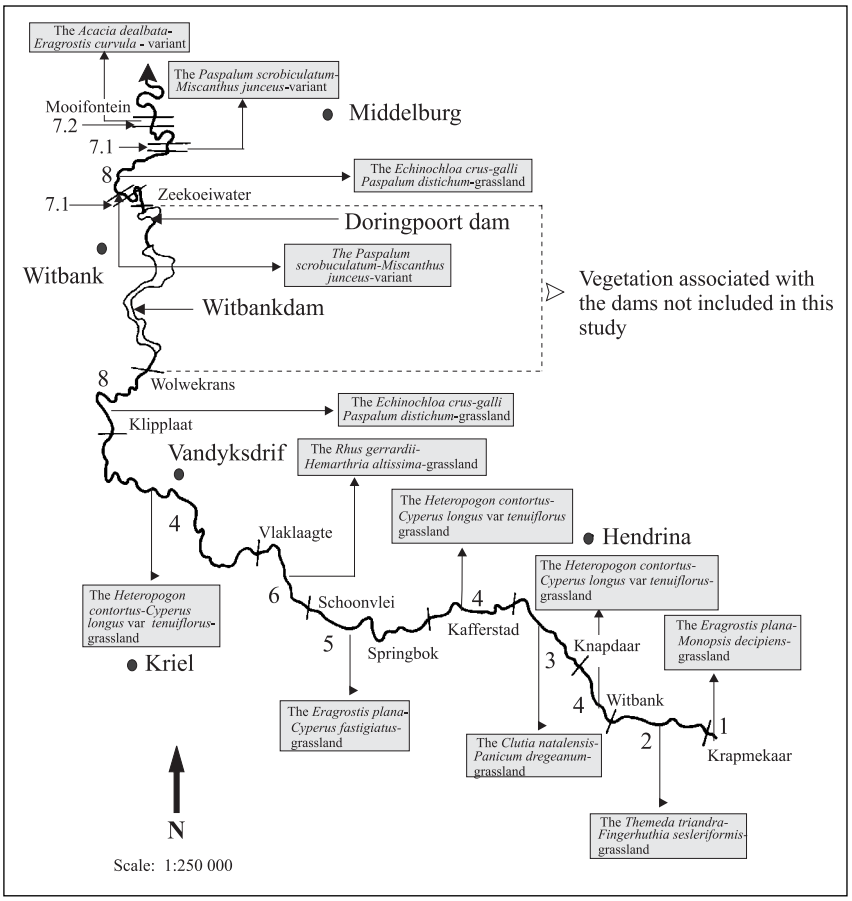

Fig. 1. Distribution of the plant communities of the Olifants River associated with the Grassland Biome.

therefore used as baseline template to stratify the landscapes through which the Olifants River flows.

The width of the riparian zone varies in correspondence to the slope and height of the banks at any given locality (Nilsson *et al.* 1994). An area-based vegetation sampling method was used to survey the vegetation. Variable-sized belt transects were placed within the stratified units. The number of sample plots placed in each stratified unit was calculated proportionally depending on the length of the unit. The width and length of the belt transects were influenced by the width of the channel bank and the species richness and growth forms present at a specific site. Floristic and habitat data were collected at 18 geo-referenced localities representing 36 relevés (>200 m²), since both macro-channel banks were surveyed as separate 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 floristic data were analysed using the PHYTOTAB-PC computer program package (Westfall 1997).

Results and discussion

A total of eight clearly recognisable plant communities, representative of the vegetation of this section of the macro-channel of the Olifants River System (Myburgh 2000, 2001), were identified, mapped and described

at a spatial scale of 1:250 000 (Fig. 1, Table 1).

1. The *Eragrostis plana-Monopsis decipiens* grassland

The *Eragrostis plana-Monopsis decipiens* grassland is represented by two relevés only. This grassland community represents primarily the grassland along the macro-channel banks of that section of the Olifants River that stretches from its origin to the Nooitgedacht farm (Fig. 1). The distribution is limited to the areas associated with the Ea Land Type (Land Type Series 1985a), which are characterised by rocks from the Karoo Sequence, at an altitude of about 1 750 m a.s.l. The soil depth at the top of the banks varies between 600 mm and 640 mm.

This section of the river has a single active channel in the macro-channel floor that is 1–6 m wide (Fig. 2). The tops of the banks are flat, with a slope gradient of ≤1°, and there is no clear riparian zone. The vegetation on top of the banks may be described as typically terrestrial *Eragrostis plana* grassland and it cannot be visually distinguished from the surrounding grassland. There are no

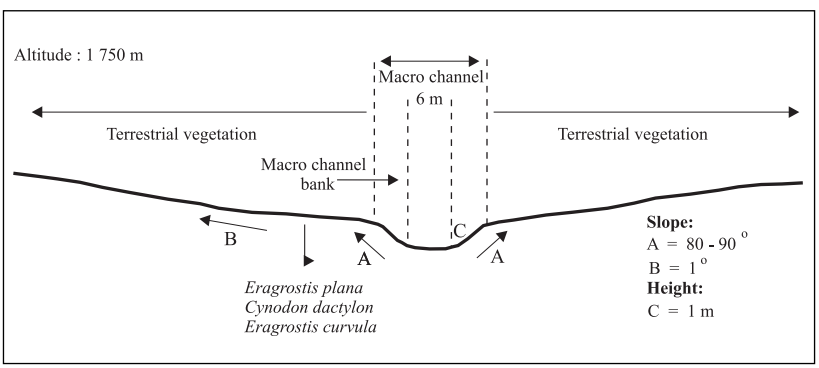

Fig. 2. River profile of the *Eragrostis plana-Monopsis decipiens* grassland

Table 1
Mean canopy cover (M.C.C) of the plant communities identified in the Grassland Biome section of the Olifants River

