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VEGETATION OF THE KOOBI FORA REGION NORTHEAST OF LAKE TURKANA, MARSABIT COUNTY, NORTHERN KENYA

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ABSTRACT

The Koobi Fora region east of Lake Turkana in northern Kenya ranges in elevation from *ca*. 360 to 560 m, has a mean annual temperature of *ca*. 32°C, and rainfall of *ca*. 130 mm per year. The area, much of which lies within Sibiloi National Park, supports a diverse flora. Here we provide a list of 367 plant species (361 angiosperms) collected from an area of about 2600 km^2 between 2012 and 2014, compare the region's angiosperm flora with the only other documented floras nearby, discuss the principal vegetation types in the study area, and highlight occurrences of some less common plants and plants of restricted distribution. Some 137 plant species (131 angiosperms) are newly documented in this region, none of which have been recorded in the Marsabit region to the east-southeast or in the lower Omo Valley to the northwest. Comparison of the flora of this region with reported floras of the Omo Valley and the Marsabit region show that only 98 species are common to all three areas, and that each area has unique taxa that make up about one-third of its angiosperm flora. Thus each region has a distinct flora, despite having a similar physiognomic appearance. Most of the area is covered by grassland or dwarf shrubland, with about 16% shrubland, and $<0.5\%$ riparian forest and riparian woodland combined.

Keywords: Grassland, shrubland, dwarf shrubland, diverse flora, Sibiloi.

INTRODUCTION

Knowledge of current vegetation is critical to reconstruction of environments in which our ancient ancestors lived. Koobi Fora, with an area of *ca*. 2600 km^2 in northern Kenya between the Ethiopian border and Jarigole (figure 1) extending *ca*. 30 km eastward from Lake Turkana, has been investigated by palaeontologists, anthropologists and geologists continuously since 1968, when Richard Leakey and his colleagues first discovered fossils of early human ancestors there (*e.g.*, Leakey, 1970a, b). In 1973 the government of Kenya

established Sibiloi National Park to encompass much of the area (1570 km^2) to protect the wildlife of the region, and also because of its remarkably abundant, well-preserved fossils of human ancestors, other vertebrate fossils, and archaeological remains. As one of the Lake Turkana National Parks, the area was listed as a UNESCO World Heritage Site in 1997.

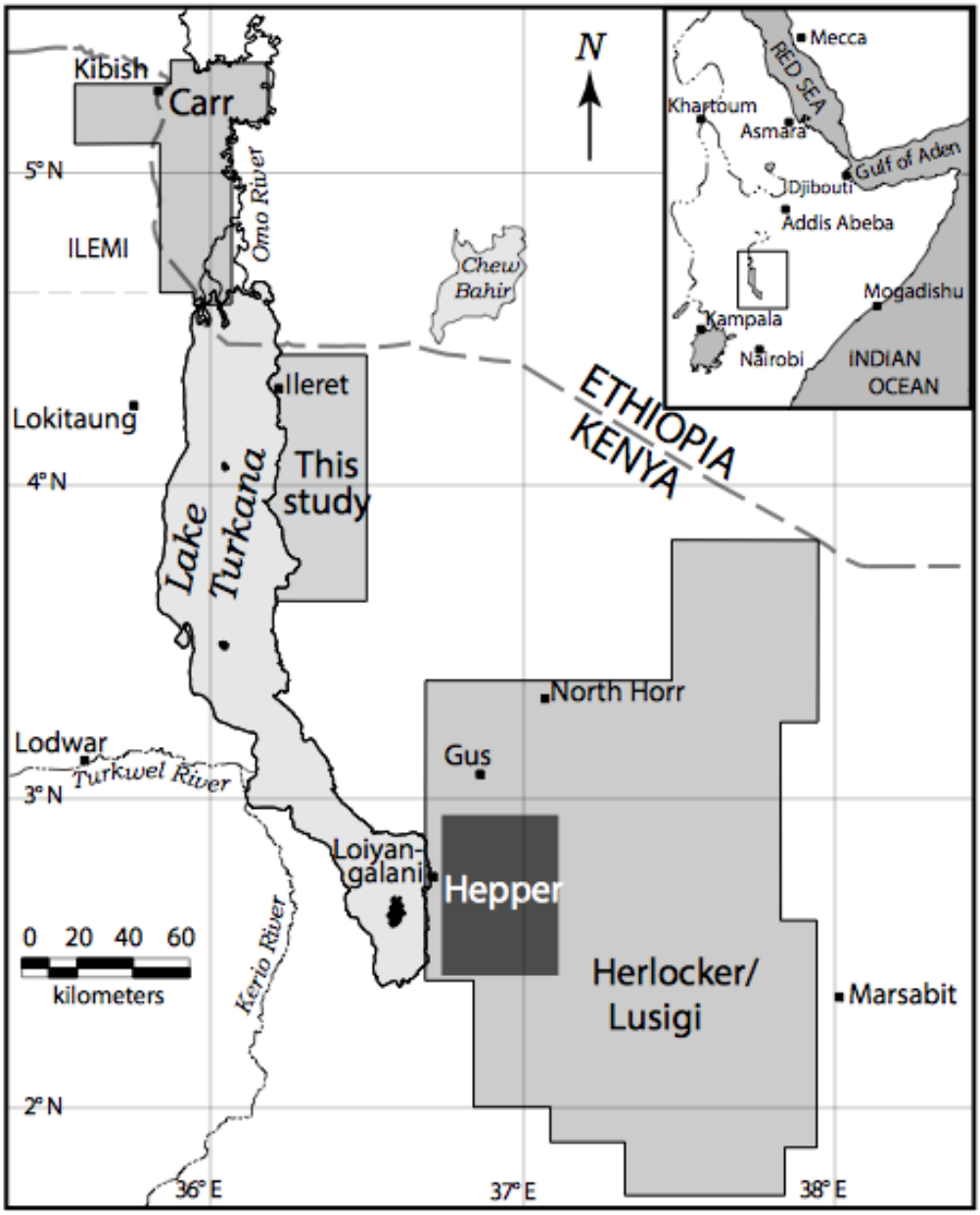

Figure 1. Regional map showing the areas studied by Carr (1976, 1998) in the lower Omo Valley, Ethiopia, by Herlocker (1979) and Lusigi et al. *(1984) in the Marsabit region, Kenya, by Hepper* et al. *(1981) on Mount Kulal, Kenya, and in this study. Inset shows placement of Lake Turkana in broader context.*

The flora of the region is of interest to botanists, palynologists (*e.g.*, Bonnefille, 1971), paleoanthropologists (*e.g.*, Kiura, 2008), archaeologists (*e.g.*, Bunn, 1994; Sept, 1984, 1986), and range managers (*e.g.*, Lusigi *et al.*, 1984; Herlocker, 1991). Despite the immense interest in the botany of the region for over 40 years, for whatever reason, the few botanical observations made in the area resulted only in lists of plants consigned to files of interested researchers. Hence the region lacks a comprehensive published plant list available to other interested scientists, and only a few plants are recorded from the area by Dale & Greenway (1961) and Beentje (1994). However, several comparable published botanical studies exist for areas adjacent to the Koobi Fora region. For example, Herlocker (1979) and Lusigi *et al.* (1984) previously described the flora of the Marsabit area 150–200 km to the south-southeast, and Hepper *et al.* (1981) published a thorough checklist of plants from Mount Kulal and the surrounding area. Other comparable studies are by Carr (1976, 1998) who described the vegetation of the lower Omo Valley 70–160 km to the northwest, and Bytebier and Bussman (2000; also Bussman, 2002) who studied the vegetation of highland regions >200 km to the south (Nyiru, Loroghi, Poror) as part of a broader investigation of forests in the Kenyan highlands. Still farther away, Gemedo-Dalle *et al.* (2005) provided a list of >320 angiosperms from an area north of Moyale that lies mainly between *ca.* 1300–1700 m elevation. Terefe *et al.* (2010) worked in an area adjacent to the Koobi Fora region in southern Ethiopia and gave a brief list of plants in the Benna-Tsemay and Hamer areas, all from elevations above 550 m.

Accordingly, to advance our knowledge of the botany of Koobi Fora region one of us (JKM) from East African Herbarium took advantage of two geological field seasons in the area to collect plants from the region. The principal goals of the study were: 1) to document plant taxa of the region, 2) to compare the region's angiosperm flora with the only other documented nearby floras in the Omo Valley to the northwest (Carr, 1976; 1998), and to the south and southeast (Lusigi *et al.*, 1984; Hepper *et al.* (1981) and 3) to provide notes on existing vegetation types and occurrences of some less common plants and plants of restricted distribution.

Access to the study area, resources, local inhabitants, and climate

Access to the region through Kenya is by unpaved road north from Loiyangalani near the southern end of the lake, or via Marsabit and North Horr if approached from the east. Travel is slow, so at least two days should be allowed for the trip from Loiyangalani to Ileret, although it can be accomplished in one very long day. Permanent settlements are maintained by the Kenya Wildlife Service (KWS) in two places: the headquarters of Sibiloi National Park at Allia Bay, and a small outpost near Derati on the eastern margin of the park. The National Museums of Kenya maintain research facilities at Koobi Fora, and more recently the Turkana Basin Institute (TBI) has established a research centre near the northern end of the study area a few kilometres south of Ileret (figure 1). Some researchers fly directly to TBI from Nairobi, as it is adjacent to an airstrip. Ileret has a Kenya Police post surrounded by a growing town in which basic supplies can be purchased. From the Ethiopian border southward, the area is used for grazing by Daasanach people, whereas Gabra people utilize the eastern and southeastern parts of the study area, and Turkana graze their domestic animals on Jarigole (figure 2). We have used the spelling Daasanach, because it is preferred in Ethnologue (www.ethnologue.com/language/dsh) where it is noted that the people and language are also known by many other names. In order to gain some appreciation for human activity in the principal collection areas we recorded the position of bomas and groups of bomas visible on the satellite imagery (see figure 2).

