

The woody vegetation communities of the Hluhluwe-Corridor-Umfolozi Game Reserve Complex

A. WHATELEY* and R. N. PORTER*

ABSTRACT

Land units for the 900 km² Hluhluwe-Corridor-Umfolozi Game Reserve Complex in north eastern Natal were identified on aerial photographs. The physiognomy, dominants and description of the woody vegetation for each unit were identified during ground inspections and, where necessary, the point-centred quarter method was applied. Two forest, two riverine forest, ten woodland and two thicket communities were recognized. These communities are described according to their distribution, height and percentage frequency of the components in the different canopy strata. A map at a scale of 1:25 000 was also compiled. Some of these communities are compared with other similar woodlands previously described for Natal. In some communities the frequency of certain dominant canopy species in the under tree strata was extremely low and autecological research has been suggested.

RÉSUMÉ

LES FORMATIONS VÉGÉTALES LIGNEUSES DES RESERVES DE FAUNE DE HLUHLUWE ET UMFOLOZI ET DE LA ZONE INTERMÉDIAIRE

L'interprétation des photographies aériennes des 900 km² des Réserves de faune de Hluhluwe et Umfolozi et de la zone intermédiaire dans le nord-est du Natal a permis de délimiter un certain nombre de formations végétales. La physiognomie, les espèces dominantes et la description de la végétation ligneuse pour chaque formation ont été établies au cours de prospections de terrain, et lorsque cela se justifiait, la méthode 'point-centred quarter' a été appliquée. Deux types de forêts, deux types de forêts riveraines, dix types de forêts claires et deux types de fourrés ont été reconnus. Ces formations sont décrites suivant leur répartition, la hauteur et la fréquence exprimée en pourcentage des composantes des différentes strates de la voûte. Une carte à l'échelle de 1:25 000 a également été établie. Certaines de ces formations sont comparées avec d'autres forêts claires similaires décrites antérieurement au Natal. Dans certaines formations, la fréquence de certaines espèces dominantes de la voûte dans la strate arbustive était extrêmement faible et une recherche autécologique a été préconisée.

INTRODUCTION

The Hluhluwe-Corridor-Umfolozi Game Reserve Complex is a 900 km² area in central Zululand (28°00'S and 28°26'S; 31°43'E and 32°09'E) and comprises the Hluhluwe Game Reserve (225 km²) in the north, the Umfolozi Game Reserve (447 km²) in the south and an intervening area of state land referred to as the Corridor (227 km²). The whole area, bounded by a game proof fence, is surrounded by KwaZulu where population densities are high and peasant agriculture is extensive (Fig. 1).

The Game Reserve Complex occupies the foothills of the first escarpment on the western side of the Zululand coastal plain. The terrain is broken by numerous hills and valleys and ranges in altitude from 60-750 m above sea level. Part of the catchment areas of four large river systems occur in the Complex: the Hluhluwe River with its two major tributaries, the Manzibomvu and Nzimane Rivers in the north, the Nyalazi River to the south and further south, the Black and White Mfolozi Rivers.

By far the largest area is covered by shales and sandstones of the Volksrust, Vryheid and Pietermaritzburg formations (Ecca series). Dolerite sills have intruded and are particularly extensive in the Corridor and Umfolozi Reserve. On the western boundary of the Corridor and Hluhluwe Reserve areas of dwyka tillite, table mountain sandstone and granite are found. The eastern part of Hluhluwe

Reserve is covered mainly by shales and sandstones belonging to the Beaufort series and a small area of basalt lava is also present.

Swartland and Sterkspruit are the main soil forms associated with the Ecca areas, whereas extensive areas of Shortlands as well as Milkwood and Bonheim series are found on dolerite areas. Shallow Mispah soils also occur extensively.

Rain falls mainly between October and March. Hluhluwe Game Reserve has a greater mean annual rainfall (990 mm, n = 47) than Umfolozi Reserve (720 mm, n = 20) and the coefficient of variation for the two stations is 27,4% (n = 24) and 25,2% (n = 20) respectively. Temperatures are warm to hot, particularly during summer months. Very occasional frosts have been recorded in some river valleys.

The Game Reserve Complex lies within two veld types as described by Acocks (1953). Most of the area lies within the Lowveld subcategory of the Tropical Bush and Savanna Types and the remainder is Zululand Thornveld, a subcategory of the Coastal Tropical Forest Types. These areas correspond with bioclimatic subregions 9 and 10 as described by Phillips (1973).

Archaeological evidence indicates that man has occupied these areas more or less continuously for the last half million years (Penner, 1970). Both the vegetation and fauna were modified by Iron Age inhabitants. Following the thinning of woody plant cover for cultivation and fuel needs, fire was an important factor in maintaining the open nature of the vegetation that existed at the time of proclamation of the two game reserves in 1895 (Hall, 1979;

* Natal Parks, Game and Fish Preservation Board, P. O. Box 662, Pietermaritzburg 3200, South Africa.