Plant community number	Mean canopy cover (%)					Total M.C.C. (%)
	Trees	Shrubs	Dwarf shrubs	Forbs	Grasses	
1	-	-	-	3	30	33
2	-	-	-	10	32	42
3	-	-	7	4	26	37
4	-	<1	<1	5	50	56
5	-	-	1	5	33	39
6	<1	4	2	9	23	38
7.1	-	2	<1	6	39	48
7.2	12	9	2	21	24	68
8	4	<1	<1	12	46	62

Table 2
Diagnostic species of the Eragrostis plana-Monopsis decipiens - *grassland (M.C.C. - mean canopy cover)*

Species name	Growth form	Consistency (%)	M.C.C. (%)
Monopsis decipiens	forb	100	<1
Cyperus esculentus	grass	50	<1

stones or rocks in the channel bed or on the banks.

This grassland is characterised by two diagnostic species (Table 2). On average, the canopy cover of both the forb *Monopsis decipiens* and the sedge *Cyperus esculentus* is <1 %. Dominant grasses are *Eragrostis plana*, *Eragrostis curvula* and *Cynodon dactylon*. The total average canopy cover of this grassland is 33 % (Table 1).

2. The *Themeda triandra-Fingerhuthia sesleriiformis* grassland

The *Themeda triandra-Fingerhuthia sesleriiformis* grassland is represented by four relevés and describes the floristics of both the macro-channel banks and the vegetation of the surrounding terrestrial grassland. As is the case with plant community 1, this plant community (Fig. 1) is associated with the Ea Land Type (Land Type Series 1985a) at an altitude of about 1 750 m a.s.l., but here the rock is typically dolerite. The soil depth varies between 700 mm and 1 000 mm, and the soil has a high clay content throughout (>55 % clay).

This section of the Olifants River has a single active channel that is < 17 m wide (Fig. 3). The river has cut into the landscape and consequently has steep macro-channel banks of about 2–3 m high. The vegetation above the macro-channel banks may be described as typical terrestrial *Themeda triandra* grassland on flat plains. The presence of large, isolated sheets of rock characterises parts of the active channel bed.

The grass species, *Fingerhuthia sesleriiformis*, *Brachiaria eruciformis*, *Aristida bipartita*, and the forb species, *Hemizygia* sp., *Haplocarpha scaposa*, *Falckia oblonga*, *Ledebouria* sp., *Anthospermum pumilum* subsp. *rigidum*, *Scabiosa columbaria* and *Jamesbrittenia montana* are diagnostic for this community (Table 3). Grass species, such as *Themeda triandra* and *Eragrostis plana*, and the forb *Haplocarpha scaposa* are dominant and have the highest average canopy cover. These plant species also occur in the adjacent terrestrial veld. *Fingerhuthia sesleriiformis, Brachiaria eruciformis, Cirsium vulgare, Tagetes minuta* and *Cyperus longus* var. *tenuiflorus* are mostly limited to

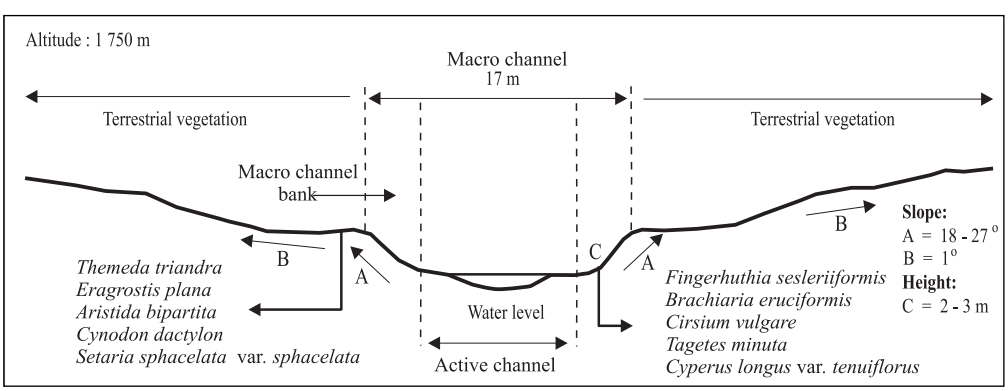

Fig. 3. River profile of the *Themeda triandra-Fingerhuthia sesleriiformis* grassland.

Table 3
Diagnostic spesies of the Themeda triandra-Fingerhuthia sesleriiformis *grassland*
(M.C.C. - mean canopy cover)

Species name	Growth form	Consistency (%)	M.C.C. (%)
Fingerhuthia sesleriiformis	grass	100	3
Hemizygia sp.	forb	100	<1
Haplocarpha scaposa	forb	75	3
Falcforbia oblonga	forb	75	1
Ledebouria sp.	forb	75	<1
Brachiaria eruciformis	grass	75	1
Anthospermum pumilum subsp. *rigidum*	forb	50	<1
Scabiosa columbaria	forb	50	>1
Jamesbrittenia montana	forb	50	<1
Aristida bipartita	grass	50	2

the macro-channel banks and active channel bed. A woody component is absent in this grassland community. The total average canopy cover of the *Themeda triandra-Fingerhuthia sesleriiformis* grassland is 42 % (Table 1).