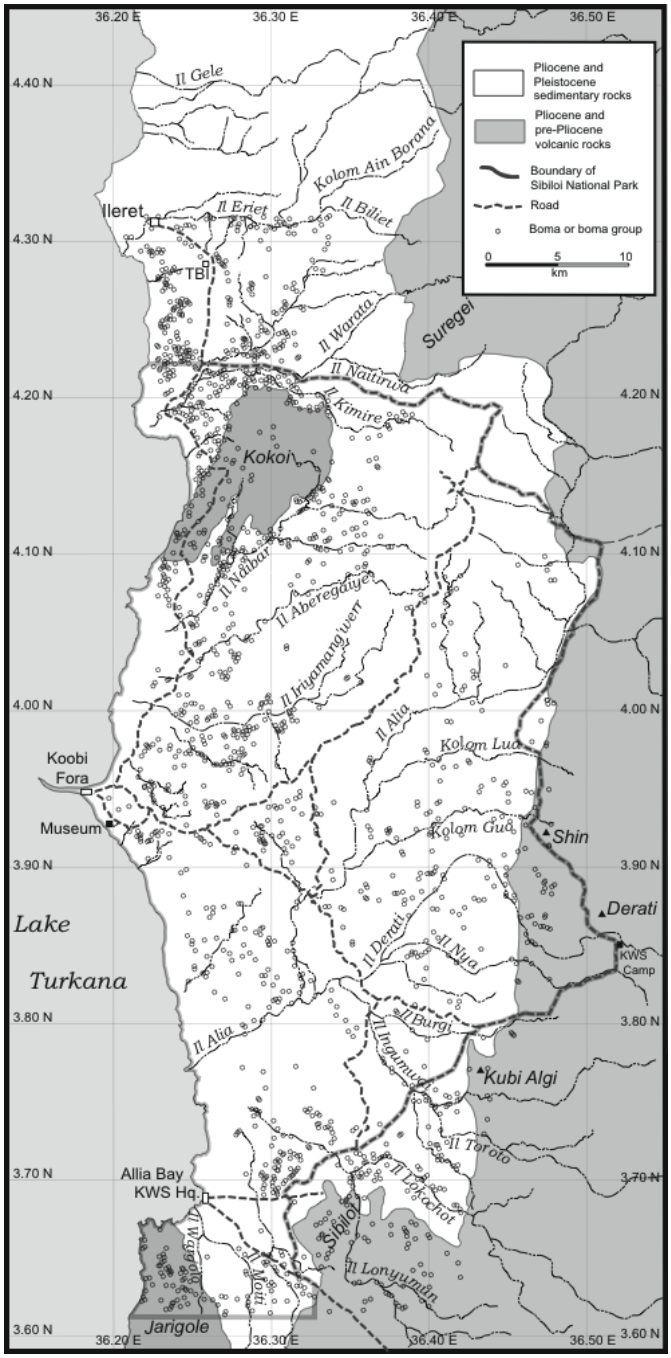

Figure 2. Map of geographic and cultural features east of Lake Turkana, including Sibiloi National Park. Intact bomas between Il Eriet and Jarigole mapped from satellite imagery acquired between 2 March, 2004 and 24 August, 2004(58%), and from October 1, 2010 to 9 April, 2013 42%).

Climatic data for the region are scarce. Lodwar, west of Lake Turkana, has the nearest long-term weather station in the region, and Hijmans *et al.* (2005) places the region in the hottest 1% of the land area on Earth. The mean annual, mean maximum, mean minimum, and 25 cm-depth soil temperatures are 32°C, 37°C, 26°C, and 37°C, respectively. From a study of bond ordering in paleosol carbonates high temperatures have evidently pertained in the area for at least the past 4 million years (Passey *et al.*, 2010). Solar insolation is 250 W/m^2. Data collected at a weather station at TBI, Ileret (June, 2010–March, 2012; Appendix B, Mace, 2012) show that annual rainfall of *ca.* 130 mm occurs primarily during two seasons centred on April and November. Winds come dominantly from the southeast, driven by the Turkana Jet (Kinuthia, 1992), and are noticeably stronger south of *ca.* 4°N latitude.

Geology and relevant landforms in the study area

The Koobi Fora region occupies a large low area northeast of Lake Turkana that is covered with Pliocene and Pleistocene sedimentary strata and bounded by volcanic rocks of Miocene to Pliocene age on the northeast, east, and southeast (figure 2). Most of the region lies at elevations below 500 m, and areas below 457 m were submerged beneath Lake Turkana until about 5300 years ago (Garcin *et al.*, 2012). From the Ethiopian border to Jarigole (figure 2) only one high area, the Kokoi, breaks the plain immediately east of the lake. The Kokoi exposes basalts and sedimentary strata up to elevations of *ca.* 560 m (figure 2).

Eastward from the lake (*ca.* 360 m), plains slope gently upward, leading to a band of steeper topography of variable width beginning at *ca.* 420 m elevation. These plains are covered chiefly by alluvium, much of which is sandy, particularly near the lake, but some low areas are underlain by finer alluvial sediment that harbors shallow ponds for a week or two following rains. In a few places surface water may persist for up to a month in ponds up to 1.5 m deep behind Holocene beach features after rains. The band of steeper topography exposes Pliocene and Pleistocene sedimentary strata, and supports only sparse plant cover. Substrates for vegetation in these regions depend on the exposed strata, so that sandy incipient soils are juxtaposed with incipient soils much richer in clays.

Upland plains, land surfaces of low slope, cap the principal areas of sedimentary exposures, reaching elevations of *ca.* 560 m. North of Il Alia, these plains are covered mainly with sand and clay, but south of Il Alia they are covered with volcanic pebbles and cobbles. The Karari plains, the highest of the upland plains, slope gently eastward or southward, and have incipient soils rich in $CaCO_3$ nodules. These surfaces support shrublands, dwarf shrublands, and annual grasslands with *Aristida mutabilis* as a prominent constituent appearing after rains, and persisting as dry stalks for several months.

East of the margin of the study area, Miocene and Pliocene volcanic rocks are exposed on the edges of a dissected plateau that rises in elevation from *ca.* ~650 m in the north to *ca.* 895 m in the south (figure 2). Topography is generally subdued on basalt flows, but rhyolitic ash flows form several high points (*e.g.*, Derati (865 m), Shin (755 m), Kubi Algi (725 m), and Sibilot (560 m) (figure 2)). Regions shallowly underlain by volcanic rocks extend to the lakeshore at Jarigole and on the Kokoi (figure 2). Soils are poorly developed on these rocks, and stream channels through them are floored with coarse gravel, locally in steep-sided gorges.

Ephemeral streams cut through the marginal volcanic rocks, the high plains, the sedimentary outcrops and the higher parts of alluvial surfaces. These streams carry surface water only briefly following rains (normally less than a day), but alluvium in the larger streams (*e.g.*, Il Eriet, Il Naibar, Il Kimire, Il Alia, Il Ingumwai, Il Lokochot) normally contains water 1–3 m below the surface for much of the year. These streams flow through

well-defined channels in their upper reaches, but 4–5 km from the lakeshore they break into distributary channels, most of which fail to reach the lake. South of Il Alia the stream channels are floored with gravel.

MATERIAL AND METHODS

Plant collection and checklist compilation

We collected plants in the Koobi Fora region in July 2012, July 2013 and March 2014, recording their location using a handheld GPS device that provides positioning with an accuracy of ± 7 m. Collection areas were dictated in part by places where geological work was being done, but special excursions were made to include all of the principal physiographic areas and also some locations where plants of restricted distribution had been previously noted. Plant specimens were pressed by standard methods (Bridson and Forman, 1992) and identified later at the East African Herbarium (EA) by one of us (JKM) using appropriate botanical identification manuals (appropriate parts of the Flora of Tropical East Africa (FTEA); Ibrahim & Kabuye, 1987; and Beentje, 1994), comparative specimens, and expertise of other personnel within the institution. The compiled checklist presented in appendix 1 includes plants from our own collections (IDs = JKM- and FHB-) and collections made by the following individuals taken from a list compiled in 1974 by Dr Jan Gillett at the East African Herbarium: Miss K.M. Nesbit-Evans, later Mrs. Elliot (ID = N-E) who collected 17 specimens in 1970; Mr. I.M. Blankenship (ID = B), who collected 15 specimens in 1970; R.B. Faden & Miss A. Evans, later Mrs. Faden (ID = F & E) who collected 75 specimens in 1970-1971; Dr Glynn Isaac (ID = GI), who collected 3 specimens in 1972; Miss Catherine Badgley (ID=CB), who collected 26 specimens in 1974 and Mr. G.R. Jackson (ID=J), who collected 25 specimens in 1974.

Included also in the compiled checklist are: 1) seven taxa from September 1984 that were identified at the East African Herbarium, but are not recorded in other collections, and 2) four taxa given on distribution maps in Beentje (1994), but for which we have no voucher specimens.

Nomenclature

Names of mosses follow O'Shea (2006); those of liverworts, Wigginton & Grolle (1996) and Wigginton (2009); and those of ferns Launert (2003) and Verdcourt (1999). In assigning angiosperm genera to families, and of specimens to species, we followed the African Plant Database (http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php), despite knowing of some recent changes. For example, although Kyalangaliwa *et al*. (2013) assigned African trees and shrubs in genus *Acacia* to *Vachellia* or *Senegalia*, we continue to use *Acacia* as the generic nomen, as is preferred by this journal. At present, the nomenclature of the "acacias" is an area of contention in botany (Moore *et al.*, 2010). In appendix 1, we give voucher specimen numbers for most taxa, but lack voucher specimens for 19 of the plants listed, principally because available material was not suitable for preservation; in most cases photographic images from the area confirm the presence of these plants. All voucher specimens are deposited in the East African Herbarium of the National Museums of Kenya, Nairobi, Kenya.

