



# Potential Natural Vegetation of Eastern Africa (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia)

## VOLUME 2

### Description and Tree Species Composition for Forest Potential Natural Vegetation types

R. Kindt, P. van Breugel, J.-P.B Lillesø, M. Bingham, Sebsebe Demissew,  
C. Dudley, I. Friis, F. Gachathi, J. Kalema, F. Mbago, V. Minani, H.N. Moshi,  
J. Mulumba, M. Namaganda, H.J. Ndangalasi, C.K. Ruffo, R. Jamnadass and  
L. Gaudal



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**Authors**

Kindt, R., van Breugel, P., Lillesø, J.-P.B., Bingham, M., Sebsebe Demissew, Dudley, C., Friis, I., Gachathi, F., Kalema, J., Mbago, F., Minani, V., Moshi, H.N., Mulumba, J., Namaganda, M., Ndangalasi, H.J., Ruffo, C.K., Jamnadass, R. and Gaudal, L.

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sl@life.ku.dk  
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# Introduction

This book represents **Volume 2** in a seven-volume series that documents the potential natural vegetation map that was developed by the VECEA (Vegetation and Climate change in East Africa) project. The VECEA map was developed as a collaborative effort that included partners from each of the seven VECEA countries (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia).

- In **Volume 1**, we present the potential natural vegetation map that we developed for seven countries in eastern Africa. In Volume 1, we also introduce the concept of potential natural vegetation and give an overview of different application domains of the VECEA map.
- **Volumes 2 to 5** describe potential natural vegetation types, also including lists of the “useful tree species” that are expected to naturally occur in each vegetation type – and therefore also expected to be adapted to the environmental conditions where the vegetation types are depicted to occur on the map. **Volume 2** focuses on forest and scrub forest vegetation types. **Volume 3** focuses on woodland and wooded grassland vegetation types. **Volume 4** focuses on bushland and thicket vegetation types. In **Volume 5**, information is given for vegetation types that did not feature in Volumes 2 to 4.
- **Volume 6** gives details about the process that we followed in making the VECEA map.
- **Volume 7** shows the results of modelling the distribution of potential natural vegetation types for six potential future climates.

# Acknowledgements

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Thanks to UNEP-GEF for funding the Carbon Benefits Project (CBP) through which information was compiled on indicator and characteristic species for The Vegetation Map of Africa (White 1983). (This work led to the publication in 2011 of an Africa-wide tree species selection tool that is available from: [http://www.worldagroforestrycentre.org/our\\_products/databases/useful-tree-species-africa](http://www.worldagroforestrycentre.org/our_products/databases/useful-tree-species-africa)) Thanks to BMZ for funding the ReACCT project in Tanzania through which funding was made available for field verification of the VECEA map around Morogoro (this was essential in preparing the VECEA map as the base map for Tanzania was essentially a physiognomic map.



# Abbreviations

Abbreviation	Full
A	Afroalpine vegetation
B	Afromontane bamboo
Bd	Somalia-Masai <i>Acacia-Commiphora</i> deciduous bushland and thicket
Be	Evergreen and semi-evergreen bushland and thicket
bi (no capital)	Itigi thicket (edaphic vegetation type)
br (no capital)	Riverine thicket (edaphic vegetation type, mapped together with riverine forest and woodland)
C	In species composition tables: we have information that this species is a characteristic (typical) species in a national manifestation of the vegetation type
D	Desert
DBH	diameter at breast height (1.3 m)
E	Montane <i>Ericaceous</i> belt (easily identifiable type)
f (no capital)	In species composition tables: since this species is present in the focal country and since it was documented to occur in the same vegetation type in some other VECEA countries, this species potentially occurs in the national manifestation of the vegetation type
Fa	Afromontane rain forest
Fb	Afromontane undifferentiated forest (Fbu) mapped together with Afromontane single-dominant <i>Juniperus procera</i> forest (Fbj)
Fc	Afromontane single-dominant <i>Widdringtonia whytei</i> forest
fc (no capital)	Zanzibar-Inhambane scrub forest on coral rag (edaphic forest type)
Fd	Afromontane single-dominant <i>Hagenia abyssinica</i> forest
Fe	Afromontane moist transitional forest
fe (no capital)	Lake Victoria <i>Euphorbia dawei</i> scrub forest (edaphic forest type mapped together with evergreen and semi-evergreen bushland and thicket)
FeE	distinct subtype of Afromontane moist transitional forest in Ethiopia
FeK	distinct subtype of Afromontane moist transitional forest in Kenya
Ff	Lake Victoria transitional rain forest
Fg	Zanzibar-Inhambane transitional rain forest
Fh	Afromontane dry transitional forest
Fi	Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest
FLD	Forest & Landscape (URL <a href="http://sl.life.ku.dk/English.aspx">http://sl.life.ku.dk/English.aspx</a> )
Fm	Zambezi dry evergreen forest
Fn	Zambezi dry deciduous forest and scrub forest
Fo	Zanzibar-Inhambane lowland rain forest
Fp	Zanzibar-Inhambane undifferentiated forest
Fq	Zanzibar-Inhambane scrub forest
fr (no capital)	Riverine forests (edaphic forest type mapped together with riverine woodland and thicket)
Fs	Somalia-Masai scrub forest (mapped together with evergreen and semi-evergreen bushland and thicket)
fs (no capital)	Swamp forest (edaphic forest type)
G	Grassland (excluding semi-desert grassland and edaphic grassland)
g (no capital)	Edaphic grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type)
gv	Edaphic grassland on volcanic soils (edaphic subtype)
ICRAF	World Agroforestry Centre (URL <a href="http://www.worldagroforestry.org/">http://www.worldagroforestry.org/</a> )
L	Lowland bamboo
M	Mangrove
P	Palm wooded grassland (physiognomically easily recognized type)
PROTA	Plant Resources of Tropical Africa (URL <a href="http://www.prota.org/">http://www.prota.org/</a> )
S	Somalia-Masai semi-desert grassland and shrubland

s (no capital)	Vegetation of sands (edaphic type)
T	<i>Termitaria</i> vegetation (easily identifiable and edaphic type, including bush groups around <i>termitaria</i> within grassy drainage zones)
UNEP	United Nations Environment Programme (URL <a href="http://www.unep.org/">http://www.unep.org/</a> )
VECEA	Vegetation and Climate Change in Eastern Africa project (funded by the Rockefeller Foundation)
Wb	Vitellaria wooded grassland
Wc	Combretum wooded grassland
Wcd	dry <i>Combretum</i> wooded grassland subtype
Wcm	moist <i>Combretum</i> wooded grassland subtype
WCMC	World Conservation Monitoring Centre (URL <a href="http://www.unep-wcmc.org/">http://www.unep-wcmc.org/</a> )
wd (no capital)	Edaphic wooded grassland on drainage-impeded or seasonally flooded soils (edaphic vegetation type)
We	Biotic <i>Acacia</i> wooded grassland
Wk	Kalahari woodland
Wm	Miombo woodland
Wmd	Drier miombo woodland subtype
Wmr	Miombo on hills and rocky outcrops subtype
Wmw	Wetter miombo woodland subtype
Wn	north Zambebian undifferentiated woodland and wooded grassland (abbreviation: undifferentiated woodland)
Wo	Mopane woodland and scrub woodland
wr (no capital)	Riverine woodland (edaphic vegetation type, mapped together with riverine forest and thicket)
Wt	<i>Terminalia sericea</i> woodland
Wvs	<i>Vitex</i> - <i>Phyllanthus</i> - <i>Shikariopsis</i> ( <i>Sapium</i> ) - <i>Terminalia</i> woodland (not described regionally)
Wvt	<i>Terminalia glaucescens</i> woodland (not described regionally)
Wy	Chipya woodland and wooded grassland
X	Fresh-water swamp
x (no capital)	In species composition tables: we have information that this species is present in a national manifestation of the vegetation type
Z	Halophytic vegetation
ZI	Zanzibar-Inhambane coastal mosaic (Kenya and Tanzania coast)

# Contents

Introduction	i
Acknowledgements	i
Abbreviations	ii
1. Definition of forest	1
2. Methodology	3
2.1. Main description of a forest type	3
2.2. Information for the VECEA region	3
2.3. Information on species assemblages for a particular forest type	3
2.4. Information on the distribution of altitude, rainfall and temperature for each forest type	5
3. Afromontane rain forest (Fa)	6
3.1. Description	6
3.2. VECEA region	9
3.3. Species composition	13
4. Afromontane undifferentiated forest (Fbu) and Afromontane single-dominant <i>Juniperus procera</i> forest (Fbj)	21
4.1. Description	21
4.2. VECEA region	26
4.3. Species composition	31
5. Afromontane single-dominant <i>Widdringtonia whytei</i> forest (Fc)	39
5.1. Description	39
5.2. VECEA region	41
5.3. Species composition	42
6. Afromontane single-dominant <i>Hagenia abyssinica</i> forest (Fd)	43
6.1. Description	43
6.2. VECEA region	45
6.3. Species composition	48
7. Afromontane moist transitional forest (Fe)	50
7.1. Description	50
7.2. VECEA region	52
7.3. Species composition	55
8. Lake Victoria transitional rain forest (Ff)	59
8.1. Description	59
8.2. VECEA region	61
8.3. Species composition	64
9. Zanzibar-Inhambane transitional rain forest (Fg)	69
9.1. Description	69
9.2. VECEA region	72
9.3. Species composition	76

10. Afromontane dry transitional forest (Fh)	79
10.1. Description	79
10.2. VECEA region	81
10.3. Species composition	89
11. Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest (Fi)	90
11.1. Description	90
11.2. VECEA region	92
11.3. Species composition	97
12. Zambezian dry evergreen forest (Fm)	105
12.1. Description	105
12.2. VECEA region	107
12.3. Species composition	111
13. Zambezian dry deciduous forest and scrub forest (Fn)	113
13.1. Description	113
13.2. VECEA region	116
13.3. Species composition	120
14. Zanzibar-Inhambane lowland rain forest (Fo)	123
14.1. Description	123
14.2. VECEA region	125
14.3. Species composition	128
15. Zanzibar-Inhambane undifferentiated forest (Fp)	131
15.1. Description	131
15.2. VECEA region	133
15.3. Species composition	137
16. Zanzibar-Inhambane scrub forest (Fq)	143
16.1. Description	143
16.2. VECEA region	144
16.3. Species composition	147
17. Somalia-Masai scrub forest (Fs)	150
17.1. Description	150
17.2. VECEA region	152
17.3. Species composition	152
18. Zanzibar-Inhambane scrub forest on coral rag (fc, edaphic forest type)	154
18.1. Description	154
18.2. VECEA region	154
18.3. Species composition	155
19. Lake Victoria <i>Euphorbia dawwei</i> scrub forest (fe, edaphic forest type)	158
19.1. Description	158
19.2. VECEA region	160
19.3. Species composition	161

20. Riverine forests (fr, edaphic forest type)	163
20.1. Description	163
20.2. VECEA region	165
20.3. Species composition	166
21. Swamp forest (fs, edaphic forest type)	178
21.1. Description	178
21.2. VECEA region	178
21.3. Species composition	179
References	189
Appendices	194
Appendix 1. Information on useful tree species	194
Appendix 2. Information on synonyms	204
Appendix 3. Information on botanical families	209



# 1. Definition of forest

**Forests** are continuous stands of trees at least 10 m tall with interlocking crowns (White 1983 p. 46, Figure 1). This physiognomic type has similar height as **woodlands** (with height of at least 8 m), but woodlands never have densely interlocking crowns (although the crowns can be in contact). Woodlands can often also be distinguished from forests by the presence of heliophilous ('sun-loving') grasses in the field layer - a result from the light open canopy of woodlands. Forests have larger height than **bushlands** and **thickets** (both with maximum height of 7 m, the latter distinguished as an impenetrable community of densely interlaced bushes except along tracks made by animals).

Whereas forests are defined physiognomically to have 100% canopy cover, in reality vegetation types with canopy cover above 80% (not 100%) are likely to be classified as forest. A critical factor here is not just the physiognomy, but the species composition that indicates that the vegetation type is degraded forest (and hence the potential natural vegetation type is forest). As forest vegetation types have quite a different suite of species from woodland vegetation types, floristic information (i.e. information on species composition) allows classifying most vegetation types with canopy cover above 80% as forest potential natural vegetation types (J. Timberlake, pers. comm.).

White (1983 p. 46) distinguishes **scrub forests** as a physiognomic formation of local extent. Scrub forests are intermediate in structure between forest and bushland and thicket. They are usually 10 - 15 m high. Trees (woody plants with well-defined and upright boles) are usually present but do not form a closed canopy. Smaller woody plants (principally bushes and shrubs) contribute at least as much as the trees to the appearance of the vegetation and its phytomass. Within the VECEA classification system, four scrub forests were classified together with forests: Zanzibar-Inhambane scrub forest [Fq], Somalia-Masai scrub forest [Fs], Zanzibar-Inhambane scrub forest on coral rag [fc] and Lake Victoria *Euphorbia dawei* scrub forest [fe]). We made no distinction between forest and scrub forest subtypes for Zambezian dry deciduous forest and scrub forest (Fn).

In the VECEA map we follow White (1983 pp. 54 – 55) in not classifying mangroves (M, see volume 5) as a subtype of forests, but as a distinct physiognomic category.

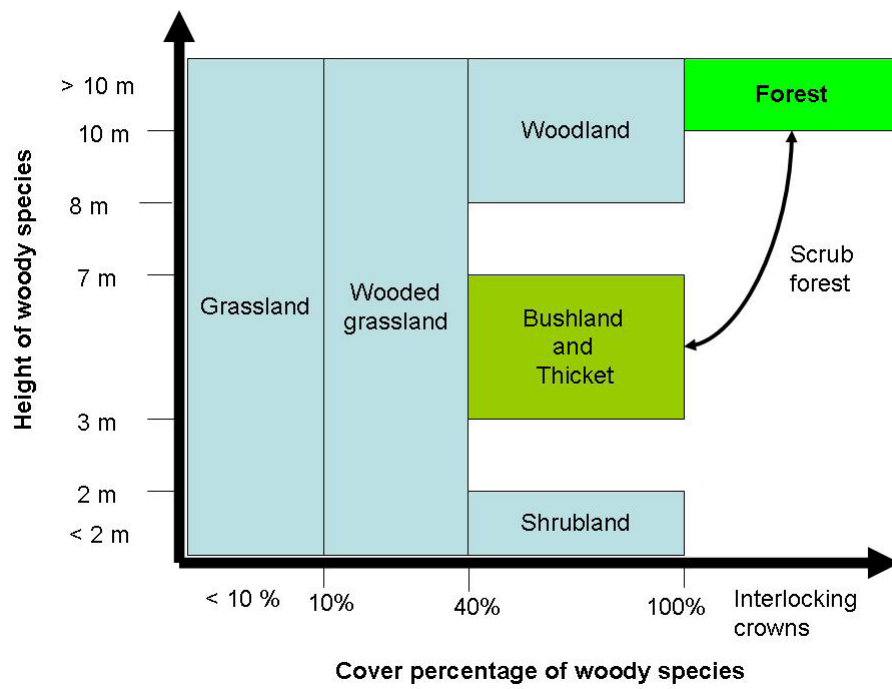


Figure 1. Height and cover percentage limits for major physiognomic types. Scrub forest is defined as a physiognomic mosaic of forest and bushland and thicket



## 2. Methodology

### 2.1. Main description of a forest type

In these sections, we relied heavily on *The Vegetation of Africa* (White 1983) - especially since this reference built on the extensive expertise that White (1983) and his co-authors obtained from literature (including 2400 references) and field work (including the experience from many reviewers [White 1983 p. 13]). By comparing species composition described at national (or subnational levels) with species composition described at a continental level, we were seeking to identify potential natural vegetation types of continental relevance that included the various national “manifestations” of these continental vegetation types. Moreover, we now expect to have set the stage for a potential further expansion of the VECEA map in other countries in Africa. **Within the structure of this volume, the first section (“description”) within the description of a particular forest type refers to the “regional information” that was mainly obtained from “The Vegetation of Africa” (White 1983).**

### 2.2. Information for the VECEA region

Other than the key reference of *The Vegetation of Africa* (White 1983), we mainly consulted the references that were directly associated with the base maps that we used: Ethiopia, Kenya (two different maps, see volume 6), Rwanda (Bloesch *et al.* [2009] contains an updated version of the vegetation map prepared by Prioul [1981] (or possibly by Georges Troupin); the latter is the vegetation map that we digitized (see volume 6), Uganda and Zambia. For two countries, information was limited and we therefore reverted to various other references: Malawi and Tanzania. **Within the structure of this volume, the second section (“VECEA region”) within the description of a particular forest type refers to information that was obtained from one of the national descriptions of the seven VECEA countries.**

**The second section also explains the correspondence between the mapping units of the regional map (the VECEA map) and the national maps. For more details how the regional map was obtained from the national maps, see volume 6.**

### 2.3. Information on species assemblages for a particular forest type

For each of the forest types, we obtained information on species assemblages (those tree species expected to occur in a particular forest) based on information that was provided in the national references. For each of the countries where we had information on the national “manifestation” of a forest type (for example, Afromontane rain forest as it was described for Ethiopia by Friis *et al.* 2010), we created a separate column within which we

gave an indication that a particular tree species was expected to occur within that forest type and within that country.

Where species were not listed in the national reference for a focal country, we checked with information on national lists of all the tree species that occur in the focal country<sup>(1)</sup> whether the species could **potentially** occur in the focal forest type and focal country **because the species was documented to occur in the same forest type in other countries**. For example, the species *Cyathea dregei* was documented to occur in Afromontane rain forest in Malawi, Rwanda and Zambia. From the UNEP-WCMC species database, there was information that this species also occurs in Ethiopia. This led us to indicate that there was information that the species **potentially** occurred in Afromontane rain forest in Ethiopia (we used the coding of “f” in the species assemblage table to indicate this). **Note that it is possible that species indicated with “f” for a particular country and forest type do NOT occur in that particular country and forest type in reality (meaning that, in reality, differences exist between species assemblages of the same forest type between countries – or possibly indicating errors in the obtained species assemblage for a particular country).**

We used a consistent naming system for all the species that were listed in this volume. Information on synonyms (see Appendix 2) was mainly obtained from the African Plants Database (URL <http://www.ville-ge.ch/musinfo/bd/cjb/africa>), whereas we generally attempted to use the same botanical names as adopted in the Plant Resources of Tropical Africa (PROTA) database (URL <http://www.prota4u.org/>). Generally we did not differentiate below the species level. Even though the type species of the *Acacia* genus has recently been modified to be an Australian species (previously the type species was *Acacia nilotica*), we will continue to use the name of *Acacia* (in its widest sense, i.e. combining *Senegalia* and *Vachellia*) in Africa.

After compiling information on species assemblages, we selected a subset of tree species to feature in species composition tables. These were mainly “useful tree species”, which are tree, bushland or liana species that were listed in at least one of the references that we consulted on tree species that are expected to be useful to farming or pastoral communities in the VECEA countries (see Appendix 1).

The regional information (*i.e.* mainly White 1983) was used to collate information on the “regional status” of a species. The regional status included regional information on “indicators”, “characteristic species” and “species that are not characteristic”. We defined these categories as:

- **Indicator:** A species that was **only listed for the focal forest type** among all the forest types described for the same floristic region as of the focal forest type. For example, *Chrysophyllum gorungosanum* is a (regional) indicator for Afromontane rain forest since this species was only listed for Afromontane rain forest (White 1983 p. 164) among all the forests described for the Afromontane floristic region.

1: These floristic references included the UNEP-WCMC species database, the Flora of Tropical East Africa (for Kenya, Tanzania and Uganda), the Flora Zambesiaca (for Malawi and Zambia), and some of the national references (Friis *et al.* 2010 for Ethiopia; Beentje (1994) for Kenya; Bloesch *et al.* 2009 for Rwanda; the Uganda Forest Department Biodiversity Database (Howard & Davenport [1996], Viskanic [1999]) for Uganda; and Burgess and Clarke (2000) for the coastal areas of Kenya and Tanzania)

- **Characteristic species:** A species that was listed **for more than one** of the forest types that were described for the same floristic region, **including the focal forest type**. For example, *Diospyros abyssinica* is a characteristic species for Afromontane rain forest since it is listed for Afromontane rain forest (White 1983 p. 164), but is also listed for Afromontane dry transitional forest (White 1983 p. 166).
- **Species that are not characteristic:** A species that was **listed once** among all the forest types described for the same floristic region as the focal forest type, but that was **not listed** for the focal forest type. For example, *Albizia gummifera* is a negative indicator for Afromontane rain forest since this species was only listed for Afromontane dry transitional forest (White 1983 p. 166) among all the forests described for the Afromontane floristic region (and thus not listed as a species for Afromontane rain forest).

Information on indicators was used to identify the VECEA forest type during the compilation of the VECEA map from information on national forest types. **For each of the national forest types, selected VECEA forest type was the forest type with the highest number of indicators (for this analysis, the complete species assemblages were investigated [i.e. not only the subset of species shown in the species composition tables in the ‘sections 3’]).**

We did not compile lists of indicators for riverine forests (fr) and swamp forests (fs) since these forest types can be easily recognized in the field. In other words, we did not find it necessary for these forest types to re-confirm the regional classification as riverine or swamp forest.

#### **2.4. Information on the distribution of altitude, rainfall and temperature for each forest type**

We obtained information on annual rainfall and annual mean temperature from Worldclim (Hijmans *et al.* 2005; resolution of 30 arc seconds [ $\sim 925$  m]). Information on altitude was obtained from CGIAR-CSI (2008; resolution of 3 arc seconds [ $\sim 90$  m]). We created a layer of sample points at a density of approximately one point per 5 km<sup>2</sup> and with a minimum distance of 900 m. In a next step, we sampled the environmental data layers at the sample point locations. All steps were carried out in the GRASS GIS software (GRASS Development Team 2010).

For histograms, we excluded sample points from vegetation mosaics (*i.e.* polygons that contained more than one vegetation type). In each histogram, we compare the distribution of altitude, temperature and rainfall of the focal forest type with the distributions for all vegetation types and for all forest types combined. The information for the combined vegetation types was also based on exclusion of sample points from vegetation mosaics.

