Potential natural vegetation map version 1.1

The steps below describe the major changes compared to version 1.0. Not described are the minor corrections of boundaries carried out based on examinations of lake boundaries and other conspicuous boundaries visible on Google Earth. GRASS GIS code used to implement the various steps is included for completeness.

Field survey - evergreen and semi-evergreen bushland

The field survey referred to in the text below concerns a vegetation survey carried out in Kenya and Uganda within the region mapped as evergreen and semi-evergreen bushland and thickets on the potential natural vegetation map of eastern Africa. Objectives of this fieldwork were 1) to validate vegetation map classification for evergreen bushland in Kenya and Uganda based on indicator species, and 2) to collect data on the distribution of evergreen bushland indicator species. In order to achieve this, vegetation and species were described in 1240 sites along road transects in southwestern Kenya, southern Uganda and eastern Uganda (Figure 1). Locations were selected at random at a 5 to 10 km interval, but also where we observed a clear change in vegetation cover (change in species or physiognomy). In each location we recorded :

- general description of the vegetation (physiognomy, general canopy cover and height);
- signs of human influence;
- all woody species present within a 100 meter radius
- presence of characteristic species of evergreen and semi-evergreen bushland and combretum woodland visible from the sample location (where possible the identification was confirmed by visiting the individual)
- In areas with no natural vegetation cover, we recorded the presence of indicator species along the fields and roads for 1km sections.

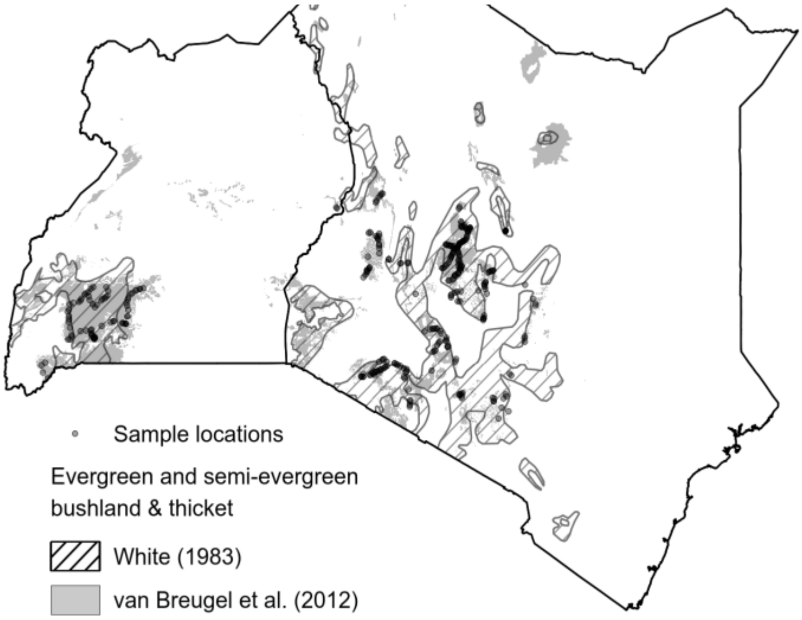
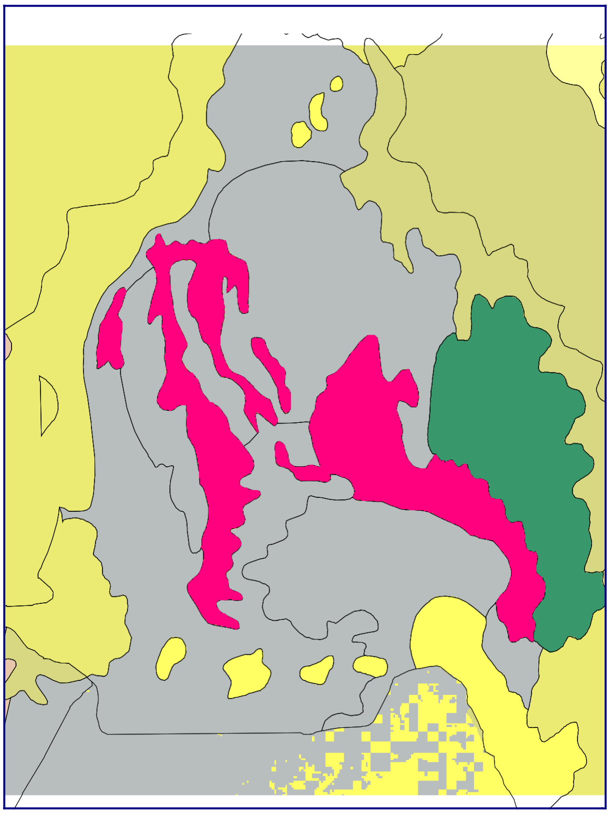


Figure 1. Field survey locations in the evergreen and semi-evergreen bushlands of Kenya and Uganda. Field surveys in Kenya were carried out in November-December 2011 by Francis Gachathi & Paulo van Breugel. In Uganda surveys were carried out in January 2012 by Olivia Wanyana Maganyi & Paulo van Breugel.

