



The Biodiversity of East Waka



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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.

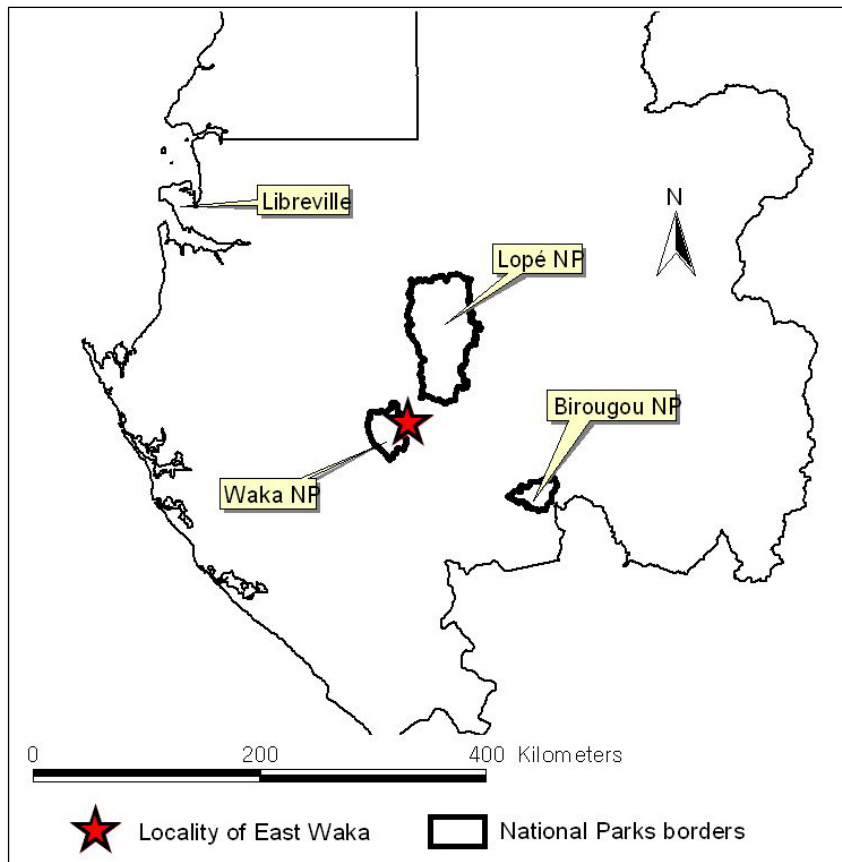
During this fiscal year Missouri Botanical Garden (MBG) has conducted two field trips in the unexplored parts of the buffer zone of the Waka National Park. The botanical survey of the flora was carried out by assessing the plant diversity of the East of Waka NP.

During this field trip, a total of 202 specimens have been collected, and 6 transects were done representing 1264 individuals. The results and observations are presented here.

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Introduction to East Waka



Waka National Park is one of the thirteen National Parks created in 2002 in Gabon, and one of the three that are in the Massif du Chaillu landscape with Lopé and Birougou National Parks (Fig. 1).

In order to improve the botanical knowledge of this region, a field survey of 10 days has been conducted in a botanically unknown locality on the East of Waka National Park, just below Mayi River (Fig. 2).

Fig. 1. The three National Parks in the Massif du Chaillu.

This region has been logged in the past (logging stopped around 10 years ago); many logging paths and forestry roads are still in pretty good condition as we were able to observe.

The region being inventoried is in the periphery of the Massif du Chaillu mountain area (Fig. 2). The topography is not particularly rugged, with altitudes ranging from 550 to 700 m. The locality presents a strong difference of topography. Gentle valleys with small streams and large swamps especially abundant in Maranthaceae and Begoniaceae alternate with hill tops and hillsides covered in *terra firme* rain forests. Annual rainfall is 2100 mm on average (Fig. 3).