## 3. Afromontane rain forest (Fa)

### 3.1. Description

Afromontane rain forest is very similar in structure (physiognomy) to certain types of Guineo-Congolian rain forest. Species composition, however, is almost entirely different (many tree genera have different species in Afromontane rain forest and Guineo-Congolian rain forest, on the other hand). Other physiognomic and floristic differentiation between Afromontane rain forest and Guineo-Congolian rain forest include the greater degree of bud protection, a lesser degree of drip tips of leaves development, the occurrence of tree ferns (*Cyathea*) and the occurrence of conifers (*Podocarpus*; especially *Podocarpus latifolius* as *Podocarpus falcatus* (synonym: *P. gracilior*) are more characteristic of Afromontane undifferentiated forest; White 1983 p. 164 - 165).

These forests occur mainly between 1200 and 2500 m on the slopes of certain mountains. However, the altitudinal limits vary greatly according to distance from the equator, proximity to the ocean, and size and configuration of the massif on which these forests occur (White 1983 p. 164). The observation that vegetation belts are scaled according to the size of the mountain on which they occur were first observed in the Alps, where this phenomenon is described as the 'Massenerhebung effect' (mass-elevation effect). The mean annual rainfall lies mostly between 1250 and 2500 mm. Mists that frequently occur during the dry season of one to five months may explain the fact that Afromontane rain forest is much less deciduous than lowland semi-evergreen forests that receive similar rainfall. Only a few of the larger tree species (*Entandophragma excelsum* and *Pouteria adolfi-friedericii*) lose their leaves - and then only for a few days (White 1983 p. 164).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Afromontane rain forest and no other Afromontane forest types) that were listed as characteristic species for one or several national maps include ***Chrysophyllum gorungosanum*, *Cola greenwayi*, *Cylicomorpha parviflora*, *Entandophragma excelsum*, *Ficalhoa laurifolia*, *Hallea rubrostipulata*, *Myrianthus holstii*, *Ochna holstii*, *Ocotea usambarensis*, *Olea capensis*, *Parinari excelsa*, *Pouteria adolfi-friedericii*, *Strombosia scheffleri*, *Syzygium guineense* ssp. *afromontanum* and *Tabernaemontana stapfiana*.**



Figure 3.1 View of canopy from Afromontane rain forest (synonym: moist evergreen Afromontane forest) north of Masha (Ethiopia). Altitude approximately 1950 m. Photograph by I. Friis and Sebsebe Demissew (September 2002). Reproduced from *Biologiske Skrifter of the Royal Danish Academy of Sciences and letters*, Vol. 58, Fig 25A. 2010.



Figure 3.2 Afromontane rain forest in Nyungwe National Park (Rwanda). Photograph by C. K. Ruffo (June 2008).



Figure 3.3 *Cyathea manniana* tree ferns in Lake Victoria transitional rain forest (Ff). The presence of tree ferns (*Cyathea* species) is typical for Afromontane rain forest (White 1983 p. 164). However, this species also occurs in other types of forests with admixture of Afromontane species. Photograph by F. Gachathi (2009).



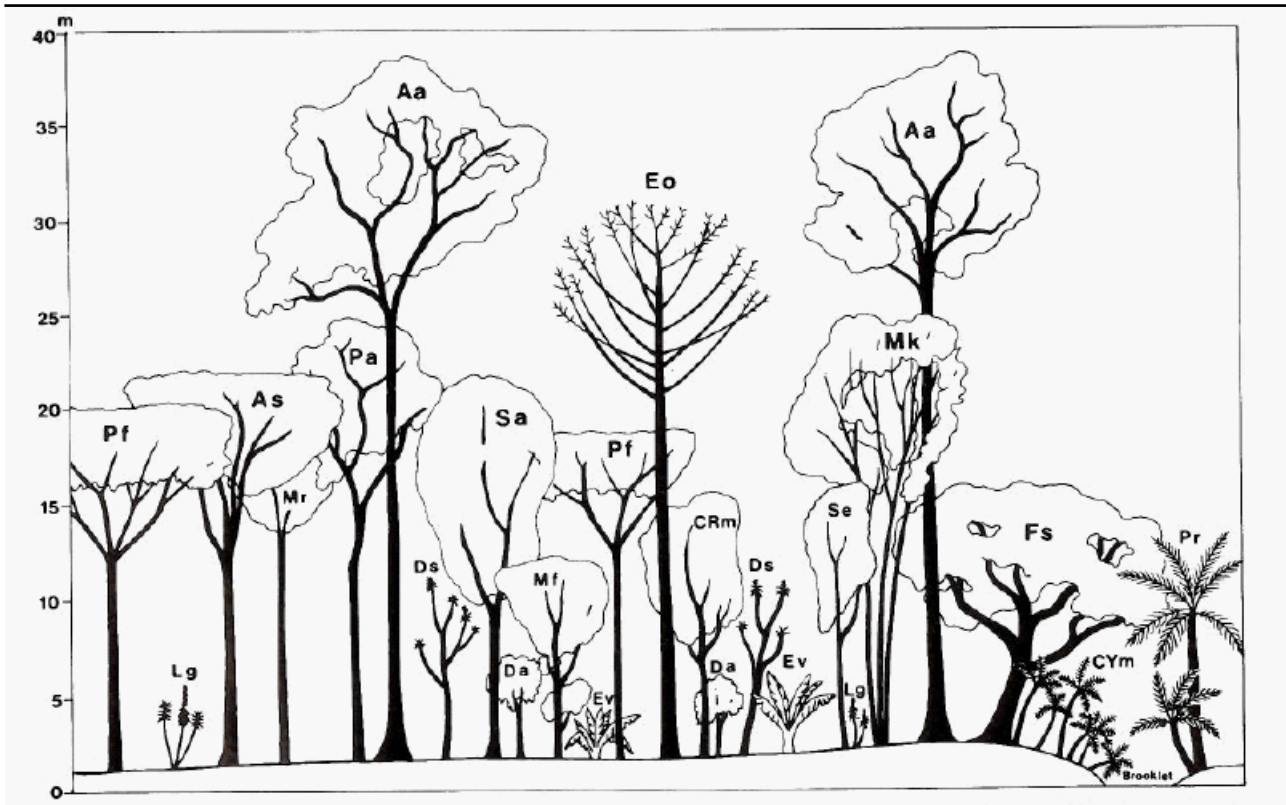


Figure 3.4 Transect of Primary or mature secondary moist evergreen Afromontane forest (classified in VECEA as Afromontane rain forest [Fa]). Generalised representation based on observations made in old secondary forest at approximately 1700 metres altitude south of Gore, IL floristic region. Although this locality is situated just below the altitudinal limit used for mapping (6) Moist evergreen Afromontane forest (Fa) no species restricted to (7) Transitional rain forest (mapped in VECEA as Afromontane moist transitional forest [Fe]) were observed, but a few species, for example *Hallea rubrostipulata*, are known from both vegetation types. The abbreviated names for the species stand for: Aa: *Pouteria (Aningeria) adolfi-friederici*. As: *Albizia schimperiana*. CRm: *Croton macrostachyus*. CYm: *Cyathea manniana*. Da: *Dracaena afromontana*. Ds: *Dracaena steudneri*. Eo: *Euphorbia ampliphylla*. Ev: *Enset ventricosum*. Fs: *Ficus sur*. Lg: *Lobelia giberroa*. Mf: *Millettia ferruginea*. Mk: *Macaranga capensis* var. *kilimandscharica*. Mr: *Hallea (Mitragyna) rubrostipulata*. Pa: *Prunus africana*. Pf: *Polyscias fulva*. Pr: *Phoenix reclinata*. Sa: *Schefflera abyssinica*. Sa: *Sapium ellipticum*. Drawn by Victoria C. Friis. Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 24. 2010.



### 3.2. VECEA region

Within the VECEA region Afromontane rain forest occurs in all countries (see Figure 3.5, see also volume 6). However, the extent of this forest type in Zambia is very small.

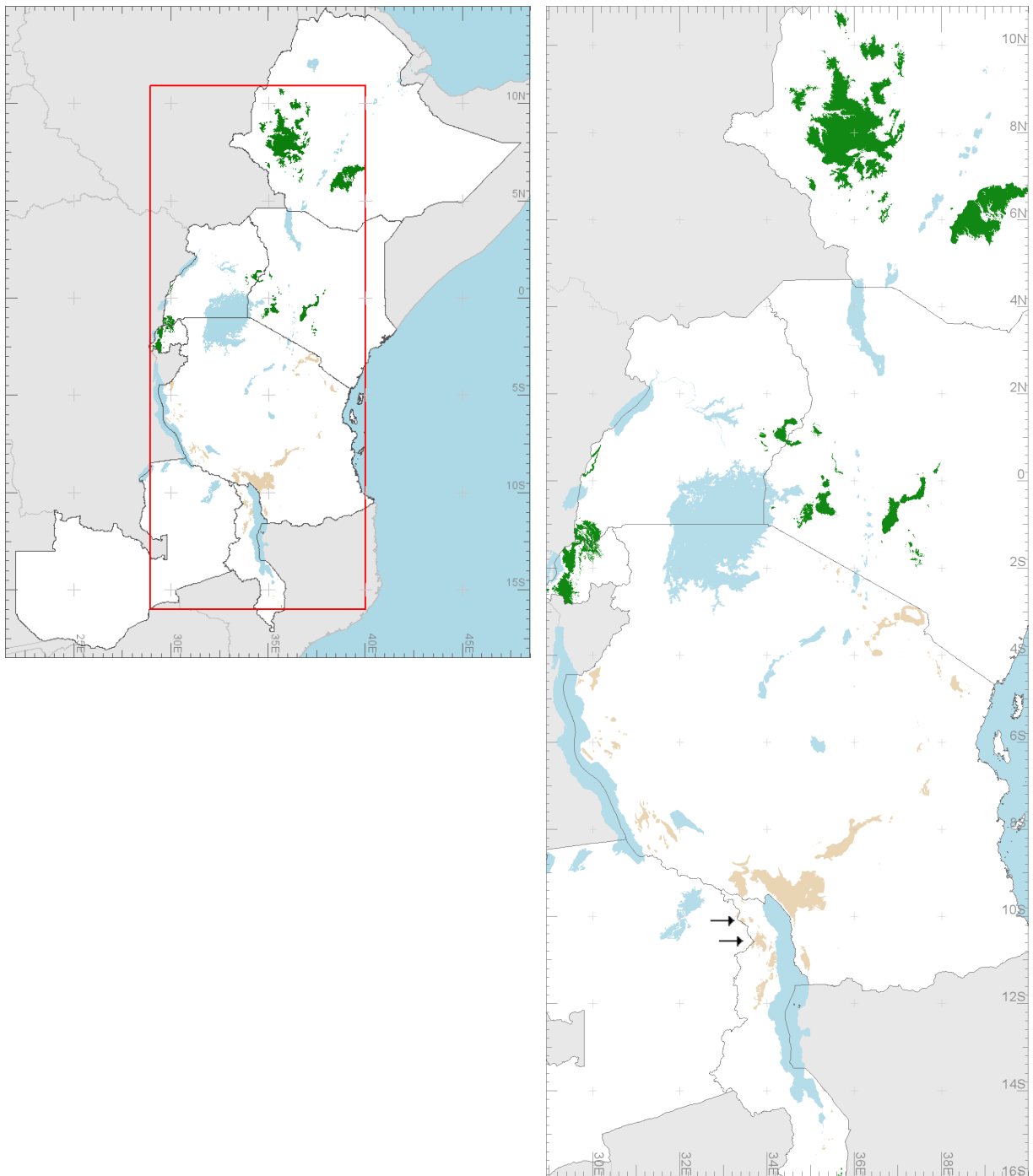


Figure 3.5. Mapped distribution of Afromontane rain forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). Where this vegetation type does not occur in mosaic, it is depicted by green polygons. In Malawi and Tanzania, this vegetation type is mapped as part of different forest mosaics (shown in greyish-brown). In Zambia, this vegetation map was originally mapped together with Afromontane undifferentiated forest (Fbu) near the border with Malawi; since these vegetation mosaics (greyish-brown) are very small when depicted on small-scale distribution maps, we added arrows to indicate the position of these forest mosaics in Zambia.

In Ethiopia, Afromontane rain forest was originally described and mapped under the synonym of primary or mature secondary moist evergreen Afromontane forest (MAF-P). Friis *et al.* (2010, pp. 93, 98 and 99) mention that the absence of *Juniperus procera* and limited prominence of *Podocarpus falcatus* is a key criterion to distinguish Afromontane rain forest from Afromontane undifferentiated forest (Fbu).

The Ethiopian subtype of “Edges of moist evergreen Afromontane forest” (coded MAF-BW)” was not mapped separately. We consider this vegetation type to be one of the seral stages of forest regeneration. *Acacia abyssinica* is among the species that are often dominant (Friis *et al.* 2010 p. 103).

In Kenya, Afromontane rain forest was originally described and mapped under the synonym of moist montane forest.

In Malawi, Afromontane rain forest was originally described and mapped under the synonym of Afromontane rain forest.

In Rwanda, Afromontane rain forest was originally described and mapped under the synonym of “forêt ombrophile de montagne”.

The Tanzanian types of “upper montane forest” and “montane forest” were both classified in the VECEA map as Afromontane rain forest, although Lovett (1993a) only treated “montane forest” (altitude 1200 - 1800 m, annual rainfall > 1200 mm) as a synonym of Afromontane rain forest sensu White (1983). Lovett (1993a) classified “upper montane forest” (altitude > 1800 m and annual rainfall > 1200 mm) as “wetter types of Afromontane undifferentiated forest sensu White (1983)”. Lovett (1993a) had further reserved his classification of “dry montane forest” (altitude > 1500 m and annual rainfall 1000 - 1200 mm) to “drier types of Afromontane undifferentiated forest sensu White (1983)”. Our interpretation of “upper montane forest sensu Lovett (1993a)” as a synonym of “Afromontane rain forest sensu White (1983)” was inspired on: (i) the absence of *Juniperus procera* and *Podocarpus falcatus*; (ii) the presence of the indicator species of *Ficalboa laurifolia*, *Ochna bolstii*, *Ocotea usambarensis*, *Olea capensis* and *Pouteria adolfi-friedericii*; (iii) the lower frequency ( $3 < 5$ ) of species of *Ilex mitis*, *Nuxia congesta* and *Rapanea melanophloeos* that indicate Afromontane undifferentiated forest; (iv) not interpreting White’s (1983 p. 165) description that Afromontane undifferentiated forest replaces Afromontane rain forest at higher altitudes on the wetter slopes as a dichotomy between moister and drier types of undifferentiated forest (lack of a drier-wetter dichotomy in Afromontane rain is also more conform with the other statement of White (1983) that Afromontane undifferentiated forest **usually**, but not always, receives a lower rainfall than Afromontane rain forest); and (v) not having seen other references that make the distinction between “moister” and “drier” variants of Afromontane undifferentiated forest.

In Uganda, Afromontane rain forest was originally described and mapped under the synonym of *Prunus* moist montane forest. Langdale-Brown *et al.* (1964 p. 42) used the name of *Prunus* (actually the synonym of *Pygeum*)



moist montane forest as the name for Afromontane rain forest, although they also mentioned that this species seldom forms pure stands and that the locally dominant species may not be *Prunus africana*. Moreover, *Prunus africana* is also a species that they listed to occur in Afromontane single-dominant *Hagenia abyssinica* forest (Fd) and various subtypes of Lake Victoria drier peripheral Guineo-Congolian rain forest (Fi).

In Zambia, Afromontane rain forest was originally described as moist montane forest. In the original vegetation map of Zambia, this vegetation type was mapped together with Afromontane undifferentiated forest (Fbu).

Investigation of environmental distribution of Afromontane rain forest in the VECEA region (Figure 3.6; limits are for areas of the VECEA map where this forest type is not mapped as mosaic) show similar distribution in altitude (with > 90% of the samples in an interval from 1500 – 2500 m) as reported by White (1983; also see section 3.1). Afromontane rain forest is among the forest types that occur at the highest altitudes. The altitude interval of 1750 – 2000 m contains the highest number of samples (36.0%); only Afromontane undifferentiated forest (Fbu and Fbj mapped together) and Afromontane single-dominant *Hagenia abyssinica* forest have most of their samples in higher altitude classes. Annual rainfall of Afromontane rain forest is mainly between 800 and 2000 mm (97.8% of samples). This interval includes lower rainfall than the interval of 1250 to 2500 mm reported by White (1983); see section 3.1). However, this forest type has the highest rainfall interval where most samples occur (34.9% in the 1800 – 2000 mm interval) of all forest types.

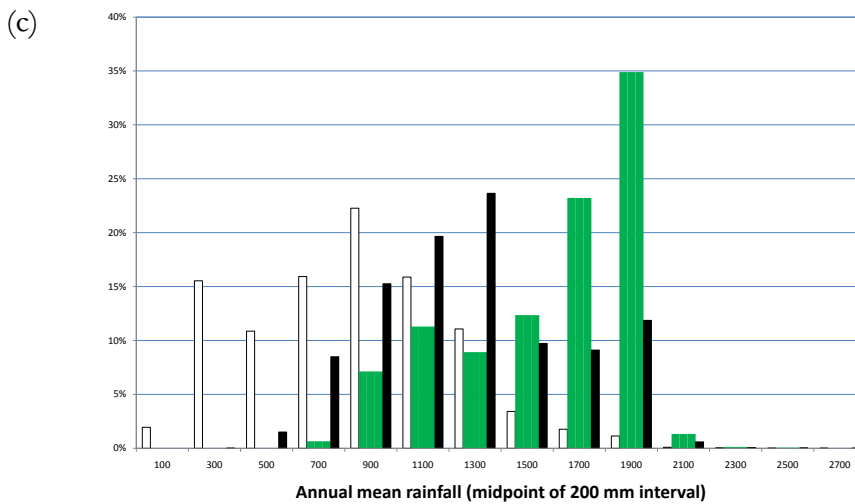
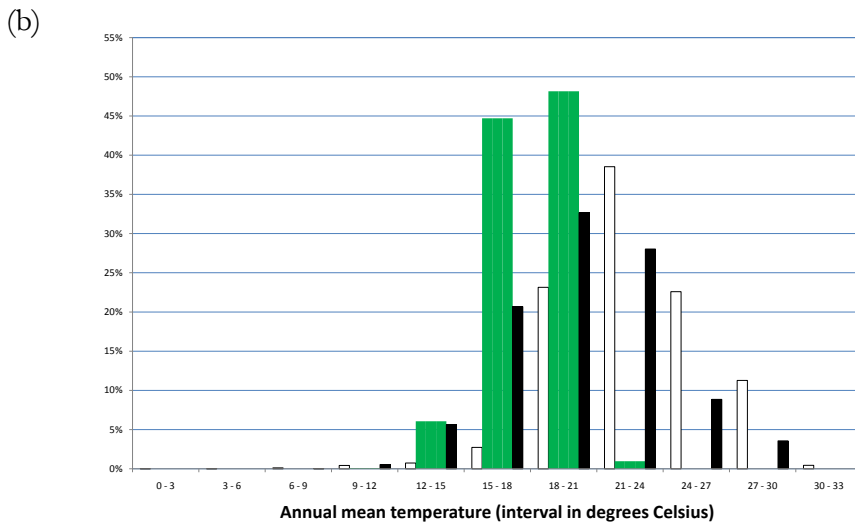
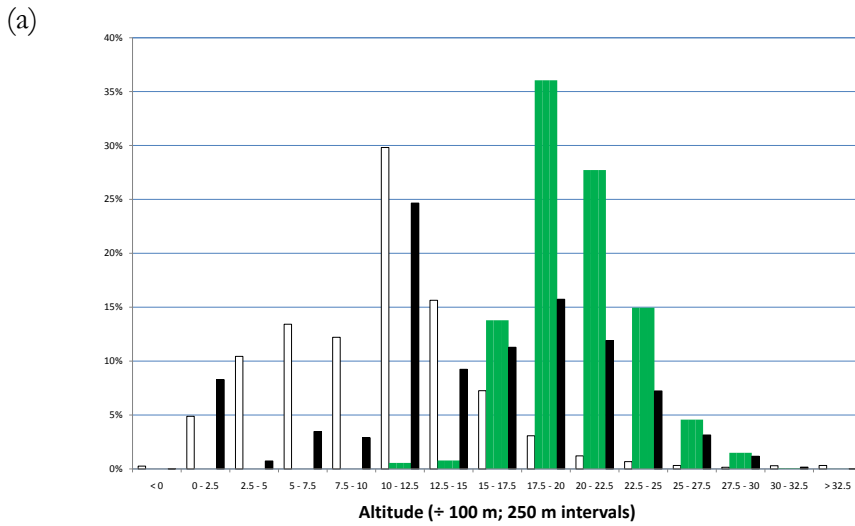


Figure 3.6. Histograms of the distribution of altitude (a), mean annual temperature (b) and mean annual rainfall (c). Bars at the centre of each interval show the percentage of samples within Afromontane rain forest (Fa,  $n = 17,664$ ). Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,0013$ ).

### 3.3. Species composition

Species assemblages were obtained from the following references:

- Ethiopia: Friis *et al.* 2010. Species mentioned in Appendix 3 for “Primary or mature secondary moist evergreen Afromontane forest” [MAF-P] were coded “x” (unless they were characteristic species). Species mentioned for “Edges of moist evergreen Afromontane forest, bushland, woodland and wooded grassland” [MAF/BW] were coded “e”.
- Kenya: Trapnell (1997). Species listed in Annex 1 for “moist montane forest, west and east”, “moist montane forest, east”, “montane sclerophyll and/or moist montane forest”, “moist montane and/or moist intermediate forest” and “of more general distribution” were coded “C”. Suffix “b” indicates that species was listed to only occur marginally in the forest or in montane bamboo. Suffix “e” indicates that the species was listed for “moist montane forest, east”. Suffix “g” indicates species of more general distribution. Suffix “i” indicates invasive species. Suffix “m” indicates that the species was also listed for Afromontane moist transitional forest (Fe; synonym: moist intermediate forest). Suffix “s” indicates secondary species. Suffix “r” indicates residual species after selective felling. Suffix “u” indicates that the species was also listed for Afromontane undifferentiated forest (Fb; synonym: montane sclerophyll forest). Numbers show the maximum height of the species provided in the Annex (Trapnell 1997). Species that were expected to occur in the forest type based on information from Beentje (1994), the Flora of Tropical East Africa and field experience from our Kenyan co-author (F. Gachathi) were coded “x”.
- Malawi: White *et al.* (2001). Species were included in species assemblages partially based on the interpretation of our Malawian co-author (C. Dudley) since species were not consistently allocated to forest types in the reference that was consulted. These species were coded “x” (unless they were characteristic species).
- Rwanda: Bloesch *et al.* (2009). All species that were mentioned to occur in floristic region 3 (montane forests of the Congo and Nile basin [3B] and forest remnants and secondary vegetation [3A]), that had part of their distribution range above 1900 m and where a reference was made to a forest habitat (‘forêt’) in the description of their ecology were coded “x” (unless they were characteristic species).
- Tanzania (columns “FarT” and “FawT”): Lovett (1993ab). Species that were mentioned for “montane forest” in Lovett (1993a; altitude 1200 - 1800 m; rainfall 1000 > 1200 mm) were coded “x” in column FarT. In a separate column (FawT), species that were mentioned for “upper montane forest” in Lovett (1993a; altitude > 1800 m; rainfall > 1200 mm) were coded “C” (since these were assumed to be characteristic species). Species that were only mentioned for “upper montane forest” in Lovett (1993b; altitude 1800 - 2900 m; annual rainfall > 1500 mm) were coded “x”.
- Uganda (column “FaU”): Langdale-Brown *et al.* (1964). All spe-

cies that were listed to occur in “*Prunus* [synonym: *Pygeum*] moist montane forest” in the Appendix were coded “x” (unless they were characteristic species). Species listed in the Appendix for forest - wooded grassland mosaics of high altitudes<sup>2</sup> occurring on moister sites were coded “s1”, whereas no new species were committed to the species assemblage.

