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ISLANDS IN THE DESERT—FOREST VEGETATION OF KENYA'S SMALLER MOUNTAINS AND HIGHLAND AREAS (Nyiru, Ndoto, Kulal, Marsabit, Loroghi, Ndare, Mukogodo, Porror, Mathews, Gakoe, Imenti, Ngaia, Nyambeni, Loita, Nguruman, Nairobi)

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ABSTRACT

A syntaxonomic survey of Kenyan montane forests was performed in a field study from 1992–1996. Most forests encountered belong to the Juniperetea procerae floral community (cedar forests), of which the Juniperion procerae Faureo salignae-Ilicetum mitis on the wet mountaintops and the Myrsino africanae-Juniperetum procerae in drier areas, were most commonly encountered. On Mt Marsabit the Coffeo arabicae-Rinoreetum convallarioidis was found as a new association of the Cassipourion malosanae. The top of Mt Nyiru is covered with large stands of the Hagenietea abyssinicae and extensive bamboo forests (Sinarundinarietea alpinae). Mathews Range harbours the largest forest tracts remaining in the dry north of Kenya. On the lower slopes of this mountain, a new alliance, assessed as Crotonion megalocarpi is described. Camphor forests (Ocotetea usambarensis) cover altitudes from 1,600–2,400 m in the southern Aberdare Range. In the submontane Imenti and Ngaia forests, and the Nyambeni Hills, between 1,200–1,600 m altitude, a variety of forest types related to the Guineo Congolian rainforest were encountered. These forests are assessed as Lovoion swynnertonii. In the montane zone of Nyambeni dense bamboo forests cover the wetter areas, whereas drier parts are covered by cedar forests.

On the drier hill slopes of southern Kenya the Juniperion procerae is the prevalent forest type. On the often mist-covered and cloudy hilltops, associations of the Cassipourion malosanae are growing. The forests around Nairobi clearly belong to the Brachylaenion huillensis. Although some syntaxa had to be newly described, the forests of the study areas clearly fit into the classification system of Bussmann & Beck (1995).

INTRODUCTION

Although occupying almost 50 % of its land area, the 'Northern Frontier District' of Kenya has always received only marginal attendance, and for long times was mainly visited by adventurers and big game hunters. From 1900–1910 a military outpost was created on Mt Kulal (Kenya Colony and Protectorate, 1917). Consisting of vast alluvial inland plains, declining from altitudes of about 1,200 m north of Mt Kenya, to barely 400 m towards Lake

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Turkana, the whole area is still only sparsely populated. Only a few scientific studies have been carried out in the north, mainly focusing on its geological features (Shackleton, 1946; Dixey, 1948; Dodson, 1963; Randel, 1967).

The northern forests comprise about 40 % of the whole forested area in Kenya and are of high ecological and economical importance as water catchments (Synott, 1979). Most areas are gazetted as forest reserves. The Ndoto Mts Reserve covers about 93,205 ha, of which only 10,155 ha consist of dense forest. On Mt Nyiru with 45,496 ha (7,890 ha) and Mt Kulal with 45,952 ha (2,240 ha), most forests have been destroyed already (Beentje, 1990). On Mt Marsabit, protected as National Park since 1961 (Mäckel & Walter, 1983), still 13,675 ha of the former 15,778 ha of forests are left standing today. On the Huri Hills only some tree islands, mainly with *Croton macrostachyus*, indicate the former presence of forest. A similar situation occurs on the Mathews Range (97,392 ha gazetted), of which however only 24,000 ha are actually forests, indicating the rapidity of forest destruction in these areas. Out of the 91,794 ha of the Loroghi, Maralal and Porror reserves, only about 29,000 ha are still forested. The situation in Mukogodo (1,800–2,200 m, 29,931 ha gazetted, barely 2,700 ha forested) and Ngare Ndare (2,100–2,200 m, 5,627 ha gazetted, 3,135 ha forested) is not much different.

Forests with *Brachylaena huillensis* and *Croton megalocarpus* probably covered most of the land between Nairobi and Mount Kenya at altitudes between 1,500 and 1,900 m. Now, only tiny patches of these forests are remaining near Mt Kenya and around Nairobi, altogether about 4,500 ha, or less than 1 % of their former extension (Beentje, 1990). Forest Reserve status has not protected these remnants. Barely 70 years ago the Ngong Hills were covered in 3,000 ha of forest, of which only 150 ha are remaining today. Few data on the vegetation of these forests are available however (Kigomo *et al.*, 1990; Kigomo, 1991; Mungai & Beentje, 1989).

In the forest reserves of southern Kenya, namely the Nguruman/Loita Hills area, the situation is even worse. In the study presented here, the forest areas of northern, central and southern Kenya are covered. A detailed description of the vegetation texture of the forests, resulting in their syntaxonomic description according to Barkman *et al.* (1986) is provided.

Geology and soils

The northern Kenyan plains are bordered by a chain of mountains consisting of old cristallinic Precambrian basement rocks, mainly extremely durable gneisses and granites (Nyiru-Ndoto and Mathews Range: Shackleton, 1946). A series of Quarternary volcanic peaks like Mt Kulal (2,285 m), Mt Marsabit (1,707 m), and the Huri Hills (1,479 m) tower over the inland plains. Most regions of central Kenya are covered with tertiary to recent lavas and tuffs (Baker, 1967; Mason, 1963). The soils of the plains consist mainly of Vertisols, Regosols, Lithosols and Cambisols. The mountain slopes are covered with humic Nitisols and Acrisols in case of the basement formations and the lower volcanic areas, and deep humic Andosols above about 2,700 m (Mäckel, 1986; Mäckel & Schultka, 1988; Mäckel & Walter, 1983; Schmitt, 1991; Speck, 1983).

Climate

According to Jätzold (1977, 1981), the study area is part of the hot, arid tropical climate, with two short, subhumid seasons, with mean monthly daytime temperatures of 26–20°C in the plains, in contrast to 17–19°C in the mountains (Gatab, 1,657 m). The average annual rainfall can be as low as 100–150 mm in the Hedad Plain and Chalbi Desert, rising to 500 mm in the valleys of the Nyiru-Ndoto mountains. In the mountain forest zone, rainfall of

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about 1,200–2,000 mm can be reached (Edwards *et al.*, 1979). The main rainfall is concentrated in two wet seasons, from March–May and October–December; extreme rainfalls occur, *e.g.* 175 mm within 6 h in Gatab on Mt Kulal (Mäckel & Walter, 1983). To depict the climatic conditions of the study area, climatic diagrams (figure 1) were produced from data of the Kenya Meteorological Department (1974, 1984), according to Walter & Lieth (1960–1967).

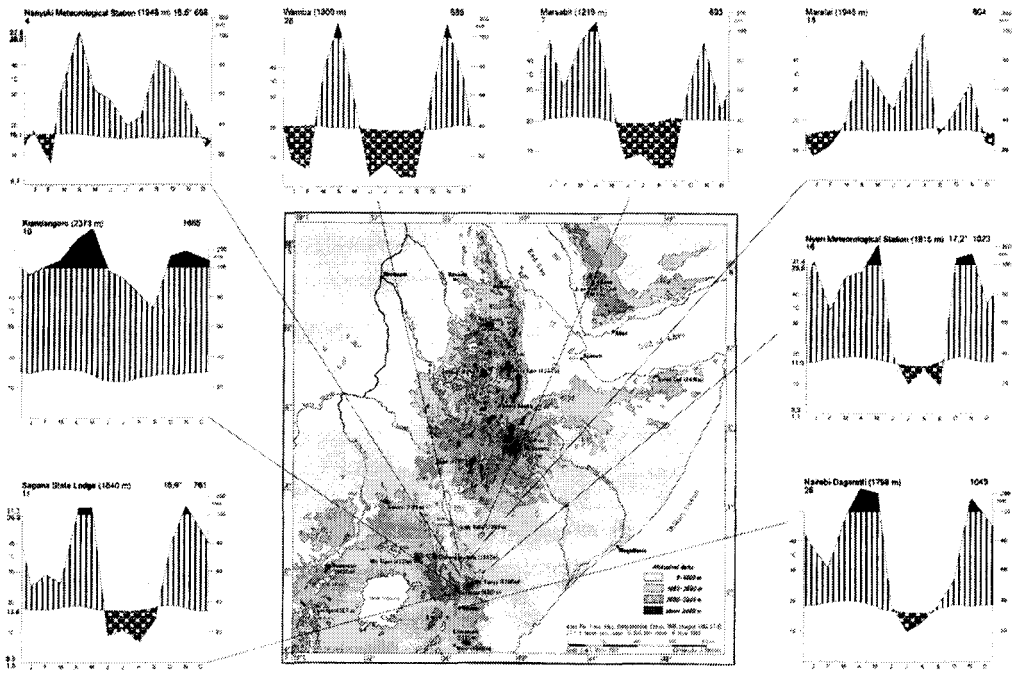

Figure 1. Location and climate of the of the study area. The area shaded indicates the former extension of the Brachylaenionhuillensis. Map provided by G. & S. Miehe.

Vegetation

Most mountain areas in northern Kenya are covered with evergreen montane forests, owing their existence especially to the humidity received from mist condensation and the frequent cloud formation in the peak areas. A first short description of Kulal, Nyiru and Mathews Range is given by Neumann (1898). Schultka & Hilger (1983) distinguished *Olea hochstetteri-Cassipourea malosana* and *Olea africana-Juniperus procera* forest on Kulal. Herlocker (1979) gave some more general remarks on the vegetation, and for Mt Kulal, a checklist for plants collected by Hepper *et al.* (1981) and Hepper (1983) exists. The importance of the forest cover as erosion barrier and water catchment is described by Synott (1979). Bronner (1990) elaborated on a vegetation description for Mathews as part of a land-use oriented study. He distinguished four main groups of forests and woodland:

- Bushland, mainly at altitudes around 1,500 m at the footslopes of the mountain
- *Croton megalocarpus* forest, from 1,500 to 2,000 m
- *Olea africana—Juniperus procera* forest around 1,960 m
- *Podocarpus* forest, divided into *Podocarpus gracilior* forest (2,000–2,300 m) and *Podocarpus latifolius* forest (2,300–2,700 m)

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The tops of the Karissia Hills are still covered with partly extensive montane forests.

A first comprehensive phytosociological study of a central Kenyan forest area, mainly concentrating on secondary forests in the Aberdare National Park was published by Schmitt (1991). A comparison of his work to the 'Mount Kenya System' (Bussmann & Beck, 1995) is given in Bussmann (1994).

MATERIALS AND METHODS

From 1992 to1996, 252 vegetation plots were established and analysed according to the methods of Braun-Blanquet (1964) and Mueller-Dombois & Ellenberg (1974), as slightly modified by Hammen *et al,* (1989). The plots were selected with respect to floristic homogeneity and representation of typical forest stands and chosen directly in the field. The plot size was always larger than the minimum areas determined for similar forest types in previous studies (Bussmann, 1994; Bussmann & Beck, 1995).

The nomenclature of plant families follows Bamps (1976), and the Flora of Tropical East Africa (FTEA, Turril *et al.*, 1952–2001). The nomenclature of genera and species of Pteridophytes, Monocotyledones and Dicotyledones follows Upland Kenya Wild Flowers (Agnew & Agnew, 1994). The genus *Sinarundinaria* is treated according to Chao & Renvoize (1989). *Cyperaceae* and *Juncaceae* are named according to Haines & Lye (1983), *Gramineae* according to Phillips (1995). The nomenclature of trees and shrubs is according to Kenya Trees, Shrubs and Lianas (Beentje, 1995).

For each relevé a species list was established and the cover/abundances were estimated according to the scale of Hammen *et al.* (1989):

5: any number of individuals with cover of 75–100% of the plot;
4: any number of individuals with cover of 50–75%;
3: any number of individuals with cover of 25–50%;
2: any number of individuals with cover of 5–25%;
1: any number of individuals with cover of 1–5%;
+: few or many individuals with cover $<1\%$;
r: solitary individuals with cover $>1\%$

Three vegetation strata were differentiated within each relevé:

T: Tree layer, plants taller than 5 m;
S: Shrub layer, woody species between 50 cm and 5 m tall, including some herbaceous plants, when a distinct stratum of small herbaceous species existed or at least is assumed to exist under undisturbed conditions.

The herb layer refers to all individuals <50 cm. All species not labelled T or S in the vegetation tables belong to the herb layer.

All plots were sampled at least twice and in different seasons, thus the inventory of species should be more or less complete. The data of the relevés were analysed by computer-aided hand sorting, whereby cover/abundance and the regular occurrence of species in the vegetation unit are given equal weight. To portray the structure of the associations, stand-profile diagrams according to Hammen *et al.* (1989) were produced.

RESULTS

Eighteen associations with ten sub-associations, five facies and five variants, belonging to nine alliances, four orders and four classes (appendices. 1–7 and table 1) were encountered:

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Table. 8. Constancy table.

	Mt. Nyiro					Marsabit		Mathews Range									Ndare, Porror, Loroghi					Gakoe, Ngaia, Nyambeni Hills							Loita Hills			Karura Ngong	
	A1 Ia 11	A1 Ia 12	B1 I a	A1 I b1	C1 I a	A1 I lab	A1 I a12	A1 I a13	A1 I IIa1 1	A1 I IIa1 2	A1 I IIb1	A1 I IIb2 1	A1 I IIb2 2	A1 I IIc	A1 I IId	A1 I a	A1 I b1	A1 I Ia1 1	A1 I Ia1 2	A1 I b2	D1 I a 1	D1 I Ia2	D1 I IIa	D1 I IIb	D1 I Ib	A1 I a	C1 I b	A1 I a1	A1 I Ia1 1	A1 I Ia1 2	A1 I IIa1 2	A1 I Ia1 2
Juniperetea procerae Bussmann 1994 (A)																																	
C Geranium arabicum	V	V	V	V	2															V													
C Achyranthes aspera	V	V	V	V	1		V	IV	V	V	V	IV	III	III	V	V	4	4	V	V								V	IV	V			
C Brachypodium flexum				V												I			IV	V													
D Juniperus procera T	III	V	V	V			V	IV	IV	IV				V		V	4	4	V	V								V	IV	IV			
D Juniperus procera S	II	V	V	V			IV	III	II	V				V		V	3	3	III	V								V	II	II			
D Sanicula elata	V	V	V	V	2		V	V	V											V						V	V						
D Stipa dregeana S		V	V	V												V	4	4	V	IV						V	V	V	V	V			
C Parochetus communis							V	V	IV	V																							
C Isoglossa gregorii							V	V								V		4										V	V	V			
C Berberis holstii S																				V													
Juniperion procerae Bussmann 1994 (A.1.I)																																	
C Olea europaea ssp. africana T		V	V	V		V								V		V	4	4	V								V	III	III			
C Olea europaea ssp. africana S		II	V	III		V								V		V	4	4	V								V	II	I			
C Rubus volkensii S	V	V	V	I		V																											
D Rapanea melanophloeos T	I		V			V																											
D Carex peregrina																		4															
Ehrharto erectae - Juniperetum procerae Bussmann 1994																																	
D Ehrharta erecta	V	V	V	V	1											3	4	V	V								V						
C Arceuthobium juniperi-procerae																II		3															
Ehrharto erectae - Juniperetum procerae warburgietosum ugandensis (A.1.I.a.1)																																	
D Warburgia ugandensis T																												V					
D Warburgia ugandensis S																												V					
D Schoenoxiphium lehmannii																												V					
Faureo salignae - Ilicetum mitis Bussmann 1994 (A.1.I.a)																																	
D Faurea saligna T	V	V	V	V			V	V																	V								
D Faurea saligna S	V	V	II	IV			V	V																	IV								
D Ilex mitis T							V	V																	V								
D Ilex mitis S							III	III																	V								
Faureo salignae - Ilicetum mitis xymaletosum monosporae (A.1.I.a.1)																																	
D Xymalos monospora T	V	V		III	2		V	V	V	III																							
D Xymalos monospora S	V	V		IV	1		V	V	V	III																							
D Brucea antidysenterica S	V	V	II		2			V																									
D Clausena anisata S	V	V		II	1																												

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	Mt. Nyiro					Marsabit					Mathews Range								Ndare, Porror, Loroghi			Gakoe, Ngaia, Nyambeni Hills								Loita Hills		Karura Ngong	
	A1 Ia 11	A1 Ia 12	B1 I a	A1 I b1	C1 I a	A1 I ab	A1 I a12	A1 I a13	A1 I IIa1 1	A1 I IIa1 2	A1 I IIb1	A1 I IIb2 1	A1 I IIb2 2	A1 I IIc	A1 I IId	A1 I a	A1 I b1	A1 I Ia1 1	A1 I Ia1 2	A1 I b2	D1 I a	D1 I Ia1 1	D1 I Ia2	D1 I IIa	D1 I IIb	D1 I Ib	A1 I a	C1 I b	A1 I a1	A1 I Ia1 1	A1 I Ia1 2	A1 I IIa1 2	A1 I IIa1 2
D Clerodendron johnstonii S	V	V	I	II	2																												
D Clematis brachiata	III	V																															
D Dicliptera kirkii	V	V	III																														
D Doryopteris concolor	IV	I																															
D Polystachya confusa	III	V			2																												
D Polystachya piersii	I	I																															
D Polystachya spec.	III	V																															
D Pteris quadriaurtia	IV																																
Faureo salignae - Ilicetum mitis xymaletosum monosporae - wet variant (A.1.I.a.1.1)																																	
D Droguetia iners	III																																
D Amauropeltis bergiana	III				1																												
D Schefflera volkensii T	III																																
D Stenogramma pozoi	II				1																												
D Dichrocephala integrifolia	II																																
D Solanum schumannianum S	II																																
D Aneilema pedunculosum	II																																
D Crassula alsinoides	II			I																													
D Dracaena spec. S	II																																
D Pilea johnstonii	I																																
Faureo salignae - Ilicetum mitis xymaletosum monosporae - dry variant (A.1.I.a.1.2)																																	
D Pupalia lappacea		V																															
D Schoenoxiphium lehmannii	I	V																															
D Stellaria sennii	I	V																															
D Plectranthus barbatus S	I	IV																															
D Spermacoce princeae		IV																															
D Solanum incanum		IV		IV																													
D Pteridium aquilinum		I		V																													
Faureo salignae - Ilicetum mitis xymaletosum monxosprae - Schefflera volkensii facies (A.1.I.a.1.3)																																	
D Schefflera volkensii T									II	V																							
D Euclea divinorum S										V																							
Myrsino africanae - Juniperetum procerae Bussmann 1994 (A.1.I.b)																																	
D Rhamnus prinoides S	I	V	V	V																V	V												
D Myrsine africana S		V	V	V																	V												
Myrsino africanae - Juniperetum procerae cadietosum purpureae (A.1.I.b.1)																																	
D Cadia purpurea S				V																													
D Vangueria apiculata S				V																													

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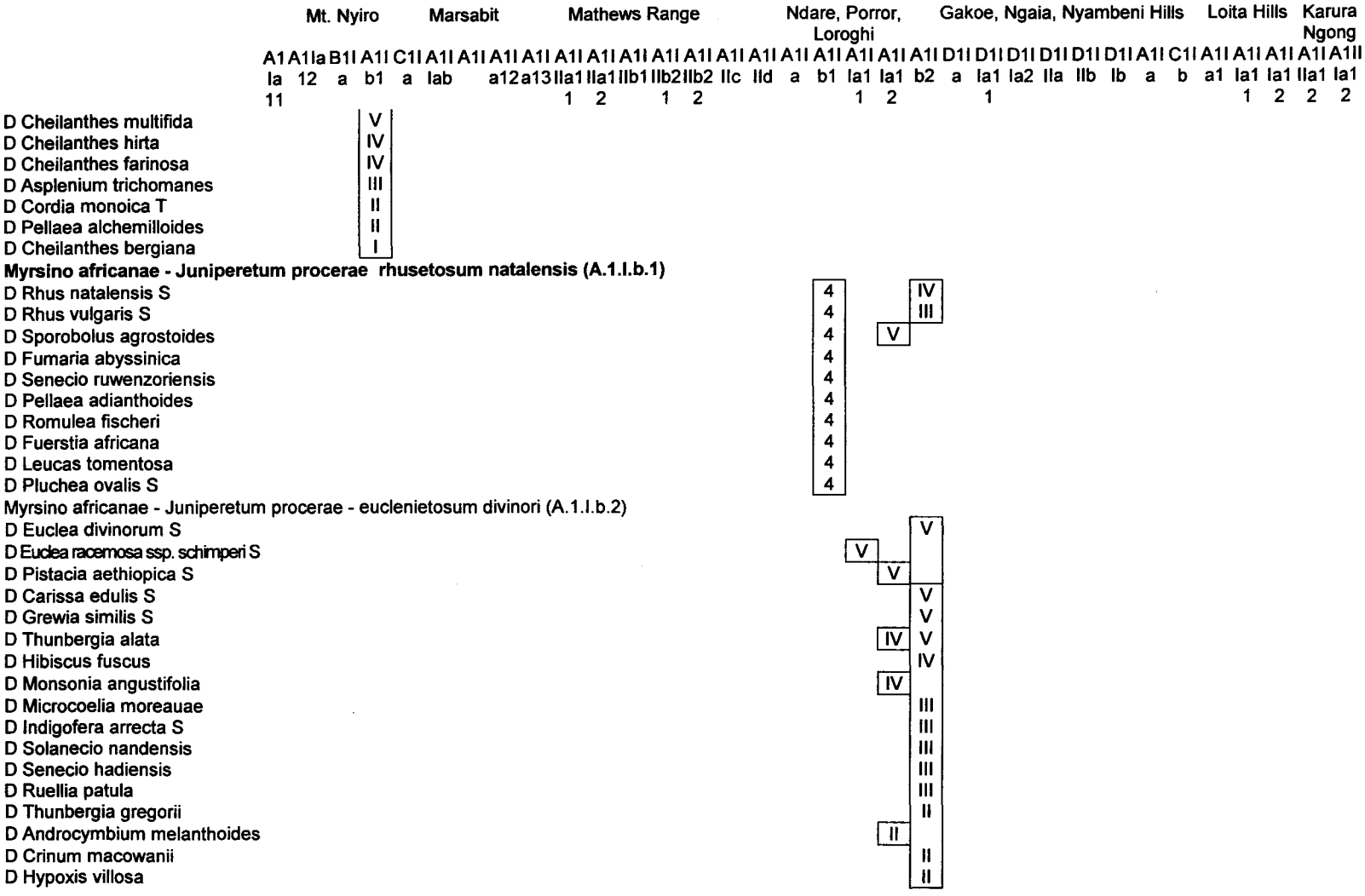

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	Mt. Nyiro	Marsabit		Mathews Range										Ndare, Porror, Loroghi				Gakoe, Ngaia, Nyambeni Hills								Loita Hills			Karura Ngong	
	A1 Ia 11	A1 Ia 12	A1 Ia a	B1 I b1	A1 I a	C1 I a	A1 I a	A1 I a	A1 I a12	A1 I a13	A1 I IIa1 1	A1 I IIa1 2	A1 I IIb1	A1 I IIb2 1	A1 I IIb2 2	A1 I IIc	A1 I IId	A1 I a	A1 I b1	A1 I Ia1 1	A1 I Ia1 2	A1 I b2	D1 I a	D1 I Ia1 1	D1 I Ia2	D1 I IIa	D1 I IIb	D1 I Ib	A1 I a	C1 I b	A1 I a1	A1 I Ia1 1	A1 I Ia1 2	A1 I IIa1 2	A1 II Ia1 2
Cassipourion malosanae Bussmann 1994 (A.1.II)																																		
C Ilex mitis T							II	V																					II	IV	IV		
C Ilex mitis S							III	II																					I	III	III		
D Cassipourea malosana T							V	V												4	V								V	V	V		
D Cassipourea malosana S							V	III												4	V								II	IV	III		
D Olea capensis ssp. hochst. T							V										V			4	V								II	V	V		
D Olea capensis ssp. hochst. S							V										V			2	V								I	III	III		
D Olea capensis ssp. hochst.																														III	II		
D Hypoestes triflora																				4	V												
D Droguetia iners																				2	V												
C Hypoestes aristata S																													III	IV	V		
Coffeo arabicae - Rinoreetum convallarioidis (A.1.II.a)																																		
C Oplismenus hirtellus							V	I																										
C Casearia battiscombei T							V																											
C Casearia battiscombei S							IV																											
C Flacourtia indica S							V	I																										
C Turraea holstii S							V																											
C Celtis africana T							III																											
C Celtis africana S							V																											
C Strychnos mitis T							IV																											
C Strychnos mitis S							IV																											
C Isoglossa lactea							IV	III																										
C Justicia betonica							IV	III																										
C Meyna tetreaphylla S							IV																											
C Celtis gomphophylla T							III																											
C Celtis gomphophylla S							IV																											
C Ocotea kenyensis T							III																											
C Ocotea kenyensis S							II																											
C Cordia monoica S							II																											
D Strychnos henningsii T							II	I																										
D Strychnos henningsii S							II	I																										
D Erythrococca bongensis S							V																											
D Coffea arabica S							V																											
D Rinorea convallarioides S							V																											
D Erythrococa fischeri S							V																											

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	Mt. Nyiro					Marsabit		Mathews Range								Ndare, Porror, Loroghi					Gakoe, Ngaia, Nyambeni Hills								Loita Hills			Karura Ngong	
	A1 Ia 11	A1Ia 12	B1I a	A1I b1	C1I a	A1I Iab	A1I	A1I a12	A1I a13	A1I IIa1 1	A1I IIa1 2	A1I IIb1	A1I IIb2 1	A1I IIb2 2	A1I IIc	A1I IId	A1I a	A1I b1	A1I Ia1 1	A1I Ia1 2	A1I b2	D1I a	D1I Ia1 1	D1I Ia2	D1I IIa	D1I IIb	D1I Ib	A1I a	C1I b	A1I a1	A1I Ia1 1	A1I Ia1 2	A1I IIa1 2	A1I IIa1 2
D Chionanthus battiscombei T						V																												
D Chionanthus battiscombei S						IV																												
D Pavetta abyssinica S						V																												
D Oxyanthus speciosus S						V																												
D Rytigynia neglecta S						IV																												
D Monodora grandidieri S						IV																												
D Vepris eugeniaefolia S						IV																												
D Rhipsalis baccifera						III																												
Tecleo nobilis - Tecletum simplicifoliae Bussmann 1994 (A.1.II.a)																																		
C Podocarpus falcatus T																	V	4	4	V										V	V	V		
C Podocarpus falcatus S																	V	2	1	V										V	V	IV		
C Erythrococca bongensis S																	V		4	V											IV	IV		
C Oplismenus compositus																	V	2	4	V														
C Teclea nobilis T																	III	2	3	V										II	V	V		
C Teclea nobilis S																	V	3	3	III										II	IV	V		
C Ehretia cymosa S																	III		2	V														
C Solanum schumannianum																	V		3	V														
C Asplenium linckii																	V		4															
C Turraea holstii S																			1	II														
C Aeschyomene schimperi S																				III														
C Helinus integrifolius S																				II														
D Teclea simplicifolia T																	III	1	1	V											IV	I		
D Teclea simplicifolia S																	V	4	4	V											IV	II		
Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae (A.1.II.a.1)																																		
D Dicliptera laxata																			4	V														
D Acanthopale pubescens																	I		4	V														
D Vepris glomerata S																			3	III														
Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae typicum (A.1.II.a.1.1)																																		
D Peperomia tetraphylla																	II		4															
D Orchidacea gen.																	I		4															
D Stolzia repens																	I		4															
D Bulbophyllum spec.																	I		3															
D Arisaema mildbraedii																			3															
Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae - Isoglossa punctata facies (A.1.II.a.1.2)																																		
D Isoglossa punctata																					V													
D Justicia diclipteroides																			1	V														
D Aneilema pedunculosum																				V														

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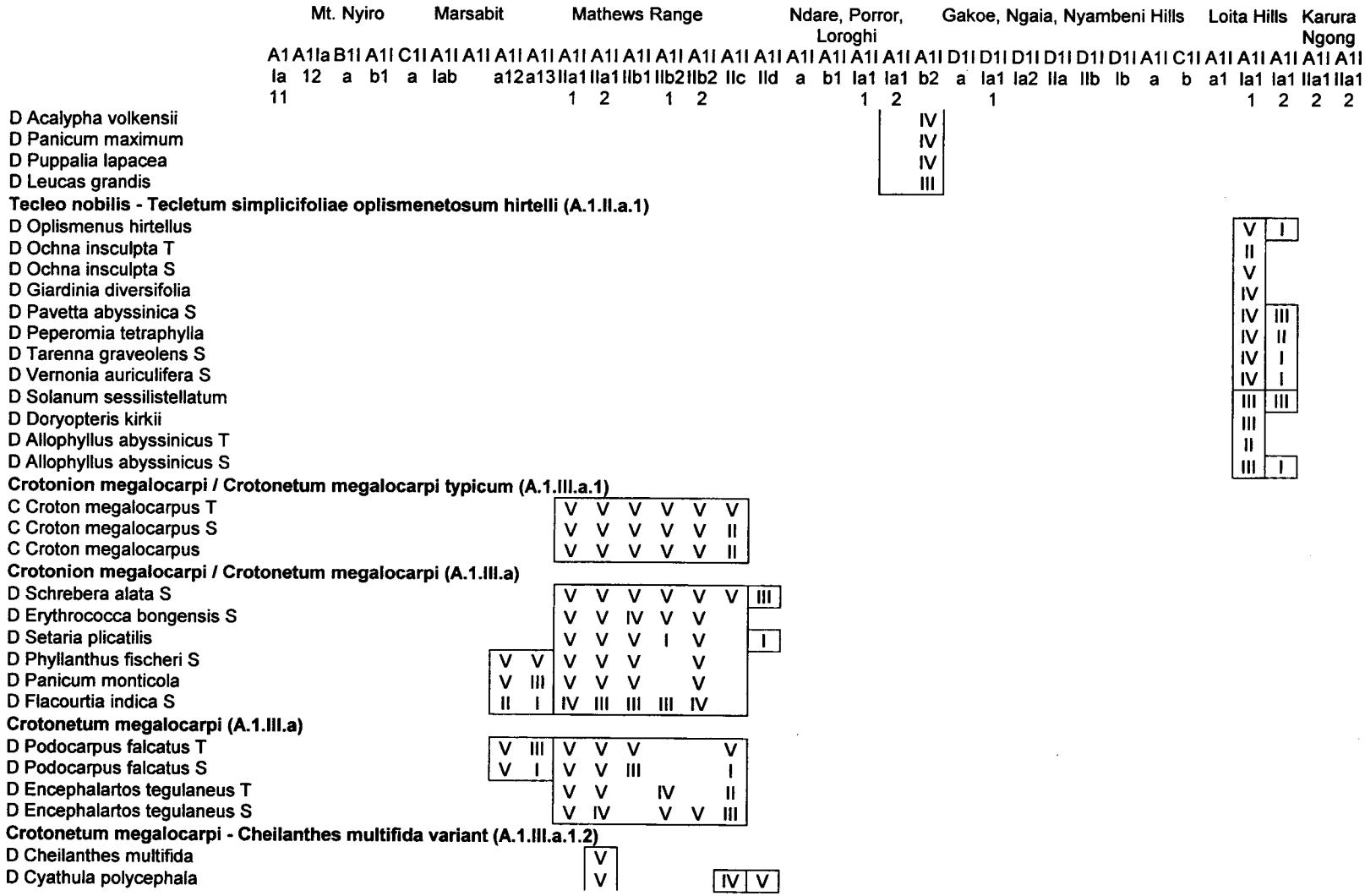

