Kavango River wetlands

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Received February 1990; accepted July 1990

ABSTRACT

In Namibia, the Kavango River and its associated floodplains are seasonally flooded, low gradient, riverine wetlands. These support a productive and diverse biota including several endangered and protected species and are essential to the economy of a large rural population. The nutrient and energy cycles of this dynamic ecosystem are largely dependent on the periodicity of the hydrological regime. The main threats to the environment are from thoughtless development and increasing population pressure. The manipulation of the flood regime, degradation of the floodplain and river margin habitats, over-exploitation, pollution and the introduction of alien species could cause irreversible damage. Namibia also has an obligation to protect the quality and quantity of the water supply to the Okavango Delta in Botswana. Conservation which takes into consideration the ecological requirements and needs of the people dependent on these wetlands both in Kavango and downstream is required. The available literature on the region is limited and little of the current environmental knowledge is quantitative. Further research to examine the resource potential, and a holistic approach to management, including co-operation with neighbouring countries, is recommended.

INTRODUCTION

This paper presents an account of available information on the wetlands associated with the 470 km section of the Kavango River in Namibia. The omiramba and pans of Kavango are dealt with by Hines (in press) and B.C.W. van der Waal (this volume) discusses the traditional fisheries associated with the Kavango River.

Much of the available scientific literature on the Kavango River deals with the Delta region in Botswana where research was given impetus by the Symposium on the Okavango Delta and its future Utilization, held in 1976. Publications dealing with the river in Namibia are relatively few. Descriptive accounts were given by early explorers such as the Swedish naturalist Charles Andersson (1861), to whom the name of the river is attributed (Fisch 1987), Frederick Green (1857), the Portuguese military officer, Henrique de Paiva Couceiro (1892) and later the German Hauptmann K. Streitwolf (1911). The earliest scientific account is a description of fish collected at Rundu (Runtu) (Barnard 1948). The 1987 *Journal of the SWA Scientific Society* is an important contribution which documents recent work in the Kavango.

Kavango is home to 120 000 of the 1,29 million inhabitants of Namibia (F.N.D.C. Report 1989). Of these 78%, i.e. 93 600, live within 5 km of the Kavango River (Page 1980). This represents the densest rural population in Namibia. Many of these people are directly dependent on the Kavango wetlands for their food and shelter. This demand on the living natural resources of the Kavango valley is expected to increase as the population expands. At present the national growth rate is 3% per year (F.N.D.C. report 1989). No information is available on the size of the riverside population along the northern bank in Angola.

The topography and hydrology of the river are described by Wilson and Dincer (1976), Gibson et al. (1981) and Fisch (1987). Hegenberger (1987) gives an account of the geology of the Kavango region, whilst Schneider (1987) evaluates the irrigation potential of terrace soils.

The vegetation types of the Kavango region are defined and described in detail by Page (1980) and by Correira & Bredenkamp (1987) who conducted surveys to determine agricultural potential. Smith (1976), Gibson et al. (1981), Wiss (1981), Coates Palgrave (1983), Muller (1984), and Hines (1987) deal with the riverine vegetation.

Recent faunal studies focus on molluscs (Curtis & Appleton 1987), fishes (Skelton et al. 1985; Skelton & Merron 1984, 1985, 1987; Skelton 1988; Van der Waal, this volume) and birds (Hines 1987, in press).

A limnological survey of the Namibian section of the Kavango River and its floodplains has been conducted to establish a baseline for determining the environmental impact of the Eastern National Water Carrier. The E.N.W.C. is a long-distance water carrier presently under construction which will eventually transport water from the Kavango River to three large impoundments in the interior of the country (Bethune 1987; Bethune & Chivell 1985; Bethune & Skelton 1984; Ravenscroft 1985; Skelton & Merron 1984, 1985, 1987; Comrie-Grieg 1986).

The ethnology of the region is fairly well documented (Bosch 1964; Van Tonder 1966; Gibson et al. 1981; Fisch 1984; Otto 1987).

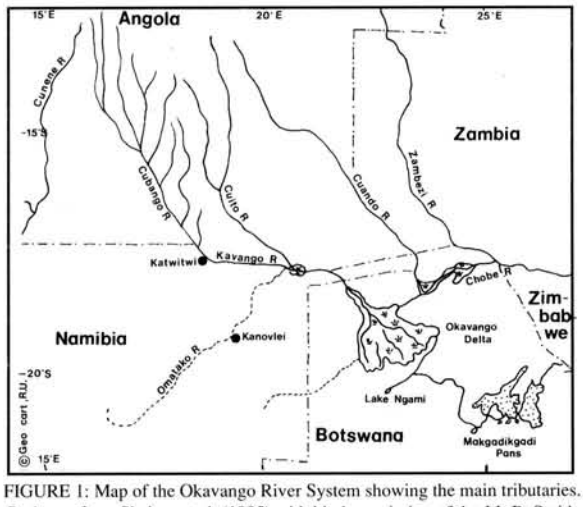

FIGURE 1: Map of the Okavango River System showing the main tributaries. Redrawn from Skelton et al. (1985) with kind permission of the J.L.B. Smith Institute of Ichthyology, Grahamstown

RESULTS

The Kavango River and its catchment

As shown in Figure 1 the Kavango River drains three countries,

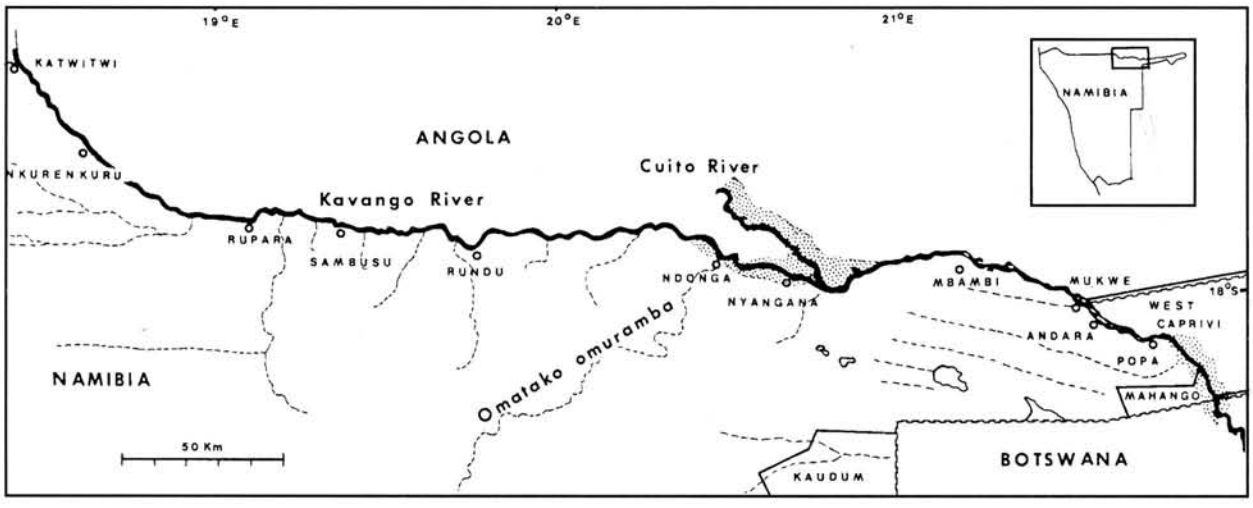

FIGURE 2: Map of the Namibian section of the Kavango River showing the main flooplain areas.

Angola, Namibia and Botswana. Rainfall in the Angolan Highlands contributes virtually the entire flow. The main tributary, called the Cubango in Angola, and the Kavango in Namibia, has a catchment area of 115 000 km^2. Its headwaters are 1700 m above sea level on the southern slopes of the highlands where the annual rainfall is 602-1125 mm (Wilson & Dincer 1976). After 600 km of southward flow through narrow gorges the river enters the Kalahari sand zone shortly before reaching Namibia. At Katwitwi it turns eastward and for the next 415 km forms the border between Angola and Namibia. This section which meanders through a 2-6 km wide valley, 30-70 m below the surrounding bush savannah and dry woodland is typical of large low-gradient African rivers. Floodwaters inundate large areas within the valley each summer but seldom reach the cultivated alluvial terraces alongside. Annual rainfall in this region varies from 534-621 mm (Gibson et al. 1981) and occurs as thunder showers between October and April.

The Cuito River is the second largest tributary with a catchment area of 73 000 km^2 (Fisch 1987). It rises further east in the Angolan highlands, 1400-1450 m above sea-level where the annual rainfall is 476-1100 mm (Wilson & Dincer 1976). The Cuito meanders through vast floodplains in southern Angola before joining the Kavango River near Nyangana Mission (Plate 2). It is characterised by extensive floodplains including a section of permanent swamp near the confluence and has a more even flow rate and a later flood peak than the Cubango.

The southern part of the catchment is considered to be a fossil catchment area because there the rainfall is seldom greater than the absorption capacity of the soil. Any runoff from the summer rains either contributes to the groundwater or evaporates. The southern tributaries, known locally as omiramba, are often blocked by dense vegetation, thorny thickets and sand dunes. The most important of these is the 650 km-long Omuramba Omatako. It seldom flows further north than Kanovlei (Fisch 1987) and it is extremely unlikely to reach the Kavango River (Bethune & Skelton 1984). However the floodwaters of the Kavango push back up the Omatako to form an important and productive backwater at Ndonga.

At Dikuyu Island near Mukwe the Kavango River turns southwards and for the next 55 km forms the border between Kavango and Western Caprivi. Here the nature of the river alters, the valley narrows and the terrain becomes rocky, a quartzite sill acts as a weir, stabilizing water levels and allowing the establishment of dense riverine forests and papyrus stands. There are several rocky islands in the river. The largest is the 2 km-long Tanhwe Island opposite Andara. The river descends about 20 m over a 22 km stretch over a series of rapids which include the Popa Falls which are 4,5-5 m high and 1-1,2 km wide (Stengel 1962).

The Kavango River enters Botswana as a broad meandering stream within a 15 km wide floodplain called the panhandle. Seventy kilometres downstream the main channel diverges to form an inland delta which covers an area of 10 000 km^2 (Wilson & Dincer 1976). The upper delta forms a permanent swamp whilst the lower reaches are typical seasonal floodplain environments.

Wetlands associated with the Kavango River in Namibia

In accordance with the decision taken at the Wetlands Workshop held in Windhoek in November 1988, the following definition of a wetland from Cowardin et al. (1976) is used: Sections pertinent to the Kavango River and its associated floodplains are highlighted.

"**Areas of marsh**, fen, peatland **or water** whether **natural** or artificial, **permanent or temporary, with water that is static or flowing, fresh**, brackish or salt, including areas of marine waters, the depth of which at low tide does not exceed six meters."

"**...may incorporate riparian** and coastal **zones adjacent to the wetlands and islands** or bodies of marine water deeper than six meters at low tide **lying within the wetlands."**

"...land where an excess of water is the dominant factor determining the nature of soil development and the types of animals and plant communities living at the soil surface. It spans a continuum of environments, where terrestrial and aquatic systems integrade."

The Kavango River is a perennial endorheic river subject to annual floods which seasonally inundate large areas of adjacent land. These wetlands vary in size from 119 km^2 in the dry season when the river is confined largely to the main channel, to 434 km^2 during the annual floods (Van der Waal, this volume). The section of the Kavango River in Namibia and the main floodplain areas are shown in Figure 2.

The wetlands associated with the Kavango River are productive systems supporting a diversity of plants and animals and more than 7% of the human population of Namibia (Van der Merwe 1983).

DOMINANT ABIOTIC FEATURES

Hydrology

The hydrological cycle is the predominant feature determining the ecology and productivity of the Kavango floodplains. Central and southern Angola receive summer rains between September and April, usually peaking in January. The resulting flood waters reach Rundu in January or February and continue to rise until April. High flood is usually 3-4,5 m higher than levels in November, but floods as high as 6 m above low water have been recorded (Fisch 1987). At high-flood the river carries 40-60 times more water than in the winter months. The floodwaters reach Maun at the southern end of the Okavango Delta in Botswana in June or July.

The Department of Water Affairs has been recording water volumes and discharges at Rundu and 200 kilometres downstream at Mukwe, below the Cuito confluence since 1949. Figure 3 shows monthly volumes recorded over a four year period. The mean annual runoff at Rundu is 5 767 Mm^3 and almost double (10 289 Mm^3) at Mukwe. The difference can be attributed to the inflow from the Cuito (Plate 1). Annual flow rates are seldom less than 50 m^3/s or more than 500 m^3/s (Hydrology Division, Department of Water Affairs, Windhoek).

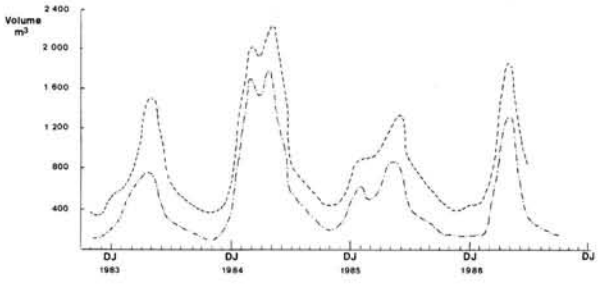

Figure 3: Monthly water volumes in cubic metres in the Kavango River at Rundu and Mukwe from October 1982 to September 1986. Based on information kindly provided by the Hydrology Division, Department of Water Affairs, Windhoek.

Between May and August the water level recedes, isolating lagoons, side channels and backwaters in the floodplain. By November the river is at its lowest level, in places less than a metre in depth, and confined to the main channel which is seldom wider than 100 m.

Water chemistry

Some aspects of the water chemistry of the Kavango River have been determined (Bethune 1987). The waters are clear, well mixed and well oxygenated. Water temperatures are relatively high in summer 23 - 30°C and decrease sharply in winter to 17-19°C and are usually within a degree of the air temperature. Temperatures remain fairly constant with depth and distance along the river but vary with the time of day. This diurnal cycle is most marked in shallow waters.

Dissolved oxygen concentrations in the mainstream vary from 5.3 to 9.4 ppm during the year. The only exception is immediately below the Popa Rapids where a slight increase is due to the aeration effect of the falls. Oxygen levels in floodplain pools are markedly higher by day than at night due to photosynthesis and tend to decrease with depth in isolated backwaters due to decomposition, particularly in late summer.

The concentrations of the major chemicals in the mainstream and floodplains of the Kavango River are given in Table 1. The water is typically soft with very low conductivity, 30-45 µSiemens/cm, and TDS (Total Dissolved Solids) values between 25 and 42 mg/l. With the possible exception of SiO^2 during floods, chemical concentrations are low. The water quality is good and remains stable for the length of the river, but may vary in the backwaters.

The nutrient levels are generally low, indicating an unenriched system but slightly higher phosphate concentrations were recorded at human access points where cattle wastes and detergents may cause a degree of pollution.

Soil

Kavango soils are generally infertile, aeolian sand and water-deposited gravel with a low organic matter content. The soils of the floodplain and river terraces, however, are enriched by alluvial silt (Schneider 1987). Although the latter no longer receive alluvial deposits they are intensively cultivated by farmers. Soil erosion is evident along most of the southern bank of the Kavango River and is particularly serious 50 kms either side of Rundu and between Andara and Popa. This erosion is due to human use, trampling by stock and indiscriminate clearing of riverine vegetation.

TABLE 1: The range in certain chemical concentrations measured in mainstream and backwater sites during 1984. (Based on a survey conducted by the Water Quality Division of Water Affairs, Windhoek)

	MAINSTREAM (n = 35)	BACKWATERS (n = 10)
Conductivity µSiemens/cm	30 - 45	45 - 205
pH	6.8 - 7.2	6.7 - 7.5
TDS mg/l	25 - 42	30 - 170
Alkalinity as CaCO3 mg/l	10 - 20	20 - 95
Na^+ mg/l	1 - 3	3 - 10
K^+ mg/l	1 - 2	1 - 3
Ca^{++} mg/l	6 - 16	7 - 46
Mg^{++} mg/l	3 - 8	6 - 22
SiO_2 mg/l	8 - 15	9 - 36
Cl^- mg/l	0,5 - 1,0	1.0 - 5.6
Total N mg/l	0.1 - 1.5	0.1 - 6.2
PO_4 - P mg/ l	0.01 - 0.07	0.02 - 0.15
Org P sol mg/l	0.01 - 0.10	0.02 - 0.32
Total P mg/l	0.01 - 0.15	0.04 - 0.37

Dominant biotic features

The annual rhythm of flooding is the predominant feature affecting the biology of the Kavango River. As the waters rise and spread out over the floodplain, new nutrient-rich aquatic habitats are created. Some nutrients are brought in by the floodwaters but the main source is decaying dried organic material which includes vegetation from the previous year, drowned terrestrial grasses, droppings from winter grazers and minerals released by burning. A rapid succession of events occurs, within days phytoplankton appears, followed by zooplankton and the growth of submerged and floating macrophytes. With time, invertebrates colonize the new habitat and a variety of emergent aquatic plants become established around the new margins. The well-vegetated, warm, shallow waters provide a suitable environment for the river fauna to breed, feed and grow. These, in turn, provide an abundant food supply for many of the terrestrial animals dependent on the river.