- Zambia (column “FaZ”): Fanshawe (1971 pp. 28 - 31). Species that were listed to occur in the species composition table for “montane forest” were coded “fx” (Fanshawe did not distinguish between Afromontane rain forest and Afromontane undifferentiated forest in the species composition table for montane forest) in case that a species was also listed within the species assemblage of another country.

Characteristic species were determined as:

- Ethiopia: Those species that were mentioned in the description of the vegetation type in the main text were coded as “C”.
- Kenya: Species that were listed by Trapnell (1997) were assumed to be characteristic species (these were coded “C”).
- Malawi: Species identified to be present as emergent trees (30 - 45 m) or large trees (20 - 30 m, including stranglers) were coded as “C”. Species recorded to have a marginal occurrence were not listed as characteristic species.
- Rwanda: Characteristic species were coded “C”. These included: (i) species listed by Prioul (1981) to occur in forests at altitudes of 1900 - 2200 m and above 2200 m; (ii) species listed by Lebrun (1956) to occur in ‘forêt ombrophile de montagne’ or ‘forêt de la dorsale du Ruanda’; and (iii) species listed by Habiyaemye (1997) to occur in *Parinari-Ocotea* forest, *Carapa-Strombosia* forest or *Carapa-Beilschmiedia* forest.
- Tanzania: species listed by Lovett (1993a) were coded “C”.
- Uganda: Species characterized as large trees in the appendix or that were mentioned in the main text where the forest type was described were coded “C”.
- Zambia: Species for which the genera were mentioned for moist types of montane forest that occur on the lower slopes and ravines were coded “C”. Species or genera that were mentioned for secondary wet types around seepage heads were coded “Cs”.

Within the information on assemblages, coding “f” indicates that there is information that the species **potentially** occurs in the vegetation type since it occurs in the focal country and in the same forest type in other countries (see section 2.3).

2: Langdale-Brown *et al.* (1964 p. 52) mention that trees mentioned in the appendix are from Mt. Elgon and are mostly remnants of a previous Afromontane rain forest (original mapping unit B1).

Table 3. Species composition of Afromontane rain forest (Fa)

Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FarT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Acacia abyssinica</i>	(invasive)	e	Ci	x	f	f	f	f	f
<i>Acacia lahai</i>	(invasive)	f	x			f	f	f	f
<i>Acacia mearnsii</i>	(exotic)	f	f		x	f	f	f	f
<i>Agauria salicifolia</i>		f	x	x	x	f	x	f	Cs
<i>Albizia grandibracteata</i>		C	x		f	f	f	f	
<i>Albizia gummifera</i>	not characteristic (near streams in Afromontane dry transitional forest)	Ce	Cgs30	C	f	x	f	Cs1	fx
<i>Albizia schimperiana</i>		Ce	f	C		f	f	f	f
<i>Alchornea hirtella</i>			x	x	x	f	f	f	f
<i>Allophylus abyssinicus</i>		xe	C21	x	x	f	f	x	f
<i>Allophylus africanus</i>		f	Cr	f	f	f	f	f	f
<i>Allophylus rubifolius</i>		f	x	f	f	f	f	f	f
<i>Anthocleista grandiflora</i>			C24	x		x	f	x	
<i>Antidesma venosum</i>		f	x	f		f	f	f	f
<i>Apodytes dimidiata</i>	not characteristic (characteristic for Afromontane undifferentiated forest and Afromontane dry transitional forest)	xe	Cu24	C	x	f	f	f	fx
<i>Balthasaria schlebenii</i>							C		
<i>Berberis holstii</i>		f	x	x		f	f	f	
<i>Bersama abyssinica</i>		xe	Cgt15	x	x	x	x	C	fx
<i>Blighia unijugata</i>		x	x	f	f	f	f	f	fx
<i>Bridelia brideliifolia</i>				x	C	f	C	f	
<i>Buddleja polystachya</i>		f	x			f	f	f	
<i>Caesalpinia decapetala</i>			x	f	f	f	f	f	f
<i>Caesalpinia volkensii</i>			x			f	f	f	
<i>Carapa procera</i>			f	f	C	f	f	f	f
<i>Carissa spinarum</i>		e	f	f	f	f	f	f	f
<i>Casearia battiscombei</i>			Cmr37	x		f	f	f	
<i>Cassipourea malosana</i>	not characteristic (Afromontane dry transitional forest)	C	Cg24	C		f	C	x	f
<i>Cassipourea ruwensoriensis</i>		f	f		C	f	f	f	f
<i>Catha edulis</i>		f	Cs12	x	f	f	f	f	f
<i>Celtis africana</i>		C	Cu27	C	f	f	f	f	f
<i>Celtis gomphophylla</i>		f	x	x	f	f	f	f	fx

Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FarT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Celtis mildbraedii</i>			x			f	f	f	
<i>Chrysophyllum gorungosanum</i>	indicator		Ce27	C	x	x	f	C	f
<i>Clausena anisata</i>		xe	x	x	x	f	f	x	fx
<i>Cola greenwayi</i>	indicator		Ce30	C		x	f		C
<i>Cordia africana</i>		xe	x	f	f	f	f	f	fx
<i>Cornus volkensii</i>			Cbu24	C	x	x	f	f	
<i>Craibia brownii</i>			xh		f	f	f	f	
<i>Crotalaria agatiflora</i>		f	x	F	f	f	f	f	
<i>Crotalaria grandibracteata</i>						f	f		
<i>Croton macrostachyus</i>		Ce	Cgs24	C	x	f	f	x s1	f
<i>Croton megalocarpus</i>	not characteristic (indicator for Afromontane dry transitional forest)		f	x	x	f	f	f	f
<i>Croton sylvaticus</i>		f	Cm24	x		f	f	f	f
<i>Cussonia spicata</i>			x	C		f	f	s1	fx
<i>Gyathea dregei</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest	f	f	x	x	f	f		fx
<i>Gyathea humilis</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest		x			f	f		
<i>Gyathea manniana</i>	tree fern that is characteristic of Afromontane rain forest and that is absent from Guineo-Congolian rain forest	x	x	x	x	f	f	C	
<i>Gylcomorpha parviflora</i>	indicator		Ce21	x		f	f		
<i>Diospyros abyssinica</i>	characteristic	x	Cgr27	x	f	f	f	f	fx
<i>Discopodium penninervium</i>		f	x	x	x	f	f	f	
<i>Dodonaea viscosa</i>		f	fb	x	x	f	f	f	f
<i>Dombeya torrida</i>		xe	Cu24	x	x	f	C	x s1	
<i>Doyyalis abyssinica</i>		f	x	x		f	f	f	fx
<i>Doyyalis macrocalyx</i>			x	x	x	f	f	f	fx
<i>Dracaena fragrans</i>		x	f	x	f	f	f	f	
<i>Dracaena steudneri</i>		xe	Cg12	x	x	f	f	x	f
<i>Ehretia cymosa</i>		xe	Cg9	x	x		f		
<i>Ekebergia capensis</i>		Ce	Cg24	C	x	f	f	s1	fx
<i>Elaeodendron buchananii</i>		x	f	x	f	f	f	f	f
<i>Embelia schimperii</i>		f	x	x	x	f	f	f	fx
<i>Englerophytum natalense</i>			x	f		f	f	f	
<i>Ensete ventricosum</i>		xe	f	x	x	f	f	f	f

Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FarT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Entandrophragma excelsum</i>	indicator		I	C	C	x	f	C	fx
<i>Erythrina brucei</i>		xe							
<i>Eugenia capensis</i>		x	f	x	x	f	f	f	fx
<i>Euphorbia abyssinica</i>		f	Cu30	x		f	f	x	fx
<i>Fagaropsis angolensis</i>	not characteristic (indicator for Afromontane dry transitional forest)	x	f	x	x	f	f	f	f
<i>Ficalhoa laurifolia</i>	indicator		I	C	C	x	C	f	f
<i>Ficus exasperata</i>		f	x	f	x	f	f	f	fx
<i>Ficus natalensis</i>			x	x	x	f	f	f	fx
<i>Ficus ovata</i>		Ce	f	x	f	f	f	f	f
<i>Ficus sur</i>		C	Cg24	x	f	f	f	f	f
<i>Ficus thonningii</i>		Ce	Cg21	C	f	f	f	f	fx
<i>Filicium decipiens</i>		x	f	f		f	f		
<i>Funtumia africana</i>			x	f		f	f	f	
<i>Galiniera saxifraga</i>		x	Cu10	x	C	f	f	C	
<i>Garcinia buchananii</i>		x	x	f	f	f	f	s1	f
<i>Hagenia abyssinica</i>		f	Cbu15	C	C *	f	f	f	fx
<i>Hallea rubrostipulata</i>	indicator	Ce	x	x		x	f		
<i>Harungana madagascariensis</i>			Cms12	f	f	f	f	f	f
<i>Hypericum quartianum</i>		f	f	x		f	f	f	f
<i>Hypericum revolutum</i>		f	f	x	x	f	f	f	f
<i>Ilex mitis</i>	not characteristic (indicator for Afromontane undifferentiated forest)	C	x	C	x	f	C	x	fx
<i>Justicia schimperiana</i>		e	f			f	f		
<i>Kigelia moosa</i>			Cm15			f	f	f	
<i>Landolphia buchananii</i>		x	f	x		f	f	f	fx
<i>Lepidotrichilia volkensii</i>		x	Cbu10	x	x	f	f	C	fx
<i>Lovoa swynnertonii</i>			x			f	f	f	
<i>Macaranga capensis</i>		f	Cs24	C	C	x	C	C	fx
<i>Maesa lanceolata</i>		e	C9	f	x	f	C	s1	Cs
<i>Manilkara butugii</i>		x	x					f	
<i>Margaritaria discoidea</i>		f	x	f		f	f	f	f
<i>Maytenus acuminata</i>			Ce9	C	x	f	C	x	fx
<i>Maytenus undata</i>		x	x	x	x	f	f	f	f

Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FarT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Milicia excelsa</i>		f	x	x	f	f	f	f	
<i>Milletia dura</i>			x	x	f	f	f	f	
<i>Mimusops bagshawei</i>			x		f	f	f	f	
<i>Mimusops kummel</i>		x	f	f		f	f	f	
<i>Mondia whitei</i>			x						
<i>Myrianthus holstii</i>	indicator		x	x	x	x	f	f	f
<i>Myrsine africana</i>		f	f	x	f	f	f	f	fx
<i>Neoboutonia macrocalyx</i>			Cms18	C	C	x	f	x	f
<i>Newtonia buchananii</i>	not characteristic (near streams in Afromontane dry transitional forest)		x	f	x	x	f	f	f
<i>Nuxia congesta</i>	not characteristic (indicator for Afromontane undifferentiated forest)	x	Cg21	x	x	f	C	f	fx
<i>Nuxia floribunda</i>	not characteristic (indicator for Afromontane undifferentiated forest)		f	x	x	f	f	f	fx
<i>Ochna holstii</i>	indicator	x	Ce21	x	x	x	C	f	fx
<i>Ocotea kenyensis</i>	not characteristic (indicator for Afromontane undifferentiated forest)	C	C30	x	x	f	f	f	
<i>Ocotea usambarensis</i>	indicator		Ce46	C	C	x	C	f	f
<i>Olea capensis</i>	indicator	C	Cm27	C	C	f	C	C s1	fx
<i>Olea europaea</i>	not characteristic (indicator for Afromontane dry transitional forest [Olea europaea ssp. cuspidata, synonym: Olea africana])	f	Cr	x	f	f	f	f	fx
<i>Olinia rochetiana</i>		f	f	x	x	f	x	f	fx
<i>Parinari excelsa</i>	indicator		l	C	C	x	f	f	C
<i>Peddiea fischeri</i>			x		x	f	f	f	fx
<i>Phoenix reclinata</i>	(palm species)	xe	x	x	f	f	f	f	f
<i>Phytolacca dodecandra</i>		f	x	x	f	f	f	f	f
<i>Pittosporum viridiflorum</i>		x	x	x	x	f	x	C	f
<i>Plectranthus barbatus</i>		f	x			f	f	f	
<i>Pleiocarpa pycnantha</i>			x		x	f	f	f	f



Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FawT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Podocarpus falcatus</i>	not characteristic (conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest)	x	x	x	C	x	f	f	
<i>Podocarpus henkelii</i>	conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest; species that is very localized north of the Limpopo river			C					
<i>Podocarpus latifolius</i>	characteristic (conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest)		Cu24	C	C	f	C	C	C
<i>Podocarpus usambarensis</i>	conifer species that is absent from Guineo-Congolian rain forest, but more characteristic of other types of Afromontane forest		x			f	f	f	
<i>Polyscias fulva</i>		C	f	C	C	x	f	x s1	fx
<i>Pouteria adolfi-friedericii</i>	indicator	C	C46	C	x	C	C	C	C
<i>Pouteria altissima</i>		f	f	f	f	f	f	f	C
<i>Prunus africana</i>	characteristic	C	Cru37	C	C	f	x	C s1	fx
<i>Pseudospondias microcarpa</i>			f		x	f	f	f	f
<i>Psychotria mahonii</i>			C24	x	x	f	x	C	f
<i>Psydrax parviflora</i>		f	C	x	x	f	f	f	f
<i>Pterolobium stellatum</i>		f	x	x	f	f	f	f	fx
<i>Rapanea melanophloeos</i>	not characteristic (indicator for Afromontane undifferentiated forest)	f	Cu27	C	x	f	C	x	fx
<i>Rauvolfia caffra</i>			f	x		x	f	f	f
<i>Rhamnus prinoides</i>		x	x	x	x	f	f	x	fx
<i>Rhamnus staddo</i>		e	f		f	f	f	f	
<i>Rhoicissus revouillii</i>		f	x	f	f	f	f	f	f
<i>Rinorea angustifolia</i>			x		x	f	f	f	
<i>Ritchiea albersii</i>		x	x		x	f	f	f	f
<i>Rothmannia urcelliformis</i>		x	f	x		f	f	f	f
<i>Rubus apetalus</i>		f	x	x	x	f	f	f	f
<i>Rubus volkensii</i>		f	x			f	f	f	
<i>Sambucus ebulus</i>			x			f	f	f	
<i>Schefflera abyssinica</i>		C	C18	C		f	f	s1	f
<i>Schefflera volkensii</i>		x	Cu24			f	f	C	

Species	Regional status see section 2.3	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	FarT (Tanzania subtype)	FawT (Tanzania subtype)	(Uganda)	Zambia)
<i>Scutia myrtina</i>		f	x	x	f	f	f	f	fx
<i>Senna didymobotrya</i>		f	x	f	f	f	f	s1	f
<i>Senna septemtrionalis</i>			x	f	f	f	f	f	f
<i>Shirakiopsis elliptica</i>		C	x	x	x	f	f	f	f
<i>Sinarundinaria alpina</i> (Afromontane bamboo)		Ce	f	x	x	f	f	x	
<i>Smilax anceps</i>		x	x		x	f	f	f	fx
<i>Solanecio mannii</i>		xe	f	x	f	f	f	f	f
<i>Solanum aculeastrum</i>			x	x	x	f	f	f	
<i>Strombosia scheffleri</i>	indicator		Cm27	C	C	x	f	C	
<i>Strychnos mitis</i>		x	f	f		f	f	f	
<i>Symphonia globulifera</i>					C	f	C	C	f
<i>Synsepalum brevipes</i>			Ce25	f		f	f	f	fx
<i>Syzygium cordatum</i>							C		fx
<i>Syzygium guineense</i>	indicator ( <i>Syzygium guineense</i> ssp. <i>afromontanum</i> )	C	Cru30	x	C	x	f	x s1	fx
<i>Tabernaemontana pachysiphon</i>				f		f	f	f	f
<i>Tabernaemontana stapfiana</i>	indicator		Cm10	x	x	f	f	x	
<i>Trema orientalis</i>		x	x	f	x	f	f	f	f
<i>Trichilia dregeana</i>		x	x	f		f	f	f	fx
<i>Trilepisium madagascariense</i>		f	f	x		f	f	f	f
<i>Vangueria apiculata</i>		f	f	x	x	f	f	f	f
<i>Vepris dainellii</i>		x							
<i>Vepris nobilis</i>		x	Cg12	x	x	f	f	f	fx
<i>Vernonia amygdalina</i>		e	f	f	f	f	f	s1	f
<i>Vernonia auriculifera</i>		e	x		x	f	f	f	
<i>Vernonia myriantha</i>		e	x	x	x	f	f	f	f
<i>Vitex keniensis</i>			Ce49						
<i>Xymalos monospora</i>	characteristic		C15	x	C	x	C	x	fx
<i>Zanthoxylum gillettii</i>		f	Cm30		x	f	f	f	
<i>Zanthoxylum rubescens</i>			Cm24			f	f	f	f

## 4. Afromontane undifferentiated forest (Fbu) and Afromontane single-dominant *Juniperus procera* forest (Fbj)

### 4.1. Description

Afromontane undifferentiated forest is usually shorter than Afromontane rain forest (Fa). Although there is some floristic overlap in species composition between these two forest types (for example, *Podocarpus latifolius*, *Prunus africana* and *Xymalos monospora* were listed as characteristic species both for Afromontane rain forest and Afromontane undifferentiated forest), species composition is distinctive (White 1983 p. 165). White (1983) reserved the term of “undifferentiated forests” to forests that undergo rapid and kaleidoscopic changes in structure and species composition over short distances (White 1983 p. 47).

Afromontane undifferentiated forest usually replaces Afromontane rain forest at comparable altitudes (usually between 1250 and 2500 m) on the drier slopes of mountains and at higher altitudes on the wetter slopes, and sometimes at lower altitudes. Afromontane undifferentiated forest usually receives lower rainfall (possibly as low as 850 mm, which is the upper rainfall limit of East African evergreen bushland [Be]) than Afromontane rain forest (White 1983 p. 165).

After fire, Afromontane undifferentiated forests are sometimes replaced by almost pure stands of Afromontane single-dominant *Juniperus procera* forest (Fbj), Afromontane single-dominant *Widdringtonia whytei* forest (Fc) or Afromontane single-dominant *Hagenia abyssinica* forest (Fd). Within the VE-CEA map, we mapped the latter two types of forests (Fc and Fd) separately but mapped Afromontane undifferentiated forest together with Afromontane single-dominant *Juniperus procera* forest (Fbj). We made this decision especially since most of the national maps only listed one of these two forests types, whereas our floristic and environmental analysis suggested that both these forests belonged to the same potential natural vegetation type.

Afromontane single-dominant *Juniperus procera* forest (Fbj) mostly occurs on the drier slopes of mountains between 1800 and 2900 m, although it sometimes descends to 1000 m. Annual rainfall is usually between 1000 and 1150 mm, but sometimes more than 1250 mm. *Juniperus procera* also occurs outside forests as in evergreen bushland (Be, see volume 5) where rainfall can be as low as 650 mm - this could be the original habitat of this species (for example, the species occurs in evergreen bushland [Be] at lower elevations on Mt. Kulal [Kenya] where it is 4 to 6 m tall [White 1983 p. 121]). *Juniperus procera* is a strong light-demander that does not regenerate in its own shade, so its presence as forest tree depends on fire. This species also seems to be intolerant of deep humus layers (White 1983 p. 165 - 166).

Besides the **potentially** dominant ***Juniperus procera***, regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Afromontane undifferentiated forest and no other Afromontane forest types) that were listed as characteristic species for one or several national maps include ***Halleria lucida***, ***Ilex mitis***, ***Kiggelaria africana*** (this species does not extend as far north as Ethiopia), ***Nuxia congesta***, ***Nuxia floribunda*** (this species does not extend as far north as Ethiopia), ***Ocotea kenyensis***, ***Podocarpus falcatus*** (synonym: ***Podocarpus gracilior***) and ***Rapanea melanophloeos***.

Figure 4.1 Afromontane undifferentiated forest with canopy of *Juniperus procera* and *Podocarpus falcatus* in Chilimo forest (Ethiopia). Altitude approximately 2550 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 20A. 2010.



Figure 4.2 Afromontane single-dominant *Juniperus procera* forest with a tree of *Hagenia abyssinica* in the foreground near the upper edge of Chilimo forest (Ethiopia). Altitude approximately 3000 m. Photograph by I. Friis and Sebsebe Demissew (September 2005). Reproduced from Biologiske Skrifter of the Royal Danish Academy of Sciences and letters, Vol. 58, Fig 21B. 2010.







Figure 4.3. Climax stand of *Juniperus procera* (30 - 37 m) in Afromontane single-dominant *Juniperus procera* forest. Photographed in 1960 by unknown photographer at unknown location (presumably in Kenya). Photograph given to F. Gachachi by C.G. Trapnell (before his decease).



Figure 4.4 Afromontane single-dominant *Juniperus procera* forest in Maralal District (Kenya, left image, photograph taken in 2009) and Mt. Kenya (right image, photograph taken in 2011). Photographs by F. Gachathi.





Figure 4.5 A glade in Afromontane undifferentiated forest (synonym: montane sclerophyll forest) with *Juniperus procera* on the right and an unidentified *Podocarpus* species on the left. Afromontane bamboo (*Sinarundinaria alpina*, synonym: *Arundinaria alpina*) is portrayed behind the unidentified *Podocarpus* species. Western slopes of Mt. Kenya along the Sirimon track. Shell guide to East African birds (reproduced with permission from URL <http://ufdc.ufl.edu/UF00077050>).

