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13. ABSTRACT (Maximum 200 Words)

The ICBG Associate Program for Biodiversity Inventory and Monitoring, Conservation and Training (AP1) is composed of three organizations: Smithsonian Institution's Monitoring and Assessing Biodiversity Program (SI/MAB), Center for Tropical Forest Science (CTFS) and the Bioresources Development and Conservation Programme. Through AP1 - SI/MAB proposed to accomplish the following long-term objectives: 1) building in-country capacity through a series of training courses, 2) expanding the network of biodiversity plots in Cameroon and Nigeria, and 3) collecting temporal data from previously established MAG sites. CTFS concurrently proposed to build upon the work, which has been accomplished and initiated at the Korup Forest Dynamic Plot (KFDP). Over the past five years of funding CTFS accomplished the following tasks: 1) establishment of the 50-Heactare Korup Forest Dynamics Plot in the Korup National Park, 2) complete enumeration, identification, and measurement of approximately 500 species, over 320,000 individual trees, 3) completion of a liana census including over 7,000 individuals (286 species) with 10-ha of the KFDP, and 4) conducted phenology and seeding studies. Both SI/MAB and CTFS enhanced the infrastructure of local organizations by providing funds to local scientists so that they may participate in various training courses. Our specific aims were to continue inventory and forest dynamics research at the large-scale (50-ha.) permanent forest plot in Korup National Park of Cameroon as well as expand the network of 1-ha. Biodiversity plots established in Nigeria and Cameroon. The large-scale plot data effectively addresses the basic biological questions as well as biodiversity monitoring, biomass monitoring, conservation, silviculture, reforestation, ethnobotany, carbon sequestration, climate change, fragmentation, and disturbance by human populations. The 1-ha. Biodiversity plots provide data for mapping regional species distributions and beta diversity. The current collaboration between SI/MAB and CTFS-KFDP is a means by which AP1 and other APs can expand the types of questions that we continue to address while creating the necessary infrastructure within local organizations to preserve the biodiversity of West-Central African forests.

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INTERNATIONAL COOPERATIVE BIODIVERSITY GROUP (ICBG) ON DRUG DEVELOPMENT AND CONSERVATION OF BIODIVERSITY IN WEST AND CENTRAL AFRICA.

Walter Reed Final Report for Award Number DAMD17-99-2-9024
Research Period: October 1,1998 – September 30, 2003

I. Introduction

ICBG's Program for Drug Discovery and Conservation of Biodiversity in Western and Central Africa supports studies in Cameroon and Nigeria through the efforts of two Programs within the Smithsonian Institution, Monitoring and Assessment of Biodiversity (MAB) and the Center for Tropical Forest Science (CTFS), in conjunction with Cameroonian and Nigerian counterpart organizations and other Associate Programs. Over the last five years, the goals of Associate Program 1 (MAB and CTFS) were to enhance conservation efforts and maintain high biodiversity in the region of West and Central Africa through the identification of the ecological and taxonomic distribution of plant species of economic and medicinal importance in different forested habitats. This information has and will enable in-country partners and organizations to develop strategies for the sustainable harvest or cultivation of their natural resources. Additionally, training in-country partners has also enabled Cameroon and Nigeria to expand their capacity to manage their natural resources.

The 1 ha plots established by MAB and the large-scale Korup Forest Dynamics Plot collectively provide temporal and spatial information on the biodiversity of both Cameroon and Nigeria. MAB has focused its attention on the expansion of its long-term forest monitoring program using a network of biodiversity plots, and continues to collect temporal data from the network of MAB sites that have been established in Nigeria and Cameroon over the past seven years. CTFS has completed the establishment of the Korup Forest Dynamics Plot, which is located at the southern end of the Korup National Park near the town of Mundemba, Cameroon. This 50 ha long-term plot will undergo a recensus every five years in order to analyze resultant growth and mortality data, forest phenology, and seedling dynamics. Ultimately, 1-ha biodiversity plots in Nigeria and Cameroon provide complementary data to the ecological information collected in the 50-ha KFDP while expanding the breadth of questions which researchers can address.

This project also addresses the program of drug discovery as both the large and small plots provide information concerning: (a) local abundance, distribution, and dynamics of trees with medicinal properties and their occurrence in different forested habitats, (b) the feasibility of sustainable collection or harvest of these species from natural forest, or their plantation cultivation and (c) a database of the genetic diversity of potentially important medicinal plants. Currently, links between ecological studies and medical prospecting work are still weak. The ethnobotanical and genetic database, which these plots will provide, will serve to connect the environmental data with the phytomedicinal data by: (i) developing a relational database for storing the ethnobotanical and genetic information of species being monitored and (ii) providing a link with chemical prospecting databases.

The training courses and workshops which MAB and CFTS have conducted have furthered the capabilities of West and Central Africa partners to conserve their biodiversity. MAB and CTFS both offer organized regional and international courses as well as intensive workshops to African students and the in-country natural resource managers. Objectives of the training component include: (a) strengthening of the local capacity for research and conservation by providing training in plant taxonomy, collection techniques, and biodiversity inventory and monitoring, data analysis, environmental management and leadership; (b) train local counterparts to conduct training courses themselves, and to promote local environmental research and conservation; (c) strengthen regional capacity through international scientific exchanges; and (d) promote cooperative linkages between the Smithsonian Institution and local counterparts.

II. Body: Research and Other Accomplishments

A. Overview

The Smithsonian Institution has implemented programs comparable to those proposed for the Associate Program at a large number of sites around the world. This Associate Program in Biodiversity Inventory and Monitoring, Training, and Conservation in Africa built on the large base of experience the Smithsonian has developed in carrying out these programs in tropical countries. In particular, this Associate Program (1) focused on the experience of the MAB network of biodiversity monitoring plots and training courses; (2) compared information with that collected by other Forest Dynamic Plots of the Center for Tropical Forest Science of the Smithsonian Tropical Research Institute network; (3) built upon the information and research data that has been gathered at the Korup Forest Dynamics Plot and the network of small-scale biodiversity plots to date and (4) established a long-term 50-ha Forest Dynamics Plot in the Korup National Park of Cameroon as well as a series of 1-ha biodiversity monitoring plots throughout Nigeria and Cameroon.

1. MAB Final Report

Over the course of the two phases of the ICBG program, MAB has expanded the network of BDPs in Nigeria and Cameroon, with 15 plots in each of the countries. In addition, the activities conducted in the region have acted as leverage to encourage other organizations to conduct biodiversity assessments in the region, greatly enhancing the information available for biodiversity conservation.

Table 1. Summary of the completed biodiversity monitoring plots in Nigeria and Cameroon. An additional ten plots are currently being established in the Okwangwo Region of Cross River National Park, Nigeria, as part of year 5 activities of the ICBG phase II.

Country	Location	Plot	# trees	#species	Basal Area (m^2)	Fishers index
Cameroon	Campo	1	397	74	30.8	26.81
		2	402	81	30.0	30.57
		3	394	74	35.0	26.91
	Ejagham	4	525	71	33.2	22.14
		5	526	80	34.0	26.27
	Takamanda	6	491	103	34.7	39.69
		7	498	98	42.1	35.95
		8	414	90	28.7	34.81
		9	428	113	21.7	50.09
		10	426	93	32.0	36.08
		11	477	118	32.1	50.17
		12	406	83	40.5	30.99
		13	438	91	33.2	33.74
		14	527	64	24.6	19.08
		15	523	74	18.6	23.53
Nigeria	Abakaliki	1	409	28	14.1	6.83
	Akampka	2	471	128	16.8	52.12
	Okwangwo	3	467	82	26.5	28.54
	Umukabia	4	350	50	18.6	12.45

Cameroon: The first plot was established in Cameroon, at Camp Saker, Mabeta-Moliwe Forest, as part of a training course held in November 1996, followed by three plots in the Campo Ma'an Faunal Reserve, South Province, and two in the Ejagham Forest Reserve SW Province (Sunderland *et al.* 1997; Figure 1 and Table 1). These plots have been subsequently remeasured for the first time in 2002, providing a valuable insight into the dynamics of the forest of Campo and Ejagham. Preliminary analysis indicates that mortality exceeded recruitment at all sites leading to a net decline in the density of trees in the five plots. The mortality rate was 1.62 ± 0.16 % per year (from 1.28 to 2.15% per year), while the recruitment rate was 0.88 ± 0.15 % per year (0.33 and 1.17% year). Turnover rates were higher in Ejagham (1.39 % per year) than in Campo (1.16% per year) indicating a more dynamic forest. Neither species richness nor diversity varied significantly at any of the sites. About 55% of the trees that died had diameter between 10 and 20 cm, a proportion that is comparable to other tropical forest sites around the world.

