

Supplementary Material

For references see the main text.

Appendix 1 - Study site supplementary information

Bia Conservation Area (CA)

The area has bimodal rainfall peaks, between May and June and between September and October, with mean annual precipitation (MAP) ranging from 1250 to 1750 mm and mean annual temperatures (MAT) between 24°C and 28°C. Bia CA covers the transition between two of Ghana's forest types, moist evergreen in the south and moist semi-deciduous in the north (Hall and Swaine 1981). The topography is generally hilly with elevations between 168 m and 238 m a.s.l. (Hawthorne 1993).

In Bia NP no systematic logging occurred in the past, while selective logging was relatively frequent in Bia RR since 1985 for approximately 15 years. Fire and elephants damage, as well as anthropic disturbance for firewood collection and small scale agriculture are also reported for Bia CA. According to Hawthorne et al. (2012) some parts of the forest still show, many years since disturbance occurrence, broken upper canopies and large patches of low density vegetation.

Dadieso Forest Reserve (FR)

Dadieso Forest Reserve has a MAT of 25-27°C while MAP ranges from 1500 to 1750 mm. It is surrounded by cocoa farms and small rural villages, and information provided by the Forestry Commission of Ghana suggests that these two elements strongly contribute to the illegal logging occurring in the reserve, given also the scarce patrolling activity, limited by lack of personnel and resources.

Despite the fact that Dadieso has not been officially logged, the forest is degraded in most areas (Hawthorne and Abu-Juam 1995).

Ankasa National Park (NP)

MAT is 23-25°C and MAP ranges from 1500 to 2100 mm, concentrated from March to mid-July and from September to November. A dry period extends from December to February; relative humidity is very high throughout the year, from 90% at night to 75% in early afternoon.

Ankasa southern part was selectively logged from the early 1960s to about 1974 (Hall and Swaine 1981; Martin 2011).

Appendix 2 - Supplementary methods

Biodiversity data sampling

In Ankasa 34 plots of 500 m² were established in 2012 in the western, unlogged, park area. In Dadieso 46 plots of 400 m² were set up in 2012 in the central-northern part. In Bia three different surveys were carried out in 2012-2013, setting a total of 47 plots of 400 m² in the middle of the conservation area (central-northern part).

Calculation and statistics

We derived Coleman's rarefaction curves, useful to estimate the species richness even in presence of smaller and uneven samples (Chazdon et al. 1998), to evaluate the number of species at the same abundances level, thus comparing the richness of three study areas characterized by different sampling efforts. We also calculated the frequency-distribution plots, in which the number of species is displayed in relation to the number of individuals per species: these graphical representations allow to understand dominance/evenness patterns, with the mode of diverse tropical forests (characterized by high number of species represented by very few individuals) that usually falls in the lowest abundance classes. The rank-abundance (Whittaker's) plot is another method we utilized to evaluate the total richness, the abundances distribution, and to evidence differences in evenness among the assemblages; we tested the significance of the abundances distribution patterns by the Kolmogorov-Smirnov statistical test (here at 95% confidence level).

However, Whittaker plots can overemphasize richness differences. When samples with major differences in richness are compared, the curves of the richer sites are stretched in the low-right end, giving the appearance that these sites have a more even species distribution (Cazzolla Gatti 2014). For this reason, together with the Whittaker plots we also presented the Empirical Cumulative Distribution Function (ECDF) plots, which better discriminate the different assemblages by rescaling the ranks according to the richness (Magurran and McGill 2011).

Appendix 3 - Supplementary conclusions

Biodiversity is not only a long list of species, it is comparison. But we cannot afford comparative studies if we do not have a reliable basis of comparison. In a century when tropical forests and biodiversity are disappearing faster than we are able to study and protect them, every notch in the table of time, which can fully picture a biological state-of-art, represents an hope of salvation for the diversity of life and an opportunity to add another piece to the puzzle of tropical ecology.

Fig. S1 - The three study areas in Ghana, West Africa. Dotted circles are sampling areas (within which plots have been randomly placed).



Tab. S1 - Species list and species abundances in each study site.