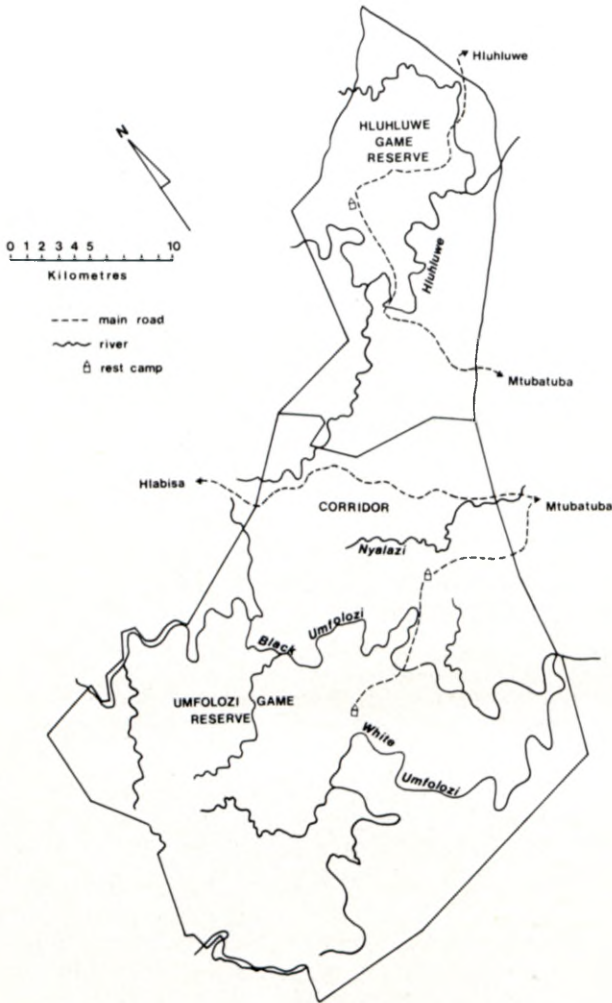


FIG. 1.—Hluhluwe-Corridor-Umfolozi Game Reserve Complex.

Feely, 1978). The fire history of this area has been the subject of a detailed investigation (Berry & Macdonald, 1979) and a widely held opinion is that the woodlands of the Game Reserve Complex are 'derived' as a result of the actions of man and/or fire. Other impacts on the vegetation occurred during the anti-nagana campaign (1942–1946) when certain specific areas were bush cleared (Mentis, 1970). The largest was a 3.2 km wide strip along the western boundary of Umfolozi Game Reserve between the White and Black Mfolozi Rivers. A large variety of animal species are found in the area (Bourquin *et al.*, 1971), including large herbivores.

METHODS

The vegetation of Hluhluwe Game Reserve was first mapped by Henkel (1937) at a scale of 1: 31 680. Subsequently, both Ward (1961) and Downing (1972) compiled preliminary physiognomic maps. The vegetation of Umfolozi Game Reserve was first classified and mapped by Downing (1972) at a scale of 1:50 000. A more detailed map of the woody vegetation communities occurring in the entire Game Reserve Complex was required. It was intended that the map should be used as an aid in management planning and would also be useful for other biological research projects. We aimed to

compile a map at a scale of 1: 25 000 of the woody plant communities occurring in the Game Reserve Complex. Accompanying the map would be a description of the various communities that were recognized.

The various landscape units were first identified on aerial photographs. Field work was extensive in order to fix the boundaries of the various plant communities. Point centred quarter transects were set up and located within representative examples of each community. Recording points were 20 paces apart in the forest and woodland communities, but 10 paces separated these positions in the thicket communities. At each recording point the nearest woody plants in two height classes growing in each quarter segment were identified and recorded. Woody plants greater than 2 m in height and plants between 0.3 m and 2 m in height were recorded separately for each plant community except for the forest communities, where plants were recorded according to their canopy strata.

RESULTS

The physiognomy of the vegetation in this part of Zululand can be variously described as forest, savanna woodland, savanna (various types) and thicket (Anon., 1956) or as woodland, wooded grassland, bushland thicket and induced types (Pratt *et al.*, 1966; Greenway, 1973). An alternative classification of Phillips (1973) would give the following physiognomic types: forest, woodland, open woodland, thicket and grassland. The classification of Phillips (*l.c.*) was adopted for this study with one modification: an induced thicket category as described by Pratt *et al.* (1966) was included.

Two forest, two riverine forest, ten woodland, one thicket and one induced thicket communities were recognized as being present in the Game Reserve Complex. These different communities are described below and in Tables 1–5. Percentage cover and canopy heights for the different woodland communities are given in Table 5.

Celtis africana – *Harpephyllum caffrum* Forest

This forest is found on the high hills in the north-western part of Hluhluwe Game Reserve, where it covers extensive areas on south-facing hill slopes (Fig. 2). These hills are steep-sided, incised by many dry, rocky water courses and rise to 570 m above sea level. Relic patches of forest are also found at a few isolated, small localities in the Corridor state land, but do not occur south of the Black Mfolozi River. This forest provides a suitable habitat for many different fauna species of tropical origin.

Three distinct canopy strata are readily distinguishable (Tables 1 & 2). The upper canopy reaches an average height of 15 m with a ceiling height of 9–12 m. The mid canopy has an average height of 7 m with an average ceiling height of 4 m. The under stratum consists of plants usually less than 2 m in height. *Ficus natalensis* and *Harpephyllum caffrum* are the largest trees in the forest with the former species being associated with drainage courses. The

TABLE 1. — Species with a recorded frequency of greater than 5% for the forest and riverine forest communities

