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THE VEGETATION OF LAKE NAKURU NATIONAL PARK, KENYA: A SYNOPSIS OF THE VEGETATION TYPES WITH ANNOTATED SPECIES LIST

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ABSTRACT

Nakuru National Park is lacking an overall account of its vegetation. A floristic survey, using satellite images and ground diversity exploration, resulted in a detailed map of 24 vegetation types, which are briefly described in ten major edaphic and geomorphological habitats. Comments are made about the diversity of the stands in terms of species numbers and life forms, and upon the relationship between diversity and environment in this area.

The survey has also produced a comprehensive Plant Check List with over 575 vascular plant species for many of which a range of distribution within the Park has been given, referring to the described vegetation types. The most diverse flowering plant families are the Compositae (Asteraceae) with 40, the Gramineae (Poaceae) with 50 and Leguminosae with 57 (Caesalpinaceae 5, Mimosaceae 10, and Papilionaceae 42) species respectively. The most characteristic families of the Park are the Solanaceae and Malvaceae whose flora represents about 19% of that in East Africa. The Euphorbiaceae and Rubiaceae are under-represented in the Park.

Key Words: alkaline grasslands, plant diversity, vegetation mapping.

INTRODUCTION

Lake Nakuru National Park is in the Rift Valley Province of Kenya, about 2 km from Nakuru town (fig. 1). The Park is internationally famous for its large population of water fowl with over one million flamingos and hundreds of pelicans, cormorants and ducks (Vaucher, 1973).

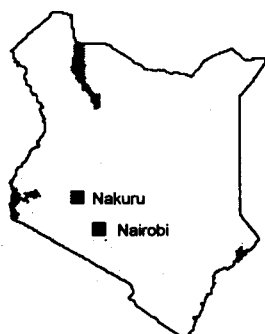


Figure 1: location of the study area

It was first established as a bird sanctuary in 1961 and consisted of the Lake and its immediate shoreline with an area of approximately 42 km². Later, with assistance from the World Wide Fund for Nature, the surrounding farms and ranches were purchased and added to the park area which now extends to about 188 km², including the lake, the shoreline and terrestrial habitats (Vaucher, 1973).

The Rift Valley is a zone of complex geology, much influenced by tectonic and volcanic forces which altered the landscape from a peneplain into the present diverse range of landforms, each with a separate vegetation cover, structure and species composition (McCall, 1967).

These landforms include Sirkon Hill (Lion Hill), the Western Escarpment, the central plains, the tuff cones (Elmenteita tuff cones consisting of the Honey Moon and Crescent Hill) and the lake with its littoral zone (fig. 2). In spite of the increasing importance of this Park as an animal and bird sanctuary, as well as the many research activities centred on the Park, comprehensive botanical information is unavailable. The purpose of this paper is to describe the overall vegetation types of the Park using physiognomic structural features and the diversity of species and habitats, and also to provide a checklist for future monitoring.

METHODS

Two survey methods were employed: aerial photographic interpretations and ground floristic survey. Aerial photographs and LANDSAT images of the Park area from 1979 and 1986 were used to locate and plot the main physiognomic vegetation types. These included forests, woodlands, bushlands and grasslands with the escarpment or cliff formations and shoreline as incidental occasional features.

Ground survey was carried out after the rainy season, from September to December 1987, when vegetation development was maximal. Each vegetation type was visited three times and all vascular plants encountered were recorded. The three species lists were finally combined. Each species was recorded under a life form category as trees, high shrubs, low shrubs, forbs and graminoids. The definitions of these categories were made as follows: trees as single-stemmed plants more than three metres in height; high shrubs as multi-stemmed species more than two metres high; low shrubs as all woody plants up to two metres in height; forbs as broad-leaved perennial or annual herbs; graminoids as grasses and sedges.

Habitats were assessed along transects from the lake shore into higher altitudes. Therefore the habitat list starts with grassland and traverses through bushland to woodland and forests. Finally the composite habitats of cliffs, nutritionally augmented vegetation and river margins are enumerated.

Various classification systems have been attempted for East African vegetation (one of the most recent being that of Grundblatt *et al.*, 1989). For simplicity, clarity and convenience, the vegetation of Lake Nakuru National Park was classified using vegetation structure classes described by Loth and Prins (1986).

Plant identifications were carried out with the aid of various publications including *the Flora of Tropical East Africa, Gramineae*, (Clayton, 1970; 1974; 1984), *Upland Kenya Wildflowers* (Agnew, 1974) and *Kenya Trees and Shrubs* (Dale & Greenway, 1961). Nomenclature has been updated from manuscript on Agnew & Agnew, 1994 and Beentje, 1994. Plants that could not be identified in the field were collected and compared with the reference collections in the National Herbarium, National Museums of Kenya, Nairobi.

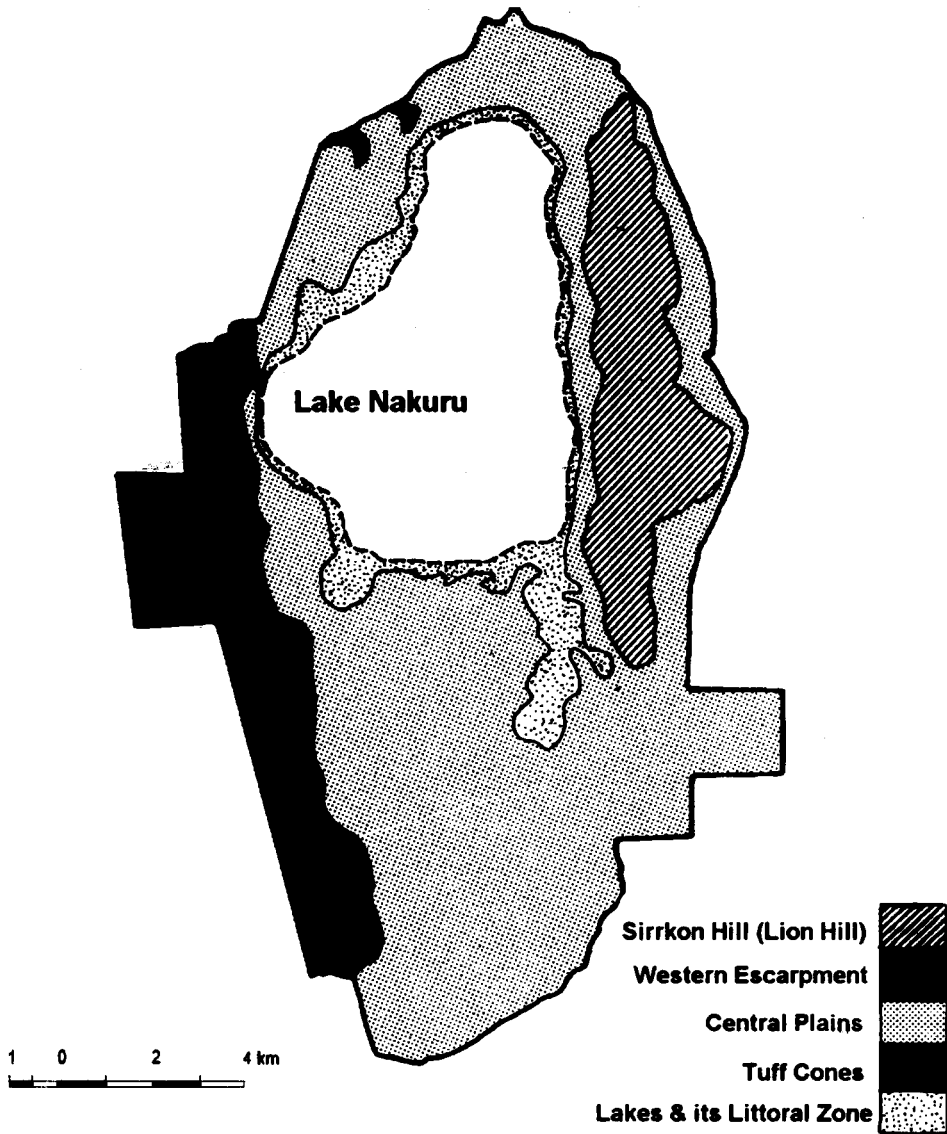


Figure 2: topographic features

Most species' records were associated with notes on a particular vegetation type, from each of a series of habitats. Here, therefore, the check-list includes a listing of the vegetation types and habitats from which the species is known. There are records of species in the Park that were made by other workers (e.g. Mr. J.B. Gillett, 1967 and O.M. Mwangangi, 1970, both unpublished). These species are listed but without any enumeration of vegetation type origin. Such additional records alter the figures of families, genera and species reported earlier by the author (Mutangah, 1989).

For simple reference the list is presented in alphabetical order of families and species. This seems to be the preferred format for field workers who need a ready memorandum for identifications. Reference works are available to assign genera to families (Mabberley, 1983).

RESULTS

Vegetation Survey

On the basis of structural characteristics and diversity, terrain features and differing shades on the infra-red LANDSAT prints, 24 vegetation types were differentiated (table 1, fig. 3).

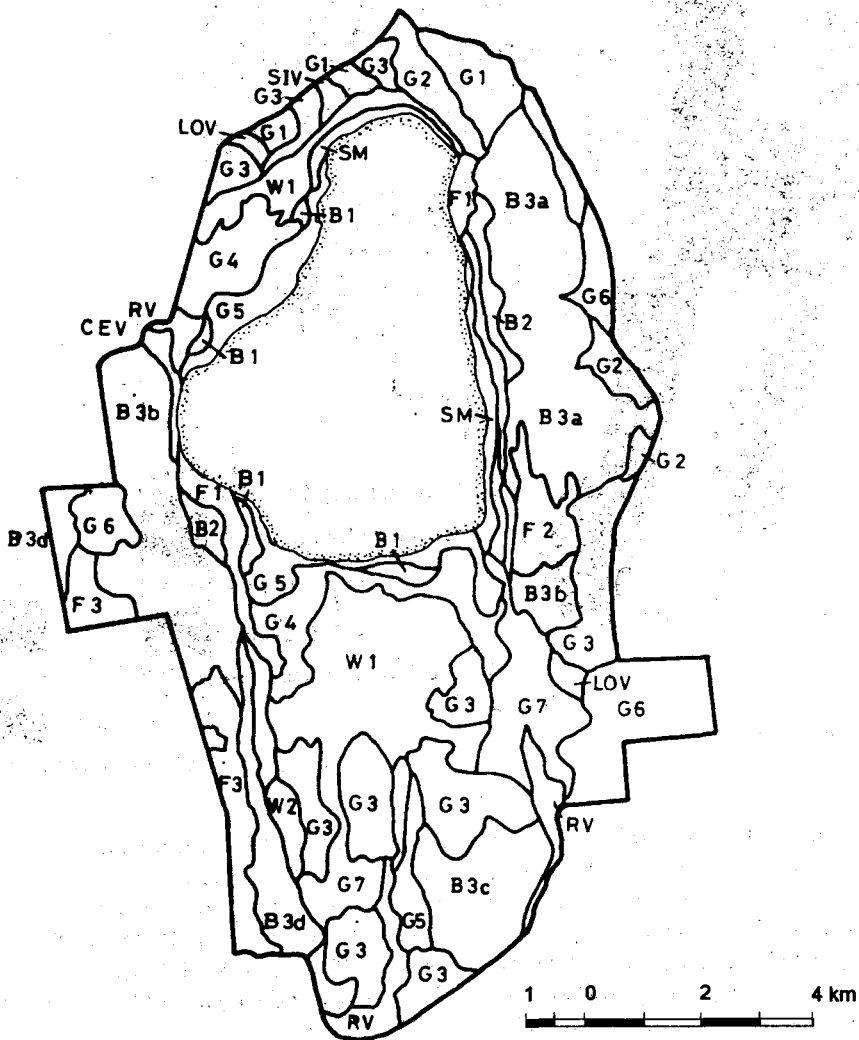


Figure 3: Physiognomic vegetation types

Table 1. Habitats and associated vegetation types of Nakuru National Park and their mnemonics used in figure 2 and table 2. The list is in the order of a natural progression from the lakeside to the Plateau hinterland.

