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ASPECTS OF THE ECOLOGY OF *ACACIA-COMMIPHORA* WOODLAND NEAR KIBWEZI, KENYA

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INTRODUCTION

Approximately one quarter of Kenya is covered in some form of arid bushland or woodland (Kenya National Atlas, p. 31). Much of this lies within Machakos, Kitui and Taita Districts, and is included in the Eco-climatic Zone V of Pratt & Gwynne (1977). The density of the vegetation of this vast area varies locally from woodland thicket to sparse bushland. Because of its aridity most of this zone is unsuitable for cultivation except in situations where a source of water other than rainfall is available. At present it is mainly used for browsing livestock, and as a source of firewood and charcoal. The marginal character of this zone with respect to agriculture makes it ideal for wildlife conservation, and large tracts of it have been incorporated into the Tsavo and Amboseli National Parks (Lind & Morison, 1974).

Since such a large proportion of the country's area is involved, research on the economic potential of this arid zone is of great importance to the development of Kenya. At Masalani (G.R. DH 0244) 20 km NE of Kibwezi, a substantial area (in the region of 20-30 km^2) of *Acacia-Commiphora* woodland has been allocated to the University of Nairobi to set up a dryland farming research station, the purpose of which is to select crops and develop techniques of cultivation appropriate to the climate. It is proposed that a proportion of the area should be set aside for ecological studies by Kenyatta University College. Investigations on the adaptations of the native species of plants and animals should complement the proposed agricultural research. This paper is a preliminary contribution to the ecological studies to be undertaken on the site. Its aim is to provide an introduction to the area for future research workers. Already several projects are in progress, notably studies on species diversity in birds (Pomeroy & Muringo, 1980), on bird pests (Pomeroy, *pers. comm.)*, on Baobab trees (Fenner, 1980), and on the water relations of common woody species (Fenner, 1981).

HISTORY OF THE SITE

Until the end of the nineteenth century the area around Kibwezi was sparsely populated, with scattered settlements of subsistence farmers. In 1898 the area was hit by a severe drought which resulted in widespread famine. Kamba from Kitui South entered the area to obtain rice from the Indians who were building the Kenya-Uganda railway. (This event is remembered locally as 'yua ya museele', the famine of the rice.) From 1914 onwards more people were attracted to the area by the employment provided by the Dwa Sisal Plantation, and more recently, by the D.C.K. and other horticultural and agricultural enterprises.

In the last decade, the general increase in the population and consequent shortage of land has resulted in numerous settlements being established in the area. Typically these are on a small scale, and involve clear felling and burning of up to five hectares for subsistence farming. A range of crops is planted but yields are very poor except in occasional seasons of exceptionally high rainfall. The most frequently attempted crops are maize, millet, pigeon peas, lablab beans, gourds, sunflowers and castor oil plants. Sisal is often planted on the .boundaries of plots.

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Clearance of the vegetation cover has resulted in serious soil erosion in many places locally, notably at Kalulini (G.R. CH 8840) where gulleys up to 3-4 m deep have formed. In other places the natural vegetation has been degraded by the selective removal of certain tree species (such as *Acacia tortilis* (Forsk.) Hayne and various species of *Commiphora)* for construction, charcoal making and firewood; by the cutting of thorn bushes *(Acacia mellifera* (Vahl) Benth. and *A.senegal* (L.) Willd.) for boundary fencing; and by de-barking of fibre trees (*Adansonia digitata* L. and *Stercularia rhynchocarpa* K.Schum.) Browzing by goats and cattle has further modified the vegetation.

The fauna of the area was until recently a very rich one. Records of large mammals going back several decades have been kept at Bushwhackers (Masalani Camp) which adjoins the site of the proposed research station. Until 1972 the following species were recorded in the area: elephant, rhinoceros, buffalo, giraffe, waterbuck, reedbuck, bushbuck and warthog, with kongoni and Burchall's zebra appearing very occasionally. These herbivores were accompanied by their predators: lion, leopard, wild dog, hyaena and jackal. By 1975 all of these mammals had disappeared either through poaching or because of habitat destruction. The native fauna which remains consists mainly of small species of which the following are the most frequent: bush squirrel, unstriped ground squirrel, genet, dwarf mongoose, bushbaby, dik-dik, baboon and black-faced vervet monkey. Hippopotamuses, once frequent by the river, are now seen only very occasionally. The same applies to crocodiles. The rich bird fauna has also been modified by the degradation of the habitat. The studies by Pomeroy & Muringo (1980) show that species diversity is markedly reduced in cleared areas, with an increase in the numbers of potential pest species.

