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# A PHYTOSOCIOLOGICAL RECONNAISSANCE OF MLILWANE WILDLIFE SANCTUARY, SWAZILAND

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*Abstract* – The orthodox Braun-Blanquet Method of sampling and synthesis is applied to obtain a classification of the Mlilwane vegetation. Rationalizing discussion of some subjective aspects of the traditional method is included.

The Mlilwane Sanctuary stretches from the Swaziland Middleveld to Highveld. The major community types are:

1. Secondary Grassland on low elevation plains, previously probably Sub-tropical, Sub-humid Thornveld and now sub-divided into young and old secondary succession stages;
2. Moist, Cool-temperate Grassland on mountain slopes, including xeric to mesic variations associated with aspect and topographic position and a bouldery variation with xeric and mesic niches; and
3. Sub-humid Mountain Bushveld on slopes in a sheltered river valley, including a Temperate and Sub-tropical community, the latter with an outcrop and a colluvium variation and different structural phases associated with soil differences. Other, more local communities are described casually and include:
4. Riparian and Ravine Bush;
5. Montane Scrub and Forest; and
6. Exotic communities, including *Psidium quajava* and Australian species of *Acacia* and *Eucalyptus*.

## *Introduction*

Swaziland may be divided into four major natural regions that are climatically, physiographically and botanically distinct (Compton 1966; Murdoch *in* Compton 1966; Schulze and McGee 1978; Werger and Coetzee 1978). These regions occur in parallel belts, each extending from north to south throughout Swaziland (Fig. 1).