SPECIES	FOREST						RIVERINE FOREST			
	Celtis africana – Harpephyllum caffrum			Celtis africana – Euclea schimperi			Ficus sycamorus – Schotia brachypetala		Spirostachys africana – Euclea schimperi	
	Upper	Middle	Lower	Upper	Middle	Lower	>2m	0,1–2m	>2m	0,1–2m
<i>Acacia robusta</i>				+	–	–	6,7	8,4	3,0	1,3
<i>Acalypha glabrata</i>	–	6,8	11,6	–	5,6	23,2	7,2	23,8	2,9	4,9
<i>Azima tetraacantha</i>							+	5,4		
<i>Bequaertiodendron natalense</i>	–	15,8	11,8							
<i>Berchemia zeyheri</i>	+	–	–	22,1	3,3	–			+	+
<i>Bersama lucens</i>	–	+	6,2	–	1,2	1,6				
<i>Calpurnia aurea</i>	+	6,0	11,3	–	7,7	3,6				
<i>Cassine aethiopica</i>	1,4	+	–	9,9	3,1	–	+	+	2,5	+
<i>Celtis africana</i>	20,4	3,4	2,3	8,9	2,3	3,9				
<i>Chaetacme aristata</i>	5,1	3,2	+	+	1,8	2,7			+	–
<i>Cola natalensis</i>	–	4,9	11,6	–	5,0	5,0				
<i>Combretum kraussii</i>	11,0	+	+	–	+	1,5				
<i>Commiphora harveyi</i>	+	–	+	11,3	+	1,2	–	–	+	+
<i>Croton menyharti</i>							–	2,3	+	8,4
<i>C. silvaticus</i>	4,4	2,3	5,5	–	+	+				
<i>Diospyros glandulifera</i>					1,6	7,2	–	2,3	3,7	3,0
<i>D. simii</i>				–	–	5,0	–	+	–	+
<i>Ehretia rigida</i>	–	+	+	–	1,2	5,6	–	1,2	+	8,5
<i>Erythroxylum emarginatum</i>	–	10,7	6,7	–	3,8	1,8	+	+		
<i>Euclea natalensis</i>	+	+	5,9	+	+	3,3	–	1,2		
<i>E. schimperi</i>	–	–	+	22,6	14,6	10,0	2,8	8,9	10,5	16,7
<i>Maytenus heterophylla</i>	+	8,2	1,3	+	10,3	2,5	1,8	+	17,5	1,5
<i>Olea africana</i>							+	–	9,5	3,0
<i>O. capensis</i>	10,4	2,0	–	–	3,8	+				
<i>Phoenix reclinata</i>							5,4	4,9		
<i>Plectroniella armata</i>				+	+	–	5,7	3,5	3,6	1,8
<i>Schotia brachypetala</i>				7,0	+	+	9,6	–	4,8	–
<i>Spirostachys africana</i>				1,6	+	+	9,3	4,9	13,7	12,1
<i>Strychnos decussata</i>	3,6	3,8	6,3	+	2,4	3,9	+	–		
<i>Teclea gerrardii</i>	6,6	3,1	+	–	1,5	1,2				
TOTAL	62,9	70,2	80,5	83,4	69,2	83,2	48,5	66,8	71,7	61,2
N.		912			742			392		580

forest is a mixed evergreen-deciduous community with major species such as *Celtis africana*, *Croton sylvaticus*, *Combretum kraussii* and others losing their leaves, whereas other species such as *Harpephyllum caffrum*, *Protorus longifolia*, *Ficus natalensis*, *Olea capensis*, *Albizia zuluensis* and others, remain evergreen. *Celtis africana* is the dominant species in the upper tree stratum and has a frequency of 20,4%. For the upper, middle and lower canopy strata some 43, 49 and 42 species were recorded respectively and for both the upper and middle strata only 5 species had a frequency of 5% or greater.

Some of the forest margin species do not occur in the interior of the forest. Trees and shrubs which appear to be exclusive to the forest margin are: *Ximenia caffra*, *Psychotria capensis*, *Dombeya burgessiae*, *Cussonia spicata*, *Canthium ventosum*, *Rhus pentheri* and *Diospyros dichrophylla*.

Lianas are abundant in the canopy. Some common species are *Dalbergia armata*, *D. obovata*,

Entada spicata, *Rhoicissus tomentosa*, *R. rhomboidea* and *Acacia ataxacantha*. Dense stands of *Isoglossa delicatula* are associated with those areas where the upper canopy strata are interrupted. Thicket patches of *Acalypha glabrata* and of *Calpurnia aurea* also occur. Cliffs and rocky outcrops with associated scree slopes occur in a number of localities within this forest community. Here *Strychnos decussata* and *Commiphora harveyi* are common associates. Growing on the forest floor are seedlings of various tree species, some fern species, the grass *Oplismenus hirtellus* and *Cyperus albostratus*.

Celtis africana–*Euclea schimperi* Forest

This forest covers fairly extensive areas in north and north eastern Hluhluwe Game Reserve between the 120 and 300 m contours (Fig. 2). Small relic patches are found in Umfolozi Game Reserve and in the Corridor. The community is mostly associated with the relatively moister south and south east hillsides.



FIG. 2.—Forest and riverine forest communities.

Three distinct canopy strata are distinguishable (Tables 1 & 2). The upper canopy reaches 9 m and has an average ceiling height of 6 m. The mid canopy has an average height of 6 m, but usually merges with the upper canopy. The ceiling height varies between 2 and 3 m above ground level and coincides with the canopy of the under stratum. *Euclea schimperi* and *Berchemia zeyheri* were found to be the most abundant species in the upper stratum with a percentage frequency of 22,1 respectively. For the upper, middle and lower canopy strata some 33, 61 and 40 species were recorded respectively and for the upper stratum only 6 species had a frequency of 5% or greater.

This mixed deciduous-evergreen forest community is closely allied to the *Celtis africana*–*Harpephyllum caffrum* Forest in terms of its general location, distribution and tree species present. However, it is a drier form of forest, being found at lower altitudes.

Ficus sycamorus – *Schotia brachypetala* Riverine Forest

This riverine forest is confined to the banks of the larger rivers and their major tributaries in the area where extensive, but narrow stands are to be found (Fig. 2.)

Three canopy strata are readily distinguishable (Tables 1 & 2). An upper canopy, often discontinuous, with a height varying between 15 and 20 m and having a ceiling height of between 6 and 10 m, is present. The mid canopy is between 8 and 10 m in height with an average ceiling height of 3,5 m. Often merging into the mid canopy is an under canopy varying in height between 3 and 4 m. The herbaceous layer consists of both stoloniferous and tufted grass species, shrubs and other woody plants. Because of its size, *Ficus sycamorus* is the most prominent tree, but *Schotia brachypetala* has the highest frequency of 9,6%. Some 59 and 48 species were recorded in height categories greater and less than 2 m respectively. This riverine forest community is well utilized by herbivores and is particularly important as a food source during the dry winter months.

Spirostachys africana – *Euclea schimperi* Riverine Forest

The *Spirostachys africana* – *Euclea schimperi* Riverine Forest community occurs throughout the area as a narrow strip along seasonal water courses throughout the whole game reserve complex (Fig. 2).

