CHAPTER 4
SOILS

INTRODUCTION

Soil forms an important part of the ecology of natural ecosystems in semi-arid regions (Venter 1990). Soil plays a role in the supply of nutrients to plants; the development and distribution of roots; and the movement of nutrients, water, and air to the root surfaces for absorption (Foth 1990). Soil properties such as depth, texture and structure determine the quantity and availability of soil water, and together with soil nutrients, are reflected in the vegetation of the area. The physical and chemical properties of soil can also influence the species composition and structure of the vegetation (Kruckeberg 1969, In: Fraser, Van Rooyen and Verster 1987). In semi-arid areas there is usually a good correlation between geological formations, soil forms and plant communities (Bredenkamp 1982; Coetzee 1983; Gertenbach 1987; Van Rooyen and Theron 1989; Venter 1990). The soils thus often determine the type of plant community growing on them. The close relationship existing between soil and vegetation is a useful aid in the mapping of vegetation types (Fraser *et al.* 1987). Soil chemistry and physics also affect the productivity and palatability of the vegetation (Van Rooyen and Theron 1995). The potential grass composition and grazing capacity of an area can also be derived from the soil properties (Coetzee 1983). Soil type therefore has an important influence on the grazing and browsing capacity of an area.

Soil type can also have a great influence on man-made structures. Therefore it must be taken into account during the planning and placing of buildings, dams, sewage pipes, water pipes and roads (Du Toit and Van Rooyen 1995; Van Rooyen *et al.* 1996). The main objectives of soil surveys in studies of the type carried out here are to gain a basic knowledge of the physical and chemical properties of the soils so as to enable an interpretation of the results derived from the vegetation studies carried out, and to classify the soils to help define management units and a management strategy for these units (Schmidt 1992). For these reasons it was therefore necessary to conduct a superficial soil survey on Sango Ranch.

The objectives of the soil survey were to:

- Describe the general soil types occurring in the study area.
- Classify the soils according to a recognised system.
- Describe the physical and chemical properties of these soils.
- Identify sensitive areas.

- Use the soil data to assist in the interpretation of data from the vegetation surveys.
- To explain the distribution of plant communities.

METHODS

The soils of the study area were surveyed according to the methods used by Bredenkamp (1982), Coetzee (1983), Bloem (1988), Pauw (1988), Sievers (1991), Schmidt (1992), Smith (1992) and Coetsee (1993).

Selection of sample sites

Sample sites were chosen in such a way that the dominant soil forms in each management unit were surveyed. The management units are discussed in Chapter 5. Sites were selected in a stratified random manner from sites used during the Braun-Blanquet survey (Chapter 5). Enough sites were selected to include at least two profile pits in each soil colour and texture variation and in each vegetation unit. In this way 98 soil profiles were dug to represent each geological, vegetation and terrain unit. Profiles were dug 1.2 m deep or until rock was reached.

Classification of soils

Each profile pit was classified according to the Zimbabwe Soil Classification System of Thompson (1965). The Zimbabwean classification system was used to allow for comparisons with other local soils studies. Because of the scale of the survey and a lack in detail of the classification system, profiles were classified only to family level. Where possible, equivalents in the United States Department of Agriculture (USDA) Soil Classification System (Soil Survey Staff 1994) are given. The horizons were tested with 10 % HCl for the presence of carbonates. Samples and photographs were also taken of each horizon.

Physical and chemical analysis

The physical information that was recorded in the field at each soil profile included:

1. Soil colour (Munsell Soil Color Chart 1954).
2. Geological type.
3. Percentage clay (FSSA 1974).
4. Soil depth (Bloem 1988).
5. Root depth (Bloem 1988).
6. Water depth (Bloem 1988).
7. Degree of moistness (Coetsee 1993).