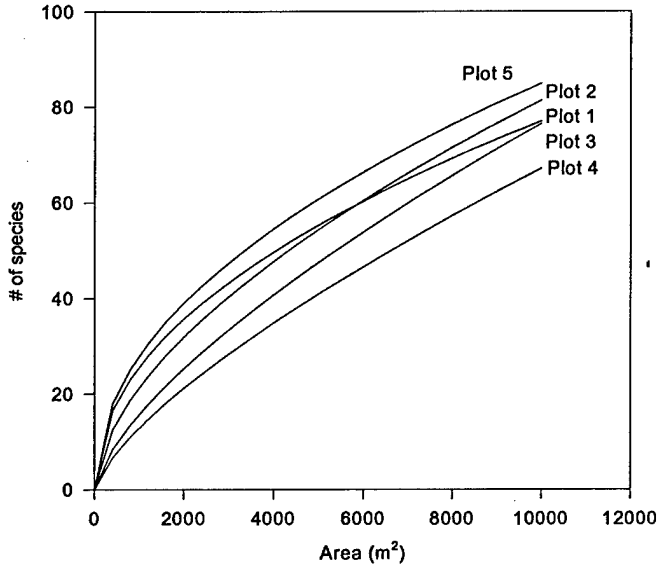


Figure 1. Species accumulation for five biodiversity plots in the Cameroon vegetation monitoring network.

Under Phase II of the ICBG, MAB expanded the network of plots in Nigeria and Cameroon, concentrating on two focal areas. In 2000, we established 10 BDPs along an altitudinal gradient in the Takamanda Forest Reserve of Cameroon (Table 1). In addition, 36 smaller (0.1ha) Modified Whittaker plots were established to further quantify the spatial variability in the structure and composition of the forests in the reserve.

- The habitats sampled included lowland forest including riverine and secondary forest, lowland ridge forest, mid-elevational forest, montane forest, and high altitude grassland;
- A total of 4,628 individual trees >= 10cm dbh were measured in ten BDPs, representing 351 species, 210 genera, and 58 families. Cumulatively, these trees had a mean dbh of 29 cm and a mean basal area of 30.8 m^2/ha;
- A total of 8,885 individuals, representing 442 species, 243 genera and 75 families were recorded on the Modified Whitaker plots;
- For the qualitative vegetation assessment, 861 voucher specimens were collected, representing 612 species, 277 genera and 91 families;

- In total, these 14,374 individual records represent 953 species, 504 genera and 113 families;
- Forty-seven species of conservation interest were recorded in the reserve.
- Partner organizations included GTZ, University Dschang, University Buea, Mount Cameroon Project, and Kew Gardens

As part of the Takamanda vegetation assessment, MAB worked with in-country partners to encourage the assessment of other taxonomic groups:

- Mammals – surveys were conducted for large mammals with a primary focus on the Cross River Gorilla subspecies. Evaluation of hunting pressure was recorded on all species. Partner organizations included Wildlife Conservation Society and WWF.
- Birds – 313 species were recorded in what is considered to be an Important Bird Area for Cameroon. Partner organizations included Birdlife International and the Cameroon Ornithological Club.
- Reptiles – surveys conducted by the Cameroon Herpetological society, CamHerp, registered 81 species which represent 30% of Cameroon's reptiles, and included several endemic and endangered species.
- Arthropods – surveys for dragonflies conducted by the Cameroon Dragonfly Project in collaboration with Imperial College, University of London registered 67 species; butterfly diversity was evaluated by the Mount Cameroon Project and found 111 species.
- Fisheries – a survey of fisheries in the area was conducted by the Project for the Protection of Forests around Akwaya, PROFA (GTZ-MINEF), found 54 species that are commonly used by local communities.
- Land use change – analyses of changes in forest cover and land use were conducted by NASA using satellite imagery from 1989 and 2000. Collaboration with the vegetation group has resulted in the first satellite derived vegetation map for the region.

As a result of this research, MAB compiled and released the volume entitled "Takamanda: the Biodiversity of an African Rainforest", SI/MAB Series #8. Smithsonian Institution, Washington D.C., edited by James Comiskey, Terry Sunderland, and Jacqueline Sunderland-Groves (see appendix 1).

In close collaboration with Wildlife Conservation Society, Terry Sunderland, MAB's Associate Researcher in Cameroon was able to leverage matching funds and participation from numerous other organizations to result in the first comprehensive survey for the Takamanda Forest Reserve. The subsequent publication of the book mentioned above, has resulted in a sound scientific justification for the increased status of Takamanda from a Forest Reserve to a Wildlife Sanctuary. The governments of Nigeria and Cameroon have also agreed to create a trans-boundary protected area along the Okwangwo-Takamanda corridor.

Nigeria: In 1998, four plots were established at Abakaliki region of the Ohatewke Ishieke Forest Reserve in Nigeria, Akampka Government Reserve, Okwangwo Government Reserve, and Umukabia Ehime Mbano Community Forest (Obialor *et al.* 1999). An additional ten biodiversity plots have been established as part of year 5 activities in the Okwangwo Region of Cross River National Park, an area adjacent to the Takamanda Forest Reserve of Cameroon. The data from these last sets of plots are in the process of being entered and final field verifications made. We will soon initiate the analysis of these data sets and comparisons to those obtained along similar altitudinal gradients in the Takamanda Forest Reserve.

There are significant variations in terms of species composition, diversity and richness, tree density, and local geology and soil types. Abakaliki, Akampka and Okwangwo plots are located inside protected areas while Umukabia is a community owned forest. Akampka is important for conservation in the region, the primary forests of southeast Nigeria having been heavily impacted, this site remains relatively undisturbed. Species richness is thus high (Table 1). Okwangwo has

sustained impacts mostly in the form of timber exploitation, though species richness remains high. The dominant species include *Treculia obovoidea*, *Pycnanthus angolensis*, *Staudtia stipitata*, and *Cola acuminata*. In contrast, Umukabia retains little semblance to the original lowland forests of the region, being a community forest that was recently managed as an oil palm plantation. The plot at this location is providing valuable information on how these community forests increase their importance as biodiversity refuges and the regeneration patterns of heavily impacted forests. The results will assist managers in developing strategies for restoration of indigenous species. Finally, the Abakaliki, site should continue to be managed for timber and pulpwood.

2. CTFS – Korup Forest Dynamics Plot Final Report

Phases I and II of the ICBG saw the 50-hectare Korup Forest Dynamics Plot move from being a plan to a reality. A huge research program was put into place by CTFS and BDCPC, under on-going agreements with the Ministry of Environment and Forests, The Korup National Park and the Limbe Botanical Garden. A research camp was constructed in the National Park near the plot, and an office building was rented in the nearest town, Mundemba. Up to 30 people labored for three dry seasons to demarcate the plot and collect the first dataset, which contains information on almost a third of a million trees ≥1 cm dbh, belonging to about 495 different species. The first dataset was created through double entry of the data sheets followed by careful checking, and through digitizing the maps, all of which was carried out in Cameroon by technicians trained by the project. The between-census program has involved fewer field staff, and activities have included the census of lianas from 10 hectares, with 7,384 individuals from about 272 species; studies on the recruitment and mortality of seedlings; the collection of phenology data on reproduction and leaf growth twice per month; the collection of information on useful plants, and working with visiting scientists, especially those associated with the ICBG program. In addition, the 5,000 individual field maps were scanned in order to extract additional environmental information on the plot. The figures below show (1) a 3-D view of the plot derived from the 1326 20-m cadastral survey points, (2) one of the 5000 scanned field maps showing some of the additional information, in this case an old termite mound about 7m in diameter and fallen timber, and (3) 2-D maps of the KFDP showing the very different distribution patterns shown by four species.

