

## AN INTRODUCTION TO THE GRASSES OF ETHIOPIA AND ERITREA

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**ABSTRACT:** Ethiopia together with Eritrea has a rich grass flora comprising over 600 species. Grasses typical of each of the vegetation types found in the area are discussed. Grasses from specialised edaphic conditions are considered, and also weed, pasture and lawn grasses. The paper concludes with a section on the importance of the Ethiopian highlands as a world centre of diversity for cultivated plants, with notes on indigenous cereal crops.

**Key words/phrases:** Ethiopia, Grasses, Grassland, Poaceae.

### INTRODUCTION

The Grass Family (Poaceae) is the second largest plant family in the Flora area (Ethiopia and Eritrea), with 612 species known at present and fieldwork in under collected areas usually yielding a few new records. Economically, it is by far the most important family, providing food for both humans and their livestock. Livestock provides the second most valuable export for Ethiopia, and grazing pressure means that an understanding of the composition and best management of the natural grassland is vitally important. Additionally, steep mountain slopes and gullies in the highlands are very susceptible to erosion during the rainy season, and the grass cover is indispensable in protecting the fragile soil.

In spite of their importance as a major element of the vegetation, grasses are often little understood by non-specialists. They are frequently overlooked, simply providing a backdrop to woody vegetation and herbaceous plants with obvious flowers. They are perceived as difficult because they lack typical flowers with colourful petals and are described in the literature using technical terminology. Nevertheless, the tribes and main genera can usually be recognised on sight with practice. Once this stage is reached, the next step is to understand the structure of the spikelets, which is explained in the introduction to the Flora. It will then be realised that this family provides a wealth of fascinating morphological modifications and adaptations, which have led to grasses spreading to virtually every habitat type throughout the world. Due to the extremes of altitude and climate found in Ethiopia and

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Eritrea, many of the major groups are present and available for study within the country.

Authorities have not been cited for specific names in this paper, as they considerably lengthen the text and are readily available in the Flora and in online databases. Occasionally the abbreviations used in the Flora for the floristic regions have been used in the text. Their interpretation can be found by reference to Table 1.

### **Distribution of grass species within Ethiopia and Eritrea**

The very diverse habitats within the Flora area, ranging from desert to forest and with an altitudinal range from below sea level to above 4000 m, have led to the occurrence of a great variety of grass species. The number of species in each floristic region is set out in Table 1 and compared with the regional distribution of all species in the Flora.

Table 1. Number of grass species in each floristic region arranged in descending order, compared with the order of regions for all species in the Flora.

<b>Floristic region</b>	<b>Grass species</b>	<b>Grasses only</b>	<b>All species in flora</b>
Shewa	252	1	2
Tigray	247	2	5
Sidamo	241	3	1
Eritrea West	223	4	4
Harerge	205	5	3
Gonder	190	6	6
Gamo Gofa	175	7	9
Kefa	159	8	7
Bale	121	9	8
Arsi	115	10	13
Gojam	103	11	10
Eritrea East	85	12	14
Illubabor	85	12	11
Welega	83	14	12
Afar	70	15	16
Welo	57	16	15

Most grass species are found in Shewa, Tigray and Sidamo regions, with Harerge slightly further down the list than for the whole of the Flora. In general, the distribution of grass species between the floristic regions closely mirrors that for the Flora as a whole. Shewa and Tigray are highland regions, but Sidamo is in the lower lying and drier southern part of Ethiopia. Diversity here and in Harerge can be explained by the high number of species of relatively local distribution, often occurring on specialised soil

types. Species numbers drop off towards the western lowlands, and as is to be expected few species occur in the harsh desert region of Afar. The surprisingly low number in Welo region is most likely due to undercollecting.

### **Vegetation types and their constituent grasses**

A detailed analysis of vegetation types within Ethiopia and Eritrea has recently been published by Friis *et al.* (2010). They have produced a standard vegetation map for the Flora, reproduced below (Sebsebe Demissew and Friis, I., 2009: 32). This map and their discussion of the natural vegetation in the Flora area is used in this paper as the basis for discussing grass distribution in relation to habitat.