Lists for comparison of floras

For comparison with the flora of the lower Omo Valley, we used the lists of plants published in Carr (1976, 1998), as these collections were made at elevations comparable to those in the

study area. For comparison with the flora of the Marsabit region, we used the lists of Lusigi *et al.* (1984), and Hepper *et al.* (1981) describing the flora of Mount Kulal, and we included specimens mentioned by Herlocker (1979). Our comparison does not extend below the level of subspecies, and therefore we excluded 12 varieties present in one or more lists.

Designation of vegetation types, less common plants and plants of restricted distribution
Observations of plants and plant associations to signature vegetation types were made during geological work in the study area from 1980 to 2014 by FHB using aerial photos taken in 1972 and satellite imagery available on Google Earth from 2 March, 2004 and 24 August, 2004 (58%), and from 10/1/2010 to 4/9/2013 (42%). Elevations have been taken mainly from the satellite imagery, with some spot elevations recorded by GPS. Areal measurements of plant communities and other geographic features (*e.g.*, area occupied by the major streams) were made using Google Earth Pro.

Vegetation types were observed and validated during the geological surveys. Less common plants and plants of restricted distribution were identified during the same years of geological work in the study area and their identities were determined by JKM between 2012 and 2014.

RESULTS AND DISCUSSION

Plant checklist
Our study recorded 367 taxa belonging to 212 genera and 68 families. Amongst these taxa, there are two marchantiophytes, two bryophytes, two pteridophytes, 275 dicots, and 86 monocots. Grasses (Poaceae) are by far the most numerous angiosperms (53 species), which is about 9% of the total number of Kenyan grass species given in Ibrahim and Kabuye (1987). They are followed by Fabaceae (27 species), Acanthaceae (22 species), Euphorbiaceae (18 species), and Capparaceae (18 species). Asteraceae and Malvaceae have 16 species each. Cyperaceae accounts for 12 species, Boraginaceae for 11 species, Convolvulaceae for 10 species, and Apocynaceae and Cucurbitaceae each have 9 species. Half of the 65 families of angiosperms are represented by two or less species.

The checklist is based on 468 specimens, 16 sight or photographic records, and 11 published records. Most plants were collected between Lake Turkana (360 m elevation) and the top of the Karari Ridge (560 m elevation). Given in the checklist is the number of the herbarium specimen and its latitude and longitude. Where a plant is known from a sight record but no specimen is available, we give the latitude and longitude of an easily accessible point where the plant occurs. We also give either an elevation (rounded to the nearest 5 m) or range of elevations for each taxon. Single entries are the elevation from which the herbarium specimen was collected. Ranges of elevation are based on observed occurrence of each taxon in the field. For specimens collected by others, no specific location or elevation was recorded, hence we have entered "Unk." in these columns, signifying that the location and elevation is unknown, although most of these plants were probably collected between Lake Turkana and the top of the Karari (*i.e.*, 360–560 m). We have retained the elevation range given for each species included from Beentje (1994). Only in listing genera of Fabaceae in three common subfamilies (Caesalpinoideae, Faboideae, and Mimosoideae) do we depart from the African Plant Database.

Comparison of the angiosperm flora of the study area with floras of adjacent regions

The edited species lists comprise 1021 angiosperms, 706 in the Marsabit region, 361 in the Koobi Fora region and 301 in the lower Omo Valley. Elevation data are given for all but 53 of the taxa in the Marsabit region reported by Hepper (1971), but elevation data are not available for the plants reported by Lusigi *et al.* (1984). It is interesting that only 147 species in the Marsabit region are recorded from unknown elevations or from elevations <850 m, because more than twice as many angiosperm taxa are present at Koobi Fora and in the Omo Valley, both of which are also areas of low elevation. This may suggest that plants at low elevation in the Marsabit region were less completely collected than those in the other two regions. Alternatively, it may mean that the low-elevation angiosperm flora of the Marsabit region is less diverse than the floras of the other two regions.

Comparison of angiosperm species from the Koobi Fora region with those of the lower Omo Valley is straightforward. These two regions have 145 plant species in common, less than half of the species present in either region. The Koobi Fora region shares 186 species with the Marsabit region, and of these 95 are recorded at >850 m on Mount Kulal, with 91 species occurring at <850 m or at unknown elevation. The Marsabit region hosts twice the number of taxa known at Koobi Fora, in large part because of upland evergreen forest (>1800 m) and evergreen bushland (1700–1800 m) at high elevations on Mount Kulal. The Marsabit region shares 141 species with the Omo valley, but only 98 species are common to all three regions. Of the 99 species common to all three areas, 77 are perennials (8 graminoids, 38 trees, and 31 forbs, climbers, *etc.*), and 22 are annuals (12 grasses and 10 forbs). The trees and shrubs give the vegetation of each area a similar visual aspect, so that the real diversity of the flora within any region is not immediately apparent. Thus, although the three regions have similar vegetational physiognomy, different floras are present. The similar vegetational physiognomy of the three regions results mainly from the trees and shrubs in common.

Many taxa are recorded from only one of the three regions being compared (504 from Marsabit; 114 from the Omo Valley, and 131 from the study area). Many taxa exclusive to the Omo Valley occur in environments along the perennial Omo River, an environment lacking east of Lake Turkana where there are no large perennial streams. Collections from all areas are still sparse, which may explain some apparent absences of taxa from one area to another.

Vegetation types in the Koobi Fora region

Distinct vegetation types with sharp (<20 m) or diffuse boundaries exist within the study area. To describe these, we use types defined by Herlocker (1979): forest, woodland, shrubland, dwarf shrubland, perennial grassland, annual grassland, and barrenland. Types that were visually observed in the study area are given in table 1, with the addition of riparian forest that is not listed by Herlocker (1979). Bushland and riparian forest and woodland are differentiable using satellite imagery, and these areas are shown in figure 3, with the other vegetation types grouped because it is not possible to differentiate them without careful field mapping.

Dwarf shrublands, perennial grasslands, and annual grasslands

These vegetation types occupy most of the study area (*ca.* 83%), but cannot be differentiated using aerial imagery or satellite imagery. Hence, they are treated as a composite unit. The most prominent dwarf shrub is *Indigofera spinosa*, and *Duosperma longicalyx* is also abundant, but in contrast to the Marsabit district, *Barleria* spp. appear to be more abundant in the study area, as *Barleria* spp. are not mentioned as important by Herlocker (1979).

Table 1. Vegetation types of Herlocker (1979) recognized in the study area.

Primary Vegetation Type	Secondary Vegetation Type	Tertiary Vegetation Type	Herlocker No.
Forest	Lowland groundwater	*Hyphaene*	2
	Riparian		2a
Woodland	Deciduous with dwarf shrub understory	*Acacia tortilis* with *Duosperma*	11
		A. tortilis with *Duosperma/Indigofera*	13
		A. tortilis with *Indigofera*	14
Shrubland	Evergreen	*Suaeda*	20
	Deciduous	*A. horrida/A. paolii*	23
	Deciduous	*A. reficiens*	27
	Deciduous	*Commiphora*/other spp.	28
	Deciduous with dwarf shrub understory	*A. reficiens* with *Duosperma*	29
Dwarf Shrubland	Dwarf shrubland	*Duosperma*	34
		Duosperma/Indigofera	36
		Indigofera	37
	Bushed	*Duosperma* with *A. reficiens*	39
		Duosperma with *A. reficiens/Commiphora*	40
		Duosperma/Indigofera with *A. reficiens/Commiphora*	42
		Indigofera with *Commiphora/Euphorbia*	43
	Wooded	*Duosperma* with *A. tortilis*	44
		Indigofera with *A. tortilis*	45
Perennial Grassland	Short lowland	*Sporobolus spicatus*	54
Annual Grassland	Dwarf shrub herb	*Heliotropium*/misc. herb with *Duosperma/Indigofera*	56
	Dwarf shrub short	*Aristida/Sporobolus/Heliotropium* with *Indigofera*	58
		Aristida with *Duosperma/Indigofera/Sericocomopsis*	59
		Aristida with *Indigofera*/other spp	60
	Dwarf shrub short sparse	*Aristida* with *Indigofera*	62
	Bushed dwarf shrub short	*Cenchrus* with *Commiphora-Indigofera/Sericocomopsis*	63
		Aristida/Enneapogon with *A. reficiens-Indigofera*	64
	Bushed dwarf shrub short	*Aristida* with *A. senegal-Duosperma/Indigofera*	66
		Aristida with *A. reficiens-Duosperma/Sericocomopsis*	67
	Bushed	*Aristida/Enneapogon* with *A. horrida/A. senegal/Commiphora*	69
	Wooded dwarf shrub short	*Aristida* with *A. tortilis-Lagenantha*	70
		S. spicatus/ann. *Sporobolus* sp. with *A. tortilis-Indigofera/Euphorbia/Dasysphaera*	71
Barrenland			73