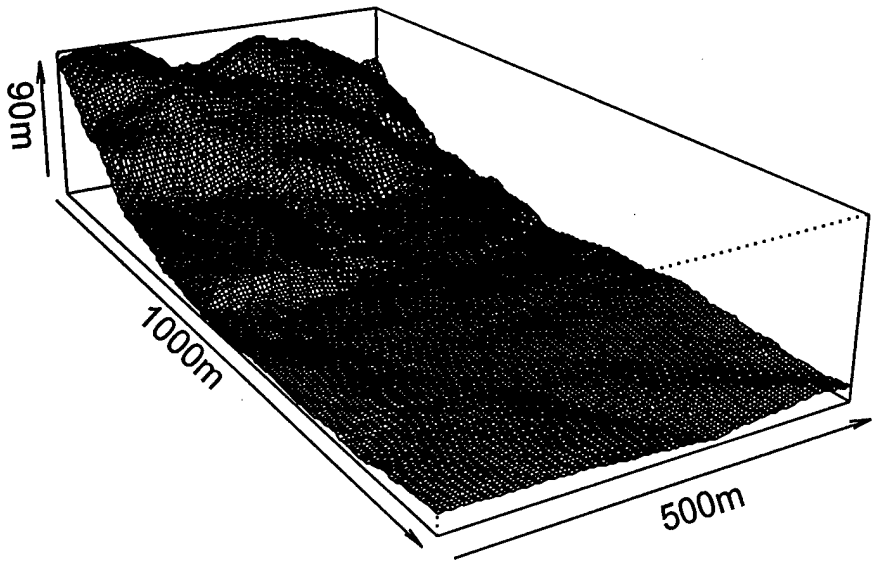


Figure 2. A 3-D view of the Korup Forest Dynamics Plot.

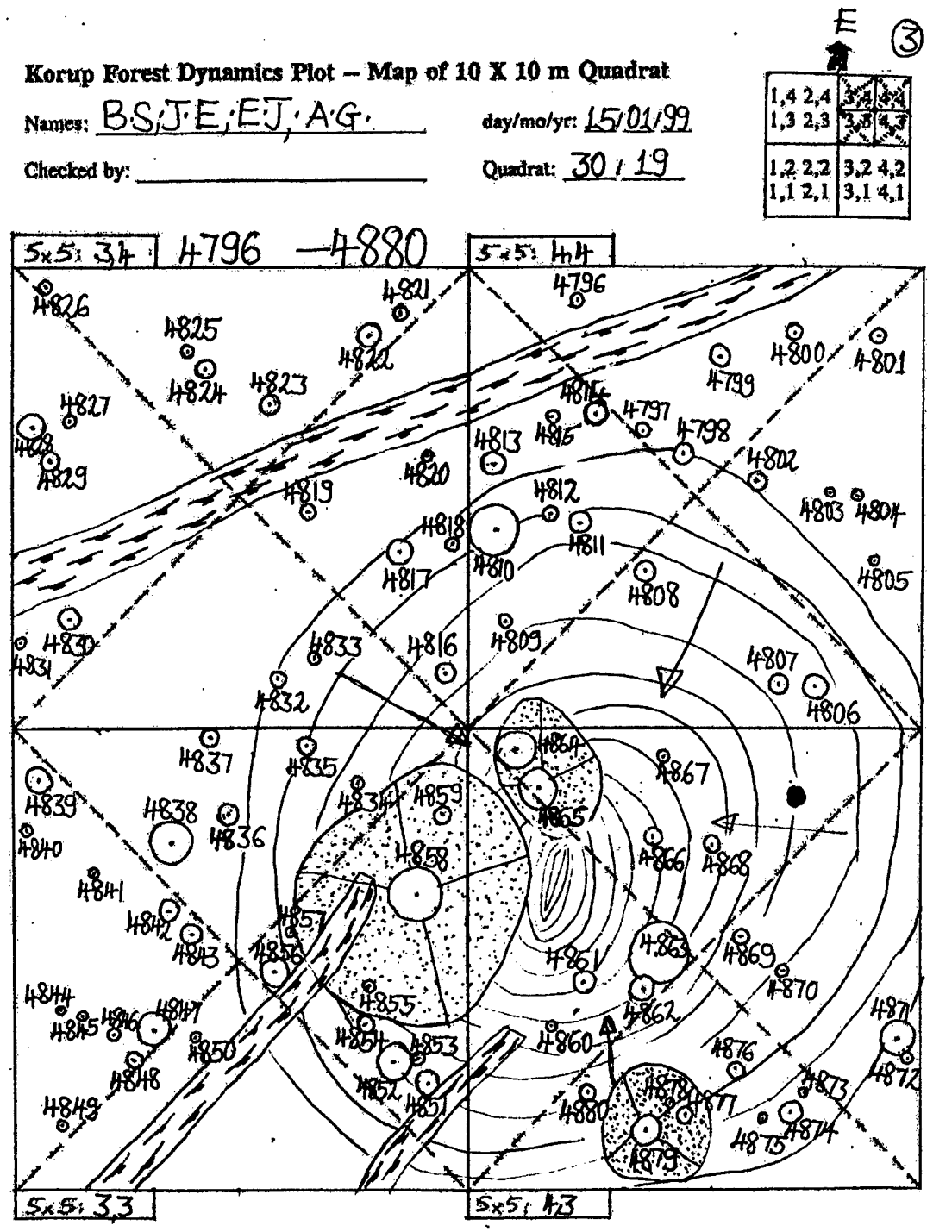
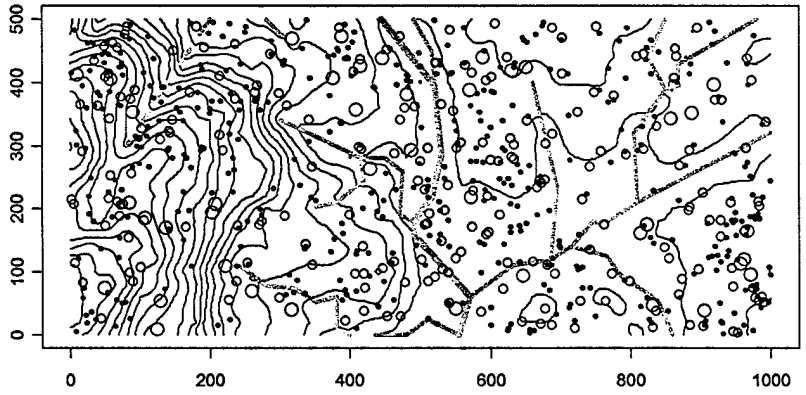


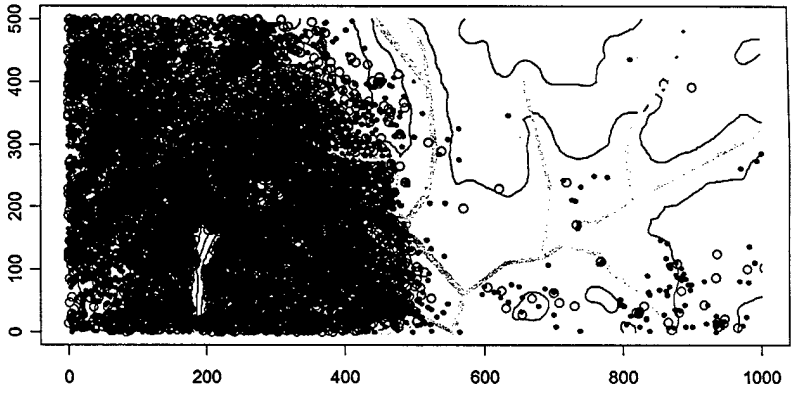
Figure 3. KFDP – Map of 10x10 Quadrat

A. Annickia (Enantia) chlorantha – widespread distribution.



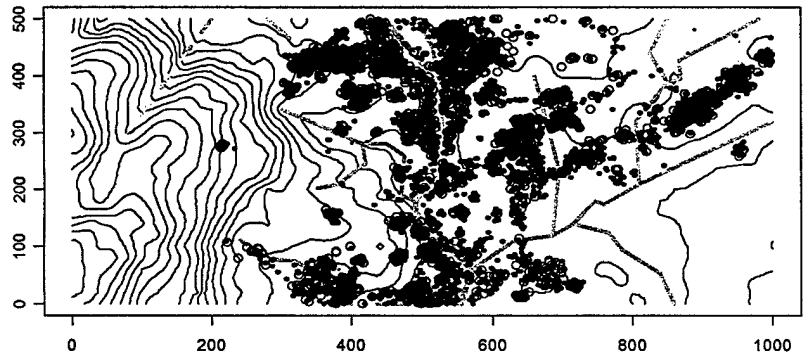
5m contours and creeks; solid circles 1-5 cm, small open circles 5-30 cm, large open circles >30 cm dbh