Three canopy strata are distinguishable (Tables 1 & 2). An upper canopy reaching a height up to 8 m with an average ceiling height of 3,5 m, is present. The mid canopy has an average height of 4,5 m and an average ceiling height of 2,3 m. Often merging into the mid canopy is an under canopy varying in height between 2 and 3 m.

The most frequent species greater than 2 m in height were *Spirostachys africana* at 13,7% and *Euclea schimperi* at 10,5%. Some 64 species were recorded for plants greater than 2 m in height and 53 species that were below the 2 m height were found.

The herbaceous layer consists mainly of tufted perennial grass species. Many small shrubs also occur.

Spirostachys africana Woodland

The *Spirostachys africana* Woodland covers extensive areas in all bottomland situations in the Umfolozi Game Reserve, particularly in the catchments of seasonal water courses. It is not found in the Corridor and has only a limited distribution in Hluhluwe Game Reserve, being found in riverine terraces along the Hluhluwe and Nzimane Rivers (Fig. 3).

Species composition is variable and this community probably consists of numerous different associations and no distinction has been made between them. However, a major difference is in the presence or absence of *Acacia grandicornuta*. This species is a common associate of this woodland in the Umfolozi Game Reserve, but is absent in Hluhluwe Reserve. *Spirostachys africana*, with a frequency of 27,2% in the upper tree stratum, and 21,5% in the under stratum, was found to be dominant (Table 3). A total of 32 plant species in the upper tree stratum and some 29 species less than 2,0 m in height were recorded, having a frequency of less than 5% (Table 4).

TABLE 2.—Species with recorded frequencies of less than 5% for the forest and riverine forest

SPECIES	FOREST						RIVERINE FOREST			
	Celtis africana — Harpephyllum caffrum			Celtis africana — Euclea schimperi			Ficus sycamorus — Schotia brachypetala		Spirostachys africana — Euclea schimperi	
	Upper	Middle	Lower	Upper	Middle	Lower	>2m	0,1–2m	>2m	0,1–2m
Acacia burkei							+	—		
A. grandicornuta							+	—		
A. karroo							—	0,5	0,2	—
A. nigrescens									0,7	—
A. nilotica							—	0,7	2,3	1,5
A. schweinfurthii							2,1	+		
Acalypha sonderiana	—	0,3	0,3	—	4,9	—			+	0,6
Acokanthera oppositifolia				—	+	—	—	+		
Albizia versicolor							+	—	+	—
A. suluensis	3,6	—	—						+	—
Allophylus natalensis										
Antidesma venosum							0,8	—		
Apodytes dimidiata	+	0,2	+							
Asparagus falcatus										
A. macowanii							—	+		2,7
A. saundersiae										1,7
A. setaceus										1,8
A. sp.										0,6
Austromimusops marginata	1,4	4,2	0,5	—	0,5	—				
Brachylaena ilicifolia									2,0	3,5
B. uniflora	1,1	—	—							
Bridelia micrantha	0,3	—	—				0,5	—		
Canthium ventosum	—	1,2	—	—	+	—			+	—
C. sp.							0,5	—		
Capparis sepiaria										0,2
Carissa macrocarpa	—	0,2	0,7							
Cassine transvaalensis									0,5	+
Clausena anisata	—	—	0,4	—	—	0,6			—	+
Clerodendrum glabrum	2,4	—	0,3	—	+	+				
Combretum molle				0,8	0,8	—	—	+	0,5	—
Commiphora woodii	0,5	—	+							
Cordia caffra	2,0	+	—	+	3,9	3,2			+	—
Cussonia spicata				0,6	+	—			+	—
C. zuluensis				+	+	—			0,3	—
C. sp.	—	+	—						0,7	—
Dalbergia armata									0,6	2,3
D. obovata							+	—	0,5	+
Dichrostachys cinerea							0,5	1,4	0,7	0,6
Dinocanthium hystrix									0,5	—
Diospyros lycioides	—	+	0,3	—	0,6	—	3,1	4,7		
D. natalensis	+	3,2	3,5	—	+	—				
D. whyteana									0,7	0,2
D. sp.							1,0	2,8		
Dombeya burgessiae	—	0,7	0,9	—	+	—				
D. cymosa				0,8	1,5	2,9	+	+	1,1	+
D. rotundifolia				+	0,4	—			0,7	—
Dovyalis caffra							+	+		
D. rhamnoides	—	0,6	0,9	—	+	0,7				
Drypetes arguta	1,3	4,6	+	—	+	—				
D. gerrardii	—	2,1	2,6							
Ekebergia capensis	0,7	0,2	+	+	0,4	—				
Erythrina lysistemon	+	—	—	0,6	+	—			+	—
Euclea divinorum							+	—	1,0	0,5
E. natalensis									0,2	0,8
E. undulata							—	0,9		
Eugenia natalitia	0,2	0,8	0,4						+	0,2
Euphorbia tirucalli							+	—	1,1	0,2
E. sp.	+	—	—							
Fagara capensis	0,2	0,2	+	+	+	+	+	0,5	0,2	—
F. davyi				—	—	+			—	+
Ficus capensis	+	—	—						+	—
F. natalensis	2,5	—	—	+	—	—				
F. sycamorus							3,4	—		
F. sp.							1,5	0,9		
Galpinia transvaalica	0,3	+	—	2,8	1,5	0,4	1,0	—	1,3	+
Gardenia amoena	—	0,5	0,7	—	+	—			0,3	1,0
Grewia caffra	—	—	0,8	—	+	1,0			—	0,2
G. sp.									—	0,2
Harpephyllum caffrum	4,3	0,3	—	1,0	+	—			0,2	—
Heteropyxis natalensis				+	—	—	1,3	—		
Hippobromus pauciflorus	—	+	—	+	+	1,6	+	0,9	+	1,0
Kraussia floribunda				—	—	0,7	0,8	1,4	0,2	1,0
Maerua rosmarinoides									0,2	—
Manilkara concolor							0,5	+		
M. discolor	1,9	0,2	—							
Maytenus senegalensis							1,3	2,6	0,2	0,2
Mimusops caffra				—	3,7	+	0,5	0,5	1,7	1,5
M. obovata	2,0	0,3	—	0,6	0,5	+	0,5	—	0,6	0,6
Nuxia floribunda									0,5	—
N. oppositifolia							3,1	1,9	0,2	—
Ochna arborea							—	+		
O. natalitia				—	1,9	1,9			0,5	1,7
Ozoroa engleri									0,2	—
Pappea capensis							3,1	—	0,8	—
Peltophorum africanum				+	—	—				
Phyllanthus reticulatus				+	0,7	—	+	0,5	+	+
Protorhus longifolia	3,0	—	—							
Psychotria capensis	—	+	—							
Ptaeroxylon obliquum	0,2	—	—							
Rawsonia lucida	—	0,2	0,8							
Ricinus communis							0,5	0,9		
Rhus chirendensis	1,8	0,3	+				3,6	0,7	0,2	1,0
R. natalensis							2,8	—		
R. pentheri	—	—	0,3	—	0,5	0,6	+	+	0,5	0,2
Rothmannia globosa	—	0,3	0,4	—	+	—				
Schotia capitata							2,1	0,5		
Sclerocarya caffra	0,3	—	—	0,8	—	—	0,8	+	0,2	—
Scolopia zeyheri	2,5	0,6	+	—	+	0,9			+	0,2
Sideroxylon inerme	—	+	—	2,8	0,9	—	2,3	0,9	1,5	0,2
Strychnos henningsii	1,5	1,5	2,0	—	0,4	—			—	+
S. madagascariensis									+	—
S. spinosa							+	—		
Syzygium cordatum							1,8	0,9		
S. guineense							0,5	—		
Tarchonanthus camphoratus				—	+	—	+	—		
Tecomaria capensis						1,0	—	0,7		
Thespesia acutiloba							0,5	—		
Trichilia emetica							0,8	—		
Trimeria grandifolia	0,4	1,2	0,3							
Turraea floribunda	—	1,0	—	—	+	—				
T. obtusifolia							+	—		
Urera tenax				—	—	+				
Vangueria infausta							+	—		
Xeromphis obovata				—	+	—	—	0,5	0,3	0,5
Ximena caffra									—	+
Ziziphus mucronata	—	+	—	1,0	+	—	1,8	2,1	0,7	—
Unknown	+	—	—	—	1,5	0,4	1,0	1,9	0,8	4,0