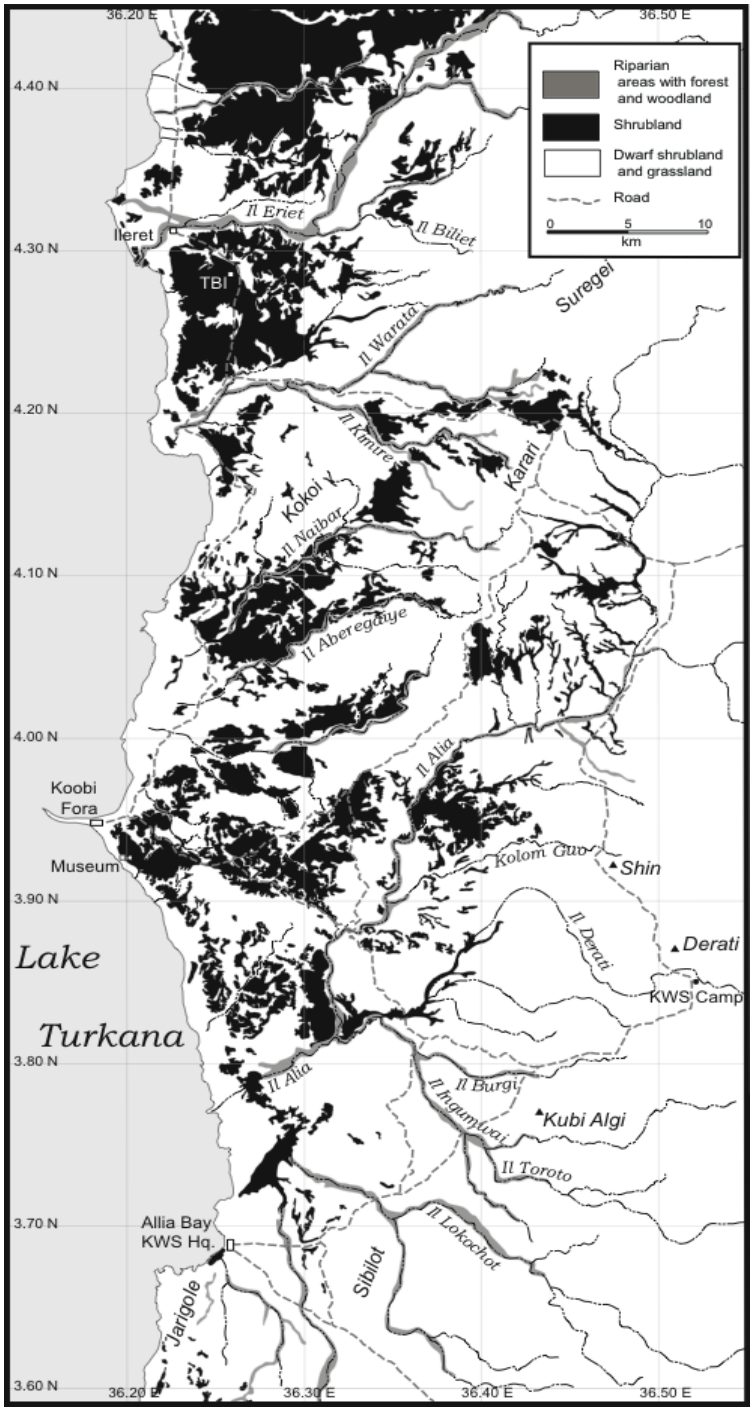

Figure 3. Map showing the distribution of grassland and dwarf shrublands (the former two combined), shrublands, and riparian areas that support limited forests and woodlands. Shrublands occur mainly on sedimentary substrates (compare with figure 2), and are mainly confined to small drainage lines east and southeast of the Karari.

Perennial grasslands dominated by *Sporobolus spicatus* occupy much of the area along the shoreline of Lake Turkana. Herlocker (1979) gives images of these vegetation types in the Marsabit region, and Hepper *et al*. (1981) provide additional images for the vegetation of Mount Kulal.

Shrubland

Using Herlocker's (1979) definition of shrubs as plants between 0.7 and 7 m height and shrubland has having >20% cover, we mapped 360 areas of shrubland from satellite imagery that total 430 km^2, or 16.5% of the study area. These areas are mainly confined to alluvium and exposures of Pliocene and Pleistocene sedimentary strata, and the area covered by shrubland increases substantially from south to north (figure 3).

Shrubland types that occur in the study area are given in table 1. *Euphorbia cuneata* is a prominent constituent of Herlocker's types 27 (*Acacia reficiens* deciduous shrubland) and 31 (*A. reficiens* deciduous shrubland with *Duosperma*) in this region, but Herlocker (1979) does not mention *E. cuneata* playing the same role in the Marsabit region. *E. cuneata* is especially prominent at the margins of many types of shrubland, and elsewhere is the dominant shrub.

Forest

Such areas as may be considered forest are restricted to small patches along active channels of the larger ephemeral streams. Active channels of these streams make up *ca*. 2.4% of the study area. To estimate the percentage of forest along these streams, we took Il Eriet as a typical example, and mapped 65 discrete patches of forest, finding just 84 hectares (4.1%) of forest in the 1751 hectares within the Il Eriet riparian zone. Thus forests account for *ca*. 0.1% (*i.e.*, 4.1% of 2.4%) of the vegetation of the region. Along Il Lokochot and Il Derati, there are small patches of single storied *Hyphaene compressa* forests of small extent. With minor exceptions *Hyphaene* is not present in the study area north of Il Derati. *Acacia elatior* forests exist as thin strips along channel margins and on stable alluvial "islands" within the braided channels of the large ephemeral streams, commonly with *Zizyphus mauritiana*, *Cordia sinensis*, *Lawsonia inermis* and *Grewia* spp. in the understory.

Woodland

As with forests, woodlands in the study area are associated with ephemeral streams. They are about three times as extensive as the forests, thus making up *ca*. 0.3% of the vegetation. In the upper parts of most drainages *Acacia tortilis* is prominent, and along Il Eriet and Il Naitirwa, *Terminalia spinosa* is present but not abundant. These woodlands thus are deciduous woodlands with a dwarf shrub understory of *Duosperma*, *Indigofera*, or both (types 12, 13 and 14 of Herlocker (1979); see table 1).

Barrenlands

These make up but a small part of the study area, and are places where water stands following the infrequent rainstorms. The largest continuous barrenland is used as an airstrip *ca*. 9 km east of Koobi Fora, and has an area of *ca*. 0.6 km^2. At some times of the year other parts of the study area are sparsely vegetated and might be considered barrenlands, but many of these are annual grasslands according to the classification of Herlocker (1979).

Occurrences of some less common plants and plants of restricted distribution:

In the section below we offer notes on some less common plants in the study area that may be of use to botanists seeking them.

The non-flowering plants, *Riccia* spp. and *Pseudocrassidium porphyoneurum* are widespread in the region on cryptogamic soils, and are particularly well represented beneath small thorny bushes where animals have not trod. They are apparent only immediately following rains. By contrast *Actinopteris radiata* and *Didymodon revolutus* were found only on small north-facing cliffs on eroded edges of the Tulu Bor Tuff along the Ileret-Karari road. *Marsilea megalomanica* has been noted only in ephemeral rocky pools along with *Aponogeton nudiflorus*, growing underwater until the pools dry out, after which it persists subaerially until the soil dries.

Hydnora sinandevu, a root parasite on *Commiphora* sp., has thus far been found only in shrubland near Ileret. This is the second report of *H. sinandevu* in Kenya, the other being near Kilifi in the Taru desert, on the Kenyan coast (Beentje & Luke, 2002). *Edithcolea grandis,* and *Plectranthus otostegoides* are also present in the same area, but are rare or absent elsewhere. Where present, *E. grandis* is quite common, growing mainly beneath other shrubs and dwarf shrubs.

The two *Moringa* species in the region have quite different distributions. *Moringa stenopetala* is reasonably common in riparian and floodplain settings along Il Eriet and along large ephemeral streams north of Il Eriet, but it has not been noted south of Il Eriet. *Moringa rivae*, by contrast, occurs in a very small area south of Il Lokochot on a limestone, and is restricted to an area of < 10 hectares.

Several plant types are present only in the higher parts of the region in the upper reaches of Il Eriet, on the Karari ridge, and in the upper reaches of Il Alia. Trees found only in these regions include *Sterculia stenocarpa, Ormocarpum trichocarpum, Parkinsonia anacantha*, *Gyrocarpus hababensis* (Il Eriet only), shrubs include *Premna resinosa* and *Ipomoea donaldsoni*, and herbs include *Dalechampia scandens, Crabbea velutina, Crinum macowani, Merremia ampelophylla*, and *Sesbania sericea. Acacia senegal*, *A. mellifera,* and *Boswellia neglecta* are mainly present at elevations > 500 m, but there are isolated occurrences of these taxa at lower elevations.

CONCLUSIONS

Our study has provided a checklist and preliminary description of the vegetation of an area that was previously poorly known botanically. The list includes 367 plant taxa, of which 137 (131 angiosperms) have been recorded from only this part of the larger region, whereas prior to our study only 84 taxa had been recorded in the literature. Thus the flora of the Koobi Fora region is now at least as well known as the floras of the Marsabit region and the lower Omo Valley. Despite the region's low rainfall and high temperatures, our study has shown that the region's flora is diverse and distinct from those of regions to the northwest, east and southeast. Most of the plants now known from the region are perennial, despite a special effort to collect short-lived annual species following rains in March, 2014.

The current list provides a foundation for quantitative ecological work in the region. In addition, the list should be of value to anthropologists studying ethnobotany and to workers in diverse fields attempting to reconstruct environmental conditions at remote times.

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Appendix 1. *List of species of plants recorded from the Koobi Fora region (KF) along with those that also occur in the Marsabit region (Mar), and the lower Omo Valley (Omo).*

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
MARCHANTIOPHYTA							
Ricciaceae							
Riccia sp. A	JKM-372a	3.7536	36.3895	435	x		
Riccia sp. B	JKM-373	3.7536	36.3895	435	x		
BRYOPHYTA							
Pottiaceae							
Didymodon revolutus Cardot var. *revolutus*	JKM-32b	4.2039	36.4020	490	x		
Pseudocrassidium porphyroneurum (Mull.Hal.) R.H. Zander	JKM-372b	3.7536	36.3895	435	x		
PTERIDOPHYTA							
Marsileaceae							
Marsilea megalomanica Launert	JKM-20	3.7852	36.3596	415	x		
Actiniopteridaceae							
Actiniopteris radiata (Sw.) Link	JKM-18, JKM-370	4.2039	36.4020	490	x	x	x
ANGIOSPERMAE--DICOTYLEDONAE							
Acanthaceae							
Barleria acanthoides Vahl	JKM-54; N-E 113; J 17	4.0735	36.3628	390–515	x	x	x
B. angustiloba Lindau	JKM-371	3.8152	36.3705	390–515	x	x	
B. argentea Balf. f.	JKM-372c	4.3398	36.3226	390–515	x	x	
B. eranthemoides R.Br. ex C.B. Clarke	Sept (1984)	4.0735	36.3628	500–550	x	x	x
B. linearifolia Rendle	JKM-17, SR	3.3883	36.3519	470	x	x	x
B. ?longissima Lindau	CB 24, J 36	Unk.	Unk	500–550	x		
B. proxima Lindau	JKM-15, SR	3.3883	36.3519	470	x	x	
B. trispinosa (Forssk.) Vahl subsp. *glandulossisima* I.Darbysh.	JKM-293	4.2907	36.2639	440	x		
Blepharis ciliaris (L.) B.L. Burtt	N-E100; J18	Unk.	Unk	380–550	x		