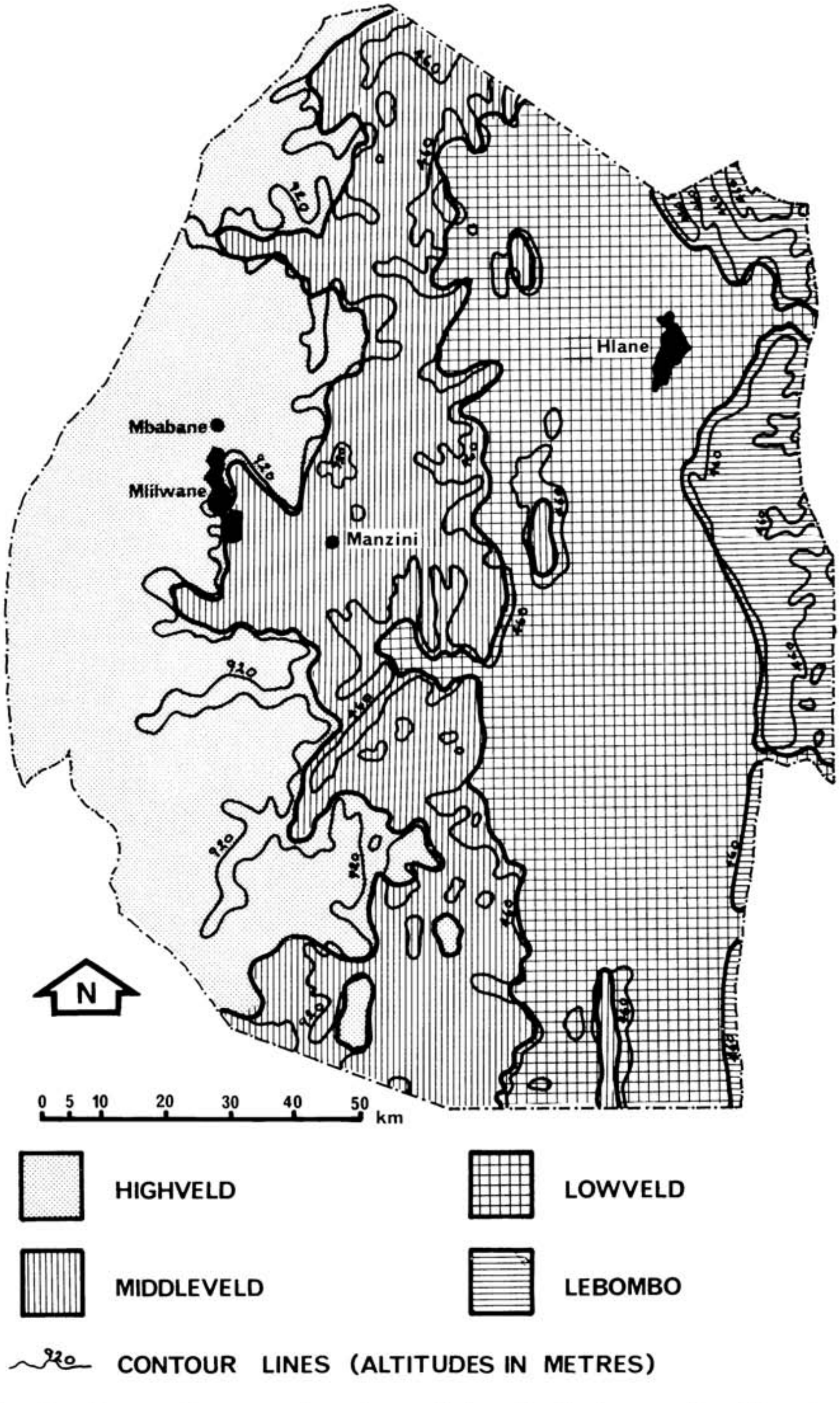


Fig. 1. Four major natural regions of Swaziland, drawn after Compton (1966).

The Highveld, which is the western-most region, is on the southern African continental escarpment and is high rugged terrain with frosty moist Cool-temperate Grassland. Below the escarpment the inherently bushy but intensively cultivated Middleveld continues eastward over undulating and hilly country. The climate here is Moist Sub-humid, Warm-temperate. The Lowveld, further to the east, occupies the low, gently undulating plains with a Dry Sub-humid, Warm-temperate to Sub-tropical climate, and is a mixture of semi-natural plains Bushveld and tropical crop cultivation. These plains are terminated by the bushy and Semi-arid, Sub-tropical Lebombo Mountain Range.

Hlane and Mlilwane Wildlife Sanctuaries are the only official nature reserves in Swaziland (*cf.* Gertenbach and Potgieter 1978). Hlane is situated in the sub-tropical Lowveld and Mlilwane stretches from the rugged cool-temperate Highveld escarpment to the undulating warm-temperate Middleveld below (Fig. 1). The reserves may therefore be regarded as well placed and representing three of the four main natural regions of Swaziland, but with reservations. The presently high aesthetic status of Hlane is being threatened by prospecting and potential mining activities. The Swaziland Middleveld has been completely changed by cultivation. On Mlilwane the undulating Middleveld plains likewise consist of secondary, albeit advanced successional, grassland dabbed by quite large stands of exotic timber. Much of the more mountainous Middleveld soils are extremely eroded and invaded by exotic plants, yet areas of well preserved natural bushveld remain here. The Highveld grasslands on Mlilwane are fairly natural and are interrupted by fragments of Montane Scrub and Forest. Areas somewhat similar and related to the Mlilwane Sanctuary are conserved further north in the Republic of South Africa – on the escarpment in the Blyde River Canyon Nature Reserve and below the escarpment in the far southwestern corner of the Kruger National Park. Mlilwane is nevertheless quite distinct, particularly owing to the clayey orange and yellow ferralitic soils at the foot of the escarpment and the elements of Montane vegetation.

The South African National Parks Board of Trustees was invited to assist in drawing up a conservation management plan for the Mlilwane Wildlife Sanctuary. A phytosociological reconnaissance formed part of this project and is reported here.

### *Geography and Physiognomy*

The Mlilwane Wildlife Sanctuary covers approximately 4 300 ha immediately south of Mbabane, with its northern boundary 4 km from the town. Geographical co-ordinates are: between 26°21′ and 26°31′S and between 31°6′ and 31°12′E (Fig. 2). The Sanctuary is reached along the main road from Mbabane to Manzini, with the Mlilwane turnoff at Mantenga, about 15 km from Mbabane. The Usutshwana or "Little Usutu" River, which flows across the width of Mlilwane, divides it into two management units, at present connected by road only via a bridge outside Mlilwane and over a considerable portion of outside property.

