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Biodiversity hotspots and conservation priorities in the Campo-Ma'an rain forests, Cameroon

M.G.P. TCHOUTO[1,*], M. YEMEFACK[2], W.F. DE BOER[3], J.J.F.E. DE WILDE[4], L.J.G. VAN DER MAESEN[4] and A.M. CLEEF[5]

*[1]Limbe Botanic Garden, BP 437, Limbe, Cameroon; [2]International Institute for Geo-Information Science and Earth Observation (ITC), PO Box 6, 7500 AA Enschede, The Netherlands; [3]Resource Ecology Group, Wageningen University, Bornsesteeg 69, 6708 PD, Wageningen, The Netherlands; [4]Biosystematics Group, Wageningen University, Generaal Foulkesweg 37, 6703 BL, Wageningen, The Netherlands; [5]Institute for Biodiversity and Ecosystem Dynamics (IBED) Research Group, Palynology and Paleo/Actuo-ecology, University of Amsterdam, Kruislaan 318, 1090 GB Amsterdam, The Netherlands; *Author for correspondence (e-mail: peguy2000@yahoo.com)*

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Abstract. Until recently, patterns of species richness and endemism were based on an intuitive interpretation of distribution maps with very limited numerical analyses. Such maps based solely on taxonomic collections tend to concentrate on collecting efforts more than biodiversity hotspots, since often the highest diversity is found in well-collected areas. During the last decades, there has been an overwhelming concern about the loss of tropical forest biological diversity, and an emphasis on the identification of biodiversity hotspots in an attempt to optimise conservation strategies. Furthermore, the concept of sites of high diversity, or hotspots, has attracted the attention of conservationists as a tool for conservation priority settings. With the development of GIS tools, geostatistics, phytosociological and multivariate analysis software packages, more rigorous numerical analyses of distributional and inventory data can be used for assessing conservation priorities. In the Campo-Ma'an rain forest, inventory data from 147 plots of 0.1 ha each and 7137 taxonomic collections were used to examine the distribution and convergence patterns of strict and narrow endemic species. We analysed the trends in endemic and rare species recorded, using quantitative conservation indices such as Genetic Heat Index (GHI) and Pioneer Index (PI), together with geostatistic techniques that help to evaluate and identify potential areas of high conservation priority. The results showed that the Campo-Ma'an area is characterised by a rich and diverse flora with 114 endemic plant species, of which 29 are restricted to the area, 29 also occur in southwestern Cameroon, and 56 others that are also found in other parts of Cameroon. Although most of the forest types rich in strict and narrow endemic species occur in the National Park, there are other biodiversity hotspots in the coastal zone and in areas such as Mont d'Eléphant and Massif des Mamelles that are located outside the National Park. Unfortunately, these areas, supporting 17 strict endemic species that are not found in the park, are under serious threat and do not have any conservation status for the moment. Taking into consideration that with the growing human population density, pressure on these hotspots will increase in the near future, it is suggested that priority be given to the conservation of these areas and that a separate management strategy be developed to ensure their protection.

Introduction

Central African rain forests are among the top conservation priority areas in the world (Davis et al. 1994; Heywood and Watson 1995; Myers et al. 2000). The Campo-Ma'an rain forest, in the southern part of Cameroon, falls under the Guineo–Congolian Regional Centre of Endemism that is reported to be species-rich with high levels of endemism (White 1979, 1983; Davis et al. 1994). It is situated in the middle of the Atlantic Biafran forest zone that extends from Southeast Nigeria to Gabon and the Mayombe area in Congo (Letouzey 1968, 1985). The vegetation in the Campo-Ma'an area is determined by climate, especially rainfall, altitude, soils, proximity to the sea and human disturbance (Tchouto 2004). The structure and composition of the forest, as well as the vegetation types change progressively from the mangrove or coastal forest on sandy shorelines through the endemic lowland evergreen forest rich in Caesalpinioideae with *Calpocalyx heitzii* and *Sacoglottis gabonensis*, to the submontane forest on hilltops and the mixed evergreen and semi-deciduous forest in the drier Ma'an area. Other vegetation types/sub-types include swamps, seasonally flooded forests, riverine and secondary forests. The forest in the Ma'an area is described as transitional between the coastal evergreen forest and the semi-deciduous forest of the interior.

In view of the rich and diverse flora of the Campo-Ma'an rain forest, as well as its high level of endemism, it has been identified as one of the key conservation sites in Cameroon (Gartlan 1989; Foahom and Jonkers 1992). The Campo-Ma'an area is a Technical Operational Unit (TOU) that comprises a National Park, five forest management units, two agro-industrial plantations, and a multi-uses zone (Tchouto 2004). Despite the low population density, there are many stakeholders and different types of land use. Activities such as logging, industrial and shifting agriculture exert varying ecological impact on the forest ecosystem. This has led to deforestation, habitat fragmentation and alteration of the coastal forests. With the increasing destruction of natural ecosystems, it is important to identify biodiversity hotspots and conservation priorities in order to enable an effective management. To achieve this, we need to study the species composition and species distribution, so that we can target conservation resources and efforts to rich and diverse areas with a high number of endemic species. Endemism is commonly regarded as an important criterion for assessing the conservation value of a given area. In this study, forest inventory data and taxonomic collections will be used to examine the distribution and convergence patterns of strict and narrow endemic species. We will use new quantitative conservation indices such as GHI (Genetic Heat Index) and Pioneer Index (PI) to analyse trends in endemic and rare species in the various forest types. Finally, geostatistic analysis and techniques will help to evaluate and identify potential areas of high conservation priority.

Materials and methods

Study area

The study was conducted in the Campo-Ma'an rain forest in south Cameroon. The site covers about 7700 km^2 and it is located between latitudes 2°10′–2°52′ N and longitudes 9°50′–10°54′ E. Following the FAO classification system, soils in the Campo-Ma'an area are generally classified as Ferrasols and Acrisols (Franqueville 1973; Muller 1979; van Gemerden and Hazeu 1999). They are strongly weathered, deep to very deep and clayey in texture (except at the seashores and in river valleys where they are mainly sandy), acid and low in nutrients with pH (H_2O) values generally around 4. The topography ranges from undulating to rolling in the lowland area, to steeply dissect in the more mountainous areas. In the Campo area, altitudes are mostly low, ranging from sea level to about 500 m. In the eastern part, which is quite mountainous, the altitude varies between 400 and 1100 m and the rolling and steep terrain brings about a more variable landscape.

The area has a typical equatorial climate with two distinct dry seasons (November–March and July to mid-August) and two wet seasons (April–June and mid-August to October). The average annual rainfall generally decreases with increasing distance from the coast, ranging from 2950 mm/year in Kribi and 2800 mm in Campo to 1670 mm in Nyabissan in the Ma'an area. The average annual temperature is about 25 °C and there is little variation between years. The hydrography of the area shows a dense pattern with many rivers, small river basins, fast-flowing creeks and rivers in rocky beds containing many rapids and small waterfalls. Generally, the area has a low population density of about 10 inhabitants per square kilometre and is sparsely populated (ca. 61,000 inhabitants) with most people living around Kribi, along the coast, and in agro-industrial and logging camps (ERE Développement 2002; de Kam et al. 2002). Despite the low population density, there are few employment opportunities. The local people are very poor and so far rely solely on the forest resources to meet their basic needs. As a result, local pressure on the Campo-Ma'an rain forest is increasing and there are several activities that are carried out in the area with varying ecological impacts on the forest ecosystem. These activities include agriculture, logging, poaching and hunting.

Botanical assessment

Sampling was carried out between 2000 and 2003 in 147 plots of 0.1 ha (50 m × 20 m) in representative and homogeneous vegetation types (see Table 6 for an overview of the plots per vegetation type). In each 0.1-ha plot, all trees, shrubs, herbs and lianas with DBH ≥1 cm (diameter at breast height, about 1.3 m above ground) were measured, recorded and identified. These plots were established in undisturbed forests or matured secondary forests within 12 vegetation

Table 1. Star categories and GHI weight classes as defined for Cameroon.

Star category	Weight for GHI	Comments
Black (BK)	27	Species which are only found in Campo-Ma'an area (strictly endemic) or near endemics (species which also occur in some localities around Campo-Ma'an such as Bipindi, Edea-Kribi, Lolodorf or southern part of Cameroon). Urgent attention to conservation of population is needed.
Gold (GD)	9	Cameroon endemics, rare and threatened Lower Guinea endemics. Cameroon has definitely responsibility for preserving these species.
Blue (BU)	3	Lower Guinea and Guineo–Congolian endemics which are widespread internationally but rare in Cameroon, or vice versa.
Scarlet (SC)	1	Common but under serious pressure from heavy exploitation. Exploitation needs to be curtailed if usage is to be sustainable. Protection of all scales vital.
Red (RD)	1	Common but under pressure from exploitation.
Pink (PK)	1	Common and moderately exploited.
Green (GN)	–	Widespread Guineo–Congolian, pantropical and tropical African species that are not under pressure. No particular conservation concern.

Adapted from Hawthorne and Abu-Juam (1995), Hawthorne (1996) and Tchouto et al. (1998).

types ranging from coastal forest, mangrove, swamp, lowland evergreen forest, mixed evergreen and semi-deciduous forest to submontane forest at higher elevations (800–1100 m above sea level). Most of the plots were located in the National Park and the forest management units which are less affected by human activities. Furthermore, in each representative vegetation type, a provisional plant species checklist was made in the field with information on their growth form, guild and frequency. A guild refers to a group associated with a common way of life (Table 2). For unknown species, a voucher specimen was collected. The study also involved the collection of fertile specimens encountered in plots, vegetation types and specific habitats such as exposed rocks and riverbanks. The geographic co-ordinates of each plot, sample or specimen were recorded using the Global Positioning System (GPS, Garmin 12XL model with estimated precision of ± 10 m). These co-ordinates were used for mapping main vegetation types, species distribution, and biodiversity hotspots. A duplicate of each specimen was mounted and preserved in the Kribi Herbarium. Others duplicates were sent to the National Herbarium in Yaounde, Cameroon (YA) and the Nationaal Herbarium Nederland, Wageningen University Branch (WAG) for further identification and preservation.

Criteria for taxa inclusion

A plant species checklist was generated from the inventory data, from the plant collections made during the study, and from specimens previously collected in the area by other scientists, stored in the Cameroon and Wageningen herbaria. Furthermore, a taxonomic search for potential taxa of high conservation

Table 2. Guild and weight classes.

Guild	Weight for PI	Comment
Pioneer (PI)	2	Regenerating only in forest gaps and therefore indicating disturbed forest (e.g. *Ceiba, Musanga, Harungana, Macaranga*).
Non-Pioneer light demanding (NP)	1	Although some juveniles are also found in the understorey of undisturbed forest, they require gaps to develop to full maturity. Generally, non-pioneer light demanding are abundant in matured disturbed forest (e.g. *Albizia, Entandrophragma, Piptadeniastrum, Pycnanthus*).
Shade-bearers (SB)	0	Understorey herbs, shrubs and trees which grow, flower and fruit in undisturbed forest (e.g. *Cola*, *Diospyros*, *Psychotria*, *Rinorea*).