As the flood waters recede the exposed waterplant beds are eaten by wildfowl, snails and other invertebrates and the remaining fish are preyed on by birds and humans. Eventually the

aquatic biota decay and nutrients are released into the sediment. Floodplain grasses are adapted to annual inundation, in the shallows thick-stemmed aquatic grasses keep growing with rising floodwaters whilst in deeper parts tussocky terrestrial grasses sprout again after the floods have receded (B. van der Waal pers. comm.). These provide lush grazing until the floodplain is again inundated and the cycle is repeated.

Vegetation

The Kavango valley in Namibia supports a rich and diverse flora. This is perhaps best illustrated by a checklist (Appendix 1) compiled on data from the Botanical Research Institute in Pretoria, collections by S. Bethune and A. Jacot-Guillarmod, and the available literature (Page 1980; Wiss 1981; Coates Palgrave 1983; Müller 1984; Correira & Bredenkamp 1987; Hines 1987). There are 869 species from 88 families listed and 19 algal species. This includes 5 ferns, 334 monocotyledons of which 185 are grasses; and 530 dicotyledons. This checklist must be considered incomplete until more intensive collections are undertaken. A similar checklist of the vegetation of the Okavango Delta (Smith 1976, 1984) lists 670 species from 81 families. Together the two regions support some 1180 species.

Classifications used to describe the vegetation in the Kavango region differ. Page (1980) defines 10 main vegetation types and 19 subunits within these, Correira & Bredenkamp (1987) differentiate between 5 major and 15 land use units of which four occur alongside the Kavango River, whilst Hines (1987) describes 3 major habitat types, of which "River" includes open water, the riverine fringe, back swamps and floodplains. For this report five main vegetation zones are distinguished: open water, river margin, floodplain, permanent marsh, and alluvial terraces. There are no clear-cut boundaries between these habitats but a gradual change from the wetter to the drier types occurs with distance from the river and time since flooding. A schematic vegetation profile is given in Figure 4.

Open water

The mainstream, which is 50 m-200 m wide, and the narrower side channels are clear and swift-flowing. The substrate is sandy or rocky with exposed sandbanks and rocks in places. Depths vary from 0,5 m to 8 m. Submerged macrophyte beds of pondweeds, *Potamogeton* spp. *Vallisneria aethiopica* and oxygen weed, *Lagarosiphon ilicifolius*, occur in beds along the mainstream at low water levels. The free-floating water ferns, *Azolla nilotica* and *A. pinnata* var. *africana*, water lilies, *Nymphaea* spp. and the water chestnut, *Trapa natans*, are sometimes found floating in the open water of bays and backwaters.

In the rapids, water flow is swift, cascading and turbulent over a substrate of bedrock, potholes, loose stones and sand pockets. Here algae and a small moss-like seedplant grow. The latter is common in the Andara-Bagani region where it completely covers rocks and offers a habitat to many invertebrates (B. van der Waal, pers. comm.). In the more sheltered marginal cascades some ferns, *Thelypteris interruptus*, and the insectivorous sundew plant, *Drosera madagascariensis* are found.

River margins

The natural vegetation of the river margins is either reed fringes or riparian forest, but in the vicinity of settlements large tracts of land have been cleared for agriculture and access to the water. In contrast, the margins on the northern bank in Angola are vitually undisturbed. This is expected to change as the area is resettled.

Reed fringes

Along the middle reaches of the Kavango River dense reedbanks occur. These typically include two reed species, *Phragmites mauritianus* and *P. astralis*, tall grasses such as *Pennisetum glaucocladum* and *Echinochloa stagnina*, creepers including *Mikania cordata* and *Kosteletzkya buettneri*, rooted emergents *Polygonum pulchrum*, knotweed, and *P. senegalense* and several aquatic legumes such as the river beans, *Sesbania cinerascens*, *S. sesban*, *Aeschynomene nilotica* and *Mimosa pigra* (Smith 1976). In the lower reaches, south of Andara, this community is replaced largely by a dense fringe of papyrus.

At highwater sheltered baylets or channels are formed behind dense reedbeds and sandbanks. These barriers are 1-4 m wide and isolate shallow pools less than a metre in depth, the substrate is sandy or muddy and covered by a light organic sediment or flooded terrestrial grass; a slow current or counter current is present. These sheltered waters support abundant temporary aquatic macrophyte communities. Submerged aquatic plants include the pondweeds, *Potamogeton octandrus* and *P. schweinfurthii*, sawweed, *Najas pectinata*, *Vallisneria aethiopica* and *Ottelia kunenensis*.

Riparian forests and thickets

Large stretches of river bank support dense riverine forests and thickets. Many of the trees and shrubs bear edible fruit. These include the bastard dwaba-berry, *Friesodielsa obovata*; the Zambezi raisin, *Grewia schinzii*; of the custard apple family, *Annona stenophylla*; the african mangosteen, *Garcinia livingstonei*; the marula, *Sclerocara birrea*; the koobooberry, *Cassine aethiopica*; the Transvaal ebony, *Diospyros mespiliformis* and the monkey orange, *Strychnos spinosa*.

Trees typical of the thickets are the ordeal tree, *Erythrophleum*

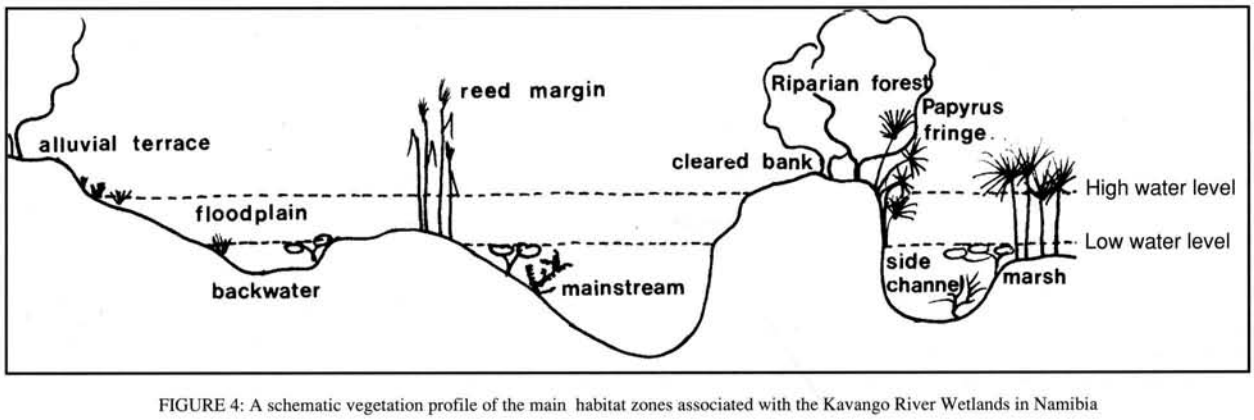

FIGURE 4: A schematic vegetation profile of the main habitat zones associated with the Kavango River Wetlands in Namibia

africanum; the knobbly bushwillow, *Combretum mossambicense*; and the birdplum, *Berchemia discolor*.

The riverine forest in the north and west is dominated by Rhodesian teak, *Baikiaea plurijuga*, whilst further east, red syringa, *Burkea africana* dominates (Fisch 1987). Forest trees include the well-known kiaat, *Pterocarpus angolensis*, the large false mopane, *Guibourtia coleosperma*, the manketti, *Ricinodendron rautanenii*, the terminalias, *Terminalia pruniodes* (purple-pod terminalia) and *T. sericea* (silver terminalia), several bushwillows, *Combretum imberbe* (leadwood), *C. psidioides* var. *psidioides* (Silver bushwillow) and *C. zeyheri* (large-fruited bushwillow) and the buffalo thorn, *Ziziphus mucronata*. (Smith 1976; Coates Palgrave 1983).

The best examples of riparian forests are downstream of Mukwe. Typical trees are the bi-coloured waterberry, *Syzygium guineense* subsp. *barotsense*; several acacias, *Acacia erubescens* (Blue thorn), *A. hebeclada* subsp. *chobiensis*, (candle acacia), and *A. nigrescens* (knob-thorn); the sausage tree, *Kigelia africana*; Rhodesian ebony, *Diospyros mespiliformis*; and two varieties of the rough leafed raisin, *Grewia flavescens*.

Cleared river banks

The large cleared areas on the low slopes next to the river are aptly described as a "mosaic of agricultural fields, old fallow lands, bush thickets and parklands" by Correira & Bredenkamp (1987). These support dense thickets of secondary vegetation which include *Acacia* species thickets of *Baphia massaiensis*, *Bauhinia petersiana* and *Terminalia sericea*.

Floodplain

The annual floodwaters spill into several braided side channels, back up into the omiramba and inundate the surrounding valley, forming a marshy environment intersected by several deep channels.

The side channels have a steady current, clear water, sandy or clay substrate and varying water depths. The islands and shallow areas are covered in terrestrial grasses, *Eragrostis rotifer*, *Chloris virgata* (feather-top chloris), *Cymbopogon caesius* (broad-leaved turpentine grass) and the lawn-like *Cynodon dactylon* and a few trees adapted to the seasonal floods, such as the paper-bark acacia, *Acacia sieberana*, the river rhus, *Rhus quartiana* and the forest waterberry, *Syzygium gerrardi*. The margins support reeds, sedges including bullrushes (*Typha capensis*) and thick-stemmed grasses. Floating vegetation includes dense stands of floating-leaved plants such as waterlilies (*Nymphaea* spp.) and floating hearts (*Nymphoides indica* subsp. *occidentalis*), floating-stemmed plants such as willow herb (*Ludwigia stolonifera*), the legume *Aeschynome fluitans* and water spinach (*Ipomoea aquatica*). Submerged macrophytes include *Ceratophyllum demersum*, sawweed (*Najas pectinata*), fine oxygenweed (*Lagarosiphon ilicifolius*), *Vallisneria aethiopica* and *Ottelia kunenensis*.

The receding flood waters isolate pools of various sizes in the floodplain. These are usually turbid, show some degree of thermal stratification, have an organic substrate and support a dense aquatic vegetation until they dry out. The tall grass *Vetiveria nigritana* often indicates the high-water mark.

Permanent marsh

At the confluence of the Kavango and Cuito Rivers (Plate 2) and within the Mahango Game Reserve there are areas of permanent marsh. These resemble the flooded zones at high water. In the dry season the water is shallow and stagnant, dissolved oxygen levels are fairly low and the substrate consists of silt and organic debris. The marshes support dense stands of *Phragmites* spp. some *Cyperus papyrus*, aquatic macrophytes similar to those in the flood channels, a variety of sedges and trees typical of marshes such as the forest waterberry, *Syzygium gerrardi*.

Alluvial terraces

The alluvial terraces are on either side of the river above the general flooding area. These terraces have been successfully farmed for the past 150 years. The main crops are sorghum, *Sorghum bicolor* and pearl millet, *Pennisetum americanum* (Schneider 1987). The terrace soil was once enriched by silt deposits. Trees which characterize these terraces are the baobab; *Adansonia digitata*, the palms; *Phoenix reclinata* (wild date palm), *Hyphaene benguellensis* (real fan palm) and *H. petersiana*, the edible mobolo plum; *Parinari curatellifolia* and the corky-bark monkey orange *Strychnos cocculoides*. Several climax grasses grow on the terraces, they include, Kalahari buffalo grass; *Panicum kalaharense*, guinea grass; *P. maximum*, silky Bushmen grass; *Stipagrostis uniplumis*, gonya grass; *Urochloa oligotrich*, buffalo grass; *Cenchrus ciliaris*, blackfooted brachiaria; *Brachiaria nigropedata*, woolgrass, *Anthephora pubescens* and *Schmidtia pappophoroides*.

The middle reaches of the Kavango River flow through the northern Kalahari sand zone. The vegetation on either side of the river valley is tree savannah and dry woodland. Trees typical of this region are the silver terminalia; *Terminalia sericea*, several types of combretum and acacia, good timber trees such as the crystal bark; *Crossopteryx febrifuga*, the horn-pod tree; *Diplorhynchus condylocarpon*, and the snake-bean; *Swartzia madagascariensis*, and several species of *Grewia* and *Commiphora*. Grasses which thrive on the aeolian Kalahari sands are *Eragrostis jeffreysii*, *E. lehmanniana*, *E. pallens* and the curly-leaved love grass, *E. rigidior*. As in the floodplains secondary vegetation has become established on areas previously cleared for agriculture (Correira & Bredenkamp 1987).

Endemics and protected plants

Only one endemic plant occurs in the Kavango valley, this is the ringwood tree, *Maerua schinzii* which grows along riverbanks and water courses. This is probably a geographical variant and it is likely that closer investigation will show the tree to be a subspecies of *Maerua angolensis* which is found in similar habitats in Angola (Coates Palgrave 1983).

Protected plants are the African protea, *Protea gaguedi*, the orchid, *Eulophia hereroensis*, the two aloes found particularly in the vicinity of Andara, *Aloe esculenta* and *A. zebrina* and the amaryllid *Crinum carolo-schmidtii* (State Herbarium list 1982). *Protea gaguedi* is threatened and possibly rare or extinct along the river as a result of over-use by local herbalists. The aloes are protected in a small reserve near Andara (B. van der Waal, pers. comm.)

The leadwood tree, *Combretum imberbe* is protected in Namibia and several other trees which are protected in South Africa may warrant protection. They are, the woolly caper bush; *Capparis tomentosa*, the ana-tree; *Acacia albida*, the baobab; *Adansonia digitata*, the apple-leaf; *Lochocarpus capassa* and the marula; *Sclerocarya birrea* (Coates Palgrave 1983).

Animals

With the exception of the snails, fish and birds, very little is

known of the fauna of the Kavango valley. Due to security problems in past years, work has concentrated on the area east of Rundu and there is almost no information available on the fauna on the northern side of the valley. Where possible, checklists of the animals have been compiled and are included in the relevant biotic accounts. Several rare and endangered animals are found and their habitats require protection. The large wetland areas on the southern banks of the river which have been cleared for settlement and agriculture are no longer suitable habitats for many animals; their numbers have declined accordingly and will continue to do so as the human pressure increases.

Aquatic invertebrates

Although several collectors (S. Bethune, C. Appleton, B.A. Curtis this volume, M. & M-L. Penrith) have collected aquatic invertebrates from the Kavango River in Namibia, generally only the more conspicuous and medically important ones have been identified to species level. Thirty mollusc species from 10 families have been found in the Kavango River and its associated floodplain, none are considered endemic nor endangered (B.A. Curtis this volume). Only the larger crustacea have been identified. They are two freshwater shrimps, *Caridina nilotica* and *C. africana* and two subspecies of the crab, *Potamon bayonianus*. These crustacea and some snails, *Pila wernei*, *Lanistes ovum* and *Mutela dubia* (Curtis & Appleton 1987) are eaten by people living along the river. Eight orders of aquatic insects are found in the river.

Amphibians

Twenty-nine species of frogs and toads from six families are expected to occur in the Kavango wetlands (M. Griffin, pers. comm.). Although none are endemic or endangered, all are dependent on water to complete their life-cycles. Of the 22 species listed for the Kavango Delta (Forrester et al. 1989), 16 occur both in Namibia and Botswana.

Fishes

Much of the recent research on the river has concentrated on the fish fauna. Of the 83 species and subspecies which occur in the Okavango drainage system 71 are found in Namibia (Skelton et al. 1985; Merron & Bruton 1988; Skelton & Merron 1984, 1985, 1987; Van der Waal this volume) and 32 in the Delta (Forrester et al. 1989). Of these, 31 are common to both regions. An annotated checklist which includes the common names and habitat preferences of the fish in the Namibian section of the Kavango is given in Appendix 2.

Two species, the ocellated spinyeel, *Aethiomastacembelus vanderwaali*, and the broadhead catfish, *Clariallabes platyprosopos*, are listed as red data species (Skelton 1987). Both favour rocky rapids and are considered rare in Namibia.

The fishes of the Kavango River are well adapted to the seasonal fluctuations in water-level and the resultant habitat changes. The different fish communities found at different stages of the floodcycle (Skelton & Merron 1985) are used here to illustrate the response of the biota to the annual flood regime.

During the annual floods, the fish migrate from the river into the newly inundated floodplain. The subsequent input of allochthonous material and nutrients creates an ideal habitat for them to breed and feed, away from predators. Fishes which remain in the mainstream are well adapted to the fast flowing waters. This population includes the silver robber, *Micralestes acutidens*, the longbeard barb, *Barbus unitaeniatus*, the orange-fin barb, *B. eutaenia*, upper Zambezi yellow fish, *B. codringtonii*, the broad-barred citharine, *Nannocharax macropterus*, the barred minnow, *Opsaridium zambezense* and two strictly rheophilic species, the redeye labeo, *Labeo cylindricus* and the mountain catfish, *Amphilius uranoscopus*.