The upland central plateau is dissected from northeast to southwest by the Rift Valley. The plateau is surrounded on its eastern and southern sides by lower country with a drier climate characterised by *Acacia-Commiphora* woodland or bushland. In the Ogaden further to the east towards Somalia this grades into semi-desert, whilst true sandy desert is found in the harsh low-lying Afar depression. A strip of coastal vegetation runs along the sandy Red Sea coast of Eritrea. Southwest of the central plateau is an area of moist evergreen montane forest. At lower altitudes towards Sudan the forest is replaced by *Combretum-Terminalia* woodland. Below 650 m in Illubabor is a small area of lowland forest. High mountains arise in several groups from the central plateau. The grasses typical of each of these vegetation types are given below.

#### **Montane grassland 1500–3000 m**

This grassland of the central plateau is the most extensive area of grassland in Ethiopia; some on land cleared from dry evergreen forest now mostly forms a mosaic with forest remnants. It is dominated by perennial tussock grasses from a wide spread of tribes, with both C3 and C4 photosynthetic pathways. Examples include *Festuca simensis* (Poeae); four species of *Helictotrichon* (Aveneae); *Bromus leptoclados* (Bromeae); *Aristida adoensis* (Aristideae); *Tripogon montanus*, *Eragrostis paniciformis* (Eragrostidaeae); *Pennisetum sphacelatum*, *Brachiaria brizantha* (Paniceae); and a majority of Andropogoneae including four species of *Andropogon*, eleven species of *Hyparrhenia* and *Exothea abyssinica*. *Pennisetum sphacelatum* is a common indicator of overgrazed areas.

