Endemism and patterns of distribution of the genus Aloe (Aloaceae) in the flora of Ethiopia and Eritrea

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It is demonstrated that 35 (87%) of the 40 species of *Aloe* found in the area covered by the Flora of Ethiopia and Eritrea are endemic to this area. Most of the species are restricted to three rather well defined local centres of endemism. These are (1) a northern and central highland area, (2) an eastern highland area, and (3) a southern highland and lowland area. Each area has its own set of locally endemic species. The majority of the species of *Aloe* are either restricted to *Acacia-Commiphora* bushland, or to dry montane evergreen forest and scrub. The distribution of the Aloe species is compared with the African phytochoria recognised by White. Thirteen species (33%) belong to an Afromontane element; eight species (20%) are Afromontane/Somalia-Masai transgressors; eighteen species (45%) belong to a Somalia-Masai element. One species (2%) is a Sudanian/Somalia-Masai/Afromontane transgressor. In comparison with other areas of Eastern Africa, there is a notably high concentration of high altitude Afromontane species in the Flora area. Moreover, the genus reaches more than 1000 m higher above sea level in the Flora area than in Tropical East Africa. There seems to be a proliferation of the genus at higher altitudes in the Flora area. A somewhat similar trend is seen in Somalia, but not in Tropical East Africa.

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Introduction

The genus *Aloe* (Aloaceae) consists of more than 360 species (Mabberley 1987). Almost all indigenous records of the species are from Africa south of the Sahara (including Socotra and Madagascar), except for a few species which extend into the Arabian Peninsula. The genus has been introduced to the West Indies and many other tropical countries.

G.W. Reynolds, a highly qualified South African amateur researcher of the genus *Aloe*, has produced two monumental publications of the genus. The first (Reynolds 1950) described the species of *Aloe* of South Africa, the second

one (Reynolds 1966) the species of tropical Africa and Madagascar. Together, these two books provide the information on the taxonomy and distribution of all African species, as they were known up to the date of publication. The two volumes spurred taxonomic, floristic and other types of research in various parts of the continent. Recent taxonomic studies in East and North-East Tropical Africa, including the Floras of Ethiopia and Eritrea, Somalia and Tropical East Africa, have indicated a large number of endemic or near-endemic species. For example in Tropical East Africa (Kenya, Uganda and Tanzania) 50 out of the 83 species known (60%) are endemic to the region (Carter 1994). In North-East Tropical Africa (Ethiopia, Eritrea, Sudan, Somalia and Djibouti) 77 species of *Aloe* have been reported to occur. Of these 59 (76%) are believed to be endemic to the region (Carter 1994; Lavranos 1995; Sebsebe Demissew 1996; Sebsebe Demissew & Gilbert 1997; Sebsebe Demissew & Gilbert 2000; Sebsebe Demissew & Dioli 2000).

Many species of *Aloe* are highly threatened. There are several reasons for this. Perhaps the most important reason is that many species, especially those that have a very restricted distribution area and only small populations, are very much sought after by succulent enthusiasts for cultivation as rarities. Other species are collected for their use in medicine and the cosmetic industry (Sebsebe Demissew 1996). All species of *Aloe* are on the CITES list number one in order to control the international trade in species of this genus as far as possible. It is therefore important to improve and explore the documented information on taxonomy, distribution and ecology of the *Aloe* species. This will help the conservation efforts and attempts at sustainable use, as well as further research in other relevant fields, such as the chemistry of the natural compounds. Therefore an analysis based on the recent flora contribution (Sebsebe Demissew & Gilbert 1997) and later research by the authors and others (Sebsebe Demissew & Gilbert 2000; Sebsebe Demissew & Dioli 2000) is presented here. Note that the recently described *A. bertemariae* has not been included in the review of geographical distribution patterns in Fig. 7.

Speciation and endemicity of Aloe species

In the area covered by the Flora of Ethiopia and Eritrea (FEE) 35 (87%) are endemic or near-endemic (that is have a restricted distribution in one or two neighbouring countries) of the 40 species known so far. Three of the species have been subdivided into subspecies; for two of these taxa all the infraspecific taxa are endemic or near-endemic. The average percentage of endemic and near endemic species for all vascular plants in the Flora area is approximately 27% according to calculations based on the volumes of the Flora published so far (Friis *et al.* 2001). The degree of endemism in the genus *Aloe* in the Flora area is therefore nearly three times as high as the average figure. Species of *Aloe* seem generally to have restricted distribution areas, both in the Flora area and in other areas. No suggestion for the reasons behind this prolific speciation and limited distribution of the species has been offered in the literature, but it could be speculated that the strange chromosome evolution of *Aloe* and its possible consequences might give clues for a possible explanation. According to Brandham & Doherty (1998) the family Aloaceae is one of the most stable angiosperm families with regard to having a uniform bimodal karyotype in all species and the same basic chromosome number of x=7, comprising four long chromosomes and three short ones. The same authors have indicated that despite the karyotypic uniformity, some variation between species and genera in overall chromosome size *i.e.* in nuclear DNA amount has been

observed. In the case of the genus *Aloe*, it has been shown that the increase in the DNA amount coincides with evolutionary advancement – the advanced species having higher amount of DNA. The same authors have also observed that structural changes in *Aloe* chromosomes are common, but do not occur as homozygotes and take no part in the speciation. The stable chromosome morphology, the constant basic number and the selection against structural changes of chromosomes getting fixed, coupled with the variations in the DNA amount in the different species, are factors which most likely play a significant part in the evolution of *Aloe* species. One could speculate that these factors might lead to the formation of homogenous populations with very limited hybridization with neighbouring populations, which would help accounting for the situations described and discussed in this paper.