Code	Type
G1	Grassland, bushed <i>Themeda triandra</i> type
G2	Grassland, <i>Digitaria abyssinica</i> type
G3	Grassland, <i>Cynodon nlemfuensis</i> type
G4	Grassland, <i>Chloris gayana</i> type
G5	Grassland, <i>Sporobolus spicatus</i> type
G6	Grassland, <i>Cynodon-Chloris-Themeda</i> type
G7	Grassland, <i>Cynodon nlemfuensis-Acacia xanthophloea</i> type
B1	Bushland, <i>Pluchea bequaertii</i> type
B2	Bushland, <i>Psiadia-Aspilia</i> type
B3a	Bushland, <i>Tarchonanthus-Acacia gerrardii</i> type
B3b	Bushland, <i>Tarchonanthus-Acacia xanthophloea</i> type
B3c	Bushland, <i>Tarchonanthus-Euphorbia candelabrum</i> type
B3d	Bushland, mixed <i>Tarchonanthus</i> type.
W1	Woodland, <i>Acacia xanthophloea</i> type
W2	Woodland, <i>Acacia seyal</i> type
F1	Forest, <i>Acacia xanthophloea</i> type
F2	Forest, <i>Euphorbia candelabrum</i> type
F3	Forest, <i>Olea africana</i> type
SM	Alkaline marsh
SV	Fresh water swamp
CEV	Cliff and escarpment vegetation
LOV	Lava Outcrop vegetation
RV	Riverine forest and woodland
SIV	Sewage-influenced vegetation

Using these as mapping units a physiognomic vegetation map was plotted (fig. 3). *Tarchonanthus* bushlands (B3) dominate the slopes, the plateau and hill tops on both sides of the Lake. These include, to the east (Lion Hill) *Tarchonanthus camphoratus* with *Acacia gerrardii* (B3a) and to the West (Mau Escarpment) *Tarchonanthus camphoratus* with *Acacia xanthophloea* (B3b). A bushland of *Tarchonanthus camphoratus* with *Euphorbia candelabrum* (B3c) dominant is only found to the South of the Lake and nowhere else on the central plain.

Three forest types were recognised: *Acacia xanthophloea* (F1) along the margins of the lakeshore, *Euphorbia candelabrum* forest (F2) on the Southern slopes of Lion Hill east of the Lake and *Olea africana* forest (F3) on the Mau escarpment to the south-west of the Lake.

The rest of the central plains, including the lake basin, are dominated by grasslands (G) and *Acacia xanthophloea* woodlands (W1) and forests (F1). The shoreline is occupied by alkaline marshes (SM), fresh-water swamps (SV) and peripheral bushlands of *Pluchea bequaertii* (B1). The main river systems are accompanied by riverine vegetation (RV).

Diversities in each stratum of vegetation are represented in histograms (fig. 4). A full species list is given in the appendix but, for the purpose of describing the stands, the dominant species of the main vegetation types are shown in table 2.

The following are brief descriptions of each vegetation community delimited here within each habitat type.

Grasslands

Grasslands in the Park sometimes have scattered or grouped trees and shrubs that contribute less than two percent cover. They are widely spread throughout the Park particularly on the lake shoreline, the flood plains in the South and on the gentle slopes of Lion Hill to the East, often on soils with impeded drainage or lacustrine sediments or superficial volcanic deposits over diatomaceous sediments. Seven grass communities were recognised and mapped (fig. 3).

G1, Bushed *Themeda triandra* grassland

This dominates the northern part of the Park and is characterised by tall grasses of *Themeda triandra*, *Chloris gayana* and *Hyparrhenia hirta*, with low bushes of *Lippia ukambensis*, *Lippia javanica* and *Lantana trifolia*. On the northern border of the Park a narrow strip of G1 is dominated by *Acacia* trees (*A. xanthophloea*, *A. gerrardii*, *A. hockii*).

G2, *Digitaria abyssinica* grassland

This type can be found on the flat furrowed plains to the north and on the eastern slopes of Lion Hill. It is composed of short grasses *Digitaria abyssinica* and *Cynodon nlemfluensis* with occasional *Themeda*, and is very important in wild herbivore grazing systems. There are scattered trees of *Acacia xanthophloea*.

G3, *Cynodon nlemfuensis* grassland

The main grassland of the Park, widely distributed in the southern and eastern areas, is dominated by *Cynodon nlemfluensis* with a few scattered trees of *Acacia xanthophloea*. There are some shrubs (*Maerua triphylla*, *Maytenus heterophylla* and *Cordia ovalis*) which make up insignificant cover.

G4, *Chloris gayana* grassland

This type is found on the western and southern shores of the Lake between the alkaline grasslands (G5) and the *Acacia xanthophloea* woodland (W1). Tall *Chloris gayana* is dominant with 95% ground cover, interrupted by occasional *Acacia xanthophloea* and bushes of *Tarchonanthus camphoratus*, *Rhus natalensis* and *Dodonaea angustifolia*.

G5, *Sporobolus spicatus*, *Cynodon dactylon* alkaline grasslands.

Seasonally flooded areas of high alkalinity on the north, west and southern shores of the lake are dominated by these soda-resistant short grasses. The meadows are interspersed with sand bars, mud flats and patches of sedges (*Cyperus laevigatus*).

Table-2. Species of every stratum which have been recorded as dominant during survey in each habitat and vegetation type. The latter are listed in the order in which they appear in table 1. Dominance is not consistent within habitats.

Life form	Species	Vegetation type codes
Trees	<i>Acacia gerrardii</i>	B3a, 3d
	<i>Acacia hockii</i>	W2, LOV
	<i>Acacia seyal</i>	W2, LOV
	<i>Acacia xanthophloea</i>	G1, 4, 7, B3b, 3d, W1, F1, RV, SIV
	<i>Cordia ovalis</i>	B3c, F1, 3
	<i>Cussonia holstii</i>	B3a, F3
	<i>Dombeya burgessiae</i>	F3, RV
	<i>Euphorbia candelabrum</i>	B3a, 3c, 3d, F2
	<i>Tarchonanthus camphoratus</i>	B3a, b, c, d
	<i>Teclea simplicifolia</i>	F1, 2, 3
	<i>Olea africana</i>	F3
Shrubs	<i>Aspilia mossambicensis</i>	B2, 3b, F3, CEV, LOV
	<i>Capparis tomentosa</i>	W1, LOV
	<i>Grewia similis</i>	B3c, F1, 2, 3, RV
	<i>Hibiscus calyphyllus</i>	F2, 3, RV
	<i>Lippia ukambensis</i>	W2, B3c
	<i>Maerua triphylla</i>	G3, F3, RV
	<i>Maytenus heterophylla</i>	B3c, F3, RV
	<i>Ocimum gratissimum</i>	B2, 3b, 3d, F1, CEV
	<i>Pluchea bequaertii</i>	B1, F1, SM
	<i>Psiadia punctulata</i>	B3b, 3c, 3d, CEV
	<i>Pterolobium stellatum</i>	F1, 2, 3
	<i>Rhus natalensis</i>	G4, B3c, W2, F3, RV
	<i>Ricinus communis</i>	F1, RV, SIV
	<i>Tarchonanthus camphoratus</i>	G4, B3a, 3b, 3c, 3d, F3
<i>Tinnaea aethiopicum</i>	B3c, LOV	
Herbs	<i>Achyranthes aspera</i>	F1, 2, RV
	<i>Aloe lateritia var. solaiana</i>	B3c, LOV
	<i>Hypoestes verticillaris</i>	F1, 2, RV
	<i>Solanum incanum</i>	B3d, RV
	<i>Urtica massaica</i>	F1, RV
Grasses	<i>Chloris gayana</i>	G1, 4, 6, B3b, SM
	<i>Cynodon dactylon</i>	G5, B1, SM
	<i>Cynodon nlemfuensis</i>	G1, 2, 3, 6, 7, B2, 3c, W1, 2, CEV
	<i>Cyperus laevigatus</i>	G5, B1
	<i>Digitaria abyssinica</i>	G2, 3, 4, 6, 7
	<i>Pennisetum procerum</i>	CEV, LOV
	<i>Pennisetum squamulatum</i>	CEV, LOV
	<i>Rhynchelytrum repens</i>	CEV, LOV
	<i>Sporobolus spicatus</i>	G5, B1, SM
	<i>Themeda triandra</i>	G1, 6, B3b, 3c, LOV

G6, *Cynodon* mixed grasslands

These are mosaics of *Cynodon nlemfuensis* with other grass associates (*Chloris gayana*, *Digitaria abyssinica*, *Themeda triandra*) with varying dominance. They occupy somewhat intermediate positions in the sequence, the western types having scattered trees, while the southern stands have a few high shrubs including *Maerua triphylla*, *Cordia ovalis*, *Maytenus heterophylla* and *Tarchonanthus camphoratus*. The eastern examples of this grassland have no woody component.

G7, *Cynodon nlemfuensis*-*Acacia xanthophloea* grassland

These are mainly found in the south, particularly on the Nderit and Makalia Plains. They contain conspicuous stands of *Acacia xanthophloea* with scattered high shrubs (*Cassia didymobotrya*, *Maerua triphylla*, *Maytenus heterophylla*, *Rhus natalensis*). The short *Cynodon* always forms over 90% of the cover.

Bushlands

This term is used for woody plant associations with a canopy less than six metres in height (except for occasional emergents) with a cover of over 20%. Bushland forms the most extensive vegetation in the park, much of it attaining the density of thickets where *Tarchonanthus camphoratus* is the principal shrub species (B3). However, low shrub associations can also be identified.

B1, *Pluchea* bushlands

These occupy marginal alkaline areas of lacustrine sediments, impeded drainage and clay-loam soils. The stands are occasionally flooded and are conspicuous along most of the lake shore except the western part. The soda-resistant *Pluchea bequaertii* is most abundant, with *Cynodon dactylon*, *Cyperus laevigatus* and *Sporobolus spicatus* contributing to the ground cover. Occasional flooding with saline water kills invading *Acacia xanthophloea*, so that populations of this tree are always young.