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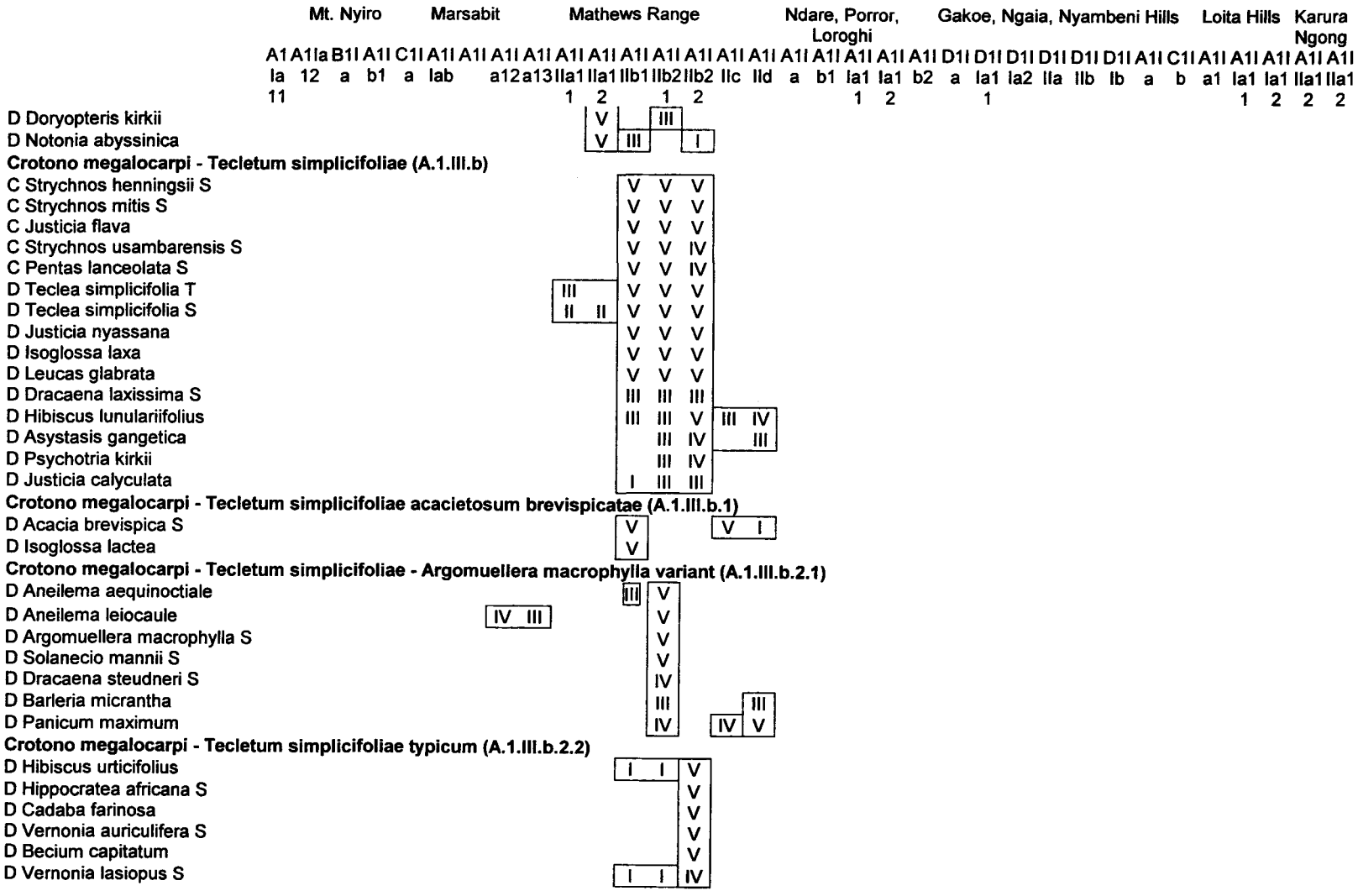

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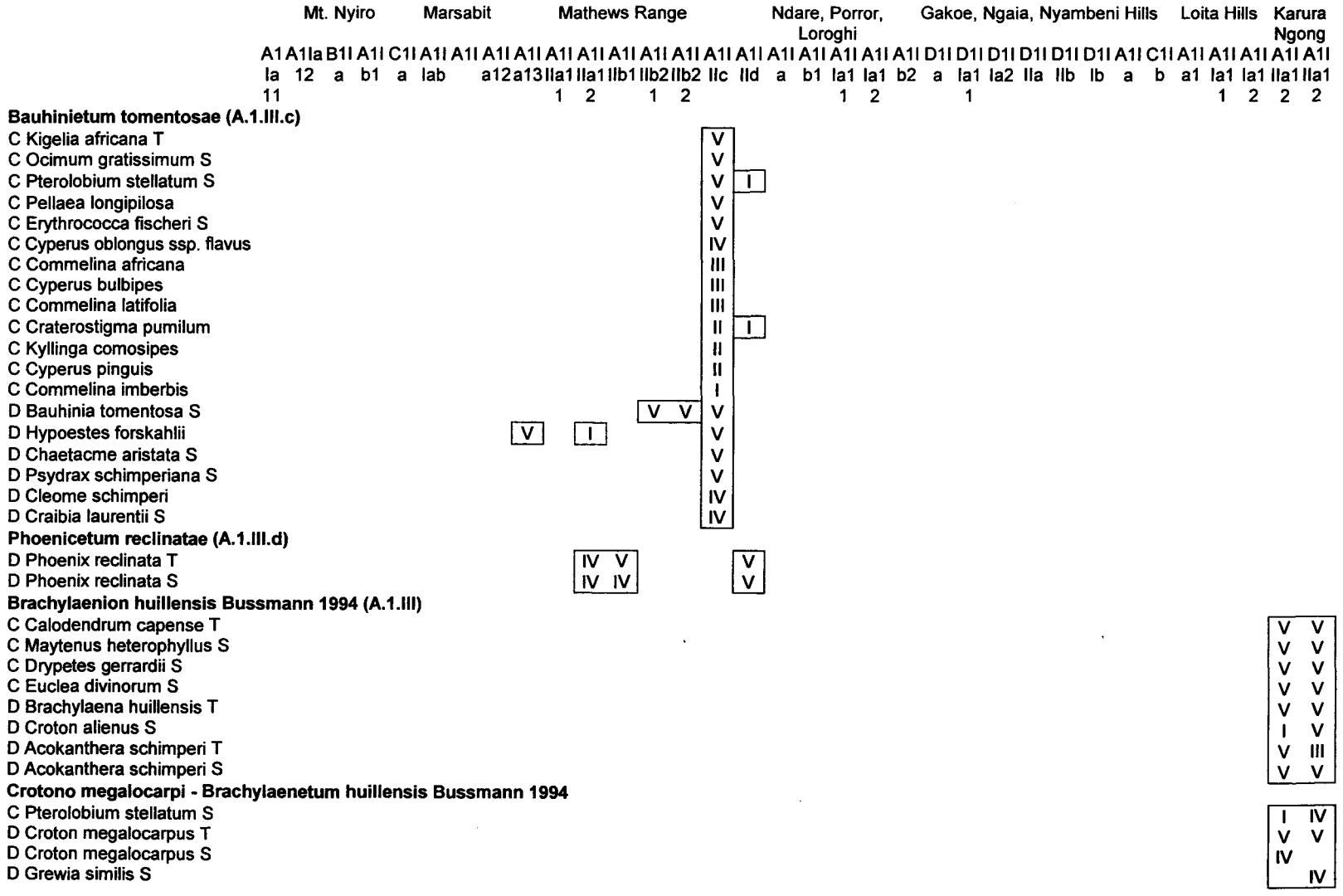

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	Mt. Nyiro					Marsabit				Mathews Range							Ndare, Porror, Loroghi					Gakoe, Ngaia, Nyambeni Hills									Loita Hills			Karura Ngong	
	A1 Ia 11	A1 Ia 12	B1 I a	A1 I b1	C1 I a	A1 I Iab	A1 I a12	A1 I a13	A1 I IIa1 1	A1 I IIa1 2	A1 I IIb1	A1 I IIb2 1	A1 I IIb2 2	A1 I IIc	A1 I IId	A1 I a	A1 I b1	A1 I Ia1 1	A1 I Ia1 2	A1 I b2	D1 I a	D1 I Ia1 1	D1 I Ia2	D1 I IIa	D1 I IIb	D1 I Ib	A1 I a	C1 I b	A1 I a1	A1 I Ia1 1	A1 I Ia1 2	A1 I IIa1 2	A1 I IIa1 2
Elaeodendro buchananii - Brachylaenetum huillensis Bussmann 1994 (A.1.III.a)																																	
C Teclea simplicifolia T																																V	V
C Teclea simplicifolia S																																V	V
C Ochna insculpta T																																V	III
C Ochna insculpta S																																V	IV
D Elaeodendron buchananii T																																V	V
D Elaeodendron buchananii S																																V	V
D Teclea trichocarpa T																																V	V
D Teclea trichocarpa S																																V	V
D Oplismenus burmannii																																V	V
Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae (A.1.III.a.1)																																	
D Acokanthera longifolia S																																IV	IV
D Gnidia subcordata S																																IV	IV
D Cassipourea rotundifolia T																																III	IV
D Cassipourea rotundifolia S																																III	IV
D Manilkara discolor T																																III	IV
D Turraea mombasana S																																II	IV
D Albizzia schimperiana T																																II	III
D Albizzia schimperiana S																																II	III
D Mimusops kumel S																																II	III
Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae - Phyllanthus obovalifolius facies (A.1.III.a.1.1)																																	
D Phyllanthus obovalifolius																																V	IV
D Schrebera alata S																																V	V
D Vernonia holstii																																V	IV
D Hibiscus corymbosus																																V	IV
D Barleria micrantha																																V	V
D Ochna sleumeri S																																V	V
Elaeodendro buchananii - Brachylaenetum huillensis accokantheretosum longifoliae - Chaetacme aristata facies (A.1.III.a.1.2)																																	
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D Panicum maximum																																	V
D Strychnos usambarensis S																																I	V
D Adenia gummifera																																I	III
D Teclea hanangensis T																																	IV
D Teclea hanangensis S																																	IV
D Uvaria scheffleri S																																I	IV
D Markhamia lutea T																																I	III
D Ochna ovata S																																II	III

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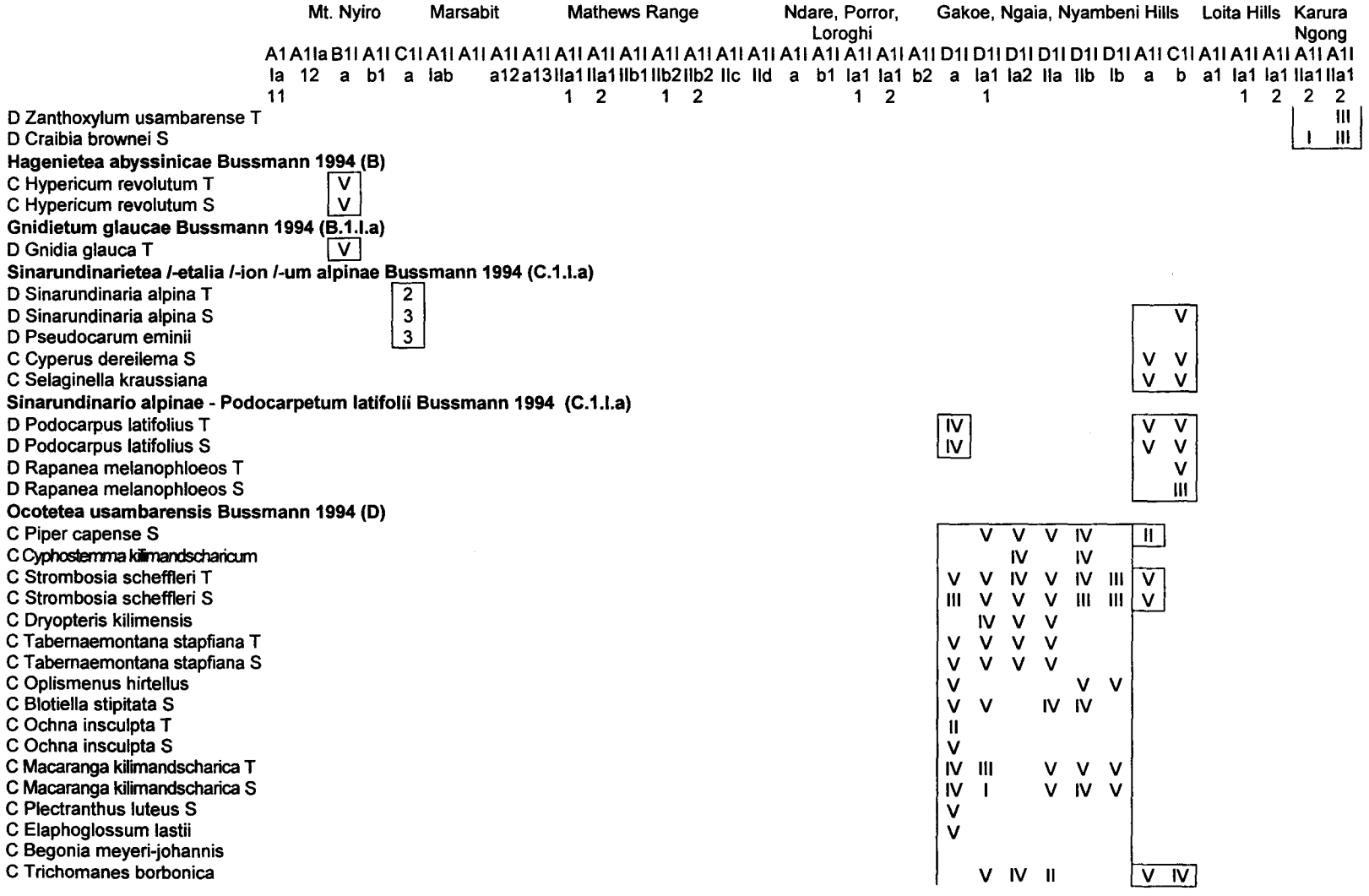

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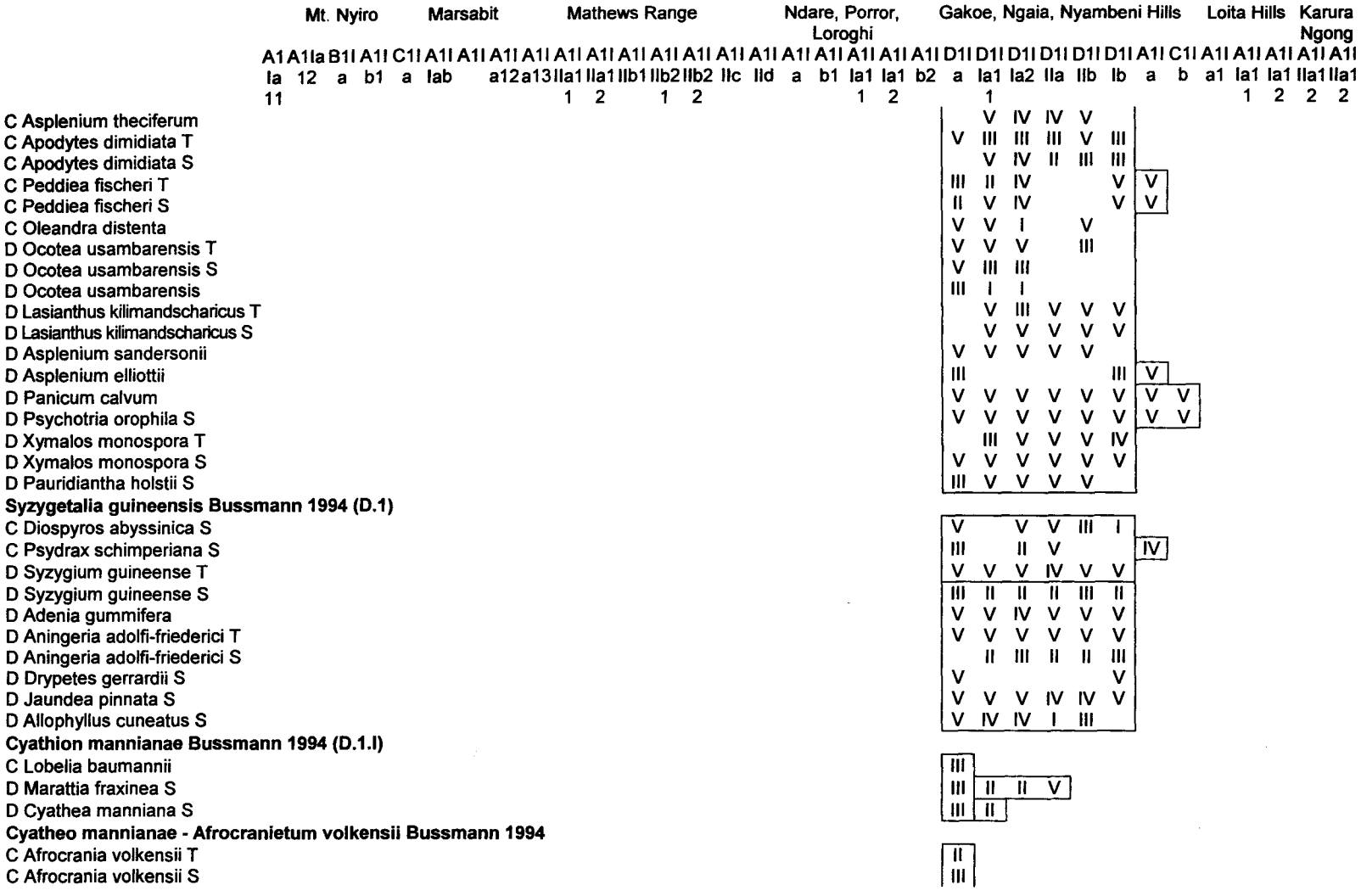

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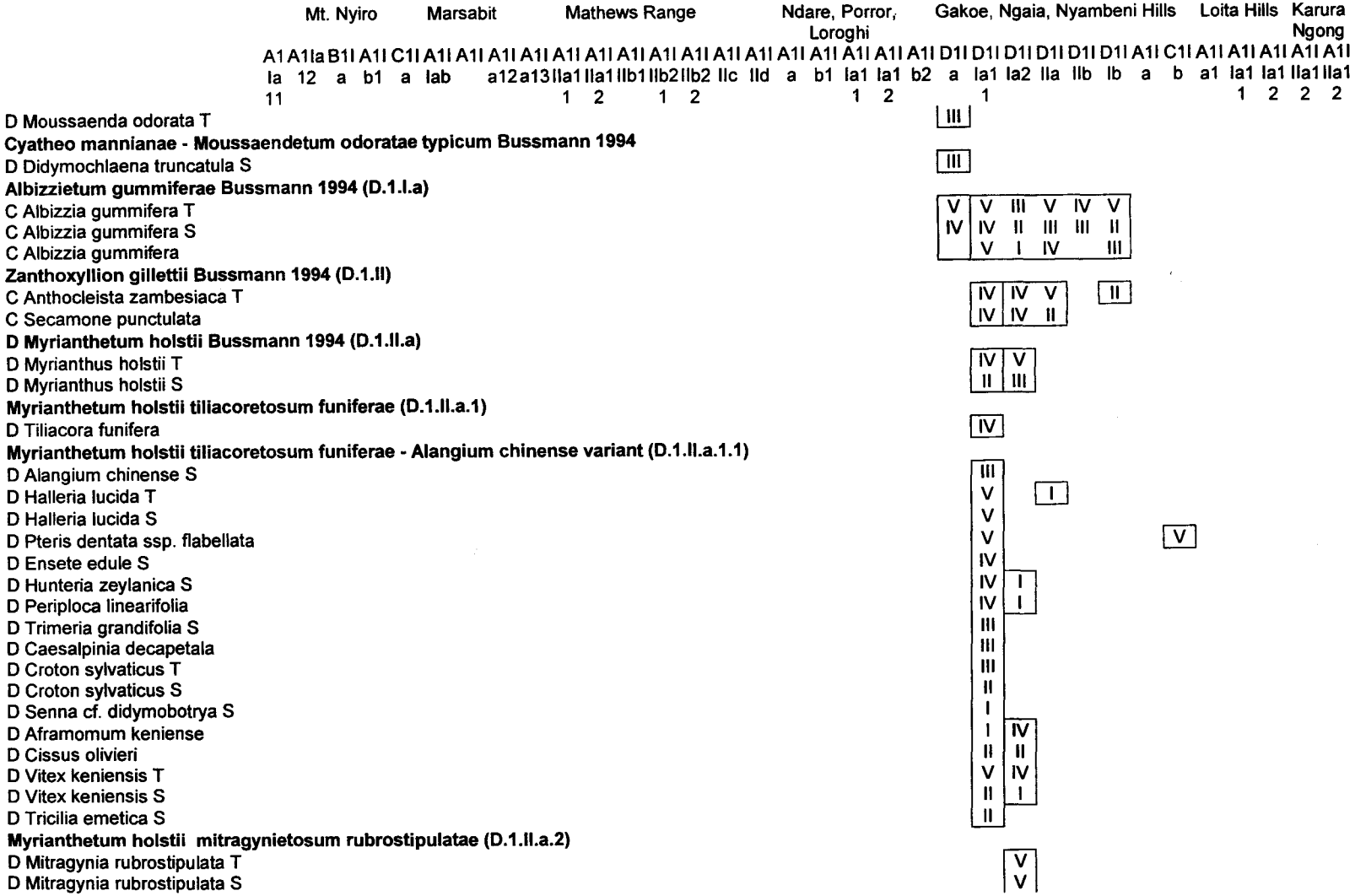

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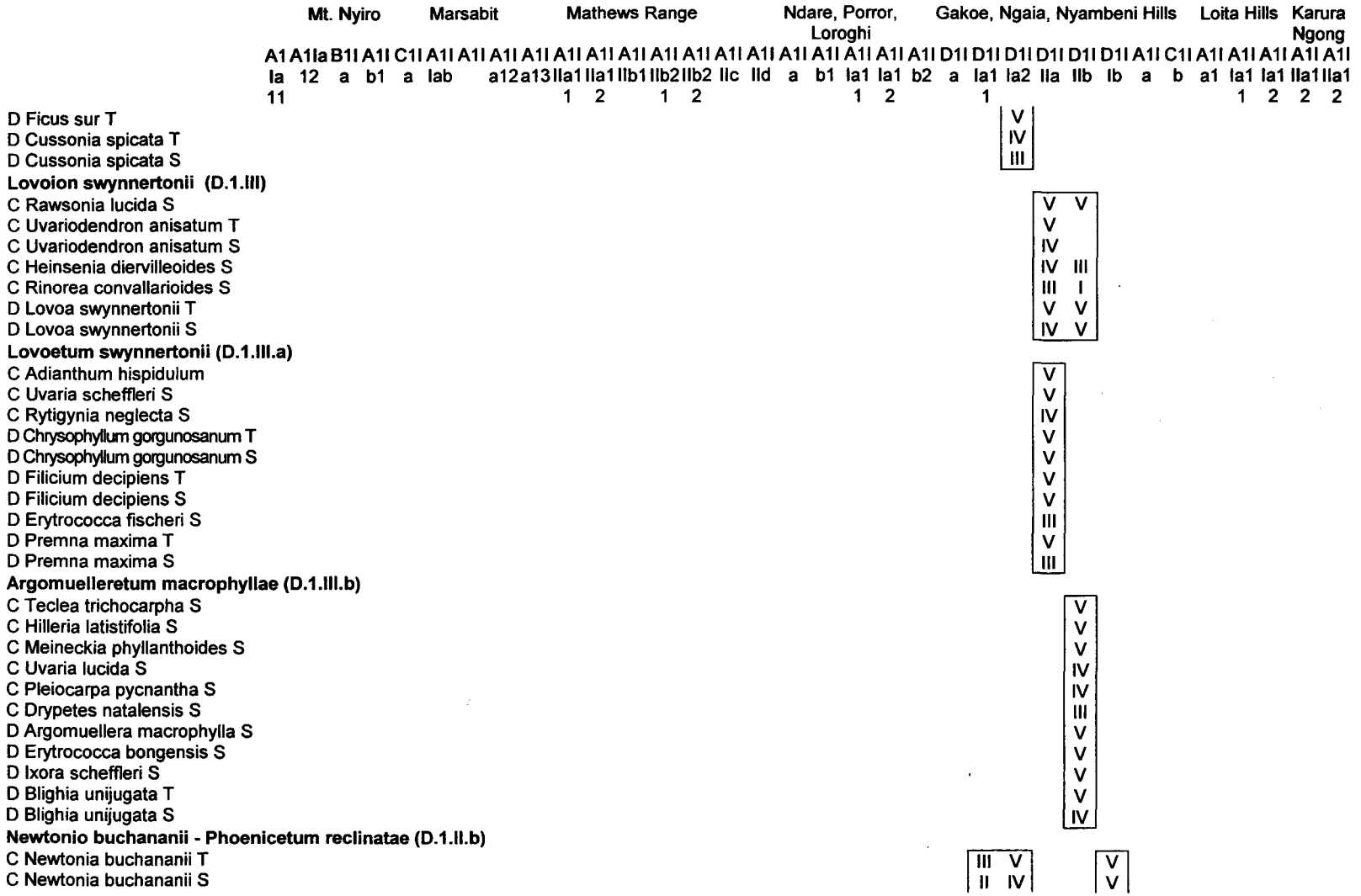

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	Mt. Nyiro					Marsabit		Mathews Range								Ndare, Porror, Loroghi				Gakoe, Ngaia, Nyambeni Hills							Loita Hills		Karura Ngong	
	A1 Ia 11	A1 Ia 12	B1 I a	A1 I b1	C1 I a	A1 I Iab	A1 I a12	A1 I a13	A1 I IIa1 1	A1 I IIa1 2	A1 I IIb1	A1 I IIb2 1	A1 I IIb2 2	A1 I IIc	A1 I IId	A1 I a	A1 I b1	A1 I Ia1 1	A1 I Ia1 2	A1 I b2	D1 I a	D1 I Ia1 1	D1 I Ia2	D1 I IIa	D1 I IIb	D1 I Ib	A1 I a	C1 I b	A1 I a1	A1 I Ia1 1	A1 I Ia1 2	A1 I IIa1 2	A1 I IIa1 2
C Newtonia buchananii																						II	II			V						
D Phoenix reclinata T																						IV	IV			V						
D Phoenix reclinata S																						III	V			IV						

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A./ A.1. Juniperetea/-etalia procerae (Relevés 1–48 in appendix 1, 1–14 in appendix 2, 1–51 in appendix 3, 1–32 in appendix 4, 44–49 in appendix 5, 1–33 in appendix 6 & 1–30 in appendix 7).

In the dry regions of northern Kenya closed forests are restricted to mountain areas and hilltops where mist condensation leads to more humid conditions. *Geranium arabicum*, *Achyranthes aspera*, *Sanicula elata*, *Berberis holstii*, *Stipa dregeana* and *Brachypodium flexum* are commonly growing in the ground layer. *Juniperus procera* is common on Nyiru and Kulal, and in most Central Kenyan forests. On Mathews Range however, *Juniperus* is very rare, growing only in few places at the lower forest limit in the middle and northern part of the mountain, and in some top areas. Bronner (1990) found dense stands of cedar on Uarges Peak, heavily influenced by fire. In the wetter parts of Loroghi, the cedar is found less frequently, as under such conditions broad-leafed species dominate (Bussmann & Beck 1995). In the drier areas of Loroghi, Porror, Maralal and in Ngare Ndare, many old cedar trees encountered are dying, or already dead, with only bare trunks and branches left standing. Only in parts of Mukogodo, *Juniperus* is found in a more healthy state. On top of the Nyambeni Hills neither *Juniperus*, nor any olive trees can be observed. In Southern Kenya typical cedar-forests are encountered on top of the Loita Hills and the nearby Nguruman Escarpment and Namanga Hill.

A.1.I. Juniperion procerae-evergreen xeromorphic montane forests, (Relevés 1–38 in appendix 2, 9–14 in appendix 3, 1–11 in appendix 4, 1–10 & 22–32 in appendix 5, 44–49 in appendix 6, 1–13 in appendix 7).

Many forests of the dry Kenyan North belong to this alliance. The East African olive, *Olea europaea* ssp. *africana* is found only in few areas, particularly on southern Mt Nyiru and the top of Mt Marsabit, forming almost exclusively the about 10 m high canopy in the latter location. In contrast, it is almost absent from the other mountains visited. *Rubus volkensii* and *Rapanea melanophloeos* are important in some areas.

On Mathews Range the pure 'Juniperus-Olea forests' described by Bronner (1990) all belong to the Myrsino africanae-Juniperetum procerae, the typical, fire influenced cedar forests. In the more northern parts of the Range *Olea europaea* ssp. *africana* grows only in some dry areas, in transition to the savannah. On the lower slopes of Nguruman, Loita and Namanga Hill *Olea* is often encountered forming a very dense lower canopy, growing together with a high number of *Cassipourea malosana* and *Podocarpus falcatus* trees. In southern Kenya the humidity is highest on top of the hills, which are mostly covered by mist for a good part of the night until the late morning hours. For this reason, the forest zonation is partly reversed, with the drought resistant cedar forests forming the boundary to the savannah areas. In the lowermost parts the closed tree stands are spliced into islands, more and more fragmented in transition to the grassland, indicating the former location of the natural lower forest limit. The burning of the old grass at the beginning of the wet season to enhance new growth destroys parts of the forests, and leads to the tree islands described. Even small tree circles encountered showed almost no difference in species composition to the closed forest areas.

A.1.I.a. Faureo salignae-Ilicetum mitis (Relevés 1–32 in appendix 2, Relevés 1–11 in appendix 4, 44–49 in appendix 6).

This association dominates many of the mountain areas studied. It is never found in areas with very deep volcanic soils and completely missing from Mt Kulal and Mt Marsabit, growing abundantly on Mt Nyiru, the Ndoto Mountains and Mathews Range. *Faurea saligna*

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is very abundant. Most areas of northern Mathews from 2,200–2,700 m are covered with forests whose canopy is dominated by *Podocarpus latifolius*. *P. falcatus*, restricted to the drier areas, is only rarely found here. In the very dense shrub stratum, *Lepidotrichilia volkensii* is a common feature. The 'Podocarpus forest' described by Bronner (1990)—who differentiated between 'Podocarpus gracilior forest' from 2,000–2,300 m and 'Podocarpus latifolius forest' from 2,300–2,700 m—falls under this association. At lower altitudes, a transition zone to the Crotonetum megalocarpi described below occurs. The Faureo-Ilicetum is the only association of the cedar forests found in Nyambeni. As on Mt Kenya (Bussmann & Beck, 1995), it is restricted to very steep slopes, and *Faurea saligna* as well as *Ilex mitis* occur with high cover/abundance. Old stumps of *Juniperus procera*, and partly *Olea europaea* ssp. *africana* indicate that these forests have been disturbed by selective logging. Growing in transition to the bamboo forests found on the uppermost parts of Nyambeni, the ground layer of the Faureo Ilicetum already contains a number of species from these areas, and the high cover/abundance of *Selaginella kraussiana* is remarkable.

A.1.I.a.1. Faureo salignae-Ilicetum mitis xymaletosum monosporae subass. nov. (Relevés 1–32 in appendix 1, Relevés 1–11 in appendix 3).