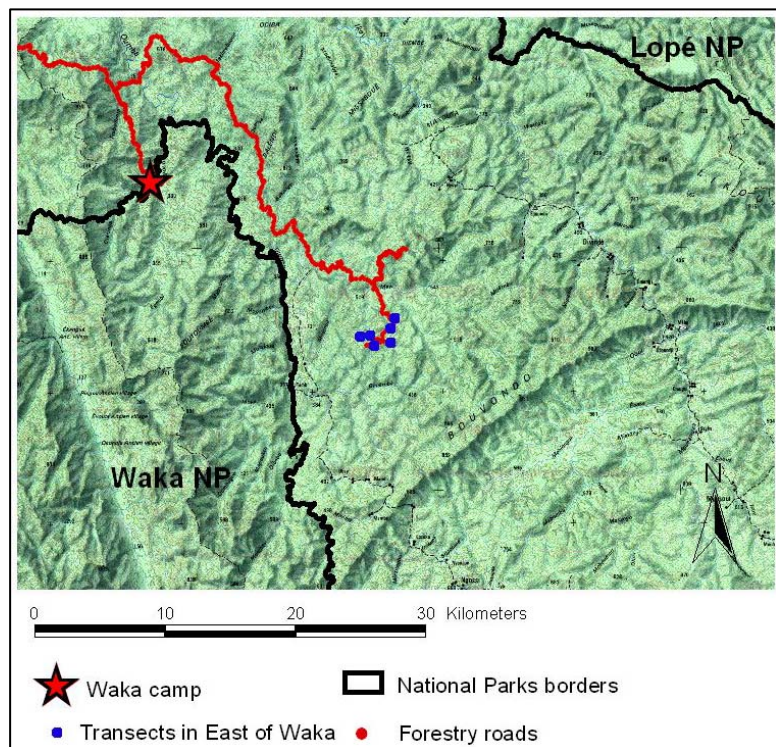


Fig. 2. Locality of East of Waka and position of the 6 transects.

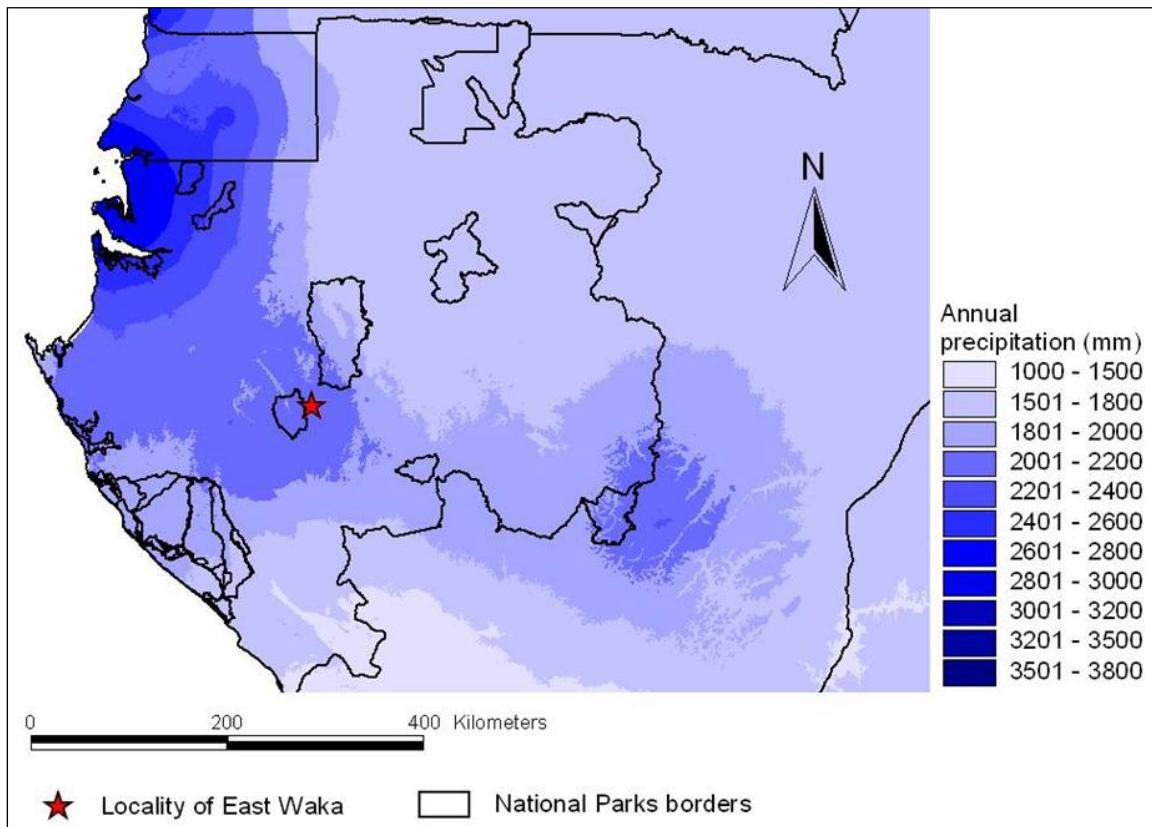


Fig. 3. Annual rainfall in Gabon (Hijmans et al., 2005)