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
B. edulis (Forssk.) Pers.	JKM-364	4.2907	36.2639	380–550	x		
B. turkanae Vollesen	JKM-32a	4.2039	36.4020	490	x		
Crabbea velutina S. Moore	JKM-32c	4.1138	36.4893	490	x		
Duosperma longicalyx (Deflers) Vollesen	JKM-13	4.2907	36.2639	365–550	x	x	
Justicia caerulea Forssk.	JKM-348	4.3404	36.3227	400–500	x	x	x
J. calyculata Deflers	JKM-280	4.2870	36.2912	480–550	x		
J. exigua S. Moore	F& E71/334	Unk.	Unk	Unk.	x		
J. matammensis (Schweinf.) Oliv.	Sept (1984)	Unk.	Unk	Unk.	x	x	
J. phillipsiae Rendle	JKM-8	4.3502	36.4029	490	x		
Megalochlamys revoluta (Lindau) Vollesen subsp. *revoluta*	JKM-12	4.3139	36.2591	400–500	x		
Neuracanthus keniensis J.-P. Lebrun & Stork	JKM-374	4.1965	36.4067	365–550	x		
Pseuderanthemum hildebrandtii Lindau	JKM-359	4.2873	36.2665	400–500	x		
Ruellia patula Jacq.	JKM-349	4.3398	36.3226	410–560	x		x
Aizoaceae							
Corbichonia decumbens (Forssk.) Exell	JKM-78	4.2873	36.2665	380–470	x		x
Mollugo cerviana (L.) Ser. ex DC. var. *spathulifolia* Fenzl	JKM-89; F&E 71/289	3.9479	36.1866	365–550	x	x	
Sesuvium sesuvioides (Fenzl) Verdc.	F&E 71/306	Unk.	Unk	Unk.	x		
Trianthema salsoloides Fenzl ex Oliv.	F&E 71/313	Unk.	Unk	Unk.	x		
T. triquetra Willd. ex Spreng. in Rottler subsp. *triquetra*	F&E 71/323	Unk.	Unk	Unk.	x		
Zaleya pentandra (L.) C. Jeffrey	JKM-375	4.2873	36.2665	365–550	x	x	
Amaranthaceae							
Achyranthes aspera L.	SR	4.2220	36.2667	365–490	x	x	x
Aerva javanica (Burm. f.) Juss. ex Schult.	N-E118; J1	Unk.	Unk	380–550	x	x	x
A. lanata (L.) Juss. ex Schult.	JKM-361	4.1176	36.4852	380–550	x		
Amaranthus sparganiocephalus Thell.	F&E 71/297	Unk.	Unk	Unk.	x		
Celosia argentea L.	JKM-79	3.8808	36.3274	400	x		x
C. polystachia (Forssk.) C.C. Towns.	JKM-80	3.8808	36.3274	400	x		
Dasysphaera prostrata (Volkens ex Gilg) Schinz	JKM-26; F&E 71/207; CB 10	4.3809	36.3450	365–560	x	x	x

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
Digera muricata (L.) Mart.	F&E 71/286; CB 11	Unk.	Unk	Unk.	x	x	x
Psilotrichum gnaphalobryum (Hochst.) Schinz	JKM-376	4.1176	36.4852	375–550	x		x
Pupalia lappacea (L.) A. Juss.	SR	4.3839	36.3929	530	x	x	x
Sericocomopsis hildebrandtii Schinz	JKM-377; F&E 71/288; CB 27	4.1176	36.4852	400–500	x	x	
S. pallida (S. Moore) Schinz	JKM-58	4.1176	36.4852	365–560	x	x	x
Apocynaceae							
Adenium obesum (Forssk.) Roem. & Schult.	JKM-90	4.3509	36.2986	375–550	x	x	x
Calotropis procera (Aiton) W.T. Aiton	CB 34; J 13	Unk.	Unk	Unk.	x		
Caralluma acutangula (Decne.) N.E. Br.	JKM-378	4.3398	36.3226	370–515	x	x	x
C. gracilipes K.Schum	JKM-379	4.1167	36.3699	490	x		
Ceropegia somalensis Chiov.	JKM-25	4.3129	36.2554	390–400	x		
Edithcolea grandis N.E. Br.	JKM-72	4.2971	36.2240	400–440	x		
Leptadenia hastata (Pers.) Decne	JKM-291	4.3174	36.3324	420	x		
Pentatropis nivalis (J.F. Gmel) D.V. Field & J.R.I. Wood	JKM-380	4.2907	36.2639	380–550	x		
Sarcostemma viminale (L.) R. Br.	F&E 71/325	Unk.	Unk	Unk.	x	x	x
Secamone punctulata Decne.	JKM-381	4.2907	36.2639	370–430	x		
Aristolochiaceae							
Aristolochia bracteolata Lam.	JKM-66; F&E 71/358A	4.1737	36.2727	400	x		
Asteraceae							
Blepharispermum fruticosum Klatt	F&E 71/357	Unk.	Unk	Unk.	x	x	
B. pubescens S. Moore	Beentje (1994)	Unk.	Unk	Unk.	x	x	
Delamerea procumbens S. Moore	JKM-157; B5; F&E 71/362	3.9544	36.2207	365–460	x		x
Doellia cf. *bovei* (DC.) Anderb.	JKM-397	4.1176	36.4852	500	x		
Geigeria acaulis Oliv. & Hiern	JKM-298	3.6923	36.3347	410–480	x	x	
G. alata (Hochst. & Steud. ex DC.) Oliv. & Hiern	JKM-46	4.1531	36.3789	410–480	x		
Gutenbergia cordifolia Benth. ex Oliv.	JKM-398	4.1176	36.4852	500–550	x		
Helichrysum glumaceum DC.	JKM-33	4.2039	36.4020	490–770	x	x	x
Kleinia kleinioides (Sch. Bip.) M. Taylor	JKM-399	4.2907	36.2639	370–440	x	x	x
Launaea cornuta (Hochst. ex Oliv. & Hiern) C. Jeffrey	JKM-301	4.1176	36.4852	475–500	x	x	
Nicolasia nitens (O. Hoffm.) Eyles var. *nitens*	JKM-366	4.2693	36.3360	420–510	x		

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
Sphaeranthus ukambensis Vatke & O. Hoffm.	JKM-400	4.2907	36.2639	440	x		x
S. zavattarii Cufod.	JKM-31; N-E 86	4.2907	36.2639	440	x		
Vernonia albocinerascens C. Jeffrey	JKM-401	4.1737	36.2727	425	x		
V. cinerascens Sch. Bip.	Beentje (1994)	Unk.	Unk	Unk.	x	x	x
Xanthium strumarium L.	JKM-402	4.1189	36.4841	495	x		
Boraginaceae							
Cordia sinensis Lam.	S12; CB 13	Unk.	Unk	Unk.	x	x	x
Echiochilon persicum (Burm. f.) I.M. Johnst.	B10, F&E 331	Unk.	Unk.	Unk.	x		
Heliotropium indicum L.	JKM-382	4.2907	36.2639	390–420	x		x
H. cf. *pallens* Delile	B10; F&E 71/333	Unk.	Unk.	Unk.	x		
H. rariflorum Stocks	JKM-383	4.2907	36.2639	440	x		
H. simile Vatke	JKM-295	4.2907	36.2639	440	x		
H. somalense Vatke	F&E 71/32	Unk.	Unk.	Unk.	x		
H. steudneri Vatke	J 39	Unk.	Unk.	Unk.	x		
H. strigosum Willd.	JKM-299	4.2907	36.2639	440	x		
H. zeylanicum (Burm. f.) Lam.	B6, F&E 71/331	Unk.	Unk.	Unk.	x		
Trichodesma hildebrandtii Gürke	JKM-384	3.6865	36.2990	385	x		
Brassicaceae							
Farsetia stenoptera Hochst. subsp. *speciosa* Jonsell	F&E 336 & 340	Unk.	Unk	Unk.	x	x	
Burseraceae							
Boswellia neglecta S. Moore	SR	4.1854	36.4333	400–540	x	x	
Commiphora boranensis Vollesen	JKM-386	4.0690	36.3727	420–540	x		
C. confusa Vollesen	JKM-387	4.2103	36.3861	455	x		
C. edulis (Klotzsch) Engl.	JKM-388	4.2103	36.3861	420–540	x	x	x
C. kataf (Forssk.) Engl.	JKM-289	4.1949	36.4252	505	x		
C. kua (R. Br. ex Royle) Vollesen	JKM-287; B 11; F&E 71/312	4.2626	36.3673	370–480	x		x
C. madagascariensis Jacq.	JKM-390	4.2103	36.3861	450	x		
C. rostrata Engl.	JKM-391	4.2626	36.3673	380–540	x	x	
C. samharensis Schweinf.	JKM-288	4.1946	36.4254	490–520	x	x	
C. schimperi (O. Berg) Engl.	JKM-285	4.2626	36.3673	440–540	x	x	

