



The Biodiversity
of

Mboumi
Hills



Missouri Botanical Garden

The biodiversity of Mboumi Hills

Prepared by

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Prologue

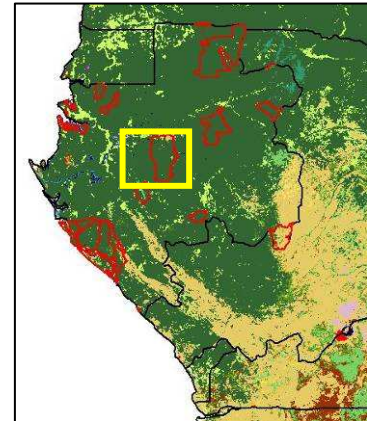
Missouri Botanical Garden was awarded a Central African Regional Program for the Environment (CARPE) subcontract from the Wildlife Conservation Society (WCS) to carry out botanical expeditions to identify Biodiversity Sanctuaries for micro-zoning in the landscape.

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

Miguel E. Leal

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Introduction



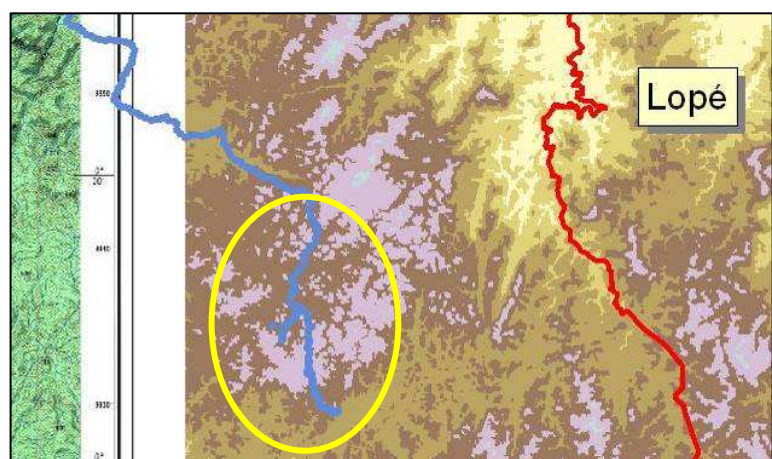
The forest cover in Gabon (dark green) and the National Parks Lopé outlined in red and Mboumi Hills (encircled in yellow). source Mayaux et al. 2003

Mboumi Hills

The Mboumi Hills are situated west Lopé NP. Its hills were covered with pristine forest, but recently logging has begun in this area. A logging road is being build (see below: blue line in yellow circle below), which will link up with existing roads east of Waka NP in the south. There does not exist a national map for this part of Gabon, which ends just west of the Mboumi Hills (see map below). This makes it more difficult to get a general idea of the ruggedness and topography. It also hinders navigating through the area.

Geomorphology

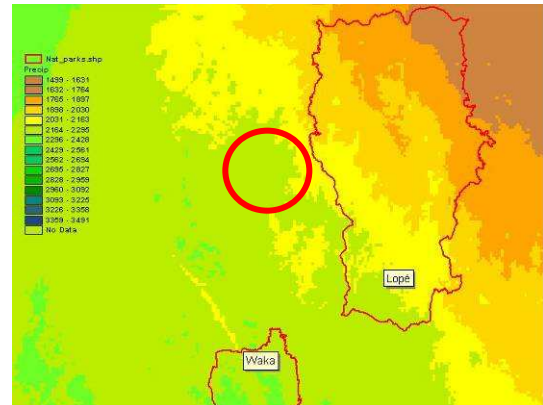
The topography on the plateau was estimated by making in GIS an altitude map with intervals of 50m from elevation data. This only gives an idea of macro-relief as pixel size blurs any information on micro-relief. Most of the plateau has an altitude around 500m and the highest summit is 750m.