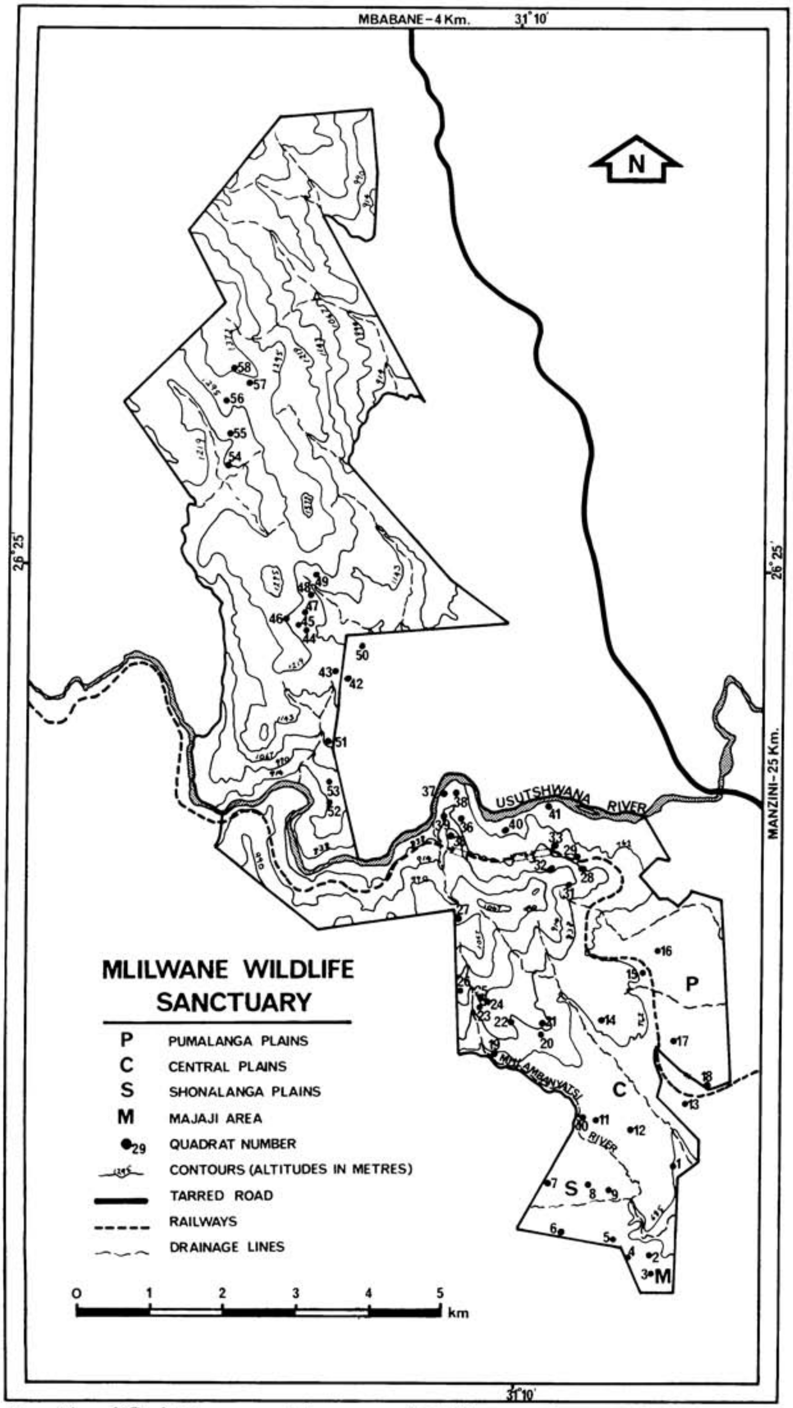


Fig. 2. Simplified Topographic map of Mlilwane showing also major geographic features and approximate position of sampling quadrats (Based on D.O.S. 1965).

Mlilwane North is largely situated in the Highveld, on the high watershed between the Usutshwana and its tributary the Mbabane. Altitude in this section ranges from 840 m in the Usutshwana Valley to 1460 metres. The average elevation given by Murdoch (*in* Compton 1966) for the Swaziland Highveld is 1 065 m–1 370 m and 75% of Mlilwane North falls in this range (Fig. 2). Altitude is a crucial determinent of Highveld climate and the weather station at nearby Mbabane, which is situated at 1 163 m and 26°19′S, 31°8′E, should provide a reasonably accurate indication of the climate over most of Mlilwane North (Weather Bureau 1954, 1957, 1965). Mean monthly maximum temperatures here range from between 24° C and 35° C during the cold winter months of June and July, to between 30° C and 33° C during the spring and summer months of November to February. Light to moderate ground frost probably occurs on the average at least once per month from May to September, when mean monthly minimum Stevenson screen temperatures range from 0° C–3° C. Stevenson screen temperatures of below 0° C, indicating ground temperatures well below zero, were recorded at Mbabane during 16 years out of an observation period of 25 years. The average first and last dates for such decidedly frosty periods were 28th June and 15th July respectively. The average annual rainfall at Mbabane for 53 years is 1 387 millimetres. Of this, 80%–85% falls during October–March. Rainfall is reliable being over 85% of the normal in three out of four years. The strong seasonality of the climate, including a cold