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
Capparaceae							
Boscia angustifolia A. Rich	FHB2015-5	4.0526	36.4928	480	x	x	x
B. coriacea Pax	N-E123; CB 16	4.2879	36.2620	380–660	x	x	x
Cadaba barbigera Gilg	JKM-59, JKM-312	4.1133	36.4890	495	x		
C. farinosa Forssk. subsp. *farinosa*	JKM-55, JKM-314	4.3115	36.2497	400–540	x	x	x
C. gillettii R.A. Graham	JKM-29	4.3072	36.3760	400–500	x	x	x
C. glandulosa Forssk.	JKM-355	3.7074	36.3209	395–555	x	x	x
C. mirabilis Gilg	JKM-56; J 4 & 14	3.7074	36.3209	395	x	x	
C. rotundifolia Forssk.	N-E106; CB 14	4.2017	36.2469	365–600	x		x
C. ruspolii Gilg	JKM-306	4.2628	36.3655	460	x	x	
Cleome allamani Chiov.	B3; F&E 71/369	Unk.	Unk	365–480	x	x	
C. brachycarpa Vahl ex DC.	JKM-392; F&E 71/304	4.2040	36.4034	365–495	x	x	x
C. gynandra (L.) Briq.	JKM-394	4.3398	36.3226	365–420	x		
C. scaposa DC.	JKM-393	4.2039	36.4021	380–560	x		
C. tenella L. f.	JKM-353; F&E 71/368	3.9479	36.1866	365–480	x	x	
Maerua crassifolia Forssk.	JKM-395; J 38	4.1641	36.4327	380–560	x	x	x
M. decumbens (Brongn.) DeWolf	JKM-396	4.2873	36.2650	375–560	x		x
M. oblongifolia (Forssk.) A. Rich.	JKM-30	4.2909	36.2254	380–560	x	x	x
M. subcordata (Gilg) DeWolf	Sept (1984)	Unk.	Unk.	Unk.	x		
Chenopodiaceae							
Fadenia zygophylloides Aellen & C.C. Towns.	F&E 71/291	3.7402	36.3826	445	x		
Salsola africana (Brenan) Botsch.	JKM-45; GI in EA 15407	4.2675	36.3276	425	x	x	
Suaeda monoica Forssk. ex J.F. Gmel.	JKM-326; J 10	4.2934	36.2097	365–370	x	x	x
Combretaceae							
Combretum aculeatum Vent.	JKM-339	4.2909	36.2254	375	x	x	x
C. hereroense Schinz	JKM-307	4.2129	36.3842	460	x		
Terminalia brevipes Pamp.	JKM-77a	3.8808	36.3274	400	x		x
T. spinosa Engl.	JKM-27	4.3809	36.3450	455	x		
Convolvulaceae							
Cuscuta hyalina Roth	JKM-403	4.1992	36.2475	376	x		

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
Hildebrandtia obcordata S. Moore	JKM-404	4.2873	36.2621	410–530	x	x	x
H. sepalosa Rendle	JKM-360, JKM-405	4.3072	36.3760	470	x	x	
Ipomoea cordofana Choisy	JKM-406	4.0696	36.3835	500	x	x	
I. donaldsonii Rendle	JKM-407	4.0670	36.3844	465–560	x		
I. mombassana Vatke subsp. *mombassana*	JKM-57	4.0688	36.3771	500	x		
I. oenotherae (Vatke) Hallier f. var. *angustifolia* (Oliv.) Verdc.	F&E 71/331	Unk.	Unk.	Unk.	x		
I. cf. *plebeia* R. Br. subsp. *africana* A. Meeuse	F&E 71/341	Unk.	Unk.	Unk.	x		
Merremia ampelophylla Hallier f.	JKM-60	4.1176	36.4852	500	x		
Seddera hirsuta Hallier f. var. *hirsuta*	JKM-303; B2; F&E 71/332	3.6244	36.3403	470	x	x	x
Cucurbitaceae							
Citrullus colocynthis (L.) Schrad.	JKM-1	4.1632	36.2605	385	x		
Coccinia grandis (L.) Voigt	JKM-35a	4.3398	36.3301	430	x	x	x
Corallocarpus schimperi (Naudin) Hook. f.	JKM-408	4.2992	36.2581	430	x		
Cucumella kelleri (Cogn.) Ghebret. & Thulin	JKM-331; F&E 71/324	3.8794	36.3324	380–440	x		
Cucumis dipsaceus Ehrenb. ex Spach	JKM-160; CB 17	4.2016	36.2465	410–550	x	x	x
C. prophetarum L. subsp. *dissectus* (Naudin) C. Jeffrey	JKM-315	4.2016	36.2465	410–550	x	x	
Kedrostis foetidissima (Jacq.) Cogn.	JKM-409	4.4001	36.3535	470	x		x
K. gijef (J.F. Gmel.) C. Jeffrey	JKM-81; CB 18	4.2873	36.2665	440	x	x	x
Momordica boivinii Baill.	JKM-410	4.3398	36.3301	390–430	x	x	
Cyclocheilaceae							
Asepalum eriantherum (Vatke) Marais	Sept (1984)	Unk.	Unk.	Unk.	x	x	
Ebenaceae							
Diospyros scabra (Chiov.) Cufod.	SR, PR	4.1947	36.4330	390–550	x	x	x
Euphorbiaceae							
Acalypha indica L.	JKM-40	4.1249	36.3641	475	x	x	x
Dalechampia parvifolia Lam. var. *parvifolia*	JKM-411; F&E 71/359	4.1176	36.4852	485–530	x		
Euphorbia acalyphoides Hochst. ex Boiss.	JKM-412	3.7068	36.3564	410	x		
E. cuneata Vahl	B4; F&E 71/292	Unk.	Unk	365–550	x	x	
E. granulata Forssk.	F&E 71/330	Unk.	Unk.	Unk.	x		

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
E. hirta L.	JKM-414	3.9479	36.1866	370	x		
Euphorbia inaequilatera Sond. var. *dentata* (N.E. Br.) M.G. Gilbert	JKM-413; F&E 71/330	3.9479	36.1866	370	x		
E. kalisana S. Carter	JKM-73	4.4018	36.3543	470	x		
E. polyantha Pax	JKM-282	4.2039	36.4020	490	x		
E. prostrata Aiton	JKM-415	4.2875	36.2638	370–540	x		
E. tescorum S. Carter	JKM-305	4.1737	36.2727	425	x		
E. triaculeata Forssk.	B 16; F&E 71/292	Unk.	Unk.	Unk.	x		
Jatropha ellenbeckii Pax	JKM-416			400–420	x	x	x
J. pelargoniifolia Courbon	FHB2010-11	4.2682	36.2610	370–510	x	x	
J. rivae Pax subsp. *parvifolia* (Chiov.) M.G. Gilbert & Thulin	JKM-67			400–520	x	x	
J. spicata Pax	JKM-61	4.1176	36.4852	500	x		
Meineckia phyllanthoides Baill. subsp. *somalensis* (Pax) G.L. Webster	JKM-417	4.1110	36.4852	515	x		
Ricinus communis L.	SR	4.3209	36.2286	380	x		x
Fabaceae (Caesalpinioideae)							
Clitoria ternatea L.	JKM-19	3.6865	36.2990	390	x		
Delonix elata (L.) Gamble	JKM-338	4.1249	36.3641	475	x	x	x
Parkinsonia anacantha Brenan	JKM-43	4.3398	36.3301	430	x		
Fabaceae (Faboideae)							
Crotalaria deserticola Taub ex Baker f.	JKM-369	3.9544	36.2207	380	x	x	
C. massaiensis Taub.	JKM-418; B 15; F&E 71/303 & 356	3.9544	36.2207	370–410	x	x	
C. saltiana Andrews	JKM-367; N-E 103; CB 5	4.0690	36.3727	505	x		
Indigofera cliffordiana J.B. Gillett	JKM-346; F&E 71/318	4.2873	36.2665	440	x	x	
I. hochstetteri Baker	JKM-345; F&E 71/319	4.2873	36.2665	440	x	x	x
I. schimperi Jaub. & Spach	JKM-341	3.8808	36.3274	400	x	x	x
I. spinosa Forssk.	B7; F&E 71/320	4.2873	36.2665	440	x	x	x
Ormocarpum trichocarpum (Taub.) Engl.	SR	4.0883	36.5078	510	x	x	x
Rhynchosia minima (L.) DC.	JKM-320	3.8808	36.3274	400	x	x	x

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Orr
Sesbania leptocarpa DC.	CB 8	Unk.	Unk.	Unk.	x		
S. quadrata J.B. Gillett	JKM-86	3.8808	36.3274	400	x		
S. sericea (Willd.) Link	JKM-420	4.1189	36.4841	495	x		
Tephrosia nubica (Boiss.) Baker	JKM-347; J 35/A	3.7750	36.3927	420	x	x	
T. subtriflora Hochst. ex Baker	F&E 71/348	Unk.	Unk.	Unk.	x		
Vatovaea pseudolablab (Harms) J.B. Gillett	F&E 71/347	4.1554	36.4145	380–530	x	x	
Fabaceae (Mimosoideae)							
Acacia elatior Brenan	JKM-42; N-E 111	4.1249	36.3641	475	x	x	
A. etbaica Schweinf.	N-E91	4.2157	36.3120	360–570	x	x	
A. horrida (L.) Willd.	JKM-24	4.1549	36.2684	475	x	x	x
A. mellifera (Vahl) Benth.	SR	4.1963	36.4202	500–800	x	x	x
A. oerfota (Forssk.) Schweinf. var. *oerfota*	N-E93	4.2206	36.2748	370–530	x	x	x
A. paolii Chiov.	N-E112	Unk.	Unk	370–560	x	x	x
A. reficiens Wawra	F&E 71/338; J 29, SR	4.2595	36.2606	365–800	x	x	x
A. senegal (L.) Willd.	N-E90; J27	4.1647	36.4227	Unk.	x	x	x
*A. tortilis (*Forssk.) Hayne subsp. *spirocarpa* (Hochst ex A. Rich.) Brenan	SR	4.1440	36.4237	500–550	x	x	x
Geraniaceae							
Monsonia senegalensis Guill. & Perr.	FHB2010-37	3.8803	36.3250	400	x	x	
Gisekiaceae							
Gisekia diffusa M.G. Gilbert	F&E 71/291; A	Unk.	Unk	370–510	x		
G. pharnaceoides L. var. *pharnaceoides*	JKM-39	4.1249	36.3641	475	x	x	
Hernandiaceae							
Gyrocarpus hababensis Chiov	JKM-91	4.3502	36.4029	490	x		
Hydnoraceae							
Hydnora sinandevu Beentje & Q. Luke	JKM-52	4.2898	36.2248	375	x		
Lamiaceae							
Leucas mwingensis Sebald var. *greenwayi* Sebald	JKM-357	4.0688	36.3771	500	x		
L. tomentosa Gürke	JKM-421	4.2873	36.2665	440	x	x	
Ocimum americanum L.	JKM-422	4.2873	36.2665	440	x	x	x