Adapted from Hawthorne and Abu-Juam (1995), Hawthorne (1996) and Cable and Cheek (1998).

priority such as endemic, rare, new and threatened species was carried out using existing floras and monographs (Keay and Hepper 1954–1972; Aubréville and Leroy 1961–1992; Aubréville and Leroy 1963–2000; Lebrun and Stork 2003; Satabié and Leroy 1980–1985; Satabié and Morat 1986–2001), the IUCN (2002) red list categories, and the WCMC (1998) world list of threatened trees. On the basis of this information, a list of 141 species of high conservation values was produced with information on their habit, guild, star category (Table 1) and chorology. In this list, priority was given to taxa that are strictly endemic to the Campo-Ma'an area. Followed by species that are endemic to southwestern Cameroon (also occurring in Bipindi and Lolodorf areas) or Cameroon and Lower Guinea endemics (especially if they reach their northern or southern limit of distribution in Campo-Ma'an). Furthermore, species that reach their northern or southern limit of distribution in the Campo-Ma'an area were also included in the list.

Star rating of species and measurement of forest conservation value

A star rating system, based on the work of Hawthorne and Abu-Juam (1995) and Hawthorne (1996) in Ghana, Cable and Cheek (1998) and Tchouto et al. (1998) in Cameroon, was used to define the conservation status of each species recorded (Table 1). The factors considered when categorising species into star categories are their distribution, ecology, local abundance, taxonomy, life history, interaction with ecosystem parameters and economic importance (Hawthorne 1996). Therefore, species that are endemic, rare, threatened, or likely to represent a scarce genetic resource, are more valuable than others are. Hence, forests richer in such species receive a higher score than others.

The GHI concept was developed by Hawthorne (1996) to express the conservation value of a given forest, and the PI concept to express the level of

disturbance in a given forest. GHI is an attempt to provide a scale, on which to measure the genetic 'temperature' or value of the forest. A plot/forest with an average GHI >150 will be considered warm or hot. In general, for species with completed monographs, black stars occupy about 1–3 filled degree squares on a standard distribution map, gold stars 4–14, blue stars 15–30, and green star more than 30 degree squares.

Hawthorne (1996) defined the guild as a flexible concept used to circumscribe a group of plant species with a similar ecology and way of life. All the species were grouped into guild classes as defined in Table 2 and a PI score was calculated as an expression of the relative contribution of pioneers. Five classes of human disturbance were used to evaluate the forest quality and condition as defined in Table 3. These classes were mainly based on the field observation of the level of human disturbance and the state of forest degradation.

The GHI and PI values of each sample were calculated using the TREMA database as follows:

$$\begin{aligned}\text{Genetic Heat Index (GHI)} = [((&\text{BK} \times \text{BK weight}) + (\text{GD} \times \text{GD weight}) \\ &+ (\text{BU} \times \text{BU weight}) + (\text{RD} \times \text{RD weight}))/ \\ &(\text{BK} + \text{GD} + \text{BU} + \text{GN} + \text{RD})] \times 100,\end{aligned}$$

where BK = number of black star species; GD = number of gold star species; BU = number of blue star species; GN = number of green star species; and RD = number of red, scarlet and pink star species.

$$\text{Pioneer Index (PI)} = \frac{(\text{Pioneer} \times \text{PI weight}) + (\text{NP} \times \text{NP weight})}{\text{Total number of species}} \times 100,$$

where PI = number of pioneer species and NP = number of non-pioneer light demanding species.

Table 3. Forest condition classes showing the degree of human disturbance on the natural forest cover.

Forest condition	Classes	Notes
Excellent	Virtually undisturbed	Undisturbed forest, with good canopy and few signs of human disturbance except for hunting and NTFPs collection.
Good	Less than 25% disturbed	Small patches of recent disturbances (<25%) with good canopy cover.
Slightly degraded	25–50% disturbed	Obviously disturbed with significant patches (25–50%) of recent degradation but with good predominant forest and broken upper canopy.
Mostly degraded	More than 50% disturbed	Considerable are (>50%) of recent degradation. Patchy with heavily disrupted canopy.
Very poor	Farm land	No significant forest left (<2% good forest). Massive land conversion for plantation or farm.

Geostatistical analysis

Conservation indices such GHI and PI are likely to vary throughout a region. Geostatistics (Isaaks and Srivastava 1989; Webster and Oliver 2001) were applied to quantify the spatial distribution of GHI within the Campo-Ma'an forest. Geographic analyses were done using ILWIS software (ILWIS 2001) and GSTAT package (Pebesma and Wesseling 1998) of R software (R Development Core Team 2002). The semivariance was calculated for GHI data on a minimum lag distance of 1250 m and each lag distance class contained at least 105 pairs of points. The semivariogram parameters (nugget, sill and range) were computed using the GSTAT fit variogram function. During the study of GHI spatial variability, the main objective was to obtain a map from point observations. Since this also required the estimation of a value at un-visited locations, the technique commonly used is known as kriging (Isaaks and Srivastava 1989). The semivariogram function was then used to extrapolate the GHI values in the Campo-Ma'an forest at 100 m $\times$ 100 m grid, using ordinary kriging. The output map was reclassified into five classes of conservation value (Hawthorne 1996).

Results

Species richness and endemism

A plant species checklist made of 2297 species of vascular plants, ferns and fern allies was generated from inventory data and from 2348 herbarium specimens and 4789 ecological specimens collected in the various plots. They belonged to 851 genera and 155 families. More than 67% of the specimens were identified at species level, 28% at generic level, 4% at family level and 1% remained unidentified. The 20 most important families and genera are shown in Tables 4 and 5. In terms of growth form, tree species contributed for 26% to the total number of 2297 species recorded, followed by herbs (24%), shrubs (23%) and climbers (17%), respectively. About 72% of the total number of species recorded was also found in the Campo-Ma'an National Park and the remaining 28% were only found in the coastal forest and the semi-deciduous forests located outside the park.

In addition to a list of 92 threatened species (Appendix 2) recorded in IUCN (2002) and WCMC (1998), a list with 141 plant species of high conservation priorities was produced, with information on their growth forms, guild, chorology and star categories (Appendix 1). Only species that are endemic to Cameroon and species that reach their northern or southern limit of distribution are included in this list. The Campo-Ma'an area has about 114 endemic species, 29 of which are only known from the area, 29 only occur in the southwestern part of Cameroon, and 56 near endemics that also occur in other parts of Cameroon (Appendix 1 and Figure 1).

Shrubs contributed for 38% of the 114 endemic species (Appendix 1), herbs 29%, trees 20% and climbers 11%. Moreover, 540 species (23% of the total

Table 4. Most important families recorded in the Campo-Ma'an area.

No.	Family	No. of species	Predominant growth forms
1	Rubiaceae	279	Trees, shrubs, herbs and climbers
2	Euphorbiaceae	117	Trees, shrubs, herbs and climbers
3	Leguminosae-Caesalpinioideae	96	Trees and shrubs
4	Apocynaceae	80	Trees, shrubs, herbs and climbers
5	Annonaceae	69	Trees, shrubs and climbers
6	Acanthaceae	68	Herbs
7	Leguminosae-Papilionaideae	65	Trees, herbs and climbers
8	Sterculiaceae	62	Shrubs and trees
9	Gramineae	54	Herbs
10	Orchidaceae	54	Terrestrial and epiphytic herbs
11	Melastomataceae	46	Shrubs and herbs
12	Moraceae	40	Trees, shrubs and herbs
13	Celastraceae	39	Climbers
14	Cyperaceae	39	Herbs
15	Dichapetalaceae	39	Climbers
16	Sapindaceae	36	Trees and shrubs
17	Araceae	34	Herbs and hemi-epiphytes
18	Loganiaceae	33	Shrubs and climbers
19	Sapotaceae	30	Trees and shrubs
20	Begoniaceae	29	Terrestrial and epiphytic herbs
	Others(135 families)	988	Trees, shrubs, climbers and herbs

Table 5. Most important genera recorded in the Campo-Ma'an area.

No.	Genus	No. of species	Predominant growth forms
1	*Dichapetalum* (Dichapetalaceae)	37	Climbers
2	*Psychotria* (Rubiaceae)	35	Shrubs
3	*Cola* (Sterculiaceae)	32	Trees and shrubs
4	*Begonia* (Begoniaceae)	29	Terrestrial and epiphytic herbs
5	*Diospyros* (Ebenaceae)	27	Trees and shrubs
6	*Salacia* (Celastraceae)	27	Climbers
7	*Strychnos* (Loganiaceae)	24	Climbers
8	*Rinorea* (Violaceae)	23	Trees and shrubs
9	*Drypetes* (Euphorbiaceae)	21	Trees and shrubs
10	*Combretum* (Combretaceae)	18	Climbers
11	*Dorstenia* (Moraceae)	18	Herbs
12	*Campylospermum* (Ochnaceae)	17	Shrubs
13	*Bulbophyllum* (Orchidaceae)	16	Terrestrial and epiphytic herbs
14	*Ficus* (Moraceae)	16	Trees and stranglers
15	*Garcinia* (Guttiferae)	16	Trees and shrubs
16	*Asplenium* (Aspleniaceae)	15	Epiphytic herbs
17	*Culcasia* (Araceae)	15	Herbs and hemi-epiphytes
18	*Landolphia* (Apocynaceae)	15	Climbers
19	*Tricalysia* (Rubiaceae)	15	Trees an shrubs
20	*Bertiera* (Rubiaceae)	14	Shrubs
	Others (831 genera)	1867	Trees, shrubs, climbers and herbs

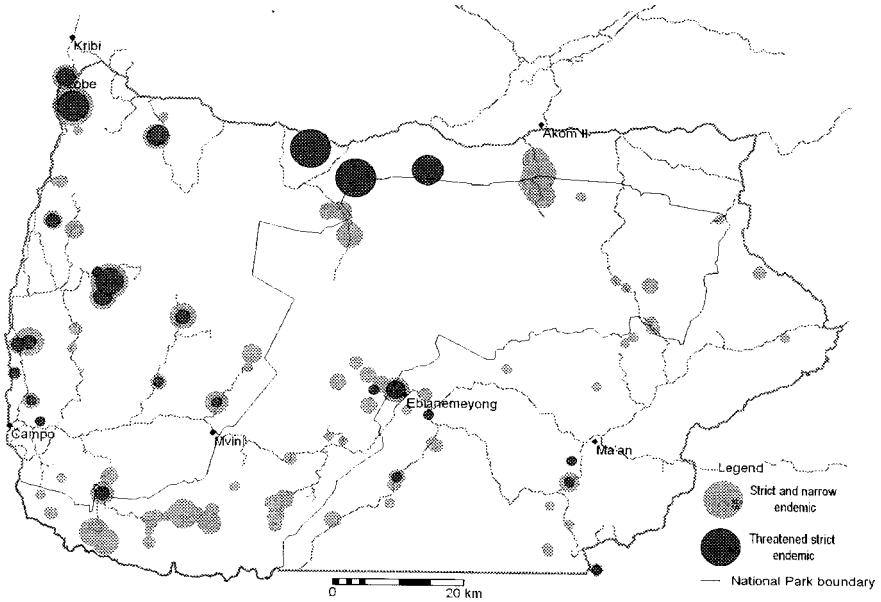

Figure 1. Distribution of 114 strict and narrow endemic plant species recorded in the Campo-Ma'an area (gray circle). Black circle represents the distribution of 17 threatened strict endemics that are not found in the National Park. The size of the circle represents the relative density of endemics at a given point.

number of species) recorded are endemic to the Lower Guinea Centre of Endemism, 1123 species (49%) are Guineo–Congolian endemics and 105 species (5%) are Guinea endemics as described by White (1979). Overall, there was a high concentration of strict and narrow endemic species in the lowland evergreen forest rich in Caesalpinioideae, coastal and submontane forests located in the western and northern parts of Ma'an and a relatively low concentration of these species in Ma'an area (Figure 1). Although more than 70% of the total endemic species recorded were also found in the National Park, 17 of the 29 strict endemic species were not recorded in the park (Appendix 1). The distribution patterns of these 17 taxa showed a high concentration of species around Campo, Lobe, Massif des Mamelles, Mont d'Eléphant and Zingui and a very poor representation in the Ma'an area (Figure 1).

