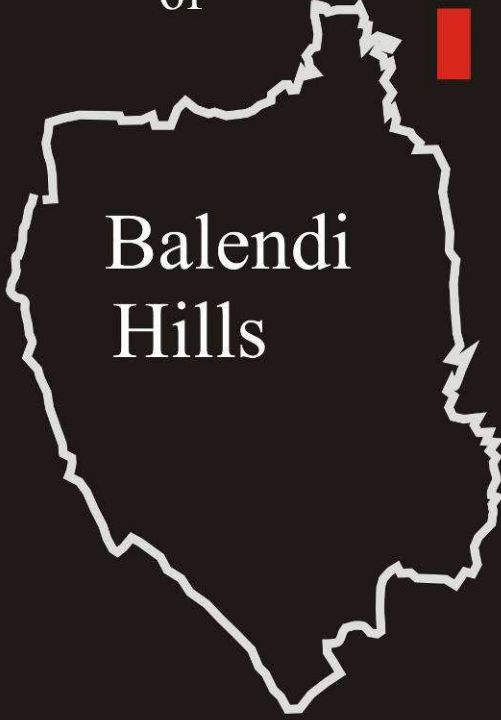




The Biodiversity  
of



Balendi  
Hills

A central graphic featuring a white outline map of the Balendi Hills region on a black background. The text "The Biodiversity of Balendi Hills" is arranged around the map. A small red rectangle is positioned to the right of the map's upper right corner.



Missouri Botanical Garden

# The biodiversity of **Balendi Hills**

Prepared by

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Field team:

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Missouri Botanical Garden  
Gabon 2007



## Prologue

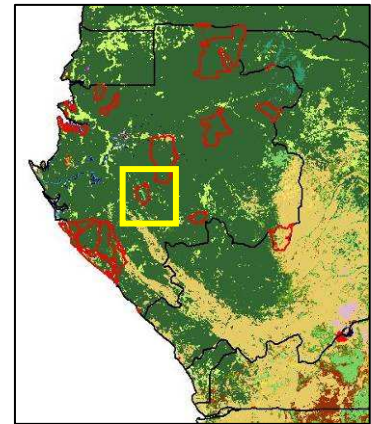
Missouri Botanical Garden was awarded a Central African Regional Program for the Environment (CARPE) subcontract from the Wildlife Conservation Society (WCS) to carry out botanical expeditions to identify Biodiversity Sanctuaries for micro-zoning in the landscape.

During this fiscal year Missouri Botanical Garden (MBG) has executed botanical activities in the Massif du Chaillu assessing the plant biodiversity of the Balendi Hills. The results and observations are presented here.

*Miguel E. Leal*

December 2007

# Introduction to Balendi Hills



The forest cover in Gabon (dark green) and the National Parks Waka and Lopé outlined in red and the Balendi Hills (encircled in yellow).  
source Mayaux et al. 2003

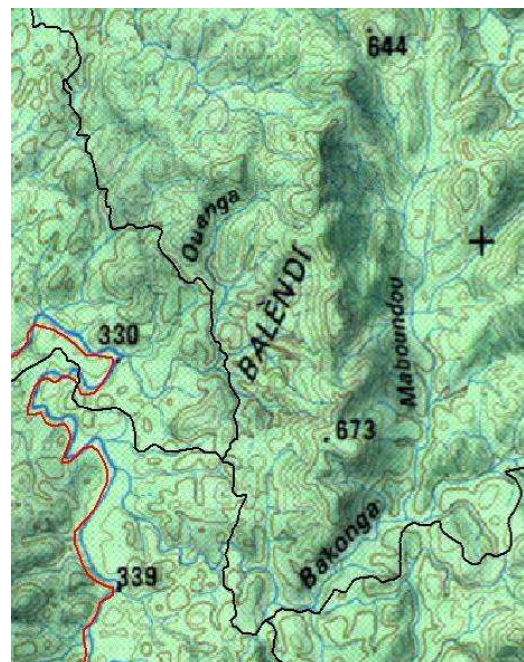
## The Balendi Hills

The Balendi Hills are situated close to Waka NP in between with Lopé NP. This range of hills may serve as a potential corridor between the two national parks. In the vegetation map above there are patches of secondary forest (light green) and patches with a highly fragmented canopy (brown patches). This part of the forest has been exploited twice, first by a Spanish logging company and most recently by a Malaysian logging company. One of the reasons to do a biodiversity in area was the recent discovering of a species which did not fit any of the existent plant families, and its distribution was thought to be restricted to the eastern part of Waka NP consequently as the name of the new plant family *Wakaceae* chosen after the park.