The field study, which was funded by a grant from the Danish Consultative Research Committee for Development Research (FFU-Danida) under project 10-095-LIFE, is further described in van Breugel et al. (in preparation).

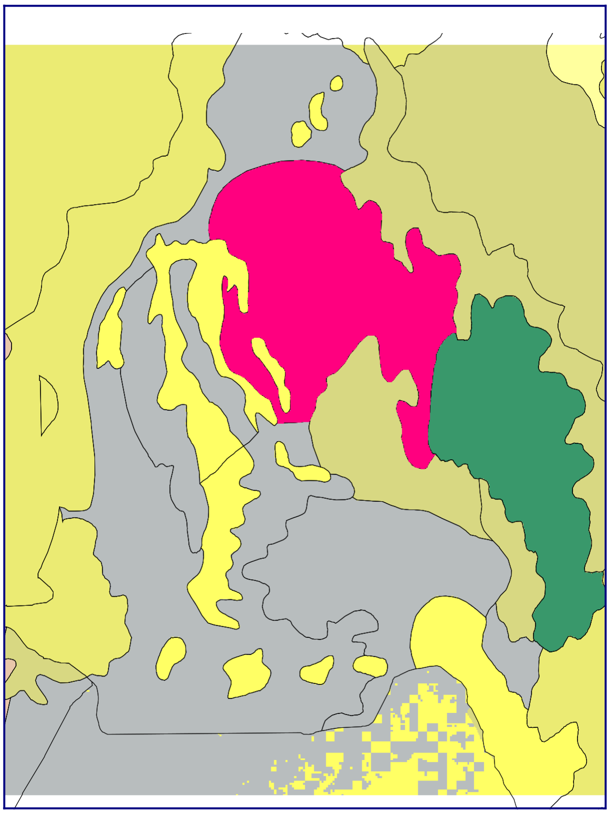
1 Around Maralal

Around Maralal, a number of areas were originally classified as climatic grasslands (1) and as Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (2). It should be noted that the Delsol and RMHK maps are not very clear. Based on observations during the above-mentioned field surveys, we reclassified these as evergreen and semi-evergreen bushland.



```
v.extract -t input=veg_kenya_rmhk1@vegetation layer=1 cats=522,550,511,499,542,523,540 output=tmp_1
g.region vect=tmp_1@vegetation
v.to.rast input=tmp_1@vegetation layer=1 output=tmp_1 use=val value=63
```

The pink area in the map below, which is a valley north of Maralal, was classified as evergreen and semi-evergreen bushland. Our observations during fieldwork in that area showed that large areas are still or were till recently covered by high Juniperus and Juniperus-Olea forest. The RMHK maps indeed indicate the prominence of Juniperus in this area, but is less clear about the physiognomic class. We reclassified this area as Single-dominant Juniperus procera forest.



```
v.extract -t input=veg_kenya_rmhk1@vegetation layer=1 cats=489 output=tmp_2
g.region vect=tmp_2@vegetation
v.to.rast input=tmp_2@vegetation layer=1 output=tmp_2 use=val value=3
```

The two corrections were merged with the vecea map as a new map tmp_3, which will be used in the next steps.

```
g.region rast=pnv_vecea_v1.1@vegetation
r.patch input="tmp_1,tmp_2,pnv_vecea_v1.1" output="tmp_3"
```

2 Lakipia and north of Mnt Kenya

For areas where we used modelling for classification, I went back to the source data, i.e., the Delsol and RMHK maps, and used those in combination with information and observations during fieldwork in the area to classify the areas.

- The Afromontane undifferentiated forest (Fb) area north-west/west of Mount Kenya was classified based on modelling (see FLD publication, volume 6). However, our observations in the field suggest that the distribution models overestimate the extend of Fb into the Lakipia area. The boundary as mapped by Delsol seems more accurate, so these were used, reclassifying the areas falling outside the boundaries mapped by Delsol as Be (in Lakipia) or Bd (north of this mountain range)
- Also based on modelling, we mapped of Combretum around the northern extension of Mount Kenya. However, our field observations suggest that on the north-west side this zone is limited to the southern part. The remaining part, the zone is much smaller or not present and should therefore be reclassified as Bd