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
O. basilicum L.	JKM-423; F&E 71/328; CB 26	4.2873	36.2665	440	x	x	
O. filamentosum Forssk.	SR	4.1626	36.3692	385–470	x		
Plectranthus otostegioides (Gürke) Ryding	JKM-96	4.3654	36.2236	375	x		
Loranthaceae							
Oncocalyx schimperi (Hochst. ex A. Rich.) M.G. Gilbert	J 47	Unk.	Unk.	Unk.	x		
Plicosepalus curviflorus (Benth. ex Oliv.) Tiegh.	FHB2010-91	4.2259	36.3850	380–550	x	x	
P. sagittifolius (Engl.) Danser	JKM-83	3.7074	36.3209	395	x		x
Lythraceae							
Lawsonia inermis L.	GI 5, SR	3.8825	36.3242	375–535	x	x	
Malpighiaceae							
Caucanthus albidus (Nied.) Nied.	F&E 71/360	Unk.	Unk.	Unk.	x	x	
Triaspis niedenzuana Engl.	JKM-425	3.6291	36.3367	465	x		
Malvaceae							
Abutilon figarianum Webb	JKM-324	4.1249	36.3641	475	x		x
A. fruticosum Guill. & Perr.	CB37; J 48	Unk.	Unk	Unk.	x		
Hermannia cf. *boranensis* K. Schum.	J 25	Unk.	Unk	.Unk.	x		
H. exappendiculata (Mast.) K. Schum.	JKM-440	3.6280	36.3342	470	x		
H. kirkii Mast.	JKM-2; F&E 71/339	3.6178	36.3454	480	x	x	
H. modesta (Ehrenb.) Planch.	F&E 71/346	Unk.	Unk.	Unk.	x		
Hibiscus micranthus L. f.	JKM-344	4.2873	36.2665	440	x	x	x
Melhania ovata (Cav.) Spreng.	JKM-325	4.2873	36.2665	440	x	x	
Pavonia arabica Hochst. & Steud. ex Boiss.	JKM-426; J 26	3.7491	36.3868	440	x	x	
P. glechomifolia (A. Rich.) Garcke	CB 19	Unk.	Unk.	Unk.	x		
P. patens (Andrews) Chiov.	SR	4.2882	36.2617	380–450	x	x	
P. propinqua Garcke	JKM-354	4.1176	36.4852	500	x		
P. zeylanica Cav.	JKM-343	4.1413	36.3739	480	x		x
Roifia dictyocarpa (Webb) Verdc.	JKM-332	3.6903	36.3853	465	x		
Senra incana Cav.	JKM-16	3.6178	36.3454	480	x		x
Sida ovata Forssk.	JKM-427	3.7040	36.3194	395	x	x	x

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Orr
Menispermaceae							
Cocculus pendulus (J.R. Forst. & G. Forst.) Diels	JKM-428; J 11	3.8276	36.3389	380	x		
Moringaceae							
Moringa rivae Chiov.	JKM-309	3.6903	36.3853	465	x		
M. stenopetala (Baker f.) Cufod.	JKM-330	4.3398	36.3226	430	x		
Nyctaginaceae							
Boerhavia coccinea Mill.	JKM-328	4.0691	36.3626	495	x	x	
B. erecta L.	JKM-429	4.2016	36.2622	380–450	x		
B. repens L.	JKM-329	4.0691	36.3626	495	x		
Commicarpus helenae (Schult.) Meikle var. *helenae*	F&E 72/355	Unk.	Unk.	Unk.	x		x
C. plumbagineus (Cav.) Standl.	JKM-430	4.2730	36.2595	380–535	x		x
Orobanchaceae							
Cistanche tubulosa (Schenk) Hook. f.	SR, PR	4.1272	36.3551	390–480	x	x	
Passifloraceae							
Adenia venenata Forssk.	JKM-292	4.2729	36.2551	405	x	x	x
A. volkensii Harms	JKM-92	4.2729	36.2551	405	x		
Pedaliaceae							
Pterodiscus ruspolii Engl.	JKM-297	4.2152	36.3115	405	x	x	x
Sesamothamnus busseanus Engl.	JKM-431	4.2016	36.3989	420–560	x	x	x
S. rivae Engl.	JKM-432	4.2016	36.3989	390–560	x		
Sesamum alatum Thonn.	JKM-98	4.2152	36.3115	405	x		
S. angustifolium (Oliv.) Engl.	Sept (1984)	Unk.	Unk.	Unk.	x		
Phyllanthaceae							
Phyllanthus maderaspatensis L.	JKM-62	4.1110	36.4852	515	x		
P. rotundifolius Klein ex Willd.	F&E 71/329	Unk.	Unk.	Unk.	x		
Polygalaceae							
Polygala erioptera DC.	JKM-327; F&E 71/335	4.3072	36.3760	470	x	x	x
Polygonaceae							
Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Dammer	JKM-305a, PR	4.2016	36.2466	380	x		

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
Portulacaceae							
Portulaca oleracea L.	JKM-53	4.1413	36.3739	480	x	x	x
P. quadrifida L.	JKM-433	4.2588	36.2601	370–520	x	x	x
P. wightiana Wall. ex Wight & Arn.	JKM-35b	4.2039	36.4020	490	x		
Talinum portulacifolium (Forssk.) Asch. ex Schweinf.	FHB2010-28	4.2882	36.2610	415–460	x	x	x
Rhamnaceae							
Berchemia discolor (Klotzsch) Hemsl.	Beentje (1994)	Unk.	Unk	1–1600	x		
Ziziphus mauritiana Lam.	JKM-93	4.2919	36.2598	380–560	x	x	x
Z. spina-christi (L.) Desf.	J 40	Unk.	Unk.	Unk.	x		
Rubiaceae							
Agathisanthemum globosum (Hochst. ex A. Rich.) Bremek.	JKM-293a	4.2872	36.2627	445	x		
Conostomium kenyense Bremek.	JKM-296	4.2907	36.2639	440	x	x	
C. quadrangulare (Rendle) Cufod.	JKM-297a	4.2882	36.3627	390–560	x		
Kohautia caespitosa Schnizl.	F&E 71/365	Unk.	Unk	365–495	x	x	x
Salvadoraceae							
Dobera glabra (Forssk.) Poir.	JKM-74	4.4133	36.3711	495	x	x	x
Salvadora persica L.	N-E87; CB 15	Unk.	Unk	375–760	x	x	x
Sapindaceae							
Haplocoelum foliolosum (Hiern) Bullock	SR	4.3342	36.3256	425	x		x
Scrophulariaceae							
Anticharis cf. *arabica* Endl.	J 45	Unk.	Unk.	Unk.	x		
A. senegalensis (Walp.) Bhandari	F&E 71/344	Unk.	Unk.	Unk.	x		
Aptosimum pumilum (Hochst.) Benth.	JKM-75	4.2873	36.2650	440	x	x	
Pseudosopubia hildebrandtii (Vatke) Engl.	JKM-437; NE-101	4.2882	36.3627	370–560	x	x	
Simaroubaceae							
Harrisonia abyssinica Oliv.	SR	4.3502	36.4029	490	x		x
Solanaceae							
Lycium europaeum L.	JKM-318; CB 29	4.2873	36.2650	440	x	x	
Solanum coagulans Forssk.	JKM-350; CB 18; J7	4.2873	36.2650	440	x	x	

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
S. hastifolium Hochst. ex Dunal	JKM-438	4.2873	36.2665	440	x	x	x
S. incanum L.	SR	4.2873	36.2650	440	x	x	x
S. nigrum L.	JKM-439	4.3131	36.2526	390	x	x	x
S. somalense Franch.	SR	4.2872	36.2656	440	x		
Sterculiaceae							
Sterculia stenocarpa H. Winkl.	JKM-44	4.1941	36.4313	520	x	x	
Tiliaceae							
Chascanum marrubiifolium Fenzl ex Walp.	JKM-358; F&E 71/314	4.2873	36.2650	410	x	x	
Corchorus olitorius L.	JKM-441	4.4136	36.3726	495	x		x
C. tridens L.	JKM-70; F&E 71/316	4.4136	36.3726	495	x		
Grewia bicolor Juss.	JKM-97	3.8796	36.3302	405	x	x	x
G. tembensis Fresen.	Beentje (1994)	Unk.	Unk	250–2100	x	x	
G. tenax (Forssk.) Fiori	JKM-71; CB 38; J6	3.8808	36.3274	375–700	x	x	x
G. villosa Willd.	SR	3.9905	36.4593	480	x	x	x
Premna resinosa (Hochst.) Schauer	JKM-313	4.1133	36.4890	495	x	x	x
Triumfetta flavescens Hochst. ex A. Rich.	JKM-442	3.7678	36.3863	420	x	x	
Vitaceae							
Cissus quadrangularis L.	JKM-323	4.1550	36.4156	440–585	x		x
C. rotundifolia (Forssk.) Vahl	JKM-443	4.1550	36.4156	525	x	x	x
Zygophyllaceae							
Balanites aegyptiaca (L.) Delile	Sept (1984)	Unk.	Unk.	Unk.	x		
B. rotundifolia (Tiegh.) Blatt. var. *rotundifolia*	N-E89	4.2595	36.2606	360–540	x		
Fagonia latifolia Delile	JKM-36	4.1965	36.4067	485	x		
F. longispina Batt.	JKM-37	4.1965	36.4067	485	x		
Tetraena simplex (L.) Beier & Thulin	JKM-88; F&E 71/337; J 2	3.9550	36.2189	380	x	x	x
Tribulus cistoides L.	B9; F&E 71/370	Unk.	Unk.	360–560	x		x
T. terrestris L.	JKM-38; F&E 71/343	4.1176	36.4852	360–560	x	x	x