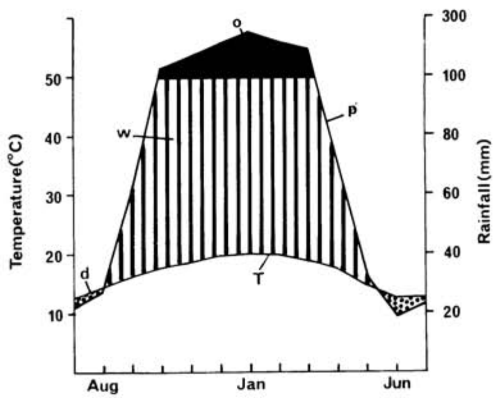


Fig. 3. Climate diagram for the Mlilwane North mountains, based on data from Mbabane Weather Station (Weather Bureau 1954 and 1965), drawn after Walther and Lieth (1960).
P = mean monthly rainfall in mm
T = mean monthly temperature in °C
d = dry season
w = wet season
O = mean monthly rainfall over 100 mm
(scale reduced to 1/10).

dry season and a warm moist season, is illustrated in Fig. 3, drawn after Walther and Lieth (1960). The humid climate and acid parent material render the soils acid. The soils are derived from the underlying Archaic granite (3 100 million years old) of the Northern Cape and Transvaal Zone of Metamorphoses and Granitisation (Dept. Mines 1970). According to Mr. T. E. Reilly* (*pers. comm.*) field fires occur regularly, virtually every year.

The climate, vegetation, soils and burning regimé of the Highveld portion of Mlilwane North fit Werger and Coetzee's (1978) description Sudano-Zambezian seasonal Moist Cool-temperate Grassland, which at higher altitudes grades into Afro-alpine vegetation. Traces of the latter occur in the highest parts of Mlilwane North. The seasonality, in combination with winter frost and fire, are regarded as the main factors rendering the environment unfavourable for trees and shrubs, thus determining the grassland structure (Fig. 4). Species composition is further

Fig. 4. Grassland on rolling terrain of high Mlilwane North Mountains. Mesic habitats among outcrop and sheltered kloofs carry Montane Scrub and Forest respectively.

determined largely by the high summer rainfall and leached mountain soils. Moist, sheltered azonal areas such as ravines and bouldery outcrops, favourable for tree and shrub growth, carry Afro-montane forest and shrub vegetation respectively (Fig. 4).

**Mlilwane Game Sanctuary, P. O. Box 33, Mbabane, Swaziland.*

*The Usutshwana Valley*

The Usutshwana Valley cuts deeply into the granite and elevation of the valley proper is from 700 m–975 metres. The bushy slopes suggest milder winters than on the uplands, which would be owing to lower altitude, rapid cold air drainage, little radiation loss and protection from cold winds. The lower slopes, particularly, are characterized by sub-tropical, Moist Sub-humid Bushveld species. Sub-tropical species disappear on the upper slopes, with a woody species composition typical of warm-temperate regions persisting and grading into cool-temperate grassland at the top (Fig. 5).

Fig. 5. Bushveld of the Usutshwana Valley grading into high grassland in the background.