THE CLIMATE

Daily rainfall records have been kept at Bushwhackers since 1968. The mean total monthly rainfalls and their standard deviations during the decade 1969-78 are given in Table 1. From this it can be seen that the distribution of the annual rainfall is markedly seasonal, with 80% of the annual total falling in the two wet seasons: November-December and March-April. Variability from year to year is very high. The unreliability of the rainfall is one of the main drawbacks of the region from the point of view of agriculture.

Table 1.
Mean monthly rainfall and standard deviations at Masalani for the period 1969-78

	Means (mm)	Standard deviations
January	23.2	16.7
February	20.5	19.3
March	65.9	68.5
April	105.5	76.0
May	24.9	29.2
June	2.3	2.6
July	0.8	1.4
August	3.7	5.6
September	6.4	11.1
October	14.3	15.7
November	143.4	64.5
December	78.9	54.0
Annual total	489.7	135.4

At Dwa (G.R. CH 9035) 14.5 km to the SW of Masalani daily rainfall records have been kept for over sixty years. This allows a more accurate statistical analysis of the data to be made. The rainfall is greater at Dwa (633mm per year, as against 490 mm at Bushwhackers) but the overall pattern is similar. Fig. 1 shows the annual rainfall at Dwa for the period 1919-78. It can be seen that the rainfall is extremely variable in amount and erratic in occurrence. At Dwa there are on average 52.4 raindays each year, compared with 46.9 at Bushwhackers. Table 2 shows the frequency of various amounts of rain per day. From this it can be seen that on most occasions

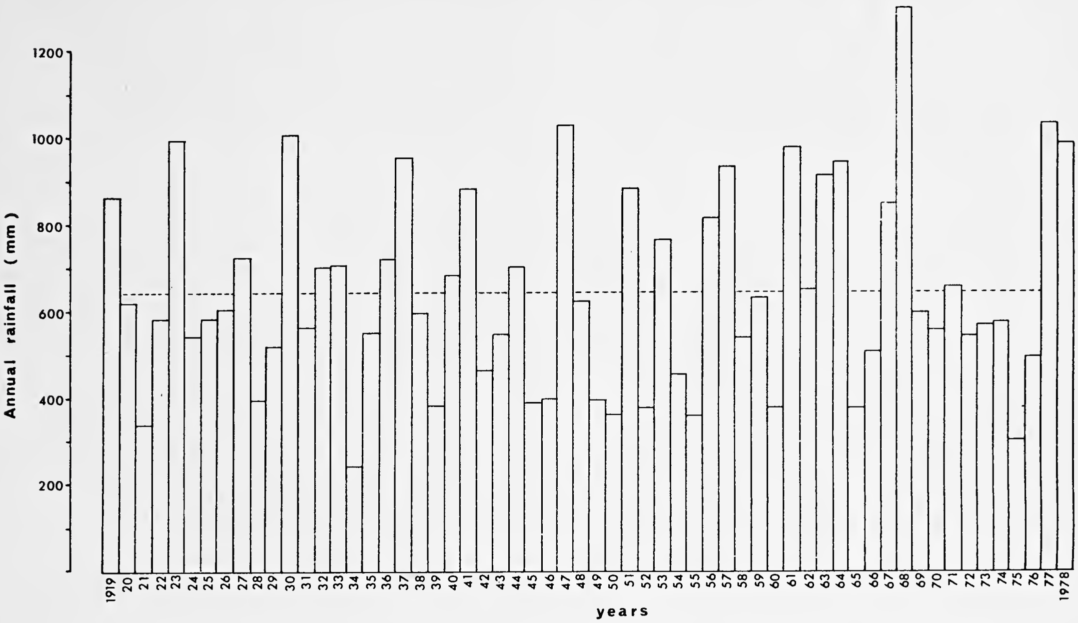

Fig. 1 Annual rainfall at Dwa. Kibwezi, from 1919 to 1978. The dashed line represents the mean.

Table 2.
The frequency of occurrence of various amounts of rain per day, and the percentage of total rain in the various size-categories of rainday.