B2, *Psiadia*-*Aspilia* bushlands

The vegetation of lowland colluvial deposits along the foot of Lion Hill and the western escarpment is characterised by dense low shrubs of *Psiadia punctulata*, *Aspilia mossambicense* and *Ocimum gratissimum*. There are a few scattered trees and high shrubs.

B3, *Tarchonanthus camphoratus* bushlands

These bushlands are the main vegetation type of the Park hinterland, and can be divided into sub-types with respect to associated tree species.

Tarchonanthus-Acacia gerrardii (B3a) occurs on Lion Hill's ridges, faulted valleys and steep slopes. *Tarchonanthus camphoratus* dominates the shrub-layer with over 80% cover. *Acacia gerrardii* and *Cussonia holstii* are frequent, especially on the ridges and slopes, while the colluvial soils of the valleys have fewer trees. A few weeks before the start of this study, August 1987, a wildfire destroyed the shrubland on the northern section of Lion Hill, leaving live stumps of *Tarchonanthus camphoratus* which showed signs of vegetative regeneration.

Tarchonanthus-Acacia xanthophloea Bushland (B3b) is found on the western Mau escarpment. The *Acacia* density increases on the ridges and slopes, with the umbelliferous *Steganotaenia*

araliacea appearing where the *Tarchonanthus camphoratus* is thickest. On the plateau there are more trees in what might be called a wooded bushland.

Tarchonanthus-Euphorbia candelabrum Bushland (B3c) grows on the south-eastern Soysambu plains of the Park, where there are superficial volcanic deposits over diatomaceous sediments and well-drained soils. The trees of the succulent *Euphorbia* disappear gradually to the west and north leaving pure *Tarchonanthus*. The latter thins out due to illegal firewood harvesting towards the east and southern margins of the Park. Where this has occurred there is a dense cover of *Cordia ovalis*, *Grewia similis* and *Tinnea aethiopica* with a closed stand of juvenile *Euphorbia candelabrum*.

Mixed Tarchonanthus (B3d) is a narrow vegetation belt along the western border from Nganyoi Ranger Post to Pwani Ranger Post. It seems to form a mosaic with Olea forest (F3). Trees associated with *Tarchonanthus* are mixed *Euphorbia candelabrum*, *Acacia xanthophloea* and *Acacia gerrardii*.

Woodlands

These are defined, following Pratt and Gwynne (1977), as a stand of trees up to 20 m high, with open or continuous but not thickly interlaced canopy of over 20% cover. Shrubs, if present, contribute under 10% of the canopy cover. By this definition the *Acacia xanthophloea* stands on the Lake shoreline are here designated as woodlands, although they were previously called forests.

W1, *Acacia xanthophloea* woodland

This occurs in a zone around the shoreline, being more widely spread on the north and south. The *Acacia* is tall (25 m) and there is little shrub layer, while the ground cover is dense with many climbers. The more frequent shrubs are *Cassia bicapsularis* and *Vernonia auriculifera*, while the ground cover is mainly *Achyranthes aspera* and *Solanum incanum* with *Urtica massaica* in the Njoro section of the woodland.

Between the Wildlife Clubs of Kenya Hostel and the Main Gate there is no shrub layer and even the clumps of lianas (*Grewia similis*, *Rhus natalensis*, *Senecio lyratipartitus* for example) are few.

W2, *Acacia seyal* woodland

Found on only one of the ridges west of the Naishi sub-headquarters, this is characterised by a lack of shrub layer, dense individuals of *Acacia seyal* and *Acacia hockii*, and poor ground cover.

Forests

These are defined as continuous stands of trees with canopy which varies from 10–40 m high, with two or more storeys. The upper canopy is interlaced (Pratt & Gwynne, 1977). Three forest types are recognised here.

F1, *Acacia xanthophloea* forest

This name is given to small patches of thicker timber within the W1 woodland. It is more prominent at Pelican Corner and at Kampi ya Nyuki in the north east of the Park where there are alien trees of *Eucalyptus citriodora*, *Grevillea robusta* and *Schinus molle* as well as the

indigenous *Warburgia ugandensis*. Shrubs are dense and include *Erythrococca bongensis*, *Grewia bicolor*, *Grewia similis*, *Pluchea bequaertii* and *Rhus natalensis*.

At Pelican Corner the forest ('Colobus Forest') is richer and less disturbed, with shrubs of *Hibiscus calyphyllus*, *Pluchea bequaertii*, *Rhus natalensis* and *Teclea simplicifolia*, and the scrambling 'Wait a bit' *Pterolobium stellatum*.

F2, Euphorbia candelabrum forest

This vegetation is very natural and well-preserved, occurring on steep basalt slopes and ridges. With the dense *Euphorbia* are *Acacia xanthophloea*, *Cussonia holstii* and *Obetia pinnatifida*. There is a rich shrub flora, while the herbs are dominated by *Hypoestes verticillaris* and *Achyranthes aspera*.

F3, Olea africana forest

This is an important intact fragment of the Kenya dry Highland Oleaceous forest, protected by the state even before the creation of the National Park. The closed canopy is mainly *Cussonia holstii*, *Euclea divinorum*, *Olea africana* and *Teclea simplicifolia*. High shrubs are *Cordia ovalis*, *Grewia similis*, *Maytenus heterophyllus*, *Tarchonanthus camphoratus*. There is a rich flora of lianas and herbs which, perhaps significantly, includes succulents such as *Notonia hildebrandtii*, *Plectranthus cylindraceus*, *Sarcostemma viminale*, *Sansevieria parva*, *Senecio petitianus*. Ground cover percentage is low.

Alkaline Marshes

SM, sedge marshes

These are waterlogged areas on alluvium along the northern and eastern shores of the lake. They are periodically flooded, and the vegetation is poor and dominated by *Cyperus laevigatus*.

Fresh water swamps

SV, Swamp vegetation

Where fresh water enters the Lake, particularly where the Nderit River enters the south-east end, there is a special swamp vegetation. The dominant plants in the various phases of a mosaic are *Cyperus immensus*, *Cyperus laevigatus* and *Typha domingensis*, with emergent low shrubs of *Pluchea bequaertii* and *Sesbania sesban*.

Basalt cliffs and rocky slopes

CEV, Open rock vegetation

These areas of basaltic cliffs and escarpments carry an open, mixed form of B3, *Tarchonanthus* Bushland without indicator species except possibly the trees *Ficus thoningii* and *F. wakefieldii*, the succulent shrub *Tetradenia multiflora* and the grass *Pennisetum squamatum*.

Lava outcrops

LOV, Lava outcrop vegetation

These landforms support characteristic undifferentiated vegetation which is treated separately here. On Honeymoon Hill the low shrub *Aspilia mossambicensis* dominates, with much of the succulent *Aloe secundiflora*.

On the western slopes there is a dense wooded bushland dominated by the shrubs of *Acacia seyal*, *Clerodendrum myricoides*, *Heteromorpha trifoliata*, *Maytenus heterophyllus* and *Rhus natalensis*.

Buffalo Hill holds thick *Tarchonanthus* bush (B3) with scattered trees of *Ficus thonningii*, *F. wakefieldii* and *Ziziphus mucronata*.

The lava ridges on Nakuru Lodge Hill again display dense *Tarchonanthus* bush (B3) but this time with *Acacia seyal*, *A. xanthophloea*, *Euphorbia candelabrum* and *Ficus cordata*.

River banks

RV, Riverine vegetation

Along the flood plains and river banks rich, often unique, vegetation types develop, often with one or more plants of special interest and abundant forest edge species such as lianas. Here only the outstanding features of such stands are noted.

Larmudiac River to the north west forms a floodplain immediately it enters the park which is frequently flooded during the wet season and supports a rich vegetation with dense undergrowth similar to F1.

The Njoro River, while enclosed with *Acacia xanthophloea* forest (F1), has the figs *Ficus cordata*, *Ficus sur* and *Ficus thonningii* along its course. The vegetation of the Naishi dry river system to the south west is rather similar but less diverse.

The Makalia River has a falls complex which is mixed F1 and F2 as described earlier but downstream the tree species are more diverse, with *Acacia albida*, *A. xanthophloea*, *Albizia gummifera*, *Ehretia cymosa*, *Ekebergia capensis*, *Euclea divinorum* and *Salix subserrata*.

The vegetation of the Nderit River to the south-east is characterised by a stand of *Acacia albida* and *A. abyssinica* trees and very few lianas.

Sewage-influenced vegetation

SV, Nutrient enriched vegetation

An exuberant vegetation can be found in the north where green vegetable farmers were utilising the sewage catchment illegally until 1986. This habitat is characterised by a high diversity of shrub species.

Floristic Survey

Over 575 plant species are listed in the appendix, including some taxa for which specific epithets are not yet available. The major groups in which these plants are placed may be summarised as follows:

Group	Number of families	Number of genera	Number of species
Pteridophytes	3	6	8
Dicotyledons	73	257	459
Monocotyledons	12	47	111
Total	88	310	578

In all cases an attempt has been made to be as conservative as possible in family, genus and species delimitation. For instance some interpretations of the Monocotyledon classification recognise many more families than are reported here.

The most diverse families were the legumes with 57 species (Leguminosae-comprising the Caesalpinaceae 5, the Mimosaceae 10 and the Papilionaceae 42), the grasses (Gramineae or Poaceae) with 50, and the sunflower family (Compositae or Asteraceae) with 40 (Table 3).

Table 3. An analysis of plant family representation in Lake Nakuru National Park compared with the total flora of East Africa as given in Blundell (1987).

Family	Number of Species		Percentage %
	Nakuru	East Africa	
Acanthaceae	17	390	4.4
Compositae	40	877	4.6
Euphorbiaceae	18	494	3.4
Gramineae	50	860	5.8
Labiatae	26	288	9.1
Leguminosae	57	1220	4.7
Malvaceae	26	137	19.0
Rubiaceae	17	741	2.3
Solanaceae	14	65	21.5

DISCUSSION

Vegetation Survey

The vegetation of Lake Nakuru National Park falls under the eco-climatic zone IV of Pratt and Gwynne (1977) which describes it as wooded and bushed grassland. Earlier ecologists recognised six habitats in the Park (Vaucher, 1973; Kutilek, 1974; Kakuyo, 1980), but the present paper describes ten, some with several vegetation types.

The main aim of this study was to describe the overall vegetation variation in Nakuru National Park. The results show a wide range of identifiable habitats and vegetation zones, some 24 in all. This high diversity arises from the geological complexity of the area.

There are basically four vegetation systems, grassland, bushlands, woodlands and forests. It is difficult to apply the term 'forest' to the closed stands of *Euphorbia candelabrum* and *Acacia xanthophloea* on the southern slopes of Lion Hill and the periphery of the lake respectively, but the term was strictly defined and was useful in order to distinguish these stands from the rest of the open woodlands. In my opinion it is only the *Olea* forest (F3) that can be regarded as a true dry evergreen forest with some resemblance to those of Nairobi and the Coast (Lind & Morrison, 1974).