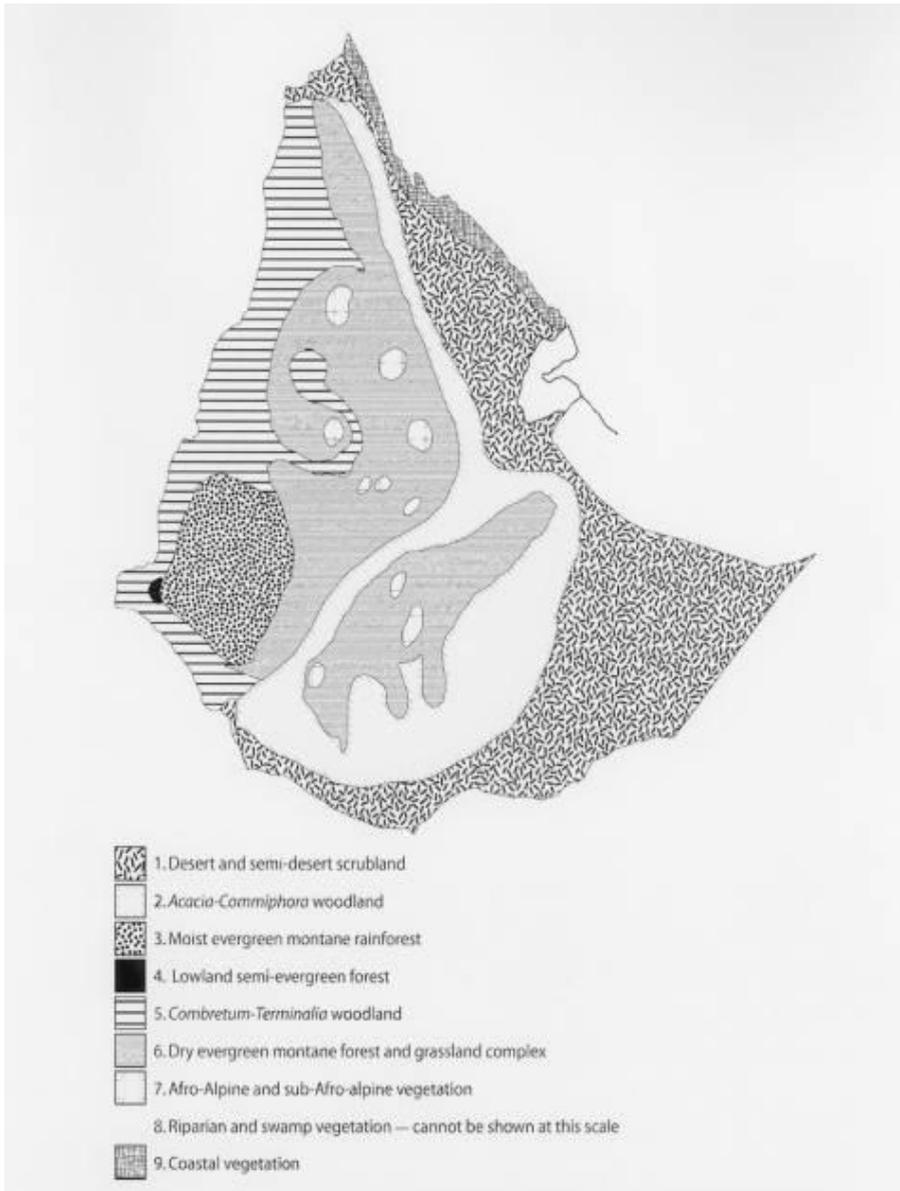


Fig. 1. Distribution of vegetation types in the Flora area. Reproduced with permission from Sebsebe Demissew and Friis (2009).

**Acacia-Commiphora deciduous woodland or bushland below ca. 1900 m**

This vegetation type occurs at lower elevations, mainly in the south and east where there is a lower rainfall regime. The grasses are exclusively from C4 tribes, reflecting the hotter drier climate and form a shorter, more open grass cover than on the upland plateau. The largest number of species belongs to tribes Eragrostideae and Paniceae, but there is also a good representation of *Aristida* species (Aristideae). Well known examples from this habitat include *Sporobolus festivus* (Eragrostideae); *Chloris roxburgiana* (Cynodoneae); *Panicum infestum* (Paniceae); *Sehima nervosum* (Andropogoneae).

The majority are tufted perennials including those listed above, but there is also a considerable number of annuals, especially in the genera *Aristida* and *Brachiaria* e.g. *Aristida funiculata* and *Brachiaria leersioides*. *Enneapogon cenchroides* (Pappophoreae), *Leptocarydion vulpiastrum* (Eragrostideae) and *Heteropogon melanocarpus* (Andropogoneae) are examples of annuals from three further tribes.

**Semi-desert scrubland below 500 m**

A much smaller number of species is found in the semi-desert areas of the Awash Valley and eastern Ogaden. Aristideae are again well represented, but with species of *Stipagrostis* taking over from *Aristida*, which are better adapted to desert conditions e.g. *Stipagrostis hirtigluma* and *S. uniplumis*. Paniceae is represented by the related genera *Cenchrus* and *Antheophora* e.g. *Cenchrus pennisetiformis*, *C. setigerus*, *Antheophora pubescens*. Andropogoneae includes the genera *Chrysopogon* and *Cymbopogon* e.g. *Chrysopogon plumulosus* and *Cymbopogon commutatus*.

**Desert**

True sandy desert is found in the Danakil Depression and the coastal plains of Eritrea. *Panicum turgidum* is one of the few plants which will grow in such harsh conditions, and is dominant on some sand dunes. It forms round twiggy bushes up to one metre or more high which catch wind-blown sand and form hummocks. It provides grazing for camels and is a useful sand-binder.

**Red Sea coastal sand**

The vegetation of the coastal area of Eritrea is usually salt and drought tolerant and is often tough or spiny to withstand the harsh conditions, including some specialised grasses to be found there. Grass species are few in number and are exclusively from tribe Eragrostideae. They can be divided

into two categories: tough perennial rhizomatous or stoloniferous sand-binders and low annuals.

*Aeluropus lagopoides* and *Odyssea mucronata* are sand-binders with very similar glaucous shoots clothed in numerous short, distichous, spiny leaves and racemes congested into dense heads. *Odyssea* forms prickly clumps up to two metres high and is a good binder of dunes. *Aeluropus* is a lower grass with elongate scaly rhizomes and surface stolons which occurs on sandy shores down to the high tide mark. Two other robust dune sand-binders are *Halopyrum mucronatum* and *Urochondra setulosa*.



Fig. 2. A, *Odyssea mucronata*; B, *Aeluropus lagopoides*.