The forests of the monosporae are differentiated by the occurrence of *Xymalos monospora*, often forming a dense shrub layer and contributing to the lower canopy. In the shrub layer, *Brucea antidysenterica* and the climbing *Clerodendrum johnstonii*, as well as *Clausena anisata* are encountered. *Pteris quadriaurita, Doryopteris kirkii*, *Clematis brachiata* and *Dicliptera colorata*, and the epiphytic orchids *Polystachya piersii* and *P. confusa* are also characteristic. The most striking feature of these forests is the abundance of very old specimens of *Faurea saligna*, some of which reach a girth of more than 2 m at breast height, indicating that these forests have never been disturbed by logging. Differences in humidity lead to the distinction of two variants in the xymaletosum: Faureo salignae-Ilicetum mitis xymaletosum monosporae-wet variant var. nov. (A.1.I.a.1.1. Relevés 1–27 in appendix 1). Growing mainly on higher altitudes, this variant receives more moisture and has a variety of fern species in the undergrowth. The Faureo salignae-Ilicetum mitis xymaletosum monosporae-dry variant var. nov. (A.1.I.a.1.2. Relevés 28–32 in appendix 1) is found at the lower limit of the Faureo-Ilicetum, in transition to the Myrsino-Junipertum cadietosum purpureae described below, where less drought resistant species, especially Pteridophytes, disappear, leaving an often bare ground. These areas are often grazed by livestock at the beginning of the dry season and weed-like species like *Solanum incanum*, *Pupalia lappacea* and *Pteridium aquilinum*, the latter of which indicating also the influence of fire, occur.

The floristic composition of the Faureo—Ilicetum on Mathews Range shows clear similarities to Mt Nyiru. The typical subassociation is encountered mainly at altitudes from 2,200–2,500 m (relevés 1–6 in appendix 3). At higher altitudes *Schefflera volkensii* dominates clearly the canopy, with *Ilex* as well as *Faurea* becoming much less abundant. In the shrub layer, *Euclea divinorum* forms dense thickets (Faureo salignae-Ilicetum mitis xymaletosum monosporae-Schefflera volkensii facies fac. nov. A.1.I.a.1.3.; relevés 7–11 in appendix 3).

A.1.I.b. Myrsino africanae-Juniperetum procerae (Relevés 34–45 in appendix 1, 9–14 in appendix 2, Relevés 7–10 & 22–32 in appendix 4, 7–10 & 22–32 in appendix 6).

On the drier lower slopes of Mt Nyiru, the Ndoto Mountains and Mt Kulal this association forms the transition zone to the savannah. Fires, either natural—in long

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intervals—or lit by pastoralists and honey hunters have a high influence. *Myrsine africana*, particularly indicating the influence of fire, is found with very high cover/abundance in most areas, often forming a second, lower shrub stratum. This species is missing on Mt Marsabit, where its absence indicates a long period without any fire, also shown by the high cover of *Olea europaea* ssp. *africana*, which has probably replaced *Juniperus procera*, as this species requires fire for successful regeneration. On Mt Kulal similar vegetation types are found in an earlier stage of succession. There fires have obviously been much more abundant (Schultka & Hilger 1983). Mainly young *Juniperus* trees, often growing in island like stands in between heavily grazed pastures occur, and olive, requiring longer absence of fire to grow, is completely missing. In contrast, on Mt Nyiru *Juniperus procera* occurs with high cover and *Nuxia congesta* is frequent in the tree stratum, with *Justicia striata* forming dense groups on the forest floor. The high abundance of *Teclea nobilis* in the shrub layer and the lower tree stratum is also worth mentioning.

In transition to a dense, thorny bushland formed by *Commiphora*, *Grewia* and partly *Acacia* species, the Cadietosum pupureae is encountered on the steep, rocky lower slopes of Mt Nyiru, and also in the Ndoto Mountains. (A.1.I.b.1. Myrsino africanae-Juniperetum procerae cadietosum purpureae subass. nov. figure 2; Relevés 34–45 in appendix 1). Forests of this type are very open, and in parts with frequent fires even the higher shrub stratum has been destroyed. Many *Juniperus* trees in these areas are found dead or dying, and young specimens are rarely observed. In the open shrub stratum, *Cadia purpurea*, *Vangueria apiculata* and the small tree *Cordia monoica* occur. The set of characteristic species is completed by a high number of drought-resistant ferns. *Pellaea alchemilloides*, *Cheilanthes bergiana*, *C. multifida*, *C. tecta* and *C. hirta* are common, whereas the very rare *Asplenium trichomanes* occurs only on some high, shady cliffs. The often high cover/abundance of *Croton megalocarpus* and *Teclea simplicifolia* show clear links to the Brachylaenion huillensis Bussmann 1994, mainly found in central and southern Kenya.

Many parts of Porror Forest and the vicinity of Maralal are found in extremely disturbed conditions. Apart from fires lit by local pastoralists and honey hunters, large areas are also destroyed by fires lit by new farmers when clearing their plots. In line with the much more intensive land use, the populations of livestock, being mainly grazed in the forest, have also increased, leading to the destruction of the ground vegetation. (A.1.I.b.2. Myrsino africanae-Juniperetum procerae rhusetosum natalensis subass. nov. (Relevés 7–10 in appendix 4). Although *Juniperus procera* partly still shows a high cover/abundance, many trees are already dead or dying. *Rhus natalensis*, *R. vulgaris* and *Pluchea ovalis* are often forming dense shrub thickets where the larger trees have disappeared. In the herb layer *Fumaria abyssinica*, *Senecio ruwenzoriensis*, *Pellaea adiantoides*, *Romulea fischeri*, *Fuerstia africana* and *Leucas tomentosa* occur, with *Sporobolus agrostoides* covering large areas. The species composition shows a clear transition from forest to more open and drier savannah and bushland types, with many grassy patches between the tree stands.

Large tracts of Ngare Ndare, Mukogodo and lower Loroghi Forest, which are either in less populated areas, or better protected, are found in a very different state of succession, with a very diverse species composition. (A.1.I.b.3. Myrsino africanae-Junipertum procerae euclenietosum divinori subass. nov. figure 3, Relevés 22–32 in appendix 4). *Juniperus procera* and *Olea europaea* ssp. *africana* often form a dense canopy in these forests, and the many young *Juniperus* trees encountered indicate that the last larger fires must have occurred a good while ago. Under the tree cover *Myrsine africana* and *Rhamnus prinoides* are fairly common, whereas in the more open areas a large set of secondary species is encountered, indicating the transition to a more open forest with many bushes. *Pistacia aethiopica* is often

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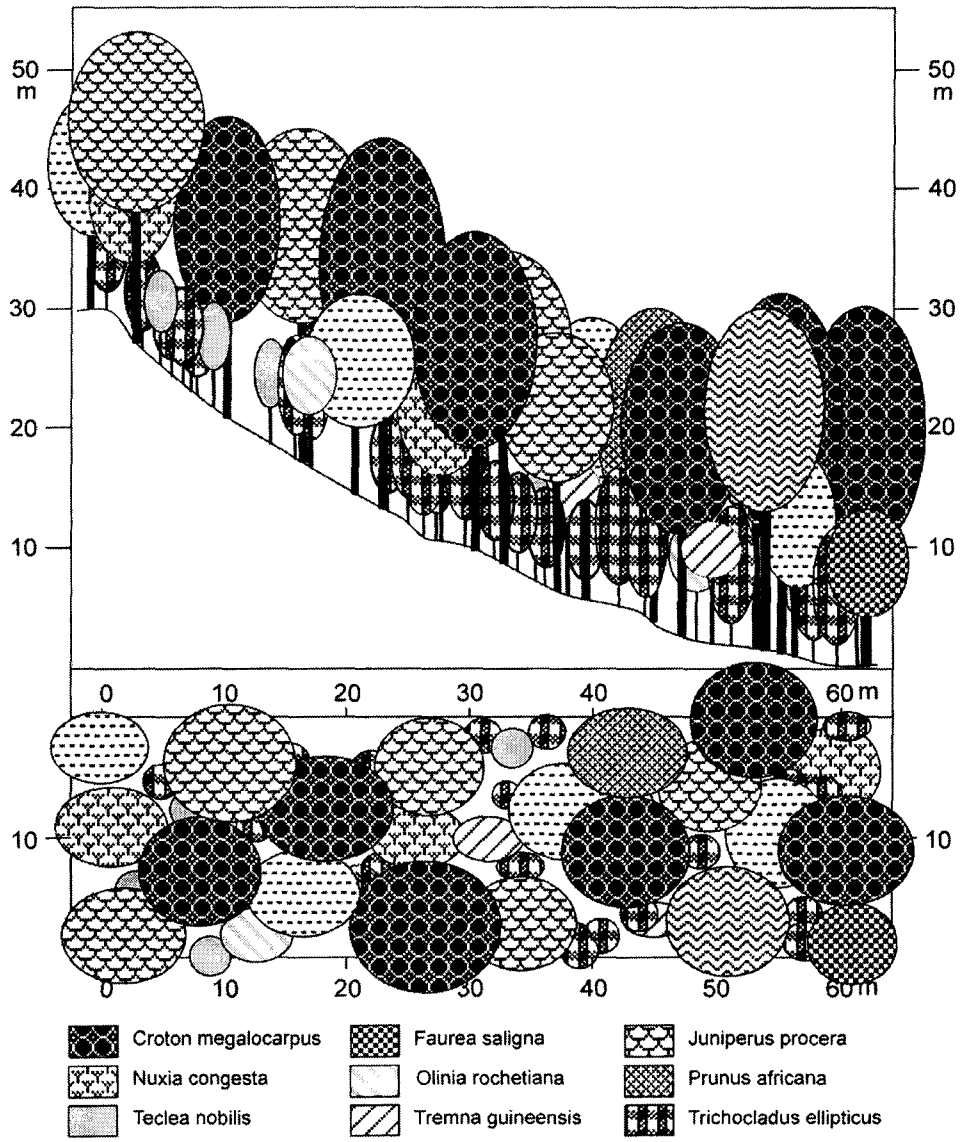

Figure 2. Myrsino africanae – Juniperetum procerae cadietosum purpureae subass. nov. (relevé 45 in appendix 2, UTM 37 259317E/0232465N; 02°06'06"N/36°50'10"E, 2400 m).

growing to the same height as olive. The most striking feature are dense bush thickets, formed by *Euclea divinorum*, *E. racemosa* ssp. *schimperi*, *Carissa edulis*, *Grewia similis* and *Indigofera arrecta*, all of which show clear links to the typical bushland vegetation growing where former forests have been destroyed. Between the bushes *Hibiscus fuscus*, *Monsonia angustifolia*, *Microcoelia moreauae*, *Solanecio nandensis*, *Senecio hadiensis*, and *Ruellia*

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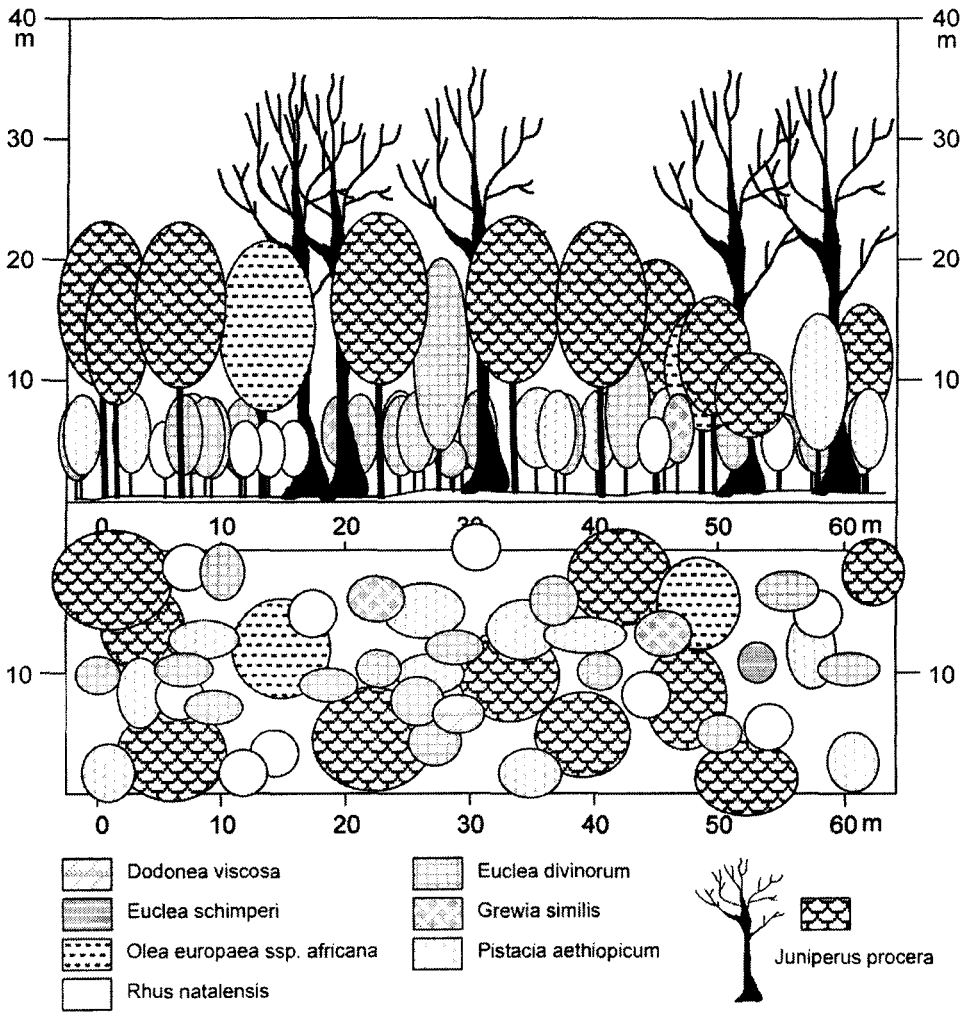

Figure 3. Myrsino africanae – Junipertum procerae euclenietosum divinori subass. nov. (relevé 22 in appendix 5, UTM 37 315000E/019000N; 00°10'19"N/37°20'16"E; 2300 m).

patula occur, together with the climbers *Thunbergia alata* and *T. gregorii*. After the start of the wet season, many geophytes *e.g. Hypoxis villosa*, *Androcymbium melanthoides* and *Crinum macowanii* appear in these forests.

A.1.I.c. Ehrharto erectae-Juniperetum procerae (figure 4, Relevés 1–6 in appendix 5, 1–13 in appendix 6).

On the lower slopes of Loroghi, forest stands with still healthy, very old and tall specimens of *Juniperus procera* occur, often infected by the parasite *Arceuthobium juniperi-procerae*. *Ehrhata erecta* grows frequently. The canopy is very dense, allowing a low

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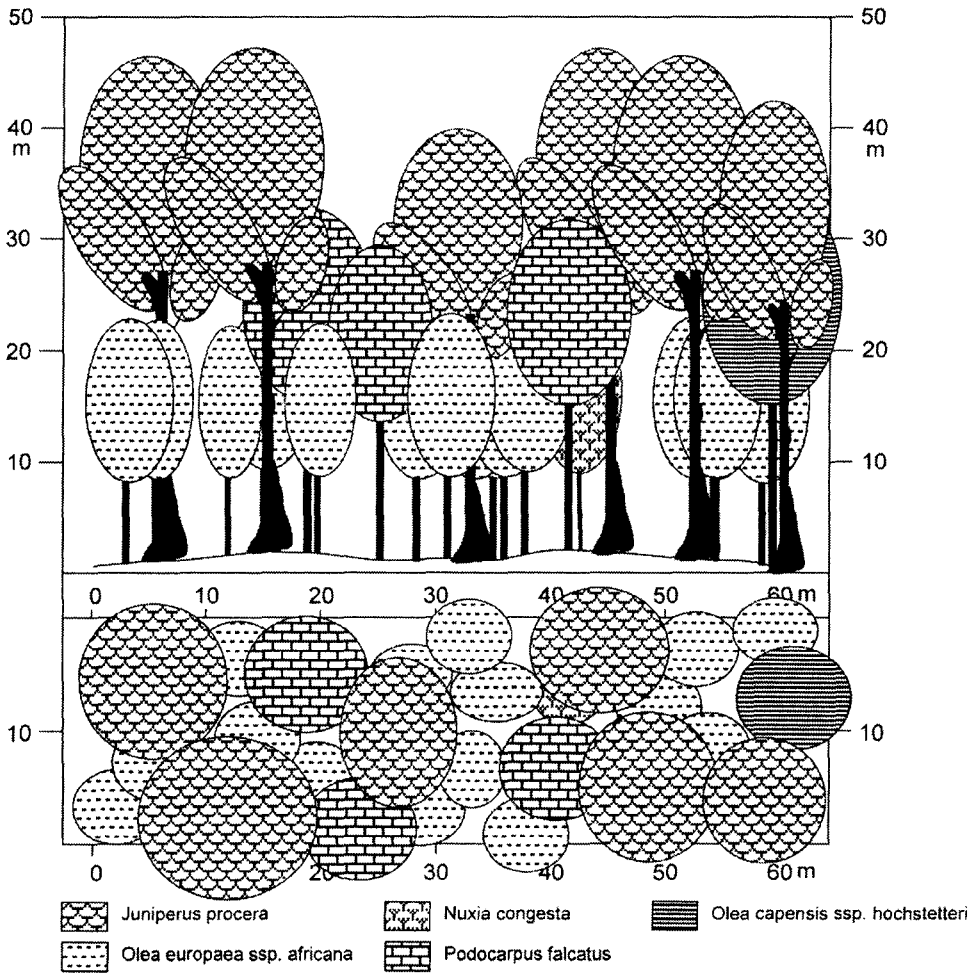

Figure 4. Ehrharto erectae – Juniperetum procerae (relevé 2 in appendix 5, 2100 m).

amount of light to reach the ground. Many trees are often found densely covered with dangling lichens of the genus *Usnea*. *Podocarpus falcatus*, otherwise in this type of cedar forests very uncommon, is found as an important canopy tree with high cover/abundance.

The species composition of the Ehrharto-Juniperetum communities of southern Kenya shows very distinct differences to the subassociations found *e.g.* on Mt Kenya (Bussmann & Beck 1995). (A.1.I.c.1. Ehrharto ercectae-Junipertum procerae warburgietosum ugandensis subass. nov. figure 5; Relevés 1–13 in appendix 6).

Schoenoxiphium lehmannii forms a very dense grass layer and many specimens of *Warburgia ugandensis* as well as the occurrence of often very old and extremely large specimens of *Prunus africana* are a common feature. Of special interest is the high cover/abundance of *Podocarpus falcatus*. This drought resistant species replaces *P. latifolius* in the drier parts of the growth range.

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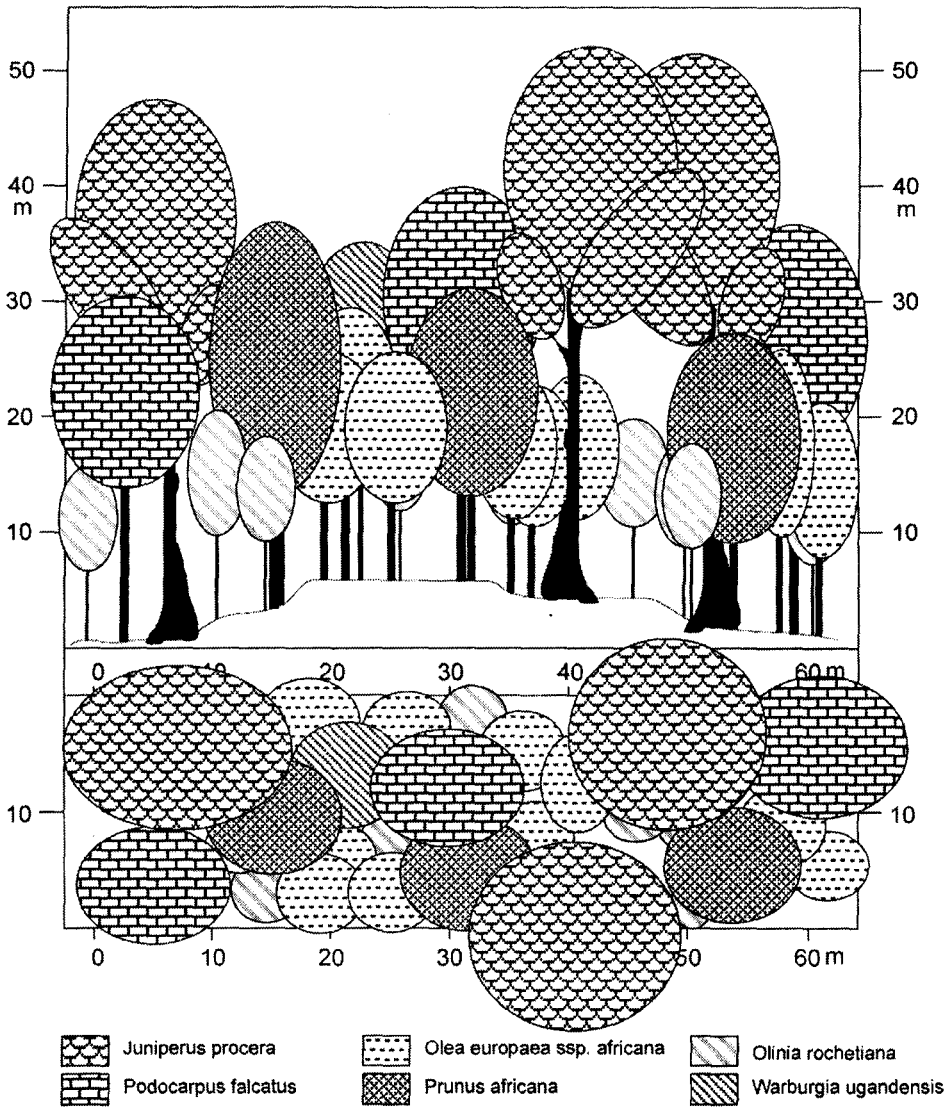

Figure 5. Ehrharto ercectae – Juniperetum procerae warburgietosum ugandensis subass. nov. (relevé 1 in appendix 7, UTM 37 825013E/9791008N; 01°53'18"S/35°55'16"E; 2050 m).

A.1.II. Cassipourion malosanae-evergreen broadleafed montane forests, (Relevés 1–8 in appendix 2, 11–21 in appendix 4, 14–23 in appendix 6).

On the northern Kenyan mountains the Cassipourion with its two tree strata can be found only on the volcanic cones of Mt Kulal and Mt Marsabit. *Ilex mitis*, a character species of this alliance, often reaches high up into the uppermost tree layer on Mt Marsabit, but is notfound on Kulal. *Cassipourea malosana* occurs abundantly on both mountains, also growing in the shrub layer, together with *Olea capensis* ssp. *hochstetteri*. The forests on both mountains show many similarities with *Teclea nobilis* in the lower tree and shrub stratum,

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where species like *Clausena anisata*, *Dovyalis abyssinica* or *Brucea antidysenterica* are also encountered. In the uppermost forests of Loita and Nguruman *Ilex mitis*, growing very tall in some places, is a conspicuous feature in the tree layer and shrub stratum. Most striking is the very high cover of *Cassipourea malosana* dominating the canopy. *Olea capensis* ssp. *hochstetteri*, though much less common, is also encountered, whereas *Juniperus procera* and *Olea europaea* ssp. *africana* are only rarely found.

A.1.II.a. Coffeo arabicae-Rinoreetum convallarioidis ass. nov. (figure 6; Relevés 1–8 in appendix 2).

Completely undisturbed areas covered with this interesting forest type are encountered in large parts of Mt Marsabit and Kulal. The Coffeo-Rinoreetum represents one of the tallest associations of the Cassipourion, with the highest trees forming an about 30–40 m high, closed upper canopy. The most striking feature of these forests is the very dense shrub stratum, which is particularly formed by large bushes of wild coffee (*Coffea arabica*). Besides *Coffea*, a high number of other shrubs are encountered, namely *Rinorea convallarioides, Chionanthus battiscombei, Pavetta abyssinica, Rytigynia neglecta, Erythrococca fischeri, Monodora grandidieri* and *Vepris eugeniifolia,* making the shrub stratum nearly impenetrable in some places. The fleshy cactacean *Rhipsalis baccifera* is dangling from many branches. The ground is often covered by dense mats of the grass *Oplismenus hirtellus* and Acanthaceans as *Justicia betonica* and *Isoglossa lactea.* Of special interest is the occurrence of *Ocotea kenyensis, Casearia battiscombei, Celtis africana* and *C. gomphophylla*, all of them often growing to huge trees, up to 40 m tall, and also regenerating very well in the shrub layer. In the lower canopy and the dense understorey, *Strychnos henningsii* and *S. mitis* grow regularly, and are joined by *Flacourtia indica, Turraea holstii, Erythrococca bongensis, Meyna tetraphylla* and *Cordia monoica.* Many of these species, indicate links of these forests to the coffee-rich forests of southern Ethiopia, particularly to the Bale region (Bussmann, 1997). Large trees like *Strombosia scheffleri, Apodytes dimidiata, Albizzia gummifera, Premna maxima*, as well as *Croton macrostachyus* and especially *Aningeria adolfi-friedericii* are encountered in the upper canopy and in the shrub layer, together with *Ritchiea albersii* These companions are otherwise found in the very humid camphor-forests (Ocotetea usambarensis Bussmann 1994) of central Kenya (Bussmann & Beck, 1995).

A.1.II.b. Tecleo nobilis-Tecletum simplicifoliae (Relevés 11–21 in appendix 4, 14–33 in appendix 6).

All Cassipourea forests in northern Kenya and the Loita Hills in the south belong to this association. *Teclea simplicifolia* grows frequently in the lower tree and the shrub stratum. Most conspicuous is the high cover/abundance of large specimens of *Podocarpus falcatus*, reaching far up in the upper tree storey. In the often very dense bushy undergrowth *Teclea nobilis, Ehretia cymosa, Erythrococca bongensis, Helinus integrifolius, Turraea holstii* and *Aeschynomene schimperi* are found. Among the herbs *Solanum schumannianum, Asplenium linckii*, and *Oplismenus compositus* are characteristic. In many parts of these forests, the vegetation is disturbed by a very high elephant population, cutting wide paths through the undergrowth.

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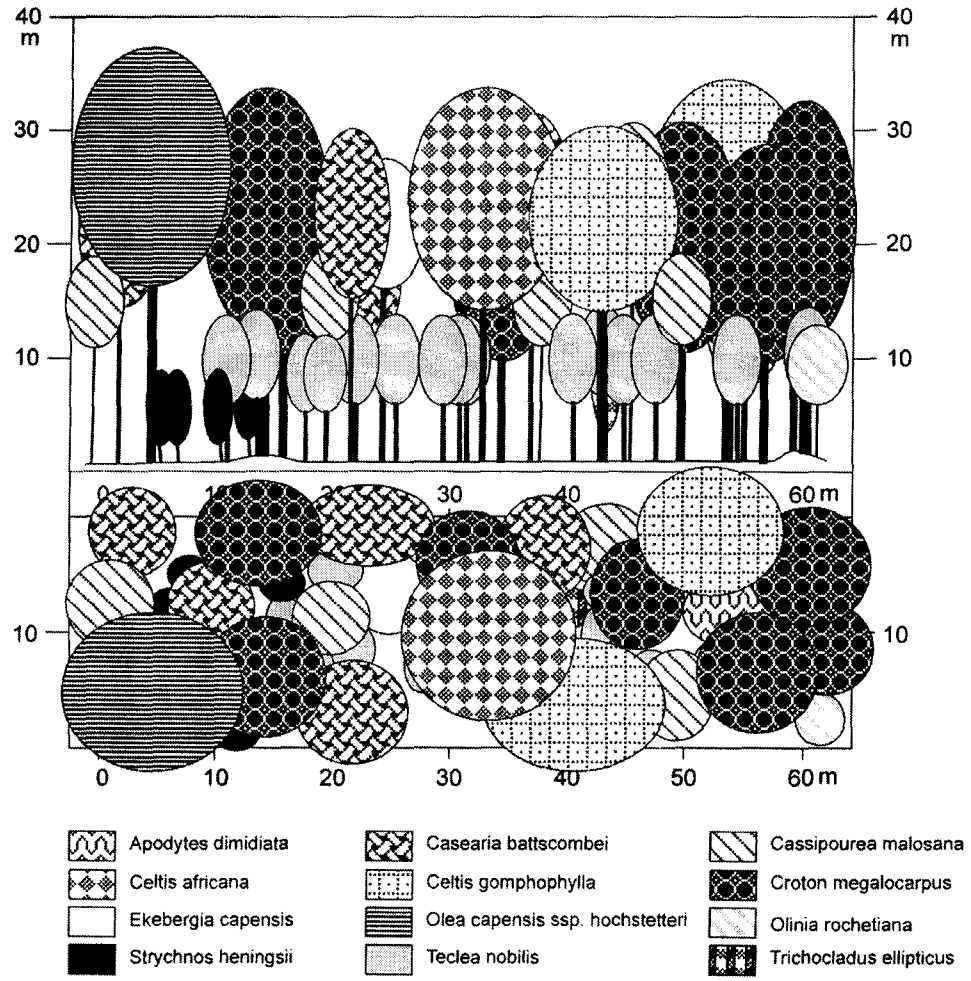

Figure 6. Coffeo arabicae – Rinoreetum convallarioidis ass. nov. (relevé 1 in appendix 3, UTM 37 385098E/0248735N; 02°15'00"N/ 37°58'00"E; 1300 m).

In contrast to south-western Mt Kenya (Bussmann & Beck, 1995), the *Teclea* forests of Loroghi often show a herb layer dominated by the *Dicliptera laxata*, which is covering almost the whole forest floor. Together with *Acanthopale pubescens* and *Vepris glomerata* (A.1.II.b.1. Tecleo nobilis-Tecletum simplicifoliae diclipteretosum laxatae subass. nov. figure 7, Relevés 11–21 in appendix 5). The typical diclipteretosum laxatae is encountered at the border to the cedar forest, with *Juniperus procera* and *Olea europaea* ssp. *africana* still appearing with high cover/abundance, together with *Stipa dregeana*. Cassipourea as well as *Olea capensis* are less dominant or nearly missing, although the first species regenerating very lush in the shrub layer. (A.1.II.b.1.1. Tecleo nobilis-Tecletum simplicifoliae diclipteretosum laxatae typicum Relevés 11–14 in appendix 4). *Dicliptera laxata* itself has its

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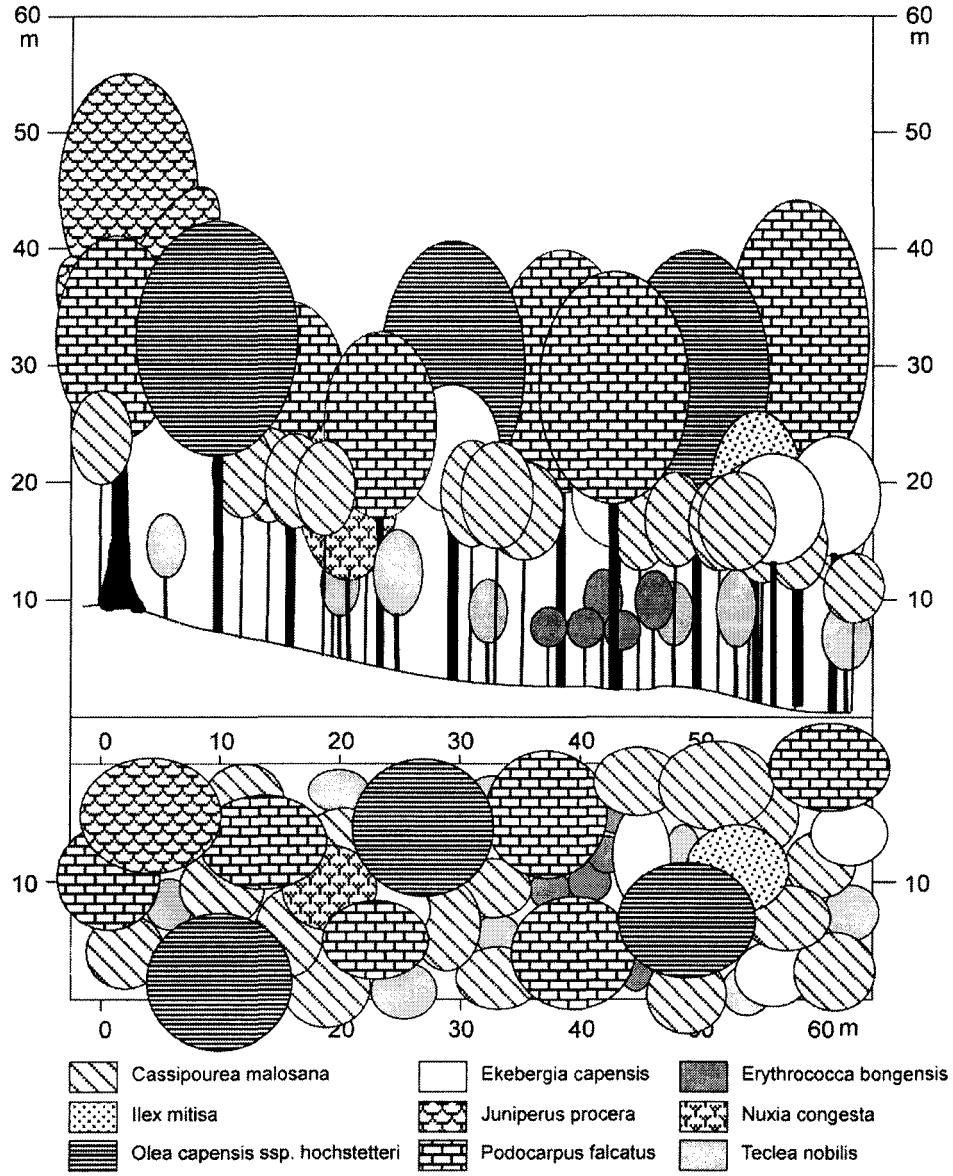

Figure 7. Tecleo nobilis – Tecletum simplicifoliae diclipteretosum laxatae subass. nov. (relevé 11 in appendix 5, UTM 37 257756E/0119810N; 01°04'59"N/36°49'25"E; 2250 m).

by far highest cover/abundance here. *Peperomia tetraphylla* is a very conspicuous feature together with a high number of orchids like the tiny *Stolzia repens*.