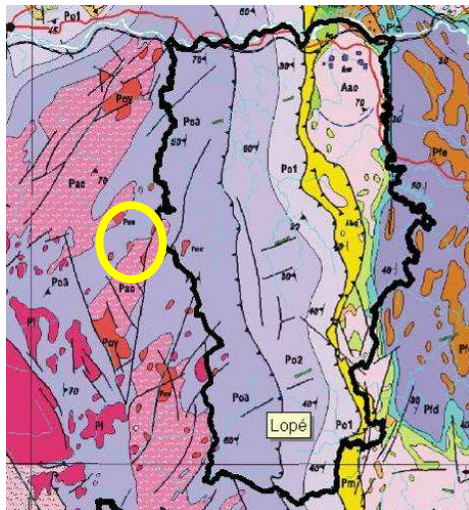
Map showing in more detail the Mboumi Hills (encircled in yellow), the big forest road (blue lines), and Lopé NP (red line).

Rainfall

Mean annual rain fall on the plateau is higher relative to most of the Lopé NP, but consistent with most of the Massif du Chaillu (see right). An orographic effect meaning that with altitude rainfall increases was not evident analyzing the rainfall data in correlation with elevation data in GIS. But field observations showed that conditions were misty and cooler, than was expected from the rainfall data only.



Mean rainfall west of Lopé NP, (gradient from dark green to orange= wet to drier.



