

The Biodiversity of Bouvala



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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 Massif du Chaillu landscape.

During this fiscal year Missouri Botanical Garden (MBG) has started the botanical survey of the flora around the Birougou National Park by assessing the plant diversity of the Bouvala area and the Mont Songo one of the highest areas in the Massif du Chaillu landscape

The results and observations are presented here.

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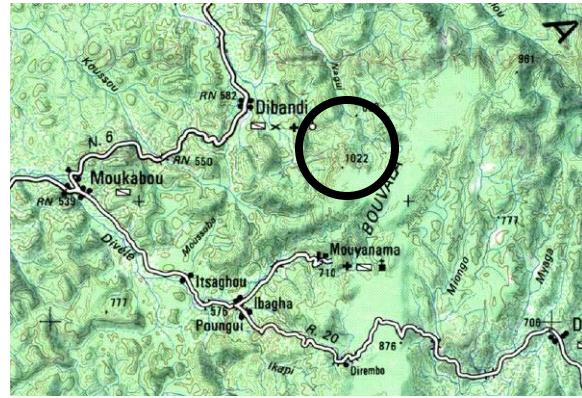
Introduction to Bouvala

The Massif du Chaillu is the largest elevated area (500m<) in Gabon and along with Belinga Mountain, one of the highest areas of Gabon. Despite the fact that it was recognized by different authors as a refuge area with a potentially high diversity of plant species, it remains poorly known and unexplored. Elevated areas in Central Africa are known to be centers of diversity and were proposed, according to different authors, as Pleistocene Refugia. These postulated refuges are key places for allopatric speciation and generally host a high number of endemic species (plants, reptiles, etc). They are therefore of high conservation concern.

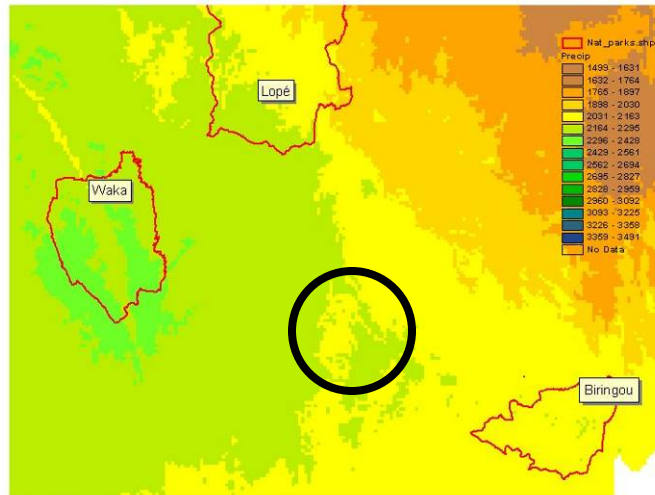
Extensive explorations in the Massif du Chaillu by MBG have been focused mainly around the Waka NP over the last few years. We now start gathering data to evaluate the biodiversity around Birougou NP. The area NW of Birougou NP was targeted first as it is the only part of this region easily accessible and also because there is no data on the forest exploitation in the area. Our biodiversity assessment aimed firstly to validate whether the forest was still botanically valuable for conservation, and also because of the recent discovery of *Begonia thomensis* in Gabon (a former endemic from Sao Tomé) which

indicates to the potential high value of the area for the conservation of the Gabonese flora.

The Bouvala mountain massif is situated between Mont Birougou NP and Waka NP, east to the village of Dibandi. The Mont Songo reaching 1022 m, is the highest peak, and also the highest summit of the Massif du Chaillu landscape. Mean annual rainfall in the area is between 2000 and 2300mm. There is a probable orographic effect for the Mont Songo due to its high altitude. Slopes close to the top are very steep; slopes at the west bottom are almost flat. East to Mont Songo, the Bouvala plateau lies above 800 m and dissected by several small streams and ravines. The west and east side of the Bouvala Massif were studied.