## 4.2. VECEA region

Within the VECEA region Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest occurs in all countries, except Rwanda (see Figure 4.6, see also volume 6). The extent of this forest type is very limited in Zambia.

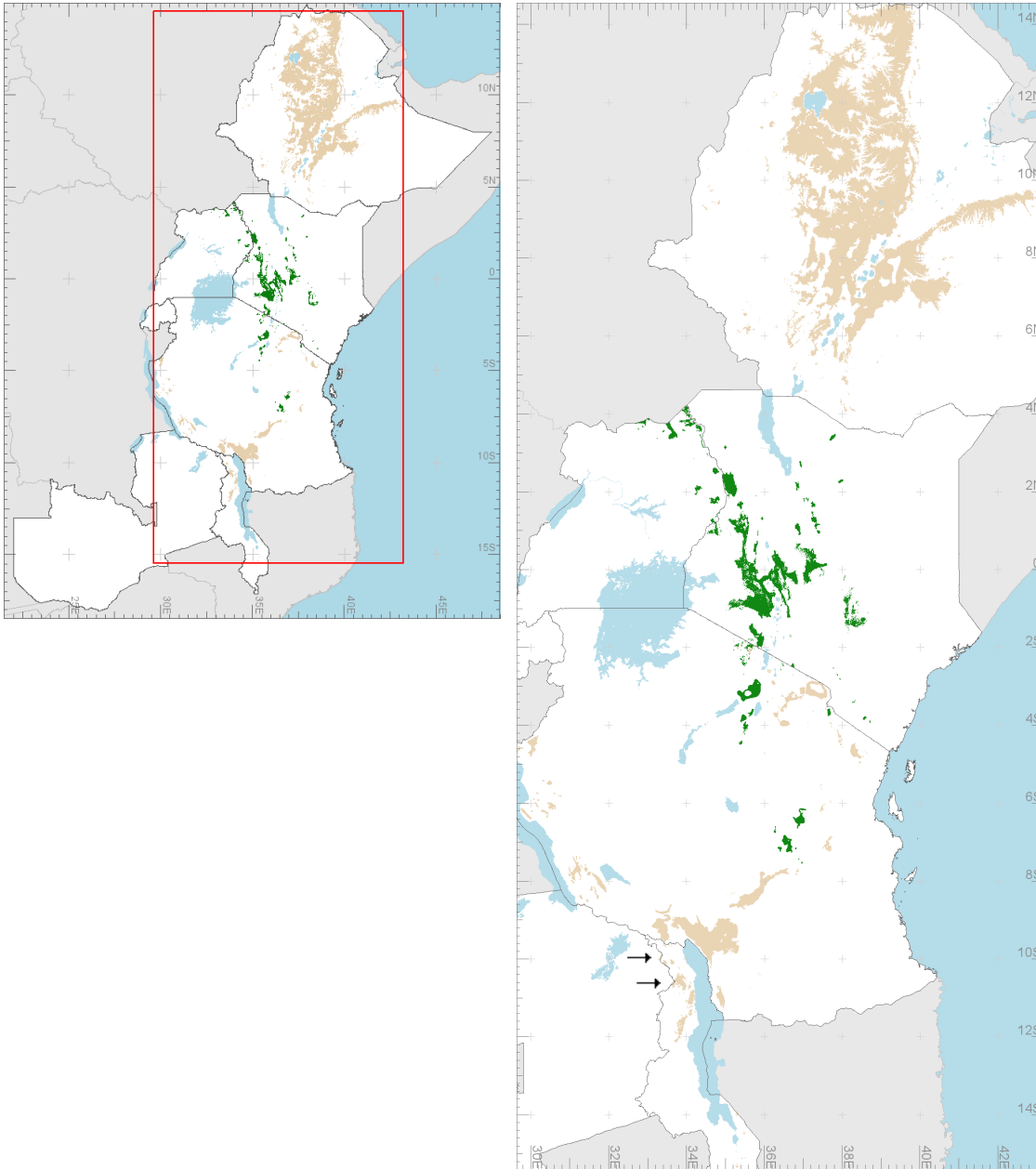


Figure 4.6. Mapped distribution of Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). Where this vegetation type does not occur in mosaic, it is depicted by green polygons. In Ethiopia, these forest types are mapped together with evergreen and semi-evergreen bushland and thicket (Be, see volume 3) and are depicted by polygons in a greyish-brown colour. In Malawi and Tanzania, this vegetation type is mainly mapped as part of different forest mosaics (greyish-brown). In Zambia, this vegetation type was originally mapped together with Afromontane rain forest (Fa) next to border with Malawi; since these vegetation mosaics (greyish-brown) are very small when depicted on small-scale distribution maps, we added arrows to indicate the position of these mosaics



In Ethiopia, Afromontane undifferentiated forest was originally described as undifferentiated dry evergreen afromontane forest (DAF-U). In the same country, Afromontane single-dominant *Juniperus procera* forest was originally described as dry single-dominant Afromontane forest (DAF-SD). These forest types were mapped together with Evergreen bushland (Be, see volume 4) within the “Dry evergreen Afromontane forest and grassland complex” (DAF). In Afromontane single-dominant *Juniperus procera* forest, *Podocarpus falcatus* is absent from the canopy. Single-dominant Afromontane forest (original coding DAF-SD) occurs at higher altitudes or under lower rainfall than Afromontane undifferentiated forest (original coding DAF-U).

The Ethiopian vegetation subtype of “Afromontane woodland, wooded grassland and grassland” (DAF-WG) is described as a mixture of primary, secondary or edaphic vegetation types; these were all mapped together in the original Ethiopian map (also with Afromontane undifferentiated forest [Fbu], Afromontane single-dominant *Juniperus procera* forest [Fbj] and Evergreen bushland [Be]). The edaphic subtype is a type of edaphic grassland [mapped elsewhere in the VECEA region as “g” (see volume 5)]. The primary woodlands consist of *Acacia abyssinica*, *Acacia labai* and five endemic *Acacia* species (Friis *et al.* 2010 p. 81). *Acacia abyssinica* and *Acacia labai* are invasive species in residual and secondary Afromontane undifferentiated forest (Trapnell 1997). Trapnell and Langdale-Brown (1972 p. 132) describe that there are a few *Acacia* vegetation types which qualify locally as woodland, the main example being montane *Acacia* vegetation of *Acacia abyssinica* and *Acacia labai* which is represented in the higher forests regions of Kenya, and which is probably secondary to forest. In an unfinished manuscript (available from F. Gachathi), Trapnell describes that *Acacia abyssinica* and *Acacia labai* are common in secondary vegetation within the Afromontane undifferentiated forest zone, but that they also form distinct belts within this zone on specific types of soils. He mentions that these belts seem to occur under areas with impeded drainage such as fringes to valley grasslands, on tuff soils with seepage tendencies, on shallow brownish black or chocolate clay soils or in areas on recent ash and pumice (such as the Menengai area of ash and pumice soils north and west of Nakuru). We suspect, therefore, that the *Acacia* woodlands described in Ethiopia (DAF-WG) also occur in other countries either as secondary vegetation types or under specific edaphic conditions.

3: other plant associations that Bussman (2002) differentiated were the *Hagenia abyssinica* - *Hypericium revoluti* evergreen subalpine Kosso forests (B1.I; Mt. Kenya, Gakoe Forest [Aberdares], Hareenna, Mt. Nyiro, Ndoto Mts.); the *Sinarundinarion alpinae* (C1.I; Mt. Kenya, Gakoe Forest [Aberdares], Ngaia Forest, Imenti Forest, Nyambeni Hills, Hareenna); the *Cyathion mannianae* (D1.I; Mt. Kenya, Gakoe Forest [Aberdares], Ngaia Forest, Imenti Forest, Nyambeni Hills); the *Zanthoxylum gilettii* (D1.II; Mt. Kenya, Gakoe Forest [Aberdares], Ngaia Forest, Imenti Forest, Nyambeni Hills) and the *Lovoion swynnertonii* (D1.III, Ngaia Forest, Imenti Forest, Nyambeni Hills).

In Kenya, Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest were originally described and mapped as montane sclerophyll forest. Bussman (2002 [Table 2]) lists forest types for “islands in the desert”. Based on a phytosociological survey based on 252 vegetation plots, most forests in northern Kenya were classified as the “Juniperetea” vegetation class, referring to *Juniperus procera* as the typical species. Bussman differentiated between four plant associations belonging to the “Juniperetea” class: (i) ‘*Juniperion procerae*’ evergreen xeromorphic montane forest (A1.I); (ii) ‘*Cassipourion malosanae*’ broadleaved montane forest (A1.II); (iii) ‘*Crotonion megalocarpi*’ deciduous broad-leaved montane forests (A1.III); and (iv) ‘*Brachylaenion huillensis*’ - deciduous broad-leaved submontane forests (A1.IV).<sup>(3)</sup> Forest (areas) with the ‘*Juniperion procerae*’ association included Imenti Forest, Mt. Kenya, Mt. Kulal, Loita Hills, Loroghi,

Mt. Marsabit, the Mathews Range, Mukogodo, Ndare Ngare, the Ndoto Mts., Ngaia Forest, Nguruman, Nyambeni Hills, Mt. Nyiro and Mt. Porrer. Forest (areas) with the '*Cassipourion malosanae*' association included Gakoe Forest (Aberdares), Harena, Mt. Kenya, Mt. Kulal, Loita Hills, Loroghi, Mt. Marsabit, Nguruman. The Mathews Range was the only area where the '*Crotonion megalocarp?*' association occurred. Nairobi was the only area where the '*Brachylaenion huillensis*' formation occurred. Based on this analysis (especially the occurrence of the 'Juniperetea' class), we classified most of the forests in northern Kenya as Afromontane undifferentiated forest but not differentiating between Afromontane undifferentiated forest (Fbu) or Afromontane single-dominant *Juniperus procera* forest (Fbj).

In Malawi, Afromontane single-dominant ***Juniperus procera*** forest was originally described as ***Juniperus procera*** forest. This forest type is too small to be mapped separately from Afromontane single-dominant ***Hagenia abyssinica*** forest [Fd]; C. Dudley, personal communication).

In Tanzania, Afromontane undifferentiated forest was originally described as "dry montane forest". One of the synonyms listed by Lovett (1993a) for dry montane forest is "drier types of Afromontane undifferentiated forest" (but see discussion for the Tanzanian manifestations of Afromontane rain forest). ***Juniperus procera*** rarely occurs as a single-dominant, but occurs in places where Afromontane undifferentiated forest regeneration appears to be associated with fire or in Evergreen bushland (Be, Lovett 1990 p. 291).

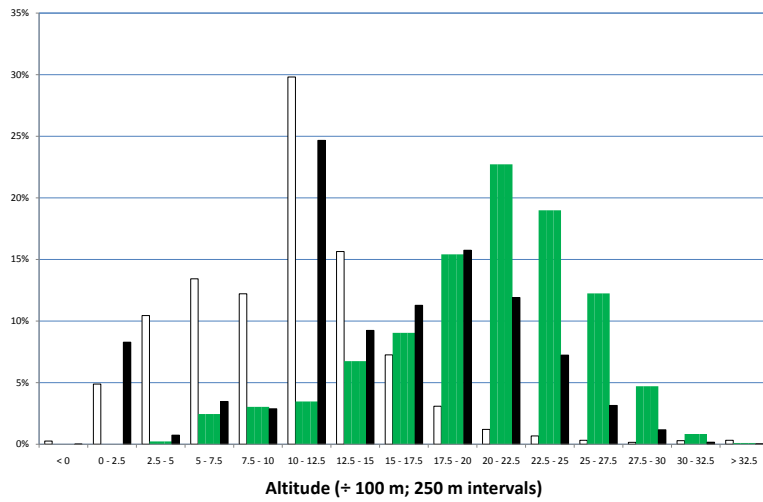
In Uganda, Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest were originally described and mapped as *Juniperus - Podocarpus* dry montane forest (original mapping unit B3).

In Zambia, Afromontane undifferentiated forest was originally described as dry montane forest. In this country, it was originally mapped together with Afromontane rain forest (see volume 6).

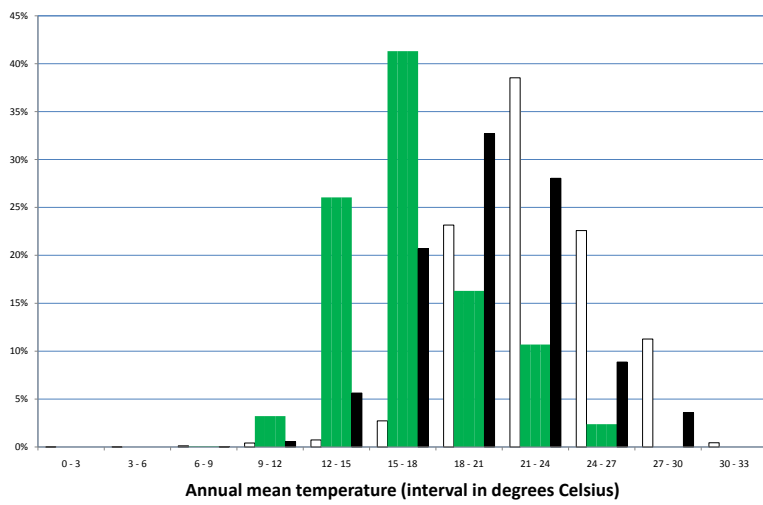
Investigation of environmental distribution of Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest in the VECEA region (Figure 4.6; limits are for areas of the VECEA map where these forests (Fa) are only mapped as mosaic of these two forest types) show a wider distribution in altitude for these forest types (with > 90% of the samples in an interval from 1000 – 3000 m) than for Afromontane rain forest, confirming the information given by White (1983; also see section 3.1). Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest are among the forest types that occur at the highest altitudes. The altitude interval of 2000 – 2250 m contains the highest number of samples (22.7%) for this forest type; only Afromontane single-dominant *Hagenia abyssinica* forest has most of its samples in a higher altitude class. Annual rainfall of Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest is mainly between 600 and 1400 mm (94.4% of samples). Afromontane undifferentiated forest and Afromontane single-dominant *Juniperus procera* forest are among the forest types that occur at locations with the lowest rainfall. The rainfall interval

of 800 – 1000 mm contains the highest number of samples (36.0%) for this forest type; only Zambebian dry deciduous forest and scrub forest (Fn) and Zanzibar-Inhambane scrub forest (Fq) have most of their samples in a smaller rainfall class.

(a)



(b)



(c)

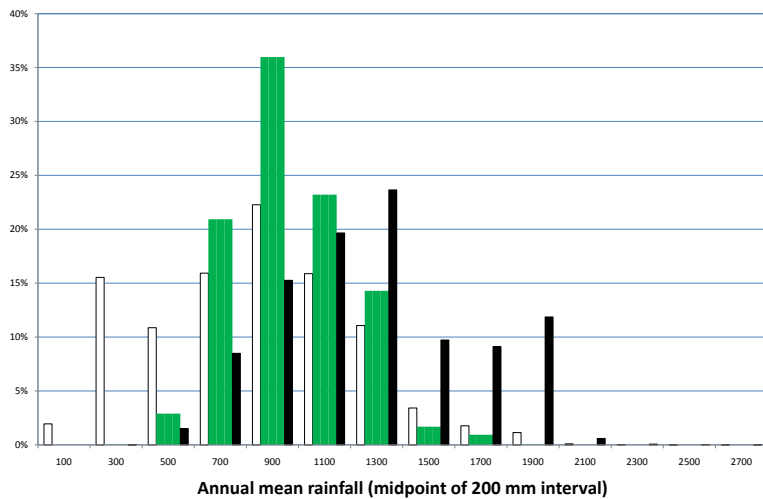


Figure 4.7. Histograms of the distribution of altitude (a), mean annual temperature (b) and mean annual rainfall (c). Bars at the centre of each interval show the percentage of samples ( $n = 8,572$ ) within Afromontane undifferentiated forests (Fbu) or Afromontane single-dominant *Juniperus procera* forest (Fb). Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,013$ ).

### 4.3. Species composition

Species composition was obtained from the following references:

- Ethiopia: Friis *et al.* 2010. Species mentioned in Appendix 3 for “Undifferentiated Dry evergreen afromontane forest” [DAF-U] were coded “x” (unless they were characteristic species) in column FbuE.. Species mentioned in Appendix 3 for “Dry single-dominant Afro-montane forest of the Ethiopian highlands” [DAF-SD] were coded “x” (unless they were characteristic species) in column FbjE. Species that were mentioned in Appendix 3 for “Edges of moist evergreen Afro-montane forest, bushland, woodland and wooded grassland” [DAF-WG] and within one of the species assemblages for any country were coded “w”.
- Kenya: Trapnell (1997). Species listed in Annex 1 for “montane sclerophyll forest”, “montane sclerophyll and/or moist montane forest” and “of more general distribution” were coded “C”. Suffix “a” indicates that the species was also listed for Afro-montane rain forest (Fa; synonym: moist montane forest). Suffix “b” indicates that species was listed to only occur marginally in the forest or in montane bamboo. Suffix “g” indicates species of more general distribution. Suffix “i” indicates invasive species. Suffix “s” indicates secondary species. Suffix “r” indicates residual species after selective felling. Numbers show the maximum height of the species provided in the Annex (Trapnell 1997). Species that were expected to occur in the forest type based on information from Beentje (1994), the Flora of Tropical East Africa and field experience from our Kenyan co-author (F. Gachathi) were coded “x”.
- Malawi: Dowsett-Lemaire (1985), Palgrave (2002) and White *et al.* (2001). Species were included in species assemblages partially based on the interpretation of our Malawian co-author (C. Dudley) since species were not consistently allocated to forest types in White *et al.* (2001). These species were coded “x” (unless they were characteristic species).
- Tanzania: Species that were mentioned for “dry montane forest” in Lovett (1993a; altitude > 1500 m; rainfall 1000 - 1200 mm) were coded “C” (since these were assumed to be characteristic species). Species that were only listed as “trees in lower altitude dry montane forest” were excluded. Species that were only mentioned for “dry montane forest” in Lovett (1993b; altitude 1250 - 2900 m; annual rainfall 900 - 1500 mm) were coded “x”.
- Uganda: Langdale-Brown *et al.* (1964) and Howard & Davenport (1996). All species that were listed to occur in “*Juniperus-Podocarpus* dry montane forest” (original mapping unit B3) in the Appendix were coded “x” (unless they were characteristic species). Species listed to occur in Moroto or Napak forests (forests indicated on page 107 to only contain the primary forest type “B3”) in the Uganda Foret Department Biodiversity Database (Howard & Davenport [1996]) were coded “xb”. Species listed in the Appendix for forest - wooded grassland mosaics of high altitudes<sup>(4)</sup> occurring on drier sites were coded “s1”, whereas no new species were committed to the species assemblage.

4: Langdale-Brown *et al.* (1964 p. 51) mention that forest remnants that occur especially in valleys within the forest - wooded grassland mosaics of high altitudes (F1) are mainly Afro-montane undifferentiated forest (original mapping unit B3) although there may also be some Afro-montane single-dominant *Hagenia abyssinica* forest (original mapping unit B2) or some Ericaceous belt vegetation (original mapping unit A2).

- Zambia: Fanshawe (1971 pp. 28 - 31). Species that were listed to occur in the species composition table for “montane forest” were coded “fx” (Fanshawe did not distinguish between Afromontane rain forest and Afromontane undifferentiated forest in the species composition table for montane forest) in case that a species was also listed within the species assemblage of another country. Characteristic species were coded “C”.

Characteristic species were determined as:

- Ethiopia: species mentioned in the main description of the vegetation type were coded “C”, unless they were described as being dominant (coded “D”).
- Kenya: Species that were listed by Trapnell (1997) were assumed to be characteristic species (these were coded “C”).
- Malawi: Species identified to be present as emergent trees (30 - 45 m) or large trees (20 - 30 m, including stranglers) were coded as “C”, unless they were dominant species (coded “D”) or co-dominant species (coded “Cd”).
- Tanzania: Species listed in Lovett (1993a) were coded “C”.
- Uganda: Species characterized as large trees in the appendix or that were mentioned in the main text where the forest type was described were coded “C”.
- Zambia: Species for which the genera were mentioned for dry types of montane forest that occur on upper slopes and in watersheds were coded “C”.

Within the information on assemblages, coding “f ” indicates that there is information that the species potentially occurs in the vegetation type since it occurs in the focal country and in the same forest type in other countries (see section 2.3).