The vector layer used in the script below to correct the pnv map is included in the zip file: extra material.7z. The map created in the steps below was tmp_4, which was used in the next steps.

```
# Set region and convert vector to raster
```

```
g.region vect=tmp_6a@vegetation
v.to.rast input=tmp_6a@vegetation layer=1 output=tmp_6a use=cat

# Create layer temp1
r.mapcalc "temp1 = if(tmp_6a==511 && tmp_3!=9 && tmp_3!=44, 56, null())" --overwrite

# Create reclass text file with reclass rules below & run reclass to create layer temp2
429 = 65
438 = 65
460 = 65
472 = 65
475 = 65
* = NULL

r.reclass input=tmp_6a@vegetation output=temp1a rules=reclass.txt

# Create layer temp3
r.mapcalc "temp3 = if((tmp_6a==356 && tmp_3!=24) || tmp_6a==367 || tmp_6a==112 || (tmp_6a==113 && tmp_3==20), 63, null())"

#  Create layer temp4
r.mapcalc "temp4 = if(tmp_6a==446, 3,null())"

# Patch the layers and remove temporary files
r.patch input=temp1@vegetation,temp2@vegetation,temp3@vegetation,temp4@vegetation,tmp_3@vegetation output=tmp_4
```

3 Eastern Uganda and bordering areas in Kenya

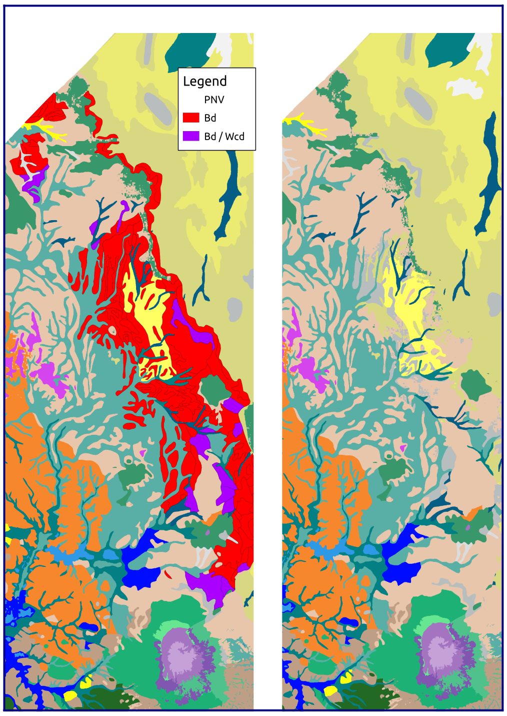
During the initial reclassification of the Langdale-Brown map for Uganda, the classificiation of the R, T, and V classes in the region north of Mount Elgon remained uncertain (red and purple areas in the figure below). On the other side of the border in Kenya, large areas were left unclassified on the RMHK map. For the first version of the map (version 1.0), we therefore used the suitablity distribution map of the combined vegetation types to classify these areas (see the VECEA FLD series volume 6). This resulted in most of these areas to be classified as *Combretum* wooded grasslands (Figure below). In addition, areas east and south-east of Rumuruto (Kenya), up to the border with Uganda were classified as Single-dominant *Juniperus procera* forest.

In the areas visited during our fieldwork, vegetation was dominated by *Acacia* species. This included the plains east of Rumuruto. We did not come up to the border, but it was very evident (with binoculars and from information from the local field assistance) that the plains with Acacia bushland extended far into Kenya, up to the hills 5-15 km east of the border (i.e., including areas marked as Single-dominant *Juniperus procera* forest mentioned above).

In most of the above-mentioned areas *Combretum* species were mostly absent, whereas in a few areas *Combretum* and *Terminalia* species were common in the upper canopy. Two possible explanations for these prominance of *Combretum* species in an otherwise *Acacia* dominanated landscape were differences in edaphic conditions (in some areas the Combretum seemed to occur in the flatter areas with black cotton soils) and the regular occurrence (up to once a year) of fire. According to local informants, these fires are mostly of anthropogenic nature and are lit to create better pastures for livestock.

Given our field observations, we re-examined the original maps used to classify these areas; the Del Sol map (Kenya) and the Langdale-Brown map (Uganda). On the Del Sol map, the areas bordering Kenya were mostly classified as Dwarf-shrub_pseudo-steppes with *Acacia.* On the Langdale-Brown map, the vegetation types could be divided in two main groups. The first were the grassland savanna, bushland, tree and shrub steppe and dry and dry tickets (red areas in figure below). Based on their names, most of these vegetation types were dominated by different combinations of *Acacia*, *Commiphora* and *Lannea* species. The names of the vegetation types in the second group (purple areas in figure below) suggest they were characterized by amongst others *Combretum* species.

Given the evidence presented above, we reclassified all areas marked in red in the figure below as Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket. The purple marked areas in the figure below were reclassified as Transitional zone Somalia-Masai Acacia-Commiphora deciduous bushland and thicket and Dry Combretum wooded grassland (Bd/Wcd). We thereby point the possible influence of anthropogenic factors, especially fire, on the current vegetation patterns.