Size-category of rainday	% raindays in each category	% total rainfall in each category
0 – 2.5	31.7	3.4
2.5 – 5	15.6	4.9
5 – 10	17.0	10.2
10 – 20	16.2	19.3
20 – 40	12.4	28.0
40 – 80	6.1	25.9
80 – 160	1.0	8.3

that it rains only light showers occur. For example, on 64% of raindays less than 10mm is received. Nevertheless, most of the annual rain falls as heavy showers on a few raindays. On average, more than a third of it falls during only four days each year.

The effectiveness of the rainfall is much reduced by the high evaporation rate which results from the high temperatures which occur throughout the year. Maximum and minimum temperatures have been recorded daily at Dwa for the years 1975-78. The mean maximum and minimum daily temperatures for each month show an annual cycle which closely parallels that of the rainfall. Temperatures are high in the wet season, and low in the dry season. Mean daily maxima range from 39.8°C in March to 31.7°C in August; mean daily minima range from 18.7°C in March to 13.4°C in August. The diurnal fluctuations at all times of year are greater than the seasonal ones. Unlike the rainfall, there is very little variation in the temperature cycle from year to year.

These data indicate that the vegetation in this region needs to be adapted primarily to cope with large erratic fluctuations in rainfall. An ability to withstand or avoid unpredictable drought would also be a requirement of any crop plant grown in the area.

THE SOILS

The soils of this area are developed from the underlying pre-Cambrian metamorphic rocks of the basement complex which is found throughout most of East Africa. The topography of the area consists of extensive flat ridges with occasional gentle slopes. A catena is formed in which the broad flat areas (which represent an old peneplain) have yellow-brown soils which are the oldest and most weathered of the series. On the gently sloping areas the soils are younger and redder in colour. At the foot of the slopes are small areas of colluvium which consist of sandy material carried downhill by gravity. Observation of erosion gulleys shows that the soils are several metres in depth. Certainly they are 'agriculturally deep'.

A typical profile both on the plains and on the slopes shows the top 50 cm or so to have the consistency of a sandy loam. The sand is derived from the weathering of the gneiss. Below this depth the clay content gradually increases, and the soil type grades from a clayey loam to a clay subsoil. This profile may well provide a favourable situation for supplying water to plants, as the rainwater would readily penetrate the upper sandy layers, and then be retained in the clay below.

From an agricultural point of view the soils are of intermediate quality. They are well drained. pH's of 6.8 and 6.6 were recorded at 10 cm and 50 cm respectively (D.E. Pomeroy, *pers. comm.).* Organic matter is low, in the region of 1-2%, probably due to low production and a high rate of decomposition. Because the soils are old and much weathered they are generally poor in nutrients, especially nitrogen and phosphorus. This is shown by the crop response obtained when extra nitrogen and phosphorus is applied along with irrigation by local farmers. Potassium, however, is probably less limiting, as it is derived from the felspars and micas of the parent rocks.

Overall, the agricultural potential of the area is limited firstly by the lack of water, and secondly, the lack of nutrients. Where these two deficiencies can be remedied yields are high, at least initially, because of the good soil texture and constantly high temperatures. In one successful local enterprise, where a simple irrigation system has been devised and fertilizer added in the form of cow dung, a wide range of high quality crops is produced.

THE VEGETATION

The natural vegetation of the area consists largely of deciduous 'woodland thicket' as defined by Pratt & Gwynne (1977). However, it is by no means uniform. Patches of 'bush woodland' and 'bush thicket' occur, possibly indicating formerly disturbed sites which have not yet fully reverted to the climatic climax. In the least disturbed areas the vegetation consists of three strata of woody plants:

(a) Below 3 m, a thicket layer of dense, much-branched shrubs occurs, in which *Combretum exalatum* Engl., *Grewia bicolor* Juss., *G.villosa* Willd., *Commiphora boiviniana* Engl., *Acacia mellifera* (Vahl) Benth., *A.senegal* (L.) Willd. and *Boscia coriacea* Pax are the most common species. The *Acacias* bear hooked thorns which contribute much to the impenetrable nature of the scrub. It is possible that when the large herbivores were present the thicket was less dense than it is now.

(b) Between 3 and 10 m a number of tree species rise above the thicket layer and form an open canopy in which the following species are common: *Commiphora africana* (A. Rich.) Engl., *C. baluensis* Engl., *Cassia abbreviata* Oliv., *Melia volkensii* Guerke, *Sterculia rhynchocarpa* K. Schum.