Mainly on top of the Loroghi range, under very humid conditions due to the frequent mist cover, *Juniperus* and *Olea europaea* are replaced almost completely by *Cassipourea*, *Olea capensis* and *Podocarpus falcatus*. (A.1.II.b.1.2. Tecleo nobilis-Tecletum simplicifoliae diclipteretosum laxatae-Isoglossa punctata facies fac. nov. Relevés 15–21 in appendix 4). In

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the undergrowth, the abundance of *Acanthopale pubescens* increases, whereas *Dicliptera laxata* is found less frequently, and several other Acanthaceans appear. Of these, *Isoglossa punctata* grows very abundantly, and *Justicia diclipteroides* is also often found. *Acalypha volkensii*, *Aneilema pedunculosum*, *Leucas grandis*, and *Pupalia lappacea* as well as the grass *Panicum maximum*, growing in tussocks almost 2 m tall are further differential species.

The by far largest areas of *Cassipourea* forests encountered in Loita and Nguruman, are characterized by a dense grassy carpet on the forest floor, formed by the trailing *Oplismenus hirtellus*. (A.1.II.b.3. Tecleo nobilis-Tecletum simplicifoliae oplismenetosum hirtelli subass. nov. figure 8; Relevés 14–27 in appendix 6). *Peperomia tetraphylla*, *Solanum sessilistellatum*, *Doryopteris kirkii* and *Girardinia diversifolia* occur in the herbal layer. In the shrub stratum *Tarenna graveolens*, *Vernonia auriculifera* as well as *Ochna insculpta* and *Allophyllus abyssinicus* are characteristic.

In the transition zone to the Ehrharto-Juniperetum warburgietosum ugandensis, the *Cassipourea* forests resemble more the typical stands described from Mt Kenya (Bussmann & Beck, 1995), with a lower cover/abundance of both, *Cassipourea malosana* and *Podocarpus falcatus*, creating an open canopy and a more open shrub stratum, allowing more light to reach the ground. *Nuxia congesta*, *Jasminum abyssinicum*, *Loxogramme abyssinica* or *Cyperus dereilema* are encountered in such places, where *Stipa dregeana* covers large tracts of the forest floor completely. (A.1.II.b.2.1. Tecleo nobilis-Tecletum simplicifoliae-Stipa dregeana facies fac. nov. Relevés 28–33 in appendix 6).

A.1.III. Crotonion megalocarpi all. nov.-deciduous broad-leafed montane forests, (Relevés 12–51 in appendix 2; type: relevé 14, UTM 37 319827E/0165586N; 01°24'58''N/37°22'50''E; 2,100 m).

At the lower extensions of Mathews Range, from 1,500 to 2,200 m, forests with the semi-deciduous euphorbiacean *Croton megalocarpus*, forming an open canopy, are found. Due to the high amount of light reaching the ground, a very diverse herbal flora is encountered in these forests, which also have a dense shrubby undergrowth. The "*Croton* forest", "*Podocarpus gracilior*" forest, and parts of the "*Olea-Juniperus* forest" Bronner (1990), fall within this alliance. *Croton megalocarpus* is the dominant canopy tree. In the dry season, when *Croton* sheds its leaves, these forests are flooded with light. *Panicum monticola* and *Setaria plicatilis* are then forming dense soft carpets on the forest floor. The shrub layer is dominated by *Erythrococca bongensis*, *Flacourtia indica*, *Schrebera alata* and *Phyllanthus fischeri*.

A.1.III.a. Crotonetum megalocarpi ass. nov. (figure 9, Relevés 12–23 in appendix 3; type: relevé 14, UTM 37 319827E/0165586N; 01°24'58''N/37°22'50''E; 2,100 m).
In this association, covering the often steep slopes at altitudes of 1,900 to 2,200 m, *Podocarpus falcatus*, is very common. The most striking species however is *Encephalartos tegulaneus*. Growing up to 8–10 m tall, the palm-like *Encephalartos* gives these forests a primeval appearance. The ground layer is often completely dominated by *Setaria plicatilis*. *Trichocladus ellipticus*, *Pavetta abyssinica*, *Plectranthus longipes* and *Rytigynia acuminatissima* in the shrub stratum, as well as the herbs *Stephania abyssinica*, *Acalypha fruticosa*, *Arisaema mildbreadii*, *Pilea rivularis* and the fern *Arthopteris orientalis*, are indicators for the humid conditions prevailing in these forests. In some rocky places *Encephalartos* appears much less abundant. In the herbal stratum the drought tolerant ferns *Cheilanthes multifida* and *Doryopteris kirkii* are found besides *Cyathula polycephala* and *Notonia abyssinica*. (A.1.III.a.1.2. Crotonetum megalocarpi-Cheilanthes multifida variant var. nov. Relevés 19–23 in appendix 3).

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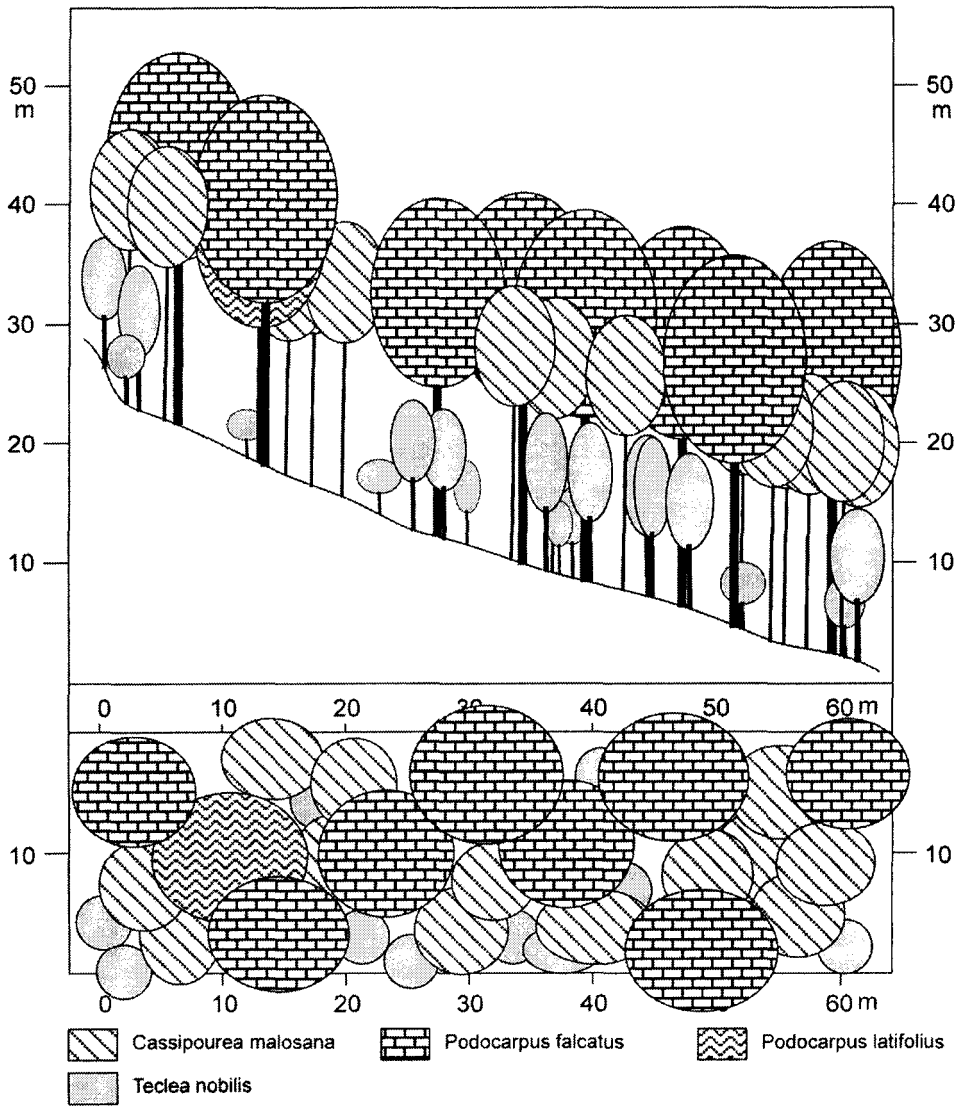

Figure 8. Tecleo nobilis – Tecletum simplicifoliae oplismenetosum hirtelli subass. nov. (relevé 14 in appendix 7, UTM 37 825947E/ 9795004N; 01°51'08"S/35°55'46"E; 2150 m).

A.1.III.b. Crotono megalocarpi-Tecletum simplicifoliae ass. nov. (Relevés 24–40 in appendix 3; type: relevé 37, UTM 37 319054E/0156433N; 011°24'53''N/ 37°33'25''E; 1,850 m).

On the lower slopes, mostly from 1600 to 1900 m, *Podocarpus falcatus* as well as other species of the Crotonetum megalocarpi disappear due to the drier conditions and more drought tolerant species start growing. *Setaria plicatilis* is mostly replaced by *Panicum monticola*. The shrub stratum gets richer in species with *Strychnos henningsii*, *S. mitis* and *S. usambarensis* appearing with high cover/abundance, making the understorey much denser than in the previous association. The high number of different Acanthaceans in the herbal

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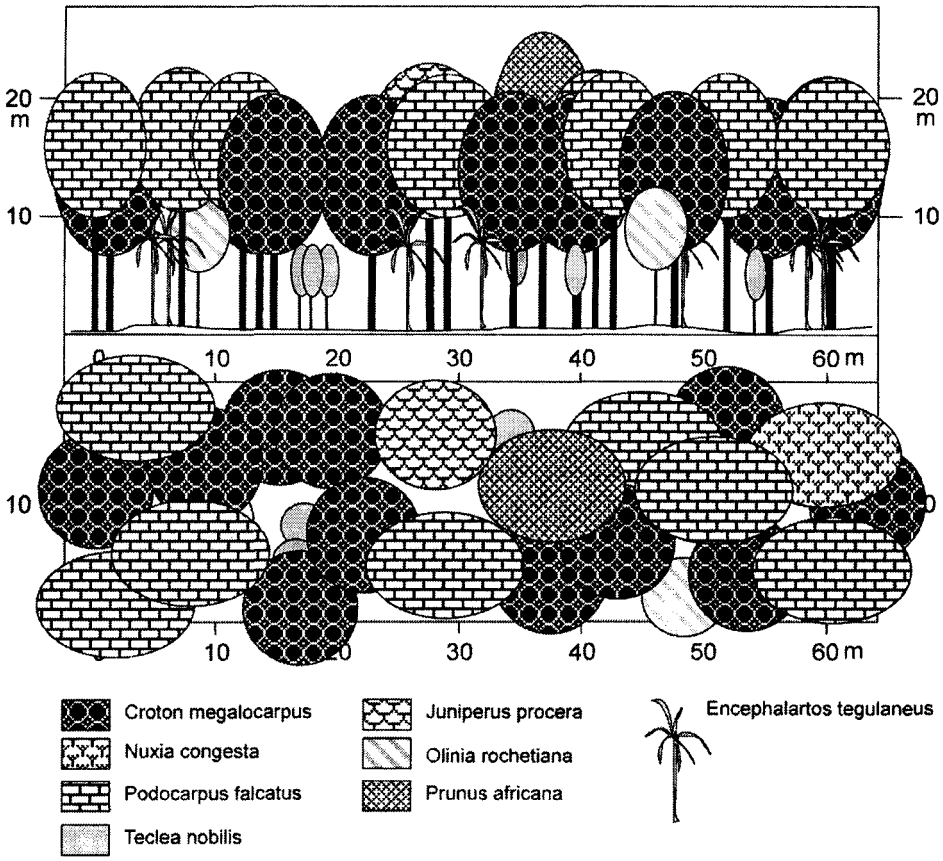

Figure 9. Crotonetum megalocarpi (Relevés 12-23 in appendix 1; type: relevé 14, UTM 37 319827E/0165586N; 01°24'58"N/37°22'50"E; 2100 m).

stratum is the prominent feature in the Crotono-Tecletum. *Teclea simplicifolia, Justicia nyassana, Isoglossa laxa, Justicia calyculata* and *Asystasia gangetica, Leucas glabrata, Hibiscus lunulariifolius, Psychotria kirkii* and *Dracaena laxissima* are differential species in this association. Where the transition to the lower bushland takes place, *Acacia brevispica* Harms and *Isoglossa lactea* occur frequently. (A.1.III.b.1. Crotono megalocarpi-Tecletum simplicifoliae acacietosum brevispicatae subass. nov., figure 10, Relevés 24–29 in appendix 3).).

Many wide paths and dung deposits indicate that these areas are very often visited by big game, especially elephants and buffaloes.

In places where *Teclea simplicifolia* grows with high cover/abundance, the amount of light is diminished considerably and the more light loving species are replaced by more shade-tolerant taxa. (A.1.III.b.2.1. Crotono megalocarpi-Tecletum simplicifoliae-Argomuellera macrophylla variant var. nov. figure 11, Relevés 30–34 in appendix 3). *Argomuellera macrophylla, Solanecio mannii* and *Dracaena steudneri* are dominant in the shrub stratum, and *Panicum maximum, Barleria micrantha, Aneilema leiocaule* and *A. aequinoctiale* in the herbal layer.

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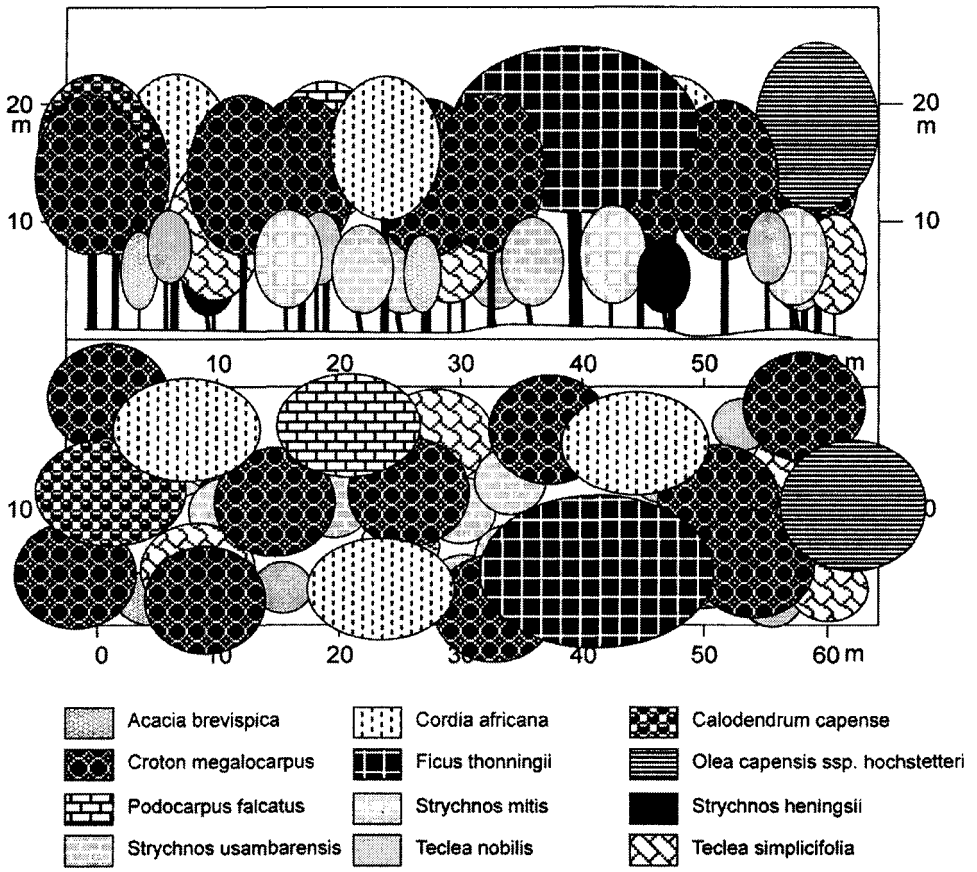

Figure 10. Crotono megalocarpi - Tecletum simplicifoliae acacietosum brevispicatae (Relevés 24-29 in appendix 1; type: relevé 25, UTM 31318591E/0156802N; 01°25'05"N/37°22'10"E; 1600 m).

Hibiscus urticifolius, *Cadaba farinosa* and *Becium capitatum*, and the large *Vernonia lasiopus* and *V. auriculifera*, as well as the liana *Hippocratea africana*, differentiate another subassociation (A.1.III.b.2.2. Crotono megalocarpi-Tecletum simplicifoliae typicum subass. nov. Relevés 35–40 in appendix 3).

A.1.III.c. Bauhinietum tomentosae ass. nov. (figure 12, Relevés 41–45 in appendix 3; type: relevé 41, UTM 37 318837E/0155420N; 01°24'20''N/37°22'18''E; 1,650 m).

Directly at the border to the savannah areas, at altitudes around 1,500 m, the *Croton* forests are more and more open, with the trees growing less tall. In these places, the Camel's Foot, *Bauhinia tomentosa*, completely dominates the understorey, making it impenetrable in places. Due to the high number of big game using these forests as resting places on their way to their grazing areas, herbs like *Hypoestes forskahlii* are commonly found. *Chaetacme aristata*, *Craibia laurentii*, *Psydrax schimperiana* and *Cleome schimperi* are characteristic. The sausage tree, *Kigelia africana*, marks the transition to the savannah most clearly,

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together with *Erythrococca fischeri*, *Ocimum gratissimum*, *Pterolobium stellatum*, *Pellaea longipilosa* and *Craterostigma pumilum*. Many small commelinaceans like *Commelina latifolia*, *C. imberbis* and *C. africana*, are covering the ground together with sedges, *e.g. Kyllingia comosipes*, *Cyperus bulbipes*, *Cyperus pinguis* and *Cyperus oblongus* ssp. *flavus*. *Myrsine africana*, indicates the influence of fire in the Bauhinietum.

A.1.III.d. Phoenicetum reclinatae ass. nov. (Relevés 46–51 in appendix 3; type: relevé 46, UTM 37 319424E/0155051N; 01°24'08''N/37°22'37''E; 2,550 m;).

Fires, probably caused by honey hunters, led to the establishment of a very unusual forest type found in some places around the Mathews Peak region, where the wild datepalm *Phoenix reclinata* is found forming a 6–10 m tall, open canopy of its own, and is also growing in very dense groups in the shrub stratum. The accompanying flora consists mainly of drought resisting savannah species like *Vangueria infausta*, *Indigoferra arrecta*, *Clutia abyssinica*, *Rhus vulgaris*, *Vangueria apiculata*, *Pavonia urens*, *Sericocomopsis hildebrandtii*, *Glycine wightii*, *Leucas grandis* and *Pupalia lappacea*, *Sporobolus agrostoides*, *Eragrostis superba*, *Digitaria velutina* and *Chloris roxburghiana*.

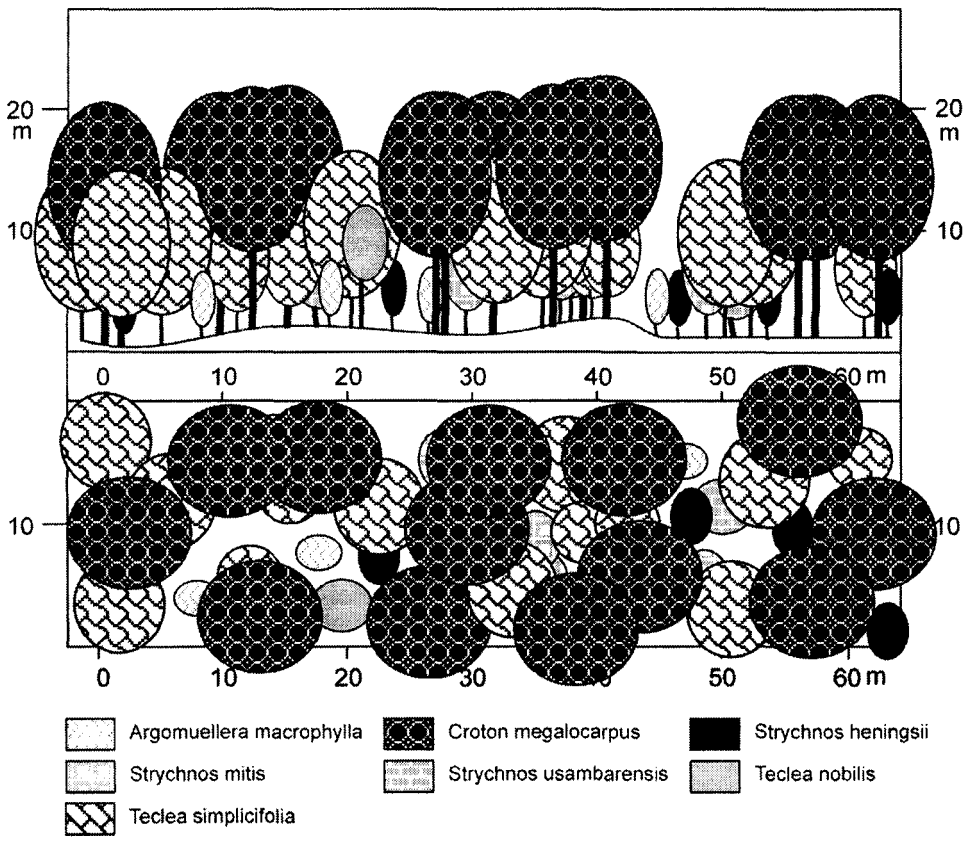

Figure 11. Crotono megalocarpi - Tecletum simplicifoliae - Argomuellera macrophylla variant (Relevés 30-34 in appendix 1; type: relevé 33, UTM 37 319672E/ 0156033N; 01°24'40"N/37°22'45"E; 1800 m).

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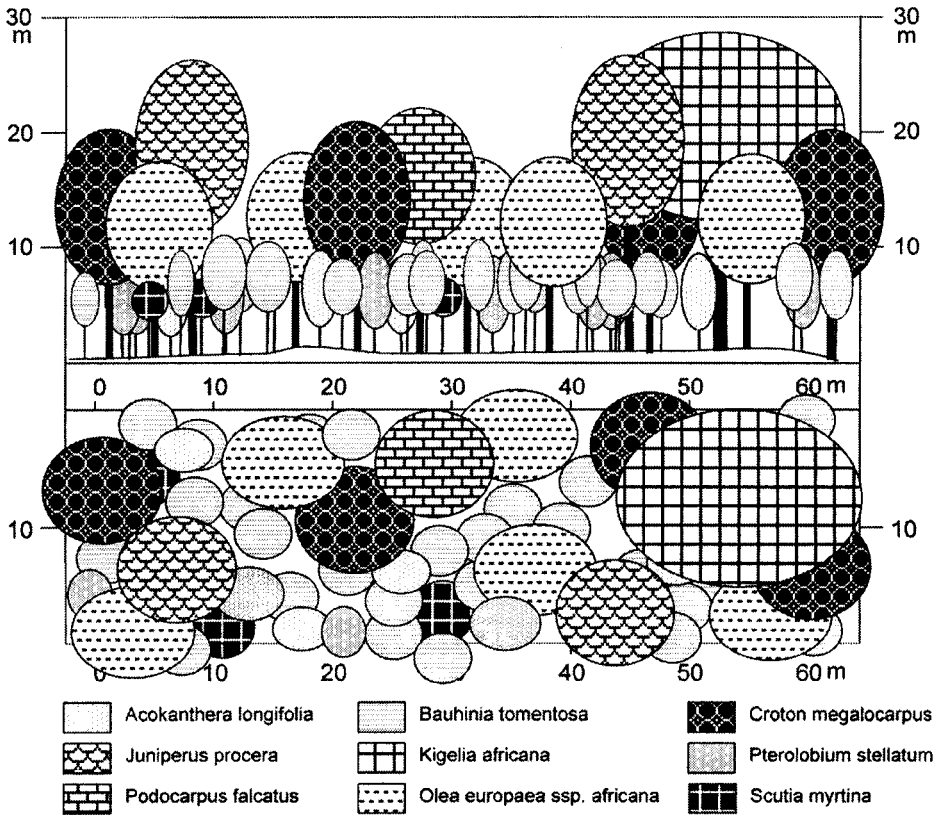

Figure 12. Bauhinietum tomentosae (Relevés 41-45 in appendix 1; type: relevé 41, UTM 37 318837E/0155420N; 01°24'20"N/37°22'18"E; 1650 m).

A.1.IV. Brachylaenion huillensis-deciduous broadleafed submontane forests (Relevés 1-30 in appendix 7).

In the first comprehensive syntaxonomic treatment for a forest area in East Africa (Bussmann & Beck 1995), the Brachylaenion huillensis with its single tree stratum, rarely reaching higher up than 20 m, was described from the Nyeri-Kiganjo area on the south-western footslopes of Mt Kenya. It included two associations, the Crotono megalocarpi-Brachylaenetum huillensis and the Elaeodendro buchananii-Brachylaenetum huillensis. Only small remnants of these forests had been found, and based on this material, it was not possible to clarify the syntaxonomic position of the Brachylaenion. The species composition encountered in other areas shows high similarities to those of Mt Kenya. As the climatic and edaphic conditions do not vary much between Nairobi and south-western Mt Kenya, it has to be assumed that this vast area, now used agriculturally, was formerly covered by such forests. The former existence of such forests in this region is already mentioned by Hoehnel, who visited the area in 1885 and wrote: "There is no doubt, that the whole of Kikuyuland... a stretch of land from about eight to eleven miles breath between Ngongo Bagas (Ngong Hills, south of Nairobi) and Kenya (Mt Kenya) is once densely wooded, but the industrious natives have cleared almost every trace of the forest from the interior, leaving only a belt as

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frontier buttress from one to two hours march deep" (Hoehnel 1894). The term "densely wooded" describes the very open Brachylaena forests, with their often open undergrowth very well. The accompanying flora of the Brachylaenion, in particular the scattered occurrence of *Olea europaea* ssp. *africana*, *Maytenus undata*, *Schoenoxiphium lehmannii*, *Asparagus setaceus*, *Scutia myrtina* and *Stipa dregeana* among others, clearly have to be seen as a link of this alliance to the Juniperion procerae. On the other hand, companions like *Cassipourea malosana*, *Ficus thoningii*, *Clausena anisata*, *Allophyllus abyssinicus*, as well as *Ekebergia capensis* and *Erythrococca bongensis*, depict connections to the Cassipourion malosanae. Therefore, it is clear now, that the Brachylaenion huillensis is a very distinct alliance of its own, but shows relations to the other two alliances described for the Juniperetea/ -etalia procerae, and therefore, without any doubt, belongs to this order and class as higher syntaxa.

In the Nairobi forests *Calodendrum capense* as well as the shrubs *Maytenus heterophyllus*, *Euclea divinorum* and *Drypetes gerrardii* are found as characteristic species of the alliance. *Brachylaena huillensis* and *Croton alienus* appear with the same cover/abundance in the canopy as on Mt Kenya. The tree stratum is partly formed by *Acokanthera schimperi,* of which many seedlings are also found in the understorey.

Crotono megalocarpi-Brachylaenetum huillensis

Especially in Karura Forest near Nairobi, *Croton megalocarpus* is found with high cover/abundance. Together with *Grewia similis* this species is differential for the Crotono-Brachylaenetum. A comparison with the data from Mt Kenya (Bussmann & Beck, 1995) depicts that this association typically includes more disturbed forests, shown by the occurrence of secondary species such as *Ocimum lamiifolium*, *Leucas martinicensis*, *Celosia anthelmetica* and *Pterolobium stellatum*. Most Brachylaenion remnants in central Kenya already represent secondary forests. Most undisturbed areas near Nairobi fall within the following association:

A.1.IV.a. Elaeodendro buchananii-Brachylaenetum huillensis (Relevés 1–30 in appendix 7).