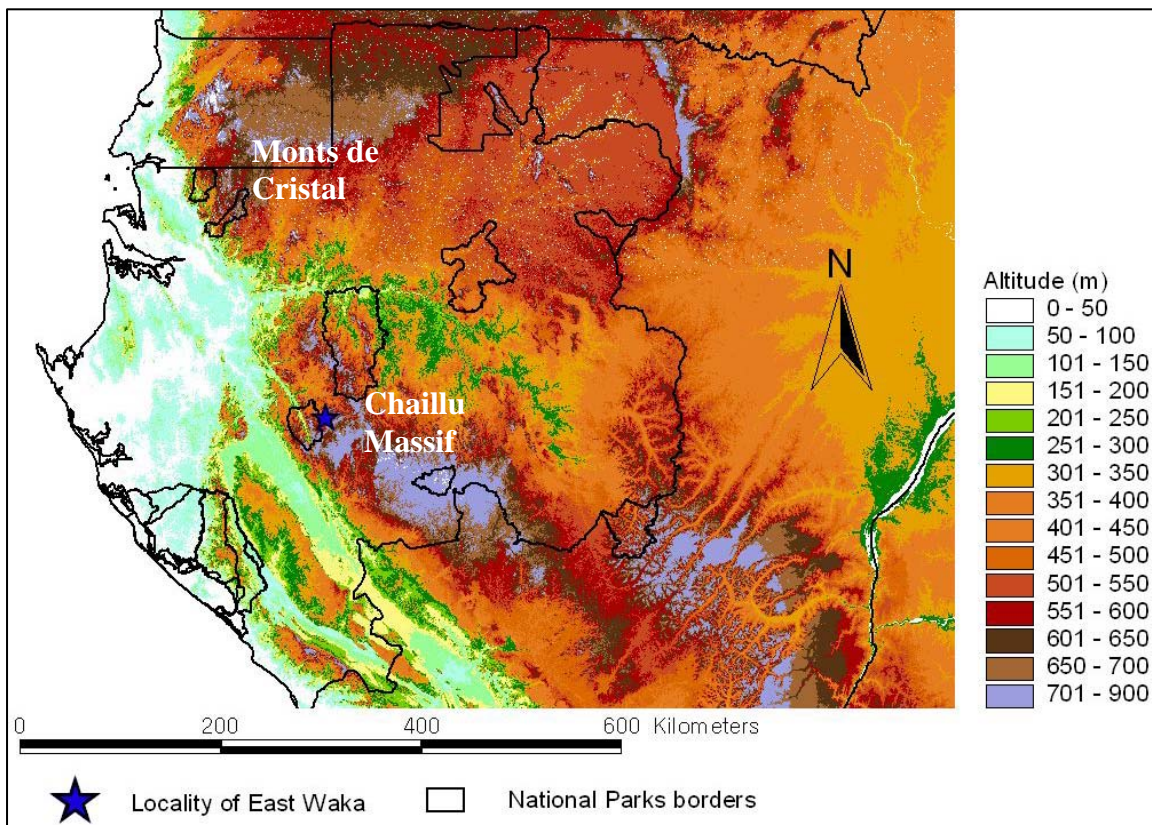


Fig. 4. Altitude distribution and localization of the Waka NP and the two massifs in Gabon: Monts de Cristal and Massif du Chaillu.

Methods

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 or more was recorded and identified. In addition to individuals present in the transect, we added 100 individuals that belong to the upper canopy stratum present on both sides of the transect. For each individual not identified in the field, a specimen was collected for identification in the herbariums of Libreville and Brussels. In several cases, we could not assign a specific name for individuals; we therefore classified those individuals as morpho-species. For each individual, the stratum to which it belongs (either dominant tree or lower canopy trees) was noted.

The transects were carried out in terra firme mature forests, separated from each other by at least 1 km, and distributed in the various topographical positions.

We also collected every plant in fruit or flowering with as many duplicates as possible. Duplicates will be distributed to the following herbariums (LBV, MO, WAG and BR).

Local diversity or diversity alpha has been estimated by rarefaction principles (Gotelli and Colwell, 2001). Based on rarefaction curves (successive re-samplings of the pool of N individuals at random and plotting of the average number of species and number of individuals), we can obtain an unbiased diversity index for a fixed number of re-sampled individuals (=k). For example, for a k=50 we obtain the expected number of species for 50 individuals randomly chosen in the pool. This index was computed with the BiodivR software written by Hardy (2005). We also computed local diversity by using the fisher alpha index.