3. The *Clutia natalensis-Panicum dregeanum* grassland

The *Clutia natalensis-Panicum dregeanum* grassland is represented by two relevés and occurs on both the macro-channel banks and the terrestrial area above the banks. This plant community is situated in the vicinity of the Frischgewaagd farm (Fig. 1). It is a grassland community found where the Olifants River runs through the Bb Land Type (Land Type Series 1985a), associated with the Karoo Sequence and aeolic sand at an altitude of about 1 650 m a.s.l. The deep (≥ 1 200 mm) soil on the macro-channel banks is typically a sand-deposit covering clayey subsoil (>55 % clay).

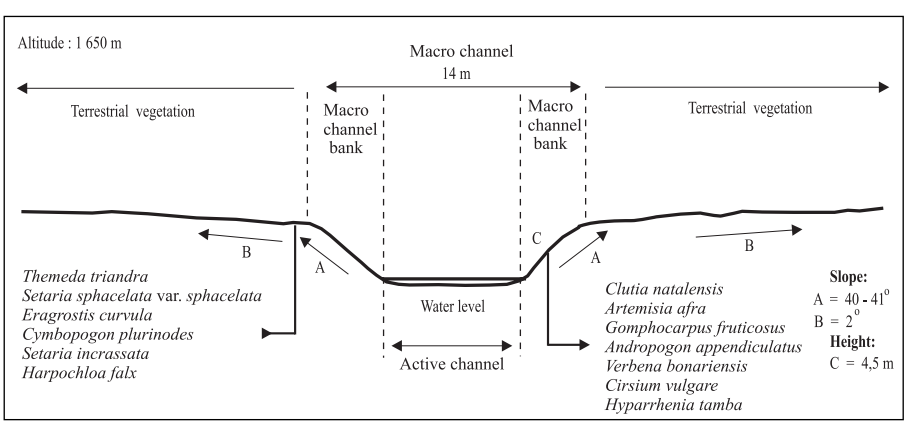

Fig. 4. River profile of the *Clutia natalensis-Panicum dregeanum* grassland.

Table 4
Diagnostic species of the
Clutia natalensis-Panicum dregeanum *grassland*
(M.C.C. - mean canopy cover)

Species name	Growth form	Consistency (%)	M.C.C. (%)
Panicum dregeanum	grass	100	2
Artemisia afra	dwarf shrub	100	7
Oenothera erythrosepala	forb	100	<1

The macro-channel in this section of the river is, on average, 14 m wide and the steep macro-channel banks are similar to the *Themeda triandra-Fingerhuthia sesleriiformis* grassland (Fig. 4). The surrounding grassland above the banks is situated on flat to convex plains, with a clear riparian zone limited to the macro-channel banks. This grassland community is characterised by the presence of a woody component, with the dwarf shrub species *Clutia natalensis*, *Artemisia afra* and *Gomphocarpus fruticosus* limited to the steep macro-channel banks, while the reed *Phragmites australis* and forb *Persicaria lapathifolia* are found at the waterside in the active channel.

The grass *Panicum dregeanum*, forb *Oenothera erythrosepala*, and dwarf shrub *Artemisia afra* are diagnostic for this community (Table 4). Dominant dwarf shrub species are *Clutia natalensis* and *Artemisia afra*, while *Themeda triandra*, *Eragrostis curvula*, *Setaria sphacelata* var. *sphacelata*, *Andropogon appendiculatus* and *Hyparrhenia tamba* mostly dominate the grass layer. The total average canopy cover of this grassland is 37 % (Table 1).

4. The *Heteropogon contortus-Cyperus longus* var. *tenuiflorus* grassland

The *Heteropogon contortus-Cyperus longus* var. *tenuiflorus* grassland is represented by seven relevés and occurs on both the steep macro-channel banks and the terrestrial area above the banks. This plant community (Fig. 1) is associated with that section of the Olifants River that is situated in the Bb Land Type (Land Type Series 1985a) with sandstones and shales from the Karoo Sequence. Deep soil (1 000–1 200 mm) is common and the soil texture varies from sandy loam (11 % to 15 % clay) to clayey soil (>55 % clay).

The width of the macro-channel varies from 15–27 m (Fig. 5). The river has cut deeply into the landscape, and steep macro-channel

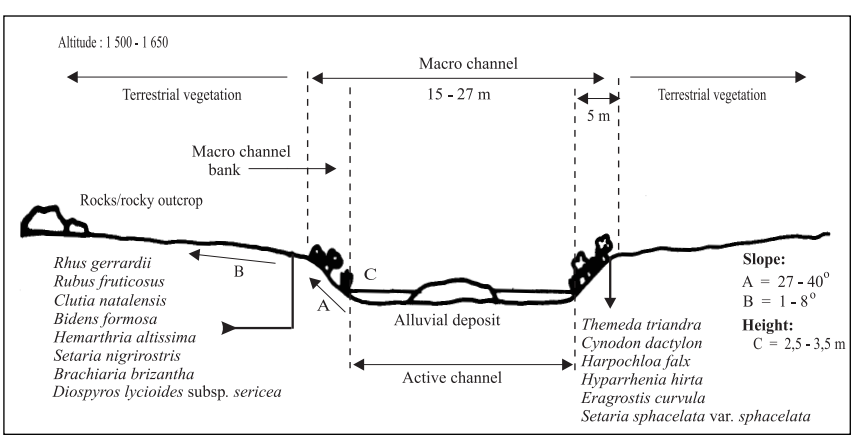

Fig. 5. River profile of the *Heteropogon contortus-Cyperus longus* var. *tenuiflorus* grassland.