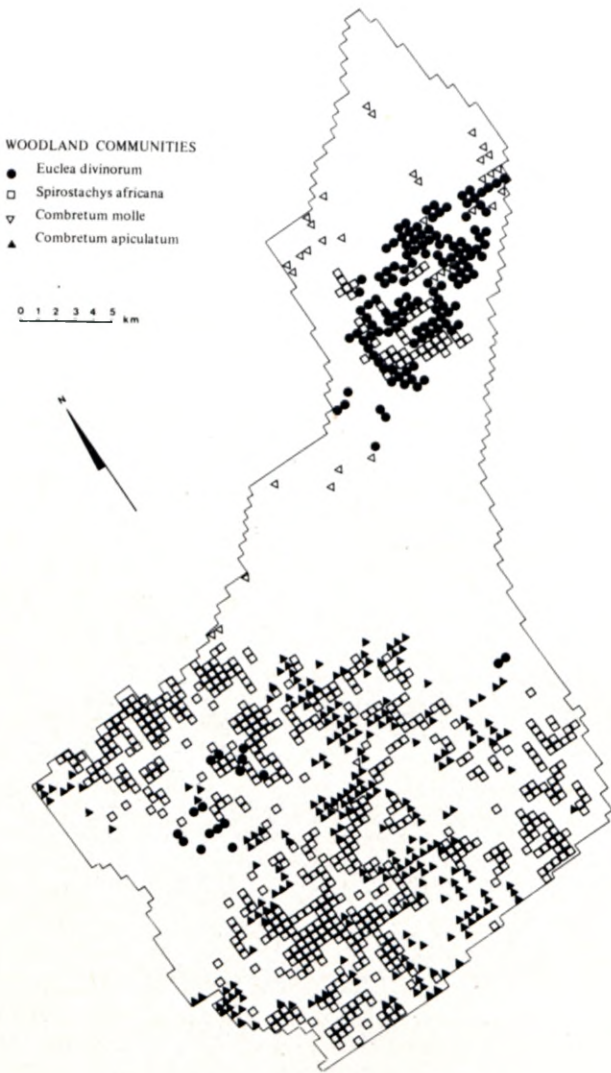


FIG. 3.—Woodland communities.

The herbaceous layer consists of a variable mixture of shrubs and grasses. Where tree canopy cover is dense, the grasses are stoloniferous, but where breaks in the tree canopy occur, various tufted perennial grasses are found.

Combretum apiculatum Woodland

Combretum apiculatum Woodland has a restricted distribution, occurring on rocky hillsides in Umfolozi Game Reserve (Fig. 3). Species composition is variable, probably depending on local edaphic and climatic differences. *Combretum apiculatum* is the dominant species and characterizes this community. In the upper tree stratum it has a percentage frequency of 24,0 (Table 3).

Some 31 species were recorded in the upper tree stratum and 48 species, being less than 2,0 m in height, having a frequency of less than 5% (Table 4).

This deciduous community of irregular shaped trees has a highly variable canopy cover due to variations in tree density. Where trees are clumped, the canopy cover lies between 50 and 75%, whereas the more usual situation is for trees to be well

separated and with a canopy cover between 10 and 25%. An under stratum of very widely separated plants of usually less than 2 m in height, is present.

A grass sward of medium to tall tufted perennial species is characteristic of the herbaceous layer. Fires penetrate this community and are often of high intensity.