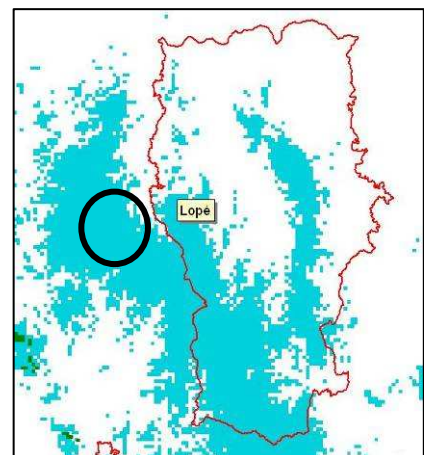
Source: Thomas et al. 2000

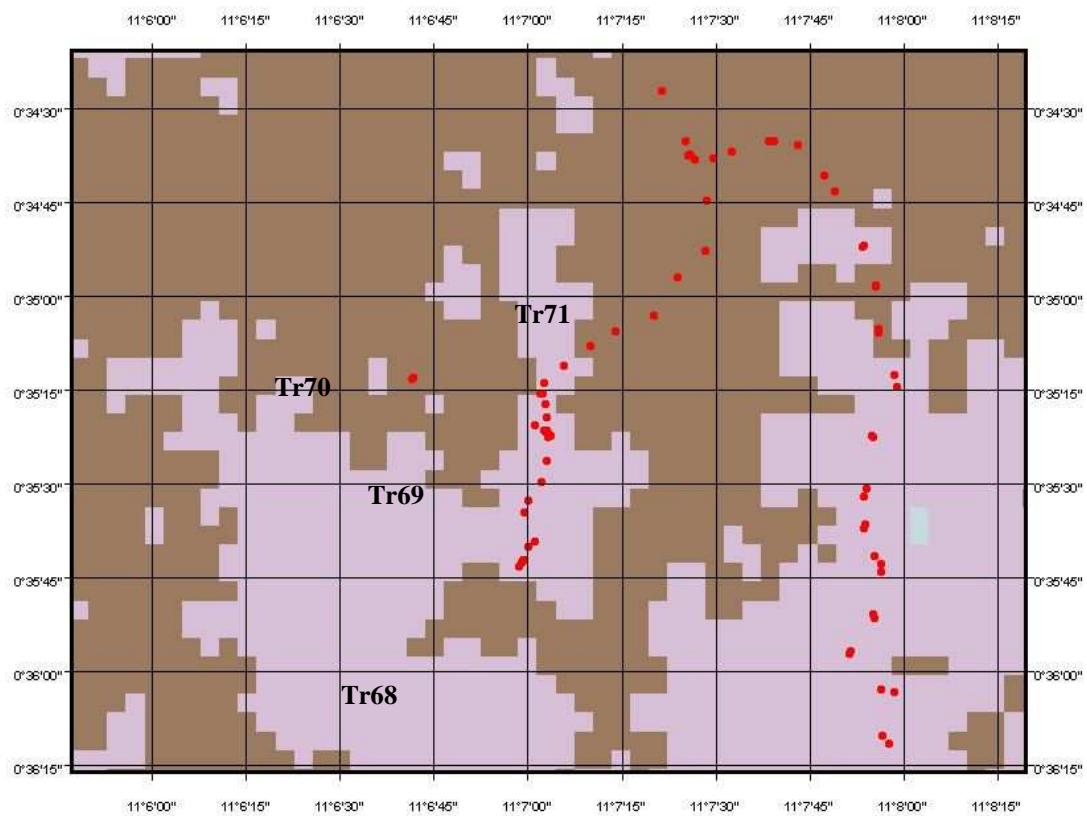
Geology

Geologically the plateau is not very different from the rest of the Massif du Chaillu, which is dominated by paragneis (Po2) and orthogneis (Pac) rock formations. The latter dating from the Archean and metamorphosed over the Paleoprotozoic (2300-2400 Myrs). Geology in general determines the geomorphology of the area, as rock formation erode differently and types of soils.

GIS model

The model developed over the years during CARPE phase II has been refined which allows locating Pleistocene forest refuge areas in more detail. In the model altitude > 500m and rainfall > 2.5m is overlapped in GIS. The areas identified are also reverred to as climatically stable forests, which with climate change have to highest conservation priority. The Mboumi Hills was identified as part of the humid Massif du Chaillu refuge area (see right encircled in red).





Map showing transects (Tr) and logging road (red dots)

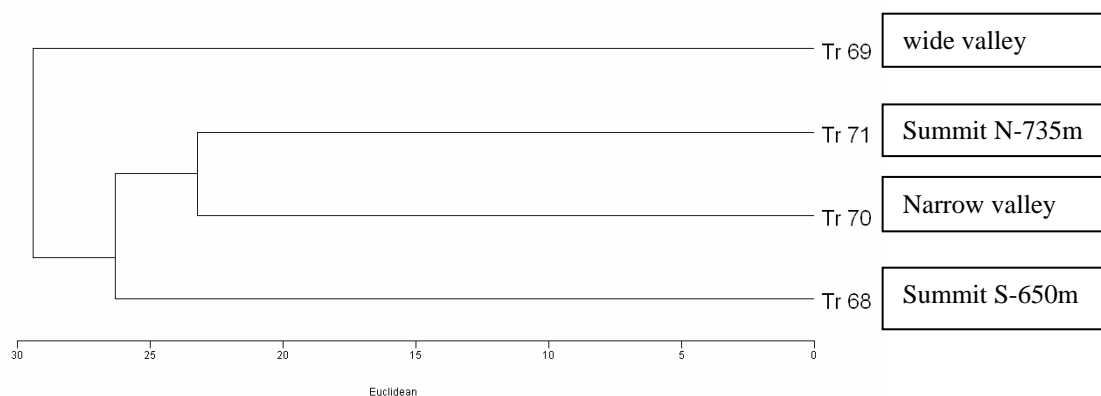
Transect layout

The hills or plateau are situated at the north-eastern edge of the Massif du Chaillu. Previous fieldwork has shown that topography is a strong force driving species composition. Therefore transects were placed on the highest summit in the south (Tr68), on the highest summit in north (Tr71), and two at a lower altitude (Tr69 and Tr70).

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 70 and Tr 71 or distant e.g. Tr 69 and Tr 70 or Tr 71.

Mboumi	Tr 68	Tr 69	Tr 70	Tr 71	average
F-alpha	45.4	45.1	46.5	41.3	44.6
species	66	67	67	66	67
n	149	154	150	163	154
endemic	24	28	25	25	25.5
end%	36.4	41.8	37.3	37.9	38.3