Comparison of the grassland types (fig. 4, G1 to G7) shows the low species diversity for those stands near the alkaline Lake (G2, G5) and high diversity inland (G3, G6, G7) with intermediates. The same is observed for bushlands where B1 and B2 are shoreline stands while B3, far from the Lake, has the highest diversity. There is thus an increasing trend in diversity away from the Lake (Mutangah, 1989).

The three forests are moderate in diversity, particularly that of low shrubs in F1 and F2 where they form a dens understorey. *Acacia xanthophloea* woodland and forest (W1 and F1) have a lower diversity of tree species than other types and research is needed to discover whether this *Acacia* species inhibits establishment of other tree species.

The distribution of leguminous plants is also demonstrated in figure 4. These plants were found to occur mainly in the grassland and bushland habitats away from the influence of the

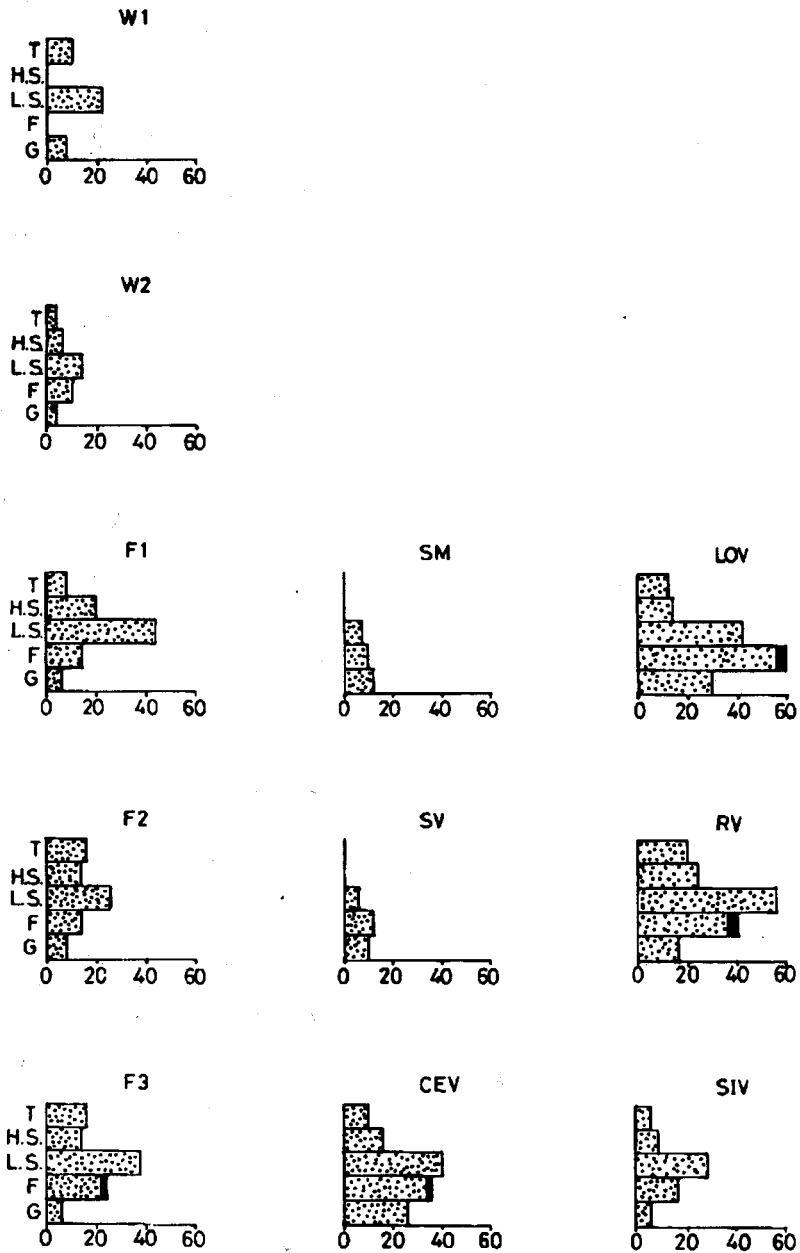


Figure 4: Species numbers in each lifeform within vegetation types as described in the text and table 1. T: trees more than 3 m in height; HS: high multi-stemmed shrubs more than 2 m high; LS: shrubs up to 2 m; F: forbs, broad-leaved perennial or annual herbs; G: gramminoids and sedges

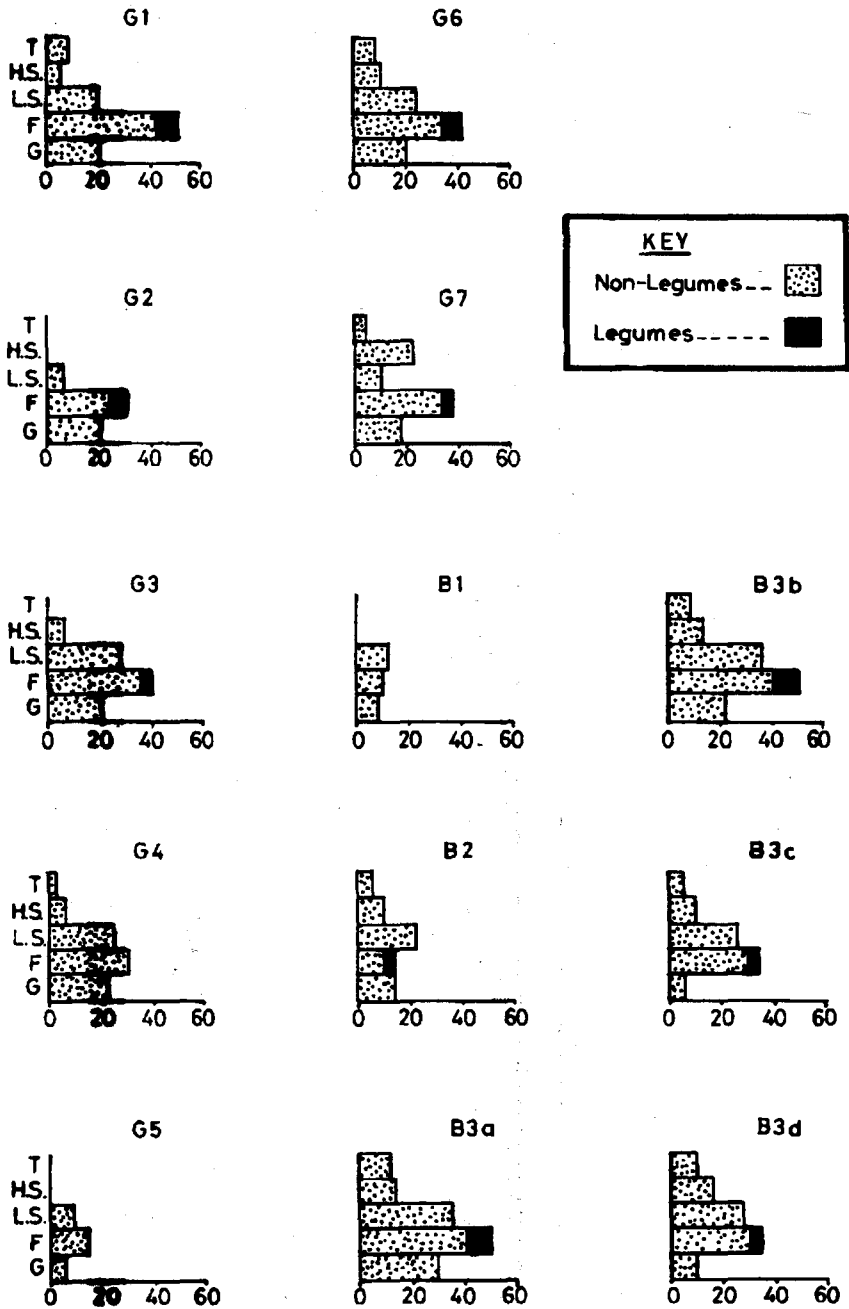


Figure 4 (continued)

Lake. The absence of leguminous plants in the forests (which are also away from the Lake) need further investigation to establish the controlling distribution mechanism of these plants.

Finally, from the floristic spectrum point of view, and based on the data presented here, the vegetation of Nakuru National Park can be summarised as wooded bushland with patches of open grasslands rather than as generalised wooded grassland, as concluded from physiognomic analysis by Pratt and Gwynne (1977).

Floristic Survey

The simplest method of recording floristic information for a given area is by enumeration of the species composition in the form of a species list. The plant check-list can then become a useful point of reference for farther studies especially those designed to assess the presence and dominance of plant species forming diet of a particular animal species. Such information is vital in the formulation of Park's conservation status and management options

It is interesting to note that, amongst the families that have most species in the flora of the Park, two contribute significantly to the flora of East Africa as estimated by Blundell (1987) and shown on table 3. These are the Solanaceae and the Malvaceae, which perhaps are particularly adapted to the climatic and edaphic environment of this area. Conversely the two families, Euphorbiaceae and Rubiaceae are seen to have been comparatively under-represented as would have been expected from this region.

Figure 5 demonstrates a sharp decline of the frequency (number of species) curve from species occurring in one or two habitats to that found in three or more habitats. The majority of the species have their distribution limited up to three habitats only out of the twenty four habitats investigated. This is a normal result for this type of analysis (Williams, 1964). Any other pattern of distribution might cast into doubt the vegetation type and habitat delimitation used here. The limited ecological range of distribution or narrow species niche width also requires more investigations to ascertain whether perhaps is a consequence of the great landscape and habitat diversity in this area.

It may be of interest to discuss which is the richest vegetation type in the Park. LOV and RV have the greatest number of species, but neither is a single habitat type but rather a composition of many, differing in topography, ecology and floristics. For example RV comprises five

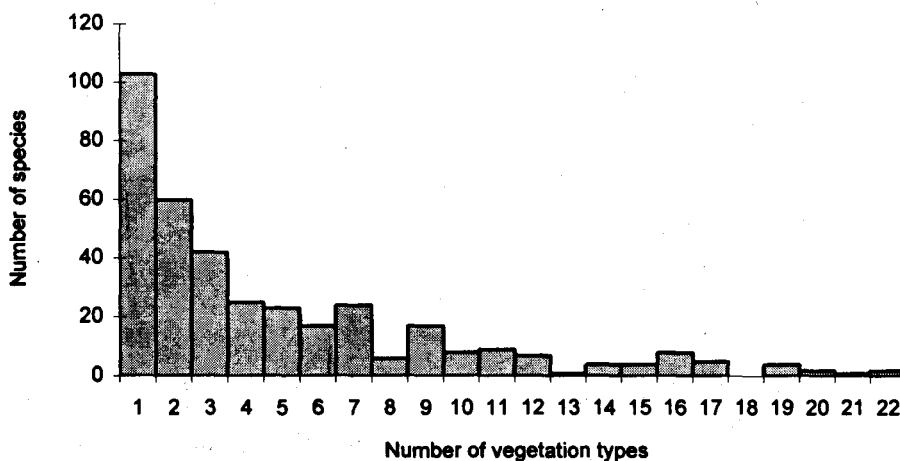


Figure 5: Frequency of species occurring in various combinations of the 24 vegetation types delimited in Lake Nakuru National Park

riverine systems: Makalija, Njoro, Nderit, Larmudiac and Naishi. They all differ in drainage patterns and flora composition but for the convenience of vegetation classification the five have been put together under RV (Riverine Vegetation). Taking single unit vegetation types, the richest are the bushlands: B3a, 3b and B3c, and next the grasslands: G1, 6, 3 and G7 respectively. The woodlands and shoreline habitat have the poorest diversity in the study area.