GHI and measurement of forest conservation value

More than 57% of the plots have a high GHI score with the highest score recorded in the submontane forest (GHI = 294.4) and the lowest score in mangrove (GHI = 3.1). As shown in Figure 2, the submontane forest had the highest average GHI score of 214.7, followed by the lowland evergreen forest rich in Caesalpinioideae with *Calpocalyx heitzii* and *Sacoglottis gabonensis*

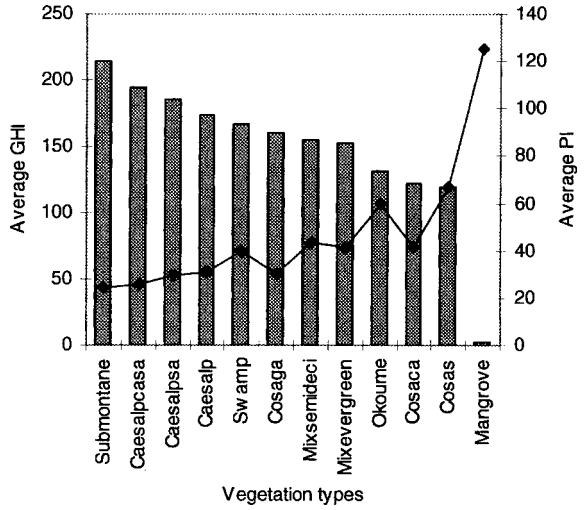

Figure 2. The average Genetic Heat Index (GHI = bars) and average Pioneer Index (PI = line) for the various vegetation types as defined in Table 6.

(GHI = 194.1). The mangrove and the coastal forest on sandy shorelines had the lowest average GHI score (GHI = 3 and 120.2, respectively). The average PI was very high in the mangrove forest (PI = 125), coastal forest on sandy shorelines (PI = 66.9) and in the forest rich in *Aucoumea klaineana* (PI = 60). Generally, there was a significant decrease in average GHI with increasing average PI (Figure 2). As shown in Figure 3, there was a very strong significant negative correlation between the average GHI scores and the PI scores recorded in the various vegetation types ($F_{1-10} = 111.71$, $R^2 = 0.918$, $p < 0.0001$). However, the correlation was rather weak with a low explanatory factor when the analysis was carried out using all plots as individual data points ($F_{1-45} = 94.00$, $R^2 = 0.393$, $p < 0.0001$). Most of the forest types within the National Park were virtually undisturbed or less than 25% disturbed (Figure 4). The coastal forest between Campo and Kribi, as well as the forests around Massif des Mamelles, Mont d'Eléphant, agro-industrial plantations, logging concessions and settlements were much more affected by human activities (Figure 4). These forests were often more than 25% disturbed by human activities and were characterised by a high PI scores (Figures 2 and 4).

Geostatistical results

The analysis of the spatial structure of the dataset did not show any preferential spatial trend. Therefore, an omni-directional analysis of the semivariance (best described by a spherical model) was applied. Figure 5 shows the semivariogram and its characteristics. The GHI variable showed a strong spatial dependence

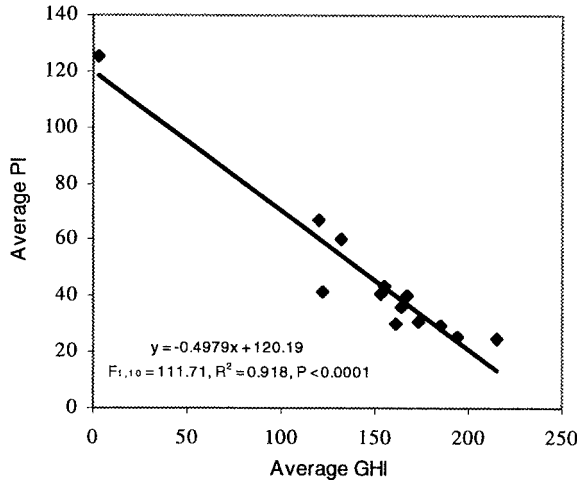

Figure 3. Correlation between the average GHI scores and the average PI scores for the various vegetation types.

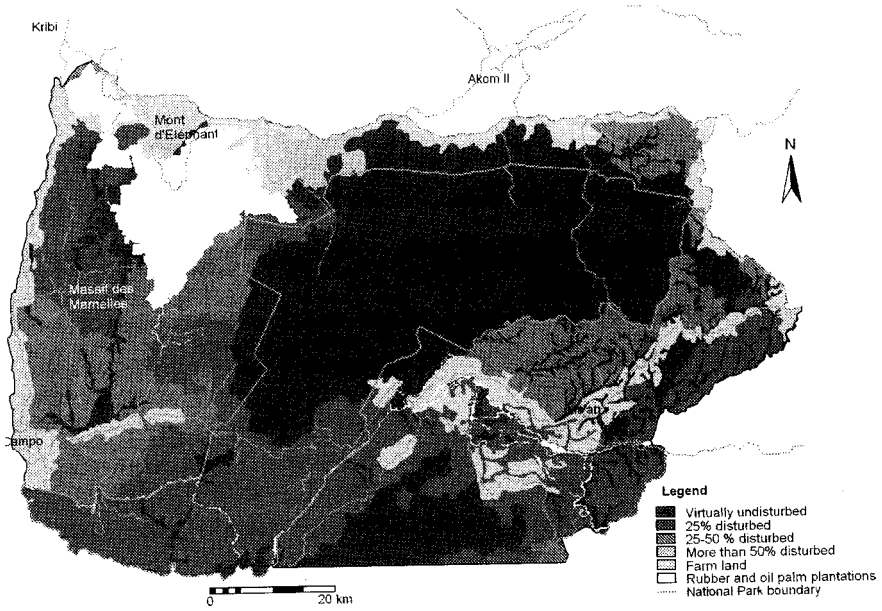

Figure 4. Impact of human disturbance on the Campo-Ma'an rain forest.

within a range of 10,500 m. The nugget (645) was low compared to the total variance or sill (3700). This suggests that more than 82% (100*(Sill-Nugget)/Sill) of the semivariance of GHI could be modelled by the variogram over a range of 10 km. The output map of the ordinary kriging (Figure 6) was reclassified into

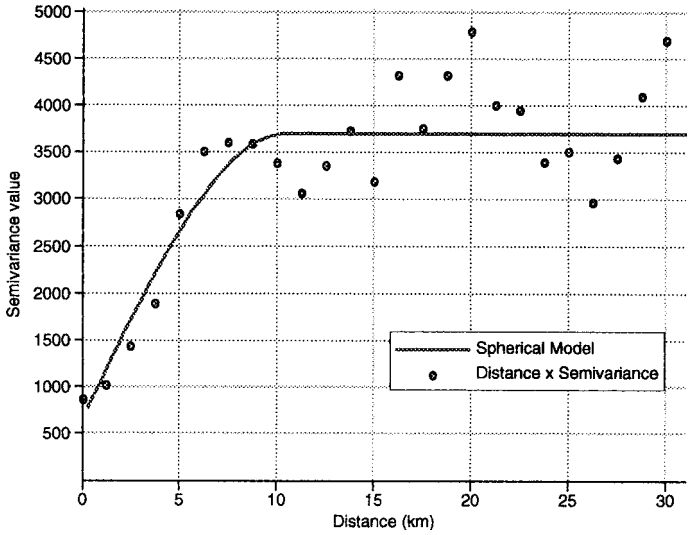

Figure 5. Spherical variogram model for GHI in the Campo-Ma'an rain forest (estimated from 147 points of 0.1 ha each).

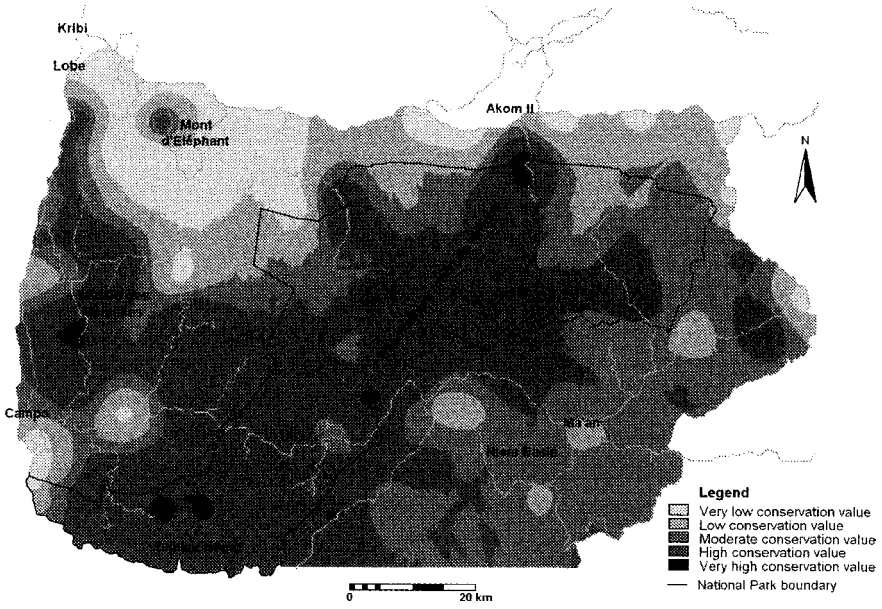

Figure 6. Ordinary kriging map showing the distribution of GHI scores and conservation hotspots within the Campo-Ma'an rain forest The following GHI values are defined for the various conservation classes (Hawthorne 1996): Very high conservation value for GHI >200; High conservation value ($150 \geq$ GHI <200); Moderate conservation value ($100 \geq$ GHI <150); Low conservation value ($50 <$ GHI <100) and very low conservation value (GHI <50).

five GHI classes, partitioning the conservation value of the Campo-Ma'an forest. This partition showed that 1% of the area was characterised by a very high conservation value, 45% by a high conservation value, 30% by an average conservation value, 15% by a low conservation value and 9% by a very low conservation value. A considerable portion of the National Park and the forests around Massif des Mamelles and Mont d'Eléphant was characterised by a high conservation value, with highest values found in Dipikar Island, Massif des Mamelles, Mont d'Eléphant and in the submontane forest on hilltops. The forests in the Ma'an area, around Campo and agro-industrial plantations, near villages and along the roads had a low conservation value. Similar patterns were observed for the distribution of strict and narrow endemic species (Figure 1).