*Mlilwane South*

The Mountain terrain continues south of the Usutshwana River and approximately 50% of Mlilwane South is mountainous and between 760 m and 1 130 m elevation (Fig. 2). Geology of this portion is of the same granitic formation as Mlilwane North. The other 50% is low undulating plains at 685 m–760 m altitude, underlain by Gneiss that belongs to the somewhat older Ancient Swaziland Complex. An indication of temperatures on the plains below the escarpment may be obtained from the Manzini (previously Bremersdorp) Weather Station. This station is situated at 26°29′ S, 31°23′ E i.e. 11 minutes due east of Mlilwane and at 599 m, which is 85 m lower than Mlilwane. Mean monthly maximum temperatures here are 28° C–29° C during June and July and 34° C–35° C from September to January, i.e. markedly warmer than those quoted for Mbabane to represent the high portion of Mlilwane North. The Manzini mean monthly minimum Stevenson screen temperatures are also higher, being lowest at 3,7° C–3,9° C for June and July. This corroborates with Reilly's (*loc. cit.*), observation that frost on the Mlilwane South plains is a rare phenomenon. Rainfall on the Mlilwane South plains is accurately indicated by records from the McCreedy weather station over a 40 year period. This weather station is situated at 26°27'S, 31°12'E and 762 m elevation, on the extension, directly outside Mlilwane, of the Mlilwane South plains. The average annual rainfall here is 1 136 millimetres. This is 250 mm less than for high Mlilwane North, but the rainfall in the south is as reliable and as seasonal. A climate diagram for the Mlilwane South plains, showing the seasonality and mild winters is given in Fig. 6. Soils on the gentle slopes and on the

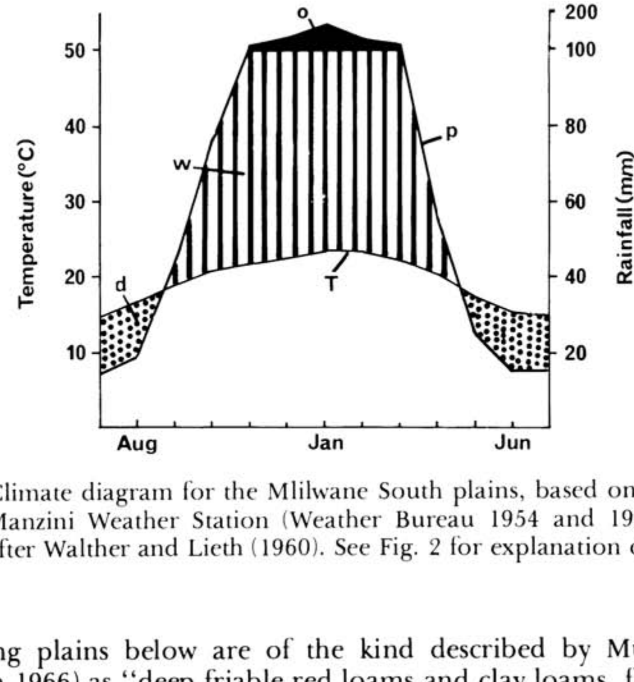


Fig. 6. Climate diagram for the Mlilwane South plains, based on data from Manzini Weather Station (Weather Bureau 1954 and 1965), drawn after Walther and Lieth (1960). See Fig. 2 for explanation of symbols.

undulating plains below are of the kind described by Murdoch (*in* Compton 1966) as "deep friable red loams and clay loams, ferralitic or ferrisolic, interspersed with shallower profiles, often transitional between lithosols and fersialitic soils". The deep soils of the lower mountain slopes have been severely eroded and deep dongas are characteristic of these slopes (Fig. 7). According to Reilly (*loc. cit*) this erosion was caused by tin mining during which water was used to intentionally wash soil down the slopes. The site of the McCreedy mine on the footslopes of the Mlilwane South mountains features on a 1965 topocadastral map (D.O.S. 1965).

The Mlilwane South mountains are lower than those across the Usut-

Fig. 7. Deep erosional dongas, characteristic of lower mountain slopes in Mlilwane South.

shwana in Mlilwane North. Therefore, although the mountain vegetation in the south is also Moist Cool-temperate Grassland, floristically related to that of Mlilwane North, it differs from the north in being floristically related also to the secondary grasslands on the low plains. The Afro-alpine and Afro-montane floristic elements are also largely absent from the southern section. Indigenous woody plants are restricted mainly to outcrops. Approximately 15 ha in the vicinity of Nature's Corner Viewpoint has secondary grassland on previously cultivated land left fallow and a similar sized portion of the mountain at Mlilwane Hill has an exotic plantation. Exotics also abound in the erosional dongas on the footslopes.