The population in the floodplain habitats and marginal waters typically include small species such as the Zambezi parrotfish, *Hippopotamyrus discorhynchus* and other mormyrids, the stripped robber, *Brycinus lateralis*, the Okavango robber, *Rhabdalestes maunensis*, the African pike, *Hepsetus odoe*, several cyprinid *Barbus* spp., small cichlids such as the Zambezi happy, *Pharyngochromis darlingi*, the southern mouth brooder, *Pseudocrenilabrus philander*, the Okavango tilapia, *Tilapia ruweti*, the snake catfish, *Clarias theodorae* and the many-spined climbing perch, *Ctenopoma multispinis*.

As the floodwaters recede some of the fishes migrate back to the mainstream whilst others are trapped in backwaters. As these dry out the remaining fishes are concentrated and there is a high mortality from predation and desiccation. The mainstream becomes shallower (1 - 3 m) and slower flowing, exposing sandbanks and rocks. The rheophilic community is limited to the rapids or may migrate upstream.

Species found in rocky habitats include the rare broadhead catfish, *Clariallabes platyprosopos*, the rock catlet, *Chiloglanis fasciatus*, the stargazer mountain catfish, *Amphilius uranoscopus*, and the spiny eels, *Aethiomastacembelus frenatus* and *A. vanderwaali*.

Mainstream residents include the tiger fish, *Hydrocynus vittatus*, which is the top fish predator in the river, the silver catfish *Schilbe mystus*, and the dashtail barb, *Barbus poechii*. Marginal rocky areas abound with squeakers, *Synodontis* spp.. Cichlids tend to keep to the vegetated marginal areas by day. These include the threespot tilapia, *Oreochromis andersonii*, the green-headed tilapia, *Oreochromis macrochir*, the pink happy, *Serranochromis* (*Sargochromis*) *giardi*, the purple-face large-mouth, *Serranochromis* (*Serranochromis*) *macrocephalus*, the northern redbreast bream, *Tilapia rendalli rendalli*, and the banded tilapia, *Tilapia sparrmanii*. Fishes found in the middle reaches of the Kavango River but not in the Delta region include *Clarias liocephalus*, the Okavango catfish, *Opsaridum zambezense*, the redspot barb, *Barbus tangandensis* and the upper Zambezi yellow fish, *B. codringtonii* (G.S. Merron pers. comm.).

The fish populations of the few permanent floodplain pools such as those in the swamp at the confluence of the Cuito and Kavango Rivers are similar to those found in the Delta region. They include the species found in the floodplain at high water, several cyprinids, the snake catfish, *Clarias theodorae*, the topminnow *Aplocheilichtys hutereaui* and *Coptostomabarbus wittei*. In the Delta region catfish, *Clarias gariepinus* and tigerfish, *Hydrocynus vittatus*, migrate upstream prior to each flood. It is not known whether similar migrations occur in the Namibian section.

Reptiles

Branch (1988) mentions 63 reptiles found in Kavango. These include three tortoises, three turtles, 32 snakes, 24 lizards and the Nile crocodile. Of the 51 reptiles listed for the Delta (Forrester *et al.* 1989), 43 are common to both regions. All crocodiles and monitors are protected. The South African Red Data list classifies all monitors as endangered and the African

rock python as vulnerable (Branch 1988). Protected species in the Kavango wetland area are, the Nile crocodile, *Crocodylus niloticus*, two tortoises, *Psammobates oculifer* (Kalahari tent tortoise) and *Geochelone pardalis* (leopard tortoise) both lequaan species, *Varanus exanthematicus* (rock monitor) and *V. niloticus* (water monitor) and the African rock python, *Python sebae* (The Nature Conservation Ordinance No.4 of 1975).

Birds

The Kavango River and its associated floodplain support a wide variety of birds. A checklist by Hines (1987) lists 390 species for the Kavango region east of Rundu, of these 80% (310) are found in riverine habitats. This compares well with the 350 species listed for the Delta of which 60% are wetland associated (Forrester et al. 1989).

Eighteen species associated with the Kavango wetlands are listed in the Namibian red-data list (Brown and Williams, in prep.) Two of these are included in the African red-data list (Collar & Stuart 1985). They are the wattled crane, *Grus carunculata* and the slaty egret, *Egretta vinaceigula*. Both are considered endangered.

Other endangered species are the African skimmer, *Rhynchops flavirostris*, the pinkbacked pelican, *Pelicanus rufescens*, the African finfoot, *Podica senegalensis*, the rock pratincole, *Glareola nuchalis*, the western-banded snake eagle, *Circaetus cinerascens*, and Pel's fishing owl *Scotopelia peli*.

The white pelican, *Pelecanus onocrotalus*, the white-backed night heron, *Gorsachius leuconotus*, the saddlebilled stork, *Ephippiorhynchus senegalensis*, the spurwing goose, *Plectropterus gambensis* and the broad-billed roller, *Eurystomus glaucurus* are considered vulnerable.

Also included are several species which are vulnerable to riverine forest clearing such as the Cape parrot, *Poicephalus robustus*, the emerald cuckoo, *Chrysococcyx cupreus*, the wood owl, *Strix woodfordii*, the African broadbill, *Smithornis capensis* and Sousa's shrike, *Lanius souzae* (A.J. Williams and C.J. Brown pers. comm.).

By law all birds, with the exception of certain "agricultural pests" and gamebirds, are protected (The Nature Conservation ordinance No. 4 of 1975). Unfortunately this does little to alleviate the four main threats to the birds of the Kavango area. These are: the ever increasing destruction of their habitats as the river margins and floodplains are cleared for settlement and agriculture: local hunting, particularly of spurwing geese, crowned cranes and various ducks; pesticides such as DDT and Dieldrin which are sprayed to control malaria and tsetse flies; and human disturbance at nesting sites particularly of colonial breeders such as the African skimmer and carmine bee-eater, *Merops nubicoides* (C.J. Brown pers. comm.)

Mammals

Unfortunately much of the wildlife along the river has disappeared due to hunting, loss of habitat and other disturbances caused by the dense human population. Most of the larger mammals are now limited to the Mahango Game Reserve in the northeastern corner of Kavango and the West Caprivi Game Reserve on the opposite bank of the Kavango River.

Smithers (1983) includes 99 mammals from 32 families found along the Kavango River in Namibia. Forrester et al. (1989) lists 54 species for the Delta in Botswana. Only one of these, the bushpig, *Potamochoerus porcus*, does not occur in the Kavango, but neither shrews nor bats are included in the Delta checklist.

The species closely associated with a wetland environment include four shrew species, *Crocidura mariquensis* (swamp musk shrew), *C. bicolor* (tiny musk shrew), *C. flavescens* (greater musk shrew), and *C. hirta* (lesser red musk shrew), the greater cane rat, *Thryonomys swinderianus*, the water rat, *Dasymys incomtus*, Shortridge's mouse *Praomys* (*Mastomys*) *shortridgei*, which has only been found at the confluence of the Kavango and the Cuito Rivers and at Shakawe in Botswana, the water mongoose, *Atilax paludinosus*, both protected otter species, *Aonyx capensis* (the Cape clawless otter) and *Lutra maculicollis* (the spotted-necked otter), the specially protected impala, *Aepyceros melampus* which occurs in riverine woodlands and is dependent on open water, the red lechwe, *Kobus leche* and the sitatunga *Tragelaphus spekei*. The latter two are protected.

The riverine woodland provides an ideal habitat for three bat species; *Taphozous mauritianus* (tomb bat), *Pipistrellus nanus* (banana bat), *Chalinolobus variegatus* (butterfly bat). Several other bat species associated with the Kavango River in Angola and Botswana probably also occur but have not been recorded from Namibia.

The common molerat, *Cryptomys hottentotus*, prefers riverine alluvial sand for burrowing, as does the fat mouse, *Steatomys pratensis*. Other inhabitants of sandy alluvial terraces are the tiny fat mouse, *S. parvus*, and two gerbils, *Tatera leucogaster* (the bushveld gerbil) and *T. brantii* (the highveld gerbil). Brandt's climbing mouse, *Dendromus mesomelas*, is found in the tall grass associated with the floodplains.

Several carnivores, other than the otters and the water mongoose, favour a riverine or swamp habitat. These include the serval, *Felis serval*, often found in the reeds near water, the side-striped jackal, *Canis adustus*, found in riverine woods, and four viverrids found only in the north-east of Namibia. They are the large spotted genet, *Genetta genetta*, found in riverine associations in Kavango and Caprivi, Selous' mongoose, *Paracynictis selousi*, found only along the Cuito and Kavango Rivers, the large grey mongoose, *Herpertes ichneumon*, found along the Kavango and possibly the white-tailed mongoose, *Ichneumia albicauda*, associated with wetlands in Caprivi.

Five ungulates which are dependent on wetland habitat are the buffalo, *Syncerus caffer*, and four protected species; the bushbuck, *Tragelaphus scriptus*, the sitatunga, *T. spekei*, the reedbuck, *Redunca arundinum* and the oribi, *Ourebia ourebi* which are found only in the Mahango and West Caprivi Game Reserves.

The five specially protected mammal species found along the river are the elephant, *Loxodonta africana*, Burchell's zebra, *Equus burchelli*, the hippopotamus, *Hippopotamus amphibius*, the giraffe, *Giraffa camelopardalis*, and the impala, *Aepyceros melampus*. (Nature Conservation Ordinance No. 4 of 1975, amended 1976 & 1987).

Protected species not yet mentioned are; the bushbaby, *Galago senegalensis*, the leopard, *Panthera leo*, the bat-eared fox, *Otocyon megalotis*, the honey badger, *Mellivora capensis*, the antbear, *Orycteropus afer*, the blue wildebeest, *Connochaetes taurinus*, the tsessebe, *Damaliscus lunatus*, the common duiker, *Sylvicapra grimmi*, the steenbok, *Rhaphicerus campestris*, the eland, *Taurotragus oryx* as well as roan, *Hippotragus equinus*, and sable, *H. niger*, which were translocated from the Caprivi to

the Mahango Game Reserve in 1984. Altogether there are 18 protected mammal species in this region.

WETLAND EVALUATION

The wetlands associated with the Kavango River are of economic and ecological importance both nationally and internationally. They must be evaluated in terms of the people dependent on them and in environmental terms.

From west to east five tribes, the Kwangali, the Mbunza, the Shambyu, the Gciriku and the Mbukushu, live along the Namibian section of the Kavango River. These tribes practice a mixed economy which includes subsistence agriculture, cattle raising, artisanal fishing, gathering and some hunting. All these activities use natural wetland resources to some extent. The alluvial terraces and in some areas omiramba and dry floodplains are used for cultivating crops particularly millet (mahango). Floodplain grasses provide good grazing for cattle during the dry season. Reeds are used for thatching, fencing, baskets and traps. Fish are harvested by a variety of traditional methods largely for local consumption. Many wild fruits and animals are eaten or used as medicines.

The contributors to the 1988 Wetlands Workshop agreed to evaluate the wetlands in terms of certain resource and systems values to allow comparisons between different regions. The following evaluation is descriptive and to a certain extent subjective due to the present lack of quantitative information. Two types of values are distinguished; resource or economic values and system or ecological values.

TABLE 2: Resource evaluation for the Kavango River wetlands occurring in Namibia.

RESOURCE VALUES		SYSTEM VALUES	
Water	High	Flood attenuation	High
Soil	Moderate	Aquifer recharge	Moderate
Salt	Low	Water quality modifier	Moderate
Animals	High	Aesthetics	High
Plants	High	Social attributes	High
Peat	Low	Atmosphere quality modifier	Unknown

Resource values

These resources are those raw materials which are used by man. In the Kavango region the wetland plants and animals are traditionally exploited on a sustainable level. The demand for water and alluvial soil is expected to increase. Peat and salt deposits are low and do not appear to be collected.

Water

The main tributaries each contribute about 5 000 Mm^3 of water per year. This year-round availability of water, so unusual in an arid country, accounts for the dense human population and the rich biota. Irrigation is limited to government agricultural schemes and mission stations. In Rundu, water is drawn off and purified for municipal use but most of the schools, hospitals and mission stations on the river have groundwater supplies which are bilharzia free. Villagers use river water for their stock, limited crop irrigation, and water for household needs. Agricultural expansion and water extraction schemes such as the E.N.W.C., designed to withdraw 2 - 3 cubic metres per second (Ravenscroft 1985) will substantially increase future water demand.

As the main source of water to the Okavango Delta, the Kavango River is of international importance. The Delta contains 95% of the surface water in Botswana which supports a large population of farmers and fishermen as well as the bulk of the tourist industry. It supplies water to the diamond mines at Orapa and provides water and grazing to 3,5 million head of cattle (Bruton & Merron 1985).

Soil and sediment

Crops of maize, sorghum, millet, pumpkins, melons, beans, groundnuts, gourds, potatoes and tobacco are planted on the fertile alluvial terraces and in the upper reaches of the omiramba. In winter the dry floodplains and omiramba provide nutritious grazing for cattle. Sand and clay from the river are used for building and pottery, and gravel is removed for road building.

Wetlands are often regarded as sediment traps, the dense vegetation reduces flow rates and nutrient-rich sediments are deposited (Furness 1983). The sediment load in the Kavango River is generally low. The water is clear, except during the annual floods when allochtonous and bottom sediments resuspended by the turbulence are carried downstream. In recent years the clearing of river banks, trampling and overgrazing of the floodplains during the winter has probably increased erosion and hence the sediment load in the river. With time this accumulation of sediment can elevate downstream wetlands and so convert an aquatic habitat into a terrestrial one (Furness 1983).

Salt and peat

Chemical concentrations in the river are low and nutrient fluxes high with the result that little salt is deposited, despite high evapo-transpiration rates. There is no salt available for harvesting. Floodplains which have both a wet and a dry phase, accumulate very little organic carbon, due to grazing losses and rapid decomposition under oxidized conditions (Rogers 1983). Peat formation is highest in the areas of permanent marsh but does not appear to be harvested.

Animals

A large variety of wetland animals are eaten by the people living in the Kavango valley. These include snails, crabs, frogs, reptiles, birds and to a lesser extent game, but the most important are fish.

Fish are the main protein source for the Mbunza, Shambyu and Gciriku who inhabit the main floodplain region. Fisch (1984) gives a detailed account of fishing in Kavango and documents the rich folklore and tradition associated with fishing. She observed that the fishermen are very knowledgeable about the ecology of the river and the habits of the fish, and that many of the words related to fishing are probably of Khoi origin.

The only quantitative data available on fish exploitation is based on a short survey conducted in July 1987. Of the 71 fish species found in the river 52 were recorded in traditional fishing basket catches and an annual cropping rate of 19,4 kg per ha of river and floodplain area was estimated. At least 32 percent of the population living near the river actively caught fish (Van der Waal, this volume).

Merron and Bruton (1988) found that fish production in the Delta region is determined by the timing, magnitude and duration of the annual flood cycle, large yields are correlated to good floods and low yields to poor floods and drought. Floodplain

fish are resilient and can withstand heavy fishing pressure (Bruton et al. 1985).

Traditional fishing techniques vary from area to area and with the different stages of the floodcycle. These are well documented for the Kwangali (Gibson et al. 1981, Otto 1987), Shambyu (Bosch 1964, Gibson et al. 1981, Fisch 1984), Gciriku (Gibson et al. 1981, Fisch 1984) and the Mbukushu (van Tonder 1966, Gibson et al. 1981). Van der Waal summarises the methods presently used elsewhere in this volume, whilst Fisch (1984) gives an excellent account in German of both past and present fishing techniques which used to include the annual harvest of backwaters by poisoning.

Plants

Many of the plants in the Kavango valley are used. Edible fruits have been mentioned earlier and include sour plums *Ximenia caffra* and *X. americana* and the nuts of the maketti tree *Ricinodendron rauteneii*. Timber for building and carving is obtained from the red syringa, *Burkea africana*, the mobola plum, *Parinari curatellifolia*, kiaat *Pterocarpus angolensis*, Rhodesian teak, *Baikiaea plurijuga*, the weeping wattle, *Peltophorum africanum* and the Transvaal ebony, *Diospyros mespiliformis*. The latter two are also suitable for dugout canoes, as are the sausage tree, *Kigelia africana*, the large false mopane, *Guibourtia coleospermum* and the apple-leaf, *Lonchocarpus capassa*. Hoes and other impliments are made from leadwood, *Combretum imberbe*, and *Gardenia jovis-tonatis* is used to make handles.

Baskets and mats are woven from palm fibres, obtained from the wild date palm, *Phoenix reclinata*, and two species of fan palm, *Hyphaene benguellensis* and *H. petersiana*, the two reed species *Phragmites australis* and *P. maurtianus*, papyrus, *Cyperus papyrus* and a variety of sedges (Cyperaceae). Grasses used for thatching include broom grass, *Eragrostis pallens*, yellow-spike thatching grass, *Hyparrhenia rufa*, blue-grass, *Andropogon gayanus* var. *polycladus* and broad-leaved turpentine grass, *Cymbopogon caesius*.