8. Rock or stone size.

Soil samples were also taken from the topsoil and sub-soil at each profile pit. The topsoil is defined as the upper 50 mm of the soil. Soil samples considered to be most representative of each type were then analysed physically and chemically at a soil analytical laboratory.[9] Soil texture and the chemical properties phosphate concentration(P_2O_5), exchangeable cations, anions (SO_4^2 and NO^3), electrical conductivity, pH ($CaCl_2$), mineral nitrogen (N), and copper (Cu) were analysed. Soil texture was determined with the soil hydrometer method.[9] In some cases texture was determined using the sausage method (National Working Group for Vegetation Ecology 1986). Mineral nitrogen was extracted using 1M KCl Nitrate reduced to ammonia with Devarda's alloy. All ammonia was displaced by MgO and steam distilled over.[9] Titration was done with 0.0025M H_2SO_4.[9] Exchangeable cations were extracted using 1.0M ammonia acetate pH 7.0 and determined by I.C.P.[9] Nitrate and sulphate are water soluble and were extracted using 0.01M KH_2PO_4.[9] The nitrate and sulphate concentrations were then determined by ion micrograph.[9]

RESULTS AND DISCUSSION

The soil map for Sango Ranch appears in Figure 8. The classification and chemical analytical data for the soils of Sango Ranch appear in Tables 3 and 4, and the physical analytical data in Table 5. Data are given for each of the six management units as identified and described in Chapter 5.

The *Acacia tortilis* Open Woodland Management Unit

The soils of this unit are all a mosaic of siallitic soils of the Calcimorphic Order and saline-sodic soils of the Natric Order and are found on the footslopes of the floodplains of the Msaizi, Makore, Saindota and smaller rivers (Figure 8). The 4U family of siallitic soils is derived from alluvium (Nyamapfene 1991). Siallitic soils correspond to the Inceptosols, some Entisols and vertic sub-groups of Aridosols and Alfisols of the USDA Soil Classification System (Nyamapfene 1991). The P_2O_5 value in the topsoil is fairly high in comparison with the results for the other management units (Table 3). According to Brady (1974) phosphorous availability is highest between pH values 5.0 and 7.0 and the results for the *Acacia tortilis* Open Woodland Management Unit indicate a high phosphorous availability. The soils of the Siallitic Group are relatively unleached and possess a high base status. Total exchangeable bases (TEB)/100 g clay values are not less than 31

[9] Aglab, PO Box 2472, Harare, Zimbabwe.

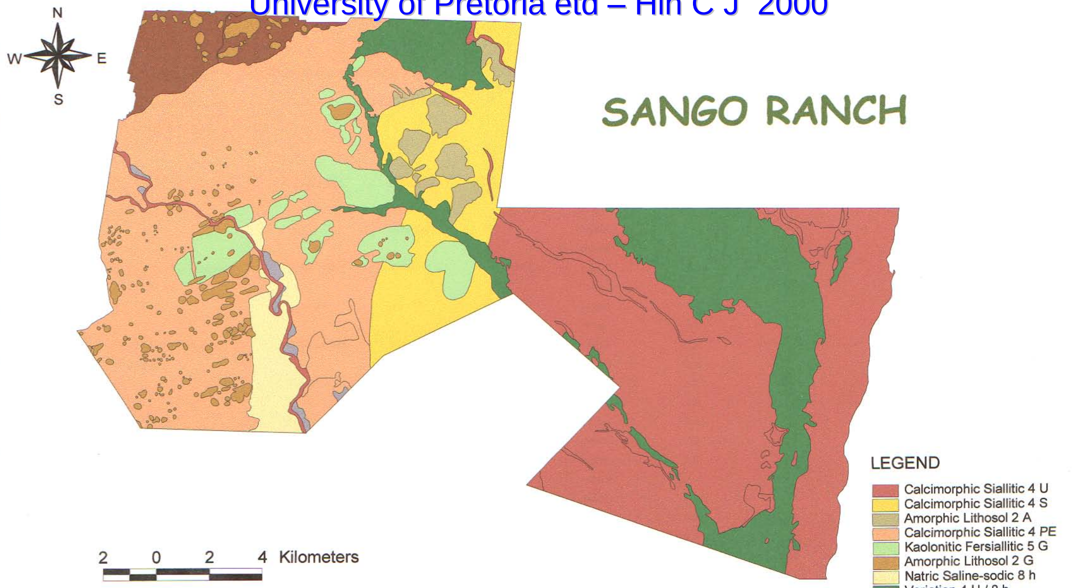

Figure 8: Soils of Sango Ranch, Save Valley Conservancy, Zimbabwe.