The Mont Songo area, East of Waka NP and North West of Birougou NP (circle = Mont Songo)



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

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 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 . Local diversity or diversity alpha has been estimated by using alpha fisher index, but also by rarefaction methods: based on rarefaction curves, we can obtain an unbiased diversity index for a fixed number of individuals re-sampled (in this study $k = 64$).

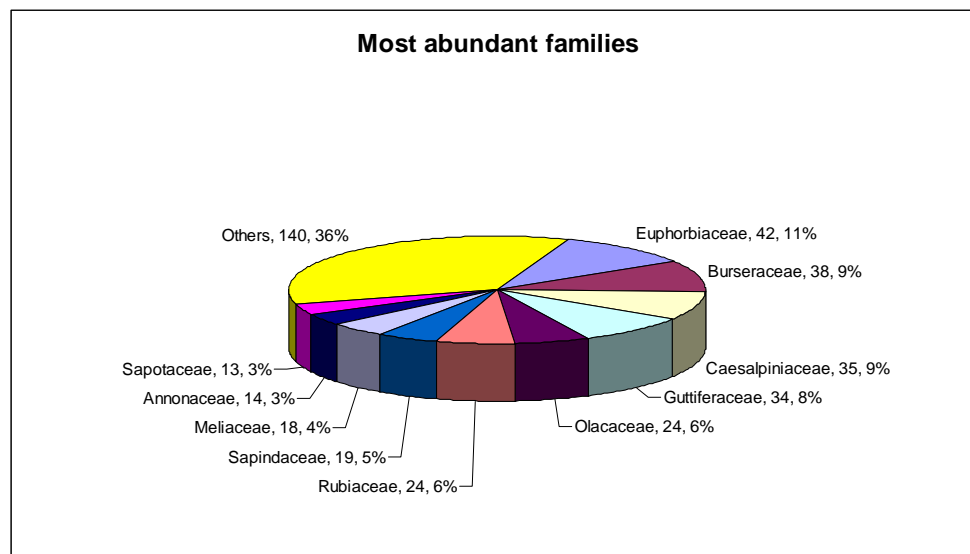
Results

General characteristics

A total of 255 species were recorded. On average 66 species were present on a transect and differences between transects were low (except for Tr74 in the valley). The highest score was 75 morpho-species on Tr72 (Mont Songo) and the lowest, 55 species on Tr74 (valley). The average number of trees on a transect was 136 individuals and much lower in Tr74 (valley). Alpha-diversity was highly variable among transects (between 40.5 and 64.9). Higher values were encountered on Mont Songo (Tr72), and on the plateau in East Bouvala (Tr 77). Unbiased diversity index was higher for Tr75 and Tr76.

	Tr72	Tr73	Tr74	Tr75	Tr76	Tr77	average
spp	75	64	55	64	71	72	66.83
n	149	128	111	156	140	133	136.17
alpha	60.22	50.93	43.25	40.54	57.59	64.09	52.77
S(k) for k=64	41.99	40.76	38.43	35.6	43.09	43.6	40.58