Table 5
Diagnostic species of the Heteropogon contortus-Cyperus longus *var*. tenuiflorus *grassland (M.C.C. - mean canopy cover)*

Species name	Growth form	Constancy (%)	M.C.C. (%)
Heteropogon contortus	grass	71	2
Eragrostis gummiflua	grass	71	<1
Elionurus muticus	grass	43	<1
Bidens formosa	forb	43	<1
Alloteropsis semialata	grass	29	<1
Acalypha caperonioides	forb	29	<1
Aristida congesta subsp. *congesta*	grass	29	<1
Aristida sp.	grass	29	3
Pteridium aquilinum	forb	29	<1

banks, up to 3.5 m high, are common. The landscape above the banks is flat to convex and has slopes with gradients of 1–8 º. Riparian vegetation is limited to the macro-channel banks. Woody vegetation is mostly limited to rocky areas along the macro-channel banks.

The active channel bed has alluvial deposits or sand banks (depositional bars), and large rocks are quite common on both the macro-channel banks and in the active channel. This section of the active channel is characterised by pools, and a few rapids. In certain areas mining activities have seriously disturbed the adjacent terrestrial vegetation, while planted pastures that stretch down to the macro-channel replaced the natural grassland.

Diagnostic species are, *inter alia*, the grasses *Heteropogon contortus*, *Eragrostis gummiflua*, *Elionurus muticus*, *Alloteropsis semialata*, *Aristida congesta* subsp. *congesta*, *Aristida* sp., the forbs *Bidens formosa*, *Acalypha caperonoides*, and the fern *Pteridium aquilinum* (Table 5). The grass layer is completely dominated by *Themeda triandra*, followed by *Cynodon dactylon*, *Aristida* sp., patches of *Phragmites australis* and *Hyparrhenia tamba*. Dominant sedges are *Cyperus longus* var. *tenuiflorus* and *Cyperus latifolius*. These species, and *Phragmites australis*, are, however, limited to the waterside and alluvial deposits (depositional bars) in the active channel. The grasses *Brachiaria brizantha*, *Hemarthria altissima* and the forb *Persicaria lapathifolia* are also associated with the lower-lying, moister sections of the macro-channel banks.

The shrub component is represented by *Rubus fruticosus*, *Rhus gerrardii* and *Diospyros lycioides* subsp. *sericea*. The latter shrub is associated with stony and rocky substrates, similar to the surrounding terrestrial Bankenveld substrates. The average canopy cover of these three species is less than 1 %, while the total average canopy cover of the *Heteropogon contortus-Cyperus longus* var. *tenuiflorus* grassland is 56 % (Table 1).

5. The *Eragrostis plana-Cyperus fastigiatus* grassland

The *Eragrostis plana-Cyperus fastigiatus* grassland is represented by five relevés and occurs both on the macro-channel banks and the terrestrial area above the banks. This plant community is associated with the Olifants River in the vicinity of the Middelkraal farm and it also occurs in the vicinity of the Vandyksdrift farm (Fig. 1). This grassland is associated with the Bb and Fa Land Types (Land Type Series 1985a) at an altitude of about 1 600 m a.s.l. Typical underlying rocks are, inter alia, sandstone, shale, layered mudstone and rhyolite from the Karoo and Transvaal Sequences. The soil depth varies (1 000–1 200 mm), and the soil texture ranges from sandy clay loam to loamy clays throughout this community. Soil texture varies from 21 % to 55 % clay.

The macro-channel of this section of the Olifants River is, on average, 16 m wide with a single active channel (Fig. 6). The river typically has steep macro-channel banks. Above ground rock occurs only in a few isolated areas, either on the banks or in the active channel. Locally, alluvial deposits or sand banks (depositional bars) are found in the active channel.

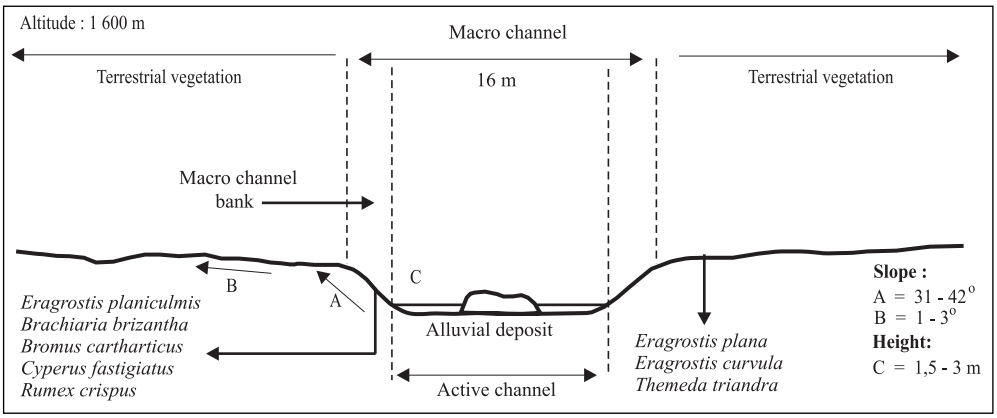

Fig. 6. River profile of the *Eragrostis plana-Cyperus fastigiatus* grassland.