Combretum molle Woodland

Combretum molle Woodland is an uncommon plant community in the area occurring mainly to the north of the Hluhluwe River. It occurs on steep, rocky hill slopes between 180 and 300 m a.s.l. (Fig. 3). The dominant woody species characterizing this community were found to be trees of *Combretum molle* with a frequency of 25,3% in the upper tree stratum and *Dombeya rotundifolia* with a frequency of 11,2% in the under stratum (Table 3). Another 21 species were recorded in the upper tree stratum and 24 species being less than 2,0 m in height, having a frequency of less than 5% (Table 4). As grass sward of short tufted perennial species is characteristic of the herbaceous layer. Fire penetrates this community on occasions, particularly in years of above average rainfall.

Euclea divinorum Woodland

Euclea divinorum Woodland covers extensive areas on gently sloping ground in the Hluhluwe River Valley, particularly below the 200 m contour (Fig. 3). It is scarce elsewhere.

The dominant species characterizing this community is *Euclea divinorum*, having a frequency of 40,5% in the upper tree stratum. In the under stratum *E. divinorum* and *Dichrostachys cinerea* have frequencies of 14,9% and 15,8% respectively (Table 3). Another 35 species were recorded in the upper tree stratum and 39 species being less than 2,0 m in height, having a frequency of less than 5% (Table 4).

Under tree canopies, the grass sward is mainly stoloniferous. Where there is a break in the canopy or it is less dense, tufted perennial grasses occur. Generally fires only rarely occur with penetration, being confined to marginal areas only.

The community is commonly found growing on marginalitic soils. Common soil series include Bonheim, Glengazi and Dumasi. Both sheet and gully erosion is a common feature in this community.

Acacia karroo Woodland

Acacia karroo Woodland is largely confined to river valleys in the north-eastern part of Hluhluwe Game Reserve (Fig. 4). It occurs on steep hillsides up to approximately 300 m above sea level.

Acacia karroo was found to be the dominant species characterizing the community, with a frequency of 60,4% in the upper and 15,2% in the under tree strata (Table 3).

Another 9 woody plant species were recorded in



FIG. 4.—*Acacia* woodland communities.

the upper stratum and 26 species that were less than 2,0 m in height, having a frequency of less than 5% (Table 4). A dense grass sward of tall, perennial species comprises the herbaceous layer.

Acacia nilotica Woodland

Acacia nilotica Woodland covers extensive areas of the Corridor and Hluhluwe Game Reserve, particularly south of the Hluhluwe River (Fig. 4). It is usually found below the 300 m contour.

The dominant species characterizing this community is *Acacia nilotica*, having a frequency of 60,9% and 25,4% in the upper and lower strata (Table 3). Another 27 species were recorded for the upper tree stratum and 36 species were less than 2,0 m in height, having a frequency of less than 5% (Table 4).

In certain areas termitaria with their associated vegetation are a common feature. Widely spaced, large, emergent, often grouped, trees of *Sclerocarya birrea* subsp. *caffra* are often a characteristic feature in this woodland.

A tall, dense sward of tufted perennial grasses comprises the herbaceous layer and therefore fires are often intense.

Acacia burkei Woodland

Acacia burkei Woodland is found at various localities throughout the area, except for the northern part of Hluhluwe Reserve. It covers extensive areas in western Hluhluwe Reserve where it occurs on both moderately steep hillsides and flat riverine terraces in the valley bottoms. In the Umfolozi Reserve this community is usually found on broad, flat ridges at lower altitudes (Fig. 4).

Acacia burkei with a frequency of 19,0% for the upper tree stratum, was found to be dominant. The most abundant woody plant in the under stratum was *Dichrostachys cinerea*, having a frequency of 20,7% (Table 2). A total of 65 species in the upper stratum and 80 species under 2,0 m in height, were recorded having a frequency of less than 5% (Table 4).

Mainly stoloniferous grass species are present and annual species tend to be more abundant than perennials. Typically, this community grows on yellow apedal soils. These are sandy loams of the following soil series: Springfield, Cartref and Paardeberg. Where it occurs on riverine terraces, sandy soils of the Dundee form have been identified.

Acacia gerrardii Woodland

Acacia gerrardii Woodland (Table 5) is only found in Umfolozi Game Reserve to the south of the Black Mfolozi River, where it covers large gently undulating areas of lower and middle Ecca shales (Fig. 4).

Characteristic species of the upper stratum were found to be *Acacia gerrardii* and *A. nilotica*, having a frequency of 20,2% and 15,7% respectively (Table 3). For the under stratum *A. karroo* was the most frequent at 17,3%. Another 29 species were recorded for the upper tree stratum and 34 species were less than 2,0 m in height, having a frequency of less than 5,0% (Table 4).

A tall, rarely dense sward of mainly tufted, perennial grasses form the herbaceous layer.

Acacia nigrescens Woodland

Acacia nigrescens Woodland is confined to the catchment areas of the Black and White Mfolozi Rivers where it covers extensive areas throughout Umfolozi Game Reserve below the 300 m contour (Fig. 4). It is nearly always found on hillsides having a dolerite substrate.

Acacia nigrescens was found to be the dominant species characterizing the community, with a frequency of 55,0%. In the under stratum, *Acacia tortilis* with a frequency of 19,4%, was the most characteristic species (Table 3). Another 13 species were recorded for the upper tree stratum and 10 for the under stratum, having a frequency of less than 5% (Table 4).

A medium to short relatively dense sward of mixed stoloniferous and tufted perennial grasses dominate the herbaceous layer.

The community grows on marginalitic soils, particularly those series of the Kiora form.