Species name	Dadieso	Bia	Ankasa
<i>Azelia bella</i>	1	2	1
<i>Aidia genipiflora</i>	0	0	3
<i>Albizia adianthifolia</i>	1	0	4
<i>Albizia ferruginea</i>	1	0	3
<i>Albizia glaberrima</i>	1	0	0
<i>Albizia zygia</i>	1	0	10
<i>Allanblackia floribunda</i>	0	1	0
<i>Alstonia boonei</i>	1	1	2
<i>Amphimas pterocarpoides</i>	3	1	8
<i>Annickia polycarpa</i>	0	3	1
<i>Anopyxis klaineana</i>	0	3	0
<i>Anthonotha fragrans</i>	1	2	0
<i>Anthonotha sassandraensis</i>	0	1	0
<i>Antiaris toxicaria</i>	3	0	3
<i>Antidesma oblonga</i>	0	2	0
<i>Aptandra zankerii</i>	0	1	0
<i>Aubrevillea kerstingii</i>	0	1	1
<i>Baphia nitida</i>	4	0	30
<i>Baphia pubescens</i>	2	4	7
<i>Beilschmiedia mannii</i>	9	1	0
<i>Berlinia confusa</i>	5	17	0
<i>Berlinia tomentella</i>	24	9	17
<i>Blighia sapida</i>	3	1	4
<i>Blighia unijugata</i>	2	0	0
<i>Bombax brevicuspe</i>	1	0	1
<i>Bombax rhodognaphalen</i>	1	0	0
<i>Buchholzia coriacea</i>	0	4	1
<i>Bussea occidentalis</i>	2	1	3
<i>Caloncoba gilgiana</i>	1	0	0
<i>Calpocalyx brevibracteatus</i>	20	2	16
<i>Canarium schweinfurthii</i>	0	0	1
<i>Carapa procera</i>	13	15	0
<i>Cassipourea gummiflua</i>	0	1	0
<i>Cassipourea hiotou</i>	0	1	0
<i>Cassipourea lescotiana</i>	0	1	0
<i>Cathormion altissimum</i>	1	0	0
<i>Cecropia peltata</i>	2	1	0
<i>Ceiba pentandra</i>	0	0	1
<i>Celtis adolfi-fredericii</i>	0	0	4
<i>Celtis mildbraedii</i>	4	0	48
<i>Celtis zenkeri</i>	0	0	1
<i>Chrysophyllum bequei</i>	0	0	1

Species name	Dadieso	Bia	Ankasa
<i>Chrysophyllum pentagonocarpum</i>	0	1	0
<i>Chrysophyllum perpulchrum</i>	0	0	1
<i>Chrysophyllum subnudum</i>	0	4	3
<i>Chytranthus macrobotrys</i>	0	0	1
<i>Cleistopholis patens</i>	3	3	5
<i>Coelocaryon oxycarpum</i>	1	0	0
<i>Cola boxiana</i>	0	1	0
<i>Cola chlamydantha</i>	5	5	0
<i>Cola gigantea</i>	2	3	12
<i>Cola lateritia</i>	1	0	1
<i>Cola nitida</i>	9	16	16
<i>Copaifera salikounda</i>	1	2	0
<i>Cordia millenii</i>	0	0	3
<i>Corynanthe pachyceras</i>	1	0	24
<i>Coula edulis</i>	0	14	0
<i>Craterispermum caudatum</i>	0	1	0
<i>Crudia gabonensis</i>	0	3	1
<i>Cylicodiscus gabunensis</i>	1	0	0
<i>Cynometra ananta</i>	1	56	0
<i>Dacryodes klaineana</i>	11	22	8
<i>Dasylepis brevipedicellata</i>	0	1	0
<i>Desplatsia chrysochlamys</i>	3	0	3
<i>Dialium aubrevillei</i>	1	3	14
<i>Dialium dinklagei</i>	1	0	3
<i>Diospyros camerunensis</i>	0	6	3
<i>Diospyros ferrea</i>	2	2	1
<i>Diospyros gabonensis</i>	3	2	0
<i>Diospyros mannii</i>	2	0	0
<i>Diospyros monbuttensis</i>	2	0	0
<i>Diospyros piscatoria</i>	2	0	1
<i>Diospyros sanza-minika</i>	0	22	0
<i>Diospyros vignei</i>	0	1	1
<i>Diospyros viridicans</i>	0	0	1
<i>Discoglyprena caloneura</i>	4	0	9
<i>Distemonanthus benthamianus</i>	2	0	2
<i>Dracaena mannii</i>	3	0	0
<i>Drypetes afzelii</i>	0	3	0
<i>Drypetes aubrevillei</i>	0	7	0
<i>Drypetes aylmeri</i>	1	31	0
<i>Drypetes gilgiana</i>	1	0	0
<i>Drypetes ivorensis</i>	0	37	0
<i>Drypetes leonensis</i>	0	11	0
<i>Drypetes principum</i>	0	2	0
<i>Duboscia macrocarpa</i>	1	0	0
<i>Elaeis guineensis</i>	1	0	1