Approximately 50% of the Mlilwane South plains are secondary grasslands in an advanced stage of succession. These are the grasslands that predominate on the Central and Shonalanga Plains and the Mujaji area, which were cultivated at some stage but have been left fallow since at least as long ago as 1908 (Reilly *loc. cit.*). Exceptions are small recently cultivated areas, one on the crest of the Mujaji area and two in the section of the Shonalanga Plains north of the Ingwavuma Vlei. The latter two areas had already been ploughed for *Eucalyptus* tree plantations when the present conservation authorities intervened.

Another 40% of the Mlilwane South plains, comprising the Pumalanga Plains, is secondary grassland in an early seral stage. Rice was cultivated here until as recently as 1964. Each year after germination, which occurred with spring rains, rice fields were flooded by irrigation for four months. This practice of seasonal flooding resulted in sedge invasion to the extent that the fields had to be abandoned. Lines of contour banks on these recently cultivated fields are still clearly visible, e.g. on aerial photos (Reilly *loc. cit*). Ten per cent of the Mlilwane South plains carry exotic tree plantations (Fig. 8).

Fig. 8. Exotic Australian *Acacia* and *Eucalyptus* stands occur on the undulating secondary grassland plains of Mlilwane South. A shrubby vegetation with abundant *Psidium guajava* occurs patchilly in the grasslands of lower mountain slopes in the foreground.

*Survey Methods*

The Braun-Blanquet Method of sampling and synthesis was followed (*cf.* Werger 1974).

*Sampling*

Normal sampling considerations apply and the theoretically simplest procedure would be to use random sampling; or stratified random sampling, allocating a large number of sampling units to stratification classes in proportion to the areas of the latter – the sampling units being randomly distributed within stratification classes (Daubenmire 1968). The latter would provide an unbiased sample that nevertheless covers any predetermined variation. Where predetermined patterns are confirmed this would not be an artifact of biased unequal sampling intensities whereby large apparently homogeneous areas are undersampled and inconspicuous but equally strong patterns neglected.

However, differences within some stratification units may be obviously small compared to differences between these units, duly considering the criteria on which the vegetation is to be classified. Rigidly objective procedures to establish this, requiring many sampling units in large homogenous areas may then be unneccessary. If such a predisposition is acceptable, the following procedures may render a greater amount of useful information, of the kind discussed under "Synthesis", on obvious but poorly understood stratification entities and less obvious entities of both higher and lower hierarchical categories:–

a. *Sub-sampling*

Areas are sub-sampled e.g. along roads that serve as representative traverses of stratification classes, as was done by Leistner & Werger (1973).

b. *Avoiding boundaries*

Boundaries between stratification classes are avoided because sampling units atypical of either class are likely to be encountered here (*cf.* Dahl 1956).

c. *Disproportionate sampling*

Sampling units are allocated to stratification classes in proportion to the areas of the latter but with a specified maximum and minimum number of sampling units per stratification class (*cf.* Coetzee 1975; Jolly 1954).

d. *Selecting homogeneous representative quadrats*

Another possibility is to select, in the field, quadrats typical of a stratification class or of the various mosaic components within a class. This could be done by predetermined, objectively applied exclusion criteria for random points (*cf.* Coetzee 1975; Walker 1976). The areas thus neglected may be estimated by applying the exclusion criteria at enough points, without actually describing all points qualifying for inclusion.

All these strategies may be carried out by formal procedures designed to precisely define bias. The much critisized subjective selecting of sampling sites according to the orthodox Braun-Blanquet System is merely an informal version of such procedures. Westhoff and Van der Maarel (1973) state: "For this purpose of equitable representation of different kinds of communities with most useful relevés, a subjective, 'stratified' sample selection is far superior to sample choice by random points on a map".

The informality of the traditional attempt to include a random element in disproportionate stratified random sampling, and the informality in defining stratification classes and exclusion criteria for unrepresentative sampling units, perhaps preclude wider application of the Braun-Blanquet System. However, this could be ascribed to misinterpretation of procedures rather than objection to the informality because the orthodox procedures, when understood, may be transcribed into an acceptably rigid sampling strategy. A more prohibiting objection would be one against the biased premise of Procedures a–d.

Distribution of sampling sites in the present survey was in the biased, informal, orthodox tradition. Furthermore, only major stratification classes were sampled adequately for formal Table Synthesis (See "Synthesis"). Additional stratification classes of small extent are represented by single examples. Fieldwork was carried out between 76.02.23–76.02.27, during which 58 sampling units were described. The approximate localities of these are shown in Fig. 2.