In the typical Elaeodendro-Brachylaenetum stands near Nairobi *Teclea simplicifolia* occurs with a very high cover in the tree stratum, and in some places also forms dense thickets in the shrub layer, however in Karura it is much less dominant than in Ngong. *Ochna insculpta* is found more scattered everywhere. *Elaeodendron buchananii* grows very abundantly in all forests investigated. *Teclea trichocarpha* in contrast is only dominant in the *Chaetacme aristata* facies described below, which in general show a much denser undergrowth. This is also the case for the herb stratum, which consists to a large extent of dense grassy carpets, in which *Oplismenus burmannii* appears with high cover, except for Ngong Road Forest. Among the companions, *Schoenoxiphium lehmannii* has to be mentioned especially, as this species grew often in dense stands in all forest areas. The acokantheretosum longifoliae, with the shrubby *Acokanthera longifolia*, as well as *Gnidia subcordata* and *Cassipourea rotundifolia* in the undergrowth, with the latter species and *Manilkara discolor* reaching the tree stratum, has to be regarded as the type of *Brachylaena* forest, which was probably, formerly, most common. (A.1.IV.a.1. Elaeodendro buchananii-Brachylaenetum huillensis acokantheretosum longifoliae subass. nov. Relevés 1–30 in appendix 7). Its accompanying flora shows clear links to other drier forest types in the north of Kenya, in particular on Mt Marsabit and southern Ethiopia (Bussmann 1997). *Warburgia ugandensis*, *Celtis africana*, as well as *Strychnos henningsii* are important companions in the canopy stratum. In the understorey, *Strychnos*, together with *Suregada procera*,

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Erythrococca bongensis, *Chionanthus battiscombei*, *Albizzia gummifera*, *Rawsonia lucida* and *Diospyros abyssinica* are often found. In some places, the liana *Hippocratea africana* covers large parts of the thickets. In Ngong Road Forest, the ground is often found covered densely by *Phyllanthus ovalifolius*. *Vernonia holstii*, *Hibiscus corymbosus*, and *Barleria micrantha* grow in dense groups in the herbal stratum. (A.1.IV.a.1.1. Elaeodendro buchananii-Brachylaenetum huillensis acokantheretosum longifoliae-Phyllanthus ovalifolius facies fac. nov. figure 13, Relevés 1–13 in appendix 7). In the understorey, *Ochna ovata* is

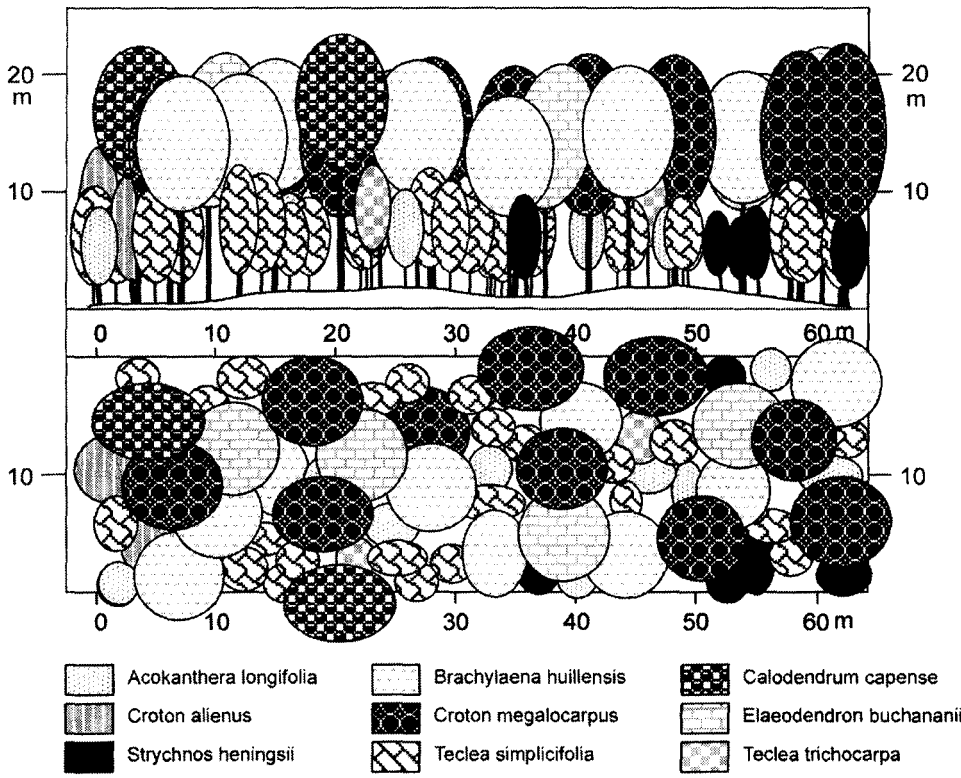

Figure 13. Elaeodendro buchananii – Brachylaenetum huillensis acokantheretosum longifoliae – Phyllanthus ovalifolius facies fac. nov. (relevé 13 in table 1, UTM 37 259000E/9863000N; 01°14'19"S/ 36°50'03"E; 1860 m).

found regularly and *Schrebera alata* adds to the shrub stratum. The ground layer consists mainly of herbs, occasionally interspersed with the prickly *Asparagus africanus*, and often bare areas covered with dead leaves could be observed. Among the shrubs, *Trema orientalis*, *Mystroxylon aethiopicum*, *Ehretia cymosa* and *Fagaropsis angolensis* are found and in some places the endemic parasite *Viscum fischeri* is encountered.

Being less shaded from the canopy trees, the ground of the Chaetacme aristata facies, prevailing in Karura, is frequently covered with a deep and dense grass layer of *Oplismenus*

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burmannii and *Panicum maximum*. (A.1.IV.a.1.2. Elaeodendro buchananii-Brachylaenetum huillensis acokanther-etosum longifoliae-Chaetacme aristata facies fac. nov. figure 14, Relevés 14–30 in appendix 7). *Adenia gummifera is* encountered climbing in the shrub stratum, which consists mainly of *Chaetacme aristata* and *Strychnos usambarensis*, although *Craibia brownei*, *Uvaria scheffleri* and *Teclea hanangensis* are also observed. *Teclea* also contributes to the tree stratum, in which *Markhamia lutea* and *Zanthoxyllum usambarense* are frequent.

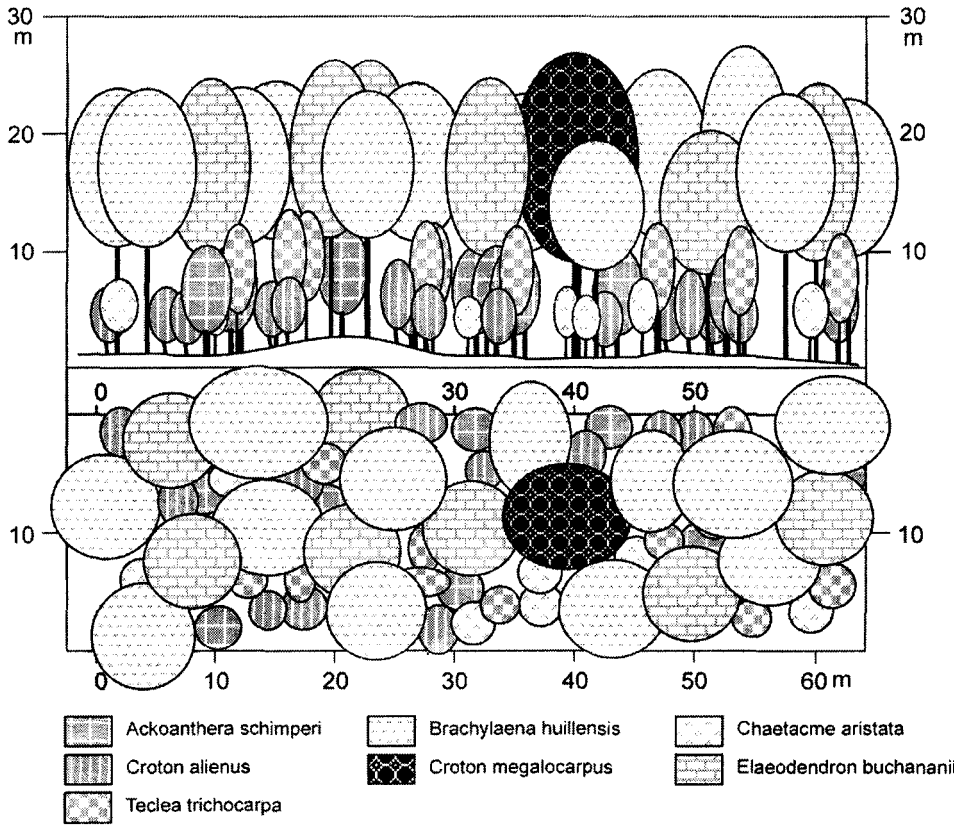

Figure 14. Elaeodendro buchananii – Brachylaenetum huillensis acokantheretosum longifoliae – Chaetacme aristata facies fac. nov. (relevé 20 in table 1, UTM 37 255500E/9854500N; 01°18'55"S/ 36°48'10"E; 1790 m).

B./ B.1./ B.1.I. Hagenietea/Hagenietalia abyssinicae/Hagenio abyssinicae-Hypericion revoluti-evergreen subalpine Kosso forests, (Relevés 33–38 in appendix 1).

Many large grassy clearings are found on top of Mt Nyiru. Small villages, used by Samburu pastoralists during the dry season, indicate that these areas are heavily grazed. At the borders of the grasslands, and partly as islands in between, dense thickets of St John's worth (*Hypericum revolutum*) are growing together with young specimens of *Juniperus procera*. The high cover/abundance of *Hypericum* indicates that these forests belong to the Hagenietea/Hagenietalia abyssinicae/Hagenio abyssinicae-Hypericion revoluti. Whether *Hagenia abyssinica* has ever grown in these areas itself remains an enigma as no Kosso trees

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are found any more. The high cover of young *Juniperus* trees of the same age has to be regarded as sign of a very large fire about 10 years ago, according to their size. Only few dead specimens of old cedars are found. It has to be assumed, that in the successional process, the Hagenio-Hypericion on Nyiru will probably be replaced by the Myrsino-Juniperetum, especially with regard to the more frequent use of the area as dry season pasture, leading to more frequent burning. At present, despite the growing influence of *Juniperus*, the Thymeleacean *Gnidia glauca* still dominates the canopy of these forests, often forming closed stands about 8 m tall. Therefore, the topmost forests of Mt Nyiru clearly belong to the Gnidietum glaucae (B.1.I.a.; figure 15; Relevés 33–38 in appendix 1).

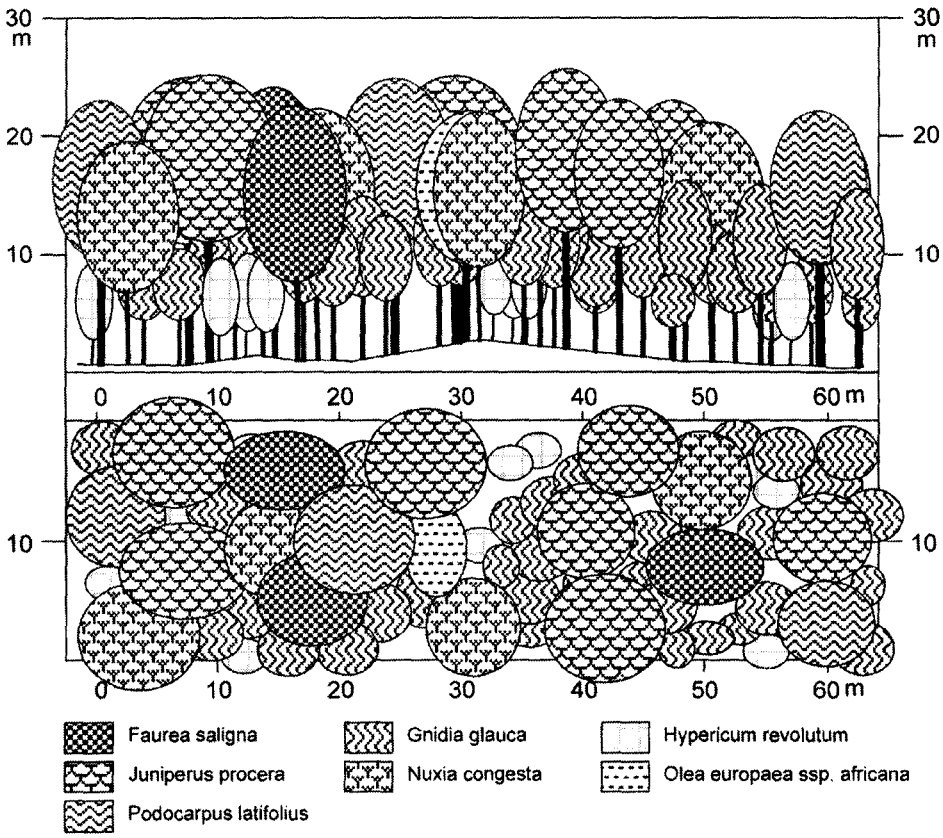

Figure 15. Gnidietum glaucae (relevé 37 in appendix 2, 2550 m).

C./ C.1./ C.1.I./ C.1.I.a. Sinarundinarietea/Sinarundinarietalia/Sinarundinarion alpinae-Podocarpo latifolii-Sinarundinarietum alpinae-evergreen montane bamboo forests, (Relevés 46–48 in appendix 1, 50–54 in appendix 5).

The East African bamboo, *Sinarundinaria alpina*, is known to cover vast areas of the wet southern and south-eastern slopes of Mt Kenya, the Aberdare and Mau Ranges. In other areas of the country however, due to the normally much drier climate, the species occurs only rarely. In northern Kenya, bamboo is nearly absent. In places of Nyiru and Nyambeni with the highest amount of condensing mist, *Sinarundinaria alpina* is encountered forming dense stands up to 6–8 m tall. These bamboo forests are very similar to the ones described

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from western Mt Kenya (Bussmann & Beck, 1995), with *Podocarpus latifolius* frequently protruding from the closed bamboo stands (Podocarpo latifolii-Sinarundinarietum alpinae). All stands studied were very dense, with only a small amount of light reaching the ground, often being bare of vegetation. Paths of large game, *e.g.* elephants and buffaloes, which are very frequent in the main growing areas of bamboo, are not found in the north, making the bamboo forests nearly impenetrable. The presence of *Sinarundinaria* on Mt Nyiru has to be regarded as of special importance with respect to the biogeography of the species. The Nyiru population can be interpreted as a link of the main growing area of the species to the bamboo stands found on the southern slopes of the Bale mountains in southern Ethiopia, about 500 km further north (Bussmann, 1997).

In Nyambeni, the dark forest floor is densely covered with *Selaginella kraussiana*, with many large tussocks of *Cyperus dereilema* growing in between. Of special interest is here the high cover/abundance of *Schefflera volkensii* in the canopy, which until now could not be observed anywhere else. Still many species of the drier cedar-forests, *e.g. Stipa dregeana* are found in the bamboo forests of Nyambeni, indicating that there the bamboo is probably at the outer limit of its distribution, and its growth is already hindered by the drier conditions. The Sinarundinario-Podocarpetum there seems to be a transition between the very wet bamboo forests on southern Mt Kenya and the Aberdare Range, and the very dry bamboo relicts on northern Mount Kenya.

D. Ocotetea usambarensis-evergreen broadleafed submontane Camphor forests, (Relevés 1–43 in appendix 5).

Large parts of the Nyambeni Hills, as well as the submontane and lower montane Aberdare Range and the Ngaia area were formerly covered with camphor-forests. Most of the forests show a high degree of similarity to the nearby Ocotetea usambarensis of Mount Kenya (Bussmann & Beck 1995), forming the same two-storied tree layer with a partly dense understorey of shrubs. Especially the Gakoe forest has an almost identical species composition. *Strombosia scheffleri*, *Macaranga kilimandscharica* and *Apodytes dimidiata* are found as tall trees in the upper storey, as well as in the lower tree strata and the undergrowth, whereas other woody species like *Tabernaemontana stapfiana*, *Peddiea fischeri* and *Ochna insculpta* occur only in the lower strata, which are much less dense than on Mt Kenya. In the open herbal layer *Piper capense* and *Begonia meyeri-johannis* are found in many areas, whereas *Plectranthus luteus* and *Cyphostemma kilimandscharicum*, appear only scattered. *Dryopteris kilimensis*, *Blotiella stipitata, Elaphoglossum lastii*, *Trichomanes borbonica*, *Asplenium theciferum* and *Oleandra distenta* are encountered regularly. *Oplismenus hirtellus* often covered nearly the complete forest floor with dense cushions. *Ocotea usambarensis* is mainly found in Gakoe forest, and appears more scattered in the other areas. In Nyambeni, many rotting stumps of this species indicated heavy logging activities, whereas in Ngaia, *Ocotea* probably always was a rare species. *Lasianthus kilimandscharicus*, *Psychotria orophila*, *Xymalos monospora* and *Pauridiantha holstii* form dense thickets in the shrub stratum, the first species also reaching the lower tree layer. *Asplenium sandersonii* appears as common epiphyte especially on the bent trunks of *Ocotea*, and *A. elliottii*, as well as *Panicum calvum* are found in the herbal layer.

D.1. Syzygetalia guineensis (Relevés 1–43 in appendix 5).

All *Ocotea*-forests in the studied areas belong to this order, and the shrubby *Diospyros abyssinica* and *Psydrax schimperiana* are commonly encountered. *Syzygium guineense* and *Aningeria adolfi-friedericii* form a partly dense upper tree storey, reaching up more than 40

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m. Besides these two species, a variety of shrubs, namely *Drypetes gerrardii* and *Allophyllus cuneatus*, together with the lianas *Adenia gummifera* and especially *Jaundea pinnata* occur.

D.1.I. Cyathion mannianae (Relevés 1–12 in appendix 5).

The camphor-forests encountered in Gakoe clearly belong to the Cyathion mannianae, although in comparison to Mt Kenya, these forests are found in much wider valleys, under more open conditions, and are clearly poorer in species. *Lobelia baumannii* and the tree ferns *Marattia fraxinea*, in many areas damaged by elephants feeding on the starch-rich trunk, and particularly *Cyathea manniana*, often grow in dense clumps and forming an own stratum about 5–7 m tall.

D.1.I.a. Albizzietum gummiferae (Relevés 1–12 in appendix 5).

The syntaxonomic position of this taxon has proven to be difficult in the forests of Mt Kenya (Bussmann & Beck 1995), as it occurs only in a few remote areas. The main area of this association—presumably the lower submontane zone—had long been destroyed for agricultural use, and the remaining forest patches often showed an intermediate position between the Cyathion mannianae and the Zanthoxyllion gillettii. In Gakoe, undisturbed forests at low altitudes, clearly belonging to the Albizzietum gummiferae are encountered, with *Albizzia gummifera* as character species appearing with a high cover/abundance. In these areas, nearly no species relating to the Zanthoxyllion gillettii are found, depicting even more clearly the intermediate character of the forests studied on Mt Kenya. Based on the new material, especially with *Cyathea manniana* and *Marattia fraxinea* often occurring very commonly in these forests, it is now clear without doubt, that the Albizzietum gummiferae is an association belonging to the Cyathion mannianae as higher syntaxonomic unit. Within this alliance, the Albizzietum shows clear relations to the Cyatheo mannianae-Afrocranietum volkensii, with *Afrocrania volkensii* often growing in its lower tree stratum, and to the Cyatheo mannianae-Moussaendetum odoratae, of which *Moussaenda odorata* (syn. *M. microdonta* ssp. *odorata*) itself also contributes to this layer, with its whitish bracts being visible already from afar. Besides these species, the large ground-fern *Didymochlaena truncatula*, a character species of the latter association, could also be found in the Albizzietum.

D.1.II. Zanthoxyllion gillettii (Relevés 13–23 & 38–43 in appendix 5).

In contrast to Mt Kenya, where this alliance is found abundantly in the submontane areas (Bussmann & Beck, 1995), the respective zones in Gakoe and the Nyambeni Hills have already been highly disturbed. Forests belonging to this alliance are thus only encountered in a few places, and even there particularly the tall *Zanthoxyllum gillettii* itself and *Anthocleista zambesiaca*, are only found rarely. *Vitex keniensis* occurs sporadically in these forest remnants, which, growing often in very steep and remote areas, show very clear differences to Mt Kenya.

D.1.II.a. Myrianthetum holstii (Relevés 13–18 in appendix 5).

On the steepest slopes of the Nyambeni Hills forests with *Myrianthus holstii* as a distinct feature of the upper canopy, and only a low amount of light reaching the ground, are encountered. *Tiliacora funifera* often grows in the herbal layer, indicating that the tiliacoretosum funiferae (D.1.II.a.1.) is the prevalent subassociation of the Myrianthetum in the studied area. The floristic composition of these forests is very diverse, and clearly different from the typical tiliacoretosum described from nearby Mt Kenya (Bussmann &

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Beck, 1995). The tall euphorbiacean *Croton sylvaticus*, found in the upper and lower tree strata and partly in the shrub layer, together with *Halleria lucida*. Large old specimens of Meru oak (*Vitex keniensis*) are found as a sign of low disturbance by human activities. (D.1.II.a.1.1. Myrianthetum holstii tiliacoretosum funiferae-Alangium chinense variant var. nov. Relevés 13–18 in appendix 5). This new variant grows in wetter areas than the typical tiliacoretosum. A very special feature of the shrub stratum is *Ensete edule*, which grows regularly in sometimes dense stands, without any signs of former cultivation. *Ceasalpinia decapetala*, *Hunteria zeylanica*, *Trimeria grandifolia*, as well as *Senna didymobotrya* and *Trichilia emetica* have to be seen as species linking the lower East African camphor-forest to the Guineo Congolian rainforests of central Africa. In the herb layer *Periploca linearifolia* and *Cissus olivieri*, together with *Aframomum keniense* and the fern *Pteris dentata* ssp. *flabellata* are encountered.

Especially along deeply incised rivers, under very humid conditions, remnants of a very different type of forest are found in few regions of Nyambeni, too steep and remote for agricultural use. Large specimens of *Mitragynia rubrostipulata*, together with giant fig trees (*Ficus sur*) and the araliacean *Cussonia spicata* characterise these forests. (D.1.II.a.2. Myrianthetum holstii-mitragynietosum rubrostipulatae subass. nov. Relevés 19–23 in appendix 5).

D.1.II.b. Newtonio buchananii-Phoenicetum reclinatae ass. nov. (figure 16; Relevés 38–43 in appendix 5; type: relevé 41, UTM 37 369000E/015000N; 00°08'08''N/37°49'22''E; 1,450 m).

On the lower slopes of the Nyambeni Hills, forests with only one closed tree layer, dominated by the mimosacean *Newtonia buchananii* and many, often very tall palms (*Phoenix reclinata*) are found, giving these areas an appearance like an Andean cloud forest. *Newtonia* and *Phoenix* are often almost the only trees found in the canopy. The seeds of *Newtonia* are often seen covering the whole forest floor, but hardly any germinants or seedlings could be observed. *Aningeria adolfi-friedericii*, protruding from the closed canopy, is sometimes found with high cover/abundance too. In the shrub stratum, *Psychotria orophila* is more common, and the herbal stratum consists mainly of dense grass cushions formed by *Oplismenus hirtellus*, amongst which *Phyllanthus fischeri*, *Triumfetta macrophylla*, *Cissampelos frieseorum*, *Solanecio angulatus* and *Pteris catoptera* are growing. In very humid places tall specimens of *Dracaena steudneri* are encountered. Although nowadays being restricted to few areas in the Nyambeni Range, the Newtonio-Phoenicetum probably covered large tracts of land especially on the eastern slopes of Mt Kenya, forming the lowermost submontane forest belt in transition to the savannah lowlands, but has long ago been cleared for cultivation. Particularly in deep ravines forest patches very similar to those found in Nyambeni can be observed in the respective zone of Mt Kenya.

D.1.III. Lovoion swynnertonii all. nov. (Relevés 24–37 in appendix 5; type: relevé 24, UTM 37 375000E/020000N; 00°10'51''N/37°52'36''E; 1,500 m).

In less steep areas a variety of very different forests is found in Imenti, Ngaia and Nyambeni. The composition of the tree and shrub strata clearly link these forests to the Syzygetalia guineensis, with *Syzygium guineense* and *Aningeria adolfi-friedericii* occurring commonly in the upper canopy. The strong differences in the floristic composition led to the description of a new alliance. *Lovoa swynnertonii*, a very tall and dominant canopy tree is the differential species for this unit. *Rawsonia lucida* is found very prevalent in the shrub layer, together with *Heinsenia diervilleoides* and *Rinorea convallarioides*. In many places

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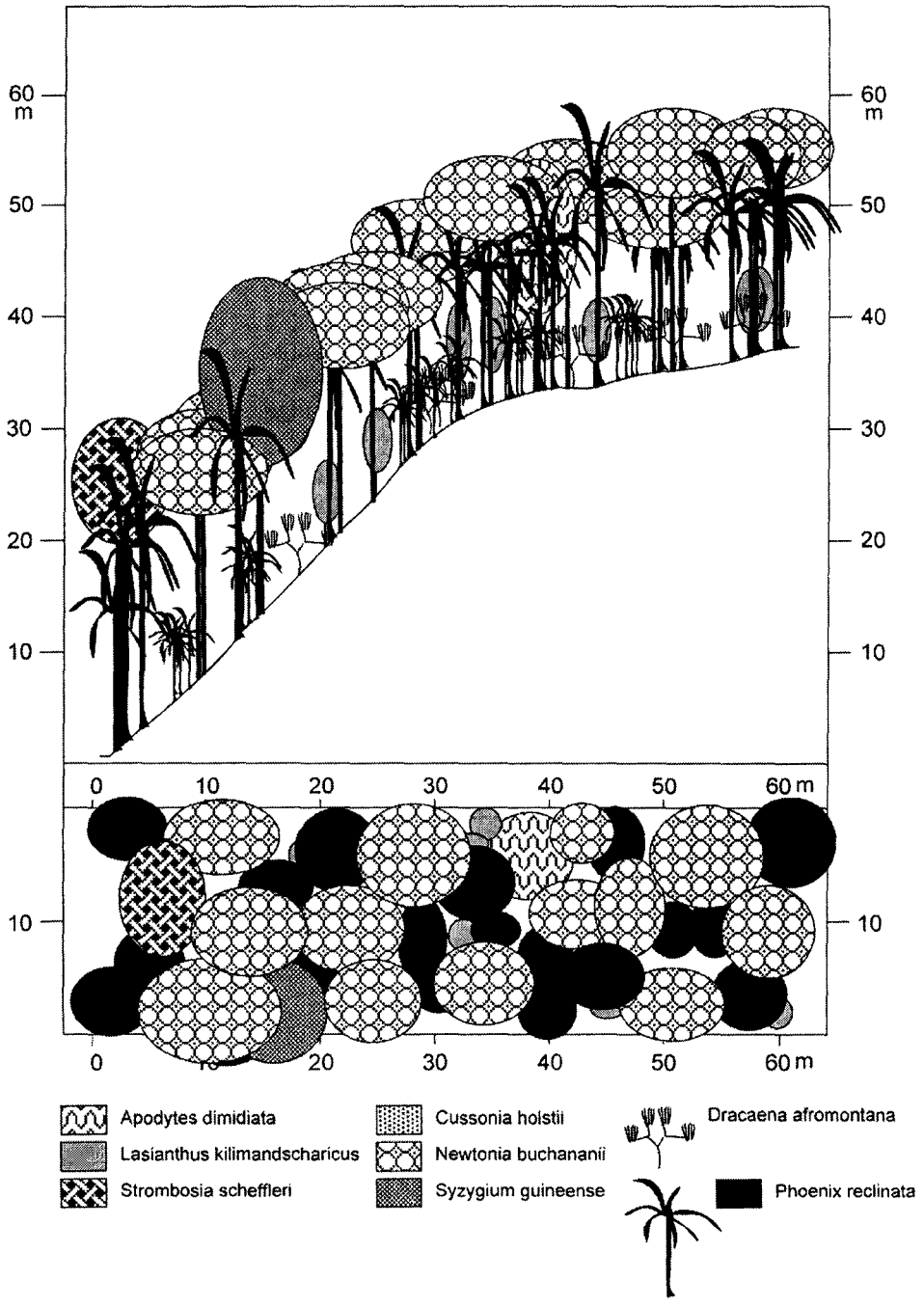

Figure 16. Newtonio buchananii – Phoenicetum reclinatae ass. nov. (relevé 41 in appendix 6, UTM 37 369000E/015000N; 00°08'08"N/ 37°49'22"E; 1450 m).

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Uvariodendron anisatum grows abundantly in the lower tree stratum and in the shrub layer. Forests of the Lovoion swynnertonii can also be found in the close vicinity of Mt Kenya in Imenti forest, which links the lower forest belt of this huge mountain to the Nyambeni Hills. There, the same syntaxa described below are encountered, indicating that this forest type must have covered also large areas of the eastern and north-eastern Mt Kenya, and also big regions in the Nyambeni Hills.

D.1.III.a. Lovoetum swynnertonii ass. nov. (figure 17; Relevés 24–30 in appendix 5; type: relevé 24, UTM 37 375000E/020000N; 00°10'51''N/37°52'36''E; 1,500 m).

The Lovoetum swynnertonii is encountered in the Nyambeni Hills and Imenti. The canopy is often very dense, the shrub stratum very open, and the herbal layer often very sparse, safe for the grass *Oplismenus hirtellus*, forming large carpets. *Rytigynia neglecta, Uvaria scheffleri* and *Adianthum hispidulum* are characteristic species. *Erythrococca fischeri* is often found in the shrub stratum, and the tall trees *Chrysophyllum gorgunosanum*, *Premna maxima* and *Filicium decipiens* are very abundant in the canopy. All these species show distinct links to the Guineo Congolian rainforests, making it clear that the Lovoion can be seen as a far outpost of these forest systems.

D.1.II.b. Argomuelleretum macrophyllae ass. nov. (figure 18; Relevés 38–43 in appendix 5; type: relevé 32, UTM 37 391500E/035500N; 00°19'16''N/38°03'23''E; 1,200 m).

In more open areas, particularly within Ngaia Forest, this association, which shows a very dense shrub layer, often exclusively dominated by *Argomuellera macrophylla* is encountered. *Erythrococca bongensis*, *Ixora scheffleri* and *Blighia unijugata*, mainly found in the lower canopy, are differential species of the taxon. *Teclea trichocarpa*, *Hilleria latifolia* and *Meineckia phyllanthoides* have a high cover/abundance in the understorey, whereas *Uvaria lucida* and *Pleiocarpa pycnantha* are found less regularly. In the open higher canopy, a wide variety of trees like *Croton macrostachyus*, *Markhamia lutea*, *Teclea nobilis*, *Celtis gomphophylla*, and *Trichilia dregeana* are found. The Argomuelleretum has to be regarded as the more drought-resistant association of the Lovoion, as it is found mainly at the lowermost extensions of Ngaia forest, on the boundary to the savannahs of Meru National Park.

DISCUSSION

The study presented here provides the first syntaxonomic description of the remote Kenyan Mountain Forest areas. The montane forests of Kenya and southern Ethiopia represent a well-defined phytogeographical area. The classification system of the forests of Mt Kenya (Bussmann & Beck, 1995) proved to be of wide applicability, as new higher vegetation units (classes or orders) could be found on any mountain studied between Simien Mts in northern Ethiopia and Kilimanjaro in the south. Only two new alliances (Lovoion swynnertonii in Nyambeni and Ngaia, Crotonion macrocarpi in Mathews Range) were encountered, both growing at altitudes or in a rainfall regime that doesn't exist on Mt Kenya. The vegetation survey indicated clearly that substrate (granite, gneisses, volcanic rocks) did not account for differences in the vegetation zonation of the investigated mountains, but rather that the zonation of forest types can be related to the respective amounts of rainfall and length of the dry season. In general, all research areas show the same vegetation zonation (table 2).