B. Cola preacuta (Sterculiaceae) – habitat specialist, hillsides.



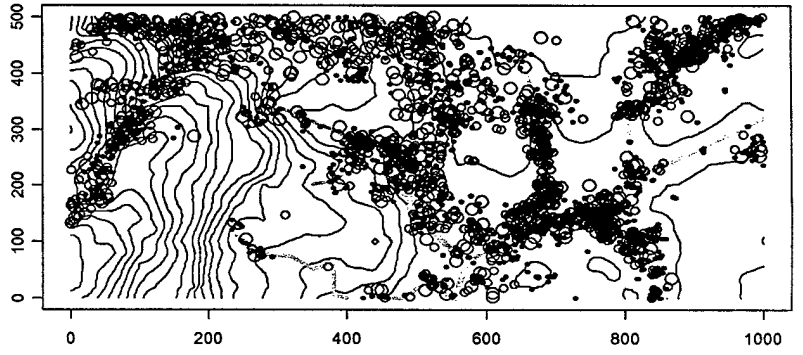
5m contours and creeks; solid circles 1-5 cm, small open circles 5-30 cm, large open circles >30 cm dbh

C. Rinorea lepidobotrys (Violaceae) – very aggregated distribution



5m contours and creeks; solid circles 1-5 cm, small open circles 5-30 cm, large open circles >30 cm dbh

D. Protomegabaria stapfiana (Euphorbiaceae) – predominantly riparian distribution.



5m contours and creeks; solid circles 1-5 cm, small open circles 5-30 cm, large open circles >30 cm dbh

Figure 4. Four tree species from the KFDP, showing different types

i. The KFDP Stand Table Book

In June 2003, CTFS and BDCPC published a 270 page volume entitled, *Tree Species of Southwestern Cameroon: Tree Distribution Maps, Diameter Tables, and Species Documentation of the 50-Hectare Korup Forest Dynamics Plot*, which is one of the first products of the KFDP dataset that includes information on almost 500 species found in the plot (see appendix 2). This volume is organized by family, and each species features a map showing its distribution within the plot. Four of these maps are shown in Figure 3. In addition, there is a brief taxonomic description of the species and a demographic table. The table and text for *Protomegabaria stapfiana* is shown below.

Species Description:

Protomegabaria stapfiana (Beille) Hutch. EUPHORBIACEAE (Phyllanthaceae[1]) PRST. Medium-sized tree, riparian, to about 20 m tall and 50 cm dbh, but trunk often very irregular in section, irregular buttresses and adventitious roots often present. Dioecious, fruits green, about 4 cm diameter, explosively dehiscent, ballistic dispersal. *Taxonomic notes*: This species may be synonymous with *P. macrophylla* Hutch., since the two main distinguishing characters (leaf pubescence, length of male infl.) are very variable. *Det. level*: F1,G1,S1. *Distribution:* Forests of Upper and Lower Guinea. *Conservation status:* Common.

Table 2. *Protomegabaria stapfiana*. Stem count, total/50 ha = 3367, Species rank = 24

Diamter class (cm)	Total no. trees in 50 ha	No. trees per ha	Cummulative tree count per ha	% by size class	% of all species by size class
1≤2	880	17.6	17.6	26.14	0.64
>2≤3	462	9.2	26.8	13.72	0.70
>3≤4	330	6.6	33.4	9.80	0.88
>4≤5	213	4.3	37.7	6.33	0.92
>5≤10	551	11.0	48.7	16.36	1.38
>10≤20	348	6.7	55.7	10.34	2.36
>20≤30	238	4.8	60.4	7.07	4.46
>30≤60	333	6.7	67.1	9.89	9.21
>60	12	0.2	67.3	0.36	2.27

This work should be cited as: D.W. Thomas, D. Kenfack, G.B. Chuyong, Sainge N. Moses, E.C. Losos, R.S. Condit, N.C. Songwe. 2003. *Tree Species of Southwestern Cameroon: Tree Distribution Maps, Diameter Tables, and Species Documentation of the 50-Hectare Korup Forest Dynamics Plot*. Center for Tropical Forest Science of the Smithsonian Tropical Research Institute and Bioresources Development and Conservation Programme-Cameroon, Washington, D.C. This volume was distributed at the AP1 Symposium held at the Limbe Botanical Gardens from August 5-6 2003.

ii. Phase II Field Season Activities

The final quarter of this grant period (April to June 2003) marks the beginning of the rainy season thus less field work can occur during this period. A total of 50 work days were covered in the field (KFDP Chimpanzee camp) during the period of April to June 2003: April - 20 days, May - 20 days, and June - 10 days. During this time frame about 8.4 ha (210 quadrates) of quadrate demarcation were completed. In all 43 hectares of 5x5m quadrate demarcation have been completed at KFDP. The final 7 hectares in the northern portion of the KFDP are very steep making 5x5m quadrate demarcation very difficult and slow going especially during this rainy season. However these remaining hectares will be completed during the next field season. Phenology and rainfall data were also collected as a new rain gauge was installed at the Chimpanzee camp the beginning of this quarter. In all 7,000 individuals of trees ≥10cm dbh were tagged and identified.

iii. Sampling of biodiversity

The 50-ha Korup Forest represents a model dataset for the trees of an African landscape, covering a varied topography (see figure 2). It is therefore a very powerful tool for measuring and modeling the effectiveness of the methods currently used in the region to measure biodiversity, since the effectiveness of the methods can be measured against the total diversity present.

The recent focus of aid organizations and governments in the central African region on the sustainable management of forests and on the protection of all biodiversity, not just larger mammals, means that there is now a much greater need for accurate information on biodiversity and forest dynamics. We are currently using the KFDP dataset to test various sampling procedures.

iv. Measuring and modeling error in botanical inventory.

Although there are a large number of methods used for biodiversity inventory, including the so-called "rapid assessment" methods, few of these methods have been thoroughly tested. Duncan Thomas is beginning to test commonly used field techniques using the KFDP database, and to measure the levels of error that occur in assigning morphospecies and in species determinations by hiring local experts to generate datasets in the KFDP, and use the KFDP database to model the effects of this error on species diversity measurements and on other commonly used statistical tests. The effects of this sampling error on ethnomedical and phytochemical studies will also be investigated. Phytochemistry, more than most other types of study, needs the highest levels of accuracy in plant identification, because plant chemistry is often species-specific, and there is already a large body of literature which can only be linked to new investigations through accurate taxonomy.

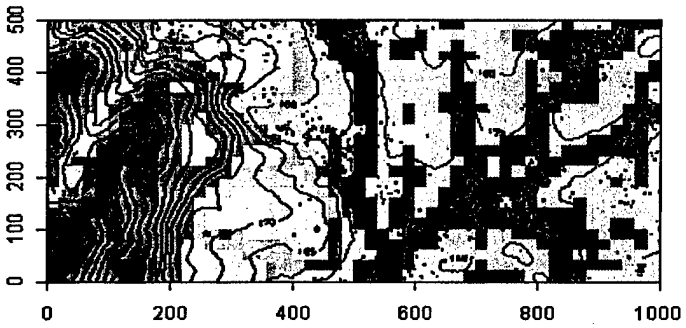
v. Habitat-type associations

This on-going study led by George Chuyong is based on the results of the first census of the KFDP. The plot covers a forested landscape with topography ranging from steep hillside to gently sloping valley floor and swamps. Using three criteria derived from the cadastral survey -- slope, convexity and elevation -- it is possible to define areas of "habitat types" and use powerful statistical tests to measure the level of association of the commoner species with these identified habitats. For this study, habitat association was measured using the Torus Translation Test described in Harms et al (2001). Habitat associations are an important step towards explaining how the diversity of habitat types contributes to the high level of species diversity found in the Korup forest. Dr. Chuyong presented a summary of this information at the ATB 2002 Annual Meeting entitled, "Habitat Specificity and Diversity in the Korup Forest Dynamic Plot, Cameroon" which described the results and analysis preformed at the CTFS workshops. Overall the plot occupies a typically diverse terrain ranging from valley bottom to steep slopes and ridge top. A stream flows across the plot in the E-W direction. Habitats were defined using a combination of mean elevation, slope and convexity as topographic features of each 20x20 m quadrat.