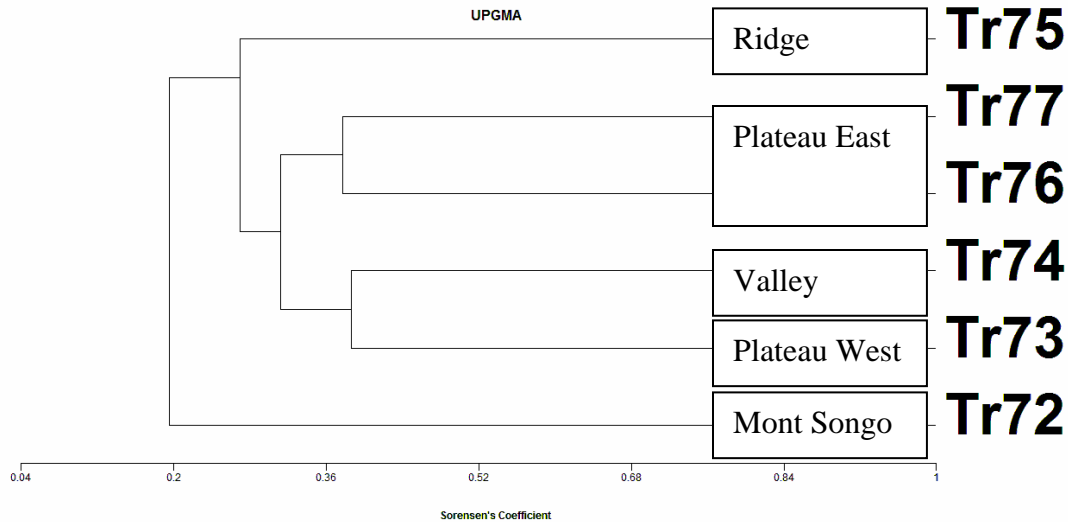
The Euphorbiaceae, Burseraceae, Caesalpinaceae were the dominant families in terms of individuals while *Santiria trimera* (Oliv.) Aubrév., *Pentadesma grandifolia* Baker f., *Garcinia conrauana* Engl. were by far the dominant species overall. These species are typical from submontane vegetation types.



Most dominant families among transects in term of individuals.

Similarity

The cladogram shows that the transect on the summit of Mont Songo and on the eastern ridge are different from the others transects in species composition. The transects of on each plateau (800 – 860 m) are most similar, and so the transects in the valley (625 – 680 m). On the east side the transects (Tr75, Tr76, Tr 77) show a higher similarity with each other than with the transect close to Mont Songo (Tr72, Tr73, Tr 74).



Dendrogram showing the floristic similarity calculated with Sorensen index between the different transects.

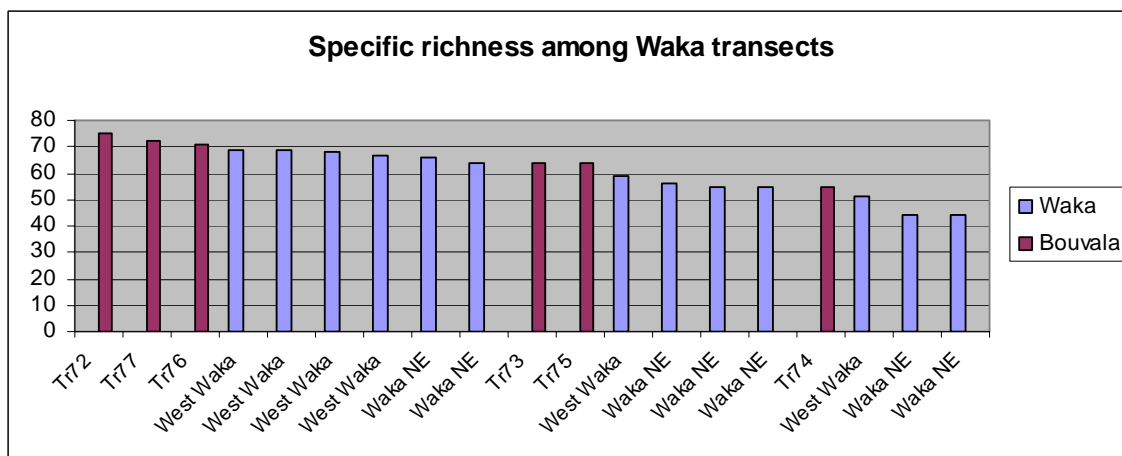
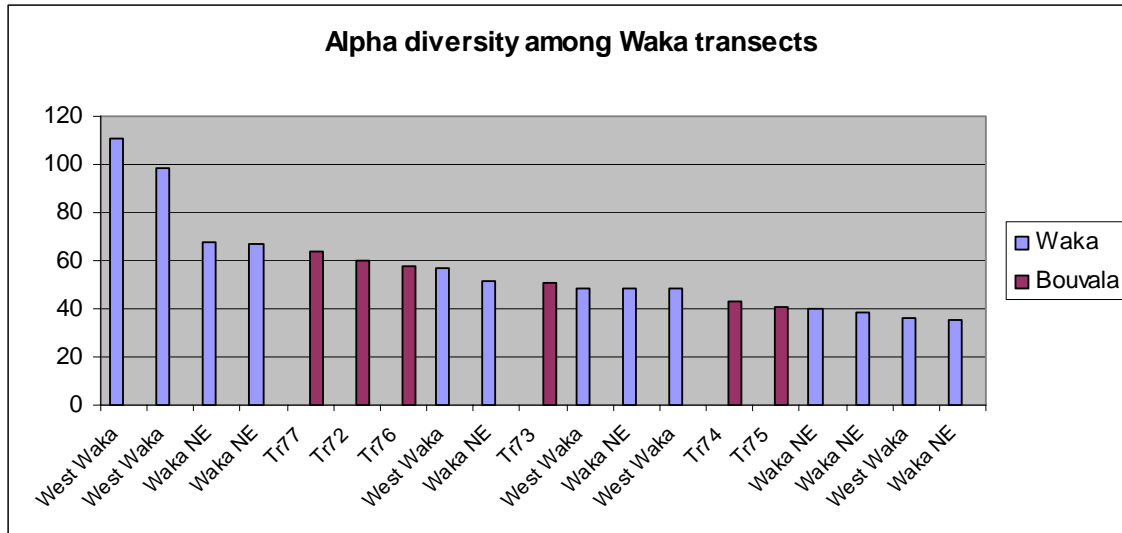
Discussion

