The Biodiversity of the

Nfaman Summit

Missouri Botanical Garden

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Prologue

Missouri Botanical Garden was awarded a Central African Regional Program for the Environment (CARPE) subcontract from the Conservation International (CI) to perform a series of tasks.

These tasks were defined accordingly:

1. Carry out botanical expeditions to identify Biodiversity Sanctuaries for micro-zoning in the landscape.

2. Develop a GIS map of the landscape identifying biodiversity hot spots based on the Pleistocene refuge theory

3. Construct a data-base for the botanical information

During this fiscal year Missouri Botanical Garden (MBG) has executed botanical activities in the landscape assessing the plant biodiversity of the Nfaman Summit in the Bosque Nacional.

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Introduction

The "bosque nacional" in the southern half of Equatorical Guinea and Nfaman summit (above); the forest cover (green/yellow) with the National Parks (orange). source Mayaux et al. 2003/ WCS GIS data base

Nfaman Summit

The Bosque Nacional in the south of Equatorial Guinea is forest set aside by presidential decree after revenue from the oil business did not longer require its exploitation. But this forest is not pristine either as it has been logging in the past. Because of the roads and villages in this landscape it is also larded with secondary forest due to plantations along roads and around villages (yellow patches in the map above). Therefore, it is important to locate the least exploited primary forest in this larger block of Bosque Nacional.

The Bosque Nacional is also part of a larger so-called Pleistocene forest refugium (explained in more detail below). This is one of the only blocks of forest which survived the dry climate during the last ice age. On the Gabonese side it has already been showed that this forest is one of the richest forests in Africa, with many species restricted to only this part of the forest so-called endemics. There is very little data available from the Equatorial Guinean side of this forest refugium.

This forest is also considered very important for the future considering the impact of global climate change. This forest could be alternatively interpreted as climatically stable forest, forest which will survive global warming. Hence, without the protection of this forest no forest will be left in the future. It is therefore important to locate the best and most pristine parts within this Bosque Nacional and protect them with an extra status for the future.

Within the western part of this Bosque Nacional the Nfaman summit was considered representative for a larger and similar forest further south. The idea is when this forest has a high level of biodiversity the area further south would be too. In these case it is also important to known where, at which altitude, biodiversity is highest.

Map showing in more detail the north-western part of the bosque nacional. Source SRTM

Geomorphology

There is no geographical map of this part of Equatorial Guinea. Therefore, elevation data from the shuttle radar topographical mission (SRTM) was used and manipulated to create an elevation map. The Nfaman summit and the area further south (encircled) are form the edge of a plateau which stretches further to the NE. The summits reach altitudes between 800 and almost 1000m.

Mean rainfall in north east , (gradient from dark green to orange= wet to drier. Source Worldclim Hijmans et al. 2005

Rainfall

Mean annual rain fall in this part of the Bosque Nacional is high and it ranges 2100 and 2300mm. Because of the high altitude of these summits they receive additional rainfall from low clouds due to what is known as the orographic effect which is especially important during the dry season in July and August.

Pleistocene forest refugia

As mentioned before most of the Bosque National is part of a Pleistocene forest refugium, which straddles the border between Equatorial Guinea and Gabon. This map was created by overlapped areas with mean annual rainfall above 2100mm and having an altitude above 500m. These are conditions which come close to the reconstruction of climate during the Pleistocene. These forests are typically rich in species and endemics, but also in so-called none dispersing Begonia forest herbs. Since these herbs disperse very slowly are not, they have gone extinct anywhere where the forest disappeared during the last ice age.

Map of Gabon showing the wet refuge areas (light blue).

Map showing the transects (TR) above.

Transect layout

Topography and altitude are strong driving forces for species composition. Therefore, transects were positioned at the summit (930m), at the eastern and northern slope at 700m, and in the lowest area (650m).

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 revered 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.

Nfaman summit	Tr 6	Tr 7	Tr 8	Tr 9	average
F-alpha	58.8	48.2	43.1	36.9	46.8
spp	77	57	56	57	62
n	159	109	115	136	129.8
end	51	25	26	27	32
end%	66.2	43.9	46.4	47.4	51.0

Results

General characteristics

On the four transects 174 species were recorded. On average 62 species were present on a transect and differences between the three of the transects were very small, except for TR6 which has the highest score of 77 species (see the above table).

Species restricted to a single transect (endemic) varied between 25 and 51, or in percentages between 43.9 and 66.2. Again TR7, 8 and 9 basically do not different, with the exception of TR 6 which had the highest number of transect endemics. Fisher- alpha-diversity values varied between 36.9 and 58.8, with the lowest value for TR7 at 700m on the north side and highest on TR6 at 930m on the summit.

Similarity

The transects most similar in species composition are TR8 and TR9, but differences with TR7 are small (see above in the cladogram). The transect on the summit is again most different outgrouping all other transects. Despite the small number of transects the difference between the summit and the rest quite is quite clear.

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

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

Discussion

Comparing the species richness on these transects with the other transects in Gabon three of the four transects have average values (TR7,TR8 and TR9), but TR6 reaches the high end of the spectrum (see graphs above). Comparing Fisher-alpha values the position of the transects changes, TR6 moves down from its high position and the other three transects are less grouped around the average.

The fact that the transect on the summit (TR6) was the most interesting one is a good sign, because this type of forest is much more abundant further south in the Bosque Nacional. The high level of biodiversity on this transect is conform the level of biodiversity observed in the Pleistocene forest refugium of the Monts de Cristal at the Gabonese side. Because there is little data available from the northern half of this Pleistocene refugium, more data would be needed to confirm this observation, but in principle it verifies the model used to map the Pleistocene forest refugia forests.

Conclusion

The biodiversity on the slower slopes of the Nfaman summit is average, but the biodiversity on the summit is very high and encouraging for the forest further south with similar environmental conditions.

General collecting

122 species were collected (Leal *et al.* 2174-2296), their full identification is still pending and field notes are being entered into the database.

The specimens shown below may be new for science:

Psychotria spp

Begonia spp

Orchid spp

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