Grasses, sedges, reeds, palm leaves and various woody plants play an important part in the construction of traditional fishing gear (Otto 1987).

Several aquatic plants are eaten; these include the tubers of water lilies, *Nymphaea* spp. and the water chestnut, *Trapa natans*.

System values

The Kavango River and its associated wetlands have environmental as well as commercial value. Although no quantitative information is available for the Kavango, the wetlands are important in terms of flood control, the maintainance of water quality, aquifer recharge and the quality of life.

Flood attenuation

The dense riverine and wetland vegetation retards waterflow and so reduces both flood damage and soil erosion.

Aquifer recharge and atmosphere quality modifier

Groundwater supplies in the Kavango valley are strong and the water quality is good. Most of the groundwater comes from a continuous aquifer hosted by Kalahari sediments. The aquifer is recharged from central-northern Bushmanland, the Karstland north-east of Tsumeb and by direct recharge as seepage from the permanently flowing river and from the dry river beds or omiramba during the rainy season (Simmonds & Schumann 1987). In the past fifty years more than 350 boreholes have been drilled, most of them within 30 kms of the river. There are no records of any drying up (ibid.).

It is not known how much of the surface flow contributes to the groundwater or how much is lost to the atmosphere by evapotranspiration. This probably depends on the climate and hydrology of the region (Howard-Williams 1983).

Water quality modifier

The water quality in the Kavango River is excellent. The water is soft and has very low nutient concentrations. The self-purification property of the wetland appears to deal effectively with present pollution levels but might not cope with heavy nutrient inputs.

In general, wetlands improve water quality by filtering out nutrients and sediment. Wetlands are more efficient at reducing concentrations of nitrogen, pathogenic bateria and heavy metals than at reducing phosphorus and organic matter (Rogers 1983).

Aesthetics and social attributes

The aesthetic appeal and recreational potential of the Kavango wetlands are not easily quantifiable. Areas of outstanding natural beauty include the Rupopo and Popa rapids, the islands near Nkurenkuru, Mukwe, Andara and Popa, the marshes at the Cuito confluence (Plate 2) and in the Muhango Game Reserve, and many of the old mission station sites.

The natural beauty of the region, the great diversity of wildlife, and superb angling (Burman 1987, Skelton 1988) make this an ideal area for tourism. With improved accessibility and upmarket tourist accommodation and fishing camps in the Mahango and West Caprivi Game Reserves similar to the East African lodges, the Kavango region can attract valuable foreign revenue. In Botswana, tourism based on the wetlands in the Okavango Delta, is the third largest source of national income.

Socially, river valleys have always attracted settlers and are important trade centres; Kavango is no exception. The valley supports a large rural population of almost 100 000 people and is the focus of future development plans. These plans include a hydro-electric power station at the Popa rapids, rail and road links to Zambia, eucalyptus plantations, commercializing mahango (pearl millet) and growing malt and barley (F.N.D.C. report 1989).

DISCUSSION AND RECOMMENDATIONS

Conservation needs

The conservation aims set out in the I.U.C.N. World Conservation Strategy (1980) are used to assess the requirements of the Kavango wetlands. These aims are; the maintenance of life support systems, the maintenance of genetic diversity, and the maintenance of sustained utilization both of consumable resources and less quantifiable aesthetic and social attributes.

The Kavango wetlands warrant conservation. As wetlands they are considered one of the essential life support systems on earth (Taylor & Cunningham 1983), they support a great variety of plants and animals, including several endemic and rare species, are essential to the artisanal fisheries and farming activities of

the local inhabitants and include several areas of outstanding natural beauty.

In a developing country such as Namibia it is important to consider future development needs in conservation. Strict nature conservation may be necessary for some sections of the river, particularly to protect vulnerable species and habitats. These have long-term value for tourism as well as ecosystem values. However, owing to the dense populations dependent on these wetlands, the more immediate consideration should be, to use the natural resources and develop the region in a way which is sustainable in the long term. Further, there is an international obligation to maintain the quality and viability of the water passing through the country.

Threats

Several potential threats to the Kavango wetlands both in Namibia and downstream in Botswana can be identified.

Alteration of the natural flood regime

The main threat to the Kavango wetlands is manipulation or change of the flood regime. Any alteration to the timing, intensity and duration of the flood will disrupt the basic driving force, and thereby destroy the delicate natural balance of the system (Bruton & Merron 1985).

Several known development plans could have adverse effects on the flood regime. Firstly, large-scale water extraction schemes for riverside irrigation and to supply the arid interior, for instance the E.N.W.C. development (Ravenscroft 1985, Comrie-Grieg 1986), can reduce flow downstream. The proposed withdrawal of $3m^3/s$ for the E.N.W.C. will have a minimal impact during flood periods and is less than 10% of the mean annual flow rate. This can increase to 20% in dry years and to as much as 47% in severe droughts (Cashman et al. 1986). As the proposed drawoff point at Rundu is upstream of the Cuito confluence, the impact will be limited largely to the floodplains between Rundu and the junction with the Cuito River. This could have an adverse effect on the artisanal fisheries of the Shambuyu and Gciriku people. Van der Waal (this volume) reiterates this fear and recommends that the E.N.W.C. intake be built below the confluence of the Cuito and Kavango Rivers. Normally high inflows from the Cuito should minimize the impact downstream.

A second scheme which has been proposed is the construction of a dam and hydro-electric scheme (Stengel 1962, F.N.D.C. report 1989). The Popa rapids are considered a suitable site because of the bedrock and steep gradient. This would have serious ecological implications both upstream and downstream of the wall. A timely lesson should be learned from a similar scheme in the Pongola floodplain in Natal (Heeg & Breen 1981). An impoundment would pose a serious threat to the fish; the rheopilic populations which include two endangered species would disappear and longitudinal migrations which may be particularly important in this river would be cut off. The riverine forests and islands near Andara would be drowned. Unless carefully managed, the operating procedure of the proposed power station would disrupt the natural flow regime essential to the functioning and productivity of all the floodplains and swamps downstream. Such changes could have serious socio-economic implications for the local communities. An alternative dam site 14 km south-east of Katwitwi would have similar adverse social and environmental consequences.

Habitat destruction and soil erosion

The second most important threat to the Kavango wetland is the destruction of both the floodplain and riverine forest habitats. The floodplains are most vulnerable during the dry phase when they are grazed and trampled by stock, used to plant crops and the emergent macrophytes are harvested for building materials. Overgrazing can cause deterioration of the grasslands; nutritious grasses being replaced by less nutritional species, whilst trampling, deep ploughing, and the removal of marginal vegetation can increase soil erosion.

Grazing and harvesting removes nutrients from the system and so decreases productivity at all levels of the food chain. Trampling during repeated communal fish drives can destroy aquatic vegetation in marginal waters (Van der Waal this volume). Large areas of natural vegetation have been cleared to provide river access, firewood, timber, agricultural land and in some cases a view. A few kilometres south of Popa a section of virgin riparian forest was thoughtlessly cut down immediately below a temporary road camp (pers. obs. 1987). The remaining riverine thickets and forests are important wildlife habitats and a source of wild fruit. It is very likely that decreases in game and bird numbers are directly linked to habitat destruction.

According to a recent F.N.D.C. report (1989) the entire Kavango valley is considered suitable for forestry and large eucalyptus plantations are proposed. Large scale afforestation particularly using eucalyptus would be disastrous to the wetlands. It is unwise to introduce aliens and if plantations are necessary, the feasibility of planting indigenous trees should be investigated.

Overexploitation of living natural resources

A third threat is overexploitation of the plants and animals. Intensive hunting, fishing and harvesting of building materials can upset the ecological balance. This type of damage is often the result of population pressure. The burden on the Kavango wetlands could double as people return to live on the Angola side.

Although recent fish surveys do not show any definite overexploitation of this resource (Skelton & Merron 1984, 1985, 1987) Van der Waal (this volume) suggests that the relatively few larger fish caught by traditional methods may be indicative of over-fishing.

The Boswana Fisheries Department realised the importance of exploiting the fish resource on a long-term sustainable basis and in consultation with the J.L.B. Smith Institute of Ichthyology recently completed an investigation on the fish and fisheries in the Delta (Bruton & Merron, 1985, Bruton et al. 1987, Merron & Bruton 1988, 1989). Namibia would do well to follow this example.

Pesticides and fertilizers

Chemical pollutants pose a fourth threat to the ecosystem. On the Kavango these include DDT used to spray huts for malaria control, dieldrin and endosulfan used for tsetse fly control, fertilizers in runoff from irrigated lands and diesolene. The pesticides are known to be harmful to birds and can become concentrated in tissues of predatory fish. DDT has been found in the eggs of reed cormorants and darters. The high concentrations found in isolated samples seem to indicate point source contamination, possibly at localities where equipment used in malaria control is rinsed. Low concentrations of dieldrin have also been detected (C.J. Brown pers. comm.). Skelton & Merron (1987) observed an oil slick caused by vehicles being cleaned in the river and warn that large-scale pollution is a serious threat not only to the plants and animals but also to the people using the water. As the rural population increases effluent and litter

disposal will become a problem.

Alien biota

An additional threat is that of alien invasives. Light localised infestations of prickly pear, *Opuntia ficus-indica*, castor oil plant, *Ricinus communis* (Hines et al. 1985), and common lantana, *Lantana camara* (pers. obs.), occur along the river bank. Thus far, no aquatic aliens have been found in the Namibian section of the river (Hines et al. 1985, C. Schlettwein pers. comm.). A potential threat is Kariba weed, *Salvinia molesta*, which previously caused serious problems in the Eastern Caprivi (Schlettwein et al. this volume). Isolated infestations have been found and controlled in the Okavango Delta (C. Schlettwein pers. comm.).

Although unlikely, the possibility exists that exotic fish species from the Omatako Dam may reach the Kavango River via floods in the Omuramba Omatako. The main threat is from Mozambique tilapia, (*Oreochromis mossambicus*) which are genetically similar to threespot tilapia, (*Oreochromis andersonii*) (Bethune & Skelton 1984). A more likely threat is from the thoughtless or uncontrolled use of exotics in fish farming enterprises near the river.

Recommendations

Wetlands are considered essential life support systems. To conserve the delicate ecological balance and to ensure long-term sustained natural productivity of the Kavango wetlands both in Namibia and downstream in the Delta, it is essential to maintain a natural flood regime, with the minimum interference in the magnitude and duration of the flood.

Environmental impact assessments should be required by law during the planning stages of all development programmes and be conducted by suitably qualified scientists.

It is important to protect the habitats of both the endangered and utilized species. Habitats which require particular protection are, the rapids where the two endangered fish species occur, the marginal and riparian zones so important to the birds and mammals, nesting sites and feeding grounds of the endangered waterfowl, fish nurseries and the permanent backwaters which provide important innoculums for the new season. The Popa, Mahango and West Caprivi Game Reserves already serve this function in the east but deforestation and bank clearing should be stopped elsewhere and this ban should ideally apply to both sides of the river to be truly effective.

Long-term conservation must curb any further habitat degradation, unwise exploitation, over-grazing and trampling of floodplains, the use of chemical pollutants and the introduction of alien species. This would involve both biological research and research into the socio-economic structure of the people dependent on the floodplain.

The controlled use of natural resources at a long-term sustainable level requires a better understanding of the extent of artisanal fisheries, the size and composition of the available fish stock, the effects of hydrological fluctuations and the extent of plant utilization both for food and building materials. Further studies on the artisanal fisheries, the potential for commercial fisheries, wetland hydrology and ecology, ethno-botany and ethno-zoology are required.

The natural beauty of the region should be conserved as a national asset and tourism in the region promoted. Areas of outstanding natural beauty and those of special scientific interest should be identified and protected.

Future development and conservation plans must consider all the components of the wetland. This type of holistic approach is only possible on an international level, involving all the countries along the Kavango drainage system. In this way, the river and floodplains can be managed and used to the best benefit of man and wildlife.

In brief, I recommend that article 95 of the Namibian Constitution be applied to the management of the Kavango River and its associated floodplains:

> **that the ecosystems, essential ecological processes and biological diversity of Namibia are maintained and living natural resources are utilized on a sustainable basis for the benefit of all Namibians, both present and future...**

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ACKNOWLEDGEMENTS

I gratefully acknowledge the assistance of; Dr Paul Skelton and Dr. Glenn Merron of the J.L.B. Smith Institute of Ichthyology in Grahamstown, Kevin Roberts of the School of Animal Biology at the University College of North Wales, Michael Silberbauer of the Hydrological Research Institute, Pretoria, Kathie Noli of the Directorate of Sea Fisheries in Luderitz, Barbara Curtis, Dr Maria Fisch and Antje Otto of the State Museum in Windhoek, Dr Ben van der Waal of the Zoology Department at the University of Venda, Dr Tony Williams of the Cape Department of Nature and Environmental Conservation, Mike Griffin, Dr Chris Brown and Dr Rob Simmons of the Ministry of Wildlife, Conservation and Tourism in Windhoek, C.H.G. Schlettwein of the Ministry of Fisheries and Marine Resources and Steve Crerar of the Department of Water Affairs in Windhoek and Dr Mike Miller of the National Herbarium in Windhoek, all of whom provided information and critical comment during the preparation of this report.

I wish to thank the Director of the Botanical Research Institute in Pretoria for providing PRECIS checklists for the vegetation of the Kavango valley, the Secretary of Agriculture and Nature Conservation for inviting me to compile this report and the Secretary of Water Affairs for permission to use hydrological and limnological data.

Finally my thanks to my family whose patience and support allowed me to get on with it.

APPENDIX 1: Checklist of plants along the Kavango River in Namibia

1/16th degree grids included in this list:
1718AD, 1718DA, 1718DC, 1718DD, 1718CC, 1719CD, 1719DC, 1719DD, 1720CC, 1720CC, 1720CD, 1720DC, 1720DD, 1820BA, 1820BB, 1721CC, 1721CD, 1821AB, 1821BA, 1821BB, 1821BC, 1821BD.

Information from : PRECIS, Botanical Research Institute, Pretoria / SWA DWA Collection - State Herbarium, Windhoek *Grasses of South West Africa/Namibia*. Muller (1984) /*Trees of Southern Africa*. Coates Palgrave (1983) / Wasserpflanzen in Südwestafrika. Wiss (1981).

Codes:
- EA - Emergent aquatic
- ESA - Emergent semi-aquatic
- SA - Submerged aquatic
- FF - Free-floating
- SFF - Submerged free floating
- FLA - Floating-leaved aquatic
- FSA - Floating-stemmed aquatic
- RF - Riverine fringe vegetation
- FP - Floodplain vegetation
- Is - Island
- SS - Seasonal swamp vegetation
- WP - Wetland associated vegetation
- WC - Wetland creeper
- DW - Dry woodland
- KS - Kalahari sand
- P - Protected
- E - Endemic
- A - Alien
- * - occurs in Botswana (Smith 1976, 1984)

The number given after each family name refers to the code used by the Botanical Research Institute in Pretoria. Where known the common name is given.

List of Algal species collected from the Kavango River during 1984, by the Department of Water Affairs. Identified by W.A. Scott and A. Madera of the National Institute of Water Research, C.S.I.R., Pretoria. Classification according to Prescott (1979).