Similarities between transects were computed using the Morisita-Horn similarity index with BiodivR software (Hardy, 2005) and a dendrogram was calculated.

$$MH_{ij} = \left[\frac{\sum_s p_{is} p_{js}}{\left(\sum_s p_{is}^2 + \sum_s p_{js}^2 \right) / 2} \right]$$

For a similarity measure between samples i and j, p_{is} is the frequency of the species S in sample i.

Results

Results

General characteristics

1264 individuals were inventoried in all transects, representing 39 different families (one individual is unidentified at the family level), 165 species and morpho-species (91 individuals are not yet identified, and several species are very likely to be added later).

Dominant families in number of species were Caesalpiniaceae and Euphorbiaceae (Fig. 5). Euphorbiaceae, Burseraceae and Caesalpiniaceae represent more than half of the total of inventoried individuals. However, if we consider lower and upper canopy trees separately, there is a shift in tree composition. The lower stratum is dominated by Euphorbiaceae and Clusiaceae, both mainly represented by the species *Conceveiba macrostachys* and *Garcinia spp.* respectively (Fig. 6). Both families are no longer dominant when considering upper canopy trees only. For upper canopy trees, 4 families represent 75 % of all individuals: Burseraceae (mainly *Aucouma klaineana* and *Dacryodes spp.*), Caesalpiniaceae, Myristicaceae (*Staudtia kamerunensis* and *Coelocaryon preussii*) and Olacaceae (Fig. 7).

Similarity

Transect 10 shows a much higher diversity than other transects. The dendrogram based on a similarity matrix shows that this transect has a floristic composition which differs from other transects (Fig. 4.). All other transects are relatively similar in terms of floristic composition.

Transect	Number of individuals	Specific richness	Altitude (m)	Topography position	Fischer alpha	S (k=50)
GD5	209	56	535	hillside	25,73	25,12
GD6	207	62	565	hillside	31,36	26,97
GD7	230	62	540	hillside	29,21	23,78
GD8	214	55	575	hill top	24,67	25,45
GD9	196	53	570	hillside	24,37	25,05
GD10	198	74	530	valley	43,78	33,51

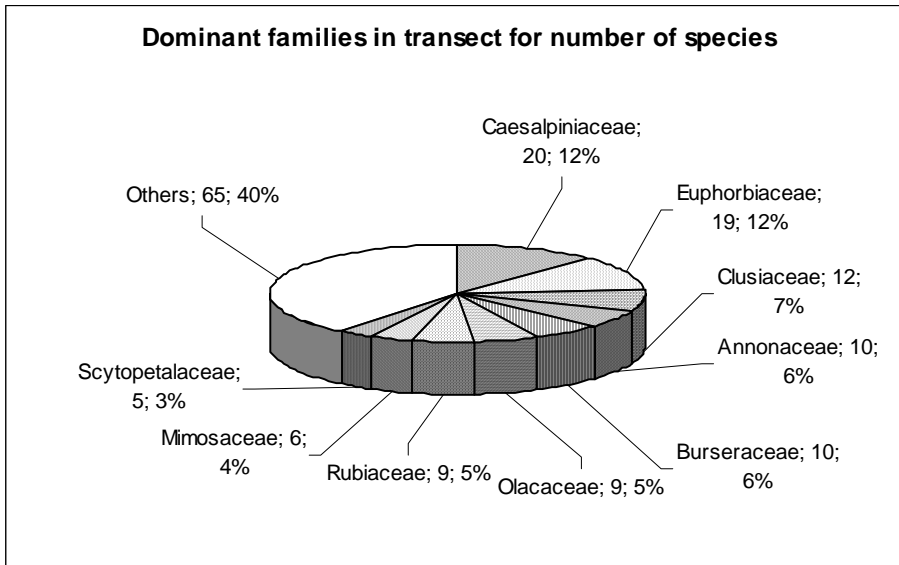


Fig. 5. Dominant families in terms of numbers of species in transects.