Figure 5. Example of species that show strong and positive association with gulley habitat type.

SPECIES THAT SHOWED STRONG AND POSITIVE ASSOCIATIONS WITH PARTICULAR HABITAT TYPES

2. Low depression



Homalium africanum

Beilschmiedia sp. 1

Habitat type	Area (ha)	*No individuals*	*No species*	Fisher's Alpha Index
River	2.08	9,779	318	62.94
Low Depression	11.04	66,567	410	58.22
High gully	3.56	18,486	322	55.39
Low flat	11.24	117,972	439	57.57
Bench	6.08	42,876	356	53.19
Ridge top	3.32	21,012	290	47.60
Steep slope	8.69	52,268	362	52.42

Table 3. Tree Diversity within seven different habitat types of Korup Forest Dynamics Plot

vi. Floristics of Korup

A floristic summary of the plot has been produced for the Korup chapter in the forthcoming CTFS book "Forest Diversity and Dynamism: Findings from a network of large-scale tropical forest plots" (Losos & Leigh eds, *in press*), edited by E.C. Losos and E.G. Leigh, Jr., and other details are included in the KFDP stand table book, which is discussed above. David Kenfack is preparing a more detailed account of the flora of the KFDP and its affinities and significance. The summary tables below are reproduced from Losos & Leigh *in press*:

Table 4. Family ranking: Top 10 tree families in Korup Forest Dynamics Plot for basal area per hectare, number of trees ≥1 cm dbh, and number of species, and cumulative percentage of all trees in plot. Data are from the first census

Rank	Family	Basal Area (m^2)	% BA	% Trees	Family	Trees	% Trees	Family	Species
1	Euphorbiaceae	256.6	16.1	13.8	Sterculiaceae	72,262	22.0	Rubiaceae	86
2	Scytopetalaceae	227.1	14.3	4.7	Euphorbiaceae	45,296	13.8	Leguminosae	37
3	Leguminosae	143.6	9.0	5.9	Violaceae	31,386	9.6	Euphorbiaceae	37
4	Sterculiaceae	139.3	8.7	22.0	Flacourtiaceae	31,077	9.5	Sterculiaceae	28
5	Sapotaceae	106.9	6.7	0.4	Rubiaceae	22,225	6.8	Annonaceae	22
6	Olacaceae	104.9	6.6	4.5	Leguminosae	19,378	5.9	Sapindaceae	18
7	Ebenaceae	57.2	3.6	5.8	Ebenaceae	19,139	5.8	Guttiferae	16
8	Flacourtiaceae	53.4	3.4	9.5	Scytopetalaceae	15,551	4.7	Anacardiaceae	15
9	Apocynaceae	45.4	2.9	1.9	Olacaceae	14,657	4.5	Ebenaceae	14
10	Irvingiaceae	41.9	2.6	0.1	Annonaceae	10,705	3.3	Violaceae	14

Table 5. Genus ranking: Top 10 tree genera in Korup Forest Dynamics Plot for total basal area, number of trees ≥1 cm dbh, and number of species. Data are from the first census

Rank	Genus	Basal Area (m^2)	% BA	% Trees	Genus	Trees	% Trees	Genus	Species
1	**Oubanguia** ***(Scytopetalaceae)***	218.9	13.8	4.6	***Cola*** **(Sterculiaceae)**	70,254	21.7	*Cola* (Sterculiaceae)	23
2	*Cola* (Sterculiaceae)	137.8	8.7	21.7	**Rinorea** ***(Violaceae)***	30,504	9.4	*Diospyros* (Ebenaceae)	14
3	*Lecomtedoxa* (Sapotaceae)	99.3	6.3	0.1	**Phyllobotryon** ***(Flacourtiaceae)***	26,736	8.3	*Rinorea* (Violaceae)	13
4	*Dichostemma* (Euphorbiaceae)	78.8	5.0	5.3	**Diospyros** ***(Ebenaceae)***	19,139	5.9	*Psychotria* (Rubiaceae)	12
5	*Protomegabaria* (Euphorbiaceae)	73.2	4.6	1.0	**Dichostemma** ***(Euphorbiaceae)***	17,251	5.3	*Garcinia* (Guttiferae)	10
6	*Strombosia* (Olacaceae)	64.9	4.1	2.4	**Oubanguia** ***(Scytopetalaceae)***	15,011	4.6	*Trichoscypha* (Anacardiaceae)	10
7	*Diospyros* (Ebenaceae)	57.2	3.6	5.9	**Strombosia** ***(Olacaceae)***	7876	2.4	*Beilschmiedia* (Lauraceae)	7
8	*Hymenostegia* (Leguminosae)	34.1	2.2	1.3	**Drypetes** ***(Euphorbiaceae)***	7576	2.3	*Drypetes* (Euphorbiaceae)	6
9	*Vitex* (Labiatae)	31.5	2.0	0.1	**Angylocalyx** ***(Leguminosae)***	5853	1.8	*Ouratea* (Ochnaceae)	6
10	*Klaineanthus* (Euphorbiaceae)	30.9	2.0	0.6	**Tabernaemontana** ***(Apocynaceae)***	4256	1.3	*Vitex* (Labiatae)	6

Table 6. Dominance by species: Ten most abundant species in plot for trees ≥1 cm dbh in 50-ha Korup Forest Dynamics Plot, number of stems or basal area, and cumulative percentage of all trees in plot. Data are from the first census.

Rank	Species	Number Trees	% Trees	Species	Basal Area (m^2)	% BA	% Trees
1	*Phyllobotryon spathulatum* Flacourtiaceae	26,728	8.1	*Oubanguia alata* Scytopetalaceae	218.6	13.7	4.5
2	*Cola semecarpophylla* Sterculiaceae	24,518	7.5	**Lecomtedoxa klaineana** Sapotaceae	99.3	6.2	0.1
3	**Dichostemma glaucescens** Euphorbiaceae	17,251	5.3	*Dichostemma glaucescens* Euphorbiaceae	78.8	5.0	5.3
4	*Cola praeacuta* Sterculiaceae	15,471	4.7	*Protomegabaria stapfiana* Euphorbiaceae	73.2	4.6	1.0
5	*Oubanguia alata* Scytopetalaceae	14,918	4.5	*Cola semecarpophylla* Sterculiaceae	34.9	2.2	4.7
6	*Cola sp.nov.* Steculiaceae	12,366	3.8	*Strombosia pustulata* Olacaceae	34.4	2.2	1.3
7	*Cola flavo-velutina* Sterculiaceae	8234	2.5	*Cola semecarpophylla* Sterculiaceae	33.3	2.1	7.5
8	*Diospyros preussii* Ebenaceae	7356	2.2	Klaineanthus gaboniae Euphorbiaceae	30.9	1.9	0.6
9	*Angylocalyx oligophyllus.* Leguminosae	5796	1.8	*Hymenostegia afzelii* Leguminosae	27.7	1.7	1.2
10	*Rinorea lepidobotrys* Violaceae	5492	1.7	*Diospyros gabunensis* Ebenaceae	27.6	1.7	1.2

vii. Lianas.

The liana dataset from Korup covers stems ≥10mm dbh from 10 hectares of the plot. Currently, this dataset is still being revised with new taxonomic information, so it is not yet ready for full-scale data analysis. Eventually, we plan to extend the liana census to the full 50 hectares, but the first census is for 10 hectares only, and we plan to examine the methodology, patterns of diversity and the taxonomy before proceeding with more inventory.

In terms of taxonomy, we find that the lianas are more difficult than the trees, and there appear to be at least as many rare and new species among them. One new liana was recently described from Korup by Thomas & Gereau (1993), and one of the rattans is undescribed. Specimens from the family Annonaceae are particularly difficult to match, so several new species are expected here. In terms of ecology, the lianas make a very interesting comparison with the trees, and will be used to study patterns of diversity.