Table 3. Chemical analytical data of the most common soils of the six management units of Sango Ranch, Save Valley Conservancy, Zimbabwe. Dash indicates no results obtained.

MANAGEMENT UNIT	SOIL ORDER	SOIL GROUP	SOIL FAMILY	SOIL LAYER	PH AS $CaCl_2$	CONDUCTIVITY IN MICROS/CM	NITROGEN IN PPM	P_2O_5 IN PPM
Acacia tortilis Open Woodland	Calcimorphic	Siallitic	4U	topsoil	6.6	50	4	111
				subsoil	5.5	30	5	9
	Natric	Saline-sodic	8h	topsoil	6.6	60	9	141
				subsoil	6.9	290	2	16
Colophospermum mopane Woodland	Calcimorphic	Siallitic	4S/4U/4PE	topsoil	5.1	60	9	9.1
				subsoil	5.9	50	7	13
	Amorphic	Lithosol	2A	topsoil	7.5	10	-	-
				subsoil	8.1	20	-	-
Combretum apiculatum Woodand	Calcimorphic	Siallitic	4PE	topsoil	4.9	70	248	8
				subsoil	4.6	40	9	2
	Kaolinitic	Fersiallitic	5G	topsoil	5.7	30	4	47
				subsoil	4.2	20	4	6
	Natric	Saline-sodic	8h	topsoil	7.0	180	12	25
				subsoil	7.0	120	2	20
	Amorphic	Lithosol	2G	topsoil	5.8	90	27	42
				subsoil	-	-	-	-
Acacia tortilis Closed Woodland	Calcimorphic	Siallitic	4U	topsoil	6.0	60	-	-
				subsoil	6.7	80	-	-
Diospyros mespiliformes Riverine	Calcimorphic	Siallitic	4U	topsoil	5.1	40	8	34
				subsoil	6.4	40	1	18
Echinochloa colona Wetland	Calcimorphic	Siallitic	4U	topsoil	6.1	90	5	42
				subsoil	-	-	-	-

Table 4. Further chemical analytical data of the most common soils of the six management units of Sango Ranch, Save Valley Conservancy, Zimbabwe. Dash indicates no results obtained.

MANAGEMENT UNIT	SOIL ORDER	SOIL GROUP	SOIL FAMILY	CATIONS CMOL+/KG					TOTAL BASES CMOL+/100G CLAY	ANIONS ppm		FREE CARBON
				Ca^{2+}	K^{+}	Mg^{2+}	Na^{+}	S-VALUE		SO_4^{2}	NO^{3}-N	
Acacia tortilis Open Woodland	Calcimorphic	Siallitic	4U	2.2	0.62	2.37	0.15	5.35	104.9	3	1	None
				1.9	0.30	0.86	0.04	3.11	124.4	3	1	None
	Natric	Saline-sodic	8h	6.7	0.50	2.03	0.07	9.25	149.2	5	9	Present
				62.3	1.72	5.78	4.97	74.75	1052.8	29	1	Present
Colophospermum mopane Woodland	Calcimorphic	Siallitic	4S/4U/4PE	2.8	0.30	1.16	0.02	4.33	96.2	3	8	None
				5.5	1.15	2.79	0.13	9.60	147.7	5	6	Present
	Amorphic	Lithosol	2A	-	-	-	-	-	-	-	-	None
				-	-	-	-	-	-	-	-	Present
Combretum apiculatum Woodland	Calcimorphic	Siallitic	4PE	0.8	0.14	0.4	0.03	1.37	26.9	18	24	None
				0.4	0.09	0.40	0.06	0.94	22.4	5	8	None
	Kaolinitic	Fersiallitic	5G	1.0	0.14	0.50	0.02	1.64	29.8	3	<1	None
				0.4	0.12	0.62	0.11	1.23	153.8	3	1	None
	Natric	Saline-sodic	8h	73.4	0.72	5.26	0.27	79.68	538.4	8	18	Present
				37.2	1.39	10.99	1.65	51.27	242.99	6	1	Present
	Amorphic	Lithosol	2G	15.2	0.40	3.61	0.03	-	19.28	5	15	None
				-	-	-	-	-	-	-	-	None
Acacia tortilis Closed Woodland	Calcimorphic	Siallitic	4U	-	-	-	-	-	-	-	-	Present
				-	-	-	-	-	-	-	-	Present
Diospyros mespiliformes Riverine	Calcimorphic	Siallitic	4U	2.1	0.46	1.22	0.06	3.79	74.3	3	6	None
				6.6	0.29	2.43	0.20	9.55	212.0	4	<1	None
Echinochloa colona Wetland	Calcimorphic	Siallitic	4U	10.0	0.68	5.08	0.51	16.28	178.9	15	1	None
				-	-	-	-	-	-	-	-	None