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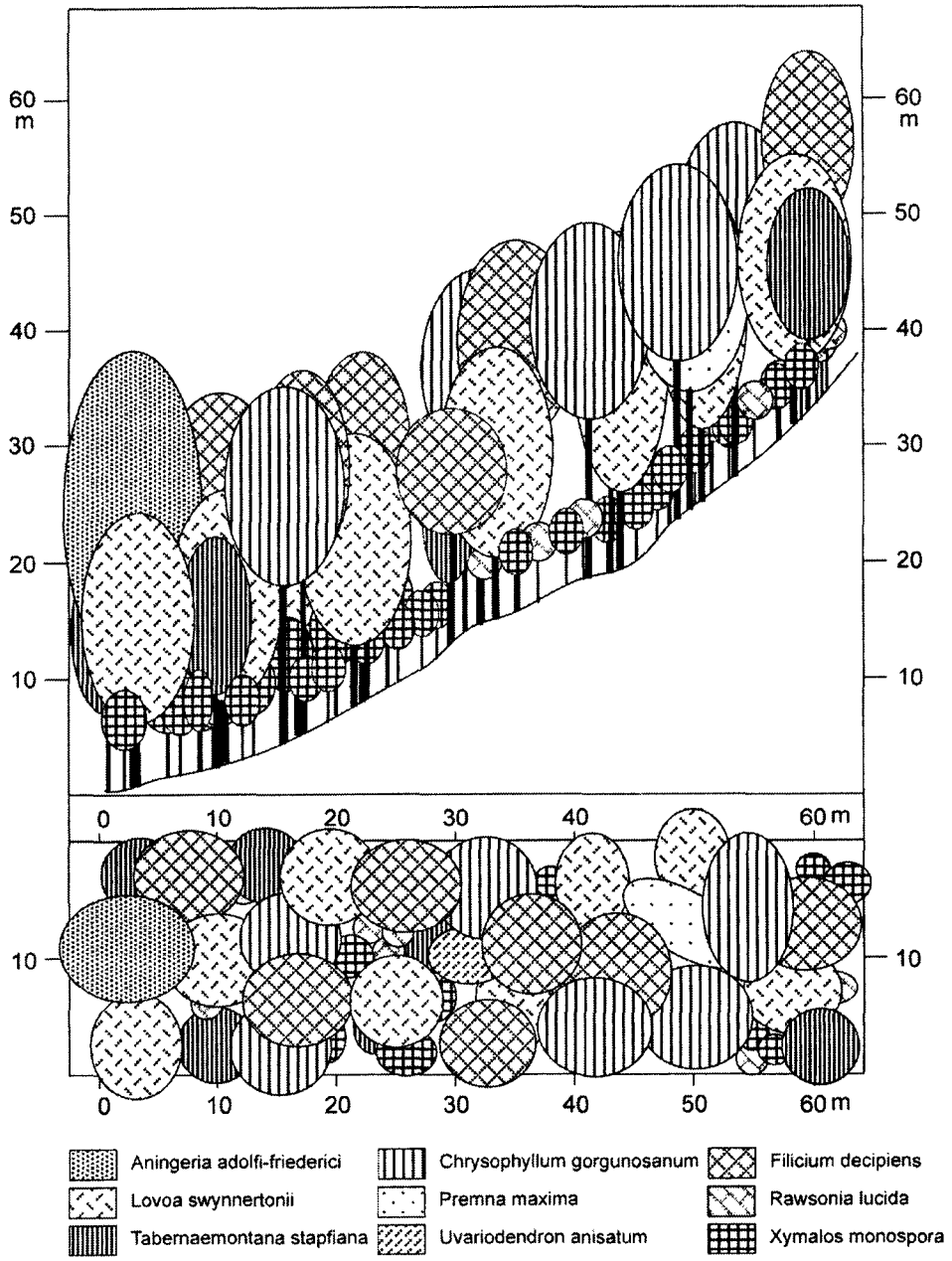

Figure 17. Lovoetum swynnertonii ass. nov. (relevé 24 in appendix 6, UTM 37 375000E/020000N; 00°10'51"N/37°52'36"E; 1500 m).

The submontane and lower montane slopes of the eastern and south-eastern sides of Mt Kenya, Aberdares, receiving 1,500–2,500 mm of annual rainfall and showing perhumid conditions are covered by dense camphor forests (*Ocotetea usambarensis*) at altitudes ranging

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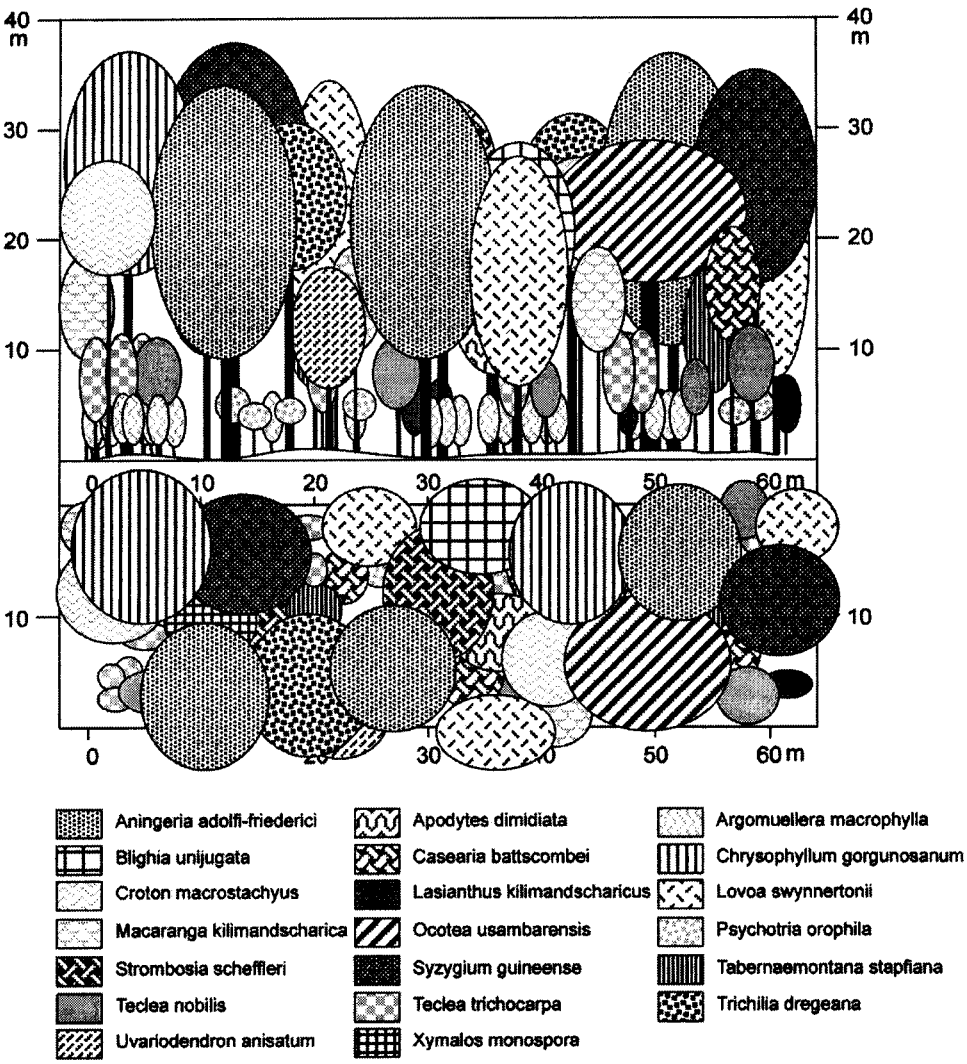

Figure 18. Argomuelleretum macrophyllae ass. nov. (relevé 32 in appendix 6, UTM 37 391500E/035500N; 00°19'16"N/38°03'23"E; 1200 m).

from 1,500–2,000 m. A similar feature is observed in the Harenna Forest (southern Bale Mountains, Ethiopia: Bussmann, 1997). The vegetation of lower altitudes (1,000–1,500 m) in small areas of the Nyambeni Hills and Ngaia belongs to the same vegetation formation. However, the abundance of species belonging rather to the Guineo Congolian region required the establishment of the Lovoion swynnertonii as a new alliance, to account for the strong differences in species composition in comparison to the typical camphor forests. All smaller mountain regions investigated did not receive enough rainfall to harbour camphor forests.

On the west, east and north of Mt Kenya/Aberdares, and on the entire smaller mountains, the submontane as well as parts of the montane zone are occupied by cedar forests (Juniperetea procerae), always found on Acrisols.

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Tab. 2. Comparison of the vegetation units of the East African forest regions.

Altitude (m)	Soils	Mt. Kenya (Bussmann/Beck 1995)	Gakoe Forest (Aberdares)	Ngaia & Imenti Forest Nyambeni Hills
3050–3400 m subalpine zone	Histosols	**Hagenietea/ -etalia** *Hagenio abyssinicae - Hypericion revoluti* (2950-3350m, west, south and east sides) *Hagenio abyssinicae - Juniperion procerae* (2650-3250m, northern side)	**Hagenietea / -etalia** *Hagenio abyssinicae - Hypericion revoluti* - Hagenietum abyssinicae (3000-3400m) - Hypericetum revoluti (3000-3400m)	
2500–3050 m upper montane zone	Andosols	**Sinarundinarietea Sinarundinarietalia** *Sinarundinarion alpinae* (2300-050m) **Juniperetea / -etalia** *Juniperion procerae* (2350-2950m) *Cassipourion malosanae* (2150-2650m)	**Sinarundinarietea Sinarundinarietalia** *Sinarundinarion alpinae* -Podocarpo latifolii - Sinarundinarietum alpinae (2500-3000m) - Sinarundinarietum alpinae (2500-3000m)	**Sinarundinarietea** *Sinarundinarion alpinae* - Podocarpo latifolii - Sinarundinarietum alpinae (2600-2700m) **Juniperetea/ -etalia** *Juniperion procerae* - Faureo salignae - Ilicetum mitis typicum (2300-2600m)
2300–2500 m middle montane zone	Acrisols	**Sinarundinarietea** *Sinarundinarion alpinae* (2300-3050m) **Juniperetea / -etalia** *Juniperion procerae Cassipourion malosanae* (2150-2950m) **Ocotetea usambarensis** (see below; east side) (1500-2550m)	**Juniperetea / -etalia** *Cassipourion malosanae* Tecleo nobilis - Tecletum simplicifoliae (2300-2500m)	**Juniperetea / -etalia** *Juniperion procerae* - Faureo salignae - Ilicetum mitis typicum (2300-2600m)
2000–2300 m lower montane zone	Acrisols	**Juniperetea / -etalia** *Juniperion procerae Cassipourion malosanae* (2150-2950m) **Ocotetea usambarensis Syzygetalia guineensis Ocotetalia usamb.** (see below; east side, 1500-2550m)	**Ocotetea usambarensis Syzygetalia guineensis** *Zanthoxyllion gillettii* -Myrianthetum holstii (2000-2300m) - Zanthoxylletum gillettii (2000-2300m) *Cyathion mannianae* - Albizzietum gummi-ferae (2000-2300m)	**Ocotetea usambarensis Syzygetalia guineensis** *Zanthoxyllion gillettii* -Myrianthetum holstii (2000-2300m) *Cyathion mannianae* - Albizzietum gummiferae (2000-2100m)
1200–2000 m submontane zone	Nitisols/Acrisols	**Ocotetea usambarensis Syzygetalia guineensis** *Zanthoxyllion gillettii Cyathion mannianae* **Ocotetalia usamb.** *Macarangion kilimand. Ocotion usambarensis* (1500-2550m) **Juniperetea / -etalia** *Brachylaenion huillensis* (1700-1950m)	**Ocotetea usambarensis Syzygetalia guineensis** *Zanthoxyllion gillettii* -Myrianthetum holstii (1500-2000m) - Zanthoxylletum gillettii (1500-2000m) *Cyathion mannianae* - Albizzietum gummi-ferae (1500-2000m)	**Ocotetea usambarensis Syzygetalia guineensis** *Zanthoxyllion gillettii* -Myrianthetum holstii (1500-2000m) *Lovoion swynnertonii* - Lovoetum swynnertonii - Argomuelleretum macrophyllae (1000-1500m)

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Altitude (m)	Soils	Harenna (Bussmann 1997)	Mathews Range	Mt. Nyiro Ndoto Mts.
3050–3400 m subalpine zone	Histosols	**Hagenietea / -etalia** *Hagenio - Hypericion* - Hypericetum revoluti ericetosum excelsae (3100-3250m) - Hagenio abyssinicae - Dombeyetum torridae (2800-3100m) **Sinarundinarietea** *Sinarundinarion alpinae*	**Juniperetea / -etalia** *Juniperion procerae* - Faureo - Ilicetum xymaletosum monosporae - Schefflera volkensii facies (2500-2700m) *Crotonion megalocarpi* - Phoenicetum reclinatae (2300-2700m)	**Hagenietea / -etalia** *Hagenio abyssinicae - Hypericion revoluti* - Gnidietum glaucae (Nyiro, 2500-2600m)
2500–3050 m upper montane zone	Andosols	**Hagenietea / -etalia** *Hagenio abyssinicae - Hypericion revoluti* **Sinarundinarietea** *Sinarundinarion alpinae* **Juniperetea / -etalia** *Cassipourion malosanae* - Cassipoureo - Scheffleretum (2600-2800m) -Erythrino-Crotonetum	**Juniperetea / -etalia** *Juniperion procerae* - Faureo salignae - Ilicetum mitis xymaletosum monosporae typicum (2300-2500m) *Crotonion megalocarpi* - Phoenicetum reclinatae (2300-2600m)	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerea cadietosum purpureae (2000-2300m)
2300–2500 m middle montane zone	Acrisols	**Juniperetea / -etalia** *Cassipourion malosanae* - Erythrino brucei - Crotonetum macrostachyi (2300-2600m)		
2000–2300 m lower montane zone	Acrisols	**Ocotetea usambarensis** **Syzygetalia guineensis** - Ocoteo kenyensis - Oleetum welwitschii (1900-2300m)	**Juniperetea / -etalia** **Juniperion procerae** - Faureo salignae - Ilicetum mitis xymaletosum monosporae typicum (2200-2500m) **Crotonion megalocarpi** Crotonetum megalocarpi (2000-2200m)	**Juniperetea / -etalia** **Juniperion procerae** - Myrsino africanae - Juniperetum procerea cadietosum purpureae (2000-2300m)
1200–2000 m submontane zone	Nitisols/Acrisols	**Ocotetea usambarensis** **Syzygetalia guineensis** - Ocoteo kenyensis - Oleetum welwitschii (1900-2300m) **Juniperetea / -etalia** *Cassipourion malosanae* - Podocarpo falcati - Coffeetum arabicae (1450-1900m)	**Juniperetea / -etalia** *Crotonion megalocarpi* Crotono megalocarpi - Tecletum simplicifoliae (1500-2000m) - Bauhinietum variegatae (1500-1600m)	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerae cadietosum purpureae (1700-2000m)

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Altitude (m)	Soils	Mt. Porror Marala	Ndare Ngare Mukogodo	Mt. Kulal Mt. Marsabit
3050–3400 m subalpine zone	Histosols			
2500–3050 m upper montane zone	Andosols			
2300–2500 m middle montane zone	Acrisols	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerae rhusetosum natalensis (2300-2500m)	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerae euclenietosum divinori (2000-2300m) rhusetosum natalensis (2000-2300m)	
2000–2300 m lower montane zone	Acrisols	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerae euclenietosum divinori (2000-2300m) rhusetosum natalensis (2000-2300m)	**Juniperetea / -etalia** *Juniperion procerae* - Myrsino africanae - Juniperetum procerae euclenietosum divinori (2000-2300m) rhusetosum natalensis (2000-2300m)	**Juniperetea / -etalia** *Juniperion procerae* -Myrsino-Juniperetum (Mt. Kulal, 2000-2100m) *Cassipourion malosanae* - Tecleo nobilis - Tecletum simplicifoliae (Mt. Kulal, 2000-2200m)
1200–2000 m submontane zone	Nitisols/Acrisols			**Juniperetea / -etalia** *Juniperion proceraea* - Myrsino africanae - Juniperetum procerae (1600-2000m) *Cassipourion malosanae* - Coffeo arabicae - Rhinoreetum convallari-oidis (Marsabit, 1300-1600m)

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Altitude (m)	Soils	Loroghi	Loita Hills Nguruman	Nairobi Forests
3050–3400 m subalpine zone	Histosols			
2500–3050 m upper montane zone	Andosols			
2300–2500 m middle montane zone	Acrisols	**Juniperetea / -etalia** Cassipourion malosanae - Tecleo nobilis - Tecletum simplicifoliae (2300-2350m)		
2000–2300 m lower montane zone	Acrisols	**Juniperetea / -etalia** *Cassipourion malosanae* - Tecleo nobilis - Tecletum simplicifoliae (2000-2300m east side, 2200-2300m west side) *Juniperion procerae* - Ehrharto erectae - Juniperetum procerae (2000-2200m)	**Juniperetea / -etalia** Cassipourion malosanae - Tecleo nobilis - Tecletum simplicifoliae oplismenetosum hirtelli (1900-2300m)	
1200–2000 m submontane zone	Nitisols/Acrisols		**Juniperetea / -etalia** *Cassipourion malosanae* - Tecleo nobilis - Tecletum simplicifoliae oplismenetosum hirtelli (1900-2300m) *Juniperion procerae* - Ehrharto erectae - Juniperetum procerae (1700-2000m)	**Juniperetea / -etalia** *Brachylaenion huillensis* - Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae - Phyllanthus obovalifolius facies - Chaetacme aristata facies

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In the Aberdares, Mt Kenya, Mt Kulal, Mt Marsabit and Harenna, the lower and middle montane zones are mostly covered by the evergreen-broadleafed Cassipourion malosanae, followed by the Juniperion procerae in the higher montane, and drier, zones.

On Loroghi and in Loita, this zonation is reversed: As clouds and mist mainly accumulate on the mountaintops, these are covered by the Cassipourion, requiring more moisture, whereas the drought resistant Juniperion is here found on the lower altitudes. The timberline is formed by cedar forests.

The driest mountains of the region (Porror, Maralal, Ndoto, Nyiru) do not harbour associations of the Cassipourion and are only covered by forest types belonging to the Juniperion procerae.

On Mathews Range, the lower forest limit is closely dovetailed with the adjacent savannah area, and receives only low amounts of rainfall. Only under these very specific conditions a deciduous alliance, the Crotonion megalocarpi could be found.

The Nairobi forests represent the very last remnants of the Brachylaenion huillensis, which formerly covered large areas between Nairobi and Naro Moru.

Under particularly humid conditions in the Aberdare Range, Mt Kenya, Nyambeni and Mt Nyiru, with deep, humic Andosols and only short dry seasons, huge areas are covered with evergreen bamboo forests (Sinarundinarietea alpinae). The main growing areas in central Kenya are separated from the bamboo stands in Ethiopia (Harenna Escarpment) by 1,000 km of dry inland plains. Only on top of Mt Nyiru, about in the middle of this distance, small bamboo stands occur.

On Mt Kenya and the Aberdares the timberline occurs in the subalpine zone, and is formed by the Kosso forest (Hagenietea abyssinicae), elfin-like, mossy, evergreen forests, dominated by the Kosso tree. This forest type grows also in Harenna. Mt Nyiru in northern Kenya shows again an isolated position, as on this small range, the top is also covered by a type of Kosso-forests (Gnidietum glaucae), and can thus be seen as a stepping stone between the Kosso populations in central and northern East Africa.

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APPENDICES 1–7

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Table 1: Forest vegetation types of Mt. Nyiro

Class	A		B	A	C					
Order	A.1		B.1	A.1	C.1					
Alliance	I		I	I	I					
Association	a		a	b	a					
Subassociation	1			1						
Variant/Facies	1	2								
Relevé-Number	123456789111111111122222222	22333	333333	3444444	444					
	012345678901234567	89012	345678	9012345	678					
Number of Species	655777777755645555566666666	66687	544545	7667667	222					
	344041445410352499322031404	82946	119080	1023730	864					
						Constancy				
Juniperetea procerae Bussmann 1994 (A)										
C Geranium arabicum	++++++++++++++++++++++++++	+++++	+++.++	+++++.+	++.	V	V	V	V	2
C Achyranthes aspera	++++++.+++.+++.++++r++.++++	r+.++	++r.++	+++++++	.+.	V	V	V	V	1
C Brachypodium flexum	.....	.....	r+.++r	.....	...				V	
D Juniperus procera T	+rr++r++++++r...+.....+.r+	+21++	22+122	3233222	...	III	V	V	V	
D Juniperus procera S	r..r...rrr+++.....	+r.++	244334	++.++++	...	II	V	V	V	
D Sanicula elata	++++++++++++++++++++++++++	+++++	++++++	+++++++	.++	V	V	V	V	2
D Stipa dregeana S	.....	+++++	+r++rr	22+1212	...		V	V	V	
Juniperion procerae Bussmann 1994 (A.1.l)										
C Olea europaea ssp. africana T	.....	2+122	++++r+	3222232	...		V	V	V	
C Olea europaea ssp. africana S	.....	+..r.	++rr.+	++..+..	...		II	V	III	
C Rubus volkensii S	++++++++++..++.++r...++++++	+++++	++++++	..+....	...	V	V	V	I	
D Rapanea melanophloeos T	...+..r.....r....	.....	++r+++	.....	...	I		V		
Ehrharto erectae - Juniperetum procerae Bussmann 1994										
D Ehrharta erecta	++++++++++22++++.22+++.++++	2++22	++++++	+332+22	+..	V	V	V	V	1
Faureo salignae - Ilicetum mitis Bussmann 1994 (A.1.I.a)										
D Faurea saligna T	2333233222+r322343322233433	23433	2++2++	+rr+.r+	...	V	V	V	V	
D Faurea saligna S	.+r++.++++..+++++++++.+++++	+++++	..+.+.	+.rr..r	...	V	V	II	IV	
Faureo salignae - Ilicetum mitis xymaletosum monosporae (A.1.I.a.1)										
D Xymalos monospora T	+21+22+2223+2322+.222+.12++	+2122	.....	.++r...	+.+	V	V		III	2
D Xymalos monospora S	+221+22+224+112222221222212	22+22	.....	+.++.+.	..2	V	V		IV	1
D Brucea antidysenterica S	+2++3+22++..2.3++22++++r++r	+++++	+..r..	.....	+r.	V	V	II		2
D Clausena anisata S	+++.2+++++..++22++12+++++2+	+2+22	.....	..+.+..	+..	V	V		II	1
D Clerodendron johnstonii S	+++.++++++..+..+++++r++++++	+++++	....+.	....+.+	+.+	V	V	I	II	2
D Clematis brachiata	..+.r++.r+.....+.r..+.rr+r	+.+rr	.....	.....	...	III	V			
D Dicliptera kirkii	2232+++21234322.++321+++2++	+++1+	.+r.r.	.....	+.r	V	V	III		
D Doryopteris concolor	+.+r+..++r...++r.++r+..++++	....+	.....	.....	...	IV	I			
D Polystachya confusa	..r.rr+..r.r.rr.+r...rr.r+r	.r++r	.....	.....	...	III	V			2
D Polystachya piersii	...r....+.....r.....r.	...r.	.....	.....	...	I	I			
D Polystachya spec.	.++...+r+..++..rr.+...rr..r	.+++r	.....	.....	...	III	V			
D Pteris quadriaurtia	rr.+r++rrr+++....+++.+r++.+	.....	.....	.....	...	IV				
Faureo salignae - Ilicetum mitis xymaletosum monosporae - wet variant (A.1.I.a.1.1)										
D Droguetia iners	++.+324.++....++....r+.++r.	.....	.....	+.rrr+r	...	III			V	
D Drymaria cordata	++.++++rr+...+++..r.r.++...	.....	.....	.....	...	III				
D Amauropeltis bergiana	...+...++.rrrr++.r.+rr+....	.....	.....	.....	+..	III				1
D Schefflera volkensii T	..+.r+.rr+..+++.+....++....	.....	.....	.....	...	III				
D Stenogramma pozoi	.r..r+...rr..rr...r....r...	.....	.....	.....	..r	II				1
D Dichrocephala integrifolia	.+...r+.r+.....+.r.++r...	.....	.....	.....	...	II				
D Solanum schumannianum S	r..+r....+.....+.+++.....	.....	.....	.....	...	II				
D Aneilema pedunculosum	..r....+r.....+...rr.....	.....	.....	.....	...	II				
D Crassula alsinoides	.++r.+..r.....++.....	...+.	.....	..+....	...	II			I	
D Dracaena spec. S	...+++.+..22....++r.....	.....	.....	.....	...	II				
D Pilea johnstonii	.r....r..+..+.....+.....	.....	.....	.....	...	I				
Faureo salignae - Ilicetum mitis xymaletosum monosporae - dry variant (A.1.I.a.1.2)										
D Pupalia lappacea	.....	+++++	.....	.....	...		V			
D Schoenoxiphium lehmannii	...r.....	r+.rr	.....	.....	...	I	V			
D Stellaria sennii	.....++.....+.....	+++r+	.....	.....	...	I	V			
D Plectranthus barbatus S	.....+.....+++	..++r	.....	.....	...	I	IV			
D Spermacoce princeae	.....	+.rr.	.....	.....	...		IV			
D Solanum incanum	.....	..++r	.....	.+++.r+	...		IV		IV	
D Pteridium aquilinum	.....	..+..	.....	++rrr++	...		I		V	
Myrsino africanae - Juniperetum procerae Bussmann 1994 (A.1.I.b)										
D Rhamnus prinoides S	..+..r...r.....+.....	+.r++	21++2+	+++rr++	...	I	V	V	V	
D Myrsine africana S	.....	r+rrr	++++++	2333233	...		V	V	V	
Myrsino africanae - Juniperetum procerae cadietosum purpureae (A.1.I.b.1)										
D Cadia purpurea S	.....	.....	.....	.++++++	...				V	
D Vangueria apiculata S	.....	.....	.....	+rr.++r	...				V	
D Cheilanthes multifida	.....	.....	.....	++.rr++	...				V	
D Cheilanthes hirta	.....	.....	.....	+..++++	...				IV	
D Cheilanthes farinosa	.....	.....	.....	..+++++	...				IV	
D Asplenium trichomanes	.....	.....	.....	..r.rrr	...				III	
D Cordia monoica T	.....	.....	.....	+...+..	...				II	
D Pellaea alchemilloides	.....	.....	.....	.....rr	...				II	
D Cheilanthes bergiana	.....	.....	.....	.....r.	...				I	
Hagenietea abyssinicae Bussmann 1994 (B)										

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C Hypericum revolutum T	.....	.....	+1++2+	.....	...		V
C Hypericum revolutum S	.....	.....	2+2222	.....	...		V
Gnidietum glaucae Bussmann 1994 (B.1.I.a)							
D Gnidia glauca T	.....	.....	233222	.....	...		V
Sinarundinarietea /-etalia /-ion /-um alpinae Bussmann 1994 (C.1.I.a)							
D Sinarundinaria alpina T	.....	.....	.....	.....	.++		2
D Sinarundinaria alpina S	.....	.....	.....	.....	554		3
D Pseudocarum eminii	.....	.....	.....	.....	+++		3

D: Differential Species C: Character Species T: Tree S: Shrub

Companions Mt. Nyiro

Juniperion procerae (A.1.I): *Impatiens meruensis*

Ehrharto erectae - Juniperetum procerae: *Maytenus undata S, Dovyalis abyssinica S*

Faureo salignae - Ilicetum mitis 1994 (A.1.I.a): *Piper capense S, Cyphostemma maranguense, Arachnoides foliosa, Rubus pinnatus S, Laportea alatipes, Lobelia gibberoa S, Maesa lanceolata S, Psychotria orophila S, Loxogramme abyssinica, Arisaema mildbraedii, Kalanchoe densiflora*

Faureo salignae - Ilicetum mitis xymaletosum monosporae (A.1.I.a.1): *Tarenna graveolens S, Turraea holstii S, Vernonia spec., Asparagus setaceus, Asplenium erectum, Cyperus sesquiflorus ssp. appendiculatus, Panicum calvum, Poa spec., Solanum sessilistellatum, Englerina woodfordioides, Pilea rivularis, Pycnostachys meyeri, Solanum appendiculatum S, Pavetta gardeniaefolia S, Jasminum floribundum S, Chionanthus battiscombei T, Chionanthus battiscombei S, Cassipourea malosana T, Cassipourea malosana S,.Olea capensis ssp.hochstetteri T, Cardamine africana, Cystopteris fragilis*

Faureo salignae - Ilicetum mitis xymaletosum monosporae - dry variant (A.1.I.a.1.2): *Crassocephalum montuosum, Desmodium repandum, Hypoestes forskalii, Leonotis nepetifolia S, Microglossa pyridifolia S, Mikaniopsis bambuseti*

Myrsino africanae - Juniperetum procerae (A.1.I.b): *Justicia striata, Nuxia congesta T, Nuxia congesta S, Jasminum abyssinicum S, Thalictrum rhynchocarpum*

Myrsino africanae - Juniperetum procerae cadietosum purpureae (A.1.I.b.1): *Croton megalocarpus T, Croton megalocarpus S, Teclea simplicifolia T, Teclea simplicifolia S, Ochna insculpta T, Ochna insculpta S, Cyathula polycephala, Dregea schimperi, Osyris abyssinica S, Pavetta spec. S, Trema guineensis S, Celtis africana S, Cussonia spicata S, Scadoxus multiflorus, Heteromorpha trifolia S, Viscum tuberculatum, Indigofera arrecta S, Rhus natalensis S, Vernonia galamensis ssp. afromontana S, Thunbergia alata, Asparagus falcatus*

Gnidietum glaucae (B.1.I.a): *Erica arborea S, Pilloselloides hirsuta, Cynoglossum lanceolatum, Alchemilla spec., Rhamnus staddo S, Hesperis petitiana, Clutia abyssinica S, Parietaria debilis*

Afromontane forests: *Podocarpus latifolius T, Podocarpus latifolius S, Teclea nobilis T, Teclea nobilis S, Asplenium aethiopicum, Clematis simensis, Aerangis thomsonii, Senecio syringifolius, Asplenium loxoscaphoides, Asplenium monanthes, Cyphostemma kilimandscharica, Maytenus heterophyllus S, Scutia myrtina S, Pentas lanceolata, Urera hypselodendra, Asplenium theciferum, Adiantum poirettii, Pleopeltis macrocarpa, Peperomia abyssinica, Zehneria scabra, Oxalis corniculata, Stephania abyssinica, Viola abyssinica, Anthriscus sylvestris, Asparagus africanus, Polystichum fuscopaleacum, Agrocharis incognita, Euphorbia ugandensis, Galium aparinoides, Satureia pseudosimensis, Prunus africana T, Prunus africana S, Pteris dentata ssp. flabellata, Dombeya goetzenii T, Dombeya goetzenii S, Basella alba, Asplenium elliottii, Asplenium friesiorum, Dichondra repens, Allophyllus abyssinicus S*

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Table 2: Forest vegetation types of Mt. Marsabit

Class	A		
Order	A.1		
Alliance	II	I	
Association	a	b	
Relevé-Number	12345678	911111 01234	
Number of Species	85566665 13645655	333322 950497	
			Constancy
Cassipourion malosanae Bussmann 1994 (A.1.II)			
C Ilex mitis T	+....+r.	.++r++	II V
C Ilex mitis S	+.r..rr.	.r.+..	III II
D Cassipourea malosana T	22122212	+.++rr	V V
D Cassipourea malosana S	+r++++++	.r+.r.	V III
D Olea capensis ssp. hochst. T	+2.+11++	.....	V
D Olea capensis ssp. hochst. S	++.r++++	.....	V
Coffeo arabicae - Rinoreetum convallarioidis (A.1.II.a)			
C Oplismenus hirtellus	32243553	+.....	V I
C Casearia battiscombei T	23122212	.....	V
C Casearia battiscombei S	+.+++1+.	.....	IV
C Flacourtia indica S	rr+.+r++	+.....	V I
C Turraea holstii S	r++.r+++	.....	V
C Celtis africana T	r..12+..	.....	III
C Celtis africana S	+.rr++++	.....	V
C Strychnos mitis T	+.+++.+.	.....	IV
C Strychnos mitis S	r.+++++.	.....	IV
C Isoglossa lactea	++.+..r+	+.+...	IV III
C Justicia betonica	+++.r++.	.+rr..	IV III
C Meyna tetreaphylla S	+.++r...	+.....	IV
C Celtis gomphophylla T	r2+..+..	.....	III
C Celtis gomphophylla S	+1+.++..	.....	IV
C Ocotea kenyensis T	+..r.++.	.....	III
C Ocotea kenyensis S	r.r..+..	.....	II
C Cordia monoica S	++....r.	.....	II
D Erythrococca bongensis S	++.1++r+	.....	V
D Strychnos henningsii T	..++.+..	.+r...	II I
D Strychnos henningsii S	.rr..+..	...r..	II I
D Coffea arabica S	22331222	.....	V
D Rinorea convallarioides S	21+221++	.....	V
D Erythrococa fischeri S	++r.+++	.....	V
D Chionanthus battiscombei T	1++2+11+	.....	V
D Chionanthus battiscombei S	+++.+++.	.....	IV
D Pavetta abyssinica S	++1++1+.	.....	V
D Oxyanthus speciosus S	++.+++++	.....	V
D Rytigynia neglecta S	+.++++.r	.....	IV
D Monodora grandidieri S	+.+++r..	.++...	IV
D Vepris eugeniaefolia S	++.r+++.	+.....	IV
D Rhipsalis baccifera	rr.+..r.	.....	III
Juniperion procerae Bussmann 1994 (A.1.I)			
C Olea europaea ssp. afri. T	.....	455344	V
C Olea europaea ssp. afri. S	.....	++++++	V
D Rapanea melanophloeos T	.....	++1+++	V
D Rapanea melanophloeos S	.....	+.++r	V