The shapefile used to make these changes (extracted from the L-B map) is [extra material 2.7z]

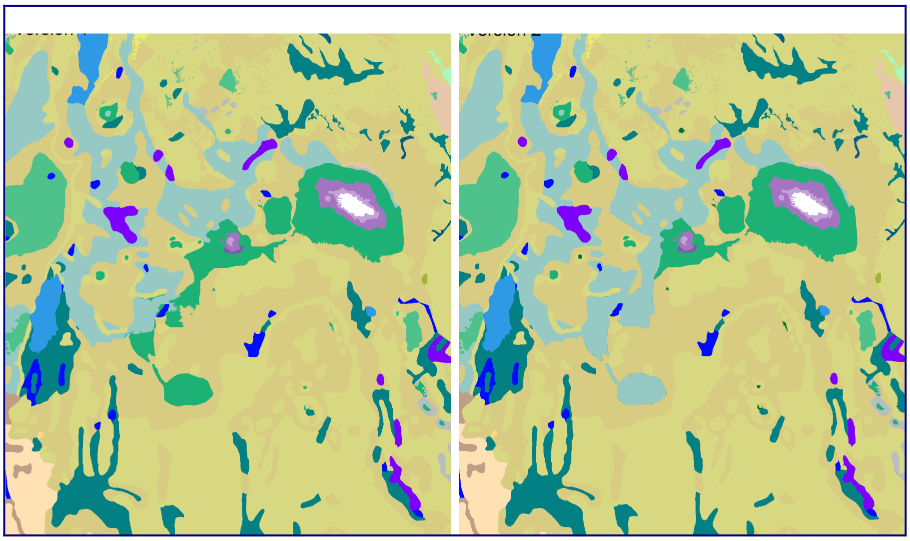
```
#The vector layer tmp_7 contains the column PNV with the classes in which these areas will be reclassified
v.to.rast input="tmp_7@vegetation" layer="1" output="tmp_7" use="attr" attrcolumn="PNV"

# Create layer temp1
v.extract input=veg_kenya_rmhk1@vegetation layer=1 cats=291 output=temp1
g.region -a vect=temp1
v.to.rast input=temp1@vegetation layer=1 output=temp1 use=val value=65

# Create layer temp2
v.extract input=veg_uganda_orig@vegetation layer=1 cats=393,406,461 output=temp2
g.region -a vect=temp2
v.to.rast input=temp2@vegetation layer=1 output=temp2 use=val value=160015
g.region rast=tmp_4 --overwrite

r.patch --overwrite input=temp1@vegetation,temp2@vegetation,tmp_7@vegetation,tmp_4@vegetation output=tmp_10
```

4 Mnt Kilimanjaro - Meru

Ridge and slope grasslands west and northwest of Mount Meru

The ridge and slope grasslands in Tanzania was reclassified as forest in the previous version. An exception was made for those grasslands falling within the zone that was defined by White as 'Edaphic grassland on volcanic soils'. These were reclassified as edaphic grassland on volcanic soils (gv).

By following the White boundaries relatively closely, large continuous areas of ridge and slope grasslands on the Gillman map were split. In this version, all continuous areas of ridge and slope grasslands that fall largely within the boundaries of the grasslands on vulcanic soild on the White map were reclassified as edaphic grassland on volcanic soils.



Fa/Fb/Fh - splitting off the Fh (Afromontane dry transitional forest)

All areas classified as Fa/Fb/Fh (the green areas on and between Mount Kilimanjaro and Mount Meru in the second figure above) were reclassified as Fh (Afromontane dry transitional forest) when below or equal to 1750 meter and as Fa/Fb when above 1750 m. This was based on Beesley (1972) for mount Meru and Bussman (2006) for both mountains.

In addition, the lower montane Cassipourea forest an the northern and western slopes and the submontane Croton-Calondendrum forest areas on the Hemp map were reclassified as Fh (thus effectively increasing the upper boundary of this type on the northwestern and southwestern slopes.

Splitting Fa/Fb

Based on Hemp 2006a,b the areas classified as Fa/Fb on Mount Kilimanjaro were reclassified in Fa and Fb. The Middle and upper montane Ocotea forest and the Potential Montane Ocotea forests were reclassified as Fa. The remainder was classified as Fb.

The Hemp map only covered Mount Kilimanjaro. For the remaining areas on and between Mount Kilimanjaro and Mount Meru, I used a modeling approach to split the Fa/Fb areas. I created models for Fa and Fb, based on the Fa, Fb and Fa/Fb areas in the vecea countries, excluding Ethiopia (see volume 7, resulting layers are FaK_wC_sc_nDEM_current and Fb_wC_ss_nDEM_current). Next, each raster cell originally classified as Fa/Fb was assigned Fb or Fa, based on the highest score of the two models. .

5 Deserts

All areas with annual rainfall < 175 mm were reclassified as Desert (S)