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APPENDIX: CHECK-LIST OF THE PLANTS OF NAKURU NATIONAL PARK

Species are listed in alphabetical order of families and genera within each of three Orders, I. PTERIDOPHYTES, II. DICOTYLEDONS and III. MONOCOTYLEDONS.

Species are assigned vegetation and habitat types according to the list and circumscription in Table 1. The 24 vegetation units and their mnemonics used here are given below in alphabetical order. The initial letter of the habitat type is not repeated in the enumeration under each species. Thus if a species has been found in all forest types these are listed as F1, 2, 3.

Nomenclature follows Agnew and Agnew (1995), Beentje (1994), Clayton (1970, 1974, 1982) and Haines and Lye (1983).

I. PTERIDOPHYTES

ADIANTACEAE

Actiniopteris semiflabellata Pic.Ser.: CEV, LOV

Adiantum thalictroides Schlecht.: RV

Doryopteris consolor (Langsd. & Fisch.) Kuhn:
RV

Pellaea adiantoides (Willd.) J.Sm.: LOV

Pellaea involuta (Swartz) Bak.

Pellaea viridis (Forsk.) Prantl: F2, CEV, LOV

ASPLENIACEAE

Asplenium aethiopicum (Burm.f.) Becherer

SELAGINACEAE

Selaginella caffrorum (Milde) Hieron.

II. DICOTYLEDONS

ACANTHACEAE

Asystasia mysorensis (Roth) Anders: B3b, F1, 3,
G6, W1

Barleria micrantha C.B.Cl.

Barleria submollis Lindau: F3

Barleria ventricosa Nees: B3b

Dyschoriste nagchana (Nees) Bennet: B2, B3a, 3b,
CEV, G1, 3, 6

Dyschoriste radicans Nees

Dicliptera colorata C.B.Cl.

Hypoestes forskahlii (Vahl) R.Br.: B2, 3a, 3b, 3c,
3d, F1, 2, 3, G1, 3, 4, 6, 7, LOV, W2

Justicia calyculata. Anders: B1, 2, 3a, 3b, 3c,
G1, 2, 3, 4, 6, 7, LOV, RV

Justicia flava Vahl: B3a, F1, 2, 3, G7, LOV, RV

Justicia heterocarpa T.Anders: B3c, G 4, 6, F1, 2,
3, CEV, RV, W1

Justicia anagalloides (Nees) T.Anders

Justicia striata Bullock: F3

Monechma debile (Forsk.) Nees: B2, 3b, 3c, G1, 2,
3, 6, 7, LOV, W2

Monothecium glandulosum Hochst.: F3

Phaulopsis imbricata (Forsk.) Sweet: RV

Thunbergia alata Sims: F3

AIZOACEAE

Delosperma nakurense (Engl.) Herre: LOV

Gisekia pharnaceoides L.

Zaleya pentandra (L.) Jeffrey: G3

AMARANTHACEAE

Achyranthes aspera L.: B2, B3a, 3b, 3d, CEV, G1,
2, 3, 4, 5, 6, 7, F1, 2, 3, LOV, RV, SIV, W1, 2

Aerva lanata (L.) Juss.: B2, 3a, 3b, 3d, G1, 3, 4, 6,
7, F3, LOV, W2

Alternanthera pungens Kunth.

Amaranthus sp.

Amaranthus spinosus L.: RV, SIV, W1

Amaranthus hybridus L.: G3, SIV

Celosia anthelminthica Asch.: B3b, 3d, F1, RV,
W1

Cyathula cylindrica Moq.: F1, F3, LOV, RV, SIV,
W1

Cyathula uncinulata (Schrad.) Schinz

Cyathula sp. LOV

Pupalia lappacea (L.) A.Juss.: G7, CEV

ANACARDIACEAE

Rhus natalensis Krause: B1, 2, 3a, 3b, 3d, CEV,
F1, 2, 3, G1, 4, 6, 7, LOV, RV, W1, W2

Schinus molle L.: F1, G4, RV, SIV, W1

Schinus terebinthifolius Raddi

APOCYNACEAE

Landolphia buchananii (Hall.f.) Stapf

Carissa edulis (Forsk.) Vahl: B3a, RV

ARALIACEAE

Cussonia holstii Engl.: B2, 3a, 3b, 3c, 3d, CEV,
F1, 2, 3, G6, RV

ASCLEPIADACEAE

Pachycymbium dummeri (N.E.Br.) Gilbert

Cynanchum tetrapteru (Turcz) R.A.Dyer: B2, F1,
W1

Cynanchum altiscandens K.Schum.: CEV, F1, 2,
SIV, W1

Cynanchum hastifolium N.E.Br.

Dregea schimperi (Decne.) Bullock: RV, W1

Gomphocarpus fruticosus (L.) Ait.f.: G5, SV

Gomphocarpus integer (N.E.Br.) Bullock: SV

Gomphocarpus semilunatus A.Rich.

Gomphocarpus stenophyllus Oliv.: B3a

Periploca linearifolia Dill. & A.Rich.: F1, RV,
SIV, W1

Pergularia daemia (Forsk.) Chiov.: F1, RV, SIV,
W1

Sarcostemma viminalis R.Br.: B2, 3a, 3b, 3c, CEV,
F1, 2, 3, RV

BASELLACEAE

Basella alba L.: F3, RV

BORAGINACEAE

Cordia ovalis R.Br.: B2, 3a, 3b, 3c, 3d, CEV, F1,
2, 3, G3, 6, 7, LOV, RV, W1, 2

Cynoglossum coeruleum DC.

Ehretia cymosa Thonn.: RV, W1

Heliotropium longiflorum (A.DC.) Jaub. & Spach
ssp *undulatiom* (Turrill) Verdc.: B3b, 3d, G1,
3, 6

Heliotropium steudneri Vatke

BUXACEAE

Notobuxus obtusifolia Mildbr.

CACTACEAE

Opuntia exaltata Berger

Opuntia sp.: B1,3d, G6, LOV, RV

CAMPANULACEAE

Wahlenbergia abyssinica (A.Rich.) Thulin

CANELLACEAE

Warburgia ugandensis Sprague: F1,2,3, RV, SIV,
W1

CAPPARACEAE

Capparis fascicularis DC.: W1

Capparis tomentosa Lam.: B3c, CEV, F1, G3, 4,
6, 7, RV, W1

Gynandropsis gynandra (L.) Briq.: G3, 6, 7

Maerua triphylla A.Rich.: B3a, 3b, 3c, 3d, CEV,
F1, 2, 3, G3, 4, 6, 7, LOV, RV, W1,2

CARYOPHYLLACEAE

Dianthus sp. = Mwangangi 442

Drymaria cordata (L.) Roem. & Schult.

Pollichia campestris Ait.

Polycarpha eriantha A.Rich.

Silene macrosolen A.Rich.: LOV

CHENOPODIACEAE

Atriplex semibaccata R.Br.: B3a, G7, W1

Chenopodium album L.: LOV, W2

Chenopodium fasciculosum Aellen: G7

Chenopodium murale L.

Chenopodium opulifolium Kock. & Ziz.: CEV

Chenopodium procerum Moq.: CEV

Chenopodium schraderanum Schult.

COMBRETACEAE

Combretum illairii Engl.: B3a

COMPOSITAE

Ageratum conyzoides L.: RV

Artemisia afra Willd.: G4

Aspilia mossambicensis (Oliv.) Willd: B2, 3a, 3b,
3c, 3d, CEV, F2, 3, G6, LOV, RV, W2

Aspilia pluriseta Schweinf. ssp *pluriseta*

Berkheya spekeana Oliv.

Bidens flagellata (Sherff) Mesfin

Bidens pilosa L.: B3c, 3d, CEV, F1, 3, G5, W1

Laggera alata Sch. Bip.: G1 G6, W1

Cirsium vulgare (Savi) Ten.: SM, SV

Conyza bonariensis (L.) Cronq.: G4, RV, SV

Conyza pedunculata (Oliv.) Wild: F3

Conyza schimperi A.Rich.

Conyza steudeli A.Rich.: B3b

Conyza stricta Willd.: G1, 5, 6, SV

Conyza sumatrensis (Retz.) E.H.Walker

Conyza tigrensis Oliv. & Hiern.: G4, 5, 6, SV

Cotula abyssinica A.Rich.

Crassocephalum crepidioides (Benth.) S.Moore

Crassocephalum montuosum (S.Moore) Milne-
Redh.

Crassocephalum picridifolium (DC.) S.Moore: SV

Crassocephalum vitellinum (Benth.) S.Moore:
CEV, F1, SIV, W1

Crassocephalum sarcobasis (DC.) S.Moore

Chrysanthemum parthenium (L.) Pers.

Dichrocephalain egrifolia O.Ktze.