Table 5. Physical analytical data of the most common soils of the six management units of Sango Ranch, Save Valley Conservancy, Zimbabwe. Dash indicates no results obtained. Asterisk indicates sausage method[a] used.

MANAGEMENT UNIT	SOIL ORDER	SOIL GROUP	SOIL FAMILY	SOIL LAYER	% SAND	% SILT	% CLAY	TEXTURE	SOIL COLOUR	SOIL DEPTH (m)
Acacia tortilis Open Woodland	Calcimorphic	Siallitic	4U	topsoil	85.34	5.10	9.58	Sandy loam	Very dark grey	>1.2
				sub-soil	85.64	2.50	11.86	Sandy loam	Dark reddish brown	-
	Natric	Saline-sodic	8h	topsoil	81.94	6.20	11.86	Sandy loam	Dark brown	>1.2
				sub-soil	74.74	7.10	18.16	Sandy loam	Light grey	-
Colophospermum mopane Woodland	Calcimorphic	Siallitic	4S/4U/4PE	topsoil	83.04	4.50	12.46	Sandy loam	Dark brown	>1.2
				sub-soil	67.04	6.50	25.46	Sandy loam	Dark brown	-
	Amorphic	Lithosol	2A	topsoil	-	-	-	Sandy clay*	Dark reddish brown	0.2
				sub-soil	-	-	-	Rock	-	-
Combretum apiculatum Wodland	Calcimorphic	Siallitic	4PE	topsoil	86.44	5.1	8.46	Sandy loam	Strong brown	>1.2
				sub-soil	87.64	4.2	8.16	Sandy loam	Strong brown	-
	Kaolinitic	Fersiallitic	5G	topsoil	87.66	5.5	8.16	Sandy loam	Very dark brown	0.6
				sub-soil	87.34	0.8	11.86	Sandy loam	Yellowish red	-
	Natric	Saline-sodic	8h	topsoil	61.04	14.8	24.16	Clay loam	Strong brown	-
				sub-soil	55.04	21.1	23.88	Sandy clay loam	Strong brown	<1.2
	Amorphic	Lithosol	2G	topsoil	80.74	11.10	8.16	Sandy loam	Black	0.25
				sub-soil	-	-	-	Rock	-	-
Acacia tortilis Closed Woodland	Calcimorphic	Siallitic	4U	topsoil	-	-	-	Sandy loam*	Very dark grey	>1.2
				sub-soil	-	-	-	Sandy loam*	Very dark grey	-
Diospyros mespiliformes Riverine	Calcimorphic	Siallitic	4U	topsoil	-	-	-	Sandy loam*	Dark yellowish brown	>1.2
				sub-soil	85.34	4.5	10.16	Sandy loam	Dark brown	-
Echinochloa colona Wetland	Calcimorphic	Siallitic	4U	topsoil	60.74	9.1	30.16	Clay loam	Very dark grey	>1.2
				sub-soil	-	-	-	-	-	-

[a] – According to National Working Group for Vegetation Ecology (1986).

and cation exchange capacity (CEC)/100 g clay values are not less than 35 (Nyamapfene 1991). The upper limit is undefined and is relatively open (Nyamapfene 1991). The E/C value (TEB per 100 g clay) for this management unit lies beyond this limit at 104.9 (Table 4) which indicates a high base status which in turn indicates a high level of productivity (Nyamapfene 1991). Free carbonates were detected in some profiles (Table 4). The siallitic soils contain relatively high amounts of both kandites and 2:1 clay minerals (Nyamapfene 1991). The composition and proportions vary according to parent material and topographic position. According to Nyamapfene (1991), soils derived from siliceous parent materials have low amounts of smectite. However, siallitic soils found around vleis tend to have high amounts of smectite and vermiculite and may therefore have vertic properties. Most siallitic soils also contain considerable reserves of feldspar and other weatherable materials.