PROCARYOTA Blue-green algae	
CYANOPHYTA	
CHROOCOCCALES	
CHROOCOCCACEAE	*Chroococcus*
	Microcystis
OSCILLATORIALES	
OCILLATORIACEAE	*Oscillatoria*
NOSTOCALES	
NOSTOCACEAE	*Nostoc*
RIVULARIACEAE	*Calothrix*
EUCARYOTA	
CHLOROPHYTA Green algae	
CHLOROPHYCEAE	
VOLVOCALES	
CHLAMYDOMONADACEAE	*Clamydomonas*
CHLOROCOCCALES	
SCENEDESMACEAE	*Scenedesmus*
HYDRODICTYACEAE	*Pediastrum boryonum*
	Pediastrum tetras
CHAETOPHORALES	
CHAETOSPHAERIDIACEAE	*Chaetosphaeridium*
OEDOGONIALES	
OEDOGONIACEAE	*Oedogonium*
	Bulbochaete
SIPHONOCLADALES (CLADOPHORALES)	
CLADOPHORACEAE	*Cladophora*
ZYGNEMATALES (CONJUGALES)	
ZYGNEMATACEAE	*Spirogyra*
	Zygnema
DESMIDACEAE	*Cosmarium*
	Staurastrum
EUGLENOPHYTA	
EUGLENOPHYCEAE	
EUGLENALES	
EUGLENACEAE	*Euglena*
CHRYSOPHYTA	
BACILLARIOPHYCEAE (DIATOMACEAE)	
CENTRALES	
COSCINODISCACEAE	*Melosira granulata*
PENNALES	Unidentified pennate diatoms

PTERIDOPHYTA: FERNS

Family and BRI code	Species and Genus	Common Name	Habitat	Code
AZOLLACEAE 200				
	Azolla pinnata R.Br.	water fern	FF	*
THELYPTERIDACEAE 532				
	Thelypteris confluens (Thunb.) Morton		EA	*
	Thelypteris interrupta (Willd.) K.Iwats		EA	*
ISOETACEAE 40				
	Isoetes schweinfurthii A.Br.			*
MARSILEACEAE 190				
	Marsilea unicornis Launert			

ANGIOSPERMAE
MONOCOTYLEDONAE

Family and BRI code	Species and Genus	Common Name	Habitat	Code
TYPHACEAE 49000				
	Typha capensis (Rohrb.) N.E.Br.	bulrush	EA	*
POTAMOGETONACEAE 58000				
	Potamogeton octandrus Poir.		SA	*
	Potamogeton pectinatus L.	fennel-leaved pondweed	SA	
	Potamogeton pusillus L.		SA	
	Potamogeton schweinfurthii A.W.Benn.	broad-leaved pondweed	FLA	*
	Potamogeton thunbergii Cham. & Schlechtd	floating pondweed	FLA	*
ZANNICHELLIACEAE 60000				
	Zanniechellia palustris L.	horned pondweed	SA	*
NAJADACEAE 64000				
	Najas pectinata (Parl.) Magnus	saw-weed	SA	
APONOGETONACEAE 65000				
	Aponogeton junceus Lehm. ex Schlechtd. subsp. *junceus*		FLA	
	Aponogeton junceus Lehm. ex Schlechtd. subsp. *rehmannii* (Oliv.) Oberm.	dog-with-two-tails	FLA	*
ALISMATACEAE 70000				
	Burnatia enneandra P.A.Mich.		EA	*
HYDROCHARITACEAE 85000				
	Lagarosiphon cordofanus Caspary		SA	*
	Lagarosiphon ilicifolius Oberm.		SA	*
	Lagarosiphon muscoides Harv.	fine oxygen weed	SA	*
	Vallisneria aethiopica Fenzl.		SA	*
	Ottelia kunenensis (Guerke) Dandy		SA	*
	Ottelia muricata (C.H.Wr.) Dandy		SA	*
POACEAE 9900010				
	Ischaemum fasciculatum Brongn.		WG	*
	Vossia cuspidata (Roxb.) Griff		EA/FLA	*
	Urelytrum agropyroides (Hack.) Hack.			
	Elionurus muticus (Sprengel) Kunth	wire grass		
	Elionurus tripsacoides Willd.			
	Rottboellia exaltata L.f.			
	Imperata cylindrica (L.) Raeuschel		WG	*
	Miscanthus junceus (Stapf) Gibbs Russel Ms		EA	*
	Sorgum bicolor	sorgum / mahangu		

Family and BRI code	Species and Genus	Common Name	Habitat	Code
POACEAE 9900010 cont.	*Vetiveria nigritana* (Benth.) Stapf		FP	*
	Eulalia aurea (Bory) Kunth		WG	*
	Bothriochloa bladhii (Retz.) S.T.Blake	purple tassel grass	WG	*
	Schizachyrium exile (Hochst.) Pilg.			
	Schizachyrium jeffreysii (Hack.) Stapf		FP	
	Andropogon brazzae Franch.		WG	*
	Andropogon gayanus Kunth var. *polycladus* (Hock.) Clayton	blue grass		
	Andropogon huillensis Rendle		FP	
	Andropogon schirensis A. Rich.			
	Cymbopogon caesius (Nees) Stapf			
	Hyparrhenia sp.			
	Hyparrhenia dichroa (Steud.) Stapf		WG	
	Hyparrhenia filipendula (Hochst.) Stapf var. *filipendula*			
	Hyparrhenia filipendula (Hochst.) Stapf var. *pilosa* (Hochst.) Stapf			
	Hyparrhenia rufa (Nees) Stapf	yellow-spike thatching grass	FP	*
	Hyperthelia dissoluta (Nees ex Steud.) Clayton			
	Trachypogon spicatus (L.f.) Kuntze			
	Heteropogon contortus (L.) Roem. & Schult.	Spear grass		
	Heteropogon melanocarpus (Ell.) Benth.	Sweet tanglehead		
	Elymandra grallata (Stapf) Clayton			
	Themeda triandra Forssk.	red grass		
	Digitaria abyssinica (A.Rich.) Stapf		WP	*
	Digitaria debilis (Desf.) Willd.		FP	*
	Digitaria gayana (Kunth) Stapf			
	Digitaria gazensis Rendle			
	Digitaria longiflora (Retz.) Pers.			
	Digitaria maniculata Stapf		WG	*
	Digitaria milanjiana (Rendle) Stapf		FP	
	Digitaria perrottetii (Kunth) Stapf		FP	
	Digitaria remotigluma (De Winter) Clayton		WG	*
	Digitaria sanguinalis (L.) Scop.		WG	*
	Digitaria seriata Stapf			
	Alloteropsis cimicina (L.) Stapf			
	Brachiaria sp.			
	Brachiaria arrecta (Dur. & Schinz) Stent		WG	*
	Brachiaria dura Stapf var. dura		FP	
	Brachiaria grossa Stapf			
	Brachiaria humidicola (Rendle) Schweick.		FP	*
	Brachiaria nigropedata (Fical.& Hiern) Stapf	blackfooted brachiaria		
	Brachiaria serrata (Thunb.) Stapf			
	Brachiaria xantholeuca (Schinz) Stapf			
	Pseudobrachiaria deflexa (Schum.) Launert	annual brachiaria		
	Paspalum sp.			
	Paspalum scrobiculatum L.		SS	*
	Paspalidium geminatum (Forssk.) Stapf			
	Urochloa brachyura (Hack.) Stapf			
	Urochloa mosambicensis (Hack.) Dandy		FP	
	Urochloa oligotricha (Fig.& De Not.) Henr.	gonya gras		
	Urochloa trichopus (Hochst.) Stapf		FP	
	Echinochloa colona (L.) Link		WG	*
	Echinochloa crus-galli (L.) Beauv.	barnyard grass		
	Echinochloa frumentacea Link			
	Echinochloa stagnina (Retz.) Beauv.		SS	*
	Acroceras macrum Stapf		FP	*
	Psilochloa pilgerana (Schweick.) Launert		WG	*
	Oplismenus burmannii (Retz.) Beauv.		FP	*
	Panicum sp.			
	Panicum brevifolium L.			
	Panicum bechuanense Brem. & Oberm.			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
POACEAE 9900010 cont.	*Panicum fluviicola* Steud.		WG	*
	Panicum gilvum Launert		WG	*
	Panicum kalaharense Mez	Kalahari buffalo grass	FP	
	Panicum maximum Jacq.	Guinea grass	FP	
	Panicum pansum Rendle			
	Panicum repens L.		ESA	*
	Panicum repentellum Napper			
	Panicum subalbidum Kunth		ESA	*
	Panicum subflabellatum Stapf			
	Panicum trichonode Launert & Renvoize		WG	*
	Sacciolepis sp.			
	Sacciolepis africana C.E.Hubb. & Snowden		EA	*
	Sacciolepis rigens (Mez) A. Chev.			
	Sacciolepis typhura (Stapf) Stapf		EA	*
	Setaria sp.			
	Setaria finita Launert			
	Setaria homonyma (Steud.) Choiv.			
	Setaria incrassata (Hochst.) Hack.			
	Setaria sphacelata (Schumach.) Moss var. *sericea* (Stapf) Clayton		FP	
	Setaria sphacelata (Schumach.) Moss var. *torta* (Stapf) Clayton			
	Setaria ustilata De Wit			
	Setaria verticillata (L.) Beauv.	Bur-bristle grass	FP	
	Cymbosetaria sagittifolia (A.Rich.) Schweick	arrow-grass		
	Rhynchelytrum sp.			
	Rhynchelytrum bellespicatum (Rendle) Stapf & C.E.Hubb.			
	Rhynchelytrum kallimorphon Clayton			
	Rhynchelytrum longisetum (A.Rich.) Stapf & C.E.Hubb.			
	Rhynchelytrum repens (Willd.) C.E.Hubb.	red-top	FP	
	Tricholaena sp			
	Tricholaena monachne (Trin.) Stapf & C.E.Hubb. var. *monachne*	blue-seed grass		
	Anthephora pubescens Nees	wool grass		
	Pennisetum americanum	pearl millet		
	Pennisetum glaucocladum Stapf & C.E.Hubb.			
	Pennisetum glaucum (L.) R.Br.			
	Cenchrus biflorus Roxb.			
	Cenchrus ciliaris L.	buffalo grass	FP	
	Oryza longistaminata A.Chev. & Roehr.		EA	*
	Leersia sp.			
	Leersia friesii Meld.		EA	*
	Trichopteryx dregeana Nees			
	Phragmites australis (Cav.) Steud.	Common reed	EA	*
	Phragmites mauritianus Kunth		EA	*
	Stipagrostis hirtigluma (Trin. & Rupr.) de Winter subsp. *patala* (Hack.)de Winter			
	Stipagrostis uniplumis (Licht.) de Winter var. *uniplumis*	silky bushman grass		
	Aristida adscensionis L. subsp. *guineesis* (Trin. & Rupr.) Henr.	annual bristle grass	Is	
	Aristida congesta Roem. & Schult. subsp. *congesta*	tassel three-awn		
	Aristida hordeacea Kunth	fox brush		
	Aristida junciformis Trin. & Rupr. subsp . *junciformis*			
	Aristida meridionalis Henr.	giant stick grass	FP	
	Aristida mollissima Pilg. subsp. *mollissima*			
	Aristida pilgeri Henr.	Pilger's stick grass	FP	
	Aristida rhiniochloa Hochst.	large-seeded bristle grass		
	Aristida scabrivalvis Hack. subsp. *scabrivalvis*			
	Aristida stipitata Hack. subsp. *graciliflora* (Pilg.) Meld.			
	Aristida stipitata Hack. subsp. *robusta* (Stent. & Rattray) Meld.			
	Aristida stipitata Hack. subsp. *spicata* (de Winter) Meld.	sandveld long-awned stick grass		
	Aristida stipoides Lam.	Grootfontein stick grass		

Family and BRI code	Species and Genus	Common Name	Habitat	Code
POACEAE 9900010 cont.	*Sartidia angolensis* (C.E.Hubb.) de Winter			
	Tragus berteronianus Schult.		FP	
	Perotis patens Gand.	bottle-brush grass	FP	
	Perotis vaginata Hack.			
	Sporobolus sp.			
	Sporobolus festivus A.Rich.			
	Sporobolus fimbriatus (Trin.) Nees var. *fimbriatus*	dropseed grass	FP	
	Sporobolus fimbriatus (Trin.) Nees var. *latifolius* Stent			
	Sporobolus iocladus (Trin.) Nees	pan dropseed grass	FP	
	Sporobolus natalensis (Steud.) Dur. & Schinz		WG	*
	Sporobolus pyrimidalis Beauv.		FP	*
	Sporobolus smutsii Stent			
	Sporobolus spicatus (Vahl) Kunth		FP	
	Eragrostis sp.			
	Eragrostis aspera (Jacq.) Nees			
	Eragrostis cilianensis (All.) F.T.Hubb.		FP	
	Eragrostis cylindriflora Hochst.			
	Eragrostis dinteri Stapf			
	Eragrostis echinochloidea Stapf	tick grass	FP	
	Eragrostis gangetica (Roxb.) Steud			
	Eragrostis heteromera Stapf			
	Eragrostis inamoema K.Schum.		ESA	
	Eragrostis jeffreysii Hack.			
	Eragrostis lappula Nees var. *divaricata* Stapf			
	Eragrostis lappula Nees var. *lappula*		FP	*
	Eragrostis lehmanniana Nees var. *lehmanniana*	Lehman's love grass		
	Eragrostis pallens Hack.	broom grass	FP	
	Eragrostis pilgerana Dinter ex Pilg.			
	Eragrostis pilosa (L.) Beauv			
	Eragrostis porosa Nees			
	Eragrostis rigidior Pilg.	curly-leaved love grass	FP	
	Eragrostis rotifer Rendle		WG	*
	Eragrostis sarmentosa (Thunb.) Trin.		FP	*
	Eragrostis stapfii de Winter		FP	
	Eragrostis superba Peyr.	heart-seeded love grass	FP	
	Eragrostis trichophora Coss. & Dur.	hairy love grass	FP	
	Eragrostis viscosa (Retz.) Trin.		FP	
	Microchloa kunthii Desv.			
	Cynodon sp.			
	Cynodon dactylon (L.) Pers.	quick grass	FP	
	Enteropogon macrostachyus (A.Rich.) Benth.		Is	
	Chloris virgata Sw.	feather-top chloris	Is	
	Craspedorhachis sarmentosa (Hack.) Pilg.			
	Eleusine sp.			
	Eleusine coracana (L.) Gaertn. subsp. *africana* (K-O'Byrne) Hilu & de Wet			
	Eleusine indica (L.) Gaertn. subsp. *africana* (K-O'Byrne) S.M.Phillips	rapoko grass		
	Dactyloctenium aegyptium (L.) Beauv.	common crowfoot		
	Dactyloctenium giganteum Fischer & Schweick.	giant crowfoot	FP	
	Pogonarthria fleckii (Hack.) Hack.			
	Pogonarthria squarrosa (Roem.& Schult.) Pilg.	herring-bone grass	Is	
	Leptocarydion vulpiastrum (De Not.) Stapf			
	Bewsia biflora (Hack.) Goossens			
	Diplachne fusca (L.) Stapf		ESA	*
	Diplachne gigantea Launert		EA	*
	Triraphis purpurea Hack.	annual needle grass		
	Triraphis schinzii Hack.	needle grass		
	Trichoneura grandiglurmis (Nees) Ekman var. *grandiglumis*		FP	
	Trichoneura grandiglumis (Nees) Ekman var. *minor* Rendle			
	Enneapogon cenchroides (Roem.& Schult., C.E.Hubb.)	common nine-awned grass	Is	