For methodology, we plan a thorough review during the coming year to see what improvements can be made before recensus. Lianas are notoriously difficult to enumerate and there are very few studies to date. CTFS does not currently have a standard methodology for lianas, in contrast to the tree enumeration which is described by Condit (1998).

In terms of useful plants, lianas are of great importance yet nowhere near as well documented as trees. In the Korup area, lianas yield food, medicine, cordage and other construction materials. Useful lianas are often harvested destructively, so that many complicated management issues arise, and the management of lianas is likely to be important as we move into partnerships for sustainable forest management.

Table 7. Summary of the KFDP Liana data:

Total stems	c. 7,384
Total area of census	10 ha
Total morphospecies	c. 272
Total families	c. 33
Total genera	c. 94

Table 8. KFDP Lianas: 10 most abundant Families and Genera in terms of no. species

	Family	no.spp	Genus	No. spp.
1	Rubiaceae	67	Salacia	18
2	Apocynaceae	26	Dichapetalum	16
3	Connaraceae	20	Landolphia	13
4	Annonaceae	19	Mussaenda	9
5	Celastraceae	18	Strychnus	8
6	Dichapetalaceae	17	Agelaea	7
7	Leg/Pap	16	Ficus	7
8	Icacinaceae	12	Uvaria	7
9	Loganiaceae	11	Sabicea	6
10	Moraceae	7	Combretum	5

viii. Discovery of a New Plant Species

Within the Korup Forest Dynamics Plot, project botanists have fully described one new species of *Tricalysia* (*Tricalysia achoundogiana Sonke, Robbrecht & Kenfack*). These findings are published in the December 2002 issue of Adansonia as the following citation: Sonke B., Kenfack D. & Robbrecht E. A new species of the *Tricalysia atherura* group (Rubiaceae) from southwestern Cameroon. Another new species was also identified and described in the paper – Gereau, E.R. & Kenfack, D. 2000, *Uvariopsis korupensis*, Annonaceace nouvelle de Cameroon. Adansonia 22 (1): 21. Four other species have also been discovered in the KFDP and are currently being described.

ix. Botany at the Limbe Botanical Gardens

Presently the Limbe Botanic Garden herbarium team are identifying and mounting KFDP fertile and vegetative tree and liana materials. In total, 164 specimens collected made by Sainge Moses and David Kenfack have been mounted under herbaria standard. Using the BRAHMS system, 980 specimens from KDFP have been entered into the Limbe Botanic Garden database.

Collections of fertile material including flowers and fruits totalled 157 and were collected in and around Rumpi hills and Korup National Park. All of these dried specimens have been sent to Limbe Botanic Garden herbarium. The 145 plant species of botanical importance at KFDP were checked for flowers and fruits, unfortunately only a few were found because many plants did not flower this year.

David Kenfack also collected various *Capara* species around Rumpi hills and Korup National Park as part of his Ph.D. research. While at Korup, the KFDP botany team (Duncan, Kenfack, Sainge, and Mambo) discovered some differences in the fruits of *Phyllobotryon*. Specifically, fruiting trees found in the low elevation portion of the KFDP had smooth fruits while those in the high elevation portion of the plot had rough fruits. This is a very difficult species to identify without flowers or fruits. Other research will need to be conducted on this species in the future.

x. Ethnobotany of Korup

The uses of the plants of the Korup area have been documented locally, and uses from elsewhere have been reported in the literature. It is now possible to make some calculations regarding the overall usefulness of the KFDP flora, and the distributions of the species that are actually used locally. Growth rates for these species will be available following the recensus. In terms of uses other than general biomass uses (firewood, ash for fertilizer etc.), it is clear that medicinal plants are the most important in

terms of the numbers of species used, though not necessarily in terms of economic value. We plan to start working directly with local harvesters and resource managers to study sustainable levels of extraction.

Table 9. Medicinal and Food Plants in Korup Forest Dynamics Plot (1 Hectare subsample)

Species	Medicinal	Food	#	Species	Medicinal	Food	#
Phyllobotryon spathulatum		x	811	Lasianthera africana	x	x	6
Oubanguia alata		x	406	Pygnanthus angolensis	x		4
Cola Cauliflora	x		178	Staudtia stipitata	x		4
Schumaniophyton magnificum	x		112	Xylopia aethiopica	x	x	4
Massularia acuminata	x		90	Cola chlamidantha	x		3
Tabernaemontana brachiantha	x		82	Glossocalyx brevipes	x		3
Angilocalyx oligophyllus	x	x	56	Irvingia gabonensis	x	x	3
Macaranga monandra	x		51	Anthocleista schwenfurthii	x		2
Garcinia conrauana	x		36	Heinsia crinita		x	2
Uapaca staudtii	x		34	Garcinia mannii	x		1
Enantia chlorantha	x		21	Irvingia grandifolia	x		1
Musanga cecropioides	x		17	Poga oleosa	x	x	1
Carpolobia lutea	x	x	7	Treculia acuminata	x	x	1
Dacryodes edulis		x	7	Trichoscypha acuminata		x	1
Barteria fistulosa	x		6	Zanthoxylon macrophylla	x		1
Cola lateritia	x		6				

xii. Complimentary Research

Dr. Chuyong has also been conducting fortnightly phonological observations of the 10 most abundant species in the KFDP and making collections of fertile specimens for the Limbe Herbarium. Seedling demographic studies have also been conducted on *Garcinia conraouna*.

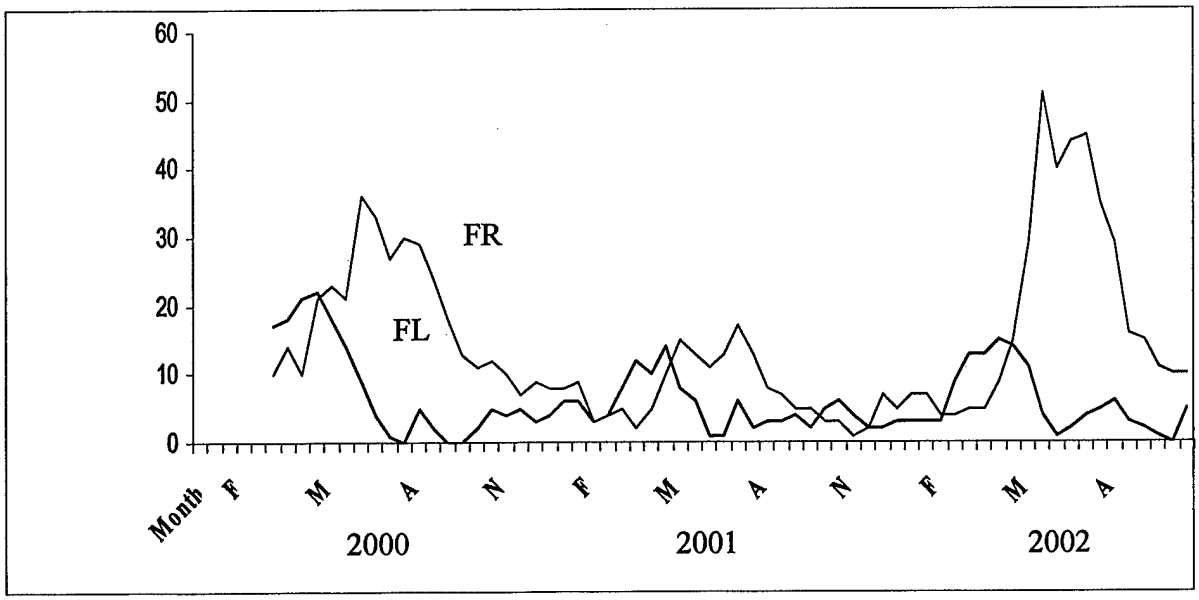


Figure 6. Flowering and fruiting phenology of monitored trees in Korup. (FL = flowering and FR = fruiting)

Table 10. Annual finite survival rates of the different cohorts of *G. conraouna* seedlings monitored over a 4 year period.