Similarity

The similarity in species composition between the west and east side of the Bouvala massif is relatively low, as they did not group together, which means that species turnover with distance is high. On other observation is that the transects on more exposed places like the summit and ridge are significantly different from the transect at a lower altitude but at a relatively short distance.

Species richness

In term of species richness some of the transects in Bouvala have the highest values recorded for all transects in and around Waka NP and also the average of around 67 is higher, 64 and 55 for transects in West Waka and NE Waka. In terms of fisher-alpha diversity, the Bouvala transects only have an average diversity compared to all other transects in the region. There is no clear indication that transects from one end of the massif are richer than the other or that transects at higher altitude are richer than the lower ones.



Conclusion

The biodiversity of the Bouvala area was assessed to identify botanically interesting forests outside the park as compensation area for the logged part of Waka National Park and Birougou National Park. This assessment showed that this mountain massif harbors a rich submontane forest indicated by the presence of *Pentadesma grandifolia* Baker f. and *Garcinia conrauana* Engl. In species richness several transects had the highest values recorded for the region, but in alpha fisher index values only average. This area could be proposed as a submontane sanctuary because it harbors non logged vegetation rich in rare and endemic plant species.

General collecting

Full identification of the 221 specimens collected during this mission is still ongoing and revealing some interesting findings. One of them is the rare liana *Begonia thomeana* C.DC., collected for the first time in Gabon in February 1983 which was at that time endemic to the island of Sao Tome in the Gulf of Guinea (see inset). It is now collected for the second time in Gabon on Mont Songo, one of the two sites surveyed during this mission. Several specimens of rare submontane plants were collected, among which *Voyeria primoloides*, a saprophytic herb that grows only in places with a lot of light, usually near summits and ridges.



Begonia thomeana

The Rubiaceae family was the dominant

family in terms of frequency in the under storey. In this family, we collected *Chassalia tchibangensis* Pellegr., endemic to Gabon, which was only known from three specimens in the checklist of Gabon (Sosef et al, 2006).



The rare liana *Begonia thomeana*

Begonia thomeana

B. thomeana was collected in February 1983 in the Massif du Chaillu. At that time, it was considered as endemic to the island of Sao Tome in the Gulf of Guinea. It was then collected for the second time in Gabon in Mont Songo, one of the two sites surveyed during our trip.