Family and BRI code	Species and Genus	Common Name	Habitat	Code
POACEAE 9900010 cont.	*Schmidtia kalahariensis* Stent	bushman grass	Is	
	Schmidtia pappophoroides Steud.	Kalahari sand quick	Is	
	Elytrophorus sp.			
CYPERACEAE 452000 Sedge family				
	Volkiella disticha Merxm. & Czech			
	Hemicarpha isolepis Nees			
	Ascolepis pusilla Ridley			
	Cyperus sp.			
	Cyperus amabilis Vahl		FP	
	Cyperus articulatus L.		EA	*
	Cyperus compressus L.		FP	*
	Cyperus difformis L.		FP	*
	Cyperus digitatus Roxb. subsp. *auricomus* (Sieber ex Spreng.) Kuekenth.		EA	*
	Cyperus halpan L.			
	Cyperus imbricatus Retz.		FP	*
	Cyperus leptocladus Kunth		WP	*
	Cyperus longus L. var. *longus*		FP	*
	Cyperus longus L. var. *tenuiflorus* (Rottb.) Kuekenth.		FP	
	Cyperus maculatus Boeck.		WP	*
	Cyperus margaritaceus Vahl		FP	
	Cyperus marginatus Thunb.			
	Cyperus papyrus L.	papyrus	EA	*
	Cyperus pectinatus Vahl		EA	*
	Cyperus schinzii Boeck.			
	Cyperus spaerospermus Schrad.			
	Cyperus tenax Boeck.			
	Cyperus zollingeri Steud.			
	Pycreus chrysanthus Boeck.		WP	*
	Pycreus macrostachyos Lam.		FP	*
	Pycreus mundtii Nees		EA	*
	Pycreus nitidus (Lam.) J.Raynal		EA	*
	Pycreus okavangensis Podlech		WP	*
	Pycreus polystachyos (Rottb.) Beauv. var. *polystachyos*		SS	*
	Mariscus sp.			
	Mariscus aristatus (Rottb.) Cherm. var. *atriceps* (Kuekenth.) Podlech			
	Mariscus breviradius P.J.Vorster ms			
	Mariscus chersinus N.E.Br.			
	Mariscus cylindristachyus Steud.			
	Mariscus dregeanus Kunth		WP	*
	Mariscus dubius (Rottb.) Kuekenth. ex G.E.C.Fischer		FP	*
	Mariscus fulgens (C.B.Cl.) Vorster ms			
	Mariscus laxiflorus Turrill		FP	
	Mariscus macropus (Kunth) C.B.Cl.			
	Monandrus hamulosus (M. Bieb.) Vorster ms		WP	*
	Monandrus longicarpus Vorster ms		WP	*
	Monandrus squarrosus (L.) Vorster ms subsp. *squarrosus*		WP	*
	Monandrus squarrosus (L.) Vorster ms subsp. *ovamboensis* Vorster ms		WP	*
	Courtoisia cyperoides (Roxb.) Nees subsp. *africanus* (C.B.Cl.ex Kuekenth.) Vorster ms		WP	*
	Kyllinga alba Nees		FP	
	Kyllinga albiceps (Ridley) Rendle		WP	*
	Kyllinga erecta Schumach.		FP	*
	Kyllinga intricata Cherm.			
	Fuirena leptostachya Oliv. var. *leptostachya*		WP	*
	Fuirena pubescens (Poir.) Kunth		SS	*
	Fuirena umbellata Rottb.		EA	*
	Scirpus cubensis Poeppig & Kunth ex Kunth		SS	
	Scirpus microcephalus (Steud.) Dandy			
	Schoenoplectus corymbosus (Roth. ex Roem. & Schult.) J.Raynal		EA	*
	Schoenoplectus erectus (Poir.) Palla ex J. Raynal		WP	*
	Eleocharis sp.			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
CYPERACEAE 452000 cont.	*Fimbristylis* sp.			
	Fimbristylis complanata (Retz.) Link		SS	*
	Fimbristylis ferruginea (L.) Vahl		WP	*
	Fimbristylis hispidula (Vahl) Kunth		FP	
	Fimbristylis squarrosa Vahl		FP	*
	Bulbostylis contexta (Nees) Bodard			
	Bulbostylis hispidula (Vahl) R. Haines			
	Bulbostylis humilis (Kunth) C.B.Cl.		FP	
	Albigaardia triflora (L.) Abeywicker		WP	*
	Rhynchospora holoschoenoides (A.Rich.) Herter		ESA	*
	Scleria foliosa Hochst. ex A.Rich.		ESA	*
ARECACEAE 528000 Palm tree family				
	Phoenix reclinata Jacq.	wild date palm	ESA	*
	Hyphaene petersiana Klotzsch	fan palm		
ARACEAE 684000				
	Pistia stratiotes L.	water lettuce / Nile cabbage	FF	*
XYRIDACEAE 826000				
	Xyris capensis Thunb.		EA	*
ERIOCAULACEAE 828000				
	Eriocaulon abyssinicum Hochst.		WP	*
	Eriocaulon cinereum R.Br.		WP	*
COMMELINACEAE 893000				
	Commelina africana L. var. *lancispatha* C.B. Cl.			
	Commelina bengalensis L.			
	Commelina erecta L.			
	Commelina diffusa Burn.f.subsp. *scandens* (C.B.Cl.) Oberm.			
	Commelina fluviatilis Brenan		EA	
	Commelina forsdalaei Vahl			
	Commelina subulata Roth		WP	*
	Commelina zambesica C.B. Cl.			
	Aneilema aequinoctiale (Beauv.) Kunth			
	Aneilema hockii De Wild.			
	Murdannia simplex (Vahl) Brenan			
	Cyanotis foecunda Hassk.			
	Cyanotis lanata Benth.			
	Cyanotis longifolia Benth.			
	Floscopa glomerata (Willd. ex Schult. & Schult. f.) Hassk.		EA	*
PONTEDERIACEAE 920000				
	Eichhornia natans (Beauv.) Solms-Laub.		FLA	*
LILIACEAE 942000				
	Gloriosa superba L.			
	Androcymbium gramineum (Cav.) Macbride			
	Trachyandra arvensis (Schinz) Oberm.			
	Anthericurn anceps Bak.			
	Anthericum whytei Bak.			
	Chlorophytum papillosum Rendle			
	Eriospermurn bakeranum Schinz			
	Aloe esculenta Leach			P
	Aloe zebrina Bak.			P
	Albunca angolensis Welw.			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
LILIACEAE 942000 cont.	*Dipcadi bakerianum* H. Bol.			
	Dipcadi glaucum (Ker-Gawl.) Bak.			
	Dipcadi longifolium (Lindl.) Bak.			
	Scilla nervosa (Burch.) Jessop			
	Ornithogalum pulchrum Schinz			
	Ornithogalum tenuifolium Delaroche subsp. *tenuifolium*			
	Sanseviera aethiopica Thunb.			
	Sanseviera hyacinthoides (L.) Druce			
	Sanseviera longiflora Sims			
	Sanseviera pearsonii N.E. Br.			
	Protasparagus africanus (Lam.) Oberm.			
	Protasparagus buchananii (Bak.) Oberm.			
	Protasparagus cooperi (Bak.) Oberm.			
	Protasparagus nelsii (Schinz) Oberm.			
	Protasparagus racemosus (Willd.) Oberm.			
AMARYLLIDACEAE 1166000				
	Nerine laticoma (Ker-Gawl..) Dur. & Schinz			
	Crinum baumii Harms			
	Crinum buphanoides .Welw. ex Bak.			
	Crinum carolo-schmidtii Dinter		WP	P *
	Crinum crassicaule Bak.			
	Crinum foetidum Verdoorn			
	Crinum paludosum Verdoorn			
DIOSCOREACEA 1250000				
	Dioscorea bulbifera L.			
	Dioscorea quartiniana A.Rich. var. *quartiniana*			
IRIDACEAE 1259000				
	Gladiolus dalenii Van Geel			
	Lapeirousia erythrantha (Klotzsch) Bak. var. *bainesii* (Bak.) Marais ms			
	Lapeirousia odoratissima Bak.			
	Lapeirousia schimperi (Aschers. & Klatt) Milne-Redh..			
ORCHIDACEAE 1389000				
	Eulophia hereroensis Schltr.			P
	Eulophia leachii Greatrex ex A.V. Hall			
	Eulophia speciosa (R.Br. ex Lindl. H. Bol.			

DICOTYLEDONAE

Family and BRI code	Species and Genus	Common Name	Habitat	Code
SALICACEAE 1872000 Willow family				
	Salix subserrata Willd.	wild willow	RF	*
MYRICACEAE 1874000	Waxberry family			
	Myrica sp.			
	Myrica serrata Lam.	lance-leaf waxberry	ESA	*
MORACEAE 1908000 Fig family				
	Ficus pygmaea Welw. ex Hiern		ESA	*
	Ficus thonningii Blume		S-A	
	Ficus sycomorus L.		S-A	
PROTEACEAE 2016000 Protea family				
	Protea gaguedi Gmel.	African protea		P
LARANTHACEAE 2070000				
	Tapianthus kraussianus (Meisn.) V Tieghem subsp. *transvaalensis* (Sprague) Weins			
	Tapinanthus oleifolius (Wendl.) Danser			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
LARANTHACEAE 2070000 cont.	*Tapinanthus rubromarginatus* (Engl.) Danser			
	Tapinanthus terminaliae (Engl. & Gilg.) Danser			
	Erianthemum ngamicum (Sprague) Danser			
	Plicosepalus kalachariensis (Schinz) Danser			
SANTALACEAE 2096000				
	Thesium sp.			
OLACEAE 2129000				
	Olax dissitiflora Oliv. (small-fruited olax)			
	Ximenia americana L. (small sourplum)			
	Ximenia caffra Sond. (large sourplum)			
POLYGONACEAE 2184000 Buckwheat family				
	Polygonum sp.			
	Polygonum limbatum Meisn.		ESA	*
	Polygonum pulchrum Blume (knotweed)		EA	*
	Polygonum salicifolium Willd.		EA	*
	Polygonum senegalense Meisn. forma *sengalense*		EA	*
	Oxygonum delagoense Kuntze			
	Oxygonum dregeanum Meisn. var. *strictum* (C.H.Wr.) R.A. Grah.			
	Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Damm.			
AMARANTHACEAE 2289000				
	Celosia trigyna L.			
	Hermbstaedtia odorata (Burch.) T.Cooke var. *odorata*			
	Amaranthus thunbergii Moq.			
	Sericocoma heterochiton Lopr.			
	Sericorema sericea (Schinz) Lopr.			
	Kyphocarpa angustifolia (Moq.) Lopr.			
	Pupalia lappacea (L.) Juss.			
	Aerva leucura Moq.			
	Alternanthera nodiflora R.Br.		WP	*
	Alternanhera sessilis (L.) DC.		ESA	*
NYCTAGINACEAE 2343000				
	Commicarpus africanus (Laur.) Dandy			
	Boerhavia diffusa L. var. *hirsuta* Heimerl			
AIZOACEAE 2374000				
	Limeum himifusum Friedr.			
	Limeum sulcatum (Klotzsch) Hutch. var. *sulcatum*			
	Limeum viscosum (Gay) Fenzl subsp. *nummulifolium* (H.Walter) Friedr.			
	Mollugo cerviana (L.) Ser. ex DC. var. *cerviana*			
	Glinus lotoides L. var. *lotoides*		WP	*
	Sesuvium hydaspicum (Edgw.) M.L.Goncalves		WP	*
	Sesuvium sesuvioides (Fenzl) Verdc.			
PORTULACACEAE 2406000				
	Portulaca hereroensis Schinz			
	Portulaca kermesina N.E.Br.			
CARYOPHYLLACEAE 2429000				
	Polycarpon prostratum (Forssk.) Aschers & Schweinf.		WP	*

Family and BRI code	Species and Genus	Common Name	Habitat	Code
CARYOPHYLLACEAE 2429000 cont.	*Polycarpaea corymbosa* (L.) Lam.			
	Polycarpaea eriantha Hochst. ex A. Rich. var. *eriantha*			
NYMPHAEACEAE 2511000 Water lily family				
	Nymphaea caerulea Sav.	blue water lily	FLA	*
	Nymphaea capensis Thunb. var. *capensis*		FLA	*
	Nymphaea lotus L.		FLA	*
CERATOPHYLLACEAE 2516000 Hornwort family				
	Ceratophyllum demersum L. var. *demersum* forma *demersum*		SFF	*
RANUNCULACEAE 2521000	*Clematis brachiata* Thunb.		WC	
	Clematopsis scabiosifolia (D.C.) Hutch. subsp. *stanleyi* (Hook.) Brummitt			
MENISPERMACEAE 2567000				
	Cocculus hirsutus (L.) Diels		WC	
	Cissampelos mucronata A.Rich.		WC	*
	Tinospora caffra (Miers) Troupin			
	Tinospora fragosa (Verdoorn) Verdoorn & Troupin			
ANNONACEAE 2665000 Custard apple family				
	Friedodielsia obovata (Benth.) Verdc.	bastard dwaba-berry	RF	*
	Xylopia odoratissima Welw. ex Oliv.	small bitterwood		
	Xylopia tomentosa Excell			
	Annona stenophylla Engl. & Diels subsp. *nana* (Excell) N.K.B.Robson			
LAURACEAE 2782000				
	Cassytha filiformis L.		WC	*
CAPPARACEAE 3082000 Caper family				
	Cleome iberidella Welw. ex Oliv.		WP	*
	Cleome rubella Burch.			
	Capparis tomentosa Lam.	woolly caper bush		
	Boscia albitrunca (Burch.) Gilg. ex Ben. var. *albitrunca*	shepards'tree, witgat		
	Cadaba termitaria N.E.Br.	pink cadaba		
	Maerua schinzii Pax	ringwood tree	RF	E
DROSERACEAE 31330000 Sundew family				
	Drosera madagascariensis DC.		Is	*
CHRYSOBALANCEAE 3405000				
	Parinari capensis Harv. subsp. *capensis*			
	Parinari curatellifolia Planch. ex Benth.	mobula plum		
FABACEAE 3436000 Pod-bearing family				
	Albizia anthelmintica (A.Rich.) Brongn.	worm-cure albizia		
	Albizia antunesiana Harms	purple-leaved albizia		
	Albizia harveyi Fourn.	sickle-leaved albizia		
	Albizia versicolor Welw. ex Oliv.	poison-pot albizia		
	Acacia albida Del.	ana tree		
	Acacia arenaria Schinz	sand acacia		
	Acacia ataxacantha DC.	flame acacia		
	Acacia erubescens Welw. ex Oliv.	blue thorn	RF	
	Acacia fleckii Schinz	blade thorn		
	Acacia hebeclada DC. subsp. *chobiensis* (O.B.Miller) A. Schreib.			
	Acacia hebeclada DC. subsp. *tristis* A.Schreib.	candle acacias		
	Acacia luederitzii Engl. var. *luederitzii*	fat-thorned acacia		

Family and BRI code	Species and Genus	Common Name	Habitat	Code
FABACEAE 3436000 cont.	*Acacia nigrescens* Oliv.	knob-thorn		
	Acacis reficiens Wawra	false umbrella thorn		
	Acacia sieberiana DC. var. *woodii* (Burtt Davy) Keay & Brenan	paperbark acacia	RF	*
	Acacia tortilis (Forssk.) Hayne subsp. *heteracantha* (Burch.) Brenan	umbrella thorn	WP	
	Mimosa pigra L.		WP	*
	Dichrostachys cinerea (L.) Wight & Arn subsp. *africana* Brenan & Brumm. var. *setulosa* (Welw. ex Oliv.) Brenan & Brummitt	sickle bush		
	Erythrophleum africanum (Welw. ex Benth.) Harms	ordeal tree	RF	
	Burkea africana Hook.	red syringa		
	Guibourtia coleosperma (Benth.) J. Leonard	large false mopane		
	Baikiaea plurijuga Harms	Rhodesian teak, white bauhinia		
	Bauhinia petersiana Bolle subsp. *macrantha* (Oliv.) Brummitt & J.H.Ross			
	Bauhinia thonningii Schum.	camel's foot		
	Bauhinia urbaniana Schinz	pink bauhinia		
	Piliostigma thonningii (Schumach.) Milne-Redh.			
	Adenolobus garipensi (E.Mey.) Torre & Hillc.			
	Dialium engleranum Henriq.	Kalahari podberry		
	Cassia abbreviata Oliv. subsp. *beareana* (Holmes) Brenan			
	Cassia mimosoides L.		WP	*
	Cassia obtusifolia L.		WP	*
	Cassia occidentalis L.		WP	*
	Peltophorum africanum Sond.	weeping wattle		
	Swartzia madagascariensis Desv.	snake bean		
	Baphia massaiensis Taub. subsp. *obovata* (Schinz) Brummitt var. *obovata*	sand camwood		
	Lotononis dinteri Schinz			
	Crotolaria flavicarinata Bak.f.			
	Crotolaria heidmannii Schinz			
	Crotolaria pisicarpa Welw. ex Bak.		WP	*
	Crotolaria podocarpa DC.			
	Crotolaria sphaerocarpa Perr. ex DC.			
	Crotolaria steudneri Schweinf.		WP	*
	Indigofera arenophila Schinz			
	Indigofera astragalina DC.			
	Indigofera charlierana Schinz var. *charlierana*			
	Indigofera daleoides Benth. ex Harv. *daleoides*			
	Indigofera flavicans Bak.			
	Indigofera gairdneriae Hutch. ex Bak. f.			
	Indigofera nummulariifolia (L.) Alston			
	Indigofera parviflora Heyne ex Wight & Arn var. *parviflora*			
	Indigofera trita L.f. var. *subulata* (Poir.) Ali			
	Tephrosia acaciifolia Bak.			
	Tephrosia caerulea Bak.f.subsp. *otaviensis* (Dinter)A.Schreib.& Brummitt			
	Tephrosia cephalantha Welw. ex Bak. var. *decumbens* Welw. ex Bak.			
	Tephrosia lupinifolia DC.			
	Tephrosia pumila (Lam.) Pers. var. *pumila*		WP	*
	Tephrosia purpurea (L.) Pers. subsp. *leptostachya* (DC.) Brummitt var. *leptostachya*			
	Mundulea sericea (Willd.) Chev.	cork bush		
	Sesbania cinerascens Welw. ex Bak.	grey river bean	ESA	*
	Sesbania caerulescens Harms	blue river bean		
	Sesbania microphyllum Phill. & Hutch.	river bean	WP	*