## Geomorphology

The flanks of this range are J-shape. Slopes close to the top and main ridge (so-called upperslope) are very steep, slopes at the bottom end or lower slope are almost flat or very gently. The main ridge has an altitude above 500m, with the highest summit reaching 670m, and the slower slopes descending to 350-400m.

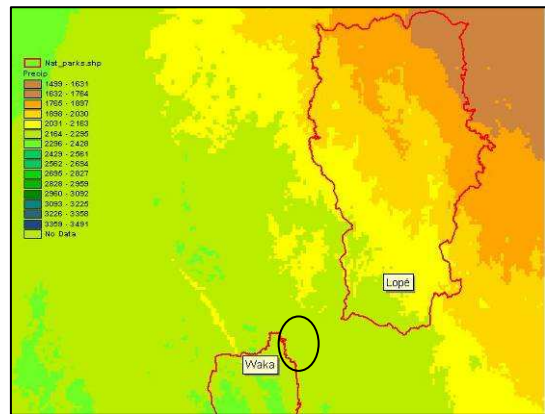
Map showing in more detail the Balendi Hills and the big forest roads (black lines).





### Rainfall

Mean annual rainfall between the parks is a wide band between 2100 and 2300mm. There does not seem to be an orographic effect for the Balendi Hills, unlike further west in the park, where the two main ridges of the Ikobé valley receives more rainfall due to their higher altitude. The higher ranges west to Balendi may place the Balendi Hills in a rain shadow.



Mean rainfall over north Massif du Chaillu , (gradient from dark green to orange= wet to drier.