- Echinops amplexicaulis* Oliv.
Bothriocline longipes (Oliv. & Hiern) N.E.Br.
Felicia abyssinica A.Rich.: B3b G3
Felicia muricata (Thunb.) Nees: B2, 3b, 3d, G6, LOV
Galinsoga parvifolia Cav.: RV, SIV, W1
Galinsoga urticifolia (Kunth) Benth.
Gutenbergia cordifolia Oliv.: B2, 3a, 3b, 3c, 3d, CEV, F1, 2, 3, G1, 2, 3, 4, 5, 6, 7, RV, SM, W1, 2
Gutenbergia rueppellii Sch.Bip.: G2
Gynura scandens O.Hoffm.: F3, RV
Helichrusum forskahlii (J.F.Gmel) Hilliard & Burt
Helichrusum foetida (L.) Moench.
Helichrysum glumaceum DC.: G1
Helichrysum odoratissimum (L.) Less.: G1
Hirpicium diffusum (O.Hoffm.) Roess: G2, LOV
Lactuca inermis Forsk.: G1, 7
Melanthera scandens (Schum. & Thonn.) Roberts
Microglossa angolensis Oliv. & Hiern.
Notonia nr. hildebrandtii Vatke: B3a, 3d, F3, LOV, RV
Notonia petraea R.E.Fries
Osteospermum vaillantii (Decne) T.Norl: LOV
Pluchea bequaertii Robyns: B1, CEV, F1, G4, 5, 6, SM, SV, W1
Pluchea nitens O.Hoffm.: LOV
Pluchea ovalis DC.: W1
Pseudognaphalium undulatum (L.) Hilliard & Burt
Pseudognaphalium luteo-album (L.) Hilliard & Burt: RV
Psiadia punctulata (DC.) Vatke: B2, 3b, 3c, CEV, F2, 3, G3, 4, 7, LOV, RV, W1, 2
Richardia tingitana (L.) Roth
Schkuhria pinnata (Lam.) Thell.: G1, 4
Emilia discifolius (Oliv.) C.Jeffrey: B1, 3a, 3b, 3c, 3d, F3, G1, 2, 3, 4, 5, 6, LOV, SM, SV, W2
Senecio lyratus Forsk.: RV SIV, W1
Senecio mesogrammoides O.Hoffm.: G4, 5, SM
Senecio hadiens Forsk.: B1, 2, 3a, 3b, 3c, 3d, CEV, F1, 2, 3, G4, 6, 7, LOV, RV, W1, 2
Senecio ruwensoriensis S.Moore
Solanecio manni (Hook.f.) C.Jeffrey: F2, W1
Sphaeranthus suaveolens (Forsk.) D.C.
Acmella calirhiza Del.: RV
Tagetes minuta L.: B1, 2, 3a, 3b, 3c, 3d, CEV, F1, 3, G2, 3, 4, 5, 6, 7, LOV, RV, SIV, W1
Tagetes patula L.: G1
Tarchonanthus camphoratus L.: B1, 2, 3a, 3b, 3c, 3d, CEV, F1, 3, G1, 3, 4, 5, 6, 7, LOV, RV, W2
- Vernonia auriculifera* Hiern.: F1, RV, SIV, W1
Vernonia brachycalyx O.Hoffm.: F2, 3
Vernonia cinerea (L.) Less.: F2
Vernonia galamensis (Cass.) Less.: F1, G7, SIV, SM, W1
Vernonia adoensis Walp.
Vernonia holstii O.Hoffm.
Vernonia karaguensis Oliv. & Hiern.
Vernonia lasiopus O.Hoffm.: G6
Xanthium pungens Wallr.
- CONVOLVULACEAE
Astripomoea grantii (Vatke) Verdc.
Cuscuta australis R.Br.
Cuscuta campestris Yuncker
Cuscuta kilimanjari Oliv.
Cuscuta planiflora Tenore
Convolvulus sicutus L.
Ipomoea cairica (L.) Sweet: B1, RV, SIV, SV
Ipomoea polymorpha Roem. & Schultes
Ipomoea wightii (Wall.) Choisy: SIV
Ipomoea sp. nr *sinensis* (Desr.) Choisy
Ipomoea kituiensis Vatke: G3, 6
- CRASSULACEAE
Crassula volkensii Engl.
Kalanchoe densiflora Rolfe: B3b, 3d, CEV, F3, RV, SIV, W1
Kalanchoe lanceolata (Forsk.) Pers.: B3b, CEV, F1, G4, RV, W1
Kalanchoe laciniata (L.) DC.: CEV, SIV
- CRUCIFERAE
Crambe kilimandscharica O.E.Schulz
Crambe hispanica L.
Erucastrum arabicum Fisch. & Mey: G1, 2, 3, 6
Farsetia stenoptera Hochst.: B3a, CEV
Farsetia undulicarpa Johnsell
Lepidium bonariense L.: SM
Raphanus raphanistrum L.
- CUCURBITACEAE
Coccinia adoensis (A.Rich.) Cogn.: LOV
Coccinia trilobata (Cogn.) C.Jeffrey: F3
Cucumella engleri (Gilg.) C.Jeffrey
Cucumis aculeatus Cogn.: G1, 2
Cucumis ficifolius A.Rich.
Gerrardianthus lobatus (Cogn.) C.Jeffrey
Kedrostis foetidissima (Jacq.) Cogn.
Kedrostis hirtella (Naud.) Cogn.: B3c
Lagenaria siceraria (Molina) Standley: SIV
Momordica foetida Schum.: RV, W1
Peponium vogelii (Hook.f.) Engl.: CEV, F2, 3

Zehneria scabra (L.f.) Sond.: B3b, RV, SIV, W1
Zehneria minutiflora C.Jeffrey

DIPSACACEAE

Pterocephalus frutescens Hochst.

EBENACEAE

Euclea divinorum Hiern.: B3a, 3b, 3d, F1, 2, 3, RV

EUPHORBIACEAE

Clutia abyssinica Jaub. & Spach.
Croton dichogamus Pax: B3b, 3c, CEV, F3, G6
Croton macrostachyus Del.
Croton megalocarpus Hutch.: SIV W1
Erythrococca bongensis Pax: B2, 3b, 3c, CEV, F1,
 2, 3, G1, 3, 4, 5, 6, 7, LOV, RV
Euphorbia candelabrum Kotschy: B1, 2, 3a, 3b,
 3c, 3d, CEV, F2, G6, LOV, RV
Euphorbia crotonoides Boiss.: B3a, LOV
Euphorbia depauperata Hochst.
Euphorbia gossypina Pax
Euphorbia hirta L.
Euphorbia inaequilatera Sond.: B3c, G1, 2, 3, 4,
 LOV
Euphorbia magnicapsula S.Carter: F2
Euphorbia schimperiana Scheele
Phyllanthus maderaspatensis L.
Phyllanthus rotundifolius Willd.
Ricinus communis L.: F1, G7, RV, SIV, W1
Tragia brevipes Pax
Tragia insuavis Prain

FLACOURTIACEAE

Dovyalis abyssinica L.
Dovyalis caffra (Hook.f. & Harv.) Warb.: F1, G1,
 RV, W1
Scolopia theifolia Gilg.

GERANIACEAE

Geranium ocellatum Cambess
Monsonia angustifolia A.Rich.: B3a
Pelargonium quinquelobatum A.Rich.: B3a, LOV

HYPERICACEAE

Hypericum annulatum Moris.
Hypericum roeperanum A.Rich.

LABIATAE (LAMIACEAE)

Becium obovatum (E.Mey.) M.E.Br.: B3a, 3c, G3,
 6, LOV
Endostemon camporum (Guerke) Ashby
Fuerstia africana T.C.E.Fr.: B3a, 3b, 3c, 3d, G1,
 2, LOV

Tetradenia riparia (Hochst.) Codd: CEV, F2, LOV
Leonotis nepetifolia (L.) Ait.f.: B1, 3a, 3b, 3d, F1
 3, G1, 3, 4, 6, 7, LOV, RV, SIV, W1

Leucas martinicensis Vahl: B3a, 3b, CEV, G1, 2,
 3, 4, 5, 6, 7, LOV, SM

Leucas glabrata (Vahl) R.Br.: B3b, 3d, CEV, G7,
 LOV, RV

Leucas grandis Vatke: CEV, RV

Leucas neustizeana Court

Leucas venulosa Bak.

Ocimum americana L.: B2, 3a, 3b, CEV, G3, 6,
 LOV

Ocimum gratissimum L.: B2,3a, 3b, 3c, 3d, CEV,
 F1, 2, 3, G1, 2, 3, 4, 6, 7, LOV, RV, SM,
 W1, 2

Plectranthus assurgens (Bak.) J.K.Morton: B3a,
 3b, CEV, F2, 3, G1, 7, LOV

Plectranthus comosus Sims: B3a, 3b, 3d, CEV, F2,
 3, LOV, RV

Plectranthus caninus Roth.: CEV, G7, CEV, LOV

Plectranthus cylindraceus Benth.: B3a, 3b, CEV,
 F2, 3, LOV, RV

Plectranthus pseudomarrubioides R.H.Willems

Plectranthus kivuense Leb. & Touss.

Plectranthus sp. nr. *P. flaccidus* A.Rich.

Pycnostachys coerulea Hook.

Pycnostachys deflexifolia Bak.: G1

Pycnostachys umbrosa (Vatke) Perkins: LOV

Satureia abyssinica (Benth.) Briq.

Satureia punctata (Benth.) Briq.

Satureia biflora (D.Don.) Benth.: B1, 3a, 3b, G4, 6

Tinnea aethiopica Hook.f.: B2, 3a, 3b, 3c, 3d,
 CEV, F2, 3, G1, 4, 7, LOV, RV, W2

LEGUMINOSAE subfam CAESALPINIOIDEAE

Cassia bicapsularis L.: F1, SIV, W1

Cassia didymobotrya Fres.: F1, G7, RV, SIV

Cassia hildebrandtii Vatke

Cassia mimosoides L.: B3a, G1

Pterolobium stellatum (Forsk.) Brenan: CEV,
 F1, 2, 3, RV, W1

LEGUMINOSAE subfam MIMOSOIDEAE

Acacia abyssinica Benth.: RV

Acacia albida Del.: G1, RV

Acacia brevispica Harms: F3

Acacia gerrardii Benth.: B2, 3a, 3b, 3c, 3d, CEV,
 F3, G1, 2, 6, 7, LOV, W2

Acacia hockii De Willd.: B3a, G1, LOV, W2

Acacia senegal (L.) Willd.: G3

Acacia seyal Del.: B1, 2, 3a, 3b, 3c, 3d, CEV,
 F1, 2, 3, G1, 2, 3, 4, 5, 6, LOV, RV, SM, SIV,
 W1, 2

Acacia xanthophloea Benth.: B1, 2, 3a, 3b, 3c, 3d,
CEV, F1, 2, 3, G1, 2, 3, 4, 5, 6, LOV, RV,
SIV, SM, W1, 2

Albizia gummifera (Gmel.) C.A.Sm.: RV
Entada abyssinica A.Rich.

LEGUMINOSAE subfam. PAPILIONOIDEAE

Alysicarpus rugosus (Willd.) DC.

Alysicarpus zeyheri Harv.

Astragalus atropilosus (Hochst.) Bunge: G1, 7

Calpurnia subdecandra (L'Herit.) Scheick.: F1,
W1

Crotalaria agatiflora Schweinf.: G1, RV, W1

Crotalaria deserticola Bak.: B3a, 3b, G1, 3, 4, 6

Crotalaria incana L.: B3a, 3b, 3c, 3d, F3, G2, 3, 4,
6, RV, W1

Crotalaria sp. nr. *greenwayi* Bak.f.

Crotalaria laburnifolia L.ssp. *laburnifolia* L.

Crotalaria lachnocarpoides Engl.

Crotalaria pycnostachys Benth.

Crotalaria spinosa Benth.

Crotalaria vallicola Bak.f.: B3a, 3b, 3c, 3d, G1, 2,
3, 4, 6, LOV

Desmodium tortuosum (Sw) DC.

Dolichos sericeus E.Mey.ssp. *formosus* (A. Rich)
Verdc.

Dolichos oliyeri Schweinf.

Eriosema shireense Bak.f.

Glycine wightii (W. & A.) Verdc.

Indigofera arrecta A.Rich.

Indigofera costata Guill. & Perr.