The sampling phase yields site descriptions. Each description is a list of plant species present in a quadrat, an estimated cover value for each species in the quadrat and a more or less detailed description of the environment. Cover values are according to the following scale:

r=single individual with negligible cover — may prove to be an exception to the general distribution pattern of the species.

+=Less than 1% cover
1=1%–5% cover
2=5%–25% cover
2a=–5%–10% cover
2b=10%–25% cover
3=25%–50% cover
4=50%–75% cover
5=75%–100% cover

The traditional scale also includes abundance in the definitions of the two lower classes, 1 and +, but this is to provide for special growth forms and was of no significance in the present survey. Various modifications of the basic seven point scale exist including the Domin–Krajina scale, which, amongst others, sub-divides class 2 into 5%–10% and 10%–25%; and class 5 into 75%–99% and 100% (Mueller-Dombois and Ellenberg (1974).

*Synthesis*

Field data are entered in a table with columns representing sampling quadrats and rows representing plant species. Entries in the matrix are cover values of species in quadrats and show the distribution of species over quadrats. Species with similar distributions are grouped together and quadrats with similar groups of associated species are put together. The net effect is to consolidate the patterns of entries in the matrix as much as possible (*cf.* Coetzee 1974b; Coetzee, Van der Meulen, Zwanziger, Gonsalves and Weisser 1976). This is achieved by successive visual approximation, with the computer assisting in rewriting tables accurately from a basic raw matrix into the desired quadrat and species sequences.*

Table 1 shows the ordered data for Mlilwane. Relationships between groups of quadrats are shown by the groups of species they have in common; and on the basis of such relationships closely related quadrat groups are combined to form a hierarchy of larger quadrat groups (Coetzee *et al.* 1976). Separate groups of species may have overlapping distributions. This means that quadrat groups may be variously combined depending on which relationships are taken into account. Different species groups and therefore different relationships between quadrats are each associated with a particular set of environmental factors. In respect of one set of environmental factors and its group of associated species, quadrat groups may be closely related, whereas in respect of another set of environmental features and its accompanying distinctive species, the same quadrat groups may be unrelated.

Quadrat groups represent plant community types. Table 1 therefore shows for each community type at any level in a hierarchy, total species composition, distinctive species composition and floristic relationships with other communities as well as the habitat features that have bearing on the distinctive floristic features and the floristic relationships. Table 1 also shows for each species its phytosociological indicator value and affinities with other species, its habitat preferences and, if the Table is read in conjunction with a map of communities, the geographical distribution of each species. In so far as the sample is unbiased in this respect, the Table could further show variability of community types and habitats. The synthetic information is presented without loosing the presentation of the original data recorded at each locality.

*Plant Communities*

Table 1 and Fig. 9 shows three major groups of plant communities on Mlilwane. These are:

1 Secondary Grassland, on the low undulating Middleveld plains in Mlilwane South;

2.1 Moist Cool-temperate Grassland of the Highveld, including open terrain in the high mountains of Mlilwane North and exposed and southfacing slopes of medium altitude mountains in Mlilwane South; and

2.2 Warm-temperate and Sub-tropical Sub-humid Mountain Bushveld, of the sheltered Usutshwana Valley.

**Computer programs were made available by the Botanical Research Institute, Private Bag X101, Pretoria 0001.*

Plant communities of minor extent are not included in Table 1. Such communities, illustrated by single examples or casual descriptions, include:

3 Warm-temperate and Sub-Tropical Riparian and Ravine Bush;

4 Afro-montane communities, including Streambank Open Scrub, Kloof Forest, Bouldery Outcrop Scrub and Sheet Outcrop Sedge communities; and

5 Communities dominated by exotic woody species and vegetation of erosion dongas.

1. *Hyparrhenia filipendula – Paspalum commersonii*
Secondary Grassland (Middleveld Secondary Grassland)