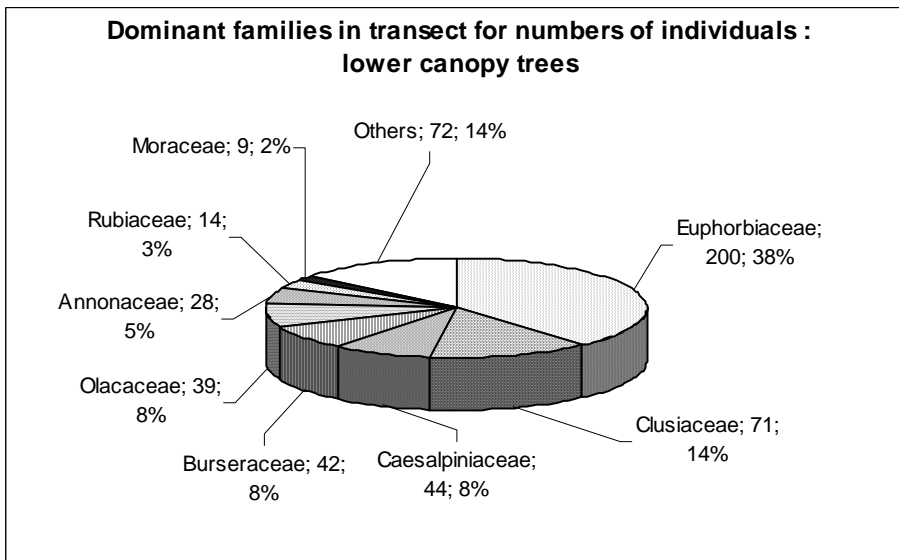


Fig. 6. Dominant families in terms of numbers of individuals for lower canopy trees.

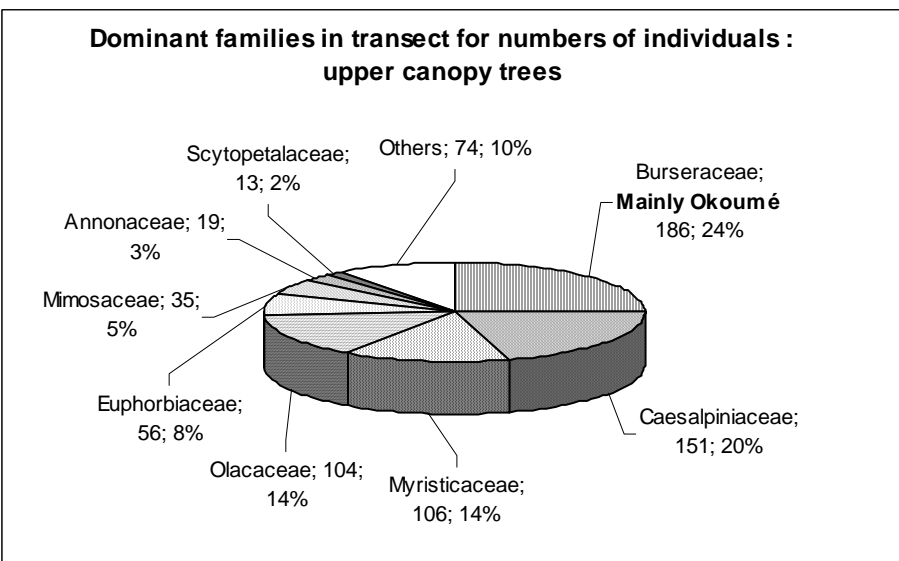


Fig. 7. Dominant families in terms of number of individuals for upper canopy trees.