(c) Above 10m there exists a very sparse stratum of scattered emergent trees. Most of them belong to four species, namely, *Adansonia digitata* L., *Acacia tortilis* (Forsk.) Hayne, *Delonix elata (L.)* Gamble and *Terminalia pruinoides* Laws. The *Adansonia* is visually the most prominent tree, with large specimens forming a dominant feature of the landscape. However, they are relatively 'rare' in terms of cover.

Climbing plants form a notable feature of the vegetation. These are mainly herbaceous or semi-woody lianes which scramble over the shrubs of the thicket layer. Common examples are

Thunbergia guerkeana Lindau, *Kedrostis gijef* (J.F. Gmel.) C. Jeffrey, *Momordica rostrata* A. Zimm., *Dalechampia ipomoeifolia* Benth., *Tryphostemma hanningtonianum* Masters, *Cayratia ibuensis* (Hook.F.) Suesseng. and *Cyphostemma nierense* (Th.Fr.jr.) Desc. Only two species, namely, *Cissus quadrangularis* L. and *C.rotundifolia* (Forsk.)Vahl regularly climb into the tree stratum.

Where the scrub is dense the herb layer is sparsely represented. However, in areas of more open woodland a rich herb community is present. Except in disturbed sites the herb layer consists mainly of perennials, in which the Acanthaceae, Labiatae, Verbenaceae, Malvaceae and Gramineae are well represented. Two coarse perennial grasses are especially common in the more open sites: *Enteropogon macrostachyus* (A.Rich.) Benth. and *Chloris roxburghiana* Schult.

Because of the impenetrable nature of much of the vegetation it is difficult to make measurements or even estimates of the relative areas covered by each species. Although there are numerous footpaths through the bush, a quantitative survey of the species on the edges of the paths would give misleading results because of the selective removal of easily accessible specimens of certain species by local people. Therefore it was decided to sample the vegetation by means of two 50 m transects avoiding pathway effects as far as possible. This was done by laying down two parallel measuring tapes 1 m apart. Within this 1 m band the height, trunk diameter and canopy length of each individual tree and shrub were measured. The heights of the taller trees were estimated by comparing them with a 5 m pole held beside them and viewed from a distance. From these data two profile diagrams of the vegetation were constructed in which the individual trees and shrubs are drawn to scale. See Figs. 2 and 3.

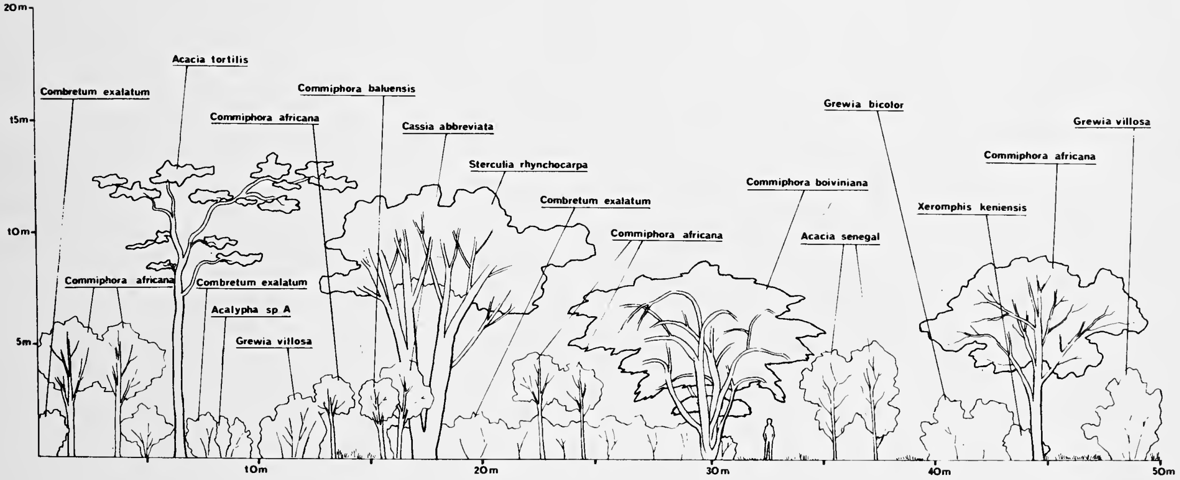

Fig. 2 Transect I.