Table 4. Species composition of Afromontane undifferentiated forest (Fbu) and Afromontane single-dominant *Juniperus procera* forest (Fbj)

Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Juniperus procera</i>	dominant in single-dominant <i>Juniperus procera</i> forest	C	D	C37	D	C	C	
<i>Acacia abyssinica</i>	(invasive)	w	w	Ci	f	f	x	
<i>Acacia drepanolobium</i>		f	f	x		f	f	
<i>Acacia gerrardii</i>		f	f	x	f	f	f	f
<i>Acacia lahai</i>	(invasive)	w	w	Ci		f	f	
<i>Acacia seyal</i>		w	w	x	f	f	f	f
<i>Acokanthera schimperi</i>		w	Cw	fh		f	f	
<i>Agauria salicifolia</i>		xw	w	x	x	C	f	fx
<i>Albizia glaberrima</i>		f	f	f	f	f	xb	f
<i>Albizia grandibracteata</i>		xw	w	Cg30	f	C	xb	fx
<i>Albizia gummifera</i>	not characteristic (indicator for Afromontane dry transitional forest)							
<i>Albizia schimperiana</i>		xw	w	f	f	f	f	f
<i>Allophylus abyssinicus</i>		C	f	x	f	f	xb	f
<i>Allophylus rubifolius</i>		w	w	x	f	f	f	f
<i>Anthocleista grandiflora</i>		f	f	f	f	f	f	f
<i>Antiaris toxicaria</i>		f	f	f	f	f	f	fx
<i>Apodytes dimidiata</i>	characteristic	Cw	w	Ca24	x	C	f	fx
<i>Berberis holstii</i>		f	f	x	x	f	C	
<i>Bersama abyssinica</i>		Cw	xw	Cg15	x	C	xb	fx
<i>Blighia unijugata</i>		f	f	x	f	f	xb	fx
<i>Brachylaena huillensis</i>		f	f	f	f	x	f	f
<i>Bridelia micrantha</i>		w	Cw	x		f	f	
<i>Buddleja polystachya</i>								
<i>Caesalpinia decapetala</i>				x	f	f	f	f
<i>Caesalpinia volkensii</i>				x		f	f	f
<i>Carissa spinarum</i>		xw	Cw	f	f	f	f	f
<i>Casearia battiscombei</i>				f	f	f	f	
<i>Cassipourea malosana</i>	not characteristic (indicator for Afromontane dry transitional forest)	C	f	Cgr24	C	C	x	f
<i>Catha edulis</i>		f	f	f	f	C	C	f

Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Celtis africana</i>		C	f	Ca27	x	f	x	f
<i>Celtis gompophylla</i>		f	f	f	f	f	f	fx
<i>Clausena anisata</i>		xw	Cw	x	x	f	x	fx
<i>Clerodendrum myricoides</i>		xw	Cw	f	f	f	f	fx
<i>Cordia africana</i>		x	f	f	f	f	xb	fx
<i>Cordia monoica</i>		w	w	f	f	f	xb	
<i>Cornus volkensii</i>				Cab24	f	f	f	
<i>Craibia brownii</i>				f	f	f	xb	
<i>Crotalaria agatiflora</i>		w	w	x	f	f	f	
<i>Crotalaria grandibracteata</i>						f		
<i>Croton macrostachyus</i>		Cw	w	Cgs24	f	C	xb	f
<i>Croton megalocarpus</i>	not characteristic (indicator for Afromontane dry transitional forest)			f	f	x	xb	f
<i>Croton sylvaticus</i>		f	f	f	f	x	f	f
<i>Cussonia holstii</i>		xw	w	C15		x	xb	
<i>Cussonia spicata</i>				C12	C	C	xb	fx
<i>Diospyros abyssinica</i>	not characteristic (characteristic for Afromontane rain forest and Afromontane Afromontane dry transitional forest)	x	f	Cgr27	f	x	x	fx
<i>Discopodium pennin- erivium</i>		xw	Cw	f	f	f	xb	
<i>Dodonaea viscosa</i>		xw	Cw	Cs	f	f	xb	f
<i>Dombeya torrida</i>		xw	w	Cas24	x	x	x	
<i>Doyalis abyssinica</i>		C	x	C9	f	f	xb	fx
<i>Doyalis macrocalyx</i>				x	x	f	xb	fx
<i>Dracaena steudneri</i>		Cw	w	Cg12	f	f	xb	f
<i>Ehretia cymosa</i>		xw	Cw	Cg9	f		f	
<i>Ekebergia capensis</i>		C	x	Cg24	x	C	C	fx
<i>Elaeodendron buchananii</i>		f	f	f	f	f	xb	f
<i>Embelia schimperi</i>		x	f	f	f	f	f	fx
<i>Ensete ventricosum</i>		xw	w	f	f	f	f	f
<i>Erica arborea</i>		x	C	f	f	f	s1	
<i>Erythrina abyssinica</i>		f	f	f	f	C	xb	f



Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Erythrina brucei</i>		C	f					
<i>Euclea divinorum</i>	not characteristic (indicator for Afromontane dry transitional forest)	xw	xw	Cs9	x	C	C	f
<i>Euclea racemosa</i>		w	Cw	f	f	f	x	fx
<i>Eugenia capensis</i>		f	f	f	x	f	f	f
<i>Euphorbia abyssinica</i>		w	Cw	Ca30	f	f	f	fx
<i>Euphorbia tirucalli</i>		f	C	f	f	f	f	f
<i>Fagaropsis angolensis</i>	not characteristic (indicator for Afromontane dry transitional forest)	x	f	f	f	x	xb	f
<i>Faurea saligna</i>				C24	f	x	xb s1	fx
<i>Ficus mucoso</i>		f	f	f		f	xb	
<i>Ficus natalensis</i>				f	f	f	xb	fx
<i>Ficus ovata</i>		Cw	w	f	f	f	f	f
<i>Ficus sur</i>		C	f	Cg24	f	f	xb	f
<i>Ficus sycomorus</i>		w	w	f	f	f	xb	f
<i>Ficus thonningii</i>		C	f	Cg21	x	f	xb	fx
<i>Flacourtia indica</i>		xw	w	f	f	f	f	f
<i>Flueggea virosa</i>		f	f	f	f	f	xb	f
<i>Galiniera saxifraga</i>		xw	Cw	Ca10	f	f	f	f
<i>Garcinia buchananii</i>		f	f	f	f	f	xb	f
<i>Grewia ferruginea</i>		xw	Cw					
<i>Hagenia abyssinica</i>		xw	xw	Cab15	x	C	f	fx
<i>Halleria lucida</i>	indicator	x	x	x	x	C	f	fx
<i>Harrisonia abyssinica</i>		f	f	f	f	f	xb	f
<i>Hypericum quartianum</i>		xw	w	f	f	f	f	f
<i>Hypericum revolutum</i>		x	f	Cb12	f	f	xb	f
<i>Hypericum roesperanum</i>		x	x	f	f	f	x s1	f
<i>Ilex mitis</i>	indicator	x	f	C24	C	x	C	fx
<i>Kigelia africana</i>		f	f	f	f	f	xb	f
<i>Kiggelaria africana</i>	indicator (species does not extend as far north as Ethiopia)				x	f		
<i>Lansea barberi</i>		f	f				xb	
<i>Lansea fulva</i>				f		f	xb	
<i>Lansea schweinfurthii</i>		f	f	f	f	f	xb	f

Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Lepidotrichilia volkensii</i>		C	f	Ca10	x	f	f	fx
<i>Maesa lanceolata</i>		xw	Cw	f	x	x	xb	fx
<i>Margaritaria discoidea</i>		xw	w	f	f	C	xb	f
<i>Maytenus acuminata</i>				f	x	x	f	fx
<i>Maytenus arbutifolia</i>		xw	w	f		f	f	
<i>Maytenus undata</i>		C	x	C12	f	f	C	f
<i>Mimusops kummel</i>		x	f	f	f	f	xb	
<i>Morella salicifolia</i>		xw	w					
<i>Myrsine africana</i>		x	f	x	x	f	x	fx
<i>Nuxia congesta</i>	indicator	xw	Cw	Cg21	C	C	x s1	C
<i>Nuxia floribunda</i>	indicator (species does not extend as far north as Ethiopia)			f	x	x	x	C
<i>Ocotea kenyensis</i>	indicator	f	f	f	f	f	f	
<i>Olea capensis</i>	not characteristic (indicator for Afromontane rain forest)	x	f	C24	Cd	C	x	fx
<i>Olea europaea</i>	not characteristic (indicator for Afromontane dry transitional forest)( <i>Olea europaea</i> ssp. <i>cuspidata</i> , synonym: <i>Olea africana</i> )	Cw	Cw	Cs24	x	f	C	fx
<i>Olinia rochetiana</i>		C	f	C12	C	C	C	C
<i>Oncoba spinosa</i>		w	w	f	f	f	xb	f
<i>Osyris lanceolata</i>		xw	w	f		f	xb s1	
<i>Ozoroa insignis</i>		w	w	f	f	f	xb	f
<i>Parinari excelsa</i>	not characteristic (indicator for Afromontane rain forest)				f	C	f	fx
<i>Pavetta crassipes</i>		f	f	f		f	xb	
<i>Pavetta oliveriana</i>		w	w	f		f	xb	
<i>Phoenix reclinata</i> (palm species)		w	w	x	f	x	f	f
<i>Phytolacca dodecandra</i>		xw	w	x	f	f	xb	f
<i>Pistacia aethiopica</i>		f	f	x		f	f	
<i>Pittosporum viridiflorum</i>		x	f	C15	C	x	xb	f
<i>Podocarpus falcatus</i>	indicator (conifer species that is absent from Guin- eo-Congolian rain forest and less characteristic of Afromontane rain forest)	C	f	C30	f	f	C	

Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Podocarpus latifolius</i>	characteristic (conifer species that is absent from Guineo-Congolian rain forest and less characteristic of Afromontane rain forest; species does not extend as far north as Ethiopia)			Ca24	C	f	xb	fx
<i>Polyscias fulva</i>		f	f	f	x	f	f	f
<i>Pouteria adolfi-friedericii</i>	not characteristic (indicator for Afromontane rain forest)	f	f	f	f	f	xb	fx
<i>Prunus africana</i>	characteristic	C	f	Ca37	C	C	xb	fx
<i>Psychotria mahonii</i>				f	f	x	f	f
<i>Psychrax parviflora</i>		f	f	f	f	f	xb	f
<i>Psychrax schimperiana</i>		w	w	x	f	f	xb	fx
<i>Pterolobium stellatum</i>		w	Cw	x	f	f	f	fx
<i>Rapanea melanophloeos</i>	indicator	x	C	C15	C	C	x	C
<i>Rhamnus prinoides</i>		xw	Cw	x	x	f	xb	fx
<i>Rhamnus staddo</i>		w	w	x		f	f	
<i>Rhoicissus revouillii</i>		f	f	x	f	f	f	f
<i>Rhoicissus tridentata</i>		w	Cw	f	x	f	f	f
<i>Rhus longipes</i>		f	f	f	x	f	xb	fx
<i>Rhus natalensis</i>		w	Cw	x	f	f	xb	f
<i>Rhus vulgaris</i>		w	w	x	f	f	xb	f
<i>Ritchiea albersii</i>		x	f	C9		x	xb	f
<i>Rosa abyssinica</i>		xw	Cw					
<i>Rothmannia urcelliformis</i>		x	f	f	f	f	xb	f
<i>Rubus apetalus</i>		xw	w	x	f	f	xb	f
<i>Rubus volkensii</i>		xw	w	x		f	f	
<i>Schefflera abyssinica</i>		x	f	f	x	f	x	f
<i>Schefflera volkensii</i>		x	f	Ca24		f	x	
<i>Schrebera alata</i>	not characteristic (indicator for Afromontane dry transitional forest)	xw	Cw	x	f	C	xb	fx
<i>Scutia myrtina</i>		xw	w	x	f	f	f	fx
<i>Senecio hadiensis</i>		w	w	x		f	f	
<i>Senna didymobotrya</i>		f	C	x	f	f	f	f
<i>Senna septemtrionalis</i>				x	f	f	f	f

Species	Regional status (see section 2.3)	FbuE (Ethiopia subtype)	FbjE (Ethiopia subtype)	(Kenya)	(Malawi)	(Tanzania)	(Uganda)	(Zambia)
<i>Shirakiopsis elliptica</i>		f	f	x	f	x	f	f
<i>Sinarundinaria alpina</i>	(Afromontane bamboo)	x	C	f	x	f	f	
<i>Solanecio mannii</i>		w	w	x	f	f	xb	f
<i>Solanum aculeastrum</i>				x	f	f	f	
<i>Strychnos hemingsii</i>		f	f	f	f	f	x	f
<i>Strychnos mitis</i>		f	f	f	f	f	xb	
<i>Syzygium cordatum</i>				f	x	x	f	fx
<i>Syzygium guineense</i>	not characteristic (indicator for Afromontane rain forest [ <i>Syzygium guineense</i> ssp. <i>afromontanum</i> ])	xw	w	Cair30	x	x	xb	fx
<i>Trema orientalis</i>		xw	w	x	f	f	xb	f
<i>Trichilia dregeana</i>		f	f	f	f	f	xb	fx
<i>Vangueria apiculata</i>		xw	w	f	f	f	xb	f
<i>Vangueria madagascariensis</i>		f	C	f	f	f	xb	
<i>Vepris dainellii</i>		C	f					
<i>Vepris nobilis</i>		C	C	Cgr12	x	f	C	fx
<i>Vernonia amygdalina</i>		xw	Cw	f	f	f	xb	f
<i>Vernonia myriantha</i>		w	w	f	x	f	x	f
<i>Warburgia ugandensis</i>	not characteristic (indicator for Afromontane dry transitional forest)	f	f	f	f	f	xb	
<i>Xymalos monospora</i>	characteristic (species does not extend as far north as Ethiopia)			x	C	f	f	fx
<i>Zanha golungensis</i>		f	f	f	f	f	xb	f
<i>Zanthoxylum chalybeum</i>		f	f	x	f	f	f	f
<i>Zanthoxylum usambarense</i>		w	Cw	C15		x		

## 5. Afromontane single-dominant *Widdringtonia whytei* forest (Fc)

### 5.1. Description

The only location where ***Widdringtonia whytei*** (synonym *Widdringtonia nodiflora* subsp. *whytei*) naturally occurs is on Mt. Mulanje (Malawi; 15° 55' S, 35° 37' E) . *Widdringtonia whytei* has a similar relationship to fire as *Juniperus procera* (a species that forms Afromontane single-dominant forests that replace Afromontane undifferentiated forest [Fbu] after fire and that requires fire for regeneration; White 1983 p. 166).

Afromontane single-dominant ***Widdringtonia whytei*** forest occurs between 1525 and 2135 m (White 1983 p. 166).



Figure 5.2 *Widdringtonia whytei* forest on Mt. Mulanje (Malawi). Photograph obtained from the archive of the Mulanje Mountain Conservation Trust by C. Dudley.



Figure 5.1 *Widdringtonia whytei* forest on Mt. Mulanje (Malawi). Photograph obtained from the archive of the Mulanje Mountain Conservation Trust by C. Dudley.

## 5.2. VECEA region

Within the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia), Afromontane single-dominant *Widdringtonia whytei* forest only occurs in Malawi.

In Malawi, Afromontane single-dominant *Widdringtonia whytei* forest was mapped together with the montane Ericaceous belt (E, see volume 6) and figure 5.3.

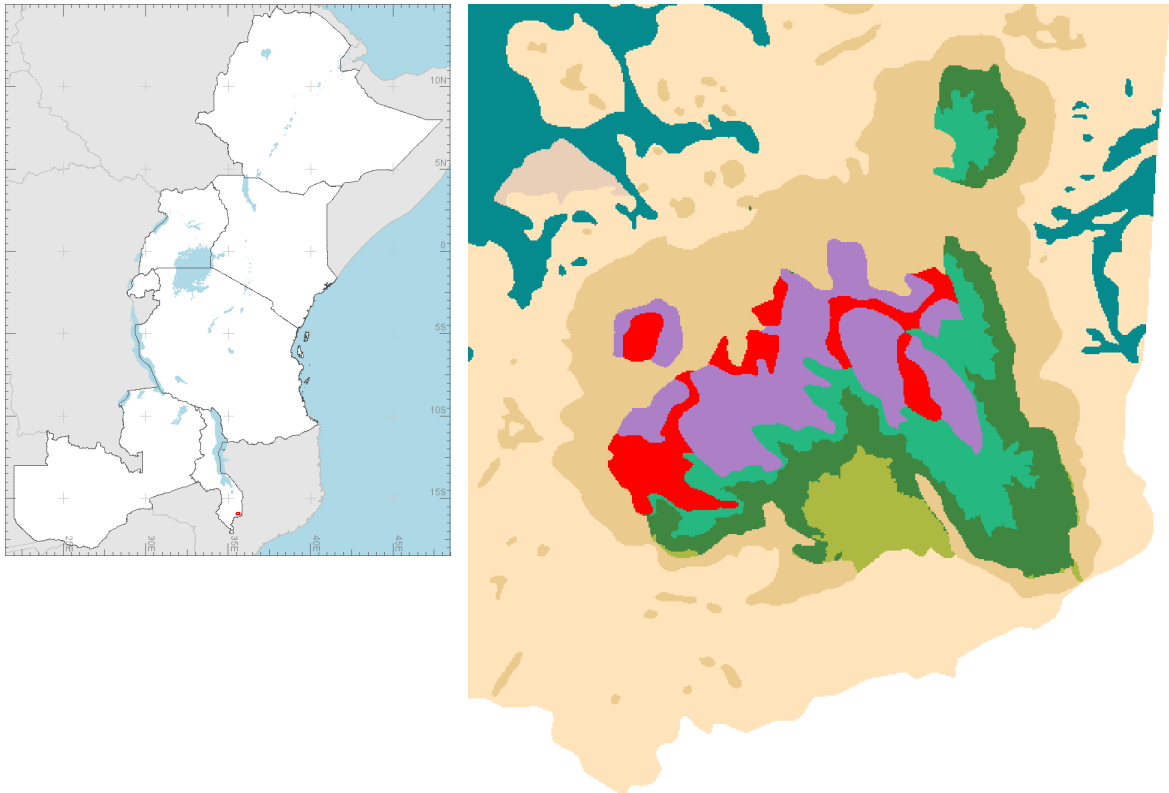


Figure 5.3. Mapped distribution of Afromontane single-dominant *Widdringtonia whytei* forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). This forest type only occurs on Mt. Mulanje, in the south of Malawi. It was mapped in mosaic with the Montane Ericaceous belt (E, see Volume 4). These vegetation mosaics are depicted in red (see also Figure 4.4 of Volume 6). Purple areas correspond to the montane Ericaceous belt (E), light-green areas to Afromontane rain forest (Fa), dark-green areas to dark green to Zanzibar-Inhambane transitional rain forest (Fg) and brownish areas to Miombo woodland on hills and rocky outcrops (Wmr; including patches of Zanzibar-Inhambane transitional rain forest [Fg] or Zanzibar-Inhambane lowland rain forest [Fo]).

### 5.3. Species composition

Species composition was obtained from the following references:

- Malawi: Chapman and White (1970), Dowset-Lemaire (1988) and White *et al.* (2001). Species were included in species assemblages partially based on the interpretation of our Malawian co-author (C. Dudley) since species were not consistently allocated to forest types in Dowsett-Lemaire (1988) and White *et al.* (2001). These species were coded “x” (unless they were characteristic species).

Characteristic species were determined as:

- Malawi: Species identified to be large trees (20 - 30 m) were coded as “C”. Dominant species were coded “D”. Species of marginal occurrence were not listed as characteristic species.

Table 5. Afromontane single-dominant *Widdringtonia whytei* forest (Fc)

Species	Regional status (see section 2.3)	(Malawi)
<i>Widdringtonia whytei</i>	dominant (species that extends from Table Mountain in the south to Mt. Mulanje in the north)	D
<i>Agauria salicifolia</i>		x
<i>Bersama abyssinica</i>		x
<i>Cassipourea malosana</i>	not characteristic (indicator for Afromontane dry transitional forest)	C
<i>Clausena anisata</i>		x
<i>Cornus volkensii</i>		x
<i>Cussonia spicata</i>		C
<i>Ekebergia capensis</i>		x
<i>Hypericum revolutum</i>		x
<i>Ilex mitis</i>	indicator (for Afromontane undifferentiated forest)	C
<i>Kiggelaria africana</i>	indicator (for Afromontane undifferentiated forest)	x
<i>Maesa lanceolata</i>		x
<i>Maytenus acuminata</i>		x
<i>Nuxia congesta</i>	indicator (for Afromontane undifferentiated forest)	x
<i>Nuxia floribunda</i>	indicator (for Afromontane undifferentiated forest)	x
<i>Olea capensis</i>	not characteristic (indicator for Afromontane rain forest)	C
<i>Olinia rochetiana</i>		C
<i>Pittosporum viridiflorum</i>		C
<i>Podocarpus latifolius</i>	characteristic (for Afromontane undifferentiated forest)	C
<i>Polyscias fulva</i>		x
<i>Prunus africana</i>	characteristic (for Afromontane undifferentiated forest)	C
<i>Rapanea melanophloeos</i>	indicator (for Afromontane undifferentiated forest)	C
<i>Rhamnus prinoides</i>		x
<i>Sinarundinaria alpina</i>	(Afromontane bamboo)	x
<i>Xymalos monospora</i>	characteristic (for Afromontane undifferentiated forest)	x



## 6. Afromontane single-dominant *Hagenia abyssinica* forest (Fd)

### 6.1. Description

*Hagenia abyssinica* is found on most of the higher mountains between Ethiopia and northern Malawi, including Mt. Kenya, Mt. Meru (Tanzania), the Nyika Plateau (Malawi) and the Virunga mountains (Rwanda). Characteristically, *Hagenia abyssinica* forms almost pure stands of 9 to 15 m tall in a narrow and often interrupted zone between the montane Ericaceous belt (E) and taller types of Afromontane rain forest (Fa) or Afromontane undifferentiated forest (Fbu). The best-developed stands are clearly forest, but other stands have a structure that is better described as woodland or scrub forest (White 1983 p. 166).

Some authors have suggested that Afromontane single-dominant *Hagenia abyssinica* forest is a climax vegetation type where low night temperatures exclude other trees. However, even at high altitudes the dominance of *Hagenia abyssinica* is probably still the result from disturbance. The altitudinal range of this species is between 1800 and 3400 m. The abundance of this species does not seem to be related to moisture conditions, although the species is usually absent from Afromontane rain forest (Fa) and taller types of Afromontane undifferentiated forest (White 1983 p. 166).



Figure 6.1 Afromontane single-dominant *Hagenia abyssinica* forest between the Gisoke and Sabyinoyo volcanoes in the Volcanoes National Park (Rwanda). Photograph by V. Minani (July 2008)



Figure 6.2 Flowering *Hagenia abyssinica* tree against a background of Afromontane bamboo (*Sinarundinaria alpina*, synonym: *Arundinaria alpina*) in Volcanoes National Park (Rwanda). *Hagenia abyssinica* is also present in other types of Afromontane forest such as Afromontane single-dominant *Juniperus procera* forest (Fbj). Photograph by V. Minani (July 2008).

## 6.2. VECEA region

Within the VECEA region, Afromontane single-dominant *Hagenia abyssinica* forest occurs in all countries except Zambia (see Figure 6.3 and volume 6).