The grass *Bromus catharticus* and forbs *Cirsium vulgare* and *Crabbea acaulis* are diagnostic for this grassland community (Table 6). The grasses *Eragrostis planiculmis, Brachiaria brizantha, Bromus cartharticus*, the sedge *Cyperus fastigiatus* and the forbs *Rumex crispus* and *Persicaria lapathifolia* are dominant on the steep macro-channel banks and at the waterside. The grass *Eragrostis plana* and to a lesser degree *Eragrostis curvula* and *Themeda triandra* are dominant above the banks.

Only three dwarf shrub species are found in this community and *Clutia natalensis* has the highest average canopy cover. The dwarf shrubs *Gomphostigma virgatum* and *Gomphocarpus physocarpus* were recorded only in one relevé and are poorly represented. The average total canopy cover of the *Eragrostis plana-Cyperus fastigiatus* grassland is 39 % (Table 1).

Table 6
Diagnostic species of the Eragrostis plana-Cyperus fastigiatus *grassland*
(M.C.C. - mean canopy cover)

Species name	Growth form	Constancy (%)	M.C.C. (%)
Bromus catharticus	grass	40	<1
Cirsium vulgare	forb	60	<1
Crabbea acaulis	forb	40	<1

6. The *Rhus gerrardii-Hemarthria altissima* grassland

The *Rhus gerrardii-Hemarthria altissima* grassland is, as is the case with the *Eragrostis plana-Cyperus fastigiatus* grassland (community 5), associated with the Bb and Fa Land Types (Land Type Series 1985a), but it occurs at an altitude of about 1 550 m a.s.l. (Fig. 1). The Karoo and Transvaal Sequences represent the geology of this area. Soil depth varies from 600 mm to 1 200 mm with a clay content of higher than 55 %. This vegetation is represented by six relevés.
The macro-channel has a single active channel varying between 19 m and 22 m in width, with pools and rapids succeeding each other (Fig. 7). The river flows through rocky ridges, consequently the above-ground rock cover is high in both the active channel bed and on the macro-channel banks. Stone sizes vary from large stones (> 250 mm) to boulders (>1 000 mm). It may be assumed that this high rock cover would play a stabilising role on both the macro-channel banks and in the active channel bed, and that it would

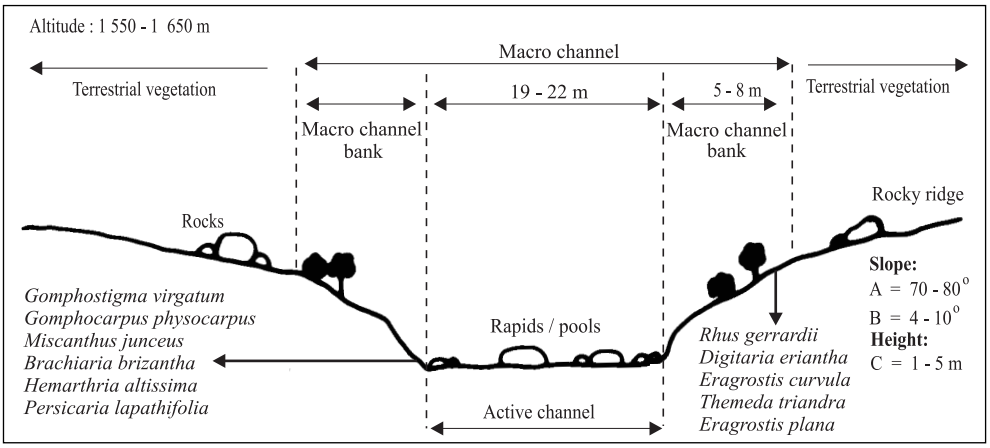

Fig. 7. River profile of the *Rhus gerrardii-Hemarthria altissima* grassland.

influence the water flow pattern, and consequently, that this section of the river would not be influenced as much as other sections by floods. The riparian zone is characterised by the presence of a shrub component.

The exotic, though naturalised, tree *Salix babylonica* and forbs *Galium capense* subsp. *garipense*, *Argyrolobium tuberosum*, *Helichrysum mundtii* and *Polygala hottentotta* are diagnostic for this grassland community (Table 7). The dwarf shrubs, *Gomphostigma virgatum* and *Gomphocarpus physocarpus*, the grasses, *Miscanthus junceus*, *Brachiaria brizantha* and *Hemarthria altissima* and the forb *Persicaria lapathifolia* are dominant at the waterside and in the lower-lying parts of the macro-channel bank.

Table 7
Diagnostic species of the Rhus gerrardii-Hemarthria altissima *grassland*
(M.C.C. - mean canopy cover)

Species name	Growth form	Constancy (%)	M.C.C. (%)
Galium capense subsp. *garipense*	forb	50	2
Argyrolobium tuberosum	forb	67	<1
Helichrysum mundtii	forb	33	<1
Polygala hottentotta	forb	33	<1
Salix babylonica	tree	33	<1

Rhus gerrardii is the only shrub recorded. It has an average canopy cover of 3.91 %. The tree *Salix babylonica* was recorded at only two sites. It has an average canopy cover of < 1 %. *Digitaria eriantha*, *Brachiaria brizantha*, *Eragrostis curvula*, *Hemarthria altissima*, *Miscanthus junceus*, *Themeda triandra* and *Eragrostis plana* are dominant in the grass stratum while the forb species *Galium capense* subsp. *garipense*, *Persicaria lapathifolia* and *Tagetes minuta* are commonly found. The average total canopy cover of the *Rhus gerrardii-Hemarthria altissima* grassland is 38 % (Table 1).