Distribution of Aloe species in relation to vegetation types

The current paper will attribute the *Aloe* species to a number of ecological zones (vegetation types in a broad sense), and to phytogeographical categories.

The ecological zones used for this study represent a slight modification of the nine major vegetation types recognised in the National Conservation Strategy (CSE 1997) and the coastal vegetation (added here). These ecological zones are further discussed in another symposium paper (Friis & Sebsebe Demissew 2001). The ten major vegetation types are, starting from the lowermost altitude:

1. Coastal vegetation. This consists of a whole range of vegetation types extending from the littoral zone to various types of coastal bushland. It is found only along the Red Sea Coast.
2. Desert and semidesert scrubland. Usually an open vegetation type with scattered shrubs or small trees and annual herbs. Succulents can be present or frequent. Extensive areas with this vegetation type exist in Afar Depression, the Ogaden and the area around Lake Chew Bahir and the Omo Delta below *c.* 500 m.
3. Lowland semi-evergreen forest. The vegetation type is characterized by mainly semi-deciduous trees and shrubby species and grasses. The woody species mainly include tall emergent trees. This vegetation type, which occurs in the Gambella Region in western Ethiopia, has been described only recently (Friis 1992). It occurs at 450-650 m.
4. *Acacia-Commiphora* bushland. This vegetation type is characterized by drought tolerant trees and shrubs, which have either small deciduous leaves or leathery persisting leaves. The canopy may reach tree-size, but is often lower. The understorey mainly consists of shrubs, perennial herbs and grasses. The trees and shrubs include species of *Acacia*, *Balanites*, various species of *Commiphora*, *Capparis*, *Combretum* and *Terminalia*. *Acacia-Commiphora* bushlands occur mainly in the north, east, south, central parts of the country at 900-1900 m.
5. *Combretum-Terminalia* woodland. This vegetation type is characterized by trees and shrubs, with fairly large deciduous leaves and an understorey of herbs and grasses which grow tall in open areas and in valleys. The dominant trees and shrubs include various species of *Combretum*, *Terminalia*, *Boswellia*, *Lannea*, *Anogeissus* and *Stereospermum*. The bamboo, *Oxytenanthera abyssinica*, is prominent in river valleys in western Ethiopia. *Combretum-Terminalia* woodlands occur mainly in the northwestern and western parts of the country, particularly in Beni-Shangul and Gumuz, and Gambella

Regions, in the Tekeze Valley and Shire lowlands in the north, the Didessa Valley in western, in south and northern Omo in southwestern Ethiopia at (500-)900-1900 m.

6. Evergreen scrub. This vegetation consists of evergreen bushes, *e.g.* species of *Euclea*, *Rhus*, *Carissa*, *Maytenus*, *Dodonaea*, *etc.* This vegetation is a transition zone between forest and woodland or bushlands. It occurs in many parts of the FEE area, where it forms a natural transitional vegetation belt around forests. However, due to human interference it has now replaced large areas in the highlands, which were probably forested previously. A special type is the Ericaceous scrub, which occurs at the upper limit of montane forest and forms a transition between forest and sub-Afroalpine vegetation. Evergreen scrub occurs at *c.* 1400-3500 m.
7. Dry evergreen montane forest and grassland. This is actually a complex, which also includes glades of grassland and wooded grassland with certain species of montane *Acacia*, and in principle the montane evergreen scrub is part of the same complex (Friis 1992). The vegetation type is characterized by small to large sized trees, and the extensive grasslands are rich in legumes. The common tree species include *Juniperus procera* and *Olea europaea* subsp. *cuspidata*. In the *Acacia* woodland and wooded grassland *A. abyssinica*, *A. negrii* and *A. pilispina* are the most common trees. The dry evergreen montane forests, *Acacia* woodlands and grasslands occur in much of the highlands in northern, north-western, central and south-western parts of the country, particularly in Shewa, Wello, Tigray, Gojam, Gonder, Gamo Gofa, Sidamo, Harerge, and Bale. On the northwestern parts of the plateau this vegetation type is found at 1900-3400 m.
8. Moist evergreen forest. This vegetation type is characterized by tall emergent and medium sized trees and by understorey shrubs. Based on altitude and floristic composition, it can be subdivided into two subtypes: (1) typical moist Afromontane forest, and (2) transitional forest. Emergent tree species typical of moist evergreen forests include in the Afromontane forest *Aningeria adolfi-friedericii*, *Albizia gummifera*, *Macaranga capensis* and *Ocotea kenyensis*. Characteristic canopy trees in the transitional forest are *Aningeria altissima*, *Alstonia boonei*, and *Manilcara butugi*. Moist evergreen forests occur mainly in western, south-western and south-eastern parts of the country. In western and south-western parts, these vegetation types occur between 1000 (near Tepi and Mizan) and 2500 m.
9. Afroalpine vegetation, including sub-Afroalpine vegetation. This vegetation type is characterized by small trees, shrubs, shrubby herbs at the lower altitudes, giant and small rosette herbs, cushion-plants and grasses, many of them forming tussocks, at the higher altitudes. Typical shrubby forms at the lower altitudes include species of *Erica* and *Hypericum*. Among the giant and small rosette herbs at higher altitudes are included the giant lobelia, *Lobelia rhynchopetalum*, species of *Kniphofia* and various species of Asteraceae, including *Dianthoseris* and *Haplocarpha*. Species of *Helichrysum* are prominent among the cushion plants, and species of *Alchemilla* among the dwarf shrubs. The transition in Ethiopia between the *Erica* scrub and Afroalpine vegetation is less sharp than on the high East African mountains. In the latter, the Afroalpine zone is characterized by the presence of giant and acaulescent rosette plants, cushion plants and tussock grasses (Hedberg 1964). This vegetation type occurs above 3400 m, with a transition zone to forest and