The clay content is also usually moderate to high. However, the content for the soils of the *Acacia tortilis* Open Woodland Management Unit is low because Siallitic soils of relatively low clay content may develop from siliceous parent material in low lying areas where bases can accumulate (Nyamapfene 1991). The soils are deep, extending below 1.2 m of the surface (Table 5). The soils are sandy; being classified as sandy loam (Table 5). In sandy soils the moisture is immediately available for the rapid germination of seeds and the regrowth of perennial grasses following light rains (Pauw 1988). The grasses growing on these soils are generally highly palatable and are classified as sweetveld (Nyamapfene 1991). Sandy soils, however, possess a poor water holding capacity and thus dry out very quickly. The high temperatures experienced in the Save River Valley contribute to this phenomenon. The soils in this management unit become hard when dry.

Because of the low rainfall, weathering intensity is low in the siallitic soils and there is generally insufficient moisture for extensive leaching to occur (Nyamapfene 1991). However, the soils are susceptible to sheet erosion by the considerable runoff which results from high rainfall.

Weakly saline-sodic soils are found adjacent to the Save River and on the floodplain of the Msaizi and other smaller rivers (Figure 8). These soils belong to the Sodic Group of Thompson (1965) and correspond to the Alfisols and Inceptisols of the USDA classification system (Nyamapfene 1991). Nyamapfene (1991) also reports on the occurrence of saline-sodic soils in the Save Valley. These soils have a limited and patchy distribution on Sango Ranch, occurring in pan depressions and along diffuse drainage lines. The soils of this group belong to the 8h family and are derived from alluvium. The restricted drainage and possible presence of parent material rich in sodium-releasing feldspars are the reasons Nyamapfene (1991) gives for the sodic properties of this soil. Saline-sodic soils are also found in the *Colophospermum mopane* Woodland Management Unit especially along drainage lines and in depressions on alluvium. The sodium cation, calcium cation, electrical conductivity, phosphorous content, E/C value and sulphur content are high in comparison to other soils of Sango Ranch (Tables 3 and 4). The high sodium and electrical conductivity suggest a saline-sodic nature (Foth 1990). Important properties of this soil are the high erodability, compacted and hard subsoil horizons and surface capping. The two latter properties result in bare patches on which few plants are able to grow. The soil pH is neutral and this property makes the soil more favourable for plant growth than strongly sodic soils (Nyamapfene 1991). Woody species such as *Salvadora australis* and *S. persica* and herbaceous species such as *Sporobolus nitens* and shallow rooted forbs are commonly found on sodic soils (Chapter 5). The surface soil is lightly textured and provides the rooting medium for plants while the impermeable subsoil creates conditions which allow appreciable amounts of water to remain within the zone in which roots can reach it (Nyamapfene 1991).

The *Colophospermum mopane* Woodland Management Unit

The soils of the *Colophospermum mopane* Woodland Management Unit fall into two groups: Siallitic Group and Lithosol Group. The siallitic soils of the *Colophospermum mopane* Woodland Management Unit are very similar to those of the *Acacia tortilis* Open Woodland Management Unit and are found on the mid-slope position (Figure 8). The soils in this area belong to the 4S, 4U and 4PE families. The 4S soils are derived from quartzites, shales, lavas and limestone while the 4U soils are alluvial and the 4PE soils are of gneissic origin (Nyamapfene 1991). The soils of the *Colophospermum mopane* Woodland Management Unit, however show a lower phosphorous content, a slightly higher nitrogen value (Table 3), and a higher E/C value and clay content in the subsoil horizon than in the topsoil horizon (Tables 4 and 5). The high clay content is associated with a high soil nutrient availability and therefore a high fertility. According to Nyamapfene (1991) the leaves of *Colophospermum mopane* occurring on siallitic soils have a high protein content and nutritive value. The bare soils in the *Colophospermum mopane* Woodland Management Unit are particularly vulnerable to high water runoff and sheet erosion.