The low Mlilwane plains fall in Compton's (1966) Middleveld, which is mapped by Acocks (1953 and 1975) as Lowveld Sour Bushveld. Acocks (1953) is of the opinion that the climax of this vegetation is probably tropical forest and that the present day sub-natural vegetation of these areas is "either an open parkland, tall, well-formed trees well spaced in tall grassveld, or else bushveld dotted with big trees". Compton (1966) points out that the greater part of the Swaziland Middleveld has been modified and botanically spoilt by cultivation, burning and overgrazing, to the extent that it is difficult to imagine what this type of country could have been like. Nevertheless, he too is of the opinion that it might have been bushveld and judges from what seem to be remnants of the original Middleveld, that it would seem to have been "thornveld" with *Acacia karroo, A. natalitia, A. davyi* and other species. Small patches of *Acacia* trees, including *A. davyi* do occur on the plains near the Mlilwane Gate. In this context, Reilly (*loc. cit.*) who agrees that reconstruction is difficult, pointed out that the following are strong indications suggesting that the area may have had a *Hyparrhenia* – dominated field layer with a good smattering of *Acacia sieberiana* trees:

a. at Mlilwane, *Hyparrhenia filipendula* is typically the most common dominant of secondary grasslands in an advanced stage of succession;

b. an old relict *Acacia sieberiana* tree occurs on Mlilwane Hill and whole groves of this species occur in adjoining areas; and

c. such communities with abundant *Hyparrhenia* in the field layer and scattered *A. sieberiana* trees occur extensively further south in similar areas in the Republic of South Africa. The rainfall pattern and precipitation is similar and the position also between the frosty grasslands of the high escarpment and the warmer, coastal or dry valley climates. These South African communities have been described by

Acocks (1953, 1975: Southern Tall Grassveld and Natal Sour Sandveld), Edwards (1967: *Acacia sieberiana* – Tree Veld of the Interior Tugella River Basin) and Moll (1976: *Acacia sieberiana* Savanna of the Three Rivers Region).

Extensive stands of fairly natural Lowveld Sour Bushveld are preserved around Pretoriuskop in the Kruger National Park, Republic of South Africa, where it has been described by Van der Schijff (1958) as *Dichrostachys – Terminalia – Hyparrhenia* communities (see also Pienaar 1963; Van der Schijff 1969; Van Wyk 1974). However, this vegetation is on leached sandy soils with an associated general type called Broad-orthophyll Bushveld by Werger & Coetzee (1978). According to the latter authors' scheme one may, under a similarly moist climate but with loamy to clayey soils, such as at Mlilwane, expect microphyllous thorny bushveld, i.e. Thornveld, which is what Compton (1966) and Reilly (*loc. cit.*) suggest.

Conversely a very local patch of a seemingly relict stand of *Combretum zeyheri* Bushveld occurs on the Mlilwane plains. It remains to be established whether the occurrence of this stand is associated with an unusual and very localized soil and drainage peculiarity. Therefore, before this area was cultivated the Mlilwane South plains probably, in Werger and Coetzee's (1978) terminology, belonged to a microphyllous thorny and/or broad orthophyl phase of Lowveld (Sub-tropical) Sub-humid Mountain Bushveld, more particularly *Acacia davyi, A sieberiana* and other species Thornveld and/or *Combretum seyheri* Broad-leaved Bushveld.

Today these plains are secondary tufted grassland (Fig. 10)

The grasses *Paspalum commersonii, Sporobolus africanus, Eragrostis curvula* and the forbs *Lippia* sp., *Acanthospermum australe, Helichrysum athrixifolium, Blumea alata, Hypoxis* sp. *cf. H. rigidula* and *Borreria natalensis* are characteristic and occur with high presence over most of the plains. This combination is indicative of the moist climate and disturbance. *Paspalum commersonii,* according to Chippendall (1955), thrives best in wet places and occurs frequently in disturbed areas. Although it does occur in marshy areas, a high rainfall such as in eastern southern Africa is sufficient to meet its moisture requirements (Chippendall 1955; Lightfoot 1970). *Sporobolus africanus,* which is common in the southern Cape and eastern southern Africa occurs most frequently in disturbed places on poor soils (Chippendall 1955). *Eragrostis curvula* (*sensu stricto*) is also a common pioneer (Roberts 1973) and is characteristic of secondary grasslands, e.g. in the Jack Scott Nature Reserve surveyed by Coetzee (1974a), although the latter author included this form with *E. chloromelas* under *E. curvula* (*sensu lato*). The forb *Acanthospermum australe* is an exotic, cosmopolitan tropical and sub-tropical weed.

Two distinct types of secondary grassland communities on Mlilwane are related to the time elapsed since major disturbance and the kind of

Fig. 10. Middleveld Secondary Grassland plains in Mlilwane South, typically interrupted by stands of exotic trees.

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