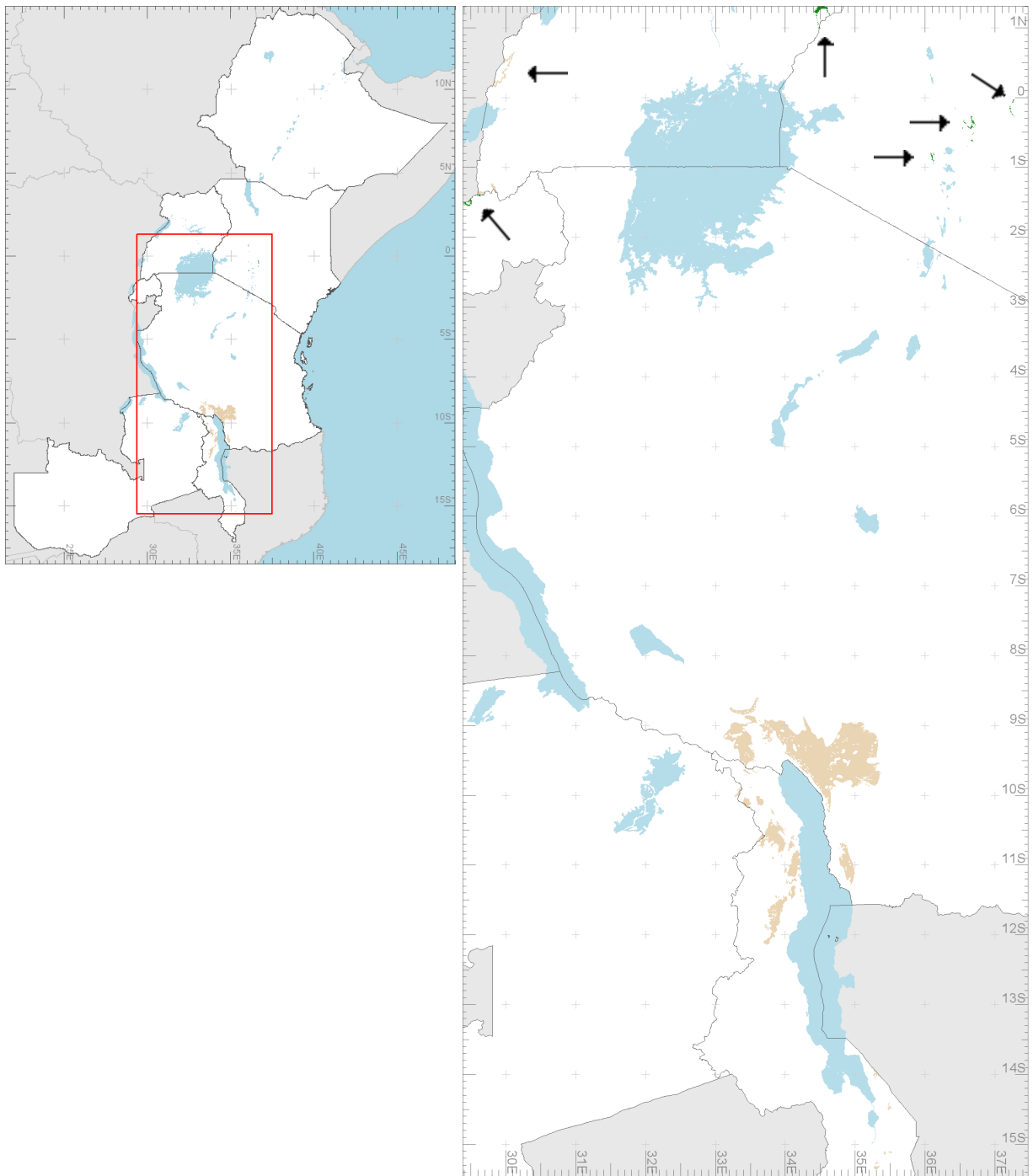


Figure 6.3. Mapped distribution of Afromontane single-dominant *Hagenia abyssinica* forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). This forest type occurs in all VECEA countries except Zambia. However, it could not be mapped everywhere as in Ethiopia. Where this vegetation type does not occur in mosaic, it is depicted by green polygons. Where this vegetation type occurs in vegetation mosaics, it is depicted by greyish-brown polygons. In some of the areas that are mapped as mosaics (like the high plateaus in southern Tanzania and northern Malawi), this forest type does occur albeit in small and widely scattered patches only. Arrows show some places in the map where small polygons occur (as in Rwanda).

The atlas of the potential vegetation of Ethiopia did not classify Afromontane single-dominant *Hagenia abyssinica* forest as a separate forest type, but mentioned that “the mixture between *Juniperus-Podocarpus* dominated forest and *Hagenia abyssinica* - *Hypericum revolutum* woodland or scrub near the upper limit of Afromontane undifferentiated woodland seems to be characteristic of the Ethiopian mountains” (Friis *et al.* 2010 p. 77).

Maps for the highlands of Kenya (Trapnell *et al.* [1966, 1969, 1976, 1986]) listed *Hagenia* - *Hypericum* woodland and scrub (mapping unit 48a).

In Malawi, Afromontane single-dominant *Hagenia abyssinica* forest is distinguishable in the field, but patches are too small to be mapped separately (C. Dudley, personal observations). This forest type was therefore mapped together with Afromontane single-dominant *Juniperus procera* forest (Fbj), where the forest type occurs in widely scattered patches. Afromontane single-dominant *Hagenia abyssinica* forest also occurs as a narrow fringe above Afromontane rain forest (Fa; C. Dudley, personal observations).

In Rwanda, Afromontane single-dominant *Hagenia abyssinica* forest was described in the national classification system as “forêt-parcs à *Hagenia*”.

Lovett (1990 p. 291) writes that *Hagenia abyssinica* occurs as a single-dominant in Tanzania on Luhombero. However, White (1983) listed *Hagenia abyssinica* to occur on Mt. Meru.

In Uganda, Afromontane single-dominant *Hagenia abyssinica* forest was described in the national classification system as *Hagenia-Rapanea* moist montane forest. Langdale-Brown (1964 p. 43) mention that *Hagenia abyssinica* is a large tree that is only locally dominant in Uganda, typically in colonizing forest. *Rapanea melanophloeos* (a “indicator” of Afromontane undifferentiated forest) is a species that is more abundant and is more frequently dominant in these forests. The main reason that they retained a reference to *Hagenia abyssinica* in the name of this vegetation type was to provide uniformity with the work from other authors.

Fanshawe (1971 p. 29) mentions that *Hagenia abyssinica* is one of the species of secondary montane forest, but does not list it in the species composition table for Montane forest (Table 8 in Fanshawe 1971). Based on altitude limits (see below), we assume that typical Afromontane single-dominant *Hagenia abyssinica* forest does not occur in Zambia. However, probably *Hagenia abyssinica* has a similar patchy distribution as described above for Malawi.

Investigation of environmental distribution of Afromontane single-dominant *Hagenia abyssinica* forest in the VECEA region (Figure 6.4; limits are for areas of the VECEA map where this forest is not mapped as mosaic) shows that this forest type occurs at the highest altitudes of all forest types (94.6% of samples occur > 2750 m). However, there were only a small number of samples where this forest type did not occur as a mosaic. Annual rainfall of Afromontane single-dominant *Hagenia abyssinica* forest is mainly between 800 and 2000 mm (96.4% of samples), which is a similar range as for Afromontane rain forest (Fa).

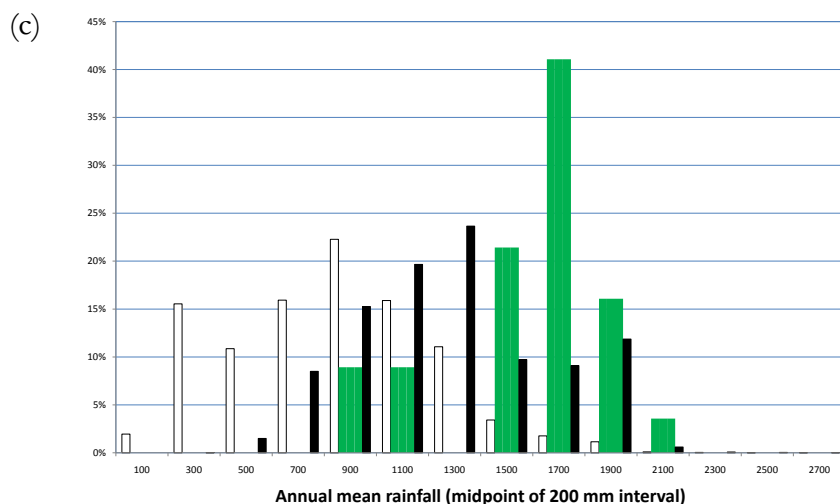
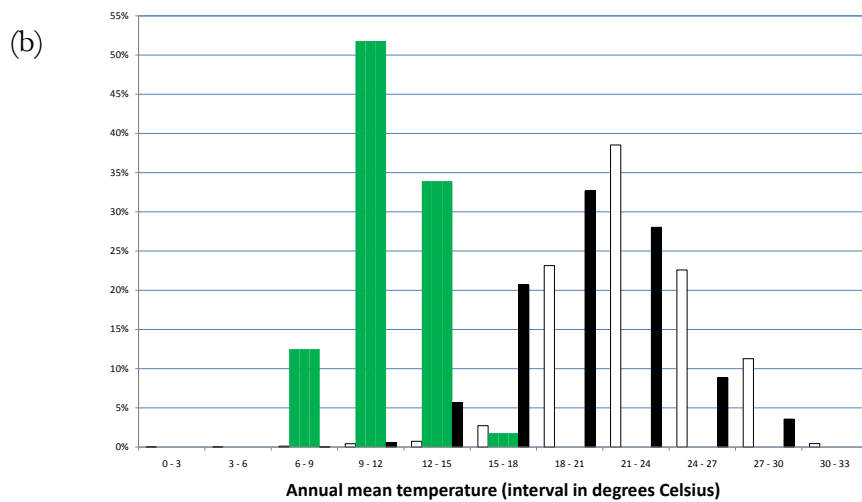
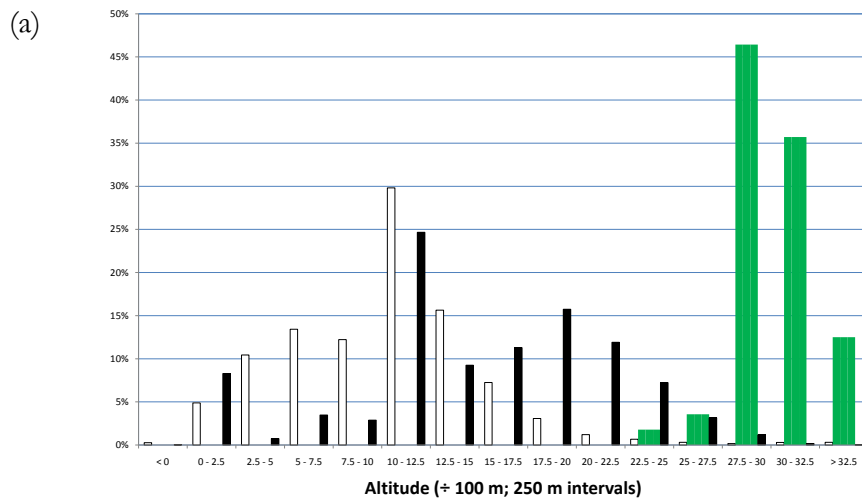


Figure 6.4 Histograms of the distribution of altitude (a), mean annual temperature (b) and mean annual rainfall (c). Bars at the centre of each interval show the percentage of samples within Afromontane single-dominant *Hagenia abyssinica* forest (Fd,  $n = 56$ ). Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,013$ ).



### 6.3. Species composition

Species composition was obtained from the following references:

- Kenya: Trapnell (1997). Species listed in Annex 1 to only occur marginally in the forest or in montane bamboo at high altitudes for “montane sclerophyll forest” or “montane sclerophyll and/or moist montane forest” were coded “C”. Numbers show the maximum height of the species provided in the Annex (Trapnell 1997).
- Malawi: Dowset-Lemaire (1985) and White *et al.* (2001). Species were included in species assemblages partially based on the interpretation of our Malawian co-author (C. Dudley) since species were not consistently allocated to forest types in the references. These species were coded “x” (unless they were characteristic species).
- Rwanda: Bloesch *et al.* (2009). All species that were mentioned to occur in floristic region 4 (volcano zone) and where a reference was made to ‘forêt-parcs à *Hagenia*’ in the description of their ecology were coded “x” (unless they were characteristic species).
- Uganda: Langdale-Brown *et al.* (1964). All species that were listed to occur in “*Hagenia - Rapanea* moist montane forest” in the Appendix were coded “x” (unless they were characteristic species).

Characteristic species were determined as:

- Kenya: The species referred by the name of mapping unit 48a (*Hagenia - Hypericum* woodland and scrub) were coded as “C”.
- Malawi: Species identified to be present as large trees (20 - 30 m) were coded as “C”. Dominant species were coded as “D”.
- Rwanda: ***Hagenia abyssinica*** was identified as the dominant species (coded “D”). *Hypericum revolutum* (listed as an associate species for the Virunga mountains by White (1983) [1983 p. 166] and Bloesch *et al.* [1999 p. 649] was identified as a characteristic species (coded “C”).
- Uganda. Species characterized as large trees in the appendix or that were mentioned in the main text where the forest type was described were coded “C”.

Within the information on assemblages, coding “f ” indicates that there is information that the species **potentially** occurs in the vegetation type since it occurs in the focal country and in the same forest type in other countries (see section 2.3).

Table 6. Species composition of Afromontane single-dominant *Hagenia abyssinica* forest (Fd)

Species	regional status	(Ethiopia)	(Kenya)	(Malawi)	(Rwanda)	(Tanzania)	(Uganda)
<i>Hagenia abyssinica</i>	dominant	D	C15	D	D	D	C
<i>Agauria salicifolia</i>		f	f	x	f	f	f
<i>Apodytes dimidiata</i>	characteristic (for Afromontane undifferentiated forest)	f	f	x	f	f	f
<i>Bersama abyssinica</i>		f	f	x	f	f	f
<i>Casearia battiscombei</i>			f	x		f	f
<i>Cassipourea malosana</i>	not characteristic (indicator for Afromontane dry transitional forest)	f	f	C		f	f
<i>Catha edulis</i>		f	f	x	f	f	f
<i>Clauseria anisata</i>		f	f	x	f	f	f
<i>Cornus volkensii</i>			C24	f	f	f	C
<i>Cussonia spicata</i>			f	C		f	f
<i>Dombeya torrida</i>		f	f	x	f	f	f
<i>Dovyalis macrocalyx</i>			f	x	f	f	f
<i>Ekebergia capensis</i>		f	f	x	f	f	f
<i>Hypericum revolutum</i>	indicator	f	C12	f	C	f	x
<i>Ilex mitis</i>	indicator (for Afromontane undifferentiated forest)	f	f	C	f	f	f
<i>Kiggelaria africana</i>	indicator (for Afromontane undifferentiated forest, species that does not extend as far north as Ethiopia)			C		f	
<i>Lepidotrachelia volkensii</i>		f	C10	x	f	f	f
<i>Maesa lanceolata</i>		f	f	x	f	f	f
<i>Maytenus acuminata</i>			f	x	f	f	f
<i>Nuxia congesta</i>	indicator (for Afromontane undifferentiated forest)	f	f	x	f	f	f
<i>Nuxia floribunda</i>	indicator (for Afromontane undifferentiated forest)		f	x	f	f	f
<i>Olea capensis</i>	not characteristic (indicator for Afromontane rain forest)	f	f	C	f	f	f
<i>Olinia rochetiana</i>		f	f	C	f	f	f
<i>Pittosporum viridiflorum</i>		f	f	C	f	f	f
<i>Podocarpus latifolius</i>	characteristic (species that does not extend as far north as Ethiopia)		f	C	f	f	f
<i>Polyscias fulva</i>		f	f	x	f	f	f
<i>Prunus africana</i>	characteristic	f	f	C	f	f	x
<i>Rapanea melanophloeos</i>	indicator (for Afromontane undifferentiated forest)	f	f	C	f	f	x
<i>Schefflera volkensii</i>		f	C24			f	f
<i>Syzygium guineense</i>	not characteristic (indicator for Afromontane rain forest [Syzygium guineense ssp. afromontanum])	f	f	x	f	f	f
<i>Xymalos monospora</i>	characteristic (species that does not extend as far north as Ethiopia)		f	x	f	f	f

## 7. Afromontane moist transitional forest (Fe)

### 7.1. Description

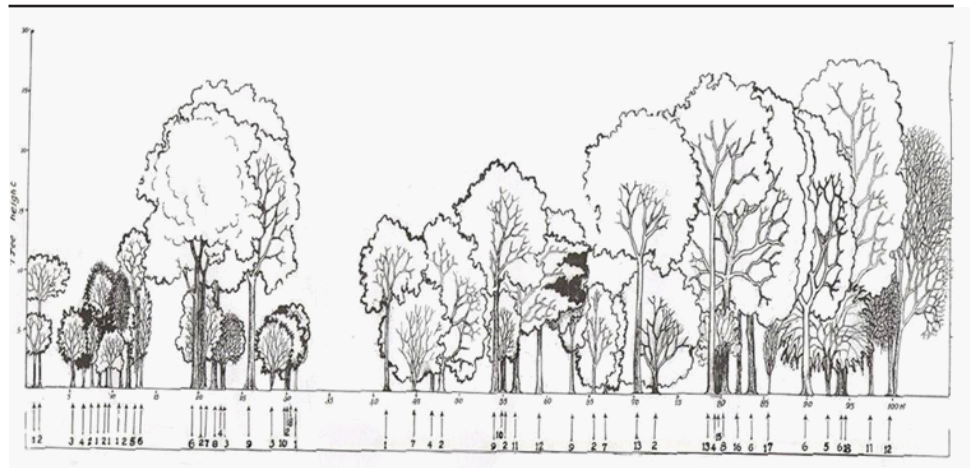
Afromontane moist transitional forest was the only VECEA forest vegetation type that could not be directly related to forest types listed for the Vegetation Map of Africa (White 1983). However, in the description of Afromontane dry transitional forest, White listed two characteristic species that occur near streams (White 1983 pp. 166 - 167). We hypothesize that these two species, *Albizia gummifera* and *Newtonia buchananii*, could be potential indicators of Afromontane moist transitional forest. *Albizia gummifera* is also a characteristic species of Lake Victoria transitional rain forest (Ff; White 1983 p. 181). *Newtonia buchananii* was also listed as characteristic species for Lake Victoria transitional rain forest (Ff; White 1983 p. 181), Zanzibar-Inhambane lowland rain forest (Fo; White 1983 p. 186), Zanzibar-Inhambane transitional rain forest (Fg; White 1983 p. 187) and evergreen and semi-evergreen Zambezi riparian forest (fr; White 1983 p. 91). However, since these two indicator species are not listed for Ethiopia, they are effectively indicators for the Kenyan manifestation of this vegetation type (FeK).



Figure 7.1 Canopy and forest margins of Afromontane moist transitional rain forest (synonym transitional rain forest) in Ethiopia. Approximate altitude of 1200 m. Photograph by I. Friis and Sebsebe Demissew (January 2009). Reproduced from *Biologiske Skrifter of the Royal Danish Academy of Sciences and letters*, Vol. 58, Fig 28A. 2010.



Figure 7.2 Profile diagram of Afromontane moist transitional forest in the Kambakia area north-east of Mt. Kenya (0° 04.498' N; 37° 37.671' E). Altitude 1612 m. This forest was classified by Trapnell *et al.* (1966, 1969, 1976, 1986) as moist intermediate forest. Species shown are: *Bersama abyssinica* (15); *Casearia battiscombei* (13); *Celtis africana* (8); *Celtis gomphophylla* (12); *Cordia africana* (6); *Croton sylvaticus* (9); *Diospyros abyssinica* (10); *Ehretia cymosa* (5); *Erythrococca bongensis* (3); *Flacourtia indica* (7); *Olea capensis* (16); *Pittosporum viridiflorum* (11); *Ritchiea albersii* (14); *Rothmannia urcelliformis* (1); *Trilepisium madagascariense* (4) and *Xymalos monospora* (2). Obtained from Matingi (2011).



## 7.2. VECEA region

Within the VECEA region, Afromontane moist transitional forest was only mapped in Ethiopia and Kenya (originally mapped as “moist intermediate forest, east”).

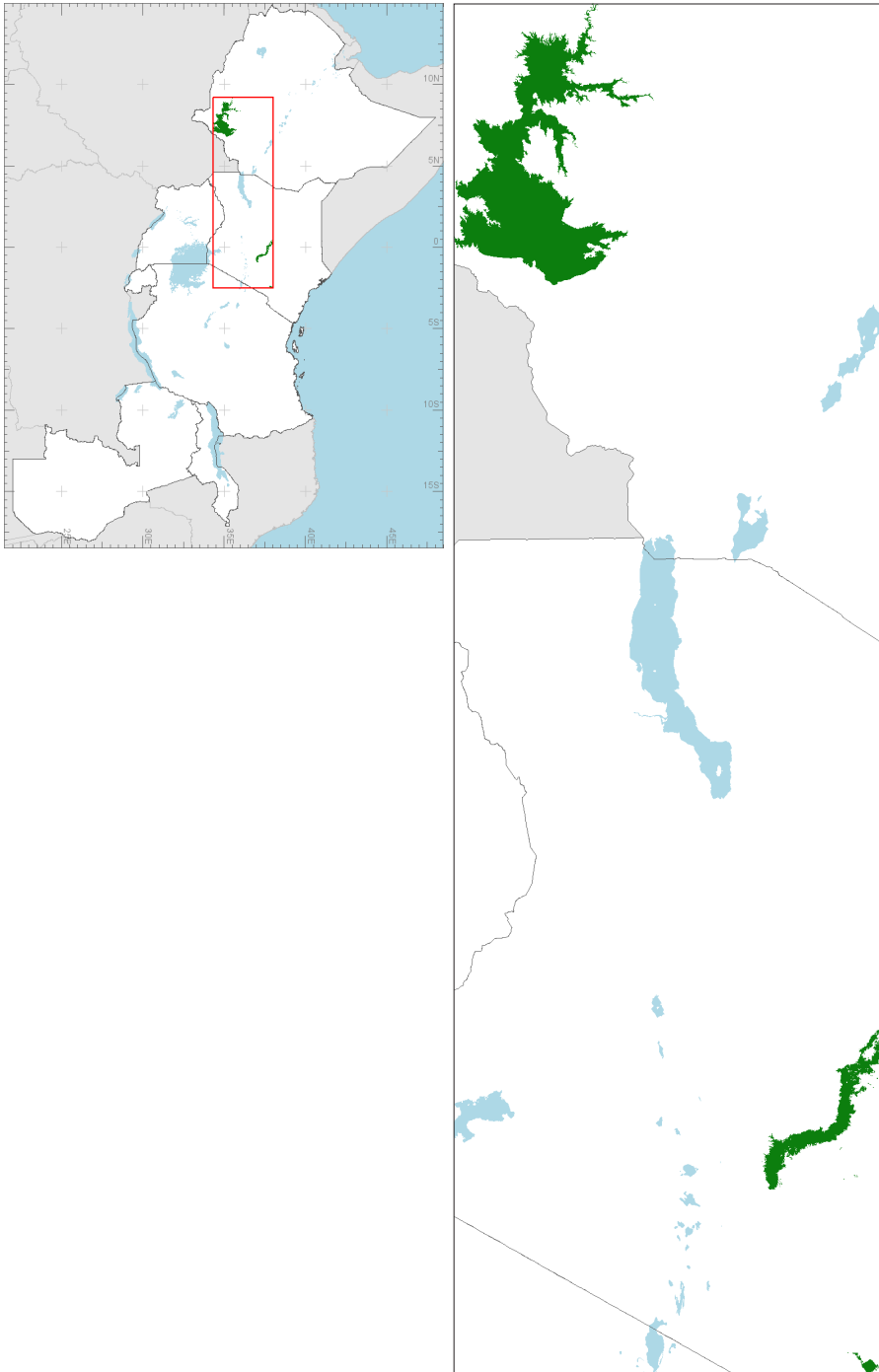


Figure 7.3. Mapped distribution of Afromontane moist transitional forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). The locations where this forest type occurs are depicted by green polygons. Note that species composition and environmental distribution is considerably different between the Ethiopian and Kenyan manifestations of this forest type. In Kenya, we used modelling to estimate the wider distribution of this forest type beyond the base maps (see Volume 6).