Lithosols of the Amorphic Order are found on the uplands and koppies (Figure 8). These soils are shallow having a depth of less than or equal to 250 mm and overlie hard or partially weathered rock (Thompson and Purves 1978). The Lithosols of the *Colophospermum mopane* Woodland Management Unit belong to the 2A family. The soils vary widely in soil reaction, clay content and morphology according to the parent material from which they are derived. In this case the soils are derived from quartzite, shales, and lavas of the Umkondo System and grits and conglomerates of the Karoo Group. The Lithosols correspond to the Entisols and Inceptisols of the USDA classification system (Nyamapfene 1991). The electrical conductivity is low, the pH is slightly alkaline and the texture is sandy clay (Tables 3, 4 and 5). No other chemical and physical data are available for the Lithosols of this management unit. The shallowness of these soils and the steep slopes on which they are generally found results in a high potential for erosion. These soils also possess a poor water holding capacity and are extremely susceptible to desiccation. Several trees on Lithosols died during the 1992 drought and this is probably because of the shallowness of the soils.

The *Combretum apiculatum* Woodland Management Unit

The soils of the *Combretum apiculatum* Woodland Management Unit fall into four groups: Siallitic, Fersiallitic, Lithosol and Saline-sodic. Siallitic soils of the *Combretum apiculatum* Woodland Management Unit are found on the midslopes and footslopes of the granite and gneiss formations in the western half of Sango Ranch (Figure 8). These soils belong to the 4PE soil family and are derived from gneiss. These siallitic soils tend to be rockier than in the *Acacia tortilis* Open Woodland and *Colophospermum mopane* Woodland Management Units and the electrical conductivity, nitrogen content, TEB, and clay content are higher in the topsoil horizon (Tables 3, 4 and 5). The clay content is lower in the subsoil horizon than in the topsoil (Table 5). The soils are slightly acidic indicating slight leaching caused by a sandy nature in the B horizon (Table 3, Table 5). However, these soils are fertile and the vegetation growing on them possesses a high nutritional status and nutritive quality (Nyamapfene 1991). Plants such as *Combretum apiculatum* subsp. *apiculatum* and *Digitaria milanjiana* are found here and are highly nutritious (Van Oudtshoorn 1992; Venter and Venter 1996; Chapter 5).

Soils of the Fersiallitic Group are found on upland areas on granite and mafic granulite and belong to the 5G soil family (Figure 8). These soils correspond to the Alfisols of the USDA classification system (Nyamapfene 1991). These soils are moderately leached with low TEB values. The rainfall in the west of Sango Ranch is slightly higher than the east and accounts for the leached soils (Chapter 2). This is evident from Tables 3 and 4. The soils are slightly acidic and possess a low electrical conductivity and TEB value, especially in the topsoil. The phosphorous content is low in the subsoil horizon. However, phosphorous availability is not a problem (Nyamapfene 1991). The TEB value, however, is high in the sub-soil horizon. Some reserves of weatherable minerals are present in

Fersiallitic soils (Thompson and Purves 1978). The clay content is higher in the subsoil horizon than the topsoil and Nyamapfene (1991) also reports this (Table 5). The dominant clay mineral in most fersiallitic soils is kaolonite, with small amounts of mica and sometimes smectite or vermiculite. These soils are mostly moderately shallow (Table 5). In the lower rainfall conditions of the Save River Valley the parent material is not as highly weathered, as is the case in most other areas in southern Africa with high rainfall (Nyamapfene 1991). The granitic saprolite resulting is relatively impenetrable, which results in conditions leading to temporary periods of water saturation, even in the uplands. This situation, according to Purves (1976 *In:* Nyamapfene 1991), is responsible for the sandy nature of these soils. The fersiallitic soils are generally low in fertility and possess a low water holding capacity.

The Lithosols of the *Combretum apiculatum* Woodland Management Unit are similar to those of the *Colophospermum mopane* Woodland Management Unit, although the Lithosols are derived from granite and gneiss and belong to the 2G soil family (Nyamapfene 1991). The Lithosols of the *Combretum apiculatum* Woodland Management Unit are found on rocky outcrops and koppies in the broken country to the west of Sango Ranch (Figure 8). These soils tend to be extremely shallow and overlie hard unweathered rock. The pH, TEB value, electrical conductivity and phosphorous content are low (Tables 3 and 4). The soils are therefore acidic, leached and the fertility is low. The soils are very sandy with a low clay content and are black in colour because of a high organic content (Table 5).