Discussion

General vegetation patterns

The Campo-Ma'an has a diverse range of vegetation that changes progressively from sea level to 1100 m at higher altitudes. The wetter Campo area was dominated by the lowland evergreen forest rich in Caesalpinioideae and the drier Ma'an area by the mixed evergreen and semi-deciduous forest. More than 65% of the forest types recorded had at least 250 species (Table 6). The submontane forest had the highest frequency of species-rich plots (93% of the plots had above 100 species/0.1 ha). Other rich vegetation types included the lowland evergreen forest rich in Caesalpinioideae with *Calpocalyx heitzii* and *Sacoglottis gabonensis* (81%), the lowland evergreen forest rich in Caesalpinioideae with *Sacoglottis gabonensis* (78%), the lowland evergreen forest rich in Caesalpinioideae (76%) and the mixed evergreen and semi-deciduous forest (67%). The mangroves, swamps and the coastal vegetations on sandy shorelines were species-poor. The explanation for the diverse range of forest types and habitats might stem partly from the fact that the Campo-Ma'an vegetation is influenced by several environmental factors such as rainfall, altitude, soil, the proximity to the sea and the degree of human disturbance (Tchouto 2004). As a result there was a gradual variation in dominant species, forest type and structure from the coast to the hilltops and the drier forest in the Ma'an region.

Species richness and endemism

The Campo-Ma'an area is characterised by a rich and diverse flora with more than 2297 species of vascular plants, ferns and fern allies. The site has about 114 endemic plant species out of which 29 are strictly endemic to the site. The number of endemic plant species is relatively high considering the size of the area, and more than 75% of the current vegetation cover was characterised

Table 6. Number of plots, number of species and number of stem/ha recorded within the various vegetation types for all plants with DBH ≥1 cm.

Vegetation types	No of plots	No of species	Average No of stems/ha
Caesalp (2.3 ha)	23	557 (75–128)	4380 (2500–5750)
Caesalpcasa (2.5 ha)	25	555 (93–139)	5326 (3120–7020)
Caesalpsa (1.4 ha)	14	474 (86–138)	5935 (4350–7120)
Cosaga (0.9 ha)	9	303 (81–140)	5810 (4940–8010)
Cosaca (0.9 ha)	9	326 (78–108)	5864 (4740–7570)
Cosas (0.4 ha)	4	100 (27–55)	4710 (3630–5700)
Mixevergreen (2.1 ha)	21	523 (63–135)	4983 (3890–6980)
Mixsemideci (1.6 ha)	16	481 (86–147)	5460 (4390–6340)
Submontane (1.4 ha)	14	499 (79–148)	6094 (3680–8449)
Swamps (0.5 ha)	5	246 (18–108)	4276 (2070–5960)
Mangrove (0.2 ha)	2	4 (3–4)	8630 (8150–9100)
Okoumé forests (0.5 ha)	5	234 (18–107)	4802 (3720–5800)
Total for the Campo-Ma'an area	147	1116 (3–148)	5312 (2070–9100)

Minimum and maximum values are given betweem brackets.
Submontane = Submontane forest; Caesalpcasa = Lowland evergreen forest rich in Caesalpinioideae, *Calpocalyx heitzii* and *Sacoglottis gabonensis*; Casealpsa = Lowland evergreen forest rich in Caselpinioideae and *Sacoglottis gabonensis*; Caesalp = Lowland evergreen forest rich in Caesalpinioideae; Cosaga = Coastal forest with *Sacoglottis gabonesis*; Mixsemideci = Mixed evergreen and semi-deciduous forest with elements predominant; Mixevergreen = Mixed evergreen and semi-deciduous forest with semi-deciduous elements of evergreen forest predominant; Okoumé = forest rich in *Aucoumea klaineana*; Cosaca = Coastal forest with *Sacoglottis gabonensis* and *Calpocalyx heitzii*; and Cosas = Coastal forest on sandy shorelines.

either by very high, high or average GHI values (Figure 6). Furthermore, the distributions of strict and narrow endemic species showed a high concentration of these species in the submontane forest between Ebianemeyong and Akom II, in Dipikar Island, and in the forests in and around Massif des Mamelles, Lobe, Mont d'Eléphant and Zingui. Surprisingly, the mixed evergreen and semi-deciduous forest in the Ma'an area showed a relatively low concentration of these species (Figure 1). The explanation for the high occurrence of endemics might stem partly from the fact that the area falls within a series of postulated rain forest refugia in Central Africa (Hamilton 1982; White 1983; Maley 1987, 1989, 1990, 1993, 1996; Sosef 1994, 1996). In such refugia, the unique combination of climatic and geological histories, contemporary ecological factors, and inherent biological properties of taxa and their combinations, may have contributed to survival and/or speciation (Barbault and Sastrapradja 1995; Hawksworth and Kalin-Arroyo 1995). Furthermore, the Campo-Ma'an area forms part of the Guineo–Congolian Regional Centre of Endemism (White 1983). All families endemic to this biogeographic region are also found in the Campo-Ma'an area (White 1983). They include Hoplestigmataceae, Huaceae, Lepidobotryaceae, Medusandraceae, Pandaceae, Pentadiplandraceae and Scytopetalaceae. Moreover, 82% of endemic genera cited by White (1983) also occur in the area.

Forest richness and biodiversity hotspots

Considering the fact that the occurrence of endemic species contributes significantly to the conservation value of a forest, it is important to study their distribution and abundance prior to any conservation initiatives. This is mainly due to the fact that strict and narrow endemic species are restricted to small areas, and are therefore highly vulnerable to human disturbance and other forms of environmental changes (Myers 1988; Williams 1993; Heywood and Watson 1995). A study carried out in the Campo-Ma'an rain forest has revealed that the submontane forest, the lowland evergreen forest rich in Caesalpinioideae with *Calpocalyx heitzii* and *Sacoglottis gabonensis*, and the lowland evergreen forest rich in Caesalpinioideae are richer in strict and narrow endemics compared to the other forest types found in secondary forest and along the coast. This is confirmed by the high average GHI scores recorded in these forest types (Figure 2). Most of these forest types were located in the National Park and the lowland evergreen forests around Massif des Mamelles and Mont d'Eléphant. They were virtually undisturbed or less than 25% disturbed by human activities (Figure 4). This implies that the Massif des Mamelles and the Mont d'Eléphant areas represent other biodiversity hotspots, located outside of the Park (Figure 6).

There was a strong significant negative correlation between the average GHI scores and the average PI scores recorded in the various vegetation types. Most plots located near settlements and in secondary forests were characterised by a low conservation value with low GHI scores and high PI scores. This confirmed that disturbed forests are rich in pioneer species but poor in plant species with high conservation priority. It is worth reiterating that a considerable portion of the Campo-Ma'an area has been selectively logged at least twice during the past 30 years. Although logging damages were moderate and had low impact on the total forest biodiversity, it has created forest gaps that allowed the development of many pioneer species. This might have contributed to the high average PI scores registered in the coastal forest types. In these areas with conflicts between human and conservation activities, there is an urgent need to develop participatory approaches to sustainable natural resource management that integrates the objectives of conservation with local development.

Threatened species

During the selection of species of high conservation priority, taxa were chosen on a global rather than a Cameroonian or a Campo-Ma'an perspective of conservation importance. Of the 29 strict endemic species that are only known from the Campo-Ma'an area, 17 were not recorded in the National Park illustrating the need for conservation activities outside the park. Although these 17 strict endemics are not immediately threatened with extinction, the

most threatened are probably those occurring in the coastal zone and in areas located at the vicinity of large agro-industrial plantations, since these areas are heavily exploited. As shown in Figure 4, their habitats are fragmented and degraded because these areas are surrounded by farms and heavily disturbed forests.

Considering the fact that extinct species are taxa that are no longer known to exist in the world after repeated search in their type localities (WCMC 1998; IUCN 2002), we cannot yet talk about extinction because no attempt has been made to search for these species. Furthermore, only 67% of the total amount of specimens collected was identified at species level. However, with the ongoing speed of forest degradation noticed in the coastal area, eight of these strict endemics (*Beilschmiedia dinklagei*, *Deinbollia macroura*, *Ledermanniella batangensis*, *Psychotria aemulans*, *P. batangana*, *P. dimorphophylla*, *P. oligocarpa*, and *Strychnos canthioides*) that are only known from the coastal zone can be categorised as endangered species. While the nine others that are located inland around Efoulan, Fenda, Massif des Mamelles, Mont d'Eléphant and Zingui can be categorised as vulnerable. They are *Afrotrewia kamerunica*, *Bulbophyllum alinae*, *Begonia montis-elephantis*, *Calvoa stenophylla*, *Dorstenia dorstenioides*, *Guaduella mildbraedii*, *Hypolytrum* sp. nov., *Scaphopetalum acuminatum* and *S. brunneo-purpureum*. Some of them so far are only known from type specimens or from a few collections made in the type locality before the 60s. Others such as *Afrotrewia kamerunica*, *Begonia montis-elephantis* and *Hypolytrum* sp. nov. have a restricted range with a small and restricted population. Furthermore, habitat fragmentation may convert a previously more continuous population structure to a metapopulation structure, with local populations becoming so small that they may have a substantial risk of extinction (Hawksworth and Kalin-Arroyo 1995).

Implications for biodiversity conservation

The Campo-Ma'an National Park

The National Park is the core conservation area of the Campo-Ma'an Technical Operational Unit. It is surrounded by areas under several land uses that have varying ecological impact on the park and the surrounding forests. The park is of high conservation priority with about 72% of the 2297 species of vascular plants, ferns and fern allies recorded so far in the Campo-Ma'an area. More than 70% of the total endemic species recorded were also found in the National Park, and most of the forest types with high GHI scores, low PI scores and high conservation priority species were also found in the park (Figures 2 and 6). The most important one is the endemic lowland evergreen forest rich in Caesalpinioideae with *Calpocalyx heitzii* and *Sacoglottis gabonensis*, a vegetation type that only occurs in the Campo area (Letouzey 1985; Gartlan 1989; Thomas and Thomas 1993). Other forest types such as the submontane forest on hilltops, the lowland evergreen forest rich in

Caesalpinioideae and the mixed evergreen and semi-deciduous forests are also well represented. So far the National Park is the only area with a legal conservation status. It is a permanent state forest that is protected by law and solely used for forest and wildlife conservation. However, its boundaries have not been marked, the management plan has not yet been produced and protection is weak. Therefore, it is of urgent need to demarcate the boundary of the park, to reinforce its protection, and to complete and implement its management plan as soon as possible.

Massif des Mamelles and Mont d'Eléphant

This study has demonstrated that other hotspots for biodiversity conservation, such as Mont d'Eléphant and Massif des Mamelles, are located outside the National Park (Figure 6). These areas are non-permanent forest estates that can be allocated for human activities such as logging, agro-industry, agriculture, agro-forestry, community forest, communal forest or private forest. Moreover, hunting, fishing, mineral exploitation or any other form of economic activities is allowed if done in accordance to the 1994 forest law. Unfortunately, these areas do not have any conservation status and a number of ongoing human activities have negative impacts on the forest ecosystem (Tchouto 2004). In addition to the construction of the Tchad-Cameroon oil pipeline terminal at Grand Batanga and the rock exploitation on Mont d'Eléphant, there exists a plan to exploit the iron ore deposits of the Massif des Mamelles. All these activities, if realized, would affect the vegetation and thus impact the biodiversity. As shown in Figure 4, these fragmented forest patches with high conservation priorities are more seriously exposed to forest degradation and habitat loss since they are surrounded by disturbed and degraded forests. Furthermore, they are the type localities for some rare endemic species such as *Afrotrewia kamerunica*, *Begonia montis-elephantis*, *Bulbophyllum alinae* and *Hypolytrum* sp. nov. that are so far only known from the type specimens or from few collections made in these areas. Pressure on these fragmented hotspots will increase in the future with the growing human population density, the few local employment opportunities and the poverty of the local people, for whom the forest is a major resource. In order to ensure the protection of these areas, it is suggested that local community be encouraged to create community forests with several management zones. Each community forest should have the identified biodiversity hotspot as the core conservation area, surrounded by a buffer zone stimulating the sustainable management of non-timber forest products and hunting practices.