7. The *Salix mucronata* subsp. *wilmsii-Eragrostis curvula* grassland

The *Salix mucronata* subsp. *wilmsii-Eragrostis curvula* grassland is represented by six relevés. This plant community is associated with the Bb Land Type (Land Type Series 1985b) at altitudes ranging between

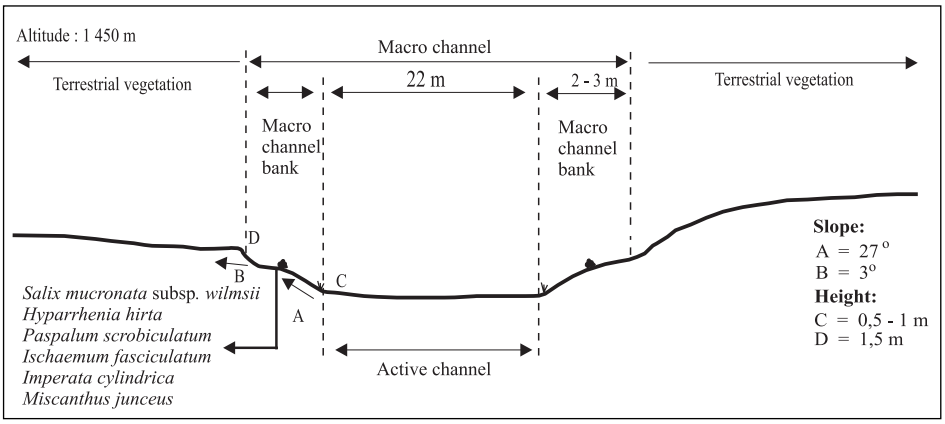

Fig. 8. River profile of the *Paspalum scrobiculatum-Miscanthus junceus* variant.

1 425 m and 1 450 m a.s.l. This grassland is limited to narrow, easily distinguishable diabase dykes and intrusions crossing the Olifants River, immediately north of the Doringpoort Dam, in the vicinity of the town Witbank (Fig. 1).

The shrub *Salix mucronata* subsp. *wilmsii* and the grass *Ischaemum fasciculatum* are diagnostic for this community. The community is divided into two variants, namely the *Paspalum scrobiculatum-Miscanthus junceus* variant (variant 7.1) and the *Acacia dealbata-Eragrostis curvula* variant (variant 7.2). The most significant difference in the habitats of these two variants lies in soil depth and above ground rock cover. The *Paspalum scrobiculatum-Miscanthus junceus* variant is found on deep soil with a low rock cover, while the *Acacia dealbata-Eragrostis curvula* variant is found on shallow soil with a high rock cover.

Table 8
Diagnostic species of the Paspalum scrobiculatum-Miscanthus junceus *variant*
(M.C.C. - mean canopy cover)

Species name	Growth form	Constancy (%)	M.C.C. (%)
Paspalum scrobiculatum	grass	100	2
Chamaecrista comosa	forb	100	<1
Imperata cylindrica	grass	50	7
Plantago virginica	forb	50	<1
Ipomoea crassipes	forb	50	<1
Cynoglossum lanceolatum	forb	50	<1

There is also a great difference in the vegetation structure of these two variants. The woody component of variant 7.1 is limited to a few dwarf shrub and shrub species with a low average canopy cover, in comparison with the woody component of variant 7.2, which consists of tree, shrub and dwarf shrub species. The tree *Acacia dealbata* (a declared alien invader,) and shrub *Sesbania punicea* (a declared weed), dominate the macro-channel banks of variant 7.2 and contribute largely to the total canopy cover of the woody component of this variant. However, these two alien problem species are not found in the *Paspalum scrobiculatum-Miscanthus junceus* variant. There is also a huge difference in the floristic composition between

these variants that are limited to the diabase intrusions.

7.1 *Paspalum scrobiculatum-Miscanthus junceus* variant

The *Paspalum scrobiculatum-Miscanthus junceus* variant is represented by two relevés only, and the extent of this unit is limited. The macro-channel is up to 22 m wide and deep, stagnant pools of water are predominant (Fig. 8). The macro-channel banks form flat to convex terraces and the above ground rock cover is limited to a few pebbles in the active channel bed. The sandy clay loam soil is deep (≥ 1 200 mm) and has a clay content of 21 % to 35 %.

This variant has six diagnostic species (Table 8), and the grass *Paspalum scrobiculatum* and forb *Chamaecrista comosa*, have been recorded only on the macro-channel banks.

The shrub layer of this variant is dominated by *Salix mucronata* subsp. *wilmsii*. The shrubs *Diospyros lycioides* subsp. *sericea* and *Rhus gerrardii* are poorly represented in this variant. *Hyparrhenia hirta*, *Paspalum scrobiculatum*, *Ischaemum fasciculatum*, *Imperata cylindric*a, *Setaria sphacelata* var. *sphacelata*, *Hemarthria altissima* and *Miscanthus junceus* dominate the grass layer. The grass species Miscanthus junceus together with the sedge species, *Cyperus latifolius*, *Cyperus marginatu*s, *Cyperus longus* var. *tenuiflorus* are limited to the lower-lying terraces on the macro-channel banks and the areas bordering the active channel.