The site of Transect I was chosen because it appeared to have been undisturbed at least for several decades. It contains a number of well-grown trees and a wide variety of species in the thicket layer. A notable feature is the number of young *Commiphora africana* trees. The position of Transect II was chosen to include a Baobab tree. Although the site appeared to be undisturbed, the profile diagram shows that none of the trees (with the exception of the Baobab) is more than 8 m high, with the mean height considerably less. The vegetation as a whole is also much less dense than that in Transect I. It seems likely therefore that the second site had been cleared (perhaps ten or twelve years ago), leaving the Baobab tree standing, as is the custom. Alternatively, it is possible that competition from the Baobab tree reduces the density of the surrounding vegetation.

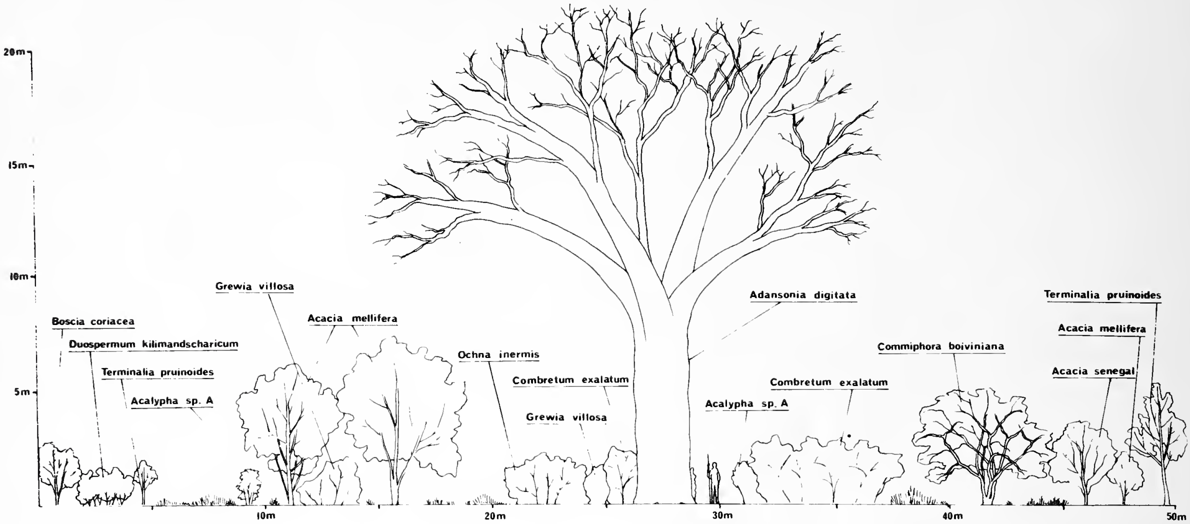

Fig. 3 Transect II.

It is possible to make a rough estimate of the relative cover of each species from the lengths of their canopies along the two transects. If the total contributions of each species along the two transects are added up, the order of abundance shown in Table 3 is obtained.

Table 3.
Total lengths (m) of canopies of all species recorded along two 50 m transects.

Combretum exalatum	25.7
Commiphora africana	24.1
Adansonia digitata	22.0
Commiphora boiviniana	18.6
Grass and herbs	14.8
Sterculia rhynchocarpa	13.2
Acacia mellifera	11.2
Grewia villosa	10.1
Acacia tortilis	10.0
Acacia senegal	8.7
Terminalia pruinoides	4.5
Grewia bicolor	3.8
Ochna inermis	3.7
Duosperma kilimandscharica	3.2
Cassia abbreviata	3.1
Commiphora baluensis	2.5
Acalypha sp A	2.1
Boscia coriacea	2.0
Xeromphis keniensis	1.3

If a large number of transect samples were made at random, the relative lengths covered by each species would reflect their percentage cover. The relative contribution of each species as derived from the data here very closely match estimates made simply by inspection, except with regard to two species: *Adansonia digitata* is here over-represented; and *Commiphora campestris*, a very common species, does not, by chance, occur at all in either of the transects. Clearly the sample taken is much too small to have any statistical validity. But as a brief preliminary survey it does provide a reasonable general impression of the structure and species composition of the vegetation.

PHENOLOGY OF THE WOODY SPECIES

The type of food available to insects, birds and herbivorous mammals varies throughout the year according to the phenological cycles of the plants. Each species has its own cycle of leafing, flowering and fruiting. A record of this was kept for thirty of the common woody species for 16 months, observations being made at about six week intervals from February 1978 to May 1979. The results of this survey are given in Fig. 4.