TABLE 5.—Percentage cover, canopy and ceiling heights for the different woodland communities

Woodland	Upper tree stratum		% cover	Under tree stratum	
	mean canopy height (m)	mean ceiling height (m)		mean canopy height (m)	% cover
<i>Spirostachys africana</i>	6,0*	9,0**	50-75	3,0	10-50
<i>Combretum apiculatum</i>	6,5	2,5	10-75	not discernible	
<i>C. molle</i>	6,3	4,0	50-75	4,0	10-25
<i>Euclea divinorum</i>	4,4	1,5	50-75	2,0	25-50
<i>Acacia karroo</i>	5,1	3,7	50-75	4,0	10-25
<i>A. nilotica</i>	4,1	2,6	50-80	1,5	5-10
<i>A. burkei</i>	8,2	6,1	50-75	5,5	10-25
<i>A. gerrardii</i>	3,5	1,8	20-30	1,5	5-10
<i>A. nigrescens</i>	8,0	3,5	25-50	1,5	5-10
<i>A. tortilis</i>	4,0	2,5	10-75	0,7	5-10

* Recorded in Hluhluwe Reserve.

** Recorded in Umfolozi Reserve.

Acacia tortilis Woodland

Acacia tortilis Woodland is confined to the catchments of the Black and White Mfolozi Rivers and occurs throughout Umfolozi Game Reserve and is usually found on east-facing hill slopes (Fig. 4).

Acacia tortilis was found to be the dominant species characterizing the community, with a frequency of 57,0% in the upper and 29,1% in the under tree strata (Table 3). Another 27 species were recorded for the upper stratum and 22 that were less than 2,0 m in height, having a frequency of less than 5% (Table 4).

A moderately short often sparse sward of tufted perennial grasses dominates the herbaceous layer.

Acacia caffra Thicket (3 573 ha, 3,97% of area)

Acacia caffra Thicket is found in upland situations, usually above the 300 m contour, on hillsides and ridges throughout the whole area (Fig. 5).

Characteristic species of the upper stratum were *Acacia caffra* and *Dichrostachys cinerea*, having a frequency of 46,7% and 24,2% respectively and for plants less than 2,0 m in height, frequencies were 27,0% and 20,7% respectively (Table 3). Some 31 less frequent species were found to be present (Table 4).

An average canopy height of 1,4 m was recorded for this community. However, where fire has been less frequent, plants reach approximately 3 m in height. A tall, tufted grass sward is found in association with the woody plants.

Acacia karroo - Dichrostachys cinerea Induced Thicket (18 504 ha, 20,56% of area)

Acacia karroo - Dichrostachys cinerea Induced Thicket is found throughout the area in steeply undulating hillsides particularly in the Corridor and Hluhluwe Reserve and may be found at all altitudes (Fig. 5).

The structure and density of this community is mainly determined by the frequency and intensity of fire. The height of woody plants varies from approximately grass height to 4,0 m, depending on the interval between burns. Typically, the spindle

form of *Acacia karroo* is dominant and, when young, the tree canopies comprise few branches which increase in the absence of fire. Density of woody plants is usually very high with as many as 5 840 per hectare having been recorded.

Acacia karroo and *Dichrostachys cinerea* were found to be the dominant woody species character-

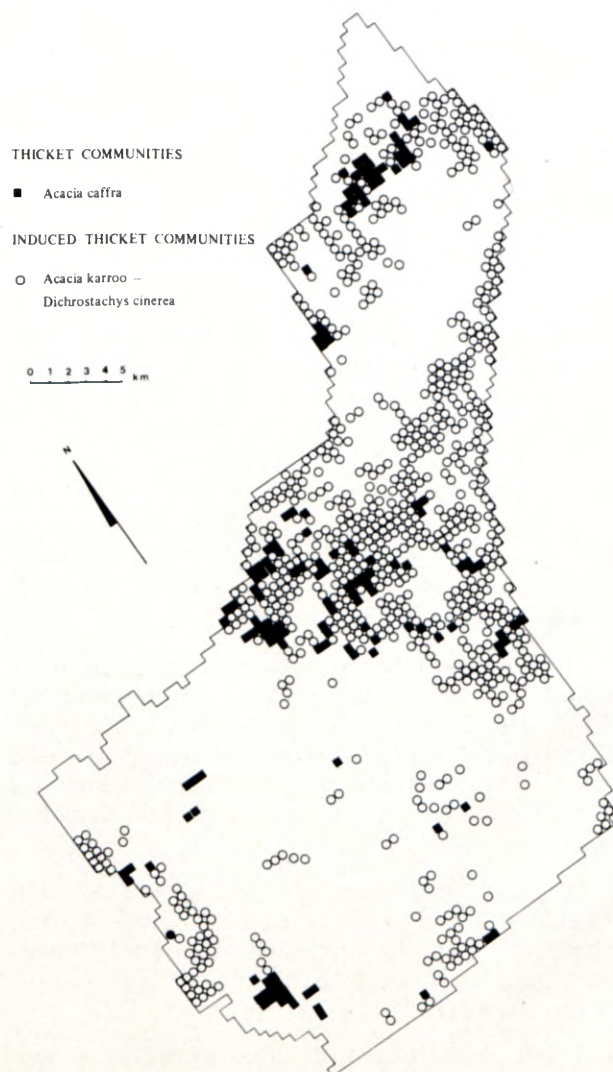


FIG. 5.—Thicket and induced thicket communities.

izing this community, with percentage frequencies of 44,2 and 31,0 and 17,0 and 23,5 for plants over and less than 2 m in height respectively (Table 3). Some 51 less frequent species were also recorded (Table 4).

A tall to very tall grass sward of tufted perennial species is associated with the community. This community is well utilized by both grazers and browsers and these areas constitute some of the most important feeding areas for game animals for several months following a burn. They are the most frequently burnt areas of the reserves, particularly when periods of good rains are experienced. Because of the role played by man-made fires which affect the physiognomy of this community, the term 'induced' is used to describe this thicket community.

Other communities

Few grassland areas in which woody plants are rare, are present and those that do occur, cover several hectares only. A *Themeda triandra* grassland occurs only above the 300 m contour on the top of certain high ridges and hills. A *Sporobolus africanus*-*Cyperus textilis* sedge-grassland is present on marginalitic soils in valley bottoms in Northern Hluhluwe Reserve.