The variant represents the vegetation associated with the macro-channel bank as well as the vegetation above the macro-channel bank. There is no single dominant forb species. All the forb species present have an average canopy cover of less than 1 %. However, the joint, average canopy cover of the forbs is 6 %. Forb species that make the largest contribution are *Crabbea acaulis*, *Berkheya radula*, *Ipomoea bathycolpos*, *Ipomoea crassipes*, *Helichrysum rugulosum* and *Tagetes minuta*. The total average canopy cover of the *Paspalum scrobiculatum-Miscanthus junceus* variant is 48 % (Table 1).

7.2 *Acacia dealbata-Eragrostis curvula* variant

The *Acacia dealbata-Eragrostis curvula* variant is represented by four relevés. The macro-channel divides in certain areas to form two active channels that are between 23 m and 25 m wide (Fig. 9). These active channels are characterised by shallow pools

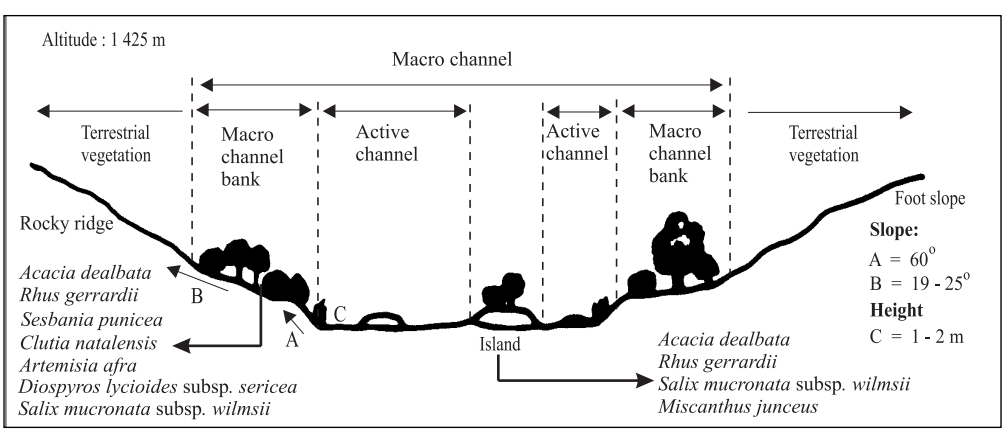

Fig. 9. River profile of the *Acacia dealbata-Eragrostis curvula* variant.

Table 9
Diagnostic species of the Acacia dealbata-Eragrostis curvula *variant (M.C.C. - mean canopy cover)*

Species name	Growth form	Constancy (%)	M.C.C. (%)
Acacia dealbata	tree	75	12
Sesbania punicea	shrub	100	2
Deverra sp.	forb	75	<1
Acacia karroo	dwarf shrub	75	<1
Bidens pilosa	forb	50	2
Dicliptera clinopodia	forb	75	1
Lepidium virginicum	forb	75	<1
Ranunculus multifidus	forb	50	<1
Sida rhombifolia	dwarf shrub	50	<1
Vangueria cyanescens	shrub	50	<1
Maytenus heterophylla	shrub	50	<1
Chenopodium ambrosioides	forb	50	<1
Typha capensis	grass	50	<1
Achyranthes aspera var. *aspera*	forb	50	<1

followed by rapids, and by the presence of a few islands on which woody plant species are found. The riparian zone is clearly visible with a strong woody component.

The soil on the macro-channel banks is 150 mm to 200 mm deep and the soil texture varies from loamy sand (11 % -15 % clay) to clayey soil (>55 % clay). This section of the river is characterised by a high percentage rock cover. The stones vary from pebbles limited to the active channel bed to large stones and rocks that occur mostly on the macro-channel banks.

This variant has 14 diagnostic species (Table 9). The declared alien invader *Acacia dealbata* and the declared alien weed *Sesbania punicea* have the highest average canopy cover. These species should be removed, since they both grow near the waterside and are a source of seed that may spread to downstream areas.

The *Acacia dealbata-Eragrostis curvula* variant is characterised by the presence of a strong woody component. Dominant woody species are the tree *Acacia dealbata*, the shrubs *Sesbania punicea*, *Diospyros lycioides* subsp. *sericea*, *Salix mucronata* subsp. *wilmsii*, *Rhus gerrardii*, and the dwarf shrubs *Clutia natalensis* and *Artemisia afra*. The grasses *Eragrostis plana*, *Miscanthus junceus*, *Hemarthria altissima*, *Eragrostis curvula* and *Paspalum distichum,* and the sedges *Cyperus marginatus* and *Cyperus latifolius* dominate the grass layer. The grass species *Miscanthus junceus*, *Hemarthria altissima*, *Paspalum distichum*, *Phragmites australis,* and sedge species *Cyperus marginatus* and *Cyperus latifolius* are mostly limited to the lower-lying parts of the macro-channel bank close to the active channels.

The macro-channel banks are disturbed in local areas. The high average canopy cover of the opportunistic weedy forbs *Tagetes minuta*, *Verbena bonariensis* and *Bidens pilosa* confirms that disturbance. The high weed cover probably results from the high woody cover and its shadow effect—the alien tree *Acacia dealbata*, with an average canopy cover of 12 %, being the greatest contributor. The negative shadow effect is clearly visible on the grass layer. The total average canopy cover of the *Acacia dealbata-Eragrostis curvula* variant is 68 % (Table 1).