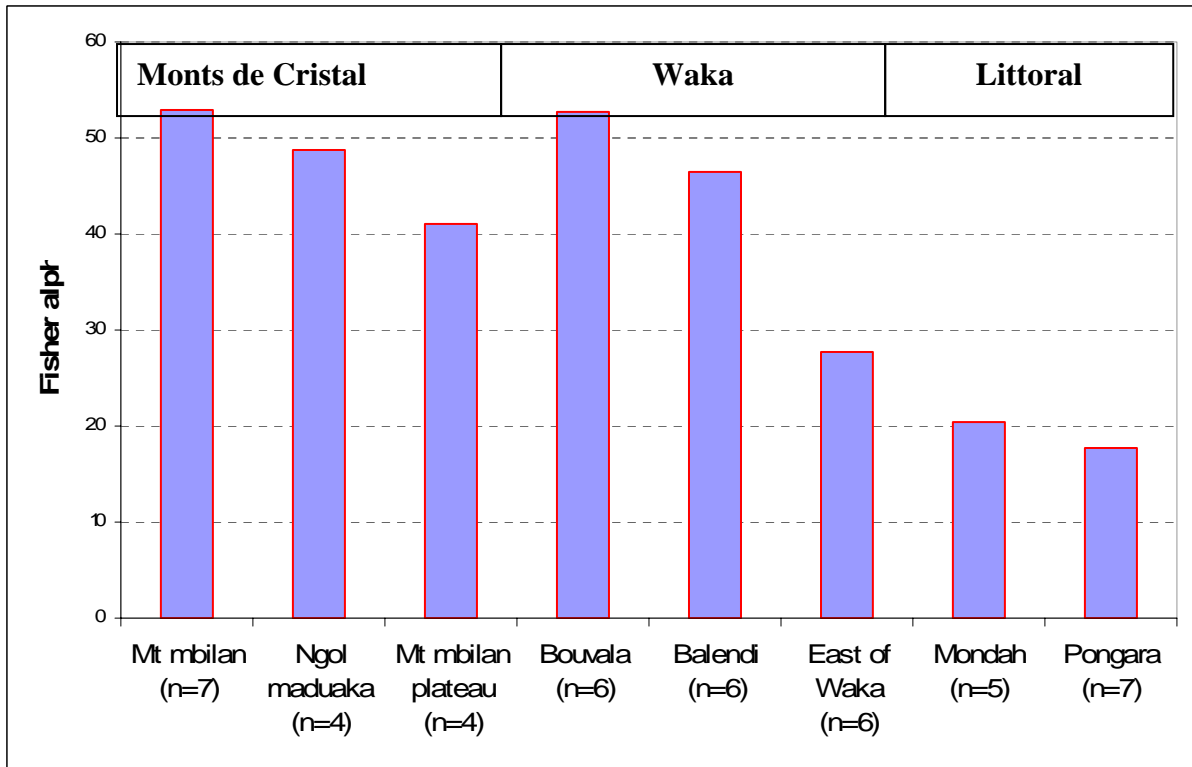


Fig. 8. Mean local diversity (expressed as fisher alpha index) for 8 Gabonese localities located in 3 regions of Gabon

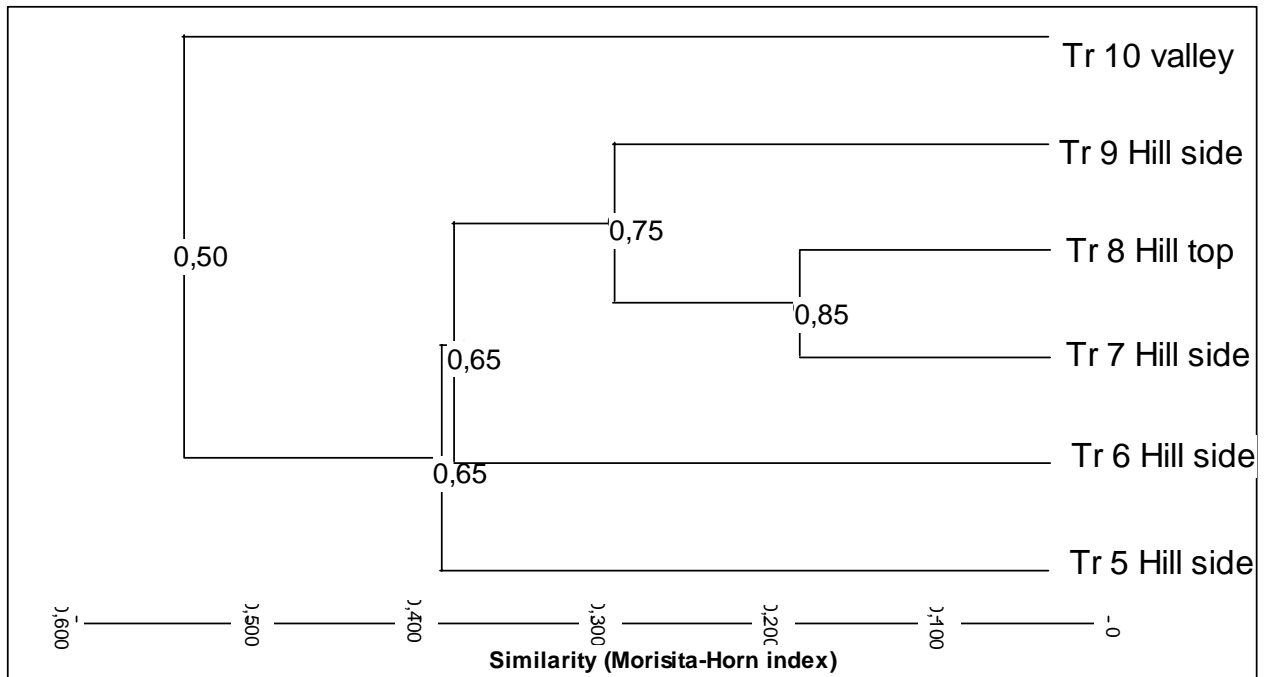


Fig. 9. Clustering dendrogram of the 6 transects obtained from a similarity matrix computed by the Morisita Horn similarity index.