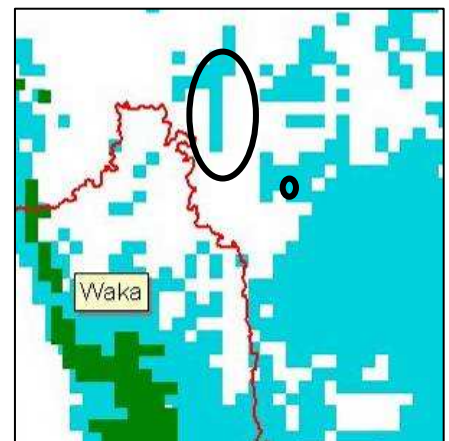


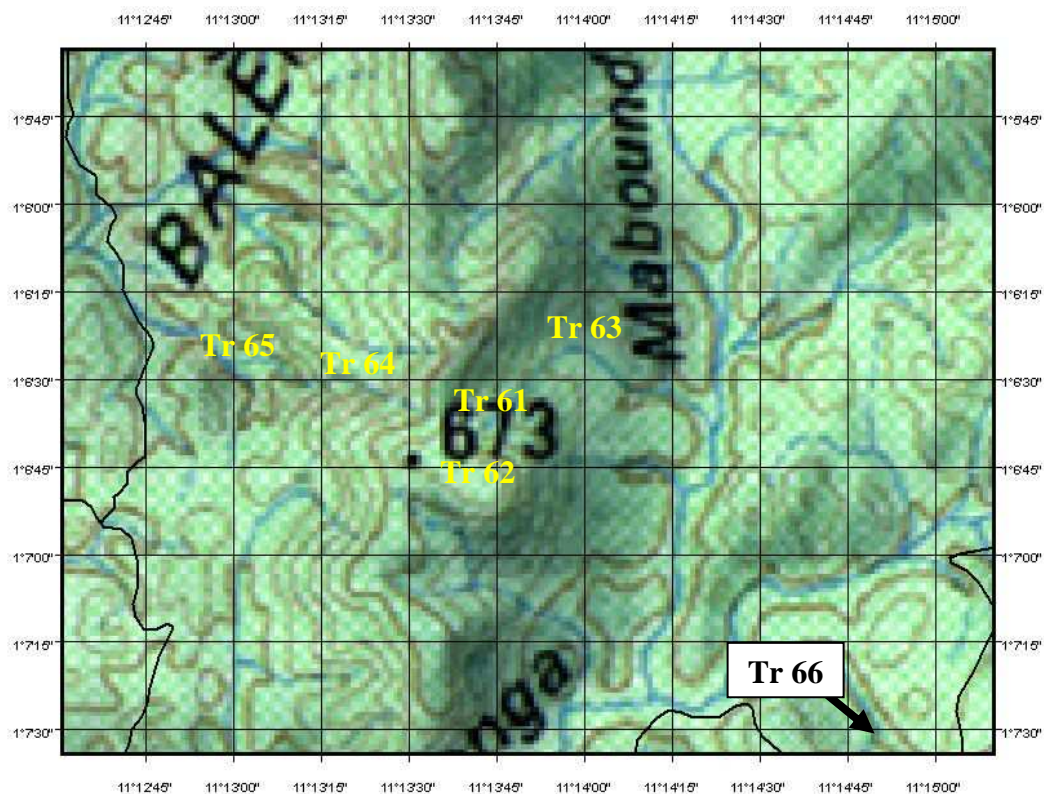
### Geology

Geology in general determines the geomorphology of the area, because rock formation different ways of eroding and they determine types of soils. The hills straddle two geological formations where the main ridge marks the border between the two of them. The western side constitutes of paragneist (Po3) and is youngest with 2400Myrs and the eastern side orthogneiss (Pac) originally dating back to Archean (at least 2600 Myrs ago) and which was metamorphosed over the Paleoproterozoic.

### GIS model

During CARPE phase II a model was developed and tested locate Pleistocene forest refuge areas in more detail within the present-day forest. In this model, areas with an altitude above 500m and rainfall above 1800mm and above 2500mm are overlapped in GIS (ArcView). The areas identified are also revered to as climatically stable forests, which with climate change have to highest conservation priority. In dark green are the wet refuge areas (the west ridge of the Ikobé valley, light blue the humid refuge areas and in white the non-refuge areas. The Balendi Hills (see right encircled in black) are part of the humid refuge forest (light blue) surrounded by non- refuge forest. Its isolated position may have comprised its refuge high biodiversity potential.

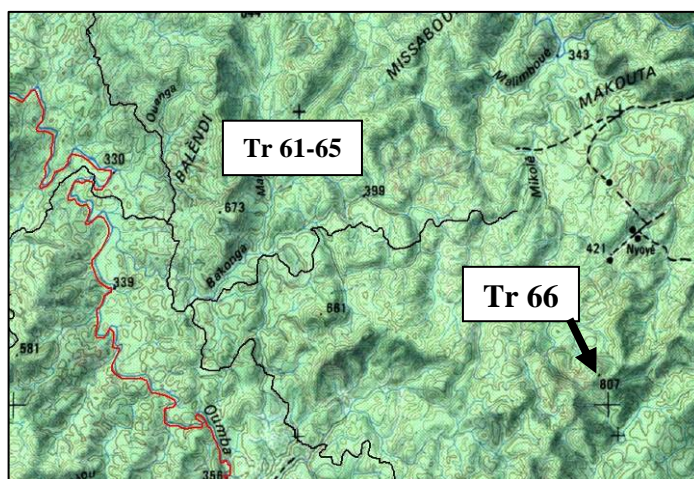




Map showing the transects (Tr) above: the transects (Tr 61-65) for Balendi Hills and below Tr 66 at 800m to the SE of Balendi Hills.