A few annuals are found on sandy soils along the coast, occurring also in coastal Sudan and around the Horn of Africa to northern coastal Kenya. Again, all are members of tribe Eragrostideae, a tribe with many species adapted to specialised conditions: *Eragrostis lepida*, *Dactyloctenium aristatum*, *Sporobolus coromandelianus*, *Coelachyrum brevifolium*.

### Moist evergreen montane forest 1500-2600 m

Generally grasses are not well adapted to the shady forest environment, but favour open habitats often with a pronounced seasonal climate. Species are few in number, usually with a C3 photosynthetic pathway, and have often evolved special characteristics such as broad leaves and animal-based dispersal mechanisms. Most species belong to tribes Poeae or Paniceae; no Andropogonoid grasses occur in the forest.

Pooid grasses include species of *Poa*, *Festuca* and *Brachypodium* e.g. *Poa leptoclada*, *P. simensis*, *Festuca mekiste*, *F. chodatiana*, *Brachypodium flexum*. Panicoid grasses include *Setaria megaphylla*, *Oplismenus compositus*, *O. undulatifolius*, *Poecilostachys oplismenoides*, *Panicum calvum* and *Acritochaete volkensisii*.



Fig. 3. A, *Panicum calvum*; B, *Oplismenus hirtellus*.

Bamboo forest comprising stands of *Arundinaria alpina* occurs in the upper parts of montane forest above 2000 m. Whilst it may form extensive pure stands, there is no bamboo zone such as occurs on some East African

mountains. It occurs with *Hagenia* in moist forest and with *Juniperus* in drier forest. Bamboo is of obvious economic importance as a building material and is frequently planted along roads and in villages.

### **Lowland semi-evergreen forest below 650 m**

This forest type is found only in the Baro Lowlands of Ilubabor. It is a dense forest with little light penetrating to the forest floor and consequently with few herbaceous species. *Streptogyna crinita* (Streptogyneae) is noteworthy, a broad-leaved bamboo ally well adapted to animal dispersal by its remarkable persistent barbed stigmas.

### **Transitional rainforest**

*Olyra latifolia* (Olyreae) and *Leptaspis zeylanica* (Phareae) occur in the undergrowth at somewhat higher elevations in Welega, Illubabor and Kefa floristic regions along the western escarpment, but below the level of montane rainforest.

### **Combretum-Terminalia woodland 500-1900 m**

This woodland type is not species rich but is relatively large in extent along the western side of the country. It is composed of tall perennials, all C4 grasses, predominantly from the Arundinelleae and Andropogoneae tribes. Several species of *Hyparrhenia* dominate, one of the most characteristic genera of the African savanna.

These woodlands are regularly burned, as can often be seen on herbarium specimens when part of the tussocky base is present. Representative species include: *Loudetia arundinacea*, *L. simplex* (Arundinelleae); *Hyparrhenia diplandra*, *H. filipendula*, *Cymbopogon giganteus*, *Ischaemum amethystinum*, *Elionurus muticus* (Andropogoneae); *Eragrostis superba* (Eragrostideae); *Panicum nervatum* (Paniceae).

### **Sub-alpine vegetation above 3200-3500 m**

The lower levels of the afro-alpine belt are characterised by the presence of evergreen shrubs (especially *Erica arborea*) and small trees scattered among the grassy ground cover. Nearly all the grasses found in this vegetation belong to the predominantly temperate tribes Poeae, Aveneae and also Arundineae, with their altitudinal range extending above 4000 m. No members of Aristideae, Eragrostideae, Cynodonteae or Paniceae occur at these altitudes. Representative species include: *Poa simensis*, *P. hedbergii* (Poeae); *Deschampsia caespitosa*, *D. flexuosa*, *Anthoxanthum aethiopicum*, *Agrostis quinqueseta* and *A. gracilifolia* (Aveneae).

It is surprising to find two species of *Andropogon*, with C4 photosynthesis, occurring between 3000-4000 m: *A. amethystinus* which extends upwards from the montane grassland of the central plateau and *A. lima* which is known only from mountains in eastern Africa. The physiology of these two species would make an interesting study.