Cohorts	2000	2001	2002	2003
C1999	0.95	0.88	0.77	0.93
C2000	0.87	1.0	0.85	1.0
C2001	-	0.96	0.85	0.97
C2002		-	0.81	0.97
Average	0.91	0.95	0.82	0.97

B. Biodiversity Training and Institutional Building: Background

One of the primary goals of AP1 was to train researchers from West Africa in biodiversity assessment and monitoring, and the collection, management, and analysis of taxonomic and ecological data. Training efforts to date have enhanced scientific infrastructure, built links between US, Cameroonian, and Nigerian researchers, and laid groundwork for continuation of project and incorporation of additional partners. At present, training activities have focused within the large and small plots, through organized courses, and through scientific exchanges.

1. MAB training report

To date, we have provided in-country training courses, policy workshops and brought persons from the region for training in the United States:

- Biodiversity Assessment and Monitoring course in Cameroon, 1996 (35 participants)
- Vegetation Assessment and Monitoring course in Nigeria, 1997 (32 participants)
- Conceptual Framework and assessment course in Cameroon, 2000 (28 participants)
- Policy workshop in Nigeria, 2001 (27 participants)
- Vegetation Assessment and Monitoring course in Nigeria, 2001 (43 participants)

i. Biodiversity Monitoring and Assessment course, Mundemba, Cameroon

A two-week training course was organized in Mundemba, Cameroon, in collaboration with WWF and BDCP-C. The first week focused on how to develop a long-term biodiversity monitoring program within an adaptive management framework. The 23 participants were project managers and research coordinators currently involved in establishing assessment and monitoring projects in a range of habitats in Cameroon, and represented several organizations including WWF, WCS, Birdlife International, BDCP International, Tropenbos, Limbe Botanic Gardens, Mount Cameroon Project, ECOFAC, and various Cameroon government agencies including MINEF and IRAD.

Nine of these participants also attended a field component at the Chimpanzee Camp, Korup National Park. Activities throughout the week included techniques for assessment and monitoring vegetation, birds, mammals, and arthropods. Data entry and analysis provided participants with practical experience in the interpretation of field data using multivariate analysis techniques.

ii. Biodiversity Assessment course in Calabar, Nigeria

The MAB program, in collaboration with BDCP, conducted a training course on "Adaptive Management for Biodiversity Monitoring Assessment and Sustainable Utilization in West/Central Africa" in Calabar, Nigeria. The primary objectives of the training were to:

- Provide an overview of biodiversity and the need for regional assessments
- An overview of regional context of biodiversity
- Provide a methodology for vegetation assessment and monitoring
- Introduce GIS and its use in relation to biodiversity assessment
- Review the economics and sustainability of biodiversity

In addition, the course aimed to facilitate the exchange of information and experience sharing among participants, and to identify the current capacities and constraints of Nigerian national parks and community based projects. Forty-three participants from national parks, state forestry departments, and local NGOs attended the course. The activity was composed of four days of lectures and 6 days of field work. Lectures include background information on the ICBG, collaborating organizations, the importance of biodiversity, the need to conduct biodiversity assessments, case studies of work conducted in the region and elsewhere, medicinal and ethnobotanical approaches, community forest studies, as well as techniques for economic valuation. Field work provided participants with experience in the use of GPS equipment, plant collecting and identification techniques, and methods for establishing permanent vegetation monitoring plots.

iii. Policy workshop in Abuja, Nigeria

MAB and BDCP organized a one-day stakeholder policy workshop in April 2001, at the Bioresources Development Centre (BioDEC), Abuja, Nigeria. This was the first of a three-phased project that resulted in the Calabar Training course and Okwangwo field work. It was organized in collaboration with local partners, including the Federal Ministry of Science and Technology, the Federal Ministry of Environment and the Nigerian National Parks Service. The 27 participants in attendance were from twenty states and four federal government ministries, comprised entirely of directors of policy-making departments and agencies.

The meeting deliberated on framework strategies for conducting a national multi-taxa biodiversity monitoring program and for integrating this into national programs. Participants gained a stronger understanding as to the conceptual framework involved for the initiation of a biodiversity assessment and monitoring program. Furthermore, the workshop recommendations have fed directly into the Nigerian Ministry of the Environment's strategy for the implementation of the Convention on Biological Diversity. The monitoring plots established by MAB and BDCP in Nigeria will be providing valuable information on the temporal and spatial trends in forested habitats for the southeast region.

iv. Second International Conference on the Conservation of the Cross River Gorilla

The second international conference on the conservation of the Cross River Gorilla was held in Limbe, Cameroon from 19th to 23rd August 2003 and was hosted by the Wildlife Conservation Society and the Ministry of Environment and Forestry. This meeting, building upon the previous stakeholder policy workshop held in Calabar in April 2001, witnessed the participation of top officials of the Republic of Cameroon and the Federal Republic of Nigeria (both Ministers of Environment attended), as well as experts from international governmental and non-governmental organizations.

Below are some of the recommendations that resulted from this meeting:
1. Establishing a trans-boundary protected area for the Takamanda-Okwangwo complex, in particular by upgrading the protection status of the Takamanda Forest Reserve.

2. Developing a land-use plan for the Takamanda/Mone/Mbulu area in Cameroon, including a network of protected areas and corridors.

The implications and results of these recommendations are as follows:
1. A decree was issued by the Ministry of Environment and Forestry announcing the upgrade of Takamanda from a Forest Reserve (ie timber production forest) to that of a Wildlife Sanctuary.

2. A consultation process will begin which will take on the views of the local communities, forestry officials and conservation agencies. This will form the basis of the development of a management plan.

3. It is important to note that within this classification, the local inhabitants maintain usufruct rights over the reserve particularly the harvest and sale of NTFPs as well as hunting of Class B-D animals. All rights of access are also guaranteed. Prohibited (and hence controlled) activities include the hunting of Class A wildlife (gorillas, drills, chimpanzees, elephants and buffalo), timber exploitation and agricultural

encroachment. This represents a good balance between conservation and utilization and provides a wide range of management options.

2. CTFS Analytical Workshop and Training Report

To date, CTFS has conducted three of its annual Analytical Workshops of 3-4 weeks duration each. The first was in Bangalore, India, in August 2001, and focused on learning the program "R", and on basic statistical analyses of diversity, species/area, spatial patterns and the production of graphics. The second workshop was held in Gamboa, Panama in July 2002, and included a review of the first workshop and sessions on associations between species and habitat, using the Torus Translation Test (Harms et al, 2001), designed specifically for large plot data. The third was held in Harvard Forest, Petersham, Massachusetts, USA in September 6-25, 2003 to introduce new programs for analyzing growth and mortality rates using datasets of two or more census periods. The workshops were led by Dr. Rick Condit, and were attended by the KFDP scientists: Duncan Thomas, George Chuyong and David Kenfack, who are all now able to work with the program using the KFDP dataset. The objectives of these workshops are to train scientists from the plots in the CTFS network in the statistical tests needed to analyze the datasets, and to work on publications from both individual plots and from the network. So far, substantial progress has been made on a series of publications from the first Korup dataset which will expand upon the structure, diversity, species habitat associations and floristics of the plot. These publications will be submitted to peer-reviewed journals.

i. Biennial CTFS Network Meeting

In July 2002, CTFS held its Biennial Network Meeting immediately following the second Analytical Workshop. The aim of the meeting was to bring together researchers from around the world to share their findings and insights into Forest Dynamic Plot research. George Chuyong and David Kenfack both attended this meeting.

ii. Presentation by Dr. George Chuyong

Dr. Chuyong's presentation at the ATB Annual Meeting entitled, "Habitat Specificity and Diversity in the Korup Forest Dynamic Plot, Cameroon" described the results and analysis preformed at the CTFS workshops. Overall the plot occupies a typically diverse terrain ranging from valley bottom to steep slopes and ridge top.

Dr. Chuyong noted that two major obstacles to monitoring forest dynamics are, first tropical forests may be comprised of many habitat types and second, most tree species in the tropics are rare and occur at low densities. Thus, knowledge of plant species association with a particular habitat can provide information on species-specific distribution, local extinction patterns, and community-wide changes in growth, mortality and turnover. These characteristics are necessary for describing forest dynamics in response to biophysical factors and providing information for models which can predict directional changes in the forest.

Preliminary results indicate that a majority of the species in the plot, have clumped distributions, often positively or negatively associated with a range of habitat types. The riverside, low depression and low flat habitat types showed relatively higher species richness that can be attributed to lower moisture stress during the tough dry season. Further research is required to understand the lack of correlation between species diversity and the different topographic variables, which may indicate that other site factors should be considered.