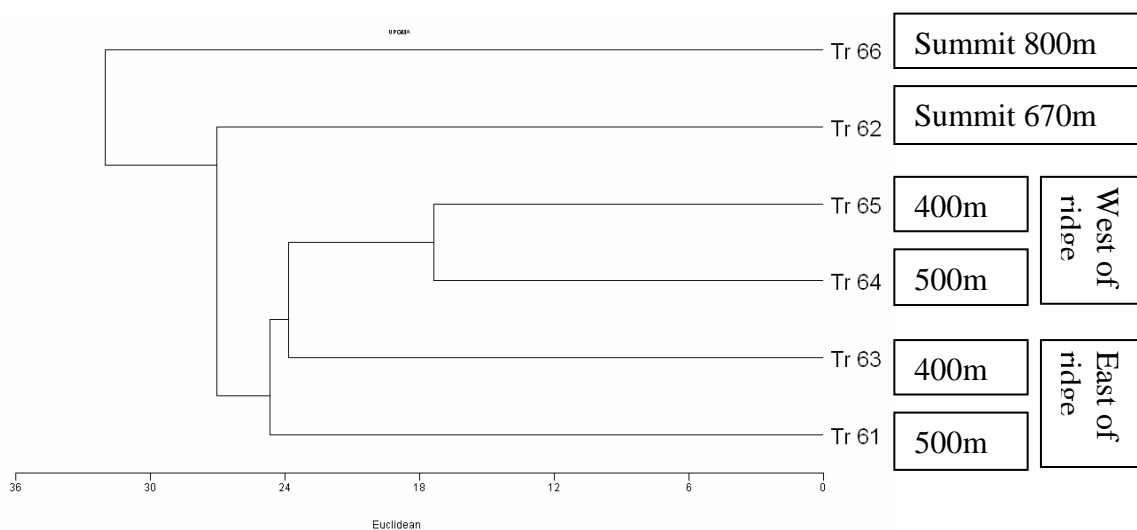
### *Transect layout*

Previous fieldwork has shown that topography is a strong force driving species composition. The range of hills have a N-S orientation and transects were placed east and west of the main ridge at upperslope (Tr 61 and Tr 64, respectively) and lower slope (Tr 63 and Tr 65 400m) and one Tr 62 on the highest summit in between (Tr 61). One last transect (Tr66) was placed at the highest summit (800m) away from Balendi Hills. This would allow to compare the highest summit east from Waka NP with those in the park.



### **Methods**

The transects used to record species composition were 200 m long and 5 m wide. Every individual with a diameter at breast height (dbh) of 5 cm and greater was recorded and identified or vouchered for identification in the herbarium of Libreville. Often voucher specimens were without flowers or fruits in which case species were identified only on sterile e.g. leaf characteristics. Such identifications are less confident and referred to as morpho-species. Similarity between the transects was calculated by using the Sørensen index. Sørensen index is  $S_{12}/[0.5(S_1+S_2)]$  where  $S_{12}$  is the number of shared species between two transects and  $S_1$  is the total number of species in transect 1 and similarly  $S_2$ .



**Cladogram showing the relationship (similarity as distance in UPGMA) between the transects, close e.g. Tr 65 and Tr 64 or distant e.g. Tr 66 and Tr 61.**

<b>Balendi</b>	<b>Tr61</b>	<b>Tr62</b>	<b>Tr63</b>	<b>Tr64</b>	<b>Tr65</b>	<b>Tr66</b>	<b>average</b>
F-alpha	48.0	48.5	43.5	51.7	46.4	41.3	46.6
species	59	73	64	65	65	66	65.3
n	116	170	146	130	142	163	144.5
endemic	13	36	24	15	18	33	23.2
end%	22.0	49.3	37.5	23.1	27.7	50.0	34.9