D: Differential Species C: Character Species T: Tree S: Shrub

Companions Mt. Marsabit

Cassipourion malosanae (A.1.II): *Teclea nobilis T, Teclea nobilis S, Ekebergia capensis T, Ekebergia capensis S, Ochna insculpta S, Maytenus heterophyllus S, Drypetes gerrardii S, Brucea antidysenterica S, Diospyros abyssinica S, Abutilon mauritianum, Schkuhria pinnata, Ocimum gratissimum S, Vernonia galamensis ssp. afromomtana S, Clerodendrum johnstonii S, Clausena anisata S, Dovyalis abyssinica S, Rhamnus prinoides S, Achyranthes aspera*

Coffeo arabicae - Rinoreetum convallarioidis (A.1.II.a): *Croton megalocarpus T, Croton megalocarpus S, Setaria plicatilis, Teclea simplicifolia T, Teclea simplicifolia S, Apodytes dimidiata T, Apodytes dimidiata S, Strombosia scheffleri T, Strombosia scheffleri S, Trichilia emetica S, Albizzia gummifera T, Albizzia gummifera S, Albizzia gummifera, Ritchiea albersii S, Croton macrostachyus T, Croton macrostachyus S, Bauhinia tomentosa S, Osyris abyssinica S, Rhamnus staddo S, Aningeria adolfi-friederici T, Maesa lanceolata S, Psychotrya kirkii S, Tarenna graveolens S, Cordia africana T, Cordia africana S, Dracaena laxissima S, Premna maxima T*

Myrsino africanae – Juniperetum procerae (A.1.I.b): *Clutia abyssinica S, Nuxia congesta T, Nuxia congesta S, Kalanchoe densiflora, Phyllanthus fischeri, Achyrospermum schimperi, Ruttya fruticosa S, Clematis brachiata, Leucas mollis, Grewia similis S, Bidens pilosa, Setaria pumilis*

Juniperion procerae (A.1.I), Cassipourion malosanae (A.1.II): *Barleria micrantha, Justicia striata, Asparagus racemosus, Peddiea volkensii T, Peddiea volkensii S, Mystroxylon aethiopicum S, Cissamphelos pareira, Justicia diclipteriodes, Crossandra mucronata, Setaria sphacelata, Canthium schimperi S, Bersama abyssinica S, Pavonia patens*

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Table 3: Forest vegetation types of Mathews Range

										Constancy								
Class	A																	
Order	A.1																	
Alliance	I		III															
Association	a		a		b			c	d									
Subassociation	1		1		1	2												
Variant/Facies	2	3	1	2		1	2											
Relevé-Number	123456	78911 01	1111111 2345678	12222 90123	222222 456789	33333 01234	333334 567890	44444 12345	444455 678901									
Number of Species	876687 648609	46656 95194	6556455 5941984	43334 28596	655565 084514	55554 31433	666656 386181	66555 61725	322222 048442									
Juniperetea procerae Bussmann 1994 (A)																		
C Parochetus communis	++++++	+2+22	r++r..r	+rr+.	......	.....	......	.....	......	V	V	IV	V					
C Isoglossa gregorii	+222++	++21+	....	.....	......	.....	......	.....	......	V	V							
C Achyranthes aspera	++++++	.++.+	+224+++	+++++	+++.++	.+++.	.+++..	..rr+	r++.++	V	IV	V	V	V	IV	III	III	V
D Juniperus procera T	+r++rr	r+.++	r..rr++	..rr+	......	.....	......	++2++	......	V	IV	IV	IV				V	
D Juniperus procera S	r...r.	.r..r	......r	....r	......	.....	......	+r+++	......	IV	III	II	V				V	
D Sanicula elata	++++++	22+++	.+.....	.....	......	.....	......	.....	......	V	V	V						
Juniperion procerae Bussmann 1994 (A.1.I)																		
C Olea europaea ssp. afri. T	......	.....	....	.....	......	.....	......	24434	......								V	
C Olea europaea ssp. afri. S	......	.....	....	.....	......	.....	......	+r++r	......								V	
Faureo salignae - Ilicetum mitis Bussmann 1994 (A.1.I.a)																		
D Faurea saligna T	++2332	2+1+1	....	.....	......	.....	......	.....	......	V	V							
D Faurea saligna S	++r.++	r+.++	....	.....	......	.....	......	.....	......	V	V							
D Ilex mitis T	+12212	+21++	....	.....	......	.....	......	.....	......	V	V							
D Ilex mitis S	+r..+.	r+..+	....	.....	......	.....	......	.....	......	III	III							
Faureo salignae - Ilicetum mitis xymaletosum monosporae (A.1.I.a.1)																		
D Xymalos monospora T	++.+++	2+211	+r.++++	.+++.	......	.....	......	.....	......	V	V	V	III					
D Xymalos monospora S	221222	22223	++.++++	.+r+.	......	.....	......	.....	......	V	V	V	III					
D Brucea antidysenterica S	......	+++++	....	.....	......	.....	......	.....	......		V							
Faureo salignae - Ilicetum mitis xymaletosum monxosprae - Schefflera volkensii facies (A.1.I.a.1.3)																		
D Schefflera volkensii T	.+r...	32234	....	.....	......	.....	......	.....	......	II	V							
D Euclea divinorum S	......	3222+	....	.....	......	.....	......	.....	......		V							
Crotonion megalocarpi / Crotonetum megalocarpi typicum (A.1.III.a.1)																		
C Croton megalocarpus T	......	.....	2232222	33223	323433	43444	344433	32+++	......			V	V	V	V	V	V	
C Croton megalocarpus S	......	.....	+++++++	+++++	+r.r+r	+rr+.	r++r.+	r.r..	......			V	V	V	V	V	II	
C Croton megalocarpus	......	.....	+2+++++	+rr++	++21++	++22+	+22+++	r+...	......			V	V	V	V	V	II	
Crotonion megalocarpi / Crotonetum megalocarpi (A.1.III.a)																		
D Schrebera alata S	......	.....	+.rr+.+	.+rr+	+.++rr	.r+++	...r.+	+++21	..1++.			V	V	V	V	V	V	III
D Erythrococca bongensis S	......	.....	++.r+++	++++r	+.rr+.	.rr++	+++.++	.....	......			V	V	IV	V	V		
D Setaria plicatilis	......	.....	221222+	32332	+rr+++	..+..	++r+++	++r++	..+...			V	V	V	I	V		I
D Phyllanthus fischeri S	++++++	.++++	++r+.++	+r+++	+r++++	.....	533+++	+r+rr	......	V	V	V	V	V		V		
D Panicum monticola	+332++	.+.r+	+++r+++	+++++	243534	.....	554454	.....	......	V	III	V	V	V		V		
D Flacourtia indica S	.+.+..	...r.	.++.r++	+...+	rr..+.	.r.+.	++++..	rr.+.	......	II	I	IV	III	III	III	IV		

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Crotonetum megalocarpi (A.1.III.a)																		
D Podocarpus falcatus T	22++++	.r+.+	2333232	23442	.+r+++	.....	......	r+rr+	......	V	III	V	V	V			V	
D Podocarpus falcatus S	++r.r+	..r..	+++++++	+++++	.+.rr.	.....	......	r....	......	V	I	V	V	III			I	
D Encephalartos tegulaneus T	......	.....	+12++2+	.+1++	......	+r..r	......	r.r..	......			V	V		IV		II	
D Encephalartos tegulaneus S	......	.....	+22+r1+	.+.++	+.....	++r++	.rr+r+	.+r.+	+.....			V	IV		V	V	III	
Crotonetum megalocarpi - Cheilanthes multifida variant (A.1.III.a.1.2)																		
D Cheilanthes multifida	......	.....	....	r++++	......	.....	......	.....	......				V					
D Cyathula polycephala	......	.....	....	++r.+	......	.....	......	+++.r	++.+r+				V				IV	V
D Doryopteris kirkii	......	.....	....	r++rr	......	+r..+	......	.....	......				V		III			
D Notonia abyssinica	......	.....	....	r+r.r	.r..rr	.....	+.....	.....	......				V	III		I		
Crotono megalocarpi - Tecletum simplicifoliae (A.1.III.b)																		
C Strychnos henningsii S	......	.....	....	.....	++++r+	+r+++	22++++	.....	......					V	V	V		
C Strychnos mitis S	......	.....	....	.....	+2++2+	22++r	rr22++	.....	......					V	V	V		
C Justicia flava	......	.....	....	.....	r1.++1	211+r	+rr++1	.....	......					V	V	V		
C Strychnos usambarensis S	......	.....	....	.....	2+2++2	+rr.r	rr+..2	.....	......					V	V	IV		
C Pentas lanceolata S	......	.....	....	.....	242343	43344	.r.+.+	.....	......					V	V	IV		
D Teclea simplicifolia T	......	.....	+..r.+.	.....	r22++2	23222	2+3++2	.....	......			III		V	V	V		
D Teclea simplicifolia S	......	.....	..rr...	.rr..	2+1122	222++	122+++	.....	......			II	II	V	V	V		
D Justicia nyassana	......	.....	....	.....	+2112+	+.+++	.++111	.....	......					V	V	V		
D Isoglossa laxa	......	.....	....	.....	+++++r	+++.+	+.rrr+	.....	......					V	V	V		
D Leucas glabrata	......	.....	....	.....	++.rr+	+++.+	++.r++	.....	......					V	V	V		
D Dracaena laxissima S	......	.....	....	.....	.r..r+	+..rr	.+.rr.	.....	......					III	III	III		
D Hibiscus lunulariifolius	......	.....	....	.....	.rr.r.	.rr.+	r++++.	+..++	+.+.+r					III	III	V	III	IV
D Asystasis gangetica	......	.....	....	.....	......	.+++.	.++.+r	.....	rr+...						III	IV		III
D Psychotria kirkii	......	.....	....	.....	......	r.+r.	+rr..r	.....	......						III	IV		
D Justicia calyculata	......	.....	....	.....	.r....	.r.r.	rr.r..	.....	......					I	III	III		
Crotono megalocarpi - Tecletum simplicifoliae acacietosum brevispicatae (A.1.III.b.1)																		
D Acacia brevispica S	......	.....	....	.....	+r+rrr	.....	......	++12+	....+.					V			V	I
D Isoglossa lactea	......	.....	....	.....	+2++++	.....	......	.....	......					V				
Crotono megalocarpi - Tecletum simplicifoliae - Argomuellera macrophylla variant (A.1.III.b.2.1)																		
D Aneilema aequinoctiale	......	.....	....	.....	+..++.	+++rr	......	.....	......					III	V			
D Aneilema leiocaule	+rr.rr	..rr.	....	.....	......	r++rr	......	.....	......	IV	III				V			
D Argomuellera macrophylla S	......	.....	....	.....	......	++++r	......	.....	......						V			
D Solanecio mannii S	......	.....	....	.....	......	++++r	......	.....	......						V			
D Dracaena steudneri S	......	.....	....	.....	......	+.rr+	......	.....	......						IV			
D Barleria micrantha	......	.....	....	.....	......	...rr	......	.....	++.r..						III			III
D Panicum maximum	......	.....	....	.....	......	+.+r.	......	+.1++	++++.+						IV		IV	V
Crotono megalocarpi - Tecletum simplicifoliae typicum (A.1.III.b.2.2)																		
D Hibiscus urticifolius	......	.....	....	.....	.....+	+....	rr+++.	.....	......					I	I	V		
D Hippocratea africana S	......	.....	....	.....	......	.....	+rr+++	.....	......							V		
D Cadaba farinosa	......	.....	....	.....	......	.....	++++r+	.....	......							V		
D Vernonia auriculifera S	......	.....	....	.....	......	.....	++r+++	.....	......							V		
D Becium capitatum	......	.....	....	.....	......	.....	+rr+r+	.....	......							V		
D Vernonia lasiopus S	......	.....	....	.....	.....r	.+...	.++.+r	.....	......					I	I	IV		
Bauhinietum tomentosae (A.1.III.c)																		
C Kigelia africana T	......	.....	....	.....	......	.....	......	r++rr	......								V	
C Ocimum gratissimum S	......	.....	....	.....	......	.....	......	+212+	......								V	
C Pterolobium stellatum S	......	.....	....	.....	......	.....	......	+1211	....+.								V	I
C Pellaea longipilosa	......	.....	....	.....	......	.....	......	+rrr+	......								V	
C Erythrococca fischeri S	......	.....	....	.....	......	.....	......	++rr+	......								V	
C Cyperus oblongus ssp. flavus	......	.....	....	.....	......	.....	......	rr.+r	......								IV	

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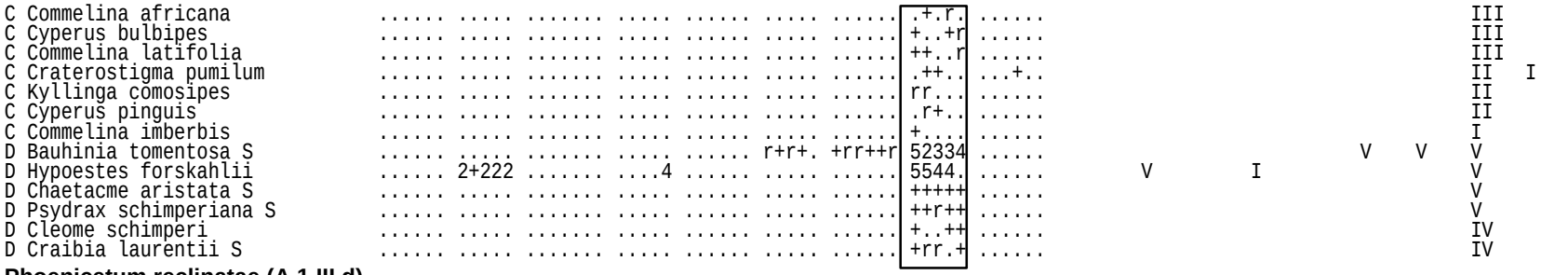

D: Differential Species **C: Character Species** **T: Tree** **S: Shrub**

Companions Mathews Range

Faureo salignae - Ilicetum mitis (A.1.I.a): *Nuxia congesta T, Nuxia congesta S, Plectranthus sylvestris S, Jasminum abyssinicum S, Hypoestes triflora, Lepidotrichilia volkensii S, Piper capense S, Cyphostemma maranguense, Peddiea volkensii S, Asplenium friesiorum, Psydrax schimperiana S, Apodytes dimidiata T, Apodytes dimidiata S, Pauridiantha holstii S, Asplenium erectum, Cyperus sesquiflorus ssp. appendiculatus, Erlangea tomentosa, Euphorbia engleri, Impatiens papillonacea, Peucedanum lindneri, Schoenoxiphium lehmannii, Solanum aculeastrum, Aerangis thomsonii, Galium aparinoides, Thalictrum rhynchocarpum, Peperomia abyssinica, Viola abyssinica, Anthriscus sylvestris, Agrocharis incognita, Pteris catoptera, Ehrharta erecta, Droguetia iners*

Crotonetum megalocarpi (A.1.III.a): *Pilea rivularis, Plectranthus longipes S, Cuscuta kilimanjari, Trichocladus ellipticus S, Arisaema mildbraedii, Arthopteris orientalis, Acalypha fruticosa, Pavetta abyssinica S, Rytigynia acuminatissima S, Hypoestes aristata S, Stephania abyssinica*

Crotono megalocarpi - Tecletum simplicifoliae (A.1.III.b): *Tarenna graveolens S, Trema orientalis S, Rinorea convalarioides S, Russonia russida S, Turraea holstii S, Hibiscus macranthus, Ficus thoningii T, Drypetes gerrardii S, Urera hypselodendra, Calodendrum capense T, Celtis africana T, Celtis africana S, Abutilon mauritiana S, Acalypha volkensii, Diospyros abyssinica S, Hibiscus fuscus, Justicia diclipteroides, Landolphia buchananii, Phaulopsis imbricata S, Olea capensis ssp. welwitschii T, Olea capensis ssp. welwitschii S, Oplismenus compositus, Oxyanthus speciosus S, Pentas parkeri S, Olea capensis ssp. hochstetteri T, Olea capensis ssp. hochstetteri S, Olea capensis ssp. hochstetteri*

Crotono megalocarpi - Tecletum simplicifoliae acacietosum brevispicatae (A.1.III.b.1): *Albizzia gummifera T, Albizzia gummifera, Cordia africana T, Cordia africana S, Uvaria scheffleri S, Rubia cordifolia, Psychotria orophila S*

Crotono megalocarpi - Tecletum simplicifoliae - typical variant (A.1.III.b.2.2): *Barleria ventricosa, Periploca linearifolia, Verbascum brevipedicellatum, Leucas martiniciensis, Clausena anisata S, Asparagus falcatus, Acokanthera schimperi S, Asplenium sandersonii, Cassipourea malosana T, Cassipourea malosana S*

Bauhinietum tomentosae (A.1.III.c): *Myrsine africana S*

Forest-bushland transition zone: *Vangueria infausta, Pavonia urens, Sericocomopsis hildebrandtii, Grewia similis S, Glycine wightii, Chloris roxburghiana, Digitaria velutina, Eragrostis superba, Indigofera arrecta S, Leucas grandis, Clutia abyssinica S, Sporobolus agrostoideus, Rhus vulgaris S, Vangueria apiculata S, Pupalia lappacea*

Afromontane forests: *Podocarpus latifolius T, Podocarpus latifolius S, Asplenium aethiopicum, Asplenium monanthes, Teclea nobilis T, Teclea nobilis S, Aneilema pedunculosum, Clerodendrum johnstonii S, Bersama abyssinica T, Bersama abyssinica S, Galiniera coffeoides S, Dicliptera laxata, Scutia myrtina S, Thunbergia alata, Maytenus undata S, Desmodium repandum, Dregea schimperi, Asparagus africanus, Cyathula cylindrica, Ochna insculpta T, Ochna insculpta S, Ochna insculpta, Canthium oligocarpum S, Droguetia debilis, Loranthus ulugurense, Asplenium loxoscophoides, Dombeya goetzii T, Dombeya goetzii S, Ekebergia capensis T, Ekebergia capensis S, Englerina woodfordioides, Chlorophytum sparsiflorum, Prunus africana T, Prunus africana S, Clematis simensis, Drymaria cordata, Polygala sphenoptera, Dahlergia lactea S, Trichomanes borbonica, Vernonia galamensis ssp. afromontana S, Dracaena afromontana S*

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Table 4: Forest vegetation types of Ndare Ngare, Porror and Loroghi

Class	A									
Order	A.1									
Alliance	I		II		I					
Association	a	b	a		b					
Subassociation		1	1		2					
Variant/Facies			1	2						
Relevé-Number	123456	7891 0	1111 1234	1111122 5678901	22222222333 23456789012					
Number of species	555555 007583	4443 4068	6566 5967	6556578 4631590	64454555455 33869651953					
						Constancy				
Juniperetea procerae Bussmann 1994 (A)										
C Achyranthes aspera	++++++	++++	++++	+++++++	+++++.+++++	V	4	4	V	V
C Isoglossa gregorii	rrr+++	....	+rr+	.....	.....	V		4		
C Brachypodium flexum	.....+	....	....	+++++..	+.12+.+++++	I			IV	V
C Geranium arabicum	.....	....	....	.....	++++++++++				V	
C Berberis holstii S	.....	....	....	.....	++.+++++r++				V	
D Juniperus procera T	322333	44+2	3223	r++r+rr	44234334233	V	4	4	V	V
D Juniperus procera S	+r++.+	+r.+	++.r	+..r.r.	+22+++322++	V	3	3	III	V
D Stipa dregeana S	324422	+222	+222	+++++++	+.++.++...+	V	4	4	V	IV
D Sanicula elata	.....	....	....	.....	+++.+++++++				V	
Juniperion procerae Bussmann 1994 (A.1.I)										
C Olea europaea ssp. afri. T	33233+	3222	2222	.....	++22+22+212	V	4	4		V
C Olea europaea ssp. afri. S	++++++	++++	++r+	.....	+.++++r.+++	V	4	4		V
C Rubus volkensii S	.....	....	....	.....	.+r...+..+.					
D Carex peregrina	.....	....	++++	.....	.....			4		
Ehrharto erectae - Juniperetum procerae Bussmann 1994 (A.1.I.a)										
C Arceuthobium juniperi-procerae	....++	....	+.rr	.....	.....	II		3		
D Ehrharta erecta	++++++	+.++	++++	+r.rr++	++.++r++++	V	3	4	V	V
Myrsino africanae - Juniperetum procerae Bussmann 1994 (A.1.I.b)										
C Rhamnus prinoides S	.....	....	....	+r.++..	+22+++12+22				V	V
D Myrsine africana S	.....	....	....	.....	++++++++1++					V
Myrsino africanae - Juniperetum procerae rhusetosum natalensis (A.1.I.b.1)										
D Rhus natalensis S	.....	++++	....	.....	++1.++...++			4		IV
D Rhus vulgaris S	.....	r+rr	....	.....	..+++.++..+			4		III
D Sporobolus agrostoides	.....	++++	....	.....	++++++++++			4		V
D Fumaria abyssinica	.....	++++	....	.....	.....			4		
D Senecio ruwenzoriensis	.....	r+++	....	.....	.....			4		
D Pellaea adianthoides	.....	rrrr	....	.....	.....			4		
D Romulea fischeri	.....	r.rr	....	.....	.....			4		
D Fuerstia africana	.....	++++	....	.....	.....			4		
D Leucas tomentosa	.....	++++	....	.....	.....			4		
D Pluchea ovalis S	.....	++++	....	.....	.....			4		
Cassipourion malosanae Bussmann 1994 (A.1.II)										
C Hypoestes aristata S	.....	....	++++	+++++++	.....					
C Ilex mitis T	.r+.++	....	+.+	+r.++1+	.....					
C Ilex mitis S	r+..r+	....	r+..	+...r++	.....					
D Olea capensis ssp. hochst. T	++++++	....	11++	232232+	.....	V		4	V	
D Olea capensis ssp. hochst. S	++r+++	....	.++.	+++++++	.....	V		2	V	
D Cassipourea malosana T	.....	....	2222	3344342	.....			4	V	
D Cassipourea malosana S	.....	....	2+22	+++++++	.....			4	V	
D Hypoestes triflora	.....	....	++++	+rr.+++	.....			4	V	
D Droguetia iners	.....	....	..++	++++.++	.....			2	V	
Tecleo nobilis - Tecletum simplicifoliae Bussmann 1994 (A.1.II.a)										
C Podocarpus falcatus T	221+21	++12	212+	3332234	.....	V	4	4	V	
C Podocarpus falcatus S	+r+.++	.++.	.+..	+++++++	.....	V	2	1	V	
C Erythrococca bongensis S	++++++	....	2212	21++r23	.....	V		4	V	
C Oplismenus compositus	+++++.	++..	r+++	+++rr+.	.....	V	2	4	V	
C Teclea nobilis T	..+.r+	.++.	++.+	221++++	.....	III	2	3	V	
C Teclea nobilis S	++++++	+++.	++++	11+++++	.....	V	3	3	III	
C Ehretia cymosa S	...+++	....	+..+	..++.++	.....	III		2	V	
C Solanum schumannianum	r.++++	....	++r.	+rrr.++	.....	V		3	V	
C Asplenium linckii	++.+++	....	+r++	.....	.....	V		4		
C Turraea holstii S	.....	....	...+	.....++	.....			1	II	
C Aeschyomene schimperi S	.....	....	....	..r..++	.....				III	
C Helinus integrifolius S	.....	....	....	....r++	.....				II	
D Teclea simplicifolia T	r.++..	..+.	.+..	+++++++	.....	III	1	1	V	
D Teclea simplicifolia S	+.++++	++++	++++	++++++	.....	V	4	4	V	
Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae (A.1.II.a.1)										
D Dicliptera laxata	.....	....	4233	2331+23	.....			4	V	
D Acanthopale pubescens	.+....	....	++++	22++r23	.....	I		4	V	
D Vepris glomerata S	.....	....	+++.	++...+r	.....			3	III	
Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae typicum (A.1.II.a.1.1)										
D Peperomia tetraphylla	+.+...	....	++r+	.....	.....	II		4		
D Orchidacea gen.	..+...	....	+rrr	.....	.....	I		4		
D Stolzia repens	..+...	....	++++	.....	.....	I		4		

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D Bulbophyllum spec.	...+..	....	r.rr	....	....	I	3		
D Arisaema mildbraedii	......	....	+.r+	....	....		3		

Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae - Isoglossa punctata facies (A.1.II.a.1.2)

D Isoglossa punctata	......	....	....	+221+++	....			V	
D Justicia diclipteroides	......	....	..+.	+++++++	....		1	V	
D Aneilema pedunculosum	......	....	....	+r++.++	....			V	
D Acalypha volkensii	......	....	....	+r.++.+	....			IV	
D Panicum maximum	......	....	....	23+++..	....			IV	
D Puppalia lapacea	......	....	....	2++31..	....			IV	
D Leucas grandis	......	....	....	.rr+...	....			III	

Myrsino africanae - Juniperetum procerae - euclenietosum divinori (A.1.I.b.2)

D Euclea divinorum S	......	....	....	....	21+22++2+22			V	
D Euclea racemosa ssp. schimperi S	......	....	....	....	+r.++r.++++			V	
D Pistacia aethiopica S	......	....	....	....	212+2+++2++			V	
D Carissa edulis S	......	....	....	....	+r+.+++1+++			V	
D Grewia similis S	......	....	....	....	++.+2+++r.+			V	
D Thunbergia alata	......	....	....	++r+..+	++++.++++++			IV	V
D Hibiscus fuscus	......	....	....	....	+.rr.+rrrr.			IV	
D Monsonia angustifolia	......	....	....	....	+.r+++.rr.+			IV	
D Microcoelia moreauae	......	....	....	....	+.rr...+rr.			III	
D Indigofera arrecta S	......	....	....	....	+++.+...++.			III	
D Solanecio nandensis	......	....	....	....	....r.++.+r			III	
D Senecio hadiensis	......	....	....	....	+....rr+.+.			III	
D Ruellia patula	......	....	....	....	+....r+.rr.			III	
D Thunbergia gregorii	......	....	....	....	..rr.+.....			II	
D Androcymbium melanthoides	......	....	....	....	r....r.....			II	
D Crinum macowanii	......	....	....	....	....rr.+...			II	
D Hypoxis villosa	......	....	....	....	..rr..r.+..			II	

D: Differential Species C: Character Species T: Tree S: Shrub

Companions Ndare Ngare, Porror and Loroghi

Ehrharto erectae - Juniperetum procerae (A.1.I.a): *Asparagus africanus, Justicia striata, Asplenium abyssinicum, Pavetta oliveriana S*

Myrsino africanae - Juniperetum procerae (A.1.I.b): *Plectranthus sylvestris S, Anthriscus sylvestris, Asparagus racemosus*

Cassipourion malosanae (A.1.II): *Ekebergia capensis T, Ekebergia capensis S, Prunus africana T, Prunus africana S*

Tecleo nobilis - Tecletum simplicifoliae (A.1.II.a): *Pilea rivularis, Pilea johnstonii, Ficus thoningii T, Drypetes gerrardii S, Urera hypselodendra, Psydrax schimperiana S, Elaeodendron buchananii T, Elaeodendron buchananii S*

Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae (A.1.II.a.1): *Vernonia galamensis ssp. afromontana S, Clausena anisata S, Polystachya spec.*

Tecleo nobilis - Tecletum simplicifoliae diclipteretosum laxatae - Isoglossa punctata facies (A.1.II.a.1.1): *Crassocephalum montuosum, Setaria plicatilis, Girardinia diversifolia, Pavonia urens, Brucea antidysenterica S, Dombeya torrida S, Peddiea volkensii S, Pavetta schimperi S, Albizzia gummifera S, Leonotis ocymifolia, Strombosia scheffleri T, Cuscuta kilimanjari, Bersama abyssinica T, Bersama abyssinica S, Urtica massaica S, Desmodium repandum, Discopodium penninervum S, Smilax kraussiana, Abutilon longicuspe S, Clerodendron johnstonii S, Ocimum gratissimum S, Drymaria cordata*

Myrsino africanae - Juniperetum procerae – euclenietosum divinori (A.1.I.b.2): *Ocimum gratissimum, Microglossa pyridifolia S, Phytolacca dodecandra, Cynanchum altiscandens, Clematis simensis, Pentas lanceolata, Pavonia patens, Aerangis thomsonii, Commelina africana, Juncus inflexus, Phyllanthus fischeri S, Pimpinella orophila, Polygala sphenoptera, Ranunculus multifidus, Rhinorea convallarioides S, Salvia merjamie, Schoenoplectus spec., Leucas volkensii, Rubia cordifolia, Clutia abyssinica S*

Afromontane forests: *Asplenium aethiopicum, Senecio syringifolius, Cyperus sesquiflorus ssp. appendiculatus, Geranium kilimandscharicum, Maesa lanceolata S, Cyphostemma maranguense, Cyphostemma kilimandscharica, Maytenus heterophyllus S, Scutia myrtina S, Asplenium theciferum, Pleopeltis macrocarpa, Loxogramme abyssinica, Kalanchoe densiflora, Impatiens meruensis, Maytenus undata S, Dovyalis abyssinica S, Jasminum abyssinicum S, Nuxia congesta T, Nuxia congesta S, Thalictrum rhynchocarpum, Peperomia abyssinica, Zehneria scabra, Plantago palmata, Stephania abyssinica, Agrocharis incognita, Galium aparinoides, Lepisorus excavata, Hypoestes forskahlii, Cissamphelos pareira, Cynanchum abyssinicum, Commelina latifolia, Senecio hadiensis, Toddalia asiatica S, Asparagus falcatus*

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Table 5: Forest types of Gakoe, Ngaia and Nyambeni Hills

Class	D						A	C
Order	D.1						A.1	C.1
Alliance	I	II		III		II	I	I
Association	a	a		a	b	b	a	b
Subassociation		1	2					
Variant/Facies		1						
Relevé-Number	123456789111	111111	12222	2222223	3333333	334444	444444	55555
	012	345678	90123	4567890	1234567	890123	456789	01234
Number of Species	876677766676	756877	66786	8678887	6755555	534544	655565	44444
	942611396707	099638	91318	7401016	8300095	076198	132626	53439

Ocotetea usambarensis Bussmann 1994 (D)