Indigofera bogdanii Gillett: B1, 2, 3a, 3b, 3d,
CEV, G2, 3, 4, 6, 7, LOV

Indigofera brevicecalys Bak.f.: B3a, 3b, 3d, G1, 2, 4,
36v, RV

Indigofera circinella Bak.f.

Indigofera hochstetteri Bak.

Indigofera masaiensis Gillett

Indigofera nairobiensis Bak.f.

Indigofera tinctoria L.

Indigofera spicata Forsk.

Lotononis platycarpus (Viv.) Pic.Serm.

Lotus beccuertii Boutique

Lotus corniculatus L. var. *eremanthus* Chiov.

Medicago laciniata (L.) Mill.: G6

Rhynchosia elegans A.Rich.: B3a, 3b, G6

Rhynchosia minima (L.) DC.: B3a, 3b, G1, 2, 3, 4,
6

Sesbania goetzei Harms.

Sesbania sesban (L.) Merr.: G5, RV, SM, SV

Tephrosia athiensis Bak.f.

Tephrosia emeroides A.Rich.: B2, 3b, RV

Trifolium rueppelianum Fres.: G4

Trifolium semipilosum Fres.

Vigna membranacea A.Rich.: B3c, F2, 3

Vigna oblongifolia A.Rich.

LINACEAE

Linum volkensii Engl.

LOBELIACEAE

Lobelia holstii Engl.

LOGANIACEAE

Buddleja polystachya Fres.: G7, RV, W1

Nuxia congesta Fres.: B3a, G1

LORANTHACEAE

Odontella fischeri (Engl.) Danser: B3b, 3d, G4

Odontella ugogensis (Engl.) Balle

Phragmanthera rufescens (DC.) Balle: G7

Tapinanthus zizyphifolius (Engl.) Danser: CEV,
F3, LOV

Viscum tuberculatum A. Rich.: B3a, 3d, F3

MALVACEAE

Abutilon englerianum Ulbr.: B2, 3a, CEV, F1, G7,
RV, SIV, W1, 2

Abutilon fruticosum Guill. & Perr.

Abutilon holstii Guerke: B3d, F1, 2, 3, G6, RV,
SIV

Abutilon longicuspe A.Rich.: B3a, F1, 3, G3, 4, 7,
RV, SIV

Abutilon mauritanum (Jacq.) Medic.

Abutilon rehmannii Bak.f.: B2, 3a, 3b, CEV,
G3, 7, LOV

Gossypium somalensis (Guerke) Hutch.

Hibiscus aethiopicus L.

Hibiscus aponeurus Sprague & Hutch.: B2, 3a, 3b,
3d, G1, 3, 4, LOV, RV

Hibiscus calyphyllus Cav.: F1, 3, CEV, LOV, RV,
W1

Hibiscus cannabinus L.: B1, G1, LOV, SM

Hibiscus diversifolius Jacq. SV

Hibiscus flavifolius Ubr.: B2, 3a, 3b, 3c, 3d, G3, 4,
6, 7, LOV, W2

Hibiscus fuscus Garcke: B2, 3a, 3b, 3c, 3d, CEV,
F1, 3, G1, 3, 4, 6, LOV, RV, W1, 2

Hibiscus micranthus L.f.: B2, 3a, 3b, 3d, CEV,
F1, 3, G1, 2, 3, 4, 6, 7, LOV, W1, 2

Hibiscus vitifolius L.: B3a, 3b, 3d, CEV, F1, 3,
G6, RV

Kosteletskya begoniifolia (Ulbr.) Ulbr.

Malva parvifolia L.

Malva verticillata L.

Melhania ovata (Cav.) Spreng

Pavonia patens (Andr.) Chiov.: B3b,3c,3d, CE,
F1,3, G1,3,6,7,LOV, RV, SIV

Pavonia urens Cav.

Sida ovata Forsk.

Sida rhombifolia L.: RV

Sida schimperiana A.Rich.

Sida tenuicarpa Vollen.: B3a, G1, 3, RV

MELASTOMACEAE

Dissotis seegambiensis (Guill. & Perr.) Tiana

MELIACEAE

Ekebergia capensis Sparm.: RV, W1

MENISPERMACEAE

Stephania abyssinica (Dill. & Rich.) Walp.: RV,
SIV, W1

MORACEAE

Ficus cordata Thunb.: LOV, RV

Ficus ingens Moq.

Ficus sur Forsk.: LOV, RV

Ficus thonningii Blume: B3b, CEV, LOV, RV

Ficus wakefieldii Hutch.: CEV, F2, G6, LOV, RV

MYRTACEAE

Callistemon speciosus (Sims) DC.

Eucalyptus citriodora Hook.: F1, W1

NYCTAGINACEAE

Commicarpus pedunculatus (A.Rich.) Cuf.: CEV

Commicarpus plumbagineus (Cav.) Standley: B3a,
3b, 3c, F1, G3, 6, 7, LOV, SIV, W1

OLEACEAE

Jasminum floribundum R.Br.

Olea africana Thunb.: B2, 3a, 3c, 3d, F1, 2, 3; G6,
RV

Schrebera alata (Hochst.) Welw.: F3

ONAGRACEAE

Oenothera rosea Ait.

OROBANCHACEAE

Orobanche minor Smith

OXALIDACEAE

Oxalis corniculata L.

PAPAVERACEAE

Argemone mexicana L.

PHYTOLACCACEAE

Phytolacca dodecandra L'Herit.: F1, G3, 7, RV,
SIV, W1

PIPERACEAE

Peperomia abyssinica Miq.: F2

PLUMBAGINACEAE

Plumbago zeylanica L.: CEV, LOV, W1

POLYGALACEAE

Polygala abyssinica Fres.

Polygala albida Schinz var. *angustifolia* (Chod.)
Exell

Polygala erioptera DC.

Polygala petitiana A.Rich.

Polygala sphenoptera Fres.: B3a, 3b, 3c, LOV, G1

POLYGONACEAE

Oxygonum sinuatum (Meisn.) Dammer: B3c, G3,
7, LOV

Polygonum pulchrum Blume

Polygonum salicifolium Willd.

Polygonum senegalense Meisn.: CEV, G1, LOV,
SV

Rumex usambarensis (Dammer) Dammer: LOV

PORTULACACEAE

Portulaca foliosa Ker-Gawl

Portulaca kermesna N.E.Br.: CEV, LOV

Portulaca oleracea L.: LOV, G3

Portulaca quadrifida L.

PRIMULACEAE

Anagallis arvensis L.

PROTEACEAE

Grevillea robusta A.Cunn.: F1, W1

RANUNCULACEAE

Clematis brachiata Thunb.: F1, RV, W1

RESEDACEAE

Caylusea abyssinica (Fres.) Fisch. & Mey.

RHAMNACEAE

Helinus integrifolius (Lam.) Kuntze: F2, 3, LOV,
RV

Helinus mystacinus (Ait.) E.Mey

Rhamnus staddo A.Rich.: B3a, F3, G6

Scutia myrtina (Burm.f.) Kurz.: B3a, RV, W1

Ziziphus mucronata Willd.: B3b, G3, 7, LOV, RV

ROSACEAE

- Alchemilla kiwuensis* Engl.
Rubus niveus Thunb.: F1, W1

RUBIACEAE

- Anthospermum herbaceum* L.f.
Canthium lactescens Hiern.: B3a, F2, RV
Galium simense Fres.
Galium spurium L.
Kohautia coccinea Royle G1.
Oldenlandia corymbosa L. B3a, G6
Oldenlandia herbacea Roxb.
Oldenlandia scopulorum Bullock: B3a, G1, 2, 3, 4,
 5, 6, LOV
Oldenlandia wiedemannii K.Schum.
Pentanisia ouranogyne S.Moore: B3a, 3b, 3c, 3d,
 G1, 2, 3, 6, LOV
Pentas longiflora Oliv.
Pentas pubiflora S.Moore
Pentas zanzibarica (Kl.) Vatke: B3a, 3c, G1, 2,
 LOV
Psydrax parviflora (Afz.) Bridson
Psydrax schimperiana (A.Rich.) Bridson: F2, 3,
 RV
Tarenna graveolens (S.Moore) Bremek: B3c, CEV,
 F2, 3, RV
Vangueria apiculata K. Schum.

RUTACEAE

- Teclea simplicifolia* (Eng.) Verdoorn: B2, 3b, 3c,
 3d, CEV, F1, 2, 3, G7, RV, W1
Toddalia asiatica (L.) Lam.: F1, RV, W1

SALICACEAE

- Salix subserrata* Willd.: F2, LOV, RV

SANTALACEAE

- Thesium schweinfurthii* Engl.
Osyris abyssinica A.Rich.

SAPINDACEAE

- Dodonaea angustifolia* L.f.: B1, 3b, F3, G3, 4, 6,
 LOV

SCROPHULARIACEAE

- Craterostigma hirsutum* S.Moore: B3c, G1, 2
Craterostigma plantagineum Hochst.: B3c
Cycnium tubulosum (L.f.) Engl.: B1, G4, 5
Cycnium volkensii Engl.
Hebenstretia angolensis Rolfe
Limosella africa Gluck.
Cycnium volkensii Engl.
Cycnium tubulosum (L.f.) Engl.

Sopubia eminii Engl.

- Sobupia ramosa* (Hochst.) Schweinf.
Striga gesnerioides (Willd.) Vatke

SOLANACEAE

- Datura stramonium* L.: F3, G1, 3, RV, SIV
Lycium europaeum L.: CEV, G4, 7, W1
Nicandra physalodes (L.) Gaertn.
Nicotiana glauca R.Grah.: F3, G1, RV, SIV, SM,
 SV
Physalis ixocarpa Hornem.: SIV, W1
Physalis peruviana L.: SIV, W1
Solanum aculeastrum Dunal: SIV
Solanum incanum L.: B1, 2, 3a, 3b, 3c, 3d, CEV,
 F1, 3, G1, 2, 3, 4, 5, 6, 7, LOV, RV, SIV, Sm,
 W1, 2
Solanum nigrum L.: G5, SIV
Solanum mauense Bitter: SIV
Solanum sesselistellatum Bitter
Solanum nakurense C.H.Wright: CEV
Solanum sp. = Natrass 1081
Withania somnifera (L.) Dunal: B1, 2, 3b, G1, 3,
 4, 5, 6, 7, F1, LOV, RV, SIV

STERCULEACEAE

- Dombeya burgesiae* Gerrard: B3a, 3b, 3d, CEV,
 F1, 2, 3, G6, 7, RV, SIV, W1
Dombeya rotundifolia (Hochst.) Planch.: W1
Melhanian ovata (Cav.) Spreng.: B2, 3b, 3c, CEV,
 G1, 2, 3, 6, 7, LOV, RV
Melhanian velutina Forsk.: B3b, 3c

THYMELAEACEAE

- Gnidia subcordata* Meisn.: F3, RV

TILIACEAE

- Grewia bicolor* Juss.: B2, 3a, CEV, F1, 2, LOV,
 W2
Grewia similis K.Schum.: B2, 3a, 3b, 3c, 3d, CEV,
 F1, 2, 3, G3, 4, 7, W1, 2
Grewia trichocarpa A.Rich.: CEV, F1
Triumfetta rhomboidea Jacq.