Another rare community is *Acacia davyi* Thicket which covers an area of only a few hectares at one location in Hluhluwe Game Reserve. It has an average canopy height of 1,4 m and *Acacia davyi* has a frequency of occurrence of 50,0% and 16,0% for height categories greater or less than 2,0 m respectively. Some 12 other woody plant species were found to be associated with this community.

DISCUSSION AND CONCLUSIONS

For the major species in each community (i.e. recorded frequency >5%), the ratio of plants greater than 2 m and those between 0,1 and 2 m in height was examined. In most cases, it was found that the ratio was greater than 1: 0,20. Therefore, more than 20% of the population of a particular major species were sub-canopy plants; this would indicate that possible recruitment and/or replacement of senescent canopy plants would occur at a reasonable rate. The continued existence of the community would thus be ensured. However, this was not the case with certain major species present in three woodland and two forest communities. Ratios of less than 1: 0,20 for major species were as follows:

<i>Acacia nigrescens</i>	1:0,7	} <i>Acacia nigrescens</i> Woodland
<i>A. grandicornuta</i>	1:0,02	
<i>Combretum apiculatum</i>	1:0,02	<i>Combretum apiculatum</i> Woodland
<i>C. molle</i>	1:0,17	<i>Combretum molle</i> Woodland
<i>C. kraussii</i>	1:0,01	} <i>Celtis africana</i> - <i>Harpephyllum caffrum</i> Forest
<i>Celtis africana</i>	1:0,17	
<i>Schotia brachypetala</i>	1:0,01	} <i>Celtis africana</i> - <i>Euclea schimperii</i> Forest
<i>Berchemia zeyheri</i>	1:0,15	

Should a process of non-recruitment to the upper canopy by these plants be allowed to continue in the long term, then the physiognomy and species composition of these different communities may change radically. Such changes may possibly lead to the disappearance of the *Acacia nigrescens* and *Combretum apiculatum* Woodland communities, either completely or over wide areas in the game reserve complex. In order to establish what is limiting survival of young plants, it is suggested that autecological research be undertaken.

Species having a frequency of less than 5% are listed in Tables 2 and 4. Some of these plants are considered to be rare species. This category is defined as those woody plants that were found in either one or two communities only and have a combined frequency of less than 1%. For the forest communities 21 rare species were identified: These are:

<i>Acokanthera oppositifolia</i>	<i>Nuxia floribunda</i>
<i>Albizia suluensis</i>	<i>Ochna arborea</i>
<i>Allophylus natalensis</i>	<i>Psychotria capensis</i>
<i>Apodytes dimidiata</i>	<i>Ptaeroxylon obliquum</i>
<i>Brachylaena uniflora</i>	<i>Rawsonia lucida</i>
<i>Capparis sepiaria</i>	<i>Syzygium guineense</i>
<i>Carissa macrocarpa</i>	<i>Trichilia emetica</i>
<i>Commiphora woodii</i>	<i>Turraea obtusifolia</i>
<i>Ficus capensis</i>	<i>Urera tenax</i>
<i>Maerua rosmarinoides</i>	<i>Vangueria infausta</i>
<i>Manilkara concolor</i>	

For the Woodland communities 24 species were similarly identified. These are:

<i>Albizia adianthifolia</i>	<i>Kigelia africana</i>
<i>Brachylaena discolor</i>	<i>Maerua angolensis</i>
<i>Bridelia micrantha</i>	<i>M. rosmarinoides</i>
<i>Capparis sepiaria</i>	<i>Phyllanthus burchellii</i>
<i>C. tomentosa</i>	<i>Protea multibracteata</i>
<i>Carissa bispinosa</i>	<i>Rhus dentata</i>
<i>Commiphora pyracanthoides</i>	<i>R. simmii</i>
<i>Erythrina latissima</i>	<i>Terminalia phanero-</i>
<i>Euphorbia tirucalli</i>	<i>phlebia</i>
<i>Ficus soldanella</i>	<i>Trema orientalis</i>
<i>Garcinia livingstonei</i>	<i>Trichilia emetica</i>
<i>Grewia monticola</i>	<i>Vangueria infausta</i>
<i>Iboza riparia</i>	

It is suggested that studies into the status of these species in the Game Reserve Complex should be undertaken. Of particular concern would be the status of the endemic *Albizia suluensis* which has been listed as a threatened species (Hall *et al.*, 1980).

Some of the different plant communities found in the Game Reserve Complex have an affinity with communities in other regions of Natal. Some of these communities occur in the Tugela Basin described by Edwards (1967) and Ndumu Game Reserve described by Pooley (1977). These communities are:

Woody plant communities:

<i>This study</i>	<i>Other studies</i>
<i>Acacia karroo</i> Woodland	Coast <i>Acacia karroo</i> - <i>Acacia nilotica</i> - <i>Acacia robusta</i> Thorn Scrub (Edwards, 1967)
<i>Acacia nilotica</i> Woodland	
<i>Acacia gerrardii</i> Woodland	
<i>Acacia karroo</i> - <i>Dichrostachys cinerea</i> Induced Thicket	Coast Secondary Thicket Communities (Edwards, 1967)

<i>Celtis africana</i> - <i>Harpephyllum caffrum</i> Forest	Coast Lowland Forest (Edwards, 1967)
<i>Celtis africana</i> - <i>Euclea schimperii</i> Forest	
<i>Combretum apiculatum</i> Woodland	<i>Combretum apiculatum</i> Tree Veld (Edwards, 1967)
<i>Acacia burkei</i> Woodland	<i>Spirostachys</i> - <i>Acacia burkei</i> Woodland (Edwards, 1967)
<i>Spirostachys africana</i> Woodland	
<i>Acacia caffra</i> Thicket	Semi-coast Mixed <i>Acacia caffra</i> Scrub (Edwards, 1967)
<i>Acacia tortilis</i> Woodland	<i>Acacia tortilis</i> Woodland (Pooley, 1977)
<i>Acacia nigrescens</i> Woodland	<i>Acacia nigrescens</i> Woodland (Pooley, 1977)

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