This strange disjunctive distribution, on the summit of São Tomé and upper slopes of Massif du Chaillu in Gabon, could be explained by the very characteristic seeds which show a specialization functional to wind dispersal (Wilde de., 1985).

Phylogenetically isolated, *B. thomeana* occurs in areas on the periphery of the main putative Pleistocene lowland forest refuges (Plana *et al* 2004). These include São Tomé and the Massif du Chaillu. The habitat of this species is the submontane forests of Gabon and Sao Tomé. It could be considered as paleoendemic and has escaped extinction during rainy period by finding refuge in the highest forest mountains. This illustrates that mountain forest species could have survived in pockets of mountain forest during rainy periods. These pockets currently cover hill summits or mid-elevation mountains like Mont Songo.

Orchid diversity in Bouvala area

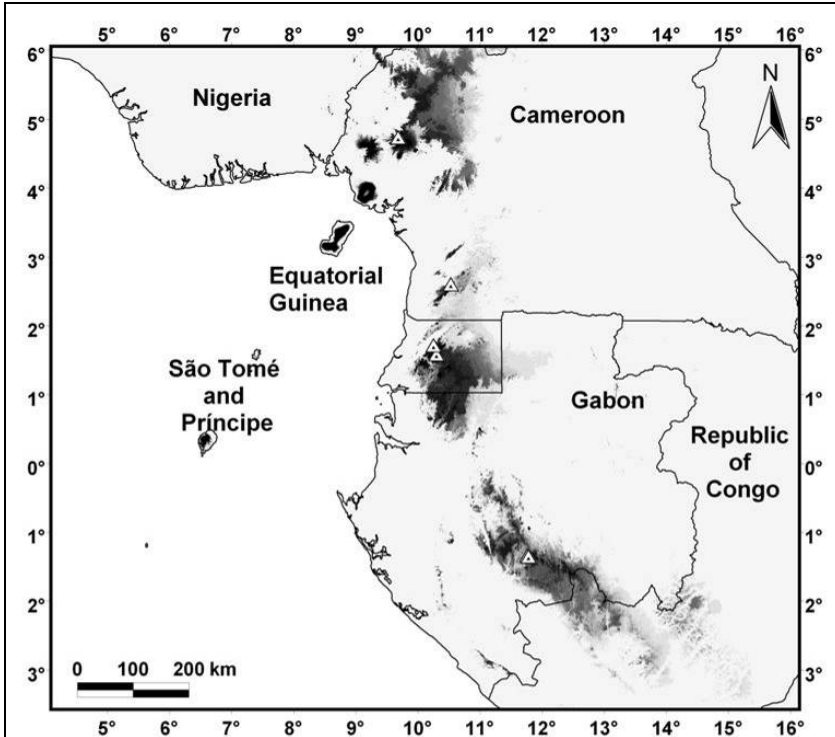
A total of 44 orchid taxa were collected during our survey of the Mont Songo Mountain representing 18% of the orchid known from Gabon. We also collected two rare orchid species which are endemic to the West Central Africa: *Polystachya bipoda* Stévar, limited to the submontane forest that occurs above 600-700 m in North Gabon, Rio Muni and South Cameroun. In Gabon, it was also collected on Mont Mbilan and Ngol Maduaka. The other species is *Eggelingia gabonensis* P.J.Cribb & Laan, a tinny orchid restricted from south Cameroon to North Gabon. The two specimens collected in Ngol Maduaka were growing in the upper part of the canopy in a narrow valley.

We also collected two orchid species that are new for Gabon: *Polystachya riomuniensis* Stévar & Nguema and *Tridactyle anthomoniaca* (Reich. f.) Summerh. subsp. *nana* P.J.Cribb & Stévar. *P. riomuniensis* was only known from Rio Muni (Monte Alen NP). Its ecology remained unknown and hence its conservation status could not be assessed until now. The species occurs frequently in the Bouvala area along streams and in swampy areas. *T. anthomoniaca* var *nana* is a typical species of the submontane forest of Central Africa. It is quite common in this vegetation type in Cameroon and Rio Muni, but its area of occurrence is quite limited. Finally, we collected a species of *Angraecum* (Orchidaceae) close to *A. pyriforme* in the wettest ravines of the area. It differs from all others *Angraecum* from central Africa and may be a new species.