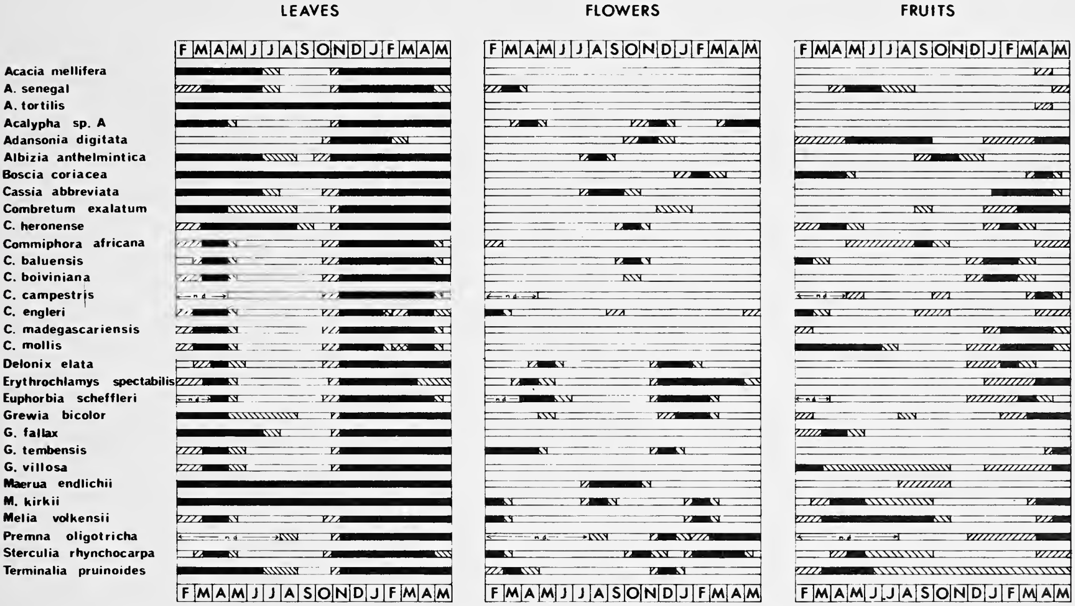

Fig. 4 Phenology of thirty woody species during the sixteen months starting February 1978.

The majority of species lose their leaves in the long dry season. All the *Commiphoras* are leafless by mid-May, but most of the other deciduous species retain their leaves for about a month longer. *Combretum exalatum* and *Grewia bicolor* roll their leaves and retain them for some months into the dry season but by September they are leafless. *Adansonia digitata* was exceptional in holding its leaves for only four months of the year (mid-October to mid-February). This early shedding of the leaves in this species is remarkable considering that March and April are among the wettest months of the year. An account of the water relations of this species is given in Fenner (1980). Only three common species of the dry bush are evergreen: *Boscia coriacea* Pax, *Maerua endlichii* Gilg & Ben. and *M.kirkii* (Oliv.) F. White. Most individuals of *Acacia tortilis* also remain green during the long dry season, though a minority of specimens appeared to be deciduous.

It is probable that leaf-fall is facultative in many species. It is noticeable for instance that at Dwa (which has a higher rainfall) the Baobabs retain their leaves for about a month longer than at Masalani; and Baobabs at the coast for longer still. In wetter seasons too the leaves of many species are retained for longer periods. For instance, it is interesting to compare the leafing of the 23 deciduous species recorded in February 1978 with their leafing in February 1979. In the January-February dry season of 1978 the rainfall was 1.9 times the ten-year mean; eight deciduous species retained their leaves. In the same period in 1979 the rainfall was 6.4 times the mean; twenty of these species retained their leaves.

Although leaf loss is thought to be primarily a mechanism for reducing water loss, measurements on the water loss of shoots of evergreen and deciduous species in the dry season show that the rate of loss is very low in both types of plant. Even towards the end of the long dry season, field water deficits are slight (Fenner 1981).

Near the river at Masalani many species are evergreen; e.g. *Newtonia hildebrandtii* (Vatke) Torre, *Lawsonia inermis* L. and *Salvadora persica* L. In the dry season the green strip of riverine vegetation contrasts sharply with the grey woodland on either side.