In Ethiopia, Afromontane moist transitional forest was originally mapped as Transitional Rain Forest (TRF). One of the synonyms used for the transitional rain forest of Ethiopia (coded TRF) is “dry peripheral semi-deciduous Guineo-Congolian forest” (Friis 1992 cited in Friis *et al.* 2010 p. 106), a name that suggests similarity with “drier peripheral semi-evergreen Guineo-Congolian forests and similar forests in the transition zones” (with the sub-type of “Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest” mapped in Kenya and Uganda within the VECEA map [Fi]). Although there could be some arguments to classify Ethiopian transitional rain forest as “Ethiopian drier peripheral semi-evergreen Guineo-Congolian rain forest”, we included it under the general heading of “Afromontane moist transitional forest” for four reasons:

- (i) in accordance to White (1983), to restrict the classification of “drier peripheral semi-evergreen Guineo-Congolian rain forest” to the Guineo-Congolian floristic region, the Guineo-Congolia to Zambezia and Guineo-Congolia to Sudania regional transitional zones and the Lake Victoria regional mosaic;
- (ii) to highlight a similarity between the Ethiopian and Kenyan manifestations of “Afromontane moist transitional forest” in occurring in areas that are adjacent to blocks of Afromontane rain forest (Fa);
- (iii) to show that both these forests could not be re-classified as one of the forest types listed in the Vegetation of Africa (White 1983); and
- (iv) to indicate that both the Ethiopian and Kenyan areas where these forest types occur are highly suitable for the cultivation of coffee and tea (*i.e.* they can be classified as the same agro-ecological zone) - and are highly threatened by conversion to plantations for these reasons.

Another choice could have been to classify the Ethiopian transitional rain forest as an “Ethiopian variant of Lake Victoria transitional rain forest”, where an argument could have been the occurrence of the characteristic species of *Pouteria altissima* in both forests.

In Kenya, Afromontane moist transitional forest was originally mapped as “moist intermediate forest, east”. We used environmental modelling to estimate the wider distribution of this forest type beyond the base maps (see Volume 6).

In Ethiopia, Afromontane moist transitional forest occurs at lower altitudes (the 500 – 750 m interval has the highest percentage of samples [38.8%]), although there is also a considerable percentage of samples at higher altitudes (samples mainly cover an altitude interval of 500 – 1750 m; Figure w1). In Kenya, more than 95% of samples are in an altitude interval of 1000 – 1750 m. Most samples in Ethiopia are in the rainfall interval of 1200 – 1400 mm (70.7%), whereas in Kenya the rainfall has a wider distribution with almost 80% of samples in the 1000 – 1800 mm interval (Figure 7.5).

**We strongly emphasize that there are clear floristic and environmental differences between the Ethiopian and Kenyan Afromontane moist transitional forests. Both vegetation types can therefore be regarded as having a unique value.**

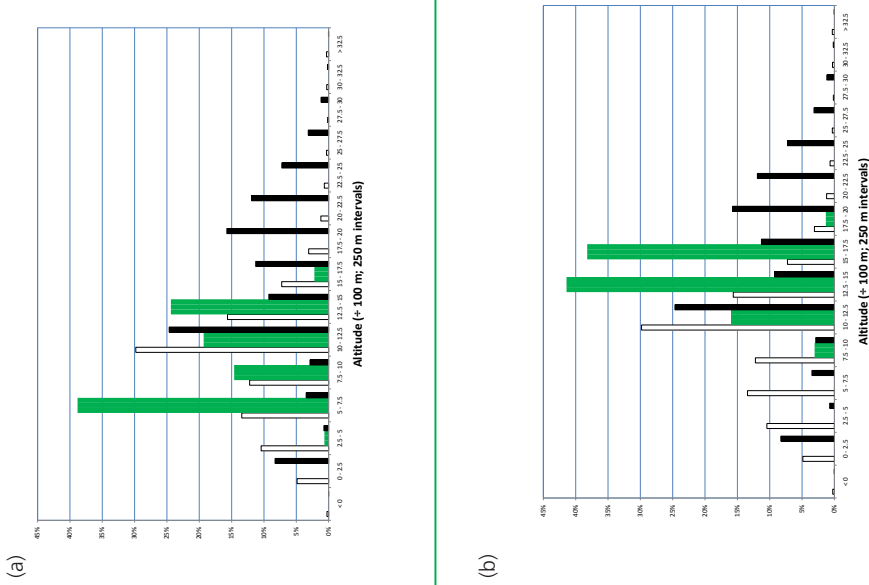


Figure 7.5.1. Histograms of the distribution of altitude. Bars at the centre of each interval show the percentage of samples within the Ethiopian manifestation (a, FeE,  $n = 3,813$ ) and Kenyan manifestation (b, FeK,  $n = 751$ ) of Afromontane moist transitional forest. Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,013$ ).

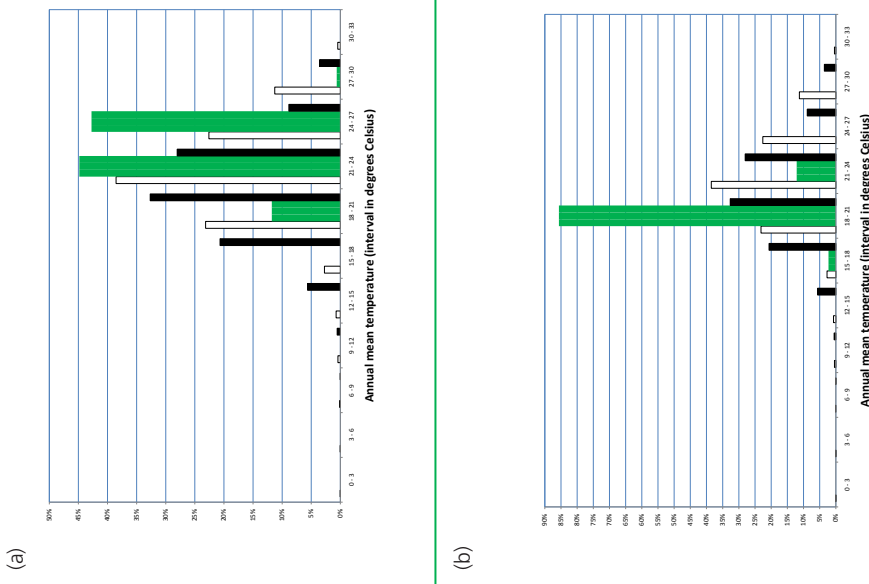


Figure 7.5.2. Histograms of the distribution of mean annual temperature. Bars at the centre of each interval show the percentage of samples within the Ethiopian manifestation (a, FeE,  $n = 3,813$ ) and Kenyan manifestation (b, FeK,  $n = 751$ ) of Afromontane moist transitional forest. Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,013$ ).

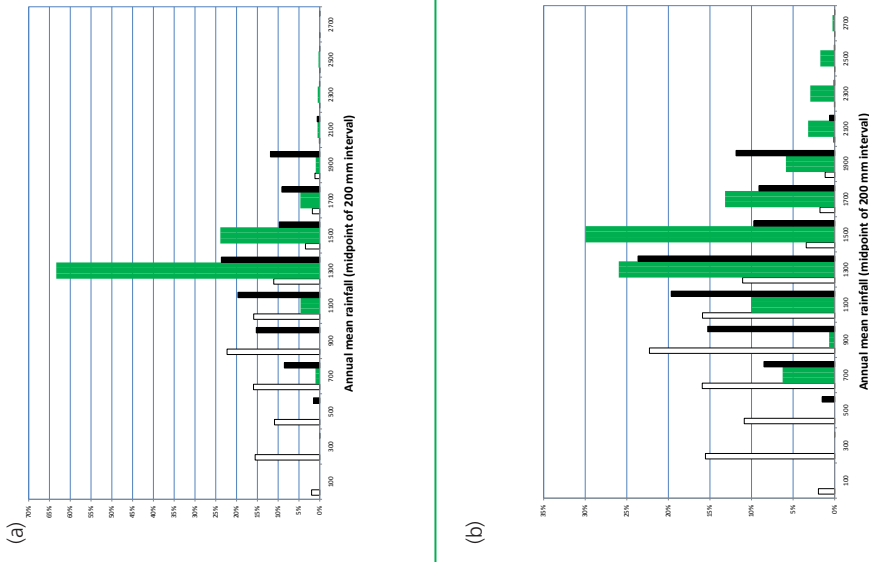


Figure 7.5.3. Histograms of the distribution of mean annual rainfall. Bars at the centre of each interval show the percentage of samples within the Ethiopian manifestation (a, FeE,  $n = 3,813$ ) and Kenyan manifestation (b, FeK,  $n = 751$ ) of Afromontane moist transitional forest. Bars on left (open) show the overall percentage of samples ( $n = 740,047$ ). Bars on the right (black) show the percentages of samples within forests ( $n = 59,013$ ).

### 7.3. Species composition

Species composition was obtained from the following references:

- Ethiopia: Friis *et al.* 2010. Species mentioned in Appendix 3 for “Transitional rainforest” (TRF) were coded as “x” (unless they were characteristic species).
- Kenya: Trapnell (1997). Species listed in Annex 1 for “moist intermediate forest, east”, “moist montane and/or moist intermediate forest”, “moist intermediate forest, west and east”, “moist intermediate and dry intermediate forest” and “of more general distribution” were coded “C”. Suffix “a” indicates that the species was also listed for Afromontane rain forest (Fa; synonym: moist montane forest). Suffix “f” indicates that the species was also listed for Lake Victoria transitional rain forest (Ff; synonym: moist intermediate forest, west). Suffix “g” indicates species of more general distribution. Suffix “h” indicates that the species was also listed for Afromontane dry transitional forest (Fh; synonym: dry intermediate forest). Suffix “s” indicates secondary species. Numbers show the maximum height of the species provided in the Annex (Trapnell 1997). Species that were expected to occur in the forest type based on information from Beentje (1994), the Flora of Tropical East Africa and field experience from our Kenyan co-author (F. Gachathi) were coded “x”.

Characteristic species were determined as:

- Ethiopia: species mentioned in the main description of the vegetation type were coded as “C”.
- Kenya: Species that were listed by Trapnell (1997) were assumed to be characteristic species (these were coded “C”).

Within the information on assemblages, coding “f ” indicates that there is information that the species potentially occurs in the vegetation type since it occurs in the focal country and in the same forest type in other countries (see section 2.3).

Table 7. Species composition of Afromontane moist transitional forest (Fe)

Species	Regional status (see section 2.3)	(Ethiopia)	(Kenya)
<i>Acacia abyssinica</i>		f	x
<i>Albizia coriaria</i>		x	f
<i>Albizia grandibracteata</i>		x	f
<i>Albizia gummifera</i>	probable indicator as near streams in Afromontane dry transitional forest	f	Cg30
<i>Albizia schimperiana</i>		C	f
<i>Allophylus abyssinicus</i>		f	x
<i>Allophylus rubifolius</i>		f	x
<i>Alstonia boonei</i>		C	
<i>Anthocleista grandiflora</i>			Cf24
<i>Antiaris toxicaria</i>		C	f
<i>Antidesma venosum</i>		f	x
<i>Aphania senegalensis</i>		x	f
<i>Apodytes dimidiata</i>	not characteristic (indicator for Afromontane dry transitional forest)	f	x
<i>Baphia abyssinica</i>		x	
<i>Bersama abyssinica</i>		f	Cg15
<i>Blighia unijugata</i>		x	Cf30
<i>Bridelia micrantha</i>		f	Cfhs12
<i>Buddleja polystachya</i>		f	x
<i>Caesalpinia decapetala</i>			x
<i>Caesalpinia volkensii</i>			x
<i>Casearia battiscombei</i>			Caf37
<i>Cassipourea malosana</i>	not characteristic (indicator for Afromontane dry transitional forest)	f	Cg24
<i>Catha edulis</i>		f	x
<i>Ceiba pentandra</i>		x	
<i>Celtis africana</i>		f	x
<i>Celtis gomphophylla</i>		C	Cf27
<i>Celtis mildbraedii</i>			x
<i>Celtis toka</i>		C	
<i>Clausena anisata</i>		f	x
<i>Cordia africana</i>		x	Cfr24
<i>Craibia brownii</i>			x
<i>Crateva adansonii</i>		x	f
<i>Crotalaria agatiflora</i>		f	x
<i>Croton macrostachyus</i>		f	Cgs24
<i>Croton megalocarpus</i>	not characteristic (indicator for Afromontane dry transitional forest)		Cfhs37
<i>Croton sylvaticus</i>		C	Caf24
<i>Diospyros abyssinica</i>	not characteristic (indicator for Afromontane dry transitional forest)	C	Cg27
<i>Dombeya torrida</i>		f	x
<i>Dovyalis abyssinica</i>		f	x
<i>Dovyalis macrocalyx</i>			x
<i>Dracaena fragrans</i>		x	f
<i>Dracaena steudneri</i>		x	Cg12
<i>Ehretia cymosa</i>		f	Cg9
<i>Ekebergia capensis</i>		f	Cg24
<i>Elaeodendron buchananii</i>		x	f



Species	Regional status (see section 2.3)	(Ethiopia)	(Kenya)
<i>Embelia schimperi</i>		f	x
<i>Englerophytum natalense</i>			x
<i>Erythroxylum fischeri</i>		x	f
<i>Eugenia capensis</i>		x	f
<i>Fagaropsis angolensis</i>	not characteristic (indicator for Afromontane dry transitional forest)	x	Cfh21
<i>Ficus exasperata</i>		C	Cf27
<i>Ficus mucoso</i>		C	f
<i>Ficus natalensis</i>			x
<i>Ficus platyphylla</i>		x	
<i>Ficus sur</i>		x	Cg24
<i>Ficus thonningii</i>		f	Cg21
<i>Funtumia africana</i>			x
<i>Hagenia abyssinica</i>		f	x
<i>Harungana madagascariensis</i>			Caf12
<i>Kigelia moosa</i>			Caf15
<i>Lannea welwitschii</i>		x	f
<i>Lecaniodiscus fraxinifolius</i>		C	f
<i>Lepidotrichilia volkensii</i>		f	x
<i>Lovoa swynnertonii</i>			C46
<i>Macaranga capensis</i>		f	x
<i>Maesa lanceolata</i>		f	x
<i>Manilkara butugii</i>		C	Cf27
<i>Margaritaria discoidea</i>		x	x
<i>Markhamia lutea</i>	not characteristic (indicator for Afromontane dry transitional forest)		Cfh18
<i>Maytenus undata</i>		f	x
<i>Milicia excelsa</i>		C	Cf49
<i>Mimusops bagshawei</i>			Cfh40
<i>Mimusops kummel</i>		f	Cfh27
<i>Morus mesozygia</i>		C	f
<i>Myrianthus holstii</i>	not characteristic (indicator for Afromontane rain forest)		Cs15
<i>Neoboutonia macrocalyx</i>			Caf18
<i>Newtonia buchananii</i>	probable indicator as near streams in Afromontane dry transitional forest		C46
<i>Nuxia congesta</i>	not characteristic (indicator for Afromontane undifferentiated forest)	f	Cg21
<i>Olea capensis</i>	not characteristic (indicator for Afromontane rain forest)	f	Caf27
<i>Olyra latifolia</i>		x	f
<i>Oncoba spinosa</i>		x	f
<i>Phoenix reclinata</i>	(palm species)	f	x
<i>Phytolacca dodecandra</i>		f	x
<i>Pittosporum viridiflorum</i>		f	xb
<i>Plectranthus barbatus</i>		f	x
<i>Polyscias fulva</i>		x	faf
<i>Pouteria adolfi-friedericii</i>	not characteristic (indicator for Afromontane rain forest)	f	xa
<i>Pouteria altissima</i>		C	ff
<i>Premna maxima</i>			C30

Species	Regional status (see section 2.3)	(Ethiopia)	(Kenya)
<i>Prunus africana</i>	not characteristic (characteristic for Afromontane rain forest and Afromontane undifferentiated forest)	f	x
<i>Psychotria mahonii</i>			x
<i>Psydrax parviflora</i>		f	Caf24
<i>Pterolobium stellatum</i>		f	x
<i>Rapanea melanophloeos</i>	not characteristic (indicator for Afromontane undifferentiated forest)	f	xab
<i>Rauvolfia caffra</i>			C24
<i>Rhamnus prinoides</i>		f	x
<i>Rhoicissus revouilii</i>		f	x
<i>Ritchiea albersii</i>		x	f
<i>Rothmannia urcelliformis</i>		x	Cfh9
<i>Rubus apetalus</i>		f	x
<i>Rubus volkensii</i>		f	x
<i>Schefflera abyssinica</i>		f	x
<i>Schefflera volkensii</i>		f	x
<i>Scutia myrtina</i>		f	x
<i>Senna didymobotrya</i>		f	x
<i>Senna septemtrionalis</i>			x
<i>Shirakiopsis elliptica</i>		x	Cfh15
<i>Smilax anceps</i>		x	f
<i>Solanum aculeastrum</i>			x
<i>Strombosia scheffleri</i>	not characteristic (indicator for Afromontane rain forest)		Caf27
<i>Strychnos mitis</i>		C	f
<i>Syzygium guineense</i>	not characteristic (indicator for Afromontane rain forest [ <i>Syzygium guineense</i> ssp. <i>afromontanum</i> ])	f	x
<i>Tabernaemontana pachysiphon</i>			Caf10
<i>Tabernaemontana stapfiana</i>	not characteristic (indicator for Afromontane rain forest)		x
<i>Trema orientalis</i>		f	Cfh12
<i>Trichilia dregeana</i>		C	f
<i>Trichilia emetica</i>		f	Cf27
<i>Trilepisium madagascariense</i>		C	f
<i>Vepris dainellii</i>		x	
<i>Vepris nobilis</i>		f	Cg12
<i>Vernonia auriculifera</i>		f	x
<i>Vernonia myriantha</i>		f	x
<i>Warburgia ugandensis</i>	not characteristic (indicator for Afromontane dry transitional forest)	f	Cfh30
<i>Xylopiya parviflora</i>		x	f
<i>Xymalos monospora</i>	not characteristic (characteristic for Afromontane rain forest and Afromontane undifferentiated forest)		x
<i>Zanha golungensis</i>		C	f
<i>Zanthoxylum gilletii</i>		x	Caf30
<i>Zanthoxylum rubescens</i>			Caf24
<i>Ziziphus pubescens</i>		x	f

## 8. Lake Victoria transitional rain forest (Ff)

### 8.1. Description

White describes two types of Lake Victoria transitional rain forest: (i) transitional rain forests occurring between 1600 and 1900 m in western Burundi, western Rwanda and eastern Kivu (DRC); and (ii) Kakamega forest in Kenya (1520 to 1680 m). Kakamega forest is described as containing a mixture of Guineo-Congolian lowland rain forest species (that reach their easternmost limits in distribution in Kakamega forest) and Afromontane species, but containing fewer Afromontane species than the other Lake Victoria transitional rain forests (White 1983 p. 181).

Regional indicator species (characteristic species listed by White (1983) [1983] that were only provided for Lake Victoria transitional rain forest and no other Lake Victoria forest types) that were listed as characteristic species for one or several national maps include *Alangium chinense* (Afromontane species, also a indicator for Zanzibar-Inhambane transitional rain forest [Ff]), *Anthonotha pynaertii*, *Apodytes dimidiata* (Afromontane species, also characteristic of Afromontane undifferentiated forest [Fbu] and Afromontane dry transitional forest [Fh]), *Carapa procera*, *Chrysophyllum gorungosanum* (also a indicator of Afromontane rain forest [Fa]), *Cordia millenii* (Guineo-Congolian lowland rain forest species), *Diospyros gabunensis*, *Macaranga capensis* (synonym: *Macaranga kilimandscharica*; **Afromontane species**), *Monodora myristica* (Guineo-Congolian lowland rain forest species), *Neoboutonia macrocalyx* (Afromontane species), *Newtonia buchananii* (also a characteristic species of Afromontane moist transitional forest [FeK], Afromontane dry transitional forest [Fh; near streams], Zanzibar-Inhambane lowland rain forest [Fo] and Zanzibar-Inhambane transitional rain forest [Fg; upland species]), *Parinari excelsa* (also an indicator of Afromontane rain forest [Fa]), *Prunus africana* (Afromontane species, also characteristic of Afromontane rain forest [Fa] and Afromontane undifferentiated forest [Fbu]), *Strombosia scheffleri* (Afromontane species, also a indicator of Afromontane rain forest [Fa]), *Symphonia globulifera*, *Syzygium guineense* (also an indicator of Afromontane rain forest [Fa]), *Turraea holstii* (Afromontane species) and *Xymalos monospora* (also characteristic of Afromontane rain forest [Fa] and Afromontane undifferentiated forest [Fbu]).