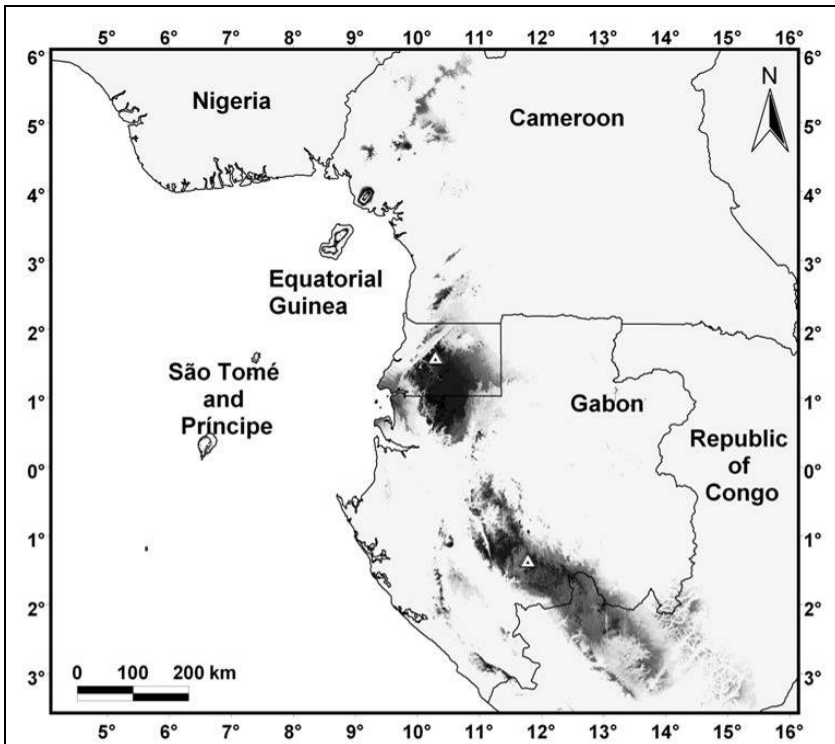
Potential distribution maps of these species were created using a GIS analysis based on 20 climatic layers (see next page). This method is used to predict potential area of occurrence and therefore helps to assess their conservation status. Compilation of these maps is a tool to identify areas of endemism and sites of concern for the conservation. Both species are endemic to the West Central Africa and seem to be restricted to mountain area and overlapping with the postulated forest refugia (their potential distributions are shown below).



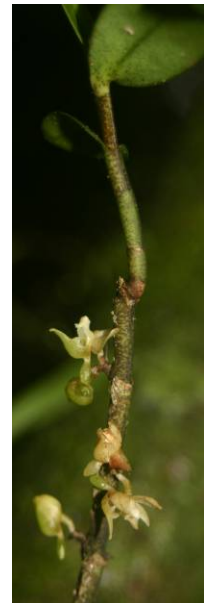
A new species of Angraecum (Orchidaceae) collected in Mont Songo area



Potential distribution map of Tridactyle anthomoniaca (Rchb. f.) Summerh. subsp. nana P.J.Cribb & Stévant (map made by Vincent Droissart, ULB). Triangles indicate points used for modelling Darker colours show areas with better predicted conditions.



Potential distribution map of Polystachya riomuniensis Stévant & Nguema (map made by Vincent Droissart, ULB). Triangles indicate points used for modelling Darker colours show areas with better predicted conditions.



Orchid diversity: (from left to right, up to down) *Polystachya riomuniensis* Stévant & Nguema, *Chamaeangis ichneumonea* (Lindl.) Schltr., *Rangaeris trilobata* Summerh., *Vanilla* sp., *Tridactyle lagesensis* (Rolfe) Schltr., *Liparis epiphytica* Schltr.



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