The coastal zone, Ntem basin, Lobe and Memve'ele waterfalls

The coastal zone is a narrow strip (65 km long) along the Atlantic Ocean from the Lobe waterfalls to the Ntem estuary in the Dipikar Island that extends about 2–3 km inland. It has suffered and continues to suffer from intense

human pressure that has led to the destruction of most of its natural vegetation (Figure 4). However, it is worth mentioning that some rare endemic species such as *Deinbollia macroura*, *Psychotria batangana*, *P. dimorphophylla*, *P. oligocarpa*, and *Strychnos canthioides* are so far only known from this zone. Furthermore, there is an impressive network of rivers and streams in the Campo-Ma'an area that presents a number of very specialised riparian habitats. Our study confirmed that the Lobe, Bongola, Memve'ele waterfalls and Ntem basin (Boucle du Ntem) support a rich riparian flora with many endemic and rare rheophile species (Cusset 1987; Thomas and Thomas 1993). Most of the endemic rheophytes are of the genus *Ledermanniella* in the Podostemaceae family. These rheophytes which are found on exposed rocks in streambeds, are seasonally submerged by fast-flowing water, and normally reproduce in drier periods when the water level recedes. The Ntem basin is also reported to constitute an important refuge for wildlife and fish fauna because of the presence of many rare species of freshwater fishes (Vivien 1991; Matthews and Matthews 2000; Djama 2001). Therefore, it is suggested to develop a separate management strategy in order to protect these riparian habitats.

Conclusion

The study provides important information on the abundance and distribution of endemic species, as well as the location of biodiversity hotspots in the Campo-Ma'an area. This information is essential for any decision-making process for biodiversity conservation and sustainable natural resource management. Our study has revealed that the area is characterised by a rich flora with more than 2297 species of vascular plants and about 114 endemic plant species, of which 29 are only found in the area. Although most of the forest types with plant species of high conservation priorities appeared to occur in the Campo-Ma'an National Park, there are several human activities in the area with varying negative ecological impacts on the forest ecosystem. Therefore, the successful management and long-term sustainability of the Park will largely depend on the ability to reconcile the objectives of conservation and other uses at its vicinity.

The study also demonstrated that there are other biodiversity hotspots in the coastal zone and areas such as Mont dEléphant and Massif des Mamelles that are located outside the National Park. These areas support 17 strict endemic species that are not found in the park. Unfortunately, these strict endemics are the most threatened since their habitats are fragmented and degraded as a result of past and present land conversion to subsistence and industrial plantations. Furthermore, these hotspots are the type localities for some rare endemic species that are so far only known from type specimens or from a few collections made in these areas. Contrary to the National Park, these hotspots do not yet have any conservation status *per se*. However, although the park is a

permanent state forest which is protected by law and should be solely used for forest and wildlife conservation, its boundaries have not been marked, the management plan has not yet been produced and protection is weak. It is, therefore, of urgent need to demarcate its boundary, reinforce its protection, and complete and implement its management plan as soon as possible. Furthermore, in view of the fact that pressure on these fragmented hotspots is likely to increase in the future with the growing human population density, it is suggested that a separate management strategy be developed to ensure the protection of these biodiversity hotspots and their endemic species.

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Appendix 1 List of 141 plant species that are either strictly endemic to the Campo-Ma'an area (only found in Carapo-Ma'an) or near endemic (also occur in the western parts of south Cameroon or other parts of Cameroon).

No.	Family	Species	Guild	Star	Habit	Chorology	Notes
1	Acanthaceae	*Stenandrium thomense* (Milne-Redh.) Vollesen	sb	GD	Hb	Cam	Akom II, Dipikar Island, Western and South Cameroon
2	Annonaceae	*Monanthotaxis elegans* (Engl. and Diels) Verdc.	sb	GD	Sh	Sw-Cam	Akom II, Dipikar Island, Massif des Mamelles, Bipindi and Lolodorf
3	Annonaceae	*Monodora zenkeri* Engl. and Diels*	sb	GD	Sh	Cam	Massif des Mamelles, Bipindi and Lolodorf
4	Apocynaceae	*Callichilia monopodialis* (K.Schum.) Stapf*	sb	GD	Sh	Cam	Ma'an, South, Centre and East Cameroon
5	Apocynaceae	*Landolphia flavidiflora* (K. Schum.) Persoon*	Np	GD	Lwcl	Cam	Efoulan, Bipindi, Makak and Mt. Cameroon
6	Apocynaceae	*Petchia africana* Leeuwenb.*	sb	BK	Sh	Sw-Cam	Campo, Bipindi and Lolodorf
7	Apocynaceae	*Tabernaemontana hallei* (Boiteau) Leeuwenb.	sb	GD	Sh	Lg	Northern limit of distribution, from Gabon to Akom II, Ono-yong and Ma'an
8	Araceae	*Culcasia bosii* Ntepe-Nyame	sb	BK	He	Sw-Cam	Massif des Mamelles, Dipikar Island, Ma'an and Bipindi
9	Araceae	*Culcasia panduriformis* Engl. and Krause	sb	GD	Hb	Cam	Bifa, Zingui, Akom II, Dipikar Island, Bipindi, Mt Cameroon and Eseka
10	Aristolochiaceae	*Pararistolochia preussii* (Engl.) Hutch. & Dalziel	Np	GD	Swcl	Cam	Dipikar Island, Ebolowa and Mt. Cameroon
11	Balsaminaceae	*Impatiens hians* Hook.f. var. *bipindensis* (Gilg) Grey- Wilson	sb	bu	Hb	Lg	Northern limit of distribution, from Gabon to Bipindi, Zingui
12	Balsaminaceae	*Impatiens gongolana* N.Hallé	sb	bu	Hb	Lg	Northern limit of distribution, from Gabon to Ebianemeyong
13	Begoniaceae	*Begonia anisosepala* Hook.f.	sb	bu	Hb	Lg	Northern limit of distribution, from Gabon to Bipindi, Zingui and Grand Batanga
14	Begoniaceae	*Begonia clypeifolia* Hook.f.	sb	bu	Hb	Lg	Northern limit of distribution, from Congo, Gabon to Mvini and Efoulan

15	Begoniaceae	*Begonia elaeagnifolia* Hook. f.	ep	bu	Ep	Lg	Northern limit of distribution, from Gabon to Mvini, Efoulan and around Kom River
16	Begoniaceae	*Begonia heterochroma* Sosef	sb	bu	Hb	Lg	Northern limit of distribution, from Gabon to Lolabe and around Kribi
17	Begoniaceae	*Begonia mbangaensis* Sosef	sb	BK	Hb	Sw-Cam	Akom II, Efoulan, Bipindi and Lolodorf
18	Begoniaceae	*Begonia microsperma* Warb.	sb	GD	Hb	Cam	Ebianemeyong, Ma'an, South-west and South Cameroon
19	Begoniaceae	*Begonia montis'-elephantis* J.J.de Wilde*	sb	BK	Hb	Campo-Ma'an	Rare species, only known from a small population on Mt d'Eléphant
20	Begoniaceae	*Begonia zenkeriana* Smith and Wassh.	sb	BK	Hb	Sw-Cam	Campo, Massif des Mamelles, Dipikar Island, Bipindi and Lolodorf
21	Burseraceae	*Aucoumea klaineana* Pierre	Pi	bu	Tr	Lg	Northern limit of distribution, from Gabon to Ma'an and Ebianemeyong
22	Burseraceae	*Dacryodes buettneri* (Engl.) Lam.	Np	bu	Tr	Lg	Northern limit of distribution, from Gabon to Ma'an and Ebianemeyong
23	Capparaceae	*Ritchiea simplicifolia* Oliv. var. *Caloneura* (Gilg) Kers	sb	BK	Sh	Cam	Lobe, Campo, Kienke, Dipikar Island, Bipindi, Lolodorf and Ebolowa
24	Celastraceae	*Pristimera luteoviridis* (Exell) N.Hallé var. *kribiana* N.Hallé	Np	BK	Swcl	Campo-Ma'an	Rare species, only known from few collections on Mt d'Eléphant and Dipikar Island
25	Chrysobalanaceae	*Dactyladenia cinera* (Engl. ex de Wild) Prance and F.White**	sb	BK	Tr	Sw-Cam	Rare species, only known from type specimens (Bipindi) and a record from Grand Batanga
26	Chrysobalanaceae	*Dactyladenia icondere* (Baill.) Prance and F.White	sb	bu	Sh	Lg	Northern limit of distribution, from Congo, Gabon to Grand Batanga, Campo and Dipikar Island
27	Combretaceae	*Combretum cinnabarinum* Engl. and Diels	np	bu	Lwcl	Lg	Northern limit of distribution, from Gabon to Bipindi and Dipikar Island
28	Cyperaceae	*Hypolytrum* sp. nov. ined.*	sb	BK	Hb	Campo-Ma'an	New species only known from Mont d'Eléphant
29	Dichapetalaceae	*Dichapetalum altescandens* Engl. *	np	bu	Lwcl	Lg	Northern limit of distribution, from Gabon to Efoulan and Zingui
30	Dichapetalaceae	*Dichapetalum cymulosum* (Oliv.) Engl.*	np	GD	Lwcl	Cam	Grand Batanga, Campo, Bipindi, Lolodorf and Douala
31	Dichapetalaceae	*Dichapetalum librevillense* Pellegr.*	np	bu	Lwcl	Lg	Northern limit of distribution, from Gabon to Mt d'Eléphant and Campo

Appendix 1 (Continued)

No.	Family	Species	Guild	Star	Habit	Chorology	Notes
32	Dichapetalaceae	*Dichapetalum oliganthum* Breteler*	np	BK	Lwcl	Sw-Cam	Grand Batanga, Campo, Mt d'Eléphant, Kribi, Longi and Lolodorf.
33	Dichapetalaceae	*Tapura tchoutoi* Breteler	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections around Bifa and Dipikar Island
34	Dryopteridaceae	*Lastreopsis davalliaeformis* (Tardieu) Tardieu*	sb	bu	He	Lg	Northern limit of distribution, from Gabon to Bipindi and Zingui
35	Ebenaceae	*Diospyros alboflavescens* (Gürke) F.White	sb	BK	Tr	Sw-Cam	Rare species, only known from few collections from Bifa, Zingui and Bipindi
36	Ebenaceae	*Diospyros soyauxii* Gürke and K. Schum.	sb	Bu	Tr	Lg	Northern limit of distribution, from Gabon to Campo and Zingui
37	Euphorbiaceae	*Afrotrewia kamerunica* Pax and Hoffm.*	sb	BK	Sh	Campo-Ma'an	Rare species, only known from Massif des Mamelles
38	Gnetaceae	*Gnetum buchholzianum* Engl.	np	GD	Hcl	Cam	Dipikar Island, Onoyong, Ma'an, Littoral, South-west and South provinces of Cameroon
39	Gramineae	*Guaduella mildbraedii* Pilg.*	sb	BK	Hb	Campo-Ma'an	Rare species, only known from few collections in the Campo area
40	Gramineae	*Hyparrhenia wombaliensis* (Vanderyst ex Robyns) Clayton*	pi	bu	Hb	Lg	Northern limit of distribution, from Congo to Campo
41	Guttiferae	*Garcinia conrauana* Engl.	Sb	GD	Tr	Cam	Akom II, South-west and South Cameroon
42	Guttiferae	*Garcinia densivenia* Engl.	ri	GD	Tr	Cam	Dipikar Island, Ebianemeyong, Mvini, Littoral and South Cameroon
43	Icacinaceae	*Alsodeiopsis zenkeri* Engl.	rh	GD	Sh	Cam	Frequent along the Bongola and Ntem rivers, and other rivers in Littoral, East and South Cameroon
44	Icacinaceae	*Iodes kamerunensis* Engl.	sb	GD	Swcl	Cam	Akom II, Dipikar Island, Bipindi, Bertoua and Nanga Eboko
45	Icacinaceae	*Rhaphiostylis ovalifolia* Engl. ex Sleumer*	sb	GD	Swcl	Cam	Coastal forest around Kribi, Grand Batanga, Lolabe, Elabi Massif des Mamelles, Littoral and South Cameroon
46	Icacinaceae	*Rhaphiostylis subsessilifolia* Engl.	sb	BK	Swcl	Campo-Ma'an	Rare species, only known from Grand Batanga, Ebianemeyong and Mt d'Eléphant