Table 1. Distributional status of the species of *Aloe* in FEE. Abbreviations for distributions: EA = species extending to East Africa (Ethiopia plus Somalia, Kenya, Uganda and/or Tanzania). WA = species extending to West Africa. NC = species endemic or near-endemic to Ethiopia, occurring in the Northern Central part of the country. S = species endemic or near-endemic to Ethiopia, occurring in the Southern part of the country. E = species endemic or near-endemic to Ethiopia, occurring in the Eastern part of the country. (e) = endemic. (n) = near-endemic. Abbreviations for Phytochoria: S-M = Somalia-Masai. SUD = Sudanian. AFM = Afromontane.

	Distribution	Altitudinal range	Coastal. Sea level	Desert and semi-desert Below 500 m	*Acacia-Commiphora* woodland (500-) 900-1900 m	Dry evergreen montane forest, etc. 1900-3200 m	Sub-Afroalpine vegetation Above 3200 m	Phytochoria according to White (1983)
A. trichosantha **subsp.** *trichosantha*	**NC(?n)**	900-1700 m			•			S-M/AFM
A. trichosantha **subsp.** *longiflora*	**NC/E/S(e)**	1000-1950 (-2200) m			•	•		S-M/AFM
A. citrina	**S(n)**	275-1000 m		•	•			S-M
A. pubescens	**NC/E(e)**	1800-2550 m				•		AFM
A. eumassawana	**NC(e)**	Sea level	•					S-M
A. schoelleri	**NC(e)**	c. 1500 m				•		S-M/AFM
A. macrocarpa	**WA**	1400-2200 (-3000) m			•	•		SUD/S-M/AFM
A. lateritia	**EA**	c. 1500 m			•			S-M
A. ellenbeckii	**S(n)**	c. 1600 m			•			S-M
A. kefaensis	**NC(e)**	c. 1800 m				•		AFM
A. ruspoliana	**S/E(n)**	300-1450 m		•	•			S-M
A. retrospiciens	**E(n)**	c. 1000 m			•			S-M
A. mcloughlinii	**S/E(e)**	1050-1250 m			•			S-M
A. pirottae	**S/E(e)**	1300-1800 m			•			S-M
A. parvidens	**S(n)**	1200-1450 m			•			S-M
A. rugosifolia	**S(n)**	c. 1350-1700 m			•			S-M
A. harlana	**E(e)**	1650-2100 m			•	(•)		S-M/AFM
A. monticola	**NC(e)**	c. 2450 m				•		AFM
A. percrassa	**NC(e)**	2100-2700 m				•		AFM
A. debrana	**NC(e)**	2000-2700 m				•		AFM
A. steudneri	**NC(e)**	2600-3150 m				•	•	AFM
A. ankoberensis	**NC(e)**	3000-3500 m				•	•	AFM
A. pulcherrima	**NC(e)**	2450-2700 m				•		AFM
A. trigonantha	**NC(e)**	c. 2100 m				•		AFM

	Distribution	Altitudinal range	Coastal. Sea level	Desert and semi-desert Below 500 m	*Acacia-Commiphora* woodland (500-) 900-1900 m	Dry evergreen montane forest, etc. 1900-3200 m	Sub-Afroalpine vegetation Above 3200 m	Phytochoria according to White (1983)
A. rivae	**EA**	1350-2000 m			•	•		S-M
A. secundiflora	**EA**	1350-1550 m			•			S-M
A. otallensis	**S(e)**	1200-1600 m			•			S-M
A. elegans	**NC(e)**	1500-2400 m			•	•		AFM
A. camperi	**NC(e)**	550-2700 m			•	•		S-M/AFM
A. adigratana	**NC(e)**	2000-2700 m				•		AFM
A. sinana	**NC(e)**	1250-1950 m			•	•		S-M/AFM
A. calidophila	**S(n)**	1200-1620 m			•			S-M
A. megalacantha **subsp.** *megalacantha*	**E(n)**	1100-1850 m			•			S-M
A. megalacantha **subsp.** *alticola*	**E(e)**	2100-2150 m				•		AFM
A. gilbertii **subsp.** *gilbertii*	**S(e)**	1300-1800 (-1900) m			•			S-M/AFM
A. gilbertii **subsp.** *megalacanthoides*	**S(e)**	1200-1350 m			•			S-M
A. schelpei	**NC(e)**	1700-2450 m				•		AFM
A. yavellana	**S(e)**	1600-1900 m			•	•		S-M/AFM
A. jacksonii	**S(n)**	c. 1050 m			•			S-M
A. tewoldii	**E(e)**	?c. 1500 m				•		AFM
A. vituensis	**EA**	c. 1200 m			•			S-M
A. friisii	**S(e)**	c. 1000 m			•			S-M
A. bertemariae	**S(e)**	300-400 m			•			S-M