Family and BRI code	Species and Genus	Common Name	Habitat	Code
FABACEAE 3436000 cont.	*Sesbania rostrata* Brem. & Oberm.		WP	*
	Sesbania sesban (L.) Merr.	river bean	RF	*
	Lessertia benguellensis Bak. f.			
	Aeschynomene cristata Vatke var. *cristata*		EA	*
	Aeschynomene fluitans Peter		FSA	*
	Aeschynomene indica L.		WP	*
	Aeschynomene nilotica Taub.		EA	*
	Stylosanthes fructicosa (Retz.) Alston			
	Arachis hypogaea L.			
	Zornia glochidiata DC.			
	Desmodium salicifolium (Poir.) DC. var. *salicifolium*		WP	*
	Pterocarpus angolensis DC.	kiaat / teak		
	Lonchocarpus capassa Rolfe	apple leaf		
	Lonchocarpus nelsii (Schinz) Heering & Grimme	Kalahari apple leaf		
	Abrus precatorius L. subsp. *africanus* Verdc.			
	Clitoria ternatea L.			
	Neonotonia wightii (Arn.) Lackey		WP	*
	Neorautanenia amboensis Schinz			
	Erythrina baumii Harms			
	Erythrina mendesii Torre			
	Rhynchosia caribaea (Jacq.) DC.			
	Rhynchosia holosericea Schinz			
	Rhynchosia minima (L.) DC. var. *minima*			
	Rhynchosia minima (L.) DC. var. *prostrata* (Harv.) Meikle			
	Rhynchosia sublobata (Schumach.) Meikle			
	Vigna sp.			
	Vigna davyi H. Bol.			
	Vigna oblongifolia A.Rich. var. *parviflora* (Bak.) Verdc.			
	Vigna unguiculata (L.) Walp. subsp.*unguiculata*			
	Otoptera burchellii DC.			
	Lablab purpureus (L.) Sweet subsp. *uncinatus* Verdc.		WP	*
	Dolichos junodii (Harms) Verdc.			
	Macrostyloma axillare (E.Mey.) Verdc. var. *axillare*			
OXALIDACEAE 3935				
	Oxalis purpurascens Salter			
	Biophytum abyssinicum Seud. ex A.Rich.			
	Biophytum petersianum Klotzsch			
RUTACEAE 3986000 Citrus family				
	Vepris termitaria Medonca			
	Citropsis daweana Swingle & Kellerm.	wild citrus	WP	*
BURSERACEAE 4136000 Myrrh family				
	Commiphora africana (A.Rich.) Engl.	poison-grub commiphora		
	Commiphora angolensis Engl.	sand commiphora		
	Commiphora edulis (Klotzsch) Engl.			
	Commiphora pyracanthoides Engl.	common commiphora		
	Commiphora tenuipetiolata Engl.	satin-bark commiphora		
MALPIGHIACEAE 4201000				
	Sphedamnocarpus pruriens (Juss.) Szyszyl. var. *pruriens*			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
POLYGALACEAE 4273000				
	Polygala africana Chod.			
	Polygala albida Schinz.		WP	*
	Securidaca longepedunculata Fresen.	violet tree		
DICHAPETALACEAE 4283000				
	Dichapetalum cymosum (Hook.) Engl.			
	Dichapetalum rhodesicum Sprague & Hutch.			
EUPHORBIACEAE 4286000				
	Pseudolachnostylis sp.			
	Pseudolachnostylis dekindtii Pax			
	Pseudolachnostylis maprouneifolia Pax	kudu-berry		
	Securinega virosa (Roxb. ex Willd.) Pax & K. Hoffm.	white-berry bush		
	Phyllanthus maderaspatensis L.			
	Phyllanthus pentandrus Schumach. & Thonn.			
	Phyllanthus reticulatus Poir.	potato bush	RF	*
	Antidesma venodum E.Mey. ex Tul.	tassel berry	WP	*
	Croton gratissimus Burch. var. *gratissimus*	lavender croton		
	Croton megalobotrys Muell. Arg.	fever berry	RF	*
	Croton menyhartii Pax	rough-leaved croton		
	Croton pseudopulchellus Pax	small lavender croton		
	Croton zambesicus Muell. Arg.			
	Caperonia sp.			
	Caperonia serrata Presl		EA	*
	Caperonia stuhlmannii Pax			
	Erythrococco menyharthii (Pax) Prain			
	Acalypha sp.			
	Acalypha ciliata Forssk.			
	Acalypha ornata Hochst. ex A.Rich.		WP	*
	Acalypha petiolaris Hochst.			
	Tragia okanyua Pax			
	Tragia physocarpa Prain			
	Pterococcus africanus (Sond.) Pax & K. Hoffm.			
	Ricinus communis L.	castor oil plant		A
	Cephalocroton mollis Klotzsch			
	Ricinidendron rautanenii Schinz	manketti tree		
	Euphorbia espinosa Pax	woody euphorbia		
	Euphorbia monteiroi Hook.f. subsp. *monteiroi*			
	Euphorbia transvaalensis Schltr.			
	Chamaesyce prostrata (Ait.) Small			
ANACARDIACEAE 4543000 Mango family				
	Sclerocarya birrea (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	marula		
	Lannea discolor (Sond.) Engl.	live-long		
	Lannea edulis (Sond.) Engl.			
	Ozoroa longipes (Engl.& Gilg.) R. & A. Fernandes	round-leaved resin tree		
	Ozoroa okavangensis R. & A. Fernandes			
	Ozoroa paniculosa (Sond.) R. & A. Fernandes	common resin tree		
	Ozoroa schinzii (Engl.) R. & A. Fernandes			
	Rhus marlothii Engl.	bitter karee		
	Rhus quartianiana A.Rich.	river rhus	RF	*
	Rhus tenuinervis Engl. var. *tenuinervis*	Kalahari taaibos		
CELASTRACEAE 4618000				
	Maytenus senegalensis (Lam.) Excell.			
	Cassine aethiopica Thunb.	kooboo berry	RF	*

Family and BRI code	Species and Genus	Common Name	Habitat	Code
CELASTRACEAE 4618000 cont.	*Hippocratea africana* (Willd.) Loes. var. *richardiana* (Cambess.) N.K.B. Robson		WP	*
	Hippocratea parviflora N.E.Br.			
	Hippocratea parvifolia Oliv.	smooth-leaved paddle pod		
	Salacia luebbertii Loes.			
SAPINDACEAE 4723000 Lichi and soap berry family				
	Allophyllus africanus Beauv.	African allophyllus	RF	
RHAMNACEAE 4858000				
	Ziziphus mucronata Willd. subsp. *mucronata*	buffalo thorn		
	Berchemia discolor (Klotzsch) Hemsl.	bird plum		
	Helinus integrifolius (Lam.) Kuntze			
VITACEAE 4909000 Grape-vine family				
	Ampelocissus obtusata (Welw. ex Bak.) Planch. subsp. *kirkiana* (Planch.) Wild & Drum.			
	Cyphostemma cirrhosum (Thunb.) Descoings ex Wild & Drum. subsp. *transvaalense* (Szyszyl. C.A.Sm.)			
	Cyphostemma congestum (Bak.) Descoings ex Wilt & Drum.			
TILIACEAE 4937000 Jute and linden family				
	Corchorus tridens L.			
	Corchorus trilocularis L.		WP	*
	Grewia avellana Hiern			
	Grewia bicolor Juss.	bastard brandy bush	RF	
	Grewia falcistipula K. Schum.			
	Grewia flava DC.	brandy bush		
	Grewia flavescens Juss. var. *flavescens*	rough-leaved raisin	RF	
	Grewia flavescens Juss. var. *olukondae* (Schinz) Wild		RF	
	Grewia retinervis Burret	Kalahari sand raisin		
	Grewia schinzii K.Schum.	Zambezi raisin	RF	*
	Grewia villosa Willd.	mallow raisin		
	Triumfetta angolensis Spargue & Hutch.			
MALVACEAE 4980000 Hibiscus and mallow family				
	Abutilon ramosum (Cav.) Guill. & Perr.			
	Malvastrum coromandelianum (L.) Garcke			
	Sida alba L.		WP	*
	Sida cordifolia L.			
	Sida ovata Forssk.			
	Pavonia sp.			
	Pavonia burchellii (DC.) R.A.Dyer			
	Pavonia senegalense (Cav.) Leistner			
	Hibiscus sp.			
	Hibiscus articulatus Hochst. ex A.Rich.			
	Hibiscus caesius Garke			
	Hibiscus cannabinus L.		WP	
	Hibiscus dongolensis Del.		WP	*
	Hibiscus mechowii Garcke			
	Hibiscus meeusei Exell			
	Hibiscus praeteritus R.A.Dyer			
	Hibiscus schinzii Guerke			
	Hibiscus vitifolius L. subsp. *vulgaris* Brenan & Excell			
	Kosteletzkya buettneri Guerke		EA	*
BOMBACEAE 5023000 Baobab family				
	Adonsonia digitata L.	baobab		
STERCULIACEAE 5044000 Cacao family				
	Melhania acuminata Mast. var. *acuminata*			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
STERCULIACEAE 5044000 cont.	*Melhania forbesii* Planch. ex Mast.			
	Dombeya rotundifolia (Hochst.) Planch. var. *rotundifolia*	wild pear		
	Hermannia cf *cordata* (E.Mey. ex Phill.) de Winter			
	Hermannia eenii Bak.f.			
	Hermannia glandulosissima Engl.		WP	*
	Hermannia guerkeana K. Schum.			
	Hermannia modesta (Ehrenb.) Mast.			
	Hermannia quartiniana A.Rich.			
	Hermannia tomentosa (Turcz.) Schinz ex Engl.			
	Waltheria indica L.			
OCHNACEAE 5112000 Ochna family				
	Ochna cinnabarina Engl. & Gilg.			
	Ochna pulchra Hook. subsp. *pulchra*	peeling bark ochna		
	Brackenridgea arenaria (De Wild. & Dur.) N.K.B.Robson			
CLUSIACEAE 5162000 St John's wort family				
	Hypericum oligandrum Milne-Redh.			
	Garcinia livingstonei T.Anders.	African mangosteen	RF	*
ELATINACEAE 5230000				
	Bergia pentheriana Keissl.			
	Bergia polyantha Sond.		WP	*
FLACOURTIACEAE 5275000				
	Oncoba spinosa Forssk.		WP	*
TURNERACEAE 5355000				
	Tricliceras lobatum (Urb.) R. Fernandes			
CACTACEAE 5401000				
	Opuntia ficus-indica (L.) Mill	prickly pear		A
THYMELAEACEAE 5429000				
	Gnidia kraussiana Meisn. var. *kraussiana*			
LYTHRACEAE 5473000				
	Rotala dinteri Koehne			
	Rotala elatinoides (DC.) Hiern			
	Rotala filiformis (Bellardi) Hiern		ESA	*
	Rotala fluitans Pohnert		WP	*
	Rotala tenella (Guill. & Perr.) Hiern		WP	*
	Ammannia baccifera L. subsp. *baccifera*		WP	*
	Ammannia preuriana Guill. & Perr.		WP	*
	Nesaea crassicaulis (Guill. & Perr.) Koehne		SA	*
	Nesaea luederitzii Koehne			
	Nesaea rautanenii Koehne		WP	*
COMBRETACEAE 5536000 Combretum family				
	Combretum albopunctatum Suesseng.	silverdot bushwillow	RF	
	Combretum celastroides Welw.ex C.Lawson	savannah bushwillow		
	Combretum collinum Fresen. subsp. *gazense* (Swynn. & Bak.f.) Okafor			
	Combretum collinum Fresen. subsp. *ondongense* (Engl.& Diels) Okafor			
	Combretum engleri Schinz			
	Combretum hereroense Schinz	russet bushwillow		
	Combretum imberbe Wawra	leadwood	RF	P
	Combretum mosssambicense (Klotzsch) Engl.	knobbly combretum	RF	
	Combretum platypetalum Welw.ex Laws. subsp. *baumii* (Engl.& Gilg.)Excell			
	Combretum platypetalum Welw.ex Laws. subsp. *platypetalum*			
	Combretum psidioides Welw. subsp. *dinteri* (Schinz) Engl.			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
COMBRETACEAE 5356000 cont.	*Combretum psidioides* Welw. subsp. *psidioides*	silver bushwillow		
	Combretum schumannii Engl.			
	Combretum zeyheri Sond.	large-fruited bushwillow		
	Terminalia brachystemma Welw.ex Hiern	Kalahari sand terminalia		
	Terminalia prunioides C.Lawson	purple-pod terminalia	RF	
	Terminalia sericea Burch. ex DC.	silver terminalia		
MYRTACEAE 5553000				
	Syzygium gerrardii (Harv.ex Hook.f.) Burtt Davy	forest waterberry	RF	
	Syzygium guineense (Willd.) DC. subsp. *barotsense* F.White	bi-colour waterberry	RF	*
	Syzygium guineense (Willd.) DC. subsp. *guineense*	woodland waterberry	RF	*
MELASTOMATACEAE 5627000				
	Dissotis debilis (Sond.) Triana var. *debilis*		WP	*
ONAGRACEAE 5791000 Evening primrose family				
	Ludwigia octavalvis (Jacq.)Raven subsp. *brevisepala* (Brenan) Raven		EA	*
	Ludwigia senegalensis (DC.) Torch		SA/EA	*
	Ludwigia stolonifera (Guill. & Perr.) Raven	willow-herb	EA	*
TRAPACEAE 5829000				
	Trapa natans L. var. *bispinosa* (Roxb.) Makina	water chestnut	FLA	*
	Trapa natans L. var. *natans*		FLA	
APIACEAE 5893000 Carrot and Parsley family				
	Heteromorpha trifoliata (Wendl.) Eckl & Zeyh		WP	*
	Steganotaenia araliracea Hochst	carrot tree		
PLUMBAGINACEAE 6343000				
	Plumbago zeylanica L.			
EBENACEAE 6403000 Ebony family				
	Euclea divinorum Hiern	magic guarri	RF	
	Euclea undulata Thunb. var. *myrtina* (Burch.) Hiern	thicket euclea	RF	
	Diospyros chamaethamnus Mildbr.			
	Diospyros lycioides Desf. subsp. *lycioides*	blue bush		
	Diospyros lycioides Desf. subsp. *sericea* (Bernh.) de Winter			
	Diospyros mespiliformis Hochst.ex A.DC.	Transvaal ebony	RF	*
	Diospyroa virgata (Guerke) Brenan			
OLEACEAE 6419000				
	Schrebera trichoclada Welw.			
	Jasminum fluminense Vell.		WC	*
LOGANIACEAE 6447000 Strychnos family				
	Strychnos cocculoides Bak.	corky-bark monkey orange		
	Strychnos pungens Soler.	spine-leaved monkey orange		
	Strychnos spinosa Lam.	spiny monkey orange	RF	*
GENTIANACEAE 6479000				
	Enicostema hyssopifolium (Willd.) Verdoorn			
	Nymphoides brevipedicellata (Vatke) Raynal		FLA	*
	Nymphoides indica (L.) Kuntze subsp. *occidentalis* Raynal	floating heart	FLA	*
APOCYNACEAE 6549000 Oleander family				
	Carissa edulis Vahl	simple spined num-num	WP	*
	Diplorhynchus condylocarpon (Muell.Arg.) Pichon	horn pod tree		
	Baissea wulfhorstii Schinz			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
PERIPLOCACEAE 6729000				
	Taccazzea apiculata Oliv.		ESA	*
	Cryptolepis oblongifolia (Meissn.) Schltr.			
	Raphionacme lanceolata Schinz			
ASCLEPIADACEAE 6752000				
	Asclepias rostrata N.E.Br.			
	Cynanchum schistoglossum Schltr.		WP	*
	Orthanthera jasminiflora (Decne.) Schinz			
	Huernia verekeri Stent var. *verekeri*			
	Gymnema sylvestre (Retz.) Schultes			
	Sphaerocodon melananthus N.E.Br			
	Fockea multiflora K.Schum.			
CONVOLVULACEAE 6968000 Morning glory family				
	Cuscuta planiflora Tenore var. *planiflora*			
	Seddera suffruticosa (Schinz) Hallier f.			
	Jacquemontia tamnifolia (L) Griseb.			
	Convolvulus sagittatus Thunb. subsp. *sagittatus* var. *sagittatus*			
	Convolvulus sagittatus Thunb. var. *ulosepalus* (Hallier f.) Verdc.			
	Merremia palmata Hallier f.			
	Merremia pinnata (Hochst. ex Choisy) Hallier f.			
	Merremia tridentata (L.) Hallier f. subsp. *angustifolia* (Jacq.) Ooststr. var. *angustifolia*			
	Merremia verecunda Rendle			
	Ipomoea aquatica Forssk.	water spinach	FSA	*
	Ipomoea bolusiana Schinz subsp.*bolusiana*			
	Ipomoea coptica (L.) Roth ex Roem.& Schult. var. *coptica*			
	Ipomoea leucanthemum (Klotzsch) Hallier f.			
	Ipomoea magnusiana Schinz var. *eenii* (Rendle) A. Meeuse			
	Ipomoea obscura (L.) Ker-Gawl. var. *fragilis* (Choisy) A. Meeuse			
	Ipomoea plebeia R.Br. subsp. *africana* A.Meeuse			
	Ipomoea purpurea (L.) Roth	morning glory		A
	Ipomoea rubens Choisy		EA	*
	Ipomoea sinensis (Desr.) Choisy subsp. *blepharosepala* (Hochst.ex A.Rich.) Verdc.		WP	
	Ipomoea sinensis (Desr.) Choisy subsp. *sinensis*			*
BORAGINACEAE 7038000 Heliotrope and forget-me-not family				
	Ehretia obtusifolia Hochst.ex DC.		RW	
	Ehretia rigida (Thunb.) Druce	puzzle bush		
	Heliotropium indicum L.		WP	*
	Heliotropium strigosum Willd.			
VERBENACEAE 7138000				
	Lantana angolensis Moldenke			
	Lantana camara L.	common lantana		A
	Vitex amboniensis Guerke			
	Vitex flavescens Rolfe	large-fruited vitex		
	Clerodendrum dekindtii Guerke			
	Clerodendrum ternatum Schinz var. *ternatum*			
	Clerodendrum uncinatum Schinz			
LAMIACEAE 7210000 Salvia family				
	Tinnea eriocalyx Welw.			
	Tinnea rhodesiana S.Moore			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
LAMIACEAE 7210000 cont.	*Acrotome angustifolia* G.Tayl.			
	Acrotome inflata Benth.			
	Leonotis nepetifolia (L.) R.Br.			
	Leucas glabrata (Vahl) Sm. var. *glabrata*			
	Plectranthus hereroensis Engl.			
	Plectranthus mirabilis (Briq.) Launert			
	Plectranthus tetensis (Bak.) Agnew		WP	*
	Englerastrum schweinfurthii Briq.			
	Hoslundia opposita Vahl			
	Acrocephalus sericeus Briq.			
	Becium knyanum (Vatke) N.E. Br. ex Broun & Massey			
	Becium obovatum (E.Mey.ex Benth.)N.E. Br. var. *obovatum*			
	Ocimum canum Sims			
	Ocimum urticifolium Roth subsp. *urticifolium*			
SOLANACEAE 7377000 Potato family				
	Solanum delagoense Dun.			
	Solanum panduriforme E.Mey.			
	Nicotiana tabacum L.	tobacco		A
SCROPHULARIACEAE 7460000 Snapdragon family				
	Aptosimum decumbens Schinz			
	Sutera elegantissima (Schinz) Skan		WP	*
	Limnophila ceratophylloides (Hiern) Skan		SA	*
	Torenia spicata Engl.		WP	*
	Melasma sp.			
	Melasma scabrum Berg.			
	Alectra sp.			
	Alectra parvifolia (Engl.) Schinz			
	Buchnera hispida Buch.-Ham.ex D.Don			
	Buchnera longespicata Schinz			
	Cycnium tubulosum (L.f.) Engl.		ESA	
	Rhymphicarpa sp.			
	Rhymphicarpa fistulosa (Hochst.) Benth.			
	Striga asiatica (L.) Kuntze			
	Striga bilabiata (Thunb.) Kuntze		WP	*
	Striga elegans Benth.			
BIGNONACEAE 7662000 Jacaranda family				
	Rhigozum brevispinosum Kuntze	western rhigozum	RF	
	Markhamia acuminata (Klotzsch) K.Schum.	bean tree		
	Kigelia africana (Lam.) Benth.	sausage tree	RF	
PEDALIACEAE 7769000 Sesame family				
	Pterodiscus aurantiacus Welw.			
	Sesamum calycinum Welw. var. *angustifolium* (Oliv.) Ihlenf.& Seidenst.			
	Sesamum calycinum Welw. var. *calycinum*		WP	
	Sesamum triphyllum Welw. ex Aschers. var *triphyllum*			
	Dicerocaryum sp.			
	Dicerocaryum eriocarpum (Decne) Abels			
LENTIBULARIACEAE 7898000				
	Utricularia benjaminiana Oliv.		SFF	*
	Utricularia foliosa L.	leafy bladderwort	SFF	*