Species name	Dadieso	Bia	Ankasa
<i>Elaeis guineensis</i>	0	0	1
<i>Enantia polycarpa</i>	0	0	1
<i>Entandrophragma angolense</i>	3	0	8
<i>Entandrophragma candollei</i>	0	0	2
<i>Entandrophragma cylindricum</i>	1	0	8
<i>Erythrina vogelii</i>	0	0	2
<i>Eugenia leonensis</i>	0	1	0
<i>Fabaceae sp.</i>	3	0	0
<i>Funtumia africana</i>	0	4	0
<i>Funtumia elastica</i>	4	4	10
<i>Garcinia gnetoides</i>	1	5	0
<i>Garcinia kola</i>	0	1	0
<i>Garcinia smeathmannii</i>	0	6	1
<i>Gilbertiodendron bilineatum</i>	3	0	0
<i>Gluema ivorensis</i>	0	13	0
<i>Glyphaea brevis</i>	1	0	0
<i>Greenwayodendron oliveri</i>	1	1	5
<i>Guarea cedrata</i>	1	0	3
<i>Guarea thompsonii</i>	1	2	1
<i>Guibourtia ehie</i>	1	0	1
<i>Hallea ledermannii</i>	1	0	0
<i>Hannoa klaineana</i>	7	7	7
<i>Heritiera utilis</i>	1	20	0
<i>Hexalobus crispiflorus</i>	0	0	5
<i>Holoptelea grandis</i>	1	0	1
<i>Homalium aylmeri</i>	0	1	0
<i>Homalium letestui</i>	12	0	1
<i>Homanium dewevrei</i>	0	1	0
<i>Hunteria eburnea</i>	4	1	1
<i>Hunteria simii</i>	0	2	0
<i>Hunteria umbellata</i>	1	11	0
<i>Hymenostegia afzelii</i>	11	0	0
<i>Hymenostegia gracilipes</i>	0	1	0
<i>Irvingia gabonensis</i>	9	0	0
<i>Khaya ivorensis</i>	4	1	2
<i>Kigelia africana</i>	2	0	0
<i>Klainedoxa gabonensis</i>	0	2	0
<i>Lanea welwitschii</i>	5	0	1
<i>Leptaulus daphnoides</i>	1	7	0
<i>Lindackeria dentata</i>	0	0	1
<i>Lophira alata</i>	0	3	1
<i>Lovoa trichilioides</i>	1	3	1
<i>Macaranga africana</i>	0	0	1
<i>Macaranga barteri</i>	0	1	1
<i>Mammea africana</i>	0	6	0

Species name	Dadieso	Bia	Ankasa
<i>Mansonia altissima</i>	0	0	11
<i>Maranthes chrysophilla</i>	0	2	0
<i>Maranthes glabra</i>	4	7	2
<i>Mareya micrantha</i>	2	0	1
<i>Margaritaria discoidea</i>	0	1	1
<i>Massularia acuminata</i>	0	0	1
<i>Meliaceae sp.</i>	2	0	0
<i>Memecylon afzelii</i>	1	11	0
<i>Memecylon blakeoides</i>	0	5	0
<i>Memecylon lateriflorum</i>	0	9	0
<i>Memecylon memecyloides</i>	0	2	0
<i>Memecylon normandii</i>	0	1	0
<i>Milicia excelsa</i>	2	0	2
<i>Milicia regia</i>	0	0	1
<i>Millettia pallens</i>	3	0	0
<i>Millettia rhodantha</i>	1	0	0
<i>Monodora myristica</i>	0	1	0
<i>Monodora tenuifolia</i>	0	0	11
<i>Musanga cecropioides</i>	3	3	0
<i>Myrianthus arboreus</i>	11	0	9
<i>Myrianthus chrysophilla</i>	0	3	0
<i>Myrianthus libericus</i>	1	10	5
<i>Napoleona vogelii</i>	5	0	1
<i>Nauclea diderrichii</i>	1	1	0
<i>Nesogordonia papaverifera</i>	1	0	12
<i>Newbouldia laevis</i>	1	0	0
<i>