47	Ixonanthaceae	*Ochthocosmus calothyrsus* (Mildbr.) Hutch. and Dalziel	np	bu	Tr	Lg	Northern limit of distribution, from Gabon to Cameroon (frequent in the Campo-Ma'an area)
48	Lauraceae	*Beilschmiedia cuspida* (K. Krause) Robyns and Wilczek	sb	BK	Tr	Campo-Ma'an	Rare species, only known from Fenda and Akom II
49	Lauraceae	*Beilschmiedia dinklagei* (Engl.) Robyns and Wilczek*	sb	BK	Tr	Campo-Ma'an	Rare species, only known from few records around Grand Batanga
50	Lauraceae	*Beilschmiedia klainei* Robyns and Wilczek	sb	BK	Tr	Sw-Cam	Rare species, only known from few records from Akom II, Ebianemeyong and Bipindi
51	Lauraceae	*Beilschmiedia papyracea* (Stapf) Robyns and R.Wilczek	sb	BK	Tr	Sw-Cam	Rare species, only known from Ebianemeyong, Akom II, Fenda and Bipindi
52	Lauraceae	*Beilschmiedia welczekii* Fouilloy	sb	BK	Tr	Sw-Cam	Akom II, Mvini, Nkoelon, Dipikar Island, Ebianemeyong, Ma'an, Bipindi and Lolodorf
53	Leguminosae -Caesalpinioideae	*Amphimas ferrugineus* Pierre ex Pellegr.	np	bu	Tr	Lg	Northern limit of distribution, from Gabon to Dipikar Island, Ma'an, Onoyong and Akom II
54	Leguminosae -Caesalpinioideae	*Anthonotha leptorrhachis* (Harms) J.Léonard	sb	GD	Tr	Cam	Bifa, Campo, Dipikar Island, Lobe, Massif des Mamelles, Mt d'Eléphant, Bipindi, Lolodorf and Mt Cameroon
55	Leguminosae -Caesalpinioideae	*Aphanocalyx hedinii* (A.Chev.) Wieringa	np	GD	Tr	Cam	Akom II, Ebianemeyong, Kom, Ma'an, Bipindi and Eseka
56	Leguminosae -Caesalpinioideae	*Aphanocalyx ledermannii* (Harms) Wieringa	sw	bu	Tr	Lg	Northern limit of distribution, occurs along rivers from Gabon, Equatorial Guinea to the Dipikar Island
57	Leguminosae -Caesalpinioideae	*Copaifera religiosa* J.Léonard	np	bu	Tr	Lg	Northern limit of distribution, from Congo to Akom II and Efoulan
58	Leguminosae-Caesalpinioideae	*Daniellia klainei* A.Chev.	ri	bu	Tr	Lg	Northern limit of distribution, from Congo to Akom II, Eoulan and Ma'an
59	Leguminosae -Caesalpinioideae	*Dialium zenkeri* Harms	sb	BK	Tr	Sw-Cam	Campo, Dipikar Island, Onoyong, Bipindi and Lolodorf
60	Leguminosae -Caesalpinioideae	*Gilbertiodendron pachyanthum* (Harms) J.Léonard	np	BK	Tr	Sw-Carm	Ebianemeyong, Kom, Massif des Mamelles, Bipindi and Lolodorf
61	Leguminosae -Caesalpinioideae	*Plagiosiphon longitubus* (Harms) J.Léonard	sb	BK	Tr	Sw-Cam	Akom II, Efoulan, Ma'an, Bipindi, and Lolodorf

Appendix 1 (Continued)

No.	Family	Species	Guild	Star	Habit	Chorology	Notes
62	Leguminosae -Caesalpinioideae	*Plagiosiphon multijugus* (Harms) J.Léonard	sb	GD	Tr	Cam	Akom II, Dipikar Island, Ma'an, Bipindi and Kribi-Edea areas
63	Leguminosae -Caesalpinioideae	*Tetraberlinia moreliana* Aubrév.*	sb	bu	Tr	Lg	Northern limit of distribution, from Gabon, Bidou and Mt. D'Eléphant
64	Liliaceae	*Chlorophytum petrophyllum* K.Krause	sb	GD	Hb	Cam	Bifa, Dipikar Island, Mvini, Littoral and South Cameroon
65	Loganiaceae	*Mostuea neurocarpa* Gilg	sb	bu	Sh	Lg	Northern limit of distribution, from Gabon to Bifa, Campo and Dipikar Island
66	Loganiaceae	*Strychnos canthioides* Leeuwenb. *	np	BK	Lwcl	Campo-Ma'an	Rare species, only known from few collections around Grand Batanga and Lolabe
67	Loganiaceae	*Strychnos elaeocarpa* Gilg ex Leeuwenb.	ri	GD	Tr	Cam	Akom II, Dipikar Island, Ebianemeyong, Onoyong, Bipindi, Lolodorf, Kribi-Edea and South-west Cameroon
68	Loganiaceae	*Strychnos mimfiensis* Gilg ex Leeuwenb.	np	GD	Lwcl	Cam	Dipikar Island, Mvini, Ma'an, Bipindi, Masok, Douala-Edea-Kribi areas.
69	Loranthaceae	*Tapinanthus preussii* (Engl.) Tiegh.	pa	GD	Pa	Cam	Grand Batanga, Bongola, Bipindi, Eseka, Barombi and along the Lokoundje and Nyong rivers.
70	Marantaceae	*Hypselodelphys zenkeriana* (K.Schum.) Milne-Redh.	pi	GD	Hb	Cam	Ma'an, Onoyong and South Cameroon
71	Melastomataceae	*Amphiblemma letouzeyi* Jacq.-Fél.*	sb	BK	Hb	Sw-Cam	Rare species, only known from few collections recorded on hills around Akom II, Efoulan and Bipindi
72	Melastomataceae	*Calvoa calliantha* Jacq.-Fél.	sb	BK	Hb	Sw-Cam	Rare species, only known from Ebianemeyong, Akom II and Bipindi
73	Melastomataceae	*Calvoa stenophylla* Jacq.-Fél*	sb	BK	Hb	Campo-Ma'an	Rare species, only known from type specimens collected in Zingui
74	Melastomataceae	*Guyonia tenella* Naud.	sb	bu	Hb	Lg	Northern limit of distribution, from Equatorial Guinea to Lobe and Bongola
75	Melastomataceae	*Memecylon arcuato-marginatum* Gilg ex Engl. var. *arcuato-marginatum*	sb	BK	Sh	Cam	Akom II Dipikar Island, Kom, Mt. D'Eléphant, Kienke, Longi and Kribi-Edea

76	Menispermaceae	*Albertisia glabra* (Diels and Troupin) Forman	sb	BK	Swcl	Sw-Cam	Rare species, only known from Dipikar Island and Bipindi
77	Menispermaceae	*Penianthus camerounensis* A.Dekker	sb	GD	Sh	Cam	Afan, Akom II, Dipikar Island, Ebianemeyong, Mekok, Littoral, South and South-west Cameroon
78	Moraceae	*Dorstenia dorstenioides* (Engl.) Hijman and C.C.Berg*	sb	BK	Hb	Campo-Ma'an	Rare species, only known from few collection around Kienke and Fenda
79	Moraceae	*Dorstenia involuta* M.Hijman	sb	BK	Hb	Campo-Ma'an	Rare species, only known from Dipikar Island and Ma'an
80	Myrsinaceae	*Ardisia dolichocalyx* Taton	sb	GD	Hb	Cam	Bifa, Campo, Dipikar Island, Onoyong, Littoral, South and South-west Cameroon
81	Myrtaceae	*Eugenia kameruniana* Engl.*	sb	BK	Sh	Cam	Rare species, only known from Ebianemeyong, Ma'an, Nyabissan
82	Ochnaceae	*Campylospermum letouzeyi* Farron	sb	GD	Sh	Cam	Dipikar Island and South Cameroon
83	Ochnaceae	*Campylospermum zenkeri* (Engl. ex Tiegh.) Farron	sb	GD	Sh	Cam	Campo, Massif des Mamelles, Kribi-Edea and South Cameroon
84	Ochnaceae	*Testulea gabonensis* Pellegr.	np	bu	Tr	Lg	Northern limit of distribution, from Gabon to Dipikar Island, Ma'an and Onoyong
85	Olacaceae	*Octoknema dinklagei* Engl.	sb	GD	Tr	Cam	Akok, Grand Batanga, Lolabe, South and South-west Cameroon
86	Orchidaceae	*Bulbophyllum alinae* Szlachetko*	ep	BK	Ep	Campo-Ma'an	Rare species, only known from few collections on Mt d'Elé-phant
87	Orchidaceae	*Corymborkis minima* P.J.Cribb*	sb	GD	Hb	Cam	Rare species, only known from few collections around Campo, Lolabe and Korup National Park
88	Orchidaceae	*Podandriella batesii* (la Croix) Szlachetko and Olszewski*	sb	BK	Hb	Campo-Ma'an	Rare species, only known from Akom II, Efoulan and Ebianemeyong
89	Orchidaceae	*Polystachya letouzeyana* Szlachetko and Olszewski*	ep	BK	Ep	Campo-Ma'an	Rare species, only known from Efoulan

Appendix 1 (Continued)