A notable feature of this vegetation is the number of species which bear their flowers towards the end of the long dry season, sometimes on bare branches and often before any appreciable amount of rain has fallen. It may be that a critical water deficit is attained which provides the trigger for flowering. The following species show this behaviour: *Sterculia rhynchocarpa, Cassia abbreviata* Oliv., *Albizia anthelmintica* Brongn., *Adansonia digitata, Combretum heronense* Schinz and *Commiphora baluensis*. A number of species flowered twice in one year; namely, *Maerua kirkii, Delonix elata, Grewia tembensis* Fres., *Sterculia rhynchocarpa* and *Euphorbia scheffleri* Pax.

There is a great deal of variability between individuals with respect to the incidence of flowering. Occasional specimens may be in full bloom, while the majority of individuals of the same species are without flowers. If flowering takes place in response to some environmental cue one would expect all the individuals of a species to respond simultaneously. Seven out of the thirty species recorded were not observed in flower during the sixteen month period of observations. The pattern of flowering seems to be rather erratic. For instance, of the twelve species which flowered during the period February to May in either of the two years recorded, only four behaved similarly in both years.

Fruiting also varied a great deal, both between individuals and from year to year. In some cases the species are dioecious, so fruit would only be expected on the female plants. But even in monoecious plants isolated individuals are often laden with fruit while the majority of the same species have none. *Combretum exalatum* was notable in this respect. A wide range of fruits is available throughout the year, a factor which may favour the rich bird life.

It is interesting to note that closely related species here tend to have similar phenological cycles. For instance, the seven species of *Commiphora* recorded do not show any well defined differences with respect to times of flowering, fruiting and leafing. Much the same applies to the four species of *Grewia*. Closely related species living in the same area might be expected on theoretical grounds to show phenological differences reflecting the evolution of separate niches.

ECOLOGICAL SUCCESSION

One of the consequences of the recent influx of subsistence farmers into the Masalani area is that the vegetation has come to consist of a mosaic of patches of various ages. The plots which are cleared are mostly less than five hectares and are usually abandoned after one or two growing seasons. Pomeroy & Muringo (1980) estimate that about 40% of the area at Masalani has been cleared at some time, and that within the disturbed areas just over half is at present under cultivation. The remainder has been colonised by ruderals and regenerating bush. All stages of secondary succession are represented locally, but it is often difficult to find out exactly when a particular patch was abandoned, and so its place in the sequence has to be inferred from the quantity of woody vegetation present.

A large number of quick-growing, short-lived pioneer species colonise the newly abandoned plots. In the very early stages four species are especially abundant, namely, *Digera muricata* (L.) Mart., *Brachiaria serrifolia* (Hochst.) Stapf, *Ipomoea obscura* (L.) Ker-Gawl and *Tridax procumbens L.* Often one or other of these is dominant for most of the first season. These early colonisers probably play a crucial role in preventing soil erosion because they provide a closed cover of vegetation on bare soil in a very short time.

Two early successional stages were examined. One area had been abandoned about one year previously; the other, about three years. In both areas, two 10m x 10 m quadrats were sampled. In the younger sere, the vegetation consisted of a dense mass of herbaceous species, *c.* 1 m high, dominated by *Digera muricata*. In the older sere, the species composition was more diverse, and many of the common woody species had appeared, e.g., *Grewia bicolor, G.villosa* and *Combretum exalatum*. No detailed description of the succession is given here, but the species found in these early and intermediate seral stages are listed in Table 4. It is interesting to note in passing that a

Table 4

Species recorded in early successional stages on cultivated plots abandoned approximately one year previously (a), and three years previously (b).