evergreen scrub in the lower part of its range. It occurs on the highest mountain peaks in Ethiopia.

10. Riparian and swamp-vegetation. This vegetation type is characterized by a range of tree and shrubby species and associated herbs and grasses. Swamps are dominated by sedges, grasses and many herbs.

The ten categories mentioned above have for this analysis been modified as follows to describe the vegetation types in which *Aloe* species occur in the FEE area. In most of these vegetation types species of *Aloe* frequently occur on rocky outcrops or on rock faces and cliffs without much other vegetation. However, in the *Acacia-Commiphora* bushland, species of

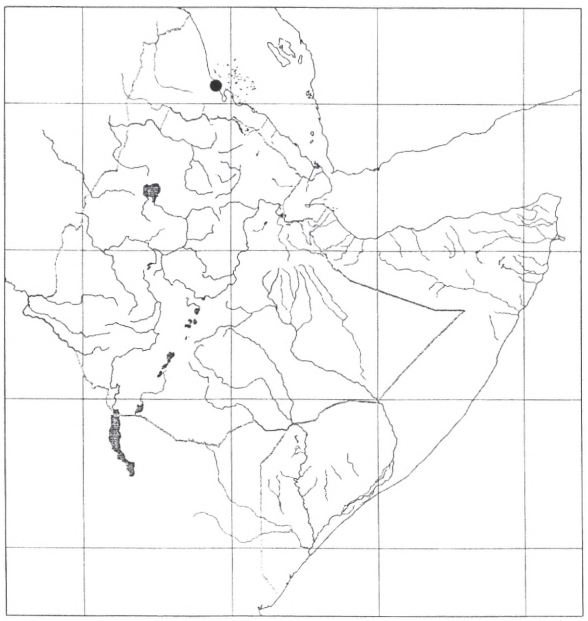


Fig. 1. Distribution of *Aloe eumassawana*.

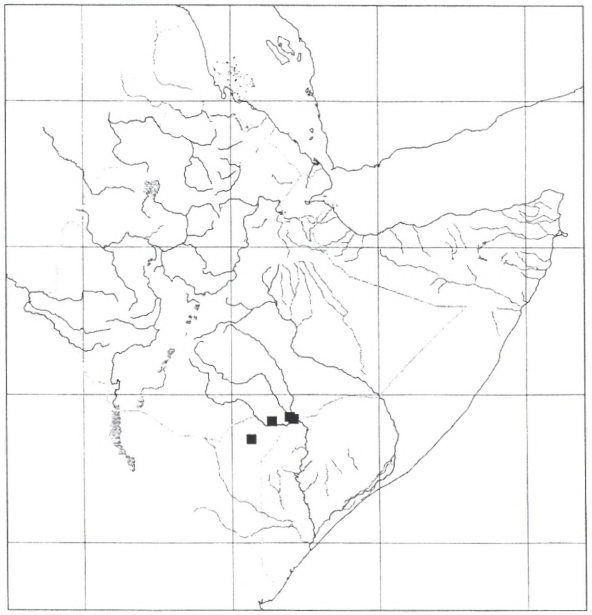


Fig. 2. Distribution of *Aloe citrina*.

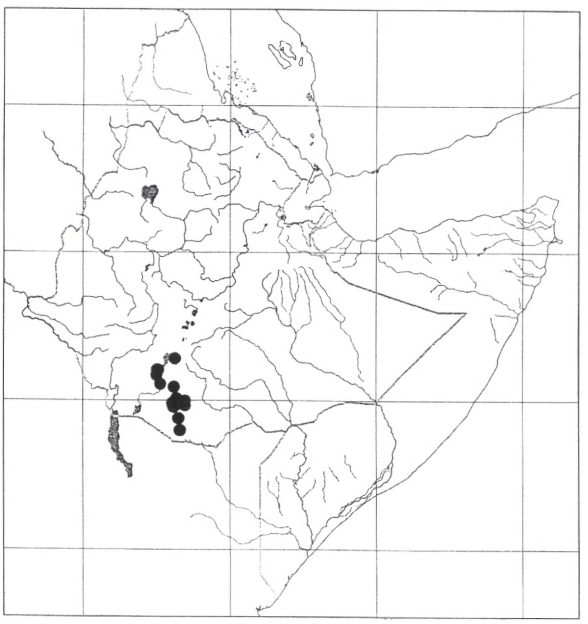


Fig. 3. Distribution of *Aloe otallensis*.