No.	Family	Species	Guild	Star	Habit	Chorology	Notes
90	Orchidaceae	*Vanilla africana* Lindley subsp. *cucullata* (Kraenzlin and K. Shum.) Szlachetko and Olszewski *	np	BK	Hcl	Sw-Cam	Campo, Massif des Mamelles, Mt d'Eléphant and Bipindi
91	Podostemaceae	*Ledermanniella annithomae* C. Cusset*	rh	BK	Hb	Campo-Ma'an	Rare species, only known from Memve'ele water falls
92	Podostemaceae	*Ledermanniella batangensis* (Engl.) C. Cusset*	rh	BK	Hb	Campo-Ma'an	Rare species, only known from Lobe water falls
93	Podostemaceae	*Ledermanniella bosii* C.Cusset	rh	BK	Hb	Campo-Ma'an	Rare species, only known from the Ntem Basin, Bongola, Lobe and Memve'ele waterfalls
94	Podostemaceae	*Ledermanniella boumiensis* C. Cusset	rh	bu	Hb	Lg	Northern limit of distribution, from Gabon to the Bongola and Memve'ele water falls
95	Podostemaceae	*Ledermanniella kamerunensis* (Engl.) C. Cusset	rh	BK	Hb	Campo-Ma'an	Rare species, only known from the Bongola water falls in Dipikar Island
96	Podostemaceae	*Ledermanniella linearifolia* Engl.	rh	GD	Hb	Cam	Lobe and Bongola falls in the Campo-Ma'an area, and in the Nkam river in Yabassi
97	Podostemaceae	*Ledermanniella variabilis* (G.Taylor) C.Cusset	rh	GD	Hb	Cam	Bongola and Lobe water falls, and in Mamfe river in South-west Cameroon
98	Rhizophoraceae	*Cassipourea kamerunensis* (Engl.) Alston	sb	GD	Sh	Cam	Akom II, Littoral and South Cameroon
99	Rhizophoraceae	*Cassipourea zenkeri* (Engl.) Alston	sb	GD	Sh	Cam	Akom II Bifa, Ebianemeyong, Eboundja, Lobe, Ma'an, Bipindi, Lolodorf and South Cameroon
100	Rubiaceae	*Chazaliella sciadephora* (Hiern) Petit and Verdc, var. *condensata* Verdc.	sb	GD	Sh	Cam	Mvini, Onoyong, Ma'an, Littoral and South Cameroon
101	Rubiaceae	*Ecpoma apocynaceum* K.Schum.	pi	BK	Sh	Sw-Cam	Rare species, only known from Bifa, Zingui and Bipindi
102	Rubiaceae	*Hymenocoleus* glaber Robbr.	sb	GD	Hb	Cam	Akom II, Dipikar Island, Massif des Mamelles, Mvini, Littoral, South and South-west Cameroon

103	Rubiaceae	*Ixora aneimenodesma* K.Schum. subsp. *aneimenodesma*	sb	GD	Sh	Cam	Akom II, Dipikar Island, Bipindi and Lolodorf
104	Rubiaceae	*Ixora synactica* De Block*	sb	BK	Sh	Sw-Cam	Rare species, only known from Efoulan, Zingui and Bipindi
105	Rubiaceae	*Oxyanthus oliganthus* K.Schum.	sb	GD	Sh	Cam	Akom II, Ma'an and South Cameroon
106	Rubiaceae	*Pavetta camerounensis* S.Manning subsp. *camerounensis*	sb	GD	Sh	Cam	Akom II, Bifa, Campo, Dipikar Island, Massif des Mamelles, Mt d'Eléphant, Littoral and South Cameroon
107	Rubiaceae	*Pavetta kribiensis* J.Manning	sb	BK	Sh	Sw-Cam	Rare species, only known from Mvini, Bipindi and Lolodorf
108	Rubiaceae	*Pavetta mpomii* S.Manning	sb	BK	Sh	Sw-Cam	Mt d'Eélephant, Mvini, Nkoelon, Ebianemeyong, Bipindi and Lolodorf
109	Rubiaceae	*Pavetta staudtii* Hutch. and Dalziel	sb	GD	Sh	Cam	Dipikar Island, Mvini, Nkoelon and South Cameroon
110	Rubiaceae	*Pseudosabicea medusula* (K.Schum.) N.Hallé	np	GD	Hb	Cam	Ebianemeyong, Nyabissan, Ma'an, Centre and South Cameroon
111	Rubiaceae	*Psychotria aemulans* K. Schum.**	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections around Grand Batanga
112	Rubiaceae	*Psychotria batangana K.* Schum.*	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections around Grand Batanga
113	Rubiaceae	*Psychotria camerunensis* Petit	sb	GD	Sh	Cam	Akom II, Bifa, Ma'an, Bipindi, Lolodorf, Centre and South Cameroon
114	Rubiaceae	*Psychotria dimorphophylla* K. Schurm.*	ri	BK	Sh	Campo-Ma'an	Rare species, only known from few collections from Grand Batanga and Lobe
115	Rubiaceae	*Psychotria lanceifolia* K.Schum.	sb	BK	Sh	Sw-Cam	Rare species, only known from Akom II, Onoyong, Bipindi and Lolodorf
116	Rubiaceae	*Psychotria oligocarpa* K.Schum.*	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections around Grand Batanga
117	Rubiaceae	*Psychotria sadebeckiana* K.Schum.var. *elongata* Petit	sb	GD	Sh	Cam	Akok, Bifa, Campo, Dipikar Island, Kom, Mvini and South Cameroon
118	Rubiaceae	*Psychotria sadebeckiana* K.Scham. var. *sadebeckiana*	sb	GD	Sh	Cam	Akom II, Dipikar Island, Massif des Mamelles, Mvini, and South Cameroon

Appendix 1 (Continued)

No.	Family	Species	Guild	Star	Habit	Chorology	Notes
119	Rubiaceae	*Tricalysia amplexicaulis* Robbr.	sb	GD	Sh	Cam	Dipikar Island, Massif des Mamelles, Centre and South Cameroon
120	Rubiaceae	*Tricalysia talbotii* (Wemham) Keay	sb	GD	Sh	Cam	Ebianemeyong, Mvini, Centre and South Cameroon
121	Rubiaceae	*Vangueriella laxiflora* (K.Schum.) Verdc.	sb	GD	Swcl	Cam	Mvini, Nkoelon, Centre and South Cameroon
122	Sapindaceae	*Deinbollia macroura* Gilg ex Radlkofer*	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections around Campo
123	Sapindaceae	*Deinbollia mezilii* D.W.Thomas and D.J.Harris	sb	BK	Sh	Campo-Ma'an	Rare species, only known from Bifa, Massif des Mamelles and Dipikar Island
124	Sapindaceae	*Deinbollia pycnophylla* Gilg ex Radlk.	sb	bu	Sh	Lg	Northern limit of distribution, from Gabon to Dipikar Island
125	Scytopetalaceae	*Pierrina zenkeri* Engl.	sb	GD	Sh	Cam	Bifa, Campo, Ebianemeyong, Ma'an, Nyabissan, Littoral and South Cameroon
126	Scytopetalaceae	*Rhaptopetalum sessilifoIium Engl.**	sb	BK	Sh	Sw-Cam	Rare species, only known from few collections around Efoulan and Bipindi
127	Sterculiaceae	*Cola fibrillosa* Engl. and Krause	sb	BK	Tr	Sw-Cam	Rare species, only known from few collections around Dipikar Island and Bipindi
128	Sterculiaceae	*Cola letouzeyana* Nkongm.	sb	GD	Sh	Cam	Akora II, Dipikar Island, Ebianemeyong, Onoyong, Centre and South Cameroon
129	Sterculiaceae	*Cola praeacuta* Brenan and Keay	sb	GD	Sh	Cam	Bifa, Dipikar Island, Massif des Mamelles, South and South-west Cameroon
130	Sterculiaceae	*Scaphopetalum acuminatum* Engl. and K. Krause*	sb	BK	Sh	Carapo-Ma'an	Rare species, only known from few collections from Efoulan and Fenda
131	Sterculiaceae	*Scaphopetalum brunneo-purpureum* Engl. and K. Krause**	sb	BK	Sh	Campo-Ma'an	Rare species, only known from few collections from Fenda and Zingui
132	Sterculiaceae	*Scaphopetalum zenkeri* K-Schum.	sb	BK	Sh	Sw-Cam	Akom II, Dipikar Island, Ebianemeyong, Bipindi and Lolodorf

133	Thymelaeaceae	*Dicranolepis glandulosa* H.H.W.Pearson	sb	GD	Sh	Cam	Akom II, Dipikar Island, Grand Batanga, Campo, Littoral South, and South-west Cameroon
134	Urticaceae	*Urera gravenreuthi* Engl.	pi	GD	Hcl	Cam	Dipikar Island, Ma'an, Littoral, South and South-west Cameroon
135	Violaceae	*Allexis zygomorpha* Achoundong and Onana*	sb	BK	Sh	Cam	Coastal forest between Edea and Campo, Bidou, Akok, Longi, Bipindi and Lolodorf
136	Violaceae	*Rinorea campoensis* M. Brandt ex Engl.	sb	BK	Sh	Campo-Ma'an	Rare species, only known from Campo, Dipikar Island, Lobe and Massif des Mamelles
137	Violaceae	*Rinorea microglossa Engl.**	sb	BK	Sh	Sw-Cam	Efoulan, Bipindi, Lolodorf, Centre and South Cameroon
138	Violaceae	*Rinorea sp. nov. 1* ined.*	sb	GD	Sh	Cam	Coastal forest between Kribi and Campo, Dipikar Island, and Douala-Edea-Kribi regions
139	Violaceae	*Rinorea sp. nov. 2* ined.*	sb	GD	Sh	Cam	Kienke, Massif des Mamelles, Dipikar Island, Kribi, Kribi-Edea, Douala- Yaounde, and Eseka regions
140	Zingiberaceae	*Aulotandra kamerunensis* Loes.	Sb	BK	Hb	Sw-Cam	Rare species, only known from few collections from Ebianemeyong, Nyabissan and Bipindi
141	Zingiberaceae	*Renealmia densispica* Koechlin	Sb	BK	Hb	Sw-Cam	Rare species, only known from few collections from Dipikar Island, Ebianemeyong and Ambam

Those species that reach their northern or southern limit of distribution in the Campo-Ma'an area are also included in the list.
*Species strictly endemic to the Campo-Ma'an area that were not recorded in the National Park.
**Species for which the status or range needs more investigation.
Guild: ep, epiphyte; np, non-pioneer light demanding; pi, pioneer; rh, rheophyte; ri, riverine; sb, shade-bearer; and sw, swamp.
Star: as defined in Table 1.
Habit: Ep, epiphyte; Hb, herb; Hcl, herbaceous climber; He, hemi-epiphyte; Lwcl, large woody climber; Swcl, small woody climber; Pa, parasite; Sh, shrub; and Tr, tree.
Chorology: Campo-Ma'an, strict endemic to Campo-Ma'an; Sw-Cam, endemic to southwestern part of Cameroon; Cam, endemic to Cameroon; Lg, Lower Guinea endemic (especially those species that reach either their northern or southern limit of distribution in the Campo-Ma'an area).

Appendix 2 IUCN (1994) threat categories for 92 plant species recorded in the Campo-Ma'an area that are listed in The IUCN (2002) Red List of Threatened Species and The World List of Threatened Trees (WCMC 1998).