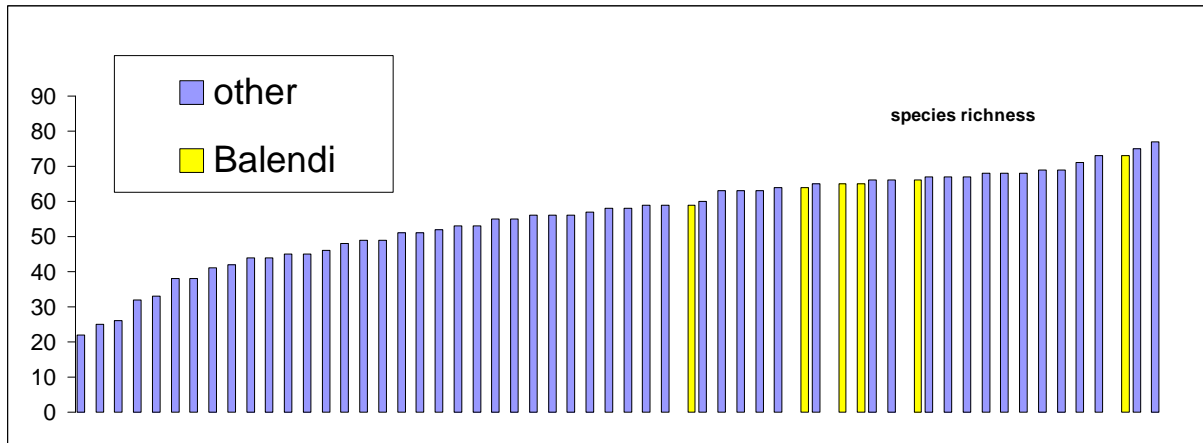
## Results

### *General characteristics*

On the five transects 220 species were recorded. On average 65 species were present on a transect and differences between transects are relatively small (see the above table). The highest score was 73 species on Tr62 and the lowest 59 species on Tr61. Species restricted to a single transect (endemic) varied between 13 (22%) and 36 (49.5%). The number of trees on a transect was lowest on Tr61 on the eastern upslope and highest on Tr62 on the summit above Tr 61. F- alpha-diversity varied between 41.9 and 51.7 with lowest value from the distant summit (800m)(Tr66) and highest value from western upslope (Tr64).

### *Similarity*

The cladogram (see above) shows the two summits are most different in species composition (Tr 62 and 66) from all the other transects. Transects on the west side of the ridge resemble each other closest (Tr 64 and Tr 65), but there is not a clear split between east and west. The level of endemism is from highest on the highest summit and furthers away (Tr66), after that it is the summit on the main ridge (Tr62).





## Discussion

### *Similarity*

The cladogram shows that the transect on the highest summit (Tr 65-800m) outside the Balendi Hills outgroups all other transects. This is only normal since species composition changes with distance for no apparent reason, also known as ecological drift. Also its altitude is considerably higher, 800m versus 670m on the highest summit of Balendi, which can cause a strong difference in species composition and which would also explain the high level of endemism observed on this transect. Geology and aspect between west and east of Balendi Hills is big, but this is somehow not reflected a clear split in species composition. Transects on the west side group together (Tr64 and Tr 64), but on the east side they do not as strongly (Tr 61 and Tr 63). The species composition on the summit is not closely linked to one of the transects, but more is closely to the eastern transects (Tr 61 and Tr 63). There is neither a strong altitudinal gradient.

### *Species richness*

Comparing the Balendi transects with other transects in Gabon species richness of these transects is slightly above average with one outlier in the high end. In terms of fisher-alpha diversity all transects have an average diversity. There are neither big differences between the transects which may have to do with the relatively dry conditions in these hills. The drier conditions in these hills is evident from the near absence of mosses in the vegetation, unlike on other summits in wetter areas like the eastern ridge of the Ikobé Valley (see biodiversity report on NE Waka).

One of the reasons to do a biodiversity assessment in this area was to estimate the abundance of the newly discovered *Wakaceae*, but in none of the transects was the new family encountered.

## Conclusion

The biodiversity of Balendi Hills was assessed to see whether in case it showed a high biodiversity or a high abundance of the new *Wakaceae* it could be added to the Waka NP as a biodiversity sanctuary. However, no *Wakaceae* were encountered and its biodiversity was not exceptionally high. The area most likely has suffered from logging activities in the distant and recent past. There were some interesting finds as mentioned below under “general collecting”.

## General collecting

188 species were collected (Leal *et al.* 1400-1588), their full identification is still pending and field note data is being entered into the landscape-database. But there are some preliminary notes and observations.

The species *Vangueria georgesii* (Leal *et al.* 1517) was collected belonging to the family of the Rubiaceae. This is the second time that it has been collected.



*Vangueria georgesii*

Also the new *Wakaceae* was encountered, but recent revision of the specimens showed that its distribution is far less restricted than only around the north east part of the park. It is also present in among other Lopé and Boué.



A pink speckled *Amphiblemma* was found on the steep slopes just below the highest summit. This is probably something new, but unfortunately it was not flowering or fruiting and so its status has to be postponed until there is more material available.



Another interesting find was species from the *Burmaniaceae* a family of saprophytes which are not well-known and it may well be new species.

## Acknowledgements

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