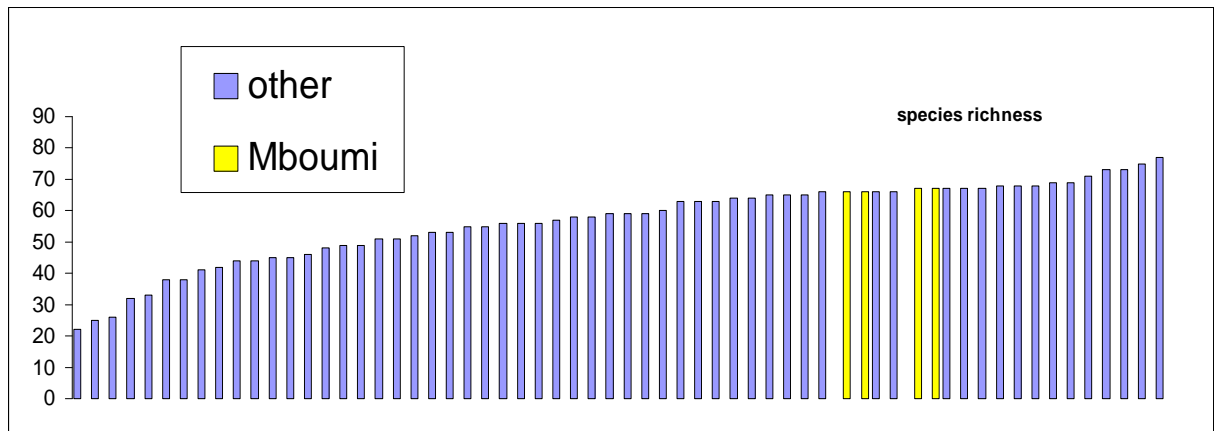
Results

General characteristics

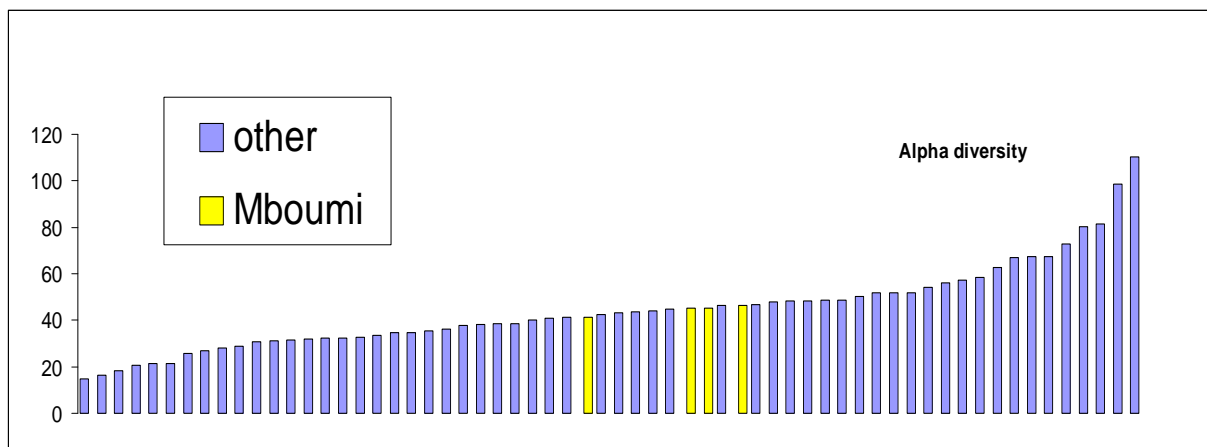
On the four transects 136 species were recorded (see the above table). On average 67 species were present on a transect and differences between transects minimal. The highest scores were 67 species on Tr69 and Tr70 and 66 species on Tr68 and 71. Species restricted to a single transect (endemic) varied between 24 (36.4%) and 28 (41.8%). The number of trees on a transect was lowest on Tr68 on the southern summit and highest on Tr71 on the northern summit. F- alpha-diversity remarkably constant varying between 41.3 and 46.5 with lowest value from the highest northern summit (Tr71) and highest value from the narrow valley (Tr70).

Similarity

The cladogram (see above) shows the that the wide valley is most different (Tr69) followed by the southern summit (Tr68), and the apparent extremes, i.e. the highest summit (Tr71) and narrow valley (Tr70) are most similar in species composition. The other measure of similarity i.e. endemism varies little among the four transects (24-28 species and 36.4-41.8%).



Graph showing species richness on the plateau (yellow bars) and other sites in Gabon (blue bars).



Graph showing Alpha diversity on plateau (yellow bars) and other sites in Gabon (blue bars).

Discussion

The cladogram shows that species composition is not clearly determined by geomorphology. The summit transects (Tr68 and Tr 71) don't group nor do the valley transects (Tr69 and Tr70). In fact the highest summit (Tr71) and the lowest valley (Tr70) are most similar. One explanation could be that they are closer to each other in this part of the catchment area. The narrow and wider valley are separated from each other by a low ridge and they only link up much further south.