								Constancy						
C Piper capense S	.....	++++++	+++++	+rr++++	++.++.+	.....	.+..r.	.....		V	V	V	IV	II
C Cyphostemma kilimandscharicum	.....	.....	+.+++	.....	++.+++.	.....	.....	.....			IV		IV	
C Strombosia scheffleri T	+++r++.++1++	++++++	+..++	++r++++	++r+.+.	..++.+	+.+rr+	.....	V	V	IV	V	IV	III V
C Strombosia scheffleri S	+...r+..++++	+.r+++	++r++	+++.+++	++...r.	.+++..	+.++++	.....	III	V	V	V	III	III V
C Dryopteris kilimensis	.....	..++++	+.+++	+++++++	.....	.....	.....	.....		IV	V	V		
C Tabernaemontana stapfiana T	++1+++++2++1	222232	322+2	+.+++++	+++.++1	.....	.....	.....	V	V	V	V		
C Tabernaemontana stapfiana S	++r.++++12++	+22222	+222+	12+2+++	+++2+++	.....	.....	.....	V	V	V	V		
C Oplismenus hirtellus	++++++++++	.....	.....	.....	2233423	554345	.....	.....	V				V	V
C Blotiella stipitata S	+++++.++22+2	+++r+.	.....	+.++++.	+++...+	.....	.....	.....	V	V		IV	IV	
C Ochna insculpta T	.....+.++.	.....	.....	.....	.....	.....	.....	.....	II					
C Ochna insculpta S	++++++++++	.....	.....	.....	.....	.....	.....	.....	V					
C Macaranga kilimandscharica T	++.. +.23244	..++.+	.....	++.++.+	++++.++	++.+++	.....	.....	IV	III		V	V	V
C Macaranga kilimandscharica S	r+..+..+++++	...r..	.....	+++.+++	+++..+.	+rr+++	.....	.....	IV	I		V	IV	V
C Plectranthus luteus S	rr..r.++1+11	.....	.....	.....	.....	.....	.....	.....	V					
C Elaphoglossum lastii	++r.r++++r++	.....	.....	.....	.....	.....	.....	.....	V					
C Begonia meyeri-johannis	++++++++++	.....	.....	.....	.....	.....	.....	.....						
C Trichomanes borbonica	.....	++++++	.+.++	.++....	.....	.....	+++rr+	++.++		V	IV	II		V IV
C Asplenium theciferum	.....	++++++	+.+++	.+r.rr.	++.+rr+	.....	.....	.....		V	IV	IV	V	
C Apodytes dimidiata T	++++.+++++++	.+..++	.+++.	+..++..	+++.+++	+.+..+	.....	.....	V	III	III	III	V	III
C Apodytes dimidiata S	.....	++++++	.++++	..++...	+++...+	.+..++	.....	.....		V	IV	II	III	III
C Peddiea fischeri T	....+.++.+++	...++.	.++.+	.....	.....	++++++	++++++	.....	III	II	IV			V V
C Peddiea fischeri S	.....++.++	+.++++	+.+++	.....	.....	++.+r+	+122++	.....	II	V	IV			V V
C Oleandra distenta	++++++++++	++++++	...+.	.....	+++++++	.....	.....	.....	V	V	I		V	
D Ocotea usambarensis T	22+1+222221+	++2222	+++++	.....	.r.+.++	.....	.....	.....	V	V	V		III	
D Ocotea usambarensis S	+++++++++.+r	..++.+	..++.	.....	.....	.....	.....	.....	V	III	III			
D Ocotea usambarensis	r....r ++r..	.r....	...r.	.....	.....	.....	.....	.....	III	I	I			
D Lasianthus kilimandscharicus T	.....	+1++++	+.+.+	++.++++	++.+++	++.+++	.....	.....		V	III	V	V	V
D Lasianthus kilimandscharicus S	.....	++21++	+++++	+++++++	++12+2+	++++++	.....	.....		V	V	V	V	V
D Asplenium sandersonii	1+++1+++++++	r.rrr+	+++++	++1+1++	+++++++	.....	.....	.....	V	V	V	V	V	
D Asplenium elliottii	+r..+..r....	.....	.....	.....	.....	.+..+r	rr++rr	.....	III					III V
D Panicum calvum	++++++++++++	+.++++	+222+	++.++++	++.+r++	++++++	rr+.++	+r+++	V	V	V	V	V	V V V
D Psychotria orophila S	++++++++++++	++++++	+++++	.+rr+++	++2+12+	1221+2	253354	+++rr	V	V	V	V	V	V V V
D Xymalos monospora T	.....	..+.r+	+222+	++.++++	+++.+1+	+.++r.	.....	.....		III	V	V	V	IV
D Xymalos monospora S	+++.++++++++	++2223	23222	212+221	++++.++	++++++	.....	.....	V	V	V	V	V	V
D Pauridiantha holstii S	.....+++++	224432	23323	+++++++	+++++++	.....	.....	.....	III	V	V	V	V	

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Syzygetalia guineensis Bussmann 1994 (D.1)									
C Diospyros abyssinica S	+++++++..... +.++r+ ++r++ +..++.. +++++++ +++.++	V		V	V	III	I		
C Psydrax schimperiana S	++r..+...... ..++.. +.+++ .... ++.+++ +.r++r	III		II	V			IV	
D Syzygium guineense T	++.+r+++++++ r+2212 +.+++ ..+21++ +2+12++ +.++++	V	V	V	IV	V	V		
D Syzygium guineense S	+...+r+.rr+. ...+.r +..r+ ....+.. ++....r +r....	III	II	II	II	III	II		
D Adenia gummifera	++.+++++.+++ ++r+++ +++.. +.+++++ ++++.++ ++.+++	V	V	IV	V	V	V		
D Aningeria adolfi-friederici T	+++r++++22+2 1+2+++ ++2++ +122+++ 1231232 442344	V	V	V	V	V	V		
D Aningeria adolfi-friederici S	.... r..+.. .+r.. .rr.... .+...+. +.++.+		II	III	II	II	III		
D Drypetes gerrardii S	++++++...... .... +.+++r	V					V		
D Jaundea pinnata S	++r+++++++++ ++++++ .++++ +.+.++r .+++.++ .+++++	V	V	V	IV	IV	V		
D Allophyllus cuneatus S	+++.++++.+++ +.+++. ++.++ ..+.... .++...+	V	IV	IV	I	III			
Cyathion mannianae Bussmann 1994 (D.1.I)									
C Lobelia baumannii	+++++++.....	III							
D Marattia fraxinea S	+++++++..... r+.... +.+.. ++++r++	III	II	II	V				
D Cyathea manniana S	+222++2..... 22+... ..... +r.++++	III	II						
Cyatheo mannianae - Afrocranietum volkensii Bussmann 1994									
C Afrocrania volkensii T	+1++111.....	II							
C Afrocrania volkensii S	+++++++.....	III							
D Moussaenda odorata T	rr+++r......	III							
Cyatheo mannianae - Moussaendetum odoratae typicum Bussmann 1994									
D Didymochlaena truncatula S	+++++++.....	III							
Albizzietum gummiferae Bussmann 1994 (D.1.I.a)									
C Albizzia gummifera T	+22+12+r..++ +.++++ +..rr +.+++++ ++r+.+. +++.++	V	V	III	V	IV	V		
C Albizzia gummifera S	+++++++..+r. r.+.++ .r..r +.rr+.. ++..++. +.+...	IV	IV	II	III	III	II		
C Albizzia gummifera	.... ++++.+ ...r. ++.+1++ .... +.++..		V	I	IV		III		
Zanthoxyllion gillettii Bussmann 1994 (D.1.II)									
C Anthocleista zambesiaca T	.... ++.+++ .++.+ ++r.rr+ .... r..+..		IV	IV	V		II		
C Secamone punctulata	....+.++r .++++ .....++		IV	IV	II				
D Myrianthetum holstii Bussmann 1994 (D.1.II.a)									
D Myrianthus holstii T	.... r..+++ ++.++		IV	V					
D Myrianthus holstii S	.... +..r.. r..r.		II	III					
Myrianthetum holstii tiliacoretosum funiferae (D.1.II.a.1)									
D Tiliacora funifera	....++++		IV						
Myrianthetum holstii tiliacoretosum funiferae - Alangium chinense variant (D.1.II.a.1.1)									
D Alangium chinense S	....rr.r		III						
D Halleria lucida T	.... +22+.+ ....+..		V		I				
D Halleria lucida S	.... ++1.++		V						
D Pteris dentata ssp. flabellata	.... ++.r++ .... ++++r		V						V
D Ensete edule S	....+.+++		IV						
D Hunteria zeylanica S	.... r.rrr. .+...		IV	I					
D Periploca linearifolia	....++.++ ..+..		IV	I					
D Trimeria grandifolia S	.... rr...r		III						
D Caesalpinia decapetala S	.... +..r+.		III						
D Croton sylvaticus T	....++.+		III						
D Croton sylvaticus S	....+.+		II						
D Senna cf. didymobotrya S	....r...		I						
D Aframomum keniense	....r.. ++++.		I	IV					
D Cissus olivieri	.... .r.r.. ..++.		II	II					
D Vitex keniensis T	.... .r++++ r.+rr		V	IV					
D Vitex keniensis S	....++. ..r..		II	I					
D Tricilia emetica S	....+..+		II						

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Myrianthetum holstii mitragynietosum rubrostipulatae (D.1.II.a.2)

```
D Mitragynia rubrostipulata T     ..........  ......  +22++  .......  .......  ......  ......  .....                V
D Mitragynia rubrostipulata S     ..........  ......  +++++  .......  .......  ......  ......  .....                V
D Ficus sur T                     ..........  ......  +++.+  .......  .......  ......  ......  .....                V
D Cussonia spicata T              ..........  ......  .++r.  .......  .......  ......  ......  .....                IV
D Cussonia spicata S              ..........  ......  .++..  .......  .......  ......  ......  .....                III
```

Lovoion swynnertonii (D.1.III)

```
C Rawsonia lucida S               ..........  ......  ..... +222+++ +21+1++  ......  ......  .....                V     V
C Uvariodendron anisatum T        ..........  ......  ..... .......  +++.r+r  ......  ......  .....                      V
C Uvariodendron anisatum S        ..........  ......  ..... ++r..++ ++.rr+.  ......  ......  .....                      IV
C Heinsenia diervilleoides S      ..........  ......  ..... ++...++ ++.+r++  ......  ......  .....                III   IV
C Rinorea convallarioides S       ..........  ..r.+r  ...r. ++.++++ +++++++  ......  ......  .....          III   I
D Lovoa swynnertonii T            ..........  ......  ..... 22+1221 2212221  ......  ......  .....                      V     V
D Lovoa swynnertonii S            ..........  ......  ..... +r.r+.r ++.++++  ......  ......  .....                      IV    V
```

Lovoetum swynnertonii (D.1.III.a)

```
C Adianthum hispidulum            ..........  ......  ..... rr++r++  .......  ......  ......  .....                      V
C Uvaria scheffleri S             ..........  ......  ..... ++.++++  .......  ......  ......  .....                      V
C Rytigynia neglecta S            ..........  ......  ..... .+++.++  .......  ......  ......  .....                      IV
D Chrysophyllum gorgunosanum T    ..........  ......  ..... 12+222+  .......  ......  ......  .....                      V
D Chrysophyllum gorgunosanum S    ..........  ......  ..... ++22++2  .......  ......  ......  .....                      V
D Filicium decipiens T            ..........  ......  ..... 21+2222  .......  ......  ......  .....                      V
D Filicium decipiens S            ..........  ......  ..... +.+++++  .......  ......  ......  .....                      V
D Erytrococca fischeri S          ..........  ......  ..... +.++..r  .......  ......  ......  .....                      III
D Premna maxima T                 ..........  ......  ..... ++.++++  .......  ......  ......  .....                      V
D Premna maxima S                 ..........  ......  ..... r..+r..  .......  ......  ......  .....                      III
```

Argomuelleretum macrophyllae (D.1.III.b)

```
C Teclea trichocarpha S           ..........  ......  .....  .......  ++2122+  ......  ......  .....                            V
C Hilleria latistifolia S         ..........  ......  .....  .......  ++12++2  ......  ......  .....                            V
C Meineckia phyllanthoides S      ..........  ......  .....  .......  +++.+++  ......  ......  .....                            V
C Uvaria lucida S                 ..........  ......  .....  .......  ++.+r..  ......  ......  .....                            IV
C Pleiocarpa pycnantha S          ..........  ......  .....  .......  ++++...  ......  ......  .....                            IV
C Drypetes natalensis S           ..........  ......  .....  .......  ++..r..  ......  ......  .....                            III
D Argomuellera macrophylla S      ..........  ......  .....  .......  3554522  ......  ......  .....                            V
D Erytrococca bongensis S         ..........  ......  .....  .......  +++++++  ......  ......  .....                            V
D Ixora scheffleri S              ..........  ......  .....  .......  ++++1++  ......  ......  .....                            V
D Blighia unijugata T             ..........  ......  .....  .......  +2112+2  ......  ......  .....                            V
D Blighia unijugata S             ..........  ......  .....  .......  ++..r++  ......  ......  .....                            IV
```

Newtonio buchananii - Phoenicetum reclinatae (D.1.II.b)

```
C Newtonia buchananii T           ..........  ..++++ 22+++  .......  .......  355453  ......  .....          III   V                    V
C Newtonia buchananii S           ..........  ...+.r r.+rr  .......  .......  ++++++  ......  .....          II    IV                   V
C Newtonia buchananii             ..........  ....++ ...++  .......  .......  ++rr++  ......  .....          II    II                   V
D Phoenix reclinata T             ..........  .++r+. .++++  .......  .......  223232  ......  .....          IV    IV                   V
D Phoenix reclinata S             ..........  .r++.. ..+..  .......  .......  +.+++.  ......  .....          III   V                    IV
```

Juniperetea procerae Bussmann 1994 (A)

```
D Sanicula elata                  ..........  ......  .....  .......  .......  ......  ++++++ +.+++                                  V     V
D Stipa dregeana S                ..........  ......  .....  .......  .......  ......  424423 33455                                  V     V
```

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Faureo salignae - Ilicetum mitis Bussmann 1994 (A.1.I.a)				
D Faurea saligna T	.... +2222+		V	
D Faurea saligna S	.... ++.+r.		IV	
D Ilex mitis T	.... 332233		V	
D Ilex mitis S	.... ++r.r+		V	
Sinarundinarietea/-etalia/-ion alpinae Bussmann 1994 (C.1.I.)				
C Cyperus dereilema S	.... +++rr+ +2222		V	V
C Selaginella kraussiana	.... 252344 332+1		V	V
D Sinarundinaria alpina S	.... 33+1+			V
Sinarundinario alpinae - Podocarpetum latifolii Bussmann 1994 (C.1.I.a)				
D Podocarpus latifolius T	rr...+.++2+2 .... 323322 44354	IV	V	V
D Podocarpus latifolius S	++....++++++ .... ++++++ ++212	IV	V	V
D Rapanea melanophloeos T	.... +rr.r			V
D Rapanea melanophloeos S	.... +...+			III

D: Differential Species **C: Character Species** **T: Tree** **S: Shrub**

Companions vegetation types of Gakoe, Ngaia and Nyambeni Hills

Ocotetea usambarensis (D): *Neoboutonia macrocalyx, Neoboutonia macrocalyx S, Arisaema mildbraedii, Smilax kraussiana, Setaria megaphylla, Casearia battiscombei T, Casearia battiscombei S, Lobelia gibberoa S, Pavetta hymenophylla S*

Syzygetalia guineensis (D.1): *Hymenophyllum melanotrichum, Thelypteris strigosa, Tectaria gemmifera, Tetradenia riparia S, Macrothelypteris aubertii*

Cyathion mannianae (D.1.I): *Amauropelta bergiana, Cystopteris fragilis, Pteris pteridioides, Elatostemma monticola, Dregea schimperi, Pentas lanceolata, Asplenium abyssinicum, Rhytigynia uhligii S, Pneumatopteris unita, Ritchiea albersii S, Ficus thoningii T, Drymaria cordata, Hydrocotyle mannii, Galiniera coffeoides T, Galiniera coffeoides S, Centella asiatica*

Cyatheo mannianae - Afrocranietum volkensii: *Rubus pinnatus S, Pleopeltis macrocarpa, Euphorbia ugandensis*

Cyatheo mannianae - Moussaendetum odoratae: *Diplazium nemorale, Dahlbergia lactea S*

Albizzietum gummiferae (D.1.I.a): *Peponium vogelii, Psychotria fractinervata T, Psychotria fractinervata S, Hypolepis sparsisora S, Drynaria volkensii, Clerodendrum johnstonii S, Cannaria eminii, Clausena anisata S, Dovyalis abyssinica S, Laportea alatipes, Asparagus racemosus, Impatiens fischeri, Elaphoglossum acrostichoideus, Keetia gueinzii S, Monanthotaxis parviflora S*

Myrianthetum holstii mitragynietosum rubrostipulatae (D.1.II.a.1): *Impatiens elegantissima, Impatiens telekii, Ocimum gratissimum S, Ocotea kenyensis T. Ocotea kenyensis S, Oyxanthus speciosus S, Solanum sessilistellatum, Urera hypselodendra, Scutia myrtina S*

Lovoetum swynnertonii (D.1.III.a): Cola greenwayii T, Cola greenwayii S, Streptocarpus montanus, Crassocephalum *crepidioides, Chaetacme aristata S, Doryopteris kirkii, Cussonia holstii T, Eulopia horsfallii*

Argomuelleretum macrophyllae (A.1.III.b): Croton macrostachyus T, Croton macrostachyus S, Tricilia dregeana T, Tricilia *dregeana S, Markhamia lutea T, Markhamia lutea S, Oxyanthus speciosus S, Teclea nobilis T, Teclea nobilis S, Pavetta abyssinica S, Celtis gomphophylla T, Celtis gomphophylla S*

Newtonio buchananii - Phoenicetum reclinatae (D.1.II.b): Phyllanthus fischeri S, Triumfetta macrophylla S, Cissamphelos *friesiorum, Dracaena steudneri T, Solanecio angulatus, Pteris catoptera*

Juniperion procerae (A.1.I): *Impatiens meruensis, Jasminum abyssinicum S, Nuxia congesta T, Nuxia congesta S, Thalictrum rhynchocarpum, Peperomia abyssinica, Dryopteris manniana, Anthriscus sylvestris, Agrocharis incognita, Pileea usambarensis var. veronicaefolia, Dracaena afromontana S, Rubus keniensis S, Carex chlorosaccus, Loxogramme abyssinica, Asplenium monanthes*

Faureo salignae - Ilicetum mitis (A.1.I.a): *Chlorophytum sparsiflorum, Lepidotrichilia volkensii T, Lepidotrichilia volkensii S, Pycnostachys meyeri, Micrococca holstii S, Cassipourea malosana T, Cassipourea malosana S, Vernonia galamensis ssp. afromontana S*

Sinarundinarietea/-etalia/-ion/-etum alpinae (C.1.I.a): *Parochetus communis, Schefflera volkensii T, Plantago palmata, Zehneria scabra, Stephania abyssinica, Galium aparinoides, Prunus africana T, Prunus africana S, Maytenus heterophyllus S, Myrsine africana S, Plectranthus kamerunensis, Polygala sphenoptera*

Afromontane forests: *Asplenium aethiopicum, Asplenium friesiorum, Asplenium linckii, Achyranthes aspera, Bersama abyssinica T, Bersama abyssinica S, Ekebergia capensis T, Ekebergia capensis S, Arachnoides foliosa, Asparagus africanus, Englerina woodfordioides, Plectranthus sylvestris S*

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Table 6: Forest vegetation types of the Loita Hills

Class	A				
Order	A.1				
Alliance	I	II			
Association	a	a			
Subassociation	1	1			
Facies		1	2		
Relevé-Number	1234567891111 0123	11111122222222 45678901234567	223333 890123		
Number of Species	7444545433334 0527491568850	85566683566666 14875809328911	545556 930680		
				Constancy	
Juniperetea procerae Bussmann 1994 (A)					
C Isoglossa gregorii	++++++++++++	+.++++++.r++++	++.+++	V	V V
C Achyranthes aspera	++++++++++.++	++.+++++.++++.	++++++	V	IV V
D Juniperus procera T	2233233332233	+rrr.rr..rr.+r	r..rr+	V	IV IV
D Juniperus procera S	+.+++.+++.+++	......r...+r.r	...r.r	V	II II
D Stipa dregeana S	+344333++222+	rr.+.r+++.++++	344355	V	V V
Juniperion procerae Bussmann 1994 (A.1.I)					
C Olea europaea ssp. afri. T	+22+122442332	r.+rr.r.r...rr	rr..r.	V	III III
C Olea europaea ssp. afri. S	++++++++++++	......+.r..rr.	....r.	V	II I
Ehrharto erectae - Juniperetum procerae Bussmann 1994 (A.1.I.a)					
D Ehrharta erecta	++.++rr++++.+	.....	.....	V	
Ehrharto erectae - Juniperetum procerae warburgietosum ugandensis (A.1.I.a.1)					
D Warburgia ugandensis T	2232333+.++++	.....	.....	V	
D Warburgia ugandensis S	+.++++++.+++.	.....	.....	V	
D Schoenoxiphium lehmannii	+22212+++++++	.....	.....	V	
Cassipourion malosanae Bussmann 1994 (A.1.II)					
C Ilex mitis T	r...r+.....	+.r++.+.++.++r	+.++.+	II	IV IV
C Ilex mitis S	....r.....	r...+.r+..rr.+	+.rr..	I	III III
C Hypoestes aristata S	r..rr.r..r.r	454445+.r++.r+	++.+++	III	IV V
D Cassipourea malosana T	221+2++++r+.+	32333244434434	232232	V	V V
D Cassipourea malosana S	+..++....+...	++.+r+++.+++.+	+...++	II	IV III
D Olea capensis ssp. hochst. T	rr...r.....	++++++r.+rr.rr	++++++	II	V V
D Olea capensis ssp. hochst. S	+....+.....	+.+++.+...r...	+++..+	I	III III
D Olea capensis ssp. hochst.	.....	+rr.+r..+.r...	.+...+		III II
Tecleo nobilis - Tecletum simplicifoliae Bussmann 1994 (A.1.II.a)					
C Podocarpus falcatus T	4342232223222	43544355435453	443222	V	V V
C Podocarpus falcatus S	++rr+r+++r..r	++++++++++++	.+.rr+	V	V IV
C Teclea nobilis T	+.rr+.....	++.+++21+22+12	++.+++	II	V V
C Teclea nobilis S	+...++.....	+1++++222+2++2	+++.++	II	IV V
C Erythrococca bongensis S	.....	+.r++.rr+.r+.+	++r+.+		IV IV
D Teclea simplicifolia T	.....	...+r++.+.rr+++.	.+....		IV I
D Teclea simplicifolia S	.....	+++++++.++++r+	..++..		IV II
Tecleo nobilis - Tecletum simplicifoliae oplismenetosum hirtelli (A.1.II.a.1)					
D Oplismenus hirtellus	.....	+21+22++++5335	.+....		V I
D Ochna insculpta T	.....	+..r..r....++.	.....		II
D Ochna insculpta S	.....	+.++r++.++++r+	.....		V
D Giardinia diversifolia	.....	+.rr.+..r.r+.+	.....		IV
D Pavetta abyssinica S	.....	++.r+++.++++.+	+..+.+		IV III
D Peperomia tetraphylla	.....	+rr+++r.++r..r	+...+.		IV II
D Tarenna graveolens S	.....	+..+r++.+++.+.	....+.		IV I
D Vernonia auriculifera S	.....	+++.+++.++++.+	..+...		IV I
D Solanum sessilistellatum	.....	.r..r.++..r+...	+.++.+		III III
D Doryopteris kirkii	.....	..++...r.+..+.	.....		III
D Allophyllus abyssinicus T	.....	+.+.....+r.	.....		II
D Allophyllus abyssinicus S	.....	++....+....++.	.+....		III I

D: Differential Species C: Character Species T: Tree S: Shrub

Companions Loita Hills

Ehrharto erectae - Juniperetum procerae (A.1.I.a): *Maytenus undata S, Dovyalys abyssinica S*

Ehrharto erectae - Juniperetum procerae warburgietosum ugandensis (A.1.I.a.1): *Prunus africana T, Prunus africana S, Asparagus falcatus, Chlorophytum sparsisorum, Cyperus dereilema S, Olinia rochetiana T, Olinia rochetiana S, Jasminum abyssinicum S, Nuxia congesta T, Nuxia congesta S, Loxogramme abyssinica, Senecio syringifolius, Clematis simensis*

Tecleo nobilis - Tecletum simplicifoliae (A.1.II.a): *Ficus thoningii T, Urera hypselodendra, Asparagus setaceus*

Tecleo nobilis - Tecletum simplicifoliae oplismenetosum hirtelli (A.1.II.a.1): *Acalypha volkensii S, Aerangis thomsonii, Celosia anthelmetica, Cissamphelos pareira, Clausena anisata S, Cynanchum abyssinicum, Cyrtorchis arcuata, Justicia diclipteroides, Pilea rivularis, Vangueria infausta S, Solanecio mannii S, Solanum acculeastrum, Cuscuta kilimanjari, Pycnostachys meyeri, Halleria lucida T, Halleria lucida S, Thunbergia alata, Pupalia lappacea, Droguetia iners*

Cassipourion malosanae (A.1.II): *Aneilema pedunculosum, Phyllanthus fischeri S, Bersama abyssinica T, Bersama abyssinica S, Urtica massaica S, Panicum calvum, Solanum terminale S*

Juniperetea procerae (A): *Podocarpus latifolius T, Podocarpus latifolius S, Asplenium aethiopicum, Cyathula cylindrica, Leucas volkensii, Rubia cordifolia, Rhamnus prinoides S, Plectranthus sylvestris S, Peperomia abyssinica, Zehneria scabra, Agrocharis incognita, Euphorbia ugandensis, Galium aparinoides, Ekebergia capensis T, Ekebergia capensis S, Cyphostemma maranguensis,*

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Asparagus racemosus, Maytenus heterophyllus S, Asplenium theciferum, Pleopeltis macrocarpa, Basella alba, Canthium schimperi S, Peddiea fischeri S, Psydrax schimperiana S

Forest - grassland transition zone: *Abutilon longicuspe, Lepisorus excavata, Ocimum gratissimum S, Toddalia asiatica S, Clutia abyssinica S, Albizzia gummifera T, Albizzia gummifera S, Mimulopsis alpina S, Mimulopsis alpina, Achyrospermum schimperi S, Kostelzia adoensis, Osyris lanceolata S, Solanum indicum, Solanum nigrum, Crassocephalum montuosum*

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Table 7: Forest vegetation types of Ngong Road and Karura forests (Nairobi)

Class	A			
Order	A.1			
Alliance	III			
Association	a			
Subassociation	1			
Facies	1	2		
Relevé-Number	1234567891111 0123	11111122222222223 45678901234567890		
Number of Species	4454554454456 8909309317793	56544565555556555 91896538404381874		
				Constancy
Brachylaenion huillensis Bussmann 1994 (A.1.III)				
C Calodendrum capense T	++++++++++1++	++++++++++++++++		V V
C Maytenus heterophyllus S	++++++++++++	++++++++++++++++		V V
C Drypetes gerrardii S	++++++++++++	+2++2222+++2222+2		V V
C Euclea divinorum S	++++++++++++	++++++++++++++++		V V
D Brachylaena huillensis T	2323222222232	32222122323222212		V V
D Croton alienus S	2	22232233332232222		I V
D Acokanthera schimperi T	++22+22+1+122	..21221.....21221		V III
D Acokanthera schimperi S	++++++++++++	++++++++++++++++		V V
Crotono megalocarpi - Brachylaenetum huillensis Bussmann 1994				
C Pterolobium stellatum S	...........++	.+++.+++..+++++++		I IV
D Croton megalocarpus T	2323343233222	33++++++++++++++		V V
D Croton megalocarpus S	++r+.+++..+.+	.....		IV
D Grewia similis S	.....	+.r+..+r++.rr++++		IV
Elaeodendro buchananii - Brachylaenetum huillensis Bussmann 1994 (A.1.III.a)				
C Teclea simplicifolia T	4342244322344	22+321++222+++221		V V
C Teclea simplicifolia S	++2++22+r++++	1++++1++++21++++		V V
C Ochna insculpta T	++++++++++++	..r....+r.++rr+..		V III
C Ochna insculpta S	+.++.+++++++.	+r..+r++++.++++++		V IV
D Elaeodendron buchananii T	32++2+232+2+2	2222232++2+222232		V V
D Elaeodendron buchananii S	++++++++++++	++++++++++++++++		V V
D Teclea trichocarpa T	++++++++++++	++22222+2222++22+		V V
D Teclea trichocarpa S	++r++++++++++	++++++++++.++++		V V
D Oplismenus burmannii	+r+rr++++r+++	22534553342353455		V V
Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae (A.1.III.a.1)				
D Acokanthera longifolia S	++++r.+..+.+.	+++.+rr+++...++++		IV IV
D Gnidia subcordata S	++..+r+.+.++r	r++...rr..++++r++		IV IV
D Cassipourea rotundifolia T	+.++.+.+++..+	.+++.++.+.+++++r+		III IV
D Cassipourea rotundifolia S	r+....+.+r.++	r..rr+r.+++rr+.++		III IV
D Manilkara discolor T	.+r.+..+..+.+	+r..+rr+++...++r.		III IV
D Turraea mombasana S	.r.+++...+..+	+++ rr+r..+r++..+		II IV
D Albizzia schimperiana T	..++....+..++	.++.r+++....+r+r.		II III
D Albizzia schimperiana S	.r+....++..r.	++....++r...r++..		II III
D Mimusops kumel S	..+r+.....+.r	.rr..+r.r..++r+..		II III
Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae - Phyllanthus obovalifolius facies (A.1.III.a.1.1)				
D Phyllanthus obovalifolius	3333344233342	+++...r++r+++..++		V IV
D Schrebera alata S	2+21+22+2+++2	+++.++++++..+++ +		V V
D Vernonia holstii	2332232223+22	+++.r++...++++r++		V IV
D Hibiscus corymbosus	2333222233332	++r++..+++++...++		V IV
D Barleria micrantha	3222331223323	++.r++++.rr++++++r		V V
D Ochna sleumeri S	++.++++++.+++	.....		
Elaeodendro buchananii - Brachylaenetum huillensis accokantheretosum longifoliae - Chaetacme aristata facies (A.1.III.a.1.2)				
D Chaetacme aristata S	...........++	22+222+++2222222+		I V
D Panicum maximum	.....	++34433233+443332		V
D Strychnos usambarensis S	...........+	+2222+22211++2221		I V
D Adenia gummifera	...........+	+r..rr+..++...r+.		I III
D Teclea hanangensis T	.....	++.+..+++.+.++r.+		IV
D Teclea hanangensis S	.....	r+.r.rr++..r.++r.		IV
D Uvaria scheffleri S	...........r	r.+r++r++.r+..+++		I IV
D Markhamia lutea T	.........+r	..rr+.r...++r..+r		I III
D Ochna ovata S	.........++r	r...rr..++r...r+.		II III
D Zanthoxylum usambarense T	.....	.rr+....r.++r..+.		III
D Craibia brownei S	...........+	+.r...++r.+...rr.		I III

D: Differential Species C: Character Species T: Tree S: Shrub

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Companions Ngong Road and Karura forests (Nairobi)

Brachylaenion huillensis (A.1.III): *Toddalia asiatihca S*

Crotono megalocarpi - Brachylaenetum huillensis (A.1.III.a): *Rhus natalensis S, Cassipourea malosana T, Cassipourea malosana S, Ficus thoningii T*

Elaeodendro buchananii - Brachylaenetum huillensis (A.1.III.a): *Stipa dregeana S, Asparagus setaceus, Scutia myrtina S, Schoenoxiphium lehmannii, Olea europaea ssp. africana T, Olea europaea ssp. africana S, Clausena anisata S, Maytenus undata S, Allophyllus abyssinicus S, Dombeya spec. S,*

Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae (A.1.III.a.1): *Suregada procera S, Erythrococca bongensis S, Warburgia ugandensis T, Chionanthus battiscombei S, Celtis africana T, Hippocratea africana S, Canthium keniense T, Strychnos henningsii T, Strychnos henningsii S, Albizzia gummifera S, Rawsonia lucida S, Diospyros abyssinica S*

Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae - Phyllanthus amara facies (A.1.III.a.1.1): *Pavetta spec. S, Trema orientalis S, Mystroxylon aethiopicum S, Cyphostemma spec. E, Viscum fischeri, Ehretia cymosa S, Fagaropsis angolensis S, Asparagus africanus*

Elaeodendro buchananii - Brachylaenetum huillensis acokantheretosum longifoliae - Chaetacme aristata facies (A.1.III.a.1.2.): *Psydrax schimperiana S, Newtonia buchananii T*

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