### **Afro-alpine moorland above 4000 m**

At this high altitude the environment is very harsh, with large diurnal temperature swings. The vegetation is dominated by a few species of low tussock plants, particularly *Helichrysum* species and small tufted perennial grasses. *Pentaschistis pictigluma* (Arundineae) is a very ornamental grass in its golden-panicked, high altitude form. *Rytidosperma subulata* is another common Arundinoid grass occurring in this moorland. All the grasses mentioned above in the subalpine vegetation also extend above 4000 m. *Agrostis sclerophylla* is known only from dry rocky places above 4000 m on the Ethiopian mountains and on Mt. Kenya.

Besides the vegetation types given above, Sebsebe Demissew and Friis (2009) also distinguish several aquatic and edaphic vegetation types which it is not possible to show on their map. These also have their characteristic grasses, as set out below.

### **Riparian and swamp vegetation**

There are many grasses which prefer a wet environment, which includes a variety of habitats such as stream and riverbanks, pools and marshes. Several truly aquatic grasses form floating mats of vegetation. Although grasses such as species of rice (*Oryza*) and reed (*Phragmites*) come to mind, in fact over half the species in this category in Ethiopia belong to tribe Paniceae. Examples from this tribe include: *Sacciolepis africana*, *Panicum repens*, *Acroceras macrum*, *Echinochloa pyramidalis*, *Paspalum lamprocaryon*, *Pennisetum macrourum*. *Odontelytrum abyssinicum*, with its main area of distribution in Ethiopia, forms extensive floating mats on open water. Examples from other tribes are: *Leersia hexandra*, *Oryza* spp. (Oryzaceae); *Phalaris arundinacea* (Aveneae); *Phragmites* spp. (Arundineae); *Desmostachya bipinnata* (Eragrostideae); *Loudetia phragmitoides* (Arundinelleae); *Vossia cuspidata*, *Hemarthria* spp. (Andropogoneae).

### **Saline habitats**

A specialised subset of the aquatic environment is the extreme environment of wet saline soils, both near the coast in Eritrea and around alkaline lakes and hot springs in the Rift Valley and Danakil depression. Those few

species that occur are concentrated in the genus *Sporobolus*, including both small annuals (*S. minutus*), and the perennial *S. spicatus* which forms widely spreading mats with radiating wiry stolons. *Aeluropus lagopoides* and *Drake-Brockmania somalensis* also occur. All these grasses belong to tribe Eragrostideae.



Fig. 4. A, *Sporobolus spicatus*; B, *Sporobolus minutus*.

### **Black clay edaphic grassland**

Seasonally waterlogged black clay soils, found in the wide valleys of the central plateau and also in depressions in bushland, are unsuitable for the growth of woody plants. These edaphic grasslands are the most important grazing areas for the domestic animals of the highland subsistence farmers.

About 25 species of grass are found mainly or exclusively in this type of grassland in Ethiopia, all within the three tribes Eragrostideae, Paniceae and Andropogoneae. They include some of the most morphologically ornamental or interesting species, including *Eleusine floccifolia* with its curious hair-tufts along the tough leaf blades, which are used for basket making. Other examples are *Dinebra retroflexa*, *Lintonia nutans*, *Sporobolus mauritanus* (Eragrostideae); *Brachiaria lachnantha*, *Echinochloa haploclada*, *Pennisetum ramosum* (Paniceae); *Sorghum purpureo-sericeum*, *Thelepogon elegans*; and *Ophiuros papillosus* (Andropogoneae).

### **Limestone and gypsum**

Most species found in this specialised alkaline habitat are representatives from the Eragrostoid-Chloridoid part of the family, where many species are adapted to restricted habitats. Species of *Sporobolus* are again well represented, as they are in saline situations (*S. ruspolianus*, *S. somalensis* and *S. tourneuxii*). Other grasses are: *Aristida ferrilateris* (Aristideae); *Tripogon subtilissimus*, *Eragrostis sennii* (Eragrostideae); *Tetrapogon ferrugineus* (Cynodonteae); and *Panicum vatovae* (Paniceae).