Discussion

Similarity

Based on the Morisita-Horn similarity index, transect 10 differs clearly from all other transects. The topographical position seems to be a strong ecological gradient to explain this difference. However, we also noted the presence of many gaps (old trees which had fallen down) around the transect, even though we tried to avoid it. Gaps dynamic may influence local diversity by allowing shade-tolerant and light-demanding tree species to coexist (Leigh et al., 2004). The other transects do not differ significantly from each other.

Local diversity

Mean local diversity expressed with fisher alpha was compared to other localities in three different regions: the littoral around Libreville, Monts de Cristal and Waka/Chaillu Massif. The East of Waka locality is the less diverse locality in Waka region. These results suggest ecological gradients play a major role in explaining this pattern of diversity. Indeed, the localities of Bouvala and Balendi are both in two landscapes with a very complex topography and relatively high mountains (see previous reports), contrary to the locality of East of Waka. This hypothesis is somehow confirmed when local diversity in Waka is compared to Monts de Cristal, which also possesses a complex topography.

Conclusion

Despite the fact that the locality explored has been logged in the recent past (roughly 10 years ago), there are still large areas of mature and undisturbed rainforests. Local diversity is not particularly high compared to mountainous localities in Waka region, but this locality's topography differs from that of the inner part of the Waka NP. These forests are probably one of the last remnants of rich in Okoumé lowland rainforest present in the area. However, more investigation is needed in this part of the buffer zone of the Waka NP in order to localize the remnant block of lowland forest that could be established as Biodiversity Sanctuaries more precisely.

Moreover, these additional data will also allow us to calculate the beta diversity which estimates the relative effects of geographical and ecological distance to explain species turn-over.

General collecting

Full identification of the 202 specimens (representing at least 156 species) collected during this mission is still ongoing and revealing some interesting findings since we already found out two new records for Gabon.

The fern *Elaphoglossum kuhnii* Hieron (Lomariopsidaceae) is newly recorded in Gabon (Fig. 5.). This species is a typical species of submountain forests, and was formerly found only on Mt Cameroun and Mt Nimba in Liberia at altitudes higher than 800 m. In Gabon, it was found at only 450 m in a very humid swampy forest in a valley. This habitat is probably a sub-optimal habitat for this species. Typical submountain species are often transgressive species in swampy forests at lower altitudes (Senterre, 2005).

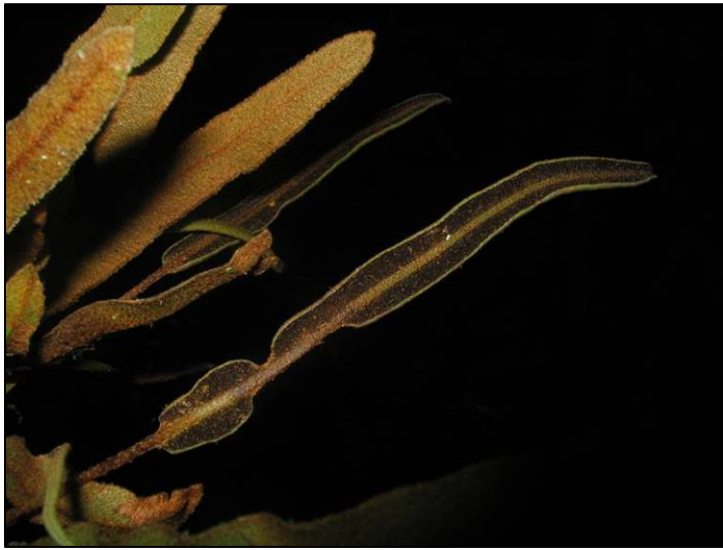


Fig. 10. Elaphoglossum kuhnii Hieron (Lomariopsidaceae), new national record for Gabon

The other new record in Gabon is *Tricalysia trachycarpa* Robbr. (Rubiaceae) (Fig. 6.). This is the second known locality for this species. It was previously found in the Central province of Congo Kinshasa (Robbrecht, 1983) and thus possesses a strong disjunctive distribution.



Fig. 6. Tricalysia trachycarpa Robbr. (Rubiaceae), a new national record for Gabon.

We also collected and identified several species endemic to Gabon.