Species	Family	Stage
Acacia mellifera (Vahl) Benth.	Mimosaceae	a
Acalypha ciliata Forsk.	Euphorbiaceae	a & b
Acanthospermum hispidum DC.	Compositae	a
Aristida adscensionis L.	Gramineae	a & b
Asparagus flagellaris (Kunth) Bak.	Liliaceae	a
Astripomoea hyoscyamoides (Vatke) Verdc.	Convolvulaceae	a
Bidens pilosa L.	Compositae	a
Boerhavia coccinea Mill	Nyctaginaceae	a & b
Brachiaria deflexa (Schumach.) Robyns	Gramineae	b
B. serrifolia (Hochst.) Stapf.	Gramineae	a & b
Cassia kirkii Oliv.	Caesalpiniaceae	a & b
Cayratia ibuensis (Hook. f.) Suesseng.	Vitaceae	a & b
Chloris roxburghiana Schult.	Gramineae	b
C. virgata Sw.	Gramineae	a
Combretum exalatum Engl.	Combretaceae	a & b
Commelina benghalensis L.	Commelinaceae	a & b
Dactyloctenium aegyptium (L.) Willd	Gramineae	a
Digera muricata (L.) Mart.	Amaranthaceae	a & b.
Digitaria velutina (Forsk.) Beauv.	Gramineae	b
Enteropogon macrostachyus (A. Rich.) Benth.	Gramineae	a & b
Eragrostis cilianensis (All.) Lutati	Gramineae	a & b
Evolvulus alsinoides L.	Convolvulaceae	a
Glycine javanica L.	Papilionaceae	b
Grewia bicolor Juss.	Tiliaceae	a & b
G. villosa Willd.	Tiliaceae	b
Gynandropis gynandra (L.) Brig.	Capparaceae	a
Hibiscus micranthus L.f.	Malvaceae	b
Indigofera brachynema Gillet	Papilionaceae	a
Ipomoea obscura (L.) Ker-Gawl	Convolvulaceae	a & b
Ocimum basilicum L.	Labiatae	a
Pavonia elegans Boiss	Malvaceae	a & b
P. patens (Andr.) Chiov.	Malvaceae	b
Pergularia daemia (Forsk.) Chiov.	Asclepiadaceae	a
Phyllanthus sp.	Euphorbiaceae	a
Premna oligotricha Bak.	Verbenaceae	a & b
Pupalia lappacea Juss.	Amaranthaceae	a & b
Sclerocarpus africanus Jacq.	Compositae	a & b
Sida ovata Forsk.	Malvaceae	a
Solanum incanum L.	Solanaceae	a & b

TABLE 4 CONTINUED

Species	Family	Stage
Spermacoce sphaerostigma (A. Rich.) Vatke	Rubiaceae	a & b
Tetrapogon tenellus (Roxb.) Chiov.	Gramineae	a & b
Tephrosia villosa (L.) Pers.	Papilionaceae	a
Thunbergia guerkeana Lindau	Acanthaceae	a
Triumfetta annua L.	Tiliaceae	a
Tryphostemma hanningtonianum Masters	Passifloraceae	a & b

high proportion of the herbaceous species in the disturbed areas have burred fruits for animal dispersal (e.g., *Puppalia lappacea* Juss., *Acanthospermum hispidum DC*. and *Tragus berteronianus* Schult.).

POTENTIAL USE OF THE SITE

The potential value of this area for agriculture is severely limited by the fact there are only two months at a time which have a mean rainfall of more than 50 mm; and by the unpredictability of the rainfall generally. Even during the growing seasons, droughts occur in most years. This pattern of rainfall makes the growing of short-lived, water-demanding crops like maize, economicaly impractical without irrigation. The provision of irrigation on a large scale would involve huge capital resources and expensive maintenance. At least in the short term it might be best to recognise the climatic limitations of the area, and encourage the development of techniques which would maintain the integrity of the habitat. For instance, strictly controlled browzing of the existing vegetation by livestock may prove to be more cost effective and of more immediate benefit to the small farmer than a more ambitious (and possibly destructive) project. This area would be ideal for pilot projects in the new techniques of 'agro-forestry' in which agriculture is combined with the maintenance of a modified natural canopy.

As for ecological studies, the site has many excellent features. The fact that the large mammals have been eliminated, though regrettable in itself, does have the advantage that one can work in the area without danger. The degree of disturbance to which much of the vegetation has been subjected has resulted in great floristic diversity, and this is probably correlated with a high insect diversity too. A detailed study of the seral stages would be of interest. Adaptations by the plants to their environment could be made. For instance, many of the trees have a green layer just below the outer skin of the bark. Do they use this to photosynthesise during the dry season? What controls the flowering in those species in which only scattered individuals flower at any one time? A particularly intriguing problem is the apparent lack of regeneration of the Baobab trees. A study of the factors controlling their seed germination and establishment in the field could be undertaken. Little is known about the processes in which plants and animals interact, such as pollination, seed dispersal and seasonal changes of diet in the birds. Studies comparing the primary productivity of the natural vegetation with local agricultural ecosystems would be of especial intererest.

A complete list of the species growing in the Masalani area has not yet been compiled. A thorough taxonomic survey of the area needs to be done. The author has compiled a preliminary list which has been deposited in the Kenya Herbarium, Nairobi. This list may form the nucleus for a more comprehensive one in the future.

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