No.	Family	Species	Guild	Habit	Chorology	IUCN/WCMC
1	Acanthaceae	*Afrofittonia silvestris* Lindau	sb	Hb	Lg	VU A1c + 2c
2	Acanthaceae	*Sclerochiton preussii* (Lindau) C.B.Clarke	sb	Hb	Lg	EN B1 + 2e
3	Anacardiaceae	*Antrocaryon micraster* A. Chev. and Guillaum.	pi	Tr	Lg	VU A1cd
4	Anacardiaceae	*Trichoscypha bijuga* Engl.	sb	Tr	Lg	CR A1c + 2abc
5	Anacardiaceae	*Trichoscypha mannii* Hook. f.	sb	Tr	Lg	VU A1C, B1 + 2c
6	Annonaceae	*Boutiquea platypetala* Le Thomas	sb	Sh	Lg	EN A1c + 2c
7	Annonaceae	*Pachypodanthium barteri* (Benth.) Hutch. and Dalziel	sw	Tr	Lg	VU A1c
8	Annonaceae	*Uvariastrum zenkeri* Engl. and Diels	sb	Sh	Lg	VU A1c, B1 + 2c
9	Annonaceae	*Uvariodendron connivens* (Benth.) R.E.Fr.	sb	Tr	Lg	LR/nt
10	Asclepiadaceae	*Tylophora cameroonica* N.E.Br.	pi	Swcl	Lg	LR/nt
11	Boraginaceae	*Cordia platythyrsa* Baker	pi	Tr	Gc	VU A1d
12	Burseraceae	*Aucoumea klaineana* Pierre	pi	Tr	Lg	VU A1cd
13	Burseraceae	*Dacryodes igaganga* Aubrev. And Pellegr.	np	Tr	Lg	VU A1cd + 2cd
14	Celastraceae	*Salacia lehmbachii* Loes. var. pes-ranulae N.Hallé	np	Swcl	Lg	VU B1 + 2c
15	Chrysobalanaceae	*Dactyladenia cinera* (Engl. ex de Wild) Prance and F.White	sb	Tr	Sw-Cam	CR B1 + 2c
16	Combretaceae	*Terminalia ivorensis* A.Chev.	np	Tr	Gu	VU A1cd
17	Connaraceae	*Hemandradenia mannii* Stapf	sb	Tr	Lg	LR/nt
18	Ebenaceae	*Diospyros barteri* Hiern	sb	Tr	Gu	VU A1c
19	Ebenaceae	*Diospyros crassiflora* Hiern	sb	Tr	Gc	EN A1d
20	Euphorbiaceae	*Amanoa strobilacea* Müll.Arg.	sb	Sh	Gu	VU A1c, B1 + 2c
21	Euphorbiaceae	*Crotonogyne manniana* Müll.Arg.	sb	Sh	Lg	LR/nt
22	Euphorbiaceae	*Drypetes preussii* (Pax) Hutch.	sb	Tr	Lg	VU B1 + 2c
23	Euphorbiaceae	*Drypetes tessmanniana* (Pax) Pax and K.Hoffm.	sb	Sh	Lg	CR A1c + 2c
24	Euphorbiaceae	*Neoboutonia mannii* Benth.	pi	Tr	Gu	LR/nt
25	Euphorbiaceae	*Pseudagrostistachys africana* (Müll.Arg.) Pax and K.Hoffm.	sb	Tr	Lg	VU A1c, B1 + 2c
26	Guttiferae	*Garcinia brevipedicellata* (Baker f.) Hutch. and Dalziel	sb	Tr	Lg	VU A1c, B1 + 2c
27	Guttiferae	*Garcinia kola* Heckel	sb	Tr	Gc	VU A1cd
28	Guttiferae	*Garcinia staudtii* Engl.	sb	Tr	Lg	VU A1c, B1 + 2c
29	Hoplestigmataceae	*Hoplestigma pierreanum* Gilg	np	Tr	Lg	CRA1c + 2c
30	Huaceae	*Afrostyrax kamerunensis* Perkins and Gilg	sb	Tr	Lg	VU A1c, B1 + 2c

31	Huaceae	*Afrostyrax lepidophyllus* Mildbr.	sb	Tr	Lg	VU A1c, B1 + 2c
32	Irvingiaceae	*Irvingia excelsa* Mildbr.	np	Tr	Gc	LR/nt
33	Irvingiaceae	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.	np	Tr	Gc	LR/nt
34	Leguminosae-Caesalpinioideae	*Afzelia bipindensis* Harms	np	Tr	Gc	VU A1cd
35	Leguminosae-Caesalpinioideae	*Afzelia pachyloba* Harms	np	Tr	Gc	VU A1d
36	Leguminosae-Caesalpinioideae	*Anthonotha leptorrhachis* (Harms) J.Léonard	sb	Tr	Cam	CR A1c + 2c
37	Leguminosae-Caesalpinioideae	*Aphanocalyx hedinii* (A.Chev.) Wieringa	np	Tr	Cam	CR B1 + 2abcd, C1 + 2ab
38	Leguminosae-Caesalpinioideae	*Daniellia klainei* A.Chev.	ri	Tr	Lg	LR/nt
39	Leguminosae-Caesalpinioideae	*Daniellia oblonga* Oliv.	np	Tr	Lg	VU A1c
40	Leguminosae-Caesalpinioideae	*Dialium bipindense* Harms	np	Tr	Lg	LR/nt
41	Leguminosae-Caesalpinioideae	*Dialium tessmannii* Harms	sb	Tr	Lg	LR/nt
42	Leguminosae-Caesalpinioideae	*Didelotia unifoliolata* J.Léonard	sb	Tr	Lg	LR/nt
43	Leguminosae-Caesalpinioideae	*Gilbertiodendron pachyanthum* (Harms) J.Léonard	np	Tr	Sw-Cam	VU D2
44	Leguminosae-Caesalpinioideae	*Guibourtia ehie* (A. Chev.) J. Léonard	np	Tr	Gc	VU A1c
45	Leguminosae-Caesalpinioideae	*Loesenera talbotii* Baker f.	sb	Tr	Lg	VU A1c, B1 + 2c
46	Leguminosae-Caesalpinioideae	*Pellegriniodendron diphyllum* (Harms) J.Léonard	sb	Tr	Gu	LR/nt
47	Leguminosae-Caesalpinioideae	*Plagiosiphon longitubus* (Harms) J.Léonard	sb	Tr	Sw-Cam	CR A1 + 2c
48	Leguminosae-Caesalpinioideae	*Swartzia fistuloides* Harms	sb	Tr	Gc	EN A1cd
49	Leguminosae-Mimosoideae	*Calpocalyx heitzii* Pellegr.	np	Tr	Lg	VU A1c, B1 + 2c
50	Leguminosae-Mimosoideae	*Calpocalyx le−testui* Pellegr.	sb	Tr	Gc	VU D2
51	Leguminosae-Mimosoideae	*Calpocalyx ngouniensis* Pellegr.	sb	Tr	Gc	VU A1c
52	Leguminosae-Papilionoideae	*Craibia atlantica* Dunn	sb	Tr	Gc	VU A1c
53	Leguminosae-Papilionoideae	*Millettia laurentii* De Wild.	np	Tr	Gc	EN A1cd
54	Leguminosae-Papilionoideae	*Millettia macrophylla* Benth.	pi	Tr	Lg	VU A1c, B1 + 2c
55	Leguminosae-Papilionoideae	*Ormocarpum klainei* Tisser.	sb	Sh	Lg	CR A1c
56	Liliaceae	*Chlorophytum petrophyllum* K.Krause	sb	Hb	Cam	CR A1c + 2c
57	Melastomataceae	*Memecylon candidum* Gilg	sb	Sh	Lg	VU B1 + 2c
58	Melastomataceae	*Memecylon dasyanthum* Gilg ex Lederman and Engl.	sb	Tr	Lg	VU B1 + 2c
59	Melastomataceae	*Warneckea wildeana* Jacq.-Fél.	sb	Sh	Lg	VU D2
60	Meliaceae	*Entandrophragma angolense* (Welw.) C.DC.	np	Tr	Tra	VU A1cd
61	Meliaceae	*Entandrophragma candollei* Harms	np	Tr	Gc	VU A1 cd
62	Meliaceae	*Entandrophragma cylindricum* (Sprague)Sprague	np	Tr	Gc	VU A1cd
63	Meliaceae	*Entandrophragma utile* (Dawe and Sprague) Sprague	np	Tr	Gc	VU A1cd
64	Meliaceae	*Guarea cedrata* (A.Chev.) Pellegr.	np	Tr	Gc	VU A1c

Appendix 2 (Continued)

No.	Family	Species	Guild	Habit	Chorology	IUCN/WCMC
65	Meliaceae	*Guarea thompsonii* Sprague and Hutch.	np	Tr	Gc	VU A1c
66	Meliaceae	*Khaya anthotheca* (Welw.) C. DC.	np	Tr	Gc	VU A1cd
67	Meliaceae	*Khaya ivorensis* A.Chev.	np	Tr	Gc	VU A1cd
68	Meliaceae	*Lovoa trichilioides* Harms	np	Tr	Gc	VU A1cd
69	Meliaceae	*Turraeanthus africanus* (Welw. ex C DC.) Pellegr.	sb	Tr	Gc	VU A1cd
70	Moraceae	*Milicia excelsa* (Welw.) C.C.Berg	pi	Tr	Tra	LR/nt
71	Myrtaceae	*Eugenia kameruniana* Engl.	sb	Sh	Cam	CR A1c
72	Ochnaceae	*Lophira alata* Banks ex Gaertn.f.	pi	Tr	Gc	VU A1cd
73	Ochnaceae	*Testulea gabonensis* Pellegr.	np	Tr	Lg	EN A1cd
74	Rhizophoraceae	*Anopyxis klaineana* (Pierre) Engl.	np	Tr	Gc	VU A1cd
75	Rubiaceae	*Hallea stipulosa* (DC.) Leroy	sw	Tr	Gc	VU A1cd
76	Rubiaceae	*Nauclea diderrichii* (De Wild. And T.Durand) Merrill	pi	Tr	Gc	VU A1cd
77	Rutaceae	*Vepris heterophylla* Letouzey	sb	Sh	Gc	EN A1c, B1 + 2c
78	Sapotaceae	*Autranella congolensis* (De Wild.) A.Chev.	np	Tr	Gc	CR AIcd
79	Sapotaceae	*Baillonella toxisperma* Pierre	np	Tr	Lg	VU A1cd
80	Sapotaceae	*Gluema ivorensis* AubréV. and Pellegr.	np	Tr	Gc	VU B1 + 2c
81	Sapotaceae	*Tieghemella africana* Pierre	np	Tr	Lg	EN A1cd
82	Simaroubaceae	*Nothospondias staudtii* Engl.	np	Tr	Gc	VU B1 + 2c
83	Sterculiaceae	*Cola hypochrysea* K.Schum.	sw	Tr	Lg	VU A1c
84	Sterculiaceae	*Cola philipi–jonesii* Brenan and Keay	sb	Sh	Lg	EN B1 + 2c
85	Sterculiaceae	*Cola praeacuta* Brenan and Keay	sb	Sh	Cam	CR A1c + 2c
86	Sterculiaceae	*Cola semecarpophylla* K.Schum.	sb	Sh	Lg	LR/cd
87	Sterculiaceae	*Mansonia altissima* (A.Chev.) A.Chev. var. kamerunica Jacq.-Fél.	np	Tr	Gu	EN A1cd
88	Sterculiaceae	*Pterygota bequaertii* De Wild.	np	Tr	Gc	VU A1cd
89	Sterculiaceae	*Pterygota macrocarpa* K.Schum.	np	Tr	Gc	VU A1cd
90	Sterculiaceae	*Sterculia oblonga* Mast.	pi	Tr	Gc	VU A1cd
91	Violaceae	*Allexis cauliflora* (Oliv.) Pierre	sb	Sh	Lg	VU A1c, B1 + 2c
92	Violaceae	*Allexis obanensis* (Baker f.) Melchior	sb	Sh	Lg	VU B1 + 2c

NB: Guild, habit and chorology categories as defined in Appendix 1.

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