Fig. 4. Distribution of *Aloe harlana*.

Aloe frequently occur in shade under bushes. The modified vegetation types are:

1. Coastal vegetation.
2. Desert and semi-desert scrub.
3. *Acacia-Commiphora* bushland.
4. Dry evergreen montane forest and grassland. For the purpose of this paper, the evergreen scrub is included here.
5. Afroalpine vegetation, including sub-Afroalpine vegetation.

So far, no species of *Aloe* has been recorded from the five other vegetation types in the FEE area.

The distribution of all *Aloe* species known from the FEE area is recorded in Table 1. The species, and especially the endemic and the near-endemic species, occur mainly in two vegetation types: dry evergreen montane forest and grassland (including montane evergreen scrub) and *Acacia-Commiphora* bushland. With the exception of two species all *Aloes* in the FEE area occur above (500-)1000 m. These two species are *A. eumassawana* (Fig. 1), which occurs in coastal vegetation, and *A. citrina* (Fig. 2, 8), which occurs both in semi-desert vegetation and *Acacia-Commiphora* bushland). Two species occur above 3000 m; these are *A. steudneri* and *A. ankoberensis*, both of which reach into the sub-Afroalpine vegetation. This agrees with the observation that species of *Aloe* are rare in the semi-desert and the desert vegetation, and in sub-Afroalpine vegetation. Examples of species mainly occurring in *Acacia-Commiphora* bushland above 1000 m, are *Aloe otallensis* (Fig. 8), which occurs in Borana in the southern part of the FEE-area (Fig. 3), and *A. harlana* (Fig. 8), which occurs in the eastern part of the FEE area (Fig. 4), although the latter transgresses to the lower part of dry evergreen forest. A species, which typically occur in the evergreen forest and scrub of the central highlands, is *A. debrana* (Fig. 5, 8). A species, which typically is associated with sub-Afroalpine vegetation, is *A. steudneri;* it mainly occurs at high altitudes in the Simen Mts (Fig. 6, 8).

Distribution patterns of endemic and near-endemic Aloe species

The concentration of *Aloe* species in the FEE area to altitudes between (500-)900 and c. 3000 m, as demonstrated in Table 1, means that they are largely found in the highlands, the foothills of the highlands and in the Rift Valley. A limited number is found on the Borana-Ogaden Plain, a system of gently sloping plains towards Somalia and Kenya. A summary of localities of most endemic and near-endemic *Aloe* species is shown on Fig. 7 (note that the newly described *A. bertemariae* has not been included), and the distribution of the species within these three regions have been indicated in Table 1. A wedge-shaped high rainfall area with vegetation of evergreen forest or secondary vegetation derived from forest penetrates into the highlands from south-west; this wedge-shaped area has few or no *Aloe* species. The wedge-shaped high rainfall area covers large parts of the FEE floristic regions of WG, IL and KF. The western lowlands with *Combretum-Terminalia* woodlands and fierce and frequent grass fires are also apparently devoid of *Aloe* species.

Thus, the distribution areas of *Aloe* species in the FEE-area fall into three parts.

1. The northern and central highlands south to SU and north-eastern KF.
2. The eastern highlands, continuing into the mountain chain in northern Somalia.
3. The southern highlands, the Rift Valley, and the Borana-Ogaden Plain.

Hardly any species overlap the boundaries between these three areas, with *A. pubescens* and *A. macrocarpa* as the two most notable

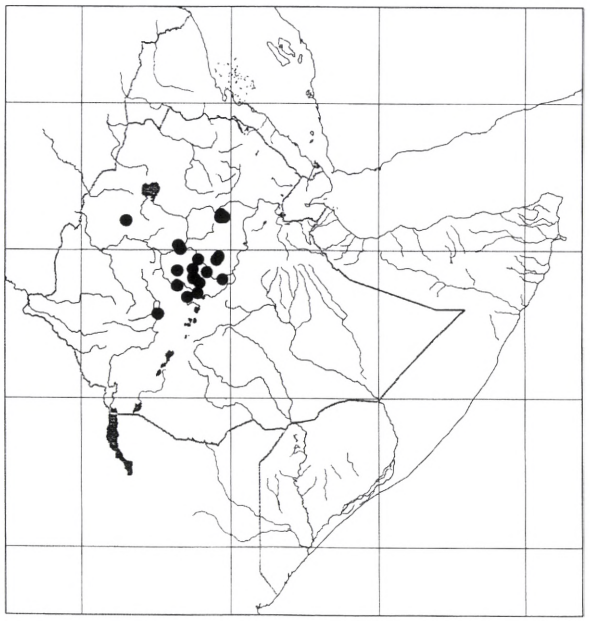


Fig. 5. Distribution of *Aloe debrana*.