Amphiblemma hallei Jacq.-Fél. (Melastomataceae) is a shrub present in the rainforest understoreys, especially in very humid valleys. According to Sosef *et al* 2006 East Waka is the seventh known locality for this species (Fig. 7). Its distribution is restricted along a South-North axis, from Monts de Cristal to Chaillu massif, matching the Oriental Atlantic phytogeographical district recognized by several authors (see Senterre 2005).

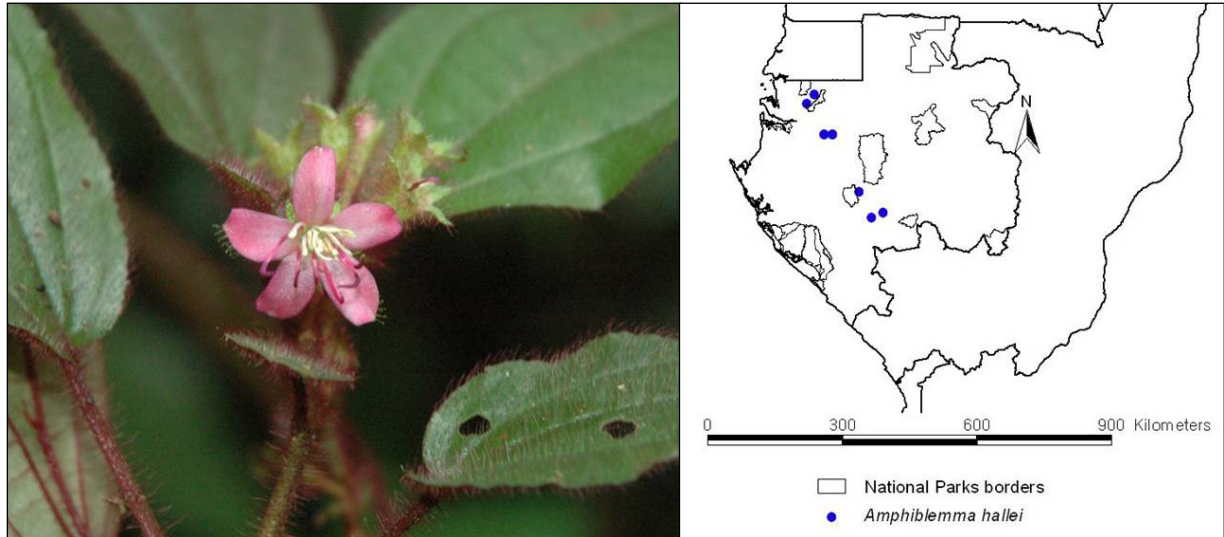


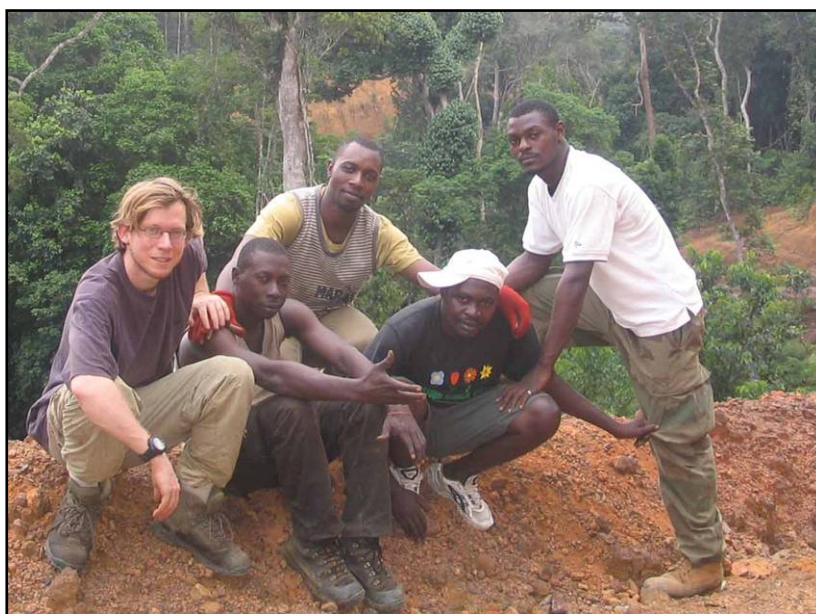
Fig. 7. *Amphiblemma hallei* Jacq.-Fél. (Melastomataceae, left) and distribution of this species, endemic



Fig. 8. *Anonidium floribundum* Pellegr. (Annonaceae) A species subendemic to Gabon



Fig. 9. *Bertiera arctistipula* N.Hallé (Rubiaceae) species endemic to Gabon



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