Family and BRI code	Species and Genus	Common Name	Habitat	Code
LENTIBULARIACEAE 7898000 cont.	*Utricularia inflexa* Forssk		SFF	*
	Utricularia stellaris L.f.	star bladderwort	SFF	*
	Utricularia subulata L.		WP	*
ACANTHACEAE 7906000				
	Thunbergia aurea N.E.Br.			
	Hygrophila sp.			
	Hygrophila pilosa Burkill		WP	*
	Dyschoriste radicans (Hochst. ex Rich.) Nees		WP	*
	Duosperma crenatum (Lindau) P.G.Mey.			
	Ruellia otaviensis P.G.Mey.			
	Ruellia patula Jacq.			
	Barleria galpinii C.B.Cl.			
	Barleria lugardii C.B.Cl.			
	Barleria mackenii Hook.f.			
	Barleria senensig Klotzsch			
	Blepharis caloneura S.Moore var. *angustifolia* Oberm.			
	Blepharis integrifolia E.Mey. ex Schinz var. *integrifolia*			
	Blepharis maderaspatensis (L.) Heyne ex Roth subsp. *maderaspatensis* var. *maderaspatensis*			
	Dicliptera micranthes Nees			
	Justicia anselliana (Nees) T.Anders.		WP	*
	Justicia betonica L.			
	Justicia dinteri S.Moore			
	Justicia glabra Koen.ex Roxb.		WP	*
	Monechma debile (Forssk.) Nees			
	Monechma divaricatum (Nees) C.B Cl			
PLANTAGINACEAE 8116000				
	Psydrax livida (Hiern) Bridson			
RUBIACEAE 8119000 Gardenia family				
	Kohautia cuspidata (K.Schum.) Brem.			
	Kohautia lasiocarpa Klotzsch			
	Pentodon pentandrus (Schumach. & Thonn.) Vatke var. *pentandrus*		WP	*
	Oldenlandia affinis (Roem.& Schult.)DC. subsp. *fugax* (Vatke) Verdc.			
	Oldenlandia capensis L.f. var. *capensis*		WP	*
	Oldenlandia herbacea (L.) Roxb. var. *herbacea*			
	Oldenlandia lancifolia (Schumach.) DC. var. *scabridula* Brem.		WP	*
	Crossopteryx febrifuga (Afzel.ex G.Don.)Benth.	crystal bark		
	Gardenia brachythamnus (K.Schum.) Launert			
	Gardenia volkensii K.Schum. subsp. *spatulifolia* (Stapf & Hutch) Verdc.	Transvaal gardenia		
	Tricalysia cacondensis Hiern			
	Vangueria cyanescens Robyns			
	Vangueria esculenta S.Moore	forest wild medlar		
	Pygmaeothamnus zeyheri (Sond.) Robyns var. *zeyheri*			
	Psydrax livida (Hiern) Bridson	bushveld canthium		
	Ancylanthos bainesii Hiern			
	Pavetta cataractarum S.Moore		WP	*
	Pavetta schumanniana F.Hoffm. ex K.Schum.	poison bride's bush		
	Pavetta zeyheri Sond.	small-leaved bride's bush		
	Richardia scabra L.			
	Spermacoce senensis (Klotzsch) Hiern			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
CUCURBITACEAE 8548000				
	Zehneria marlothii (Cogn.) R.& A.Fernandes			
	Acanthosicyos naudinianus (Sond.) C.Jeffrey			
	Momordica balsamina L.			
CAMPANULACEAE 8644000 Blue-bell family				
	Wahlenbergia banksiana A.DC.			
	Wahlenbergia ramosissima (Hemsl.) Thulin subsp. *lateralis* (V.Brehm.) Thulin		WP	*
	Wahlenbergia undulata (L.f.) A.DC.			
LOBELIACEAE 8681000				
	Lobelia angolensis Engl.& Diels		WP	*
ASTERACEAE 8729000 Composite family				
	Ethulia conyzoides L.f.		ESA	*
	Erlangea misera (Oliv. & Hiern) S.Moore			
	Vernonia sp.			
	Vernonia aurantiaca (O.Hoffm.) N.E.Br.			
	Vernonia gerberiformis Oliv. & Hiern			
	Vernonia glabra (Steetz) Vatke var. *Glabra*		WP	*
	Vernonia poskeana Vatke & Hildebr. subsp. *botswanica* Pope			
	Vernonia steetziana Oliv. & Hiern			
	Adenostemma caffrum DC.		EA	*
	Mikania sagittifera B.L.Robinson			
	Grangea anthemoides O.Hoffm.		WP	*
	Grangea maderaspatana (L.) Poir.		WP	*
	Nidorella resedifolia DC. subsp. *resedifolia*			
	Nolletia sp.			
	Blumea gariepina DC.			
	Denekia capensis Thunb.		WP	*
	Nicolasia costata (Klatt) Thell.		WP	*
	Nicolasia pedunculata S.Moore		WP	*
	Gnaphalium filagopsis Hilliard & Burtt		WP	*
	Helichrysum albanense Hilliard			
	Helichrysum argyrospaerum DC.			
	Helichrysum subglomeratum Less.			
	Pegolettia senegalensis Cass.			
	Philyrophyllum schinzii O.Hoffm.			
	Geigeria nianganensis Dinter ex Merxm.			
	Acanthospermum hispidum DC.			
	Melanthera marlothiana O. Hoffm.			
	Melanthera scandens (Schumach. & Thonn.) Roberty subsp. *madagascariensis* (Bak.) Wild		EA	*
	Bidens pilosa L.	black-jack		A
	Bidens schimperi Sch.Bip.ex Walp.			
	Cadiscus aquaticus E.Mey.			
	Tagestes minuta L.			
	Cotula anthemoides L.		WP	*
	Rennera limnophila Merxm.		WP	*
	Crassocephalum picridifolium (DC.) S.Moore		ESA	*
	Senecio cryphiactis O. Hoffm.		WP	*
	Senecio schinzii O.Hoffm.			

Family and BRI code	Species and Genus	Common Name	Habitat	Code
ASTERACEAE 8729000 cont.	*Senecio strictifolius* Hiern		EA	*
	Hirpicium gorterioides (Oliv.& Hiern) Roessl. subsp.*gorterioides* *Hirpicium gorterioides* (Oliv.& Hiern) Roessl. subsp.*schinzii* Roessl.			
	Pleiotaxis antunesii O.Hoffm. *Pleiotaxis anthemoides* O.Hoffm.			

The Director of the Botanical Research Institute is thanked for the use of species lists produced by the Pretoria National Herbarium Computerized Information System (PRECIS), for each quarter degree grid area along the Namibian section of the Okavango River.

APPENDIX II. List of Kavango fish species collected from the Namibian section of the Kavango River 1984 - 1987.

Based on Bruton et al. 1982, Skelton & Merron 1984, 1985, 1987, Skelton et al. and Van der Waal 1985.

* Rare species.

Identification, J. L. B. Smith Institute of Ichthyology, Grahamstown.

FAMILY AND SPECIES	COMMON NAME	HABITAT PREFERENCE
MORMYRIDAE - elephant snouts		
Hippopotamyrus ansorgii	Slender stonebasher	
Hippopotamyrus discorhynchus	Zambezi parrotfish	Shallow vegetated shore, gentle current
Marcusenius macrolepidotus	Bulldog	Marsh and reed beds
Mormyrus lacerda	Western bottlenose	Rocks and vegetated water
Petrocephalus castostoma	Churchill	Sheltered backwater, rocks
Pollimyrus castelnaui	Dwarf stonebasher	Vegetated, quiet water
CHARACIDAE - robbers		
Brycinus lateralis	Stripped robber	Open water, fringe of flowing marsh
Hydrocynus vittatus	Tigerfish	Open, flowing water
Micralestes acutidens	Silver robber	Open, flowing water
Rhabdalestes maunensis	Okavango robber	Vegetated, quiet water
HEPSETIDAE - pikes		
Hepsetus odoe	African pike	Vegetated, quiet water
DISTICHODONTAE - citharines		
Hemigrammocharax machadoi	Dwarf citharine	Vegetated, quiet water
Hemigrammocharax multifasciatus	Multibar citharine	Vegetated, quiet water
Nannocharax macropterus	Broad-barred citharine	Fringe vegetation of mainstream, flowing water
CYPRINIDAE - minnows + yellow fish		
Barbus afrovernayi	Spottail barb	Vegetated, quiet water
Barbus barnardi	blackback barb	Vegetated, quiet water
Barbus barotseensis	Barotse barb	
Barbus bifrenatus	Hyphen barb	Vegetated, quiet water
Barbus codringtonii	Upper Zambezi yellow fish	Flowing water, rapids
Barbus eutaenia	Orangefin barb	Partly vegetated, mainstream margins, moderate current
Barbus fasciolatus	Red barb	Vegetated, quiet water

FAMILY AND SPECIES	COMMON NAME	HABITAT PREFERENCE
CYPRINIDAE cont.		
Barbus haasianus	Sicklefin barb	
Barbus multilineatus	Copperstripe barb	Vegetated, quiet water
Barbus paludinosus	Straightfin barb	Vegetated, quiet water
Barbus poechii	Dashtail barb	Partly vegetated water, rapids, quiet current
Barbus radiatus	Redeye barb	Partly vegetated, semi-open, gentle current
Barbus tangandensis	Redspot barb	Vegetated river margin
Barbus thamalakanensis	Thamalakane barb	Semi-open, vegetated, gentle current
Barbus unitaeniatus	Longbeard barb	Semi-vegetated, gentle to moderate current
Coptostomabarbus wittei	Upjaw barb	Floodplains, marshes
Labeo cylindricus	Redeye labeo	Rapids, mainstream margins, flowing water
Labeo lunatus	Upper Zambezi labeo	Semi-vegetated, large water bodies
Mesobola brevianalis	River sardine	Semi-open shores, mainstream
Opsaridium zambezense	Barred minnow	Semi-open flowing water, mainstream margins
BAGRIDAE - rock catfish		
Auchenoglanis ngamensis	Zambezi grunter	Rocky or sheltered habitats, quiet water
Leptoglanis rotundiceps		Sand banks, flowing water
SCHILBEIDAE - butter catfish		
Schilbe mystus	Silver catfish	Open water, slow to moderate current
AMPHILIIDAE - mountain catfish		
Amphilius uranoscopus	Stargazer mountain catfish	Rocky rapids, fringe vegetation of mainstream
CLARIIDAE - common catfish		
Clarias dumerilli / C. liocephalus	Okavango catfish	
Clarias gariepinus	Sharptooth catfish	Vegetated, quiet or moderate current
Clarias ngamensis	Blunttooth catfish	Vegetated, gentle or no current
Clarias stappersii	Blotched catfish	
Clarias theodorae	Snake catfish	Quiet, muddy, semi-vegetated water
* *Clariallabes platyprosopos*	Broadhead catfish	Crevices in rapids
MOCHOKIDAE - squeakers		
Chiloglanis fasciatus	Rock catlet	Rocky rapids, fringe vegetation of mainstream
Synodontis leopardinus	Leopard squeaker	Marsh and reed fringes mainstream, rocks, gentle current
Synodontis macrostigma	Largespot squeaker	
Synodontis nigromaculatus	Spotted squeaker	Vegetated, quiet water
Synodontis woosnami	Upper Zambezi squeaker	Vegetated, quiet water
CYPRINODONTIDAE - topminnows		
Aplocheilichthys hutereaui	Mesh-scaled topminnow	
Aplocheilichthys johnstonii	Johnson's topminnow	Vegetated, quiet to moderate current
Aplocheilichthys katangae	Striped topminnow	
CICHLIDAE - cichlids (bream)		
Hemichromis elongatus	Barred jewelfish	Vegetated sandbanks, flowing water
Oreochromis andersonii	Threespot tilapia	Quiet to gentle current partly vegetated, detritus rich water

FAMILY AND SPECIES	COMMON NAME	HABITAT PREFERENCE
CICHILIDAE cont.		
Oreochromis macrochir	Green-headed tilapia	Quiet to gentle current vegetated, detritus rich
Pharyngochromis darlingi	Zambezi happy	Sheltered and exposed shallow shores of mainstream, quiet current
Pseudocrenilabrus philander	Southern mouthbrooder	Partly vegetated, shallow water, moderate current
Serranochromis (Sargochromis) carlottae	Rainbow happy	Vegetated backwater quiet to gentle current
Serranochromis (Sargochromis) codringtonii	Green happy	Vegetated backwater quiet to gentle current
Serranochromis (Sargochromis) giardi	Pink happy	Vegetated backwater quiet to gentle current
Serranochromis (Sargochromis) greenwoodi		
Serranochromis (Serranochromis) angusticeps	Thinface largemouth	Vegetated, quiet water and mainstream
Serranochromis (Serranochromis) macrocephalus	Purple face largemouth	Vegetated, quiet water and mainstream
Serranochromis (Serranochromis) robustus jallae	Nembwe	Vegetated mainstream moderate current
Serranochromis (Serranochromis) thumbergi	Brownspot largemouth	Mainstream, moderate current
Tilapia rendalli rendalli	Northern redbreast bream	Shallow flooded vegetation, gentle current
Tilapia ruweti	Okavango tilapia	Pools, backwaters, quiet vegetated water
Tilapia sparrmanii	Banded tilapia	Vegetated or semi-open water, gentle current
ANABANTIDAE - climbing perches		
Ctenopoma intermedium	Dwarf climbing perch	Shallow, sheltered, well-vegetated floodplain margins
Ctenopoma multispinis	Many-spined climbing perch	Vegetated, quiet water, pools, fringe of mainstream
MASTACEMBELIDAE - spiny eels		
Aethiomastacembalus frenatus	Longtailed spiny eel	Rocky rapids, fringe vegetation mainstream
* *Aethiomastacembalus vanderwaali*	Ocellated spiny eel	Rocky rapids, fringe vegetation mainstream