Comparing the Mboumi transects with other transects in Gabon it is noteworthy to observe that in terms of species richness they are above average and in terms of Fisher-alpha diversity average (see graphs above). But their biodiversity is similar to what is observed for other transects from the humid refuge areas in the Massif du Chaillu. However, it remains remarkable that all four transects vary very little in transect characteristics, i.e. species richness, F-alpha diversity, endemism and even in number of individuals. This has not been observed at any site before (see other biodiversity reports).

Ecological reasons which may explain this could be a minor variation in environment and habitat, e.g. a gentle topography, no strong differences in aspect (east versus west), no strong difference in drought stress during the dry season. The latter is also supported by the presence of the high altitude species *Pseudagrostistachys africana*, and *Calvoa maculata*. The former species is typical for "submontane to montane" environments where misty conditions prevail and maximum day temperatures are low.

A historical reason linked with the latter environmental characteristic (less drought stress) could be that this area has never really suffered from forest disturbances due to climatic stress. The reasoning behind this is that less impact by climate change means that fewer disturbances have occurred, less turnover of species and hence less changes in species composition within the forest.

Especially, the presence of *Pseudagrostistachys africana* is a strong indication. This species would have had a much wider distribution during the last ice age when climatic conditions were much more montane in larger parts of Gabon. At the end of the last ice age when climate warmed up its distribution became much smaller through the process of local extinction and it would only have been able to survive in areas which suffered less from this Holocene warming.

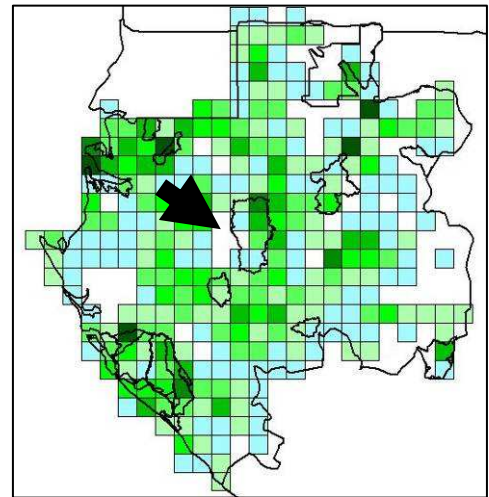
Conclusion

The Mboumi Hills are not exceptionally rich in terms of biodiversity, but the presence of *Pseudagrostistachys africana* and *Calvoa maculata* suggest very stable climatic conditions during the last ice age and late Holocene which have made it probable that forest persisted in these hills. This is so-called climatically stable forest and these forests would persist whatever climate change. Unfortunately, this area is part of a logging concession and now that its canopy has been opened edge effects linked with forest fragmentation and increased forest disturbance will make it less resilient to climate change.

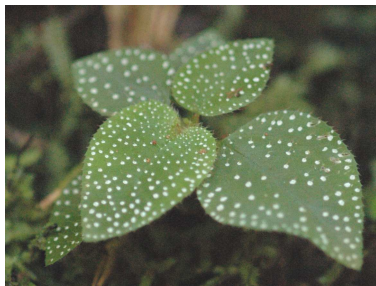
General collecting

137 species were collected, their full identification is still pending and field note data is being encoded into the landscape database. But there are some preliminary notes and observations. These are also the first collections ever from this area (see right).

Collected were the new species *Calvoa maculata* previously only known for the Monts de Cristal, *Pseudagrostistachys africana*, another indicator of high altitude or misty conditions and the new family of the Wakaceae. Other interesting finds are an unknown orchid and a *Begonia* species which may also be new for science.



Map showing the collection densities in the 15 degree grid cells over Gabon (in dark green grid cell density is high e.g. Lopé (field station) or Libreville (historical) and white grid cells are empty).

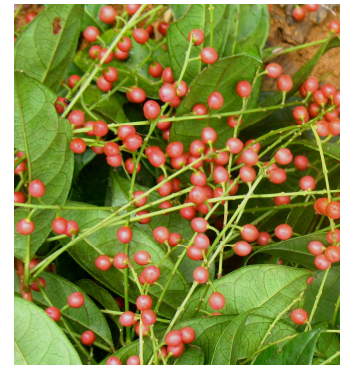


Calvoa maculata



Unknown orchid, spec. nov.?

Wakaceae in fruit



Begonia spp, spec. nov.?

Acknowledgements

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