Weakly saline-sodic soils of the 8h soil family are found adjacent to the Makore River (Figure 8). These soils are derived from gneiss (Nyamapfene 1991). The E/C values, electrical conductivity, nitrogen and clay content are high (Tables 3, 4 and 5). The high erodability of this soil has resulted in the dongas found to the west of the Makore River (Figure 8), where past overgrazing by cattle has exposed the soil. The rolling topography found in this area is caused by erosion along drainage lines. This area is sensitive and management must be applied to remedy the present erosion and prevent future erosion.

The *Acacia tortilis* Closed Woodland Management Unit

The soils of the *Acacia tortilis* Closed Woodland Management Unit are classified as siallitic and are found on the deep alluvium on the banks of the Save River and the floodplain of the Msaizi River near to the point where the Msiazi River ends (Figure 8). These soils belong to the 4U soil family. Free carbonates are present in both the top- and subsoil horizons (Table 4). The texture is a sandy loam and the TEB value is probably high although no data are available (Table 5). The water table in this management unit is high due to the Save River aquifer on which it lies (Chapter 2). The deep moist fertile soils of this management unit support a closed and dense woodland dominated by *Acacia tortilis* subsp. *heteracantha* and a rank herbaceous layer consisting almost exclusively of the highly nutritious and productive shade-loving grass *Panicum maximum* (Chapter 5).

The *Diospyros mespiliformes* Riverine Management Unit

The soils of the *Diospyros mespiliformes* Riverine Management Unit also belong to the Siallitic Group and are found along the banks of the larger rivers, particularly along the Save River (Figure 8). The soils are fertile with a high water holding capacity and belong to the 4U family. The high moisture content supports a very dense and closed riverine forest dominated by large trees and impenetrable thickets. Severe siltation of the Save River has resulted in the deposition of silt that eventually forms islands. The soils of these islands are deep and sandy and are initially highly unstable. They are stabilised by pioneer plants such as *Phragmites mauritianus* and *Ficus capreifolia* and later by *Faidherbia albida.* The islands eventually become permanent with the development of the sub- to climax community dominated by extremely large specimens of *Albizia glaberrima* var. *glabrescens* (Chapter 5). Colour mottles are sometimes visible because of a fluctuating water table.

The *Echinochloa colona* Wetland Management Unit

The soils of the *Echinochloa colona* Wetland Management Unit also fall in the Siallitic Group and are found in and around the Sune, Masiyauta, Chinga and other smaller pans (Figure 8). These soils are classified into the 4U soil family. In some cases the soils are vertic with large visible surface cracks. This is particularly evident around Sune Pan. The soils possess a high fertility due to the high clay content (Tables 3 and 4). The soils are also slightly saline-sodic but do not qualify as Saline-Sodic as defined by Thompson (1965). The soils possess a high water retention and are saturated for most of the year. In some cases colour mottles are evident due to the fluctuating water table. The grazing in these pans is nutritious because of the highly fertile soils.

CONCLUSION

The soils of Sango Ranch are highly variable ranging from deep, fertile, unleached, alkaline soils to shallow and infertile acidic soils. The fertile alkaline siallitic soils support a sweeter veld than the shallower more leached acidic soils of the Fersiallitic and Lithosol Groups. Most of the soils are vulnerable to erosion, especially where the vegetation is removed on steep slopes. Care should be taken when constructing gravel roads in the upland areas of the *Colophospermum mopane* Woodland and *Combretum apiculatum* Woodland Management Units. The midslope and footslope soils of the *Colophospermum mopane* Woodland Management Unit are also susceptible to erosion especially in areas with a low ground cover and also in the saline-sodic areas. An area of high concern with regards to erosion is the B6 area where considerable erosion has already taken place. The soils have a blocky structure and with the undulating terrain contribute to the high degree of erodability. The road passing through this area should be closed and re-routed in order to allow the area an opportunity to recover. No permanent waterholes or dams should be constructed in this area. Veld burning should not be applied in this area. A fire will remove the ground cover, resulting in exposure of the soil which could further aggravate the erosion problem. It is recommended that rehabilitation measures be taken in this area.