### **The genus *Pennisetum***

The genus *Pennisetum* deserves special mention. This is a pantropical genus of about 80 species but with as many as 37 species in Ethiopia, of which seven occur only within the Flora area. In fact, over half of all endemic members of tribe Paniceae are *Pennisetum* species. It is more varied morphologically in east and northeast Africa than elsewhere, and a study of the genus in the Flora area including molecular work would be of particular interest.



Fig. 5. *Pennisetum* species: A, *P. petiolare*; B, *P. villosum*; C, *P. schweinfurthii*; D, *P. clandestinum*.

### Pasture, lawn and weed grasses

As pointed out in the introduction, grasses are of crucial importance in providing food for domesticated livestock. Sub-Saharan Africa, including Ethiopia, has been the source of some of the most important tropical pasture and forage grasses. A number of these grass species, widespread throughout sub-Saharan Africa, are now represented by improved cultivars resulting from selection and breeding programmes, and are commonly grown in other tropical areas especially South America. Tribe Paniceae is well represented in this category. Well known examples are: *Chloris gayana* (Cynodonteae); *Melinis minutiflora*, *Panicum maximum*, *P. coloratum* and *Pennisetum purpureum* (Paniceae).

A few species are used for lawns, by far the most common being *Cynodon dactylon* (Bermuda Grass), a favourite lawn grass used in warm climates throughout the world. *Cynodon transvaalensis*, a finer-leaved species from South Africa, has been used occasionally in Ethiopia. *Stenotaphrum secundatum* (St. Augustine Grass) is another introduced species which provides a dense sward of much broader leaves suitable for shady situations.

A number of common grasses from temperate Europe have become widespread arable weeds in suitable areas around the world, including upland parts of Ethiopia. Examples include: *Lolium temulentum*, *Avena fatua* and *A. sterilis*. *Bromus catharticus*, a South American native, has been found as a weed of irrigated cultivations in Eritrea.

About 40 grasses of very widespread occurrence throughout the world are included in the Flora. This category includes species from all the main tribes, and is not clearly distinguishable from weedy and lawn species listed above. Examples include: *Poa annua* (Poeae); *Aira caryophyllea* (Aveneae); *Aristida adscensionis* (Aristideae); *Eragrostis cilianensis*, *Eleusine indica*, *Dactyloctenium aegyptium* (Eragrostideae); *Microchloa kunthii* (Cynodonteae); *Oplismenus hirtellus*, *Setaria pumila* (Paniceae); *Imperata cylindrica*, *Heteropogon contortus* (Andropogoneae).

### **Cereal crop grasses**

Ethiopia is a centre of genetic diversity for several important cereal crops. This was first recognised by the Russian geneticist N. I. Vavilov, who established Ethiopia as one of his eight regional centres of origin of cultivated plants in the world (1951: 37–39). He made a special study of the Ethiopian tetraploid wheats (1931), and even considered Ethiopia to occupy first place in the world in terms of botanical varieties of wheat. Vavilov also considered Ethiopia to take first place in terms of diversity of genetic varieties of cultivated barley. Barley has been cultivated in Ethiopia at altitudes above 1,000 m since ancient times, and there is a multiplicity of land races (Zemedede Asfaw, 1989).

The indigenous cereal teff (*Eragrostis tef*) is cultivated as the staple cereal on the upland central plateau. It grows best at altitudes of 1,800 to 2,100 m in a wide variety of soil conditions. It is grown for the production of flour, used to make the local bread (“injera”). It appears to have been cultivated in Ethiopia since antiquity, leading to the development of many land races.

Sorghum is also widely cultivated in Ethiopia, and is used for flour to make injera in lower altitude, semi-arid areas where teff does not grow well. There

are many forms of grain sorghum, with those grown in Ethiopia grouped into five main types adapted to different climatic regions within the country.

Finger millet (*Eleusine coracana*) is a tropical cereal thought to have arisen in upland Ethiopia and now grown widely in arid parts of the Old World, particularly in Africa and India. In Ethiopia, it is cultivated on sandy soils up to 2,200 m, and is used for flour and also for beer production. Tigray is a main area of cultivation and, as with other Ethiopian native cereals, a high degree of genetic diversity is retained by the continued cultivation of a large number of land races.

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