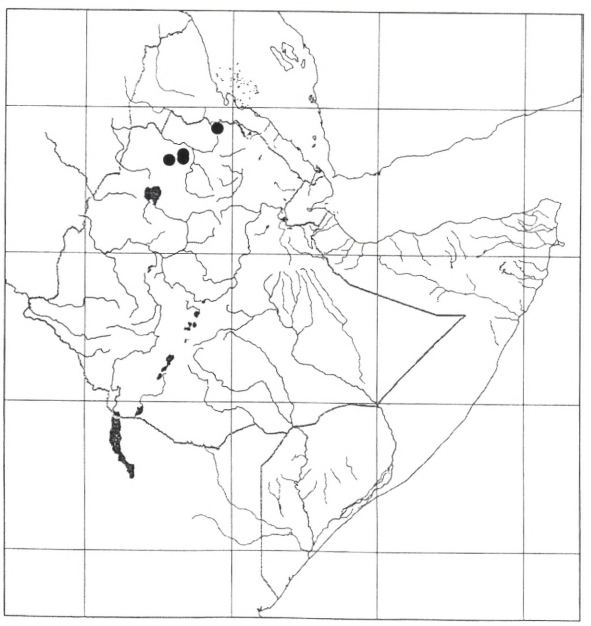


Fig. 6. Distribution of *Aloe steudneri*.

examples. These species, and others that occur in two or three of the three areas mentioned above, are excluded from the map in Fig. 7.

Aloe species and African phytochoria

One of the most characteristic features of the *Aloe* flora of the FEE area is the relatively high number of species, which mainly occur or are restricted to high altitudes (Table 1). Most high-altitude species are clearly restricted to the Afromontane region, and are thus Afromontane endemics according to the definition of White (1983). There is a number of high-altitude species associated with sub-Afroalpine vegetation; they are large, succulent rosette plants with no or only a short stem. Stemless succulent rosette-plants are not part of the normally accepted life forms of typical Afroalpine plants (Hedberg 1964), and they occur also in the vegetation zone immediately below. These *Aloe* species are therefore considered part of an Afromontane element, which reach or just transgress the border between the Afromontane and the Afroalpine zones.

The other notable endemic or near-endemic element in the *Aloe* flora of the FEE area includes the species that occur in the *Acacia-Commiphora* bushland in the Somalia-Masai regional centre of endemism (Table 2). They are thus Somalia-Masai endemics according to the definition of White (1983). A small number of these species transgress into the Afromontane region. *Aloe macrocarpa* is outside the FEE-area widespread in the Sudanian region, but in Ethiopia it behaves as a species, which transgress the border between the *Acacia-Commiphora* bushland and the dry montane evergreen forest; it is therefore recorded as SUD/S-M/AFM here (*Cf.* Table 1).

An enumeration of the phytogeographical elements indicated in Table 1 shows the following distribution:

Table 2. Elements in the *Aloe* flora of the FEE area.

Strictly Afromontane element	13 species	33%
Afromontane / Somalia-Masai transgressors	8 species	20%
Strictly Somalia-Masai element	18 species	45%
Sudanian/Somalia-Masai / Afromontane transgressor	1 species	2%
Total	40 species	

The data from the Flora of Somalia (Lavranos 1995) have been analyzed here in the same way. The results show that among the 30 indigenous species there seems to be no strict Afromontane element (see also Discussion). The ten species (33.3%), which occur at the highest altitude in Somalia, are probably best referred to as Afromontane/Somalia-Masai transgressors. These species occur mainly in