UMBELLIFERAE

- Ferula communis* L.: B3a.
Heteromorpha trifoliata (Wendl.) Eckl. & Zeyh.:
 B3a, 3d, G1, 6, LOV
Hydrocotyle ranunculoides L.f.
Steganotaenia araliacea Hochst.: B3a, 3b, 3d,
 CEV, F2, G1, LOV

URTICACEAE

- Droguetia debilis* Rendle

Girardinia diversifolia (Link.) Fries
Laportea aestuans (L.) Chew
Obetia pinnatifida Baker: B2, CEV, F1, 2, 3, RV,
 W1
Urtica massaica Midbr.: CEV, F1, G6, 7, RV,
 SIV, W1

VERBENACEAE

Clerodendron myricoides (Hochst.) Vatke: B3a,
 F3, G1 G3, LOV
Lantana camara L.: G1, SIV, W1
Lantana rhodesiensis Moldenke
Lantana tripylla L.: B3a, 3b, 3d, G1, 3, LOV, W1
Lippia javanica (Burm.f.) Spreng: B3a, 3b, G1, 3
Lippia kituiensis Vatke: B1, 3a, 3b, 3c, 3d, CEV,
 F2, 3, G1, 2, 3, 4, 6, 7, LOV, RV, W2
Lippia woodii Moldenke
Priva curtisiae Kobusk: B3b, 3c, G1, 2, 3, 6, 7
Verbena bonariense L.: G3, 4, 7, RV

VITACEAE

Cyphostemma adenocaula (A.Rich.) Willd &
 Drum.
Cyphostemma bambuseti (Gilg. & Brandt) Willd.
 & Drum.
Cyphostemma nierense (Th.Fr.) Desc.: B3a, 3b,
 CEV, F2, LOV, RV, SIV
Cyphostemma nodiglandulosum (Th.Fr.jr.) Desc.:
 B3a, 3c, F2, 3, LOV, RV
Cyphostemma serpens (A.Rich.) Desc.: B3a, 3c,
 G3
Rhoicissus tridentata (L.f.) Willd. & Drum.: B3c

ZYGOPHYLLACEAE

Tribulus terrestris L.: G3, 7, SIV

III. MONOCOTYLEDONS

AGAVACEAE

Sansevieria parva N.E.Br.: F3, RV
Sansevieria robusta N.E. Br.: B3c, F2, LOV
Sansevieria volkensii Guerke: RV

AMARYLLIDACEAE

Crinum macowanii Bak.
Crinum papillosum Nord.: G1
Scadoxus multiflorus (Martyn) Raf.: B3c, CEV,
 LOV

COMMELINACEAE

Commelina fricana L.: B3a, 3b, 3c, 3d, F2, G1, 3,
 4, 6, 7, LOV

Commelina benghalensis L.: B3a, 3b, CEV, F1, 2,
 3, G1, 2, 3, 6, 7, LOV, RV, SIV, W1
Commelina forskoolii Vahl.
Commelina reptans Brenan: B3a, 3b, 3c, CEV,
 G1, 2, 3, 6, 7, LOV
Cyanotis arachnoidea C.B.Cl.

CYPERACEAE

Bulbostylis boeckleriana (Schweinf.) K.Lye
Cyperus dichroostachyus A.Rich. SM
Cyperus dives Del.: SV
Cyperus laevigatus L.: B1, G5, SM, SV
Cyperus niveus Retz.: B2, 3b, CEV, G1, 4, 7, LOV
Cyperus rigidifolius Steud.: LOV
Cyperus rubicundus Vahl
Cyperus usitatus Burch.
Abildgaardia schimperiana (A.Rich.) K.Lye
Cyperus amauropus Steud.: LOV
Cyperus squarrosus L.
Cyperus impubes Steud.: F2, LOV

GRAMINEAE

Andropogon chinensis (Nees) Merr.: B3a, LOV
Andropogon distachyus L.
Aristida adoensis Hochst.: B2, 3a, 3b, CEV, G1, 2,
 3, 4, 6, 7, LOV, RV
Aristida kenyensis Henr.: B1, 2, 3a, 3b, 3d, CEV,
 F1, 3, G1, 2, 3, 4, 6, 7, LOV, RV
Brachiaria brizantha (A.Rich.) Stapf: B3a
Brachiaria comata Stapf
Brachiaria semiundulata (A.Rich.) Stapf
Cenchrus ciliaris L.: G3, LOV.
Chloris gayana Kunth: B1, 2, 3a, 3b, 3d, CEV, F1,
 2, G1, 2, 3, 4, 5, 6, 7, SM
Chloris pycnothrix Trin.: B2, 3d, CEV, F2, G1, 3,
 6, RV, SM, W1
Chloris virgata Sw.: G4
Cymbopogon nardus (L.) Rendle
Cymbopogon caesius (Hock. & Arn.) Stapf: B3a,
 3b, CEV, G6, LOV
Cymbopogon pospischilii (K.Schum.)
 C.E.Hubbard: B3a, 3b, CEV, G6, LOV
Cynodon dactylon (L.) Pers.: B1, G4, 5, RV, SIV,
 SM, SV
Cynodon nlemfuensis Vanderyst: B2, 3a, 3b, 3c,
 3d, CEV, F1, G1, 2, 3, 4, 6, 7, LOV, RV, SIV,
 SM, W1, 2
Dactyloctenium aegypticum (L.) Willd.: G4, 7
Digitaria abyssinica (A.Rich.) Stapf: B2, 3c, CEV,
 G1, 2, 3, 4, 6, 7, W1
Digitaria diagonalis (Nees) Stapf
Digitaria velutina (Forsk.) Beauv.: F2, 3, RV, W1
Ehrharta erecta Lam.: F2

- Eleusine indica* (L.) Gaertn.: G4
Eleusine jaegeri Pilg.
Eleusine multiflora A.Rich.: G2
Enneapogon schimperanus (A.Rich.) Renv.: LOV
Eragrostis braunii Schweinf.: B3a, G2
Eragrostis cilianensis (All.) Lut.: B3a, G1, 3, 6, 7
Eragrostis racemosa (Thunb.) Steud.: B3a
Eragrostis suberba Peyr.: B3a, 3b, 3d, G1, 6, LOV
Eragrostis tenuifolia (A.Rich.) Steud.: G2, 3
Eragrostis volkensii Pilg.
Harpachne schimperii A.Rich.: B2, 3a, 3b, CEV,
 G1, 2, 3, 4, 6, 7, LOV
Hyparrhenia anamesa W.D.Clayton: B3a, 3b,
 G1, 2, 3, 4, 6, 7, LOV
Hyparrhenia collina (Pilg.) Stapf
Hyparrhenia hirta (L.) Stapf: B3a, 3b, CEV,
 G1, 2, 4, SM
Loudetia kagerensis (K.Schum.) Hutch.: B3a, G3
Microchloa kunthii Desv.: B3a, 3b, G1, 2, 4
Oplismenus hirtellus (L.) Beauv.: F2
Panicum atrosanguineum A.Rich.: B3a
Panicum maximum Jacq.: B2, 3a, 3b, 3d, CEV,
 F1, 2, LOV, RV
Pennisetum clandestinum Chiov.: SIV, SM, SV
Pennisetum hohenackeri Steud.: CEV, RV
Pennisetum mezianum Leeke: B3a, 3b, CEV,
 G1, 3, 7, LOV
Pennisetum procerum (Stapf) W.D.Clayton: CEV,
 G2, LOV
Pennisetum purpureum Schum.
Pennisetum sphacelatum (Nees) Th.Dur. &
 Schinz.: B3a, CEV
Pennisetum squamulatum Fres.: CEV, LOV
Pennisetum trachyphyllum Pilg.
Rhynchelytrum repens (Willd.) C.E.Hubbard:
 B1, 3a, 3b, CEV; G1, LOV
Setaria orthosticha Herrm.: F3
Setaria pumila (Poir.) Roem. & Schult.: B3a, 3b,
 3c, CEV, F1, G1, 2, 3, 4, SIV, SV, W1
Setaria sphacelata (Schum.) Moss: B3a
Setaria verticillata (L.) Beauv.: B3c, CEV, F3,
 G3, 6, RV, SM, SV, W2
Sporobolus africanus (Poir.) Robyns & Tourn.:
 B1, 2, 3a, 3b, G1, 2, 3, 4, 7, LOV
Sporobolus agrostioides Chiov.: F3
Sporobolus confinis (Steud.) Chiov.: B3a, CEV,
 G1, 3, 6, 7, LOV, RV
Sporobolus consimilis Fres.: CEV
Sporobolus festivus A.Rich.
Sporobolus fimbriatus (Trin.) Nees: B3a, 3b, CEV,
 G2, 6, W1
Sporobolus ioclados (Trin.) Nees
Sporobolus pyramidalis Beauv.: B1, 2, 3a, 3b, 3c,
 3d, CEV, F1, G1, 2, 3, 4, 5, 7, LOV, RV
Sporobolus spicatus (Vahl) Kunth.: B1, G4, 5, RV,
 SM, SV
Sporobolus stapfianus Gaud.: LOV
Stipa dregeana Steud.
Themeda triandra Forsk.: B3a, 3b, 3c, 3d, CEV,
 F3, G1, 2, 3, 4, 6, 7, LOV, W2
Tragus berteronianus Schult.
Tricholaena teneriffae (L.f.) Link.: B3b, G6, LOV
- IRIDACEAE**
Gladiolus psitacinus Hook.f.
- JUNCACEAE**
Juncus oxycarpus Kunth
- LILIACEAE**
Aloe lateritia Engl. var. *solaiana* (Christian)
 S.Carter: B2, 3a, 3c, 3d, F2, 3, G1, 4, LOV,
 RV
Aloe ngongensis Christian: B3a, CEV, F2, 3, LOV,
 RV
Aloe rabaiensis Rendle
Aloe secundiflora Engl.: B3a, 3d, G1, LOV
Asparagus aethiopicus L.: B3a, 3b, CEV
Asparagus africanus Lam.: B3a, 3b, CEV
Asparagus b Buchananii Bak.: B3b, 3d
Asparagus falcatus L.: B3a, 3c, CEV
Asparagus asparagoides (L.) Wight: B3c
Bulbine abyssinica A.Rich.
Chlorophytum bakeri Poel.: B3c
Chlorophytum comosum (Thunb.) Jacq.: G2
Gloriosa superba L.: B3c, F2, G7, RV
- ORCHIDACEAE**
Cyrtorchis arcuata (Lindl.) Schltr.
Habenaria sp.
Polystachya stricta Rolfe: F2, 3
- PALMAE**
Phoenix reclinata Jacq.
- POTAMOGETONACEAE**
Potamogeton richardii Solms
- TYPHACEAE**
Typha domingensis L.: SV