In March 1-4, 1999, Dr. Chuyong presented the paper entitled: *Conserving and managing of biodiversity in Central Africa: Global challenges and local solutions* at the Cameroon Academy of Science Regional Conference on the Environment. This talk focused on the need to quantify and document Central Africa's biological resources for proper management and modeling of future trends. It also addressed the establishment of the 50-ha Forest Dynamics Plot in Korup National Park as part of a wider network of forest plots in the tropics – its objective – to provide baseline information of regeneration requirements of useful plants particularly those with pharmaceutical importance.

iii. ICBG Program Review

In August and December 2002 Dr. Losos attended the ICBG Program Review meeting to discuss future goals of the Associate Programs 1-5.

iv. Limbe Botanic Garden

Sainge Moses traveled three times to Limbe Botanic Garden to continue the process of mounting and identifying KFDP specimens. Dr. Duncan Thomas, David Kenfack also met to discuss and arrange KFDP botanical activities for June 2003.

v. Other meetings

In late June Dr. Duncan Thomas travelled to Cameroon for a series of meetings in Mundemba between KFDP, the Chief of Meka village, Korup Authorities, GTZ Korup National park, and the Divisional delegation of Environment and Forest (MINEF) Ndian. At Korup, a series of meetings were also held comprising of Duncan Thomas, David Kenfack, Sainge Moses, the Korup Project Manager, the Conservator, and the Park Adviser. The purpose of these meetings was to discuss the Korup Forest Dynamics Plot Project MOU as well as the Korup research structure.

It was agreed that during the ICBG meeting (August 7, 2003) in Limbe, Korup National Park should give a short presentation. Furthermore it was also agreed that independent researchers and key researchers involved with projects at KFDP will provide the following documents prior to their activities: Application, Research proposal, CV, copy of passport /ID, Duration of research, and six photo's (4x4). These documents will then be taken to Yaounde by the Conservator for evaluation by a research committee. Arrangements were also made with GTZ Korup and MINEF Ndian regarding the management of the KFDP botanical inventories at the Rumpi hills for the purpose of creating and establishing the first checklist for that area.

C. Presentation of Results from the ICBG Program

AP1's final goal was to disseminate the information gathered from the long-term ecological research, which CTFS and MAB have conducted over the past 5 years. To accomplish this BDCP-Cameroon, CTFS and SI/MAB hosted a two-day meeting at the Limbe Botanical Gardens in Limbe, Cameroon on August 5-6th, 2003. Over 60 in-country scientists attended this meeting. The following researchers presented a summation of results: Brian Schuster, Elizabeth Losos, James Comiskey, Albert Kemboh, David Kenfack, Terry Sunderland, George Chuyong, Thomas Tata, Nouhou Ndam, Muyiwa Odele, Maurice Iwu, and Joshua Rosenthal.

This symposium emphasized: 1) a comparison of findings from the different regions in each of the countries; 2) progress and directions in forging links between ethnomedicine/forest product extraction, forest dynamics, and sustainable forest management; 3) assessment of the relationship between long-term forest monitoring plots and conservation/protected area management; 4) the developing relationships between the SI and local organizations and civil society in the sustainable management of natural resources; 5) our achievements in the areas of capacity-building and training, and an assessment of future need. Overall this symposium allowed for a discussion regarding the potential effects of climate change, fragmentation, disturbance and exploitation by human populations.

III. Key Research Accomplishments

MAB Accomplishments

- Expansion of the 1-ha Biodiversity Monitoring Plots Network which now includes 15 plots in Nigeria and 15 plots in Cameroon
- Sponsored the attendance of 165 in-country researchers to 5 courses held in Nigeria and Cameroon
- Hosted a policy workshop in Nigeria
- Co-hosted the second International Conference of the Conservation of the Cross River Gorilla

CTFS Accomplishments

- Establishment of the 50-ha Korup Forest Dynamics Plot (KFDP) in the Korup National Park
- Complete enumeration, identification, and measurement of over 300,000 trees within the KFDP
- Creation of a protocol for measuring and modeling error in botanical inventories
- Analysis of Habitat-type associations
- Completion of a floristic survey of the KFP
- Identification, enumeration, and measurement of over 7,000 lianas within 10-ha of the KFDP
- Discovery of a new plant species
- Additions of voucher specimens to the Limbe Botanical Garden Herbarium collection

- Preliminary analysis of ethnobotanical uses of plants in the local community
- KFDP Researchers attended three CTFS Analytical Workshops as well as various meetings to build relationships with other CTFS partners

IV. Reportable Outcomes

Books (Attached as Appendix I & II)

- J.A. Comiskey, T.C.H. Sunderland, and J.L. Sunderland-Groves, eds. 2003. Takamanda: The Biodiversity of an African Rainforest, SI/MAB Series #8. Smithsonian Institution, Washington D.C.

- D.W. Thomas, D. Kenfack, G.B. Chuyong, Sainge N. Moses, E.C. Losos, R.S. Condit, N.C. Songwe. 2003. *Tree Species of Southwestern Cameroon: Tree Distribution Maps, Diameter Tables, and Species Documentation of the 50-Hectare Korup Forest Dynamics Plot.* Center for Tropical Forest Science of the Smithsonian Tropical Research Institute and Bioresources Development and Conservation Programme-Cameroon, Washington, D.C.

Chapters in Books

- G.B. Chuyong, R. Condit, D. Kenfack, E. Losos, M. Sainge, N.C. Songwe, D.W. Thomas Korup Forest Dynamics Plot, Cameroon. Chapter 29 In: Forest Diversity and Dynamism: Findings from a network of large-scale tropical forest plots. *In Press.* Edited by Elizabeth C. Losos and Egbert G. Leigh, Jr. Chicago University Press, Chicago.

Peer Reviewed Manuscripts

- Gereau, E.R. & Kenfack, D. 2000, *Uvariopsis korupensis*, Annonaceace nouvelle de Cameroon. Adansonia 22 (1): 21

- Sonké B., Kenfack D. & Robbrecht E. 2002. A new species of the *Tricalysia atherura* group (Rubiaceae) from southwestern Cameroon. Adansonia sér. 3, 24: 173-177

- Schenk, J.J., Thomas D.W. *In press.* A new species of *Ledermanniella* Engl. (Podostemaceae) from Cameroon. Novon

- Chuyong GB, Newbery DM, Songwe NC. 2002. Litter breakdown and mineralization in a central African rain forest dominated by ectomycorrhizal trees. Biogeochemistry 61:73-94.

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- Newbery DM, Chuyong GB, Green JJ, Songwe NC, Tchuenteu F, Zimmermann L. 2002. Does low phosphorus supply limit seedling establishment and tree growth in groves of ectomycorrhizal trees in a central African rainforest? New Phytologist 156:297-311.

V. Conclusions

The Monitoring and Assessing Biodiversity Program (MAB) continues to provide in-country participants with the capacity to conduct biodiversity assessments in areas considered to be of conservation importance through a series of training courses. Research at the Takamanda Forest Reserve has also yielded a series of publications detailing biodiversity in Cameroon and highlighting areas of conservation.

Research efforts at the 50-ha Korup Forest Dynamics Plot have completed a database of more than 300,000 species along with digitization of tree locations and scanning of topographic features. This information permits researchers to understand the vectors of diversity and the dynamics of this tropical forest. Long-term forest trends also provide insight into species abundance, density, and population distribution over a variety of habitat types. The discovery of new species at KFDP provides a more complete view of niche requirements and competition in forest dynamic models, while providing more potential resources for medical research. Scientists from the Korup Forest Dynamics Plot, over the next two years, will be active participants in the Analytical Workshop Series coordinated by the Center for

Tropical Science for its network of demographic tree plots. The training at these workshops has already provided participants with the basic skills necessary to continue data analysis and management currently employed at the site. The production of the Korup Stand Table volume will greatly benefit the scientists who study African Tropical rainforests. Overall, the research and training activities at Korup have moved beyond the foundation of great basic research and are on the verge of transitioning into the phase where great findings are contributed to the greater scientific community. In order to produce meaningful results and understand the dynamics of this forest, the Korup Forests Dynamics Plot will need to complete a recensus of this 50-ha plot. This is our main priority and goal to maintain this long-term large-scale research plot.

VI. References

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