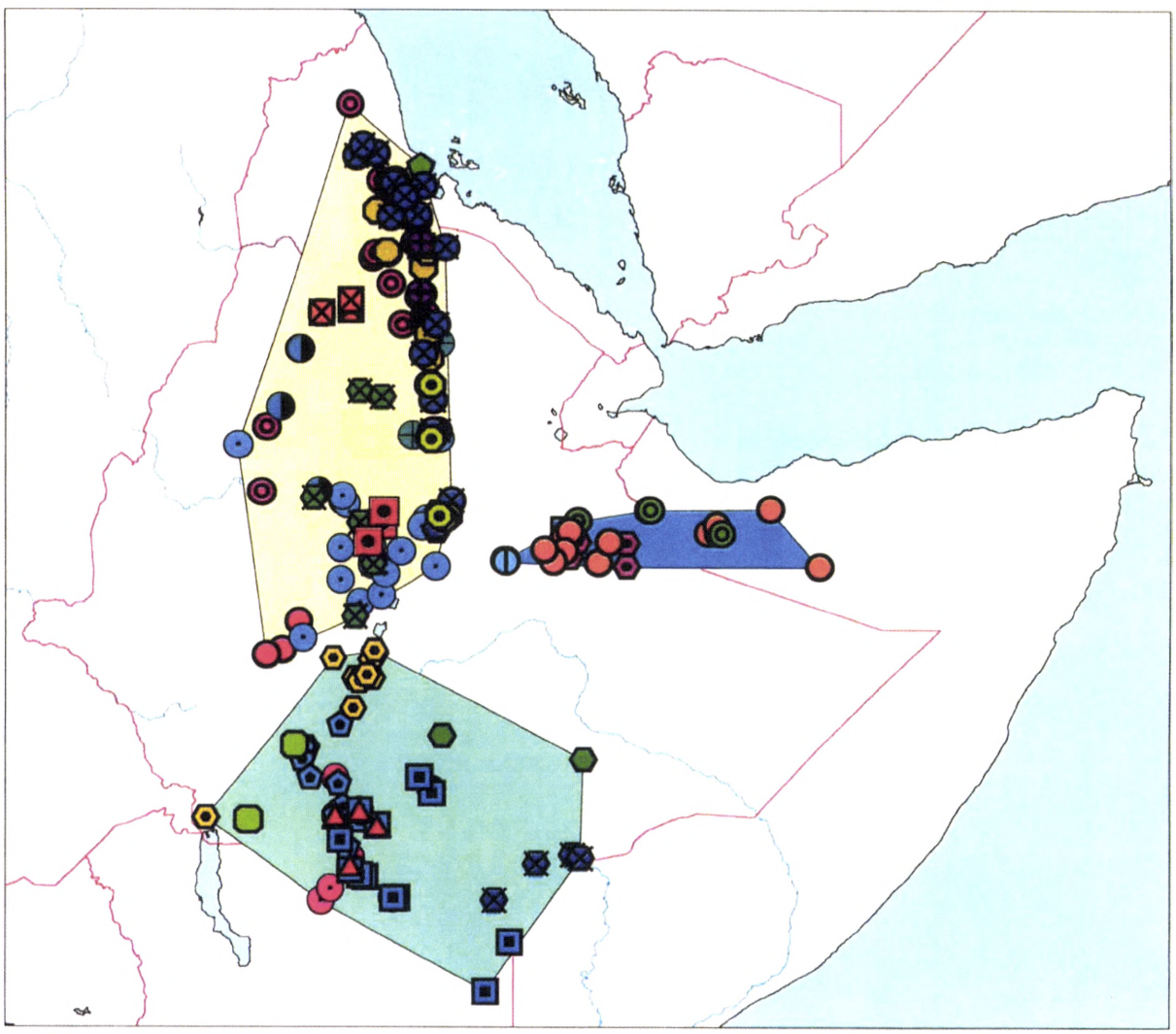


Fig. 7A. Geographical patterns of *Aloe* endemics and near-endemics in the FEE-area. Legends on opposite page.

the *Juniperus-Buxus* evergreen forest and associated evergreen scrub (Friis 1992) in the mountain chain in Northern Somalia. Nineteen species (63%) are distributed in *Acacia-Commiphora* bushland within the Somalia-Masai region and are strict Somalia-Masai endemics. One species (3%) is a Somalia-Masai/Zanzibar-Inhambane transgressor.

The 83 species in the Flora of Tropical East Africa (Carter 1994) have been analyzed in the same way. However, the result is complex, especially where the species in the Lake Victoria Regional Mosaic, the Zanzibar-Inhambane Regional Mosaic, and the Zambesian Region in southern part of the FTEA area are concerned. There are many species that would appear to occur in the transition zones between these phytochoria. We have therefore only analyzed the elements, which we also have studied from the FEE and the Flora of Somalia area, and only on a very tentative basis. Eight (10%) species seem to be strictly Afromontane in Tropical East Africa, and none of these occurs above 2650 m, which contrast with the two species reaching between 3000 and 3500 m in Ethiopia. Three species (4%) in Tropical East Africa seem to be Afromontane/Somalia-Masai transgressors. Thirty-seven (45%) species seem to be strictly endemic to the Somalia-Masai Region.

Thus, the FEE area has by far the highest concentration of Afromontane *Aloe* species in the entire Tropical East and Tropical North-East African Regions combined. But the mountains in Northern Somalia have a very notable element of *Aloe* species in the transition zone between the Somalia-Masai and the Afromontane regions.