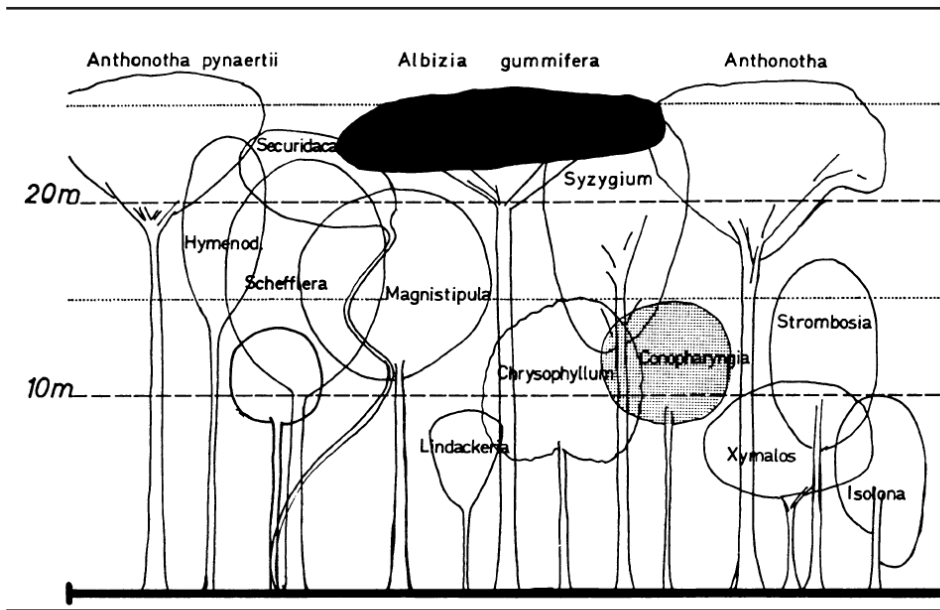


Figure 8.1 Profile diagram of Lake Victoria transitional rain forest in Burundi. Although White (1983 p. 164) listed this profile diagram for the description of Afromontane rain forest (Fa), the altitude range for this forest type of 1600 – 1900 m were described by White (1983 p. 181) for Lake Victoria transitional rain forest (Ff) and also corresponded to the altitude range of the “horizon inférieur” mentioned with the original publication of this profile diagram (Lewalle 1972). Figure obtained from URL: <http://www.jstor.org/stable/3667406>.



Figure 8.2 Lake Victoria transitional rain forest in South Nandi forest. Photograph by F. Gachathi.

## 8.2. VECEA region

Within the VECEA region, Lake Victoria transitional rain forest only occurs in Kenya and Rwanda.

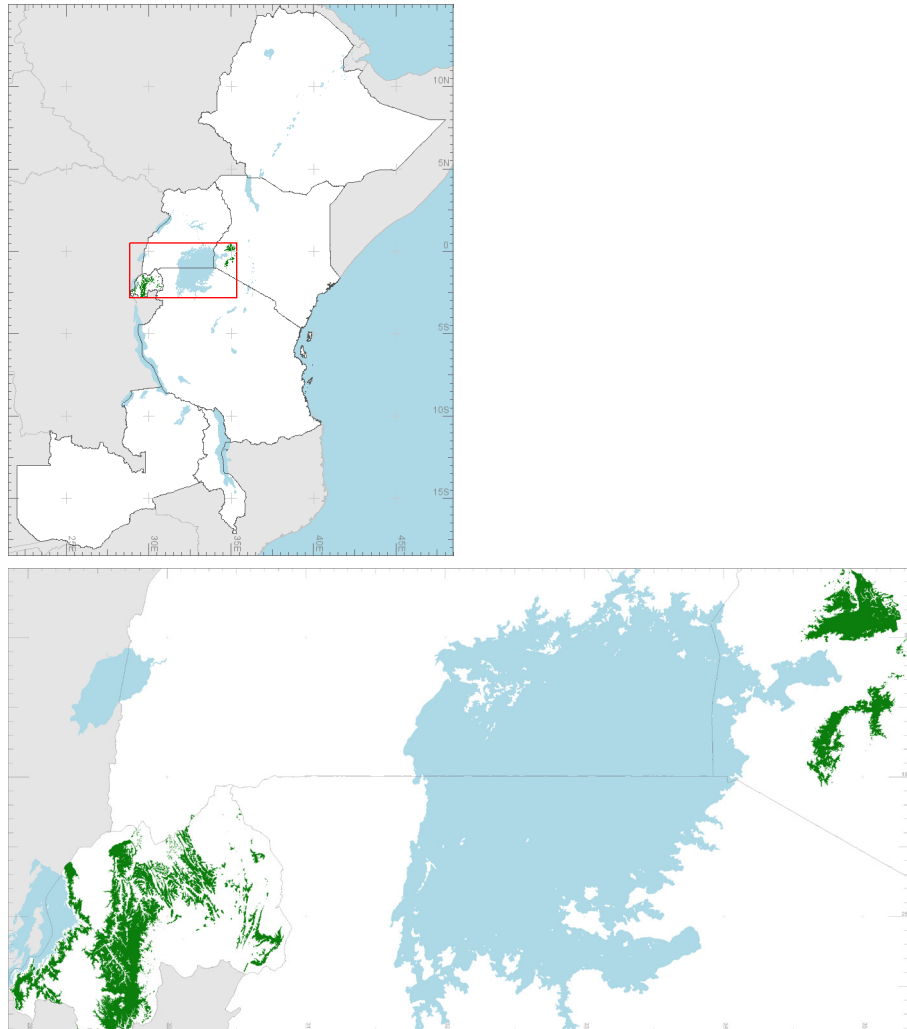


Figure 8.3. Mapped distribution of Lake Victoria transitional rain forest in the VECEA region (Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia). The locations where this forest type occurs are depicted by green polygons.

In Kenya, Trapnell *et al.* (1966, 1969, 1976, 1986; see also Trapnell and Brunt [1987]) did not differentiate between Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest (mapped in VECEA as Fi) and Lake Victoria transitional rain forest (Ff) and mapped both forests as “moist intermediate forest, west”. We used an altitude limit of 1520 m (*i.e.* the lower altitude limit mentioned by White [1983 p. 181]) to infer the boundary between these forests (see volume 6).

In Rwanda, Lake Victoria transitional rain forest was originally described as “forêts mésophiles de montagne”. The Rwandan manifestation of Lake Victoria transitional rain forest only exists as small remnants now. More than 50 years ago, Lebrun (1956) mentioned that he did not know any typical examples from these forests to occur in Rwanda and Burundi (he inferred the previous presence of these forests from isolated relicts). Gasana (1975 cited in Combe 1975) mentions that the inferior horizon of Nyungwe forests (1600 - 1900 m) contains following dominant species: *Albizia gummifera*, *Entandrophragma excelsum*, ***Parinari excelsa***, ***Newtonia buchananii*** and ***Symphonia globulifera***. ***Carapa procera*** was dominant in the shrub layer. Therefore, this forest may still exist in Rwanda (though only marginally).

Investigation of environmental distribution of Lake Victoria transitional rain forest in the VECEA region (Figure 8.4) shows that most of this forest occurs between 1500 and 2000 m (with > 95% of the samples in this interval). The rainfall interval where most of samples occur is the same for this vegetation type (1200 – 1400 mm; 29.6% of samples) as for all forests combined (23.7%).



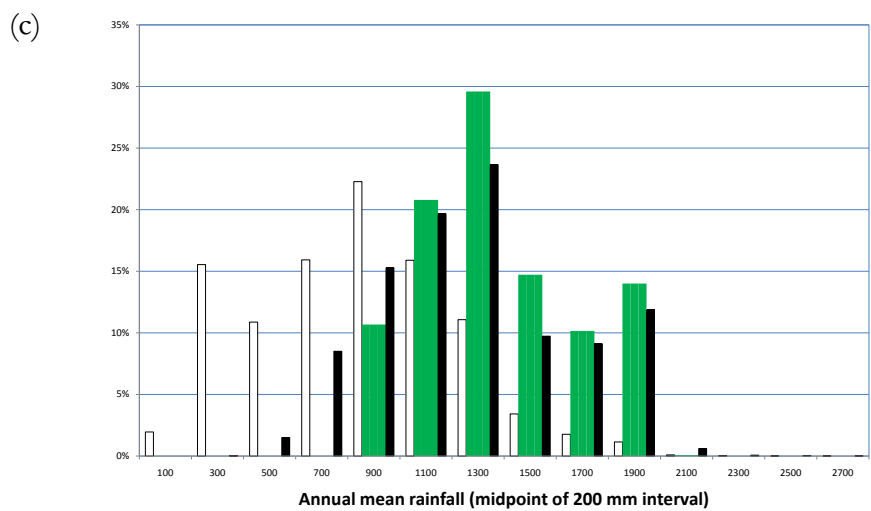
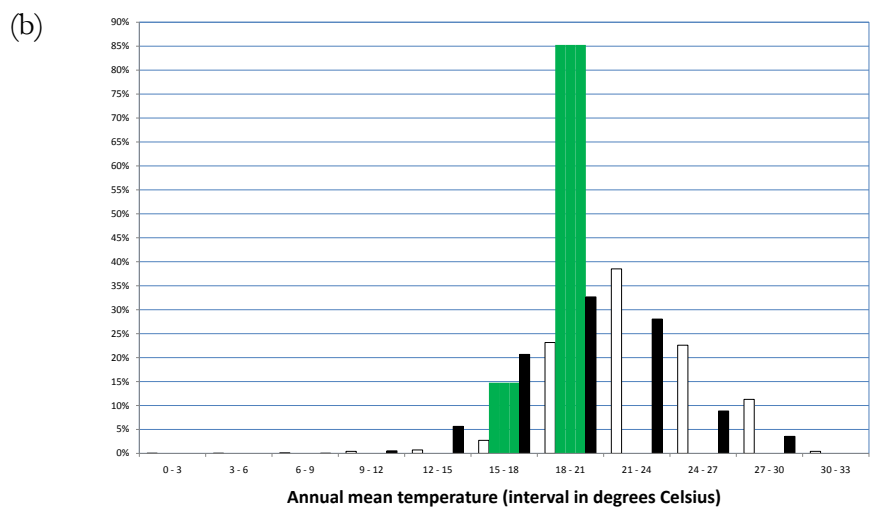
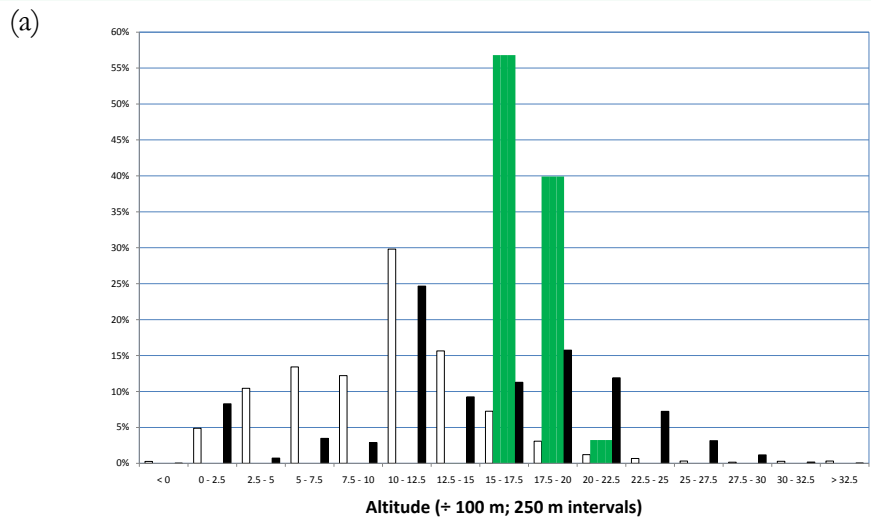


Figure 8.4. Histograms of the distribution of altitude (a), mean annual temperature (b) and mean annual rainfall (c). Bars at the centre of each interval show the percentage of samples within Lake Victoria transitional rain forest (Ff, n = 2,521). Bars on left (open) show the overall percentage of samples (n = 740,047). Bars on the right (black) show the percentages of samples within forests (n = 59,013).

### 8.3. Species composition

Species assemblages were obtained from the following references:

- Kenya: Trapnell (1997). Species listed in Annex 1 of for “moist intermediate forest, west”, “moist montane and/or moist intermediate forest”, “moist intermediate forest, west and east”, “moist intermediate and dry intermediate forest” and “of more general distribution” were coded “C”. Suffix “a” indicates that the species was also listed for Afromontane rain forest (Fa; synonym: moist montane forest). Suffix “e” indicates that the species was also listed for Afromontane moist transitional forest (Fe; synonym: moist intermediate forest, east). Suffix “g” indicates species of more general distribution. Suffix “h” indicates that the species was also listed for Afromontane dry transitional forest (Fh; synonym: dry intermediate forest). Suffix “s” indicates secondary species. Numbers show the maximum height of the species provided in the Annex (Trapnell 1997). Species that were expected to occur in the forest type based on information from Beentje (1994), the Flora of Tropical East Africa and field experience from our Kenyan co-author (F. Gachathi) were coded “x”.
- Rwanda: Bloesch *et al.* (2009). All species that were mentioned to occur in floristic region 3 (forest remnants and secondary vegetation [3A]; montane forests of the Congo and Nile basins [3B]), that had part of their distribution range below 1900 m and where a reference was made to a forest habitat (‘forêt’) in the description of their ecology were coded “x” (unless they were characteristic species). To these species we added species listed by White (1983) (1983 p. 181) to occur at altitudes of 1600 - 1900 m in western Rwanda.

Characteristic species were determined as:

- Kenya: Species that were listed by Trapnell (1997) were assumed to be characteristic species (these were coded “C”).
- Rwanda: Characteristic species were coded “C”. These included:
  - (i) species listed by Prioul (1981) to occur in forests at altitudes of 1600 - 1900 m;
  - (ii) species listed by Lebrun (1956) to occur in ‘forêts mésophiles de montagne’; and
  - (iii) species listed by Gasana (1975 cited in Combe 1975) to occur in Nyungwe forest at altitudes of 1600 - 1900 m.

Within the information on assemblages, coding "f " indicates that there is information that the species potentially occurs in the vegetation type since it occurs in the focal country and in the same forest type in other countries (see section 2.3).

Table 8. Species composition of Lake Victoria transitional rain forest (Ff)

Species	Regional status (see section 2.3)	(Kenya)	(Rwanda)
<i>Acacia abyssinica</i>		x	f
<i>Acacia lahai</i>		x	
<i>Acacia meurnsii</i>		f	x
<i>Agauria salicifolia</i>		f	x
<i>Alangium chinense</i>	indicator (Afromontane species)	x	f
<i>Albizia grandibracteata</i>		C19	f
<i>Albizia gummifera</i>	characteristic	Cgs30	C
<i>Albizia zygia</i>		C30	
<i>Alchornea hirtella</i>		x	x
<i>Allophylus abyssinicus</i>		x	x
<i>Allophylus rubifolius</i>		x	f
<i>Anthocleista grandiflora</i>		Ce24	
<i>Anthonotha pyraertii</i>	indicator		x
<i>Antiaris toxicaria</i>	not characteristic (indicator for Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest)	C46	f
<i>Antidesma venosum</i>		x	
<i>Apodytes dimidiata</i>	indicator (afromontane species)	x	x
<i>Beilschmiedia ugandensis</i>		x	
<i>Bersama abyssinica</i>		Cg15	f
<i>Blighia unijugata</i>		Ce30	f
<i>Bridelia brideliifolia</i>			x
<i>Bridelia micrantha</i>		Ceh12	f
<i>Buddleja polystachya</i>		x	
<i>Caesalpinia decapetala</i>		x	f
<i>Caesalpinia volkensii</i>		x	
<i>Carapa procera</i>	indicator		C
<i>Casearia battiscombei</i>		Cae37	
<i>Cassipourea malosana</i>		Cg24	
<i>Cassipourea ruwensoriensis</i>		C12	x
<i>Celtis africana</i>		x	f
<i>Celtis gomphophylla</i>		Ce27	C
<i>Celtis mildbraedii</i>		C30	
<i>Chrysophyllum albidum</i>	not characteristic (indicator for Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest)	C37	
<i>Chrysophyllum gorungos- num</i>	indicator (afromontane species)	f	C
<i>Clauseana anisata</i>		x	C
<i>Cordia africana</i>		Ce24	f
<i>Cordia millenii</i>	indicator (Guineo-Congolian species)	C30	
<i>Craibia brownii</i>		x	f
<i>Crotalaria agatiflora</i>		x	f
<i>Croton macrostachyus</i>		Cgs24	x
<i>Croton megalocarpus</i>		Ceh37	x
<i>Croton sylvaticus</i>		Cae24	
<i>Cyathea manniana</i>		x	x
<i>Diospyros abyssinica</i>		Cg27	f
<i>Diospyros gabunensis</i>	indicator		x
<i>Dodonaea viscosa</i>		x	x
<i>Dombeya torrida</i>		x	x
<i>Dovyalis abyssinica</i>		x	

Species	Regional status (see section 2.3)	(Kenya)	(Rwanda)
<i>Dovyalis macrocalyx</i>		x	x
<i>Dracaena fragrans</i>		x	f
<i>Dracaena steudneri</i>		Cg12	x
<i>Ehretia cymosa</i>		Cg9	C
<i>Ekebergia capensis</i>		Cgs24	x
<i>Embelia schimperi</i>		x	x
<i>Ensete ventricosum</i>		f	x
<i>Entada abyssinica</i>		x	f
<i>Entandrophragma angolense</i>	characteristic (Guineo-Congolian species)	C49	
<i>Entandrophragma excelsum</i>			C
<i>Eugenia capensis</i>		f	x
<i>Fagaropsis angolensis</i>		Ceh21	x
<i>Ficalhoa laurifolia</i>			x
<i>Ficus exasperata</i>		Ce27	x
<i>Ficus natalensis</i>		x	f
<i>Ficus sur</i>		Cg24	x
<i>Ficus thonningii</i>		Cg21	f
<i>Funtumia africana</i>		C24	
<i>Galiniera saxifraga</i>		x	x
<i>Garcinia buchananii</i>		C12	f
<i>Hagenia abyssinica</i>		x	x
<i>Harungana madagascariensis</i>		Cae12	C
<i>Hypericum revolutum</i>		f	x
<i>Ilex mitis</i>		f	x
<i>Kigelia africana</i>		f	x
<i>Kigelia moosa</i>		Cae15	
<i>Lecaniodiscus fraxinifolius</i>		C18	
<i>Lepidotrichilia volkensii</i>		x	x
<i>Lovoa trichilioides</i>			x
<i>Macaranga capensis</i>	indicator (Afromontane species)	x	x
<i>Maesa lanceolata</i>		x	x
<i>Maesopsis eminii</i>	characteristic (Guineo-Congolian species)	Cs27	f
<i>Manilkara butugii</i>		C27	
<i>Margaritaria discoidea</i>		x	
<i>Markhamia lutea</i>		Cehs18	f
<i>Maytenus acuminata</i>		f	x
<i>Maytenus undata</i>		xb	x
<i>Milicia excelsa</i>	not characteristic (indicator for Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest)	Ce49	f
<i>Mimusops bagshawei</i>		Ceh40	f
<i>Mimusops kummel</i>		Ceh27	
<i>Mondia whitei</i>		x	
<i>Monodora myristica</i>	indicator (Guineo-Congolian species)	C24	
<i>Morus mesozygia</i>	not characteristic (indicator for Lake Victoria drier peripheral semi-evergreen Guineo-Congolian rain forest)	C24	
<i>Neoboutonia macrocalyx</i>	indicator (Afromontane species)	Cae18	C
<i>Newtonia buchananii</i>	indicator	f	C
<i>Nuxia congesta</i>		Cg21	x
<i>Nuxia floribunda</i>		f	x
<i>Ocotea kenyensis</i>		f	x

Species	Regional status (see section 2.3)	(Kenya)	(Rwanda)
<i>Ocotea usambarensis</i>		f	x
<i>Olea capensis</i>		Cae27	f
<i>Olinia rochetiana</i>		f	x
<i>Parinari excelsa</i>	indicator (afromontane species)		C
<i>Peddiea fischeri</i>		f	x
<i>Phoenix reclinata</i>	(palm species)	x	f
<i>Phytolacca dodecandra</i>		x	f
<i>Pittosporum viridiflorum</i>		x	x
<i>Plectranthus barbatus</i>		x	
<i>Pleiocarpa pycnantha</i>		f	x
<i>Podocarpus falcatus</i>		f	x
<i>Podocarpus latifolius</i>		f	x
<i>Polyscias fulva</i>		C24	x
<i>Pouteria adolfi-friedericii</i>		x	f
<i>Pouteria altissima</i>	characteristic (Guineo-Congolian species)	C46	x
<i>Prunus africana</i>	indicator (Afromontane species)	x	x
<i>Pseudospondias microcarpa</i>		C30	x
<i>Psychotria mahonii</i>		x	x
<i>Psydrax parviflora</i>		Cae24	f
<i>Pterolobium stellatum</i>		x	f
<i>Rapanea melanophloeos</i>		x	x
<i>Rhamnus prinoides</i>		x	x
<i>Rinorea angustifolia</i>		f	x
<i>Ritchiea albersii</i>		x	x
<i>Rothmannia urcelliformis</i>		Ceh9	
<i>Rubus apetalus</i>		x	x
<i>Rubus volkensii</i>		x	
<i>Schefflera abyssinica</i>		x	
<i>Schefflera volkensii</i>		x	
<i>Schrebera alata</i>		f	x
<i>Scutia myrtina</i>		x	f
<i>Senna didymobotrya</i>		x	f
<i>Senna septemtrionalis</i>		x	f
<i>Shirakiopsis elliptica</i>		Ceh15	C
<i>Smilax anceps</i>		f	x
<i>Solanum aculeastrum</i>		x	x
<i>Spathodea campanulata</i>		C18	f
<i>Sterculia dawei</i>		x	
<i>Strombosia scheffleri</i>	indicator (Afromontane species)	Cae27	x
<i>Symphonia globulifera</i>	indicator		C
<i>Syzygium guineense</i>	indicator (Afromontane species [ <i>Syzygium guineense</i> ssp. <i>afromontanum</i> ])	x	x
<i>Tabernaemontana pachy- phon</i>		Cae10	
<i>Tabernaemontana stapfiana</i>		x	x
<i>Trema orientalis</i>		Ceh12	x
<i>Trichilia dregeana</i>		C30	
<i>Trichilia emetica</i>		Ce27	
<i>Trilepisium madagascariense</i>		C30	
<i>Turraea holstii</i>	indicator (afromontane species)	Cae12	

<b>Species</b>	<b>Regional status</b> (see section 2.3)	<b>(Kenya)</b>	<b>(Rwanda)</b>
<i>Vangueria apiculata</i>		f	x
<i>Vepris nobilis</i>		Cg12	x
<i>Vernonia amygdalina</i>		x	f
<i>Vernonia auriculifera</i>		x	f
<i>Vernonia myriantha</i>		x	x
<i>Warburgia ugandensis</i>		Ceh30	
<i>Xymalos monospora</i>	indicator (afromontane species)	xa	x
<i>Zanthoxylum gilletii</i>		Cae30	x
<i>Zanthoxylum rubescens</i>		Cae24	