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
ANGIOSPERMAE--MONOCOTYLEDONAE							
Aloaceae							
Aloe deserti A. Berger	JKM-284	4.1413	36.3739	480	x		
Amaryllidaceae							
Crinum macowanii Baker	JKM-444	4.1176	36.4852	500	x		
Anthericaceae							
Chlorophytum tenuifolium Baker	F&E 71/306A	Unk.	Unk.	Unk.	x		
Aponogetonaceae							
Aponogeton nudiflorus Peter	JKM-21	3.7852	36.3596	405	x		
Araceae							
Pistia stratiotes L.	CB 41	Unk.	Unk.	Unk.	x		
Arecaceae							
Hyphaene compressa H. Wendl.	SR, PR	3.7828	36.4251	410–580	x		x
Asparagaceae							
Asparagus buchananii Baker	JKM-445	4.2828	36.2374	385	x	x	
A. racemosus Willd.	JKM-446	4.2828	36.2374	370–560	x	x	
Colchicaceae							
Gloriosa superba L. *var. graminifolia* (Franch.) Hoenselaar	F&E 71/310	4.3420	36.2536	370–420	x		
Commelinaceae							
Commelina albescens Hassk.	JKM-447; F&E 71/353	4.1737	36.2727	380–490	x	x	
C. cf. *petersi* Hassk.	F&E 71/358	Unk.	Unk.	Unk.	x		
Cyperaceae							
Cyperus articulatus L.	JKM-158	3.9501	36.1841	365	x		x
C. bulbosus Vahl	JKM-448	4.2872	36.2665	440	x	x	
C. grandibulbosus C.B. Clarke var. *grandibulbosus*	F&E 71/300	Unk.	Unk.	Unk.	x		
C. laevigatus L.	JKM-449; N-E 97; CB 44	4.4518	36.2119	365	x	x	x
C. longus L.	CB 43	Unk.	Unk.	Unk.	x		
C. michelianus (L.) Link subsp. *pygmaeus* (Rottb.) Asch. & Graebn	JKM-450	4.2872	36.2665	440	x		

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
C. rotundus L.	JKM-451	4.2872	36.2665	440	x		x
C. rubicundus Vahl	JKM-452	4.2010	36.4043	490	x		
C. teneriffae Poir.	F&E 71/35	Unk.	Unk.	Unk.	x		
Fuirena sp.	JKM-453	4.2872	36.2665	440	x		
Kyllinga alba Nees	JKM-454	4.1965	36.4067	435–560	x	x	
K. chrysantha K. Schum. var. *comosipes* (Mattf. & Kük.) J.-P. Lebrun & Stork	F&E 71/352	Unk.	Unk.	Unk.	x		
Dracaenaceae							
Sansevieria ehrenbergii Schweinf. ex Baker	JKM-455	4.3536	36.3372	370–630	x		x
S. forskaoliana (Schult. f.) Hepper & J.R.I. Wood	JKM-456	4.3536	36.3372	380–450			
Hyacinthaceae							
Albuca cf. *melleri* (Baker) Baker	F&E 71/307	Unk.	Unk.	Unk.	x		
Dipcadi cf. *arenarium* Baker	F&E 71/309	Unk.	Unk.	Unk.	x		
D. viride (L.) Moench	F&E 71/308	Unk.	Unk.	Unk.	x		
Scilla sp.	F&E 71/346	Unk.	Unk.	Unk.	x		
Juncaceae							
Juncus effusus L.	JKM-14	3.9501	36.1841	360–365	x		
Poaceae							
Aristida adscensionis L.	JKM-84	4.4133	36.3711	495	x	x	x
A. kenyensis Henrard	JKM-457	3.1922	36.3381	375	x		x
A. mutabilis Trin. & Rupr.	JKM-28	4.3508	36.3301	440	x	x	x
Bothriochloa insculpta (Hochst. ex A. Rich.) A. Camus	JKM-458	3.8796	36.3300	405	x	x	
Brachiaria leersioides (Hochst.) Stapf	JKM-368	4.1759	36.2683	400	x		
Cenchrus ciliaris L.	JKM-10	3.1922	36.3381	375	x	x	x
C. pennisetiformis Hochst. & Steud.	Sept (1984)	Unk.	Unk.	Unk.	x	x	
C. setigerus Vahl	JKM-6	3.1922	36.3381	376	x		x
Chloris roxburghiana Schult.	JKM-459	4.1251	36.4782	420–510	x	x	x
C. virgata Sw.	JKM-460	4.1251	36.4782	500	x	x	x
Cymbopogon schoenanthus (L.) Spreng.	JKM-333	3.6178	36.3454	480	x		x
Cynodon dactylon (L.) Pers.	JKM-95	4.4469	36.2114	365	x		

Taxon	Record[1]	Lat (°N)[2]	Long. (°E)	Elev. (m)[3]	KF	Mar	Om
Dactyloctenium aegyptium (L.) Willd.	JKM-461	3.1922	36.3381	375	x	x	
D. aristatum Link	JKM-85	3.9544	36.2207	380	x		
D. bogdanii S.M. Phillips	JKM-47	4.1456	36.3705	475	x		
Dichanthium foveolatum (Delile) Roberty	JKM-34	4.1550	36.4144	525	x		
Digitaria rivae (Chiov.) Stapf	JKM-68	4.1514	36.4242	555	x	x	
Dinebra retroflexa (Vahl) Panz.	JKM-63	4.3072	36.3760	470	x		x
D. somalensis Stapf	JKM-77b	4.2942	36.2658	435	x	x	
Diplachne fusca (L.) Stapf	JKM-23	3.7005	36.2487	365	x		
Echinochloa colona (L.) Link	JKM-463	4.1176	36.4852	500	x		
E. haploclada (Stapf) Stapf	JKM-64	4.1176	36.4852	500	x		
Elionurus royleanus Nees ex A. Rich.	JKM-48	4.1531	36.3789	475	x		
Enneapogon cenchroides (Licht. ex Roem & Schult.) C.E. Hubb	JKM-464	4.1531	36.2720	500	x	x	x
E. persicus Boiss.	JKM-69	4.1531	36.2720	500	x		
Enteropogon barbatus C.E. Hubb.	JKM-336	4.1251	36.4782	500	x		
Eragrostis aethiopica Chiov.	JKM-465	4.2872	36.2656	440	x		
E. cilianensis (All.) Vignolo ex Janch.	JKM-335	3.1922	36.3381	375	x	x	x
E. ciliaris (L.) R. Br.	JKM-466	4.2872	36.2656	440	x		
Eriochloa fatmensis (Hochst. & Steud.) Clayton	JKM-65	4.0698	36.3603	485	x		x
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	SR	3.6584	36.2734	385	x	x	x
Leptochloa obtusiflora Hochst.	JKM-467	3.8796	36.3300	370–520	x	x	
Leptothrium senegalense (Kunth) Clayton	SR, PR	4.2828	36.2374	370–560	x	x	
Lintonia nutans Stapf	JKM-468	4.1080	36.5076	550	x	x	x
Oropetium minimum (Hochst.) Pilg.	JKM-49	4.1531	36.3789	475	x	x	
Panicum atrosanguineum Hochst. ex A. Rich.	JKM-469	4.2925	36.2729	440	x		
P. coloratum L.	JKM-470	4.4453	36.2111	385–520	x		x
Paspalidium desertorum (A. Rich.) Stapf	JKM-471	4.4453	36.2111	360–365	x		
P. geminatum (Forssk.) Stapf	JKM-94	4.4453	36.2115	360–365	x		
Setaria verticillata (L.) P. Beauv.	JKM-11	3.1922	36.3381	375	x	x	
Sorghum arundinaceum (Desv.) Stapf	JKM-22	3.3811	36.3466	460	x	x	

Taxon	Record[1]	Lat (ºN)[2]	Long. (ºE)	Elev. (m)[3]	KF	Mar	Om
Sporobolus consimilis Fresen.	JKM-82, JKM-362	3.8794	36.3305	405	x		x
S. helvolus (Trin.) T. Durand & Schinz	JKM-363	4.3574	36.2163	375	x	x	x
S. ioclados (Trin.) Nees	JKM-472	4.3574	36.2163	440	x	x	x
S. pellucidus Hochst.	JKM-473	4.2925	36.2729	375	x	x	x
S. rangei Pilg.	JKM-474	4.2869	36.2646	440	x		
S. spicatus (Vahl) Kunth	JKM-7	4.3574	36.2163	360–580	x	x	x
Stipagrostis hirtigluma (Steud. ex Trin. & Rupr.) De Winter	JKM-50	4.1531	36.3789	475	x		x
Tetrapogon cenchriformis (A. Rich.) Clayton	JKM-475	4.2873	36.2665	390–520	x	x	x
T. tenellus (J. König ex Roxb.) Chiov.	JKM-337	4.1531	36.3789	390–520	x	x	x
Tragus berteronianus Schult.	JKM-51	4.1531	36.3789	375–560	x	x	x
Tricholaena teneriffae (L. f.) Link	JKM-281	4.1551	36.4144	525	x	x	
Urochloa sclerochlaena Chiov.	JKM-41	4.1249	36.3641	475	x		
Potamogetonaceae							
Stuckenia pectinata L. Bömer	GI 11	Unk	Unk.	Unk.	x		
Typhaceae							
Typha domingensis Pers.	JKM-87	3.9497	36.1817	360–365	x		x

1. SR = site record; PR = photo record; specimen collection numbers are as detailed in text
   Beentje (1994): *Kenya Trees, Shrubs and Lianas*. National Museums of Kenya, Nairobi
   Sept (1984): *Plants and early hominids in East Africa: a study of vegetation in situations comparable to early archaeological site locations*. Ph.D. Dissertation, University of California, Berkeley
2. Unk. = unknown (region only, probably 3.7–4.3ºN, 36.2–36.5ºE)
3. Elevation range given where known; otherwise spot elevation of specimen is given