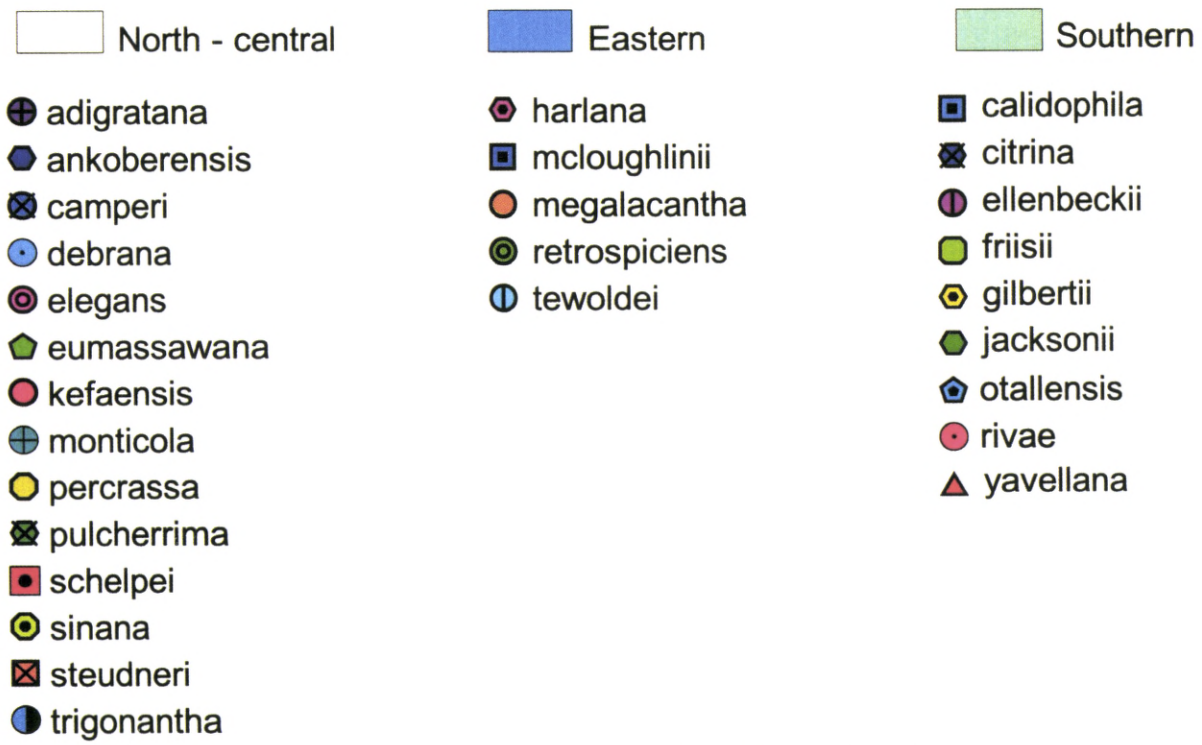
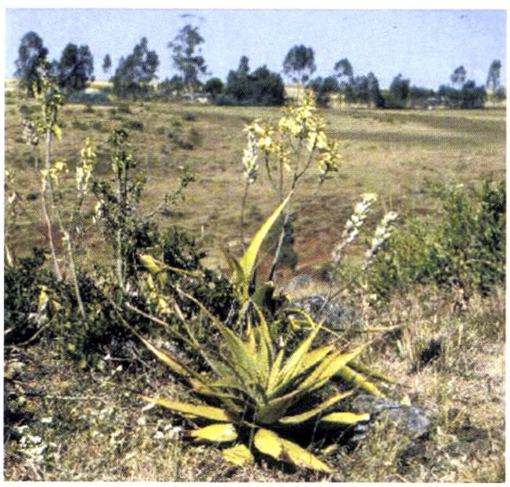


Fig. 7B. Geographical patterns of *Aloe* endemics and near-endemics in the FEE-area. Legends to map.








Discussion

The high representation of Afromontane *Aloe* species in the FEE region is partly due to the prolific speciation of two groups. The first group, comprising *A. ankoberensis*, *A. pulcherrima*, and *A. steudneri* (Fig. 8), are genuinely high-altitude species. The other group, which occurs also at slightly lower altitudes, includes *A. debrana* (Fig. 8), *A. percrassa*, and *A. trigonantha* (Fig. 8). Both groups occur within the unimodal rainfall area of the Ethiopian highlands where the rainfall is (probably) below 1000 mm, and the two groups have therefore speciated both at high altitude and low rainfall, a combination which is not so extensively represented in Tropical East Africa. The *Aloe* species of Somalia show a somewhat similar pattern, although the mountains in Somalia are lower than in Ethiopia, and dry high-altitude habitats do therefore not exist to the same extent. The endemic *Aloe* species in the Flora of Somalia region are largely found in typical Somalia-Masai vegetation types and well within the Somalia-Masai region, except the group which has speciated at higher altitudes. Here they are associated with *Buxus-Acokanthera* scrub and dry *Juniperus* forest, somewhat similar to the *Juniperus* forests in Ethiopia, which may be the main habitat for high-altitude speciation in Ethiopia. The high-altitude group in Somalia contains the following species: *Aloe jucunda* Reynolds, *A. peckii* Bally & Verdoorn, *A. albovestita* S. Carter & P. Brandham, *A. cremnophila* Reynolds & Bally, *A. gillettii* S. Carter, and *A. hildebrandtii* Bak. The exact phytogeographical position of the dry *Juniperus* forest and the *Buxus-Acokanthera* scrub in Somalia is not quite clear. White (1983) and Thulin (1986) have included these two closely associated vegetation types as an upper part of the Somalia-Masai region. Friis (1992) has found that it is worthy of being recognized as a transition zone between the Somalia-Masai and the Afromontane regions. Whatever the phytogeographical position, this zone is interesting because it is rich in endemics, a feature not usually found in phytogeographical transition zones according to White (1983).

There seems therefore to be speciation in relatively dry areas at higher altitudes in both Ethiopia and Somalia, while a similar trend does not seem to be prominent among *Aloe*-species in East Africa.

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← **Fig. 8**. Some endemic or near-endemic *Aloe* species from Ethiopia. The species in the left column, from top to bottom: *Aloe citrina*, SD, near Bokol Mayo towards Dolo Odo; 15 Dec. 1990. Photo by Sebsebe Demissew. *Aloe otallensis*, SD, NE of Yavello; 19 Nov. 1994. Photo by Sebsebe Demissew. *Aloe trigonantha*, GJ, near Yejube, SE of Debre Markos; 19 Dec. 1998. Photo by Sebsebe Demissew. The species in the right hand column, from top to bottom: *Aloe steudneri*, GD, Simen National Park. Photo by J.C. Hilman. *Aloe harlana*, HA, near Harla Village, between Dire Dawa and Dengego; 21 Apr. 1989. Photo by Sebsebe Demissew. *Aloe debrana*, SU, near Debre Berhan; 21 Dec. 1988. Photo by Sebsebe Demissew.

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