8. *The Echinochloa crus-galli-Paspalum distichum* grassland

The *Echinochloa crus-galli-Paspalum distichum* grassland is represented by four relevés and it occurs south of Witbank Dam in the vicinity of the Wolwekrans farm and downstream of the Doringpoort Dam (Fig. 1). The plant community is associated with the Bb Land Type (Land Type Series 1985b) and is found at altitudes of 1 450 m to 1 500 m a.s.l. The typical underlying geology is derived from the Loskop Formation and the Karoo Sequence, Group Ecca, and mostly consists of sandstone, shale and conglomerate. The soil is mostly 1 200 mm deep and varies from sandy clay loam (21 %–35 % clay) to heavy clayey soil (>55 % clay).

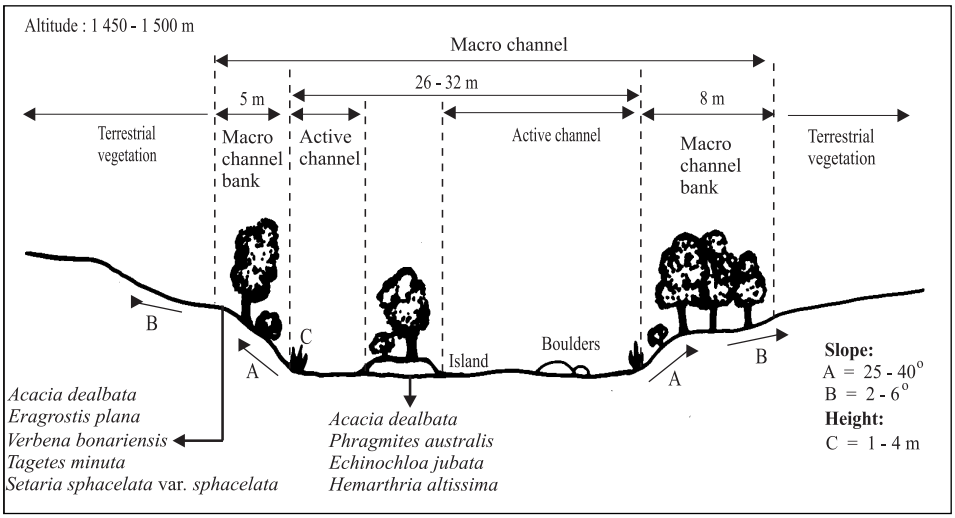

Fig. 10. River profile of the *Echinochloa crus-galli-Paspalum distichum* grassland.

The width of the macro-channel varies between 26 m and 32 m with steep banks up to 4 m high (Fig. 10). A single active channel has a rocky appearance in certain areas, and divides to form two active channels with an island covered by a dwarf shrub component.

The grasses *Echinochloa crus-galli* and *Echinochloa jubata*, the sedge *Juncus effusus*, the forb *Cotula anthemoides* and the alien tree *Morus alba* are diagnostic for this grassland community (Table 10). The tree component of this community is represented by *Acacia dealbata*, *Morus alba* and *Rhus lancea*. However, the latter two species have low average canopy covers. The woody species have a low constancy throughout.

Table 10
Diagnostic species of the Echinochloa crus-galli-Paspalum distichum *grassland*
(M.C.C. - mean canopy cover)

Species name	Growth form	Constancy (%)	M.C.C. (%)
Echinochloa crus-galli	grass	75	<1
Echinochloa jubata	grass	50	10
Juncus effusus	grass	50	<1
Morus alba	tree	50	<1
Cotula anthemoides	forb	50	<1

The grasses *Eragrostis plana*, *Phragmites australis*, *Setaria sphacelata* var. *sphacelata*, *Echinochloa jubata*, *Cyperus latifolius* and *Paspalum distichum* and the sedge *Cyperus fastigiatus* dominate the grass layer, while *Verbena bonariensis*, *Persicaria lapathifolia* and *Tagetes minuta* dominate the forb layer. The sedges *Cyperus latifolius* and *Cyperus fastigiatus*, the reed, *Phragmites australis*, the grasses *Echinochloa jubata*, *Paspalum distichum* and *Hemarthria altissima* and the forb *Persicaria lapathifolia* are mostly limited to the watersides of the macro-channels. *Phragmites australis* is also associated with the active channel bed and islands.

The total average canopy cover of the *Echinochloa crus-galli-Paspalum distichum* grassland is 62 %, with grass species making the largest contribution (Table 1).

Discussion and conclusion

The spatial scale of 1:250 000 at which the stratification and sampling took place, caused the vegetation on the macro-channel banks and the vegetation on top of the banks to be seen and described as a single unit. The species composition, representing both macro channel and terrestrial vegetation, therefore, may seem strange, unless it is taken into account that specific plant species are associated with the lower-lying sections bordering the waterside and that other plant species are associated with the banks or even on top of the banks. The locality and distribution of the species were however recorded and described.

The riparian vegetation of the macro-channel in the Grassland Biome is not clearly distinguishable from the surrounding vegetation and is mainly represented by terrestrial grass species. A few indigenous woody species occur in the rocky areas associated with the macro-channel. Floristic differences occur within and between communities due to changes in habitat but also as a result of different land use practices and intensities of utilisation. In certain areas the river was diverted due to mining activities and the natural vegetation replaced with planted pastures. The alteration of riverbanks and the occurrence of exotic woody species in certain areas modify the stabilising role of the indigenous vegetation and influence hydrological processes. *Acacia dealbata* and the declared alien weed *Sesbania punicea* pose a threat to the biodiversity of the macro-channel and should be removed. These species grow near the waterside and are a source of seed, spreading to the downstream areas. Although time consuming and costly, it is important to obtain geo-referenced baseline data for these longitudinally narrow ecosystems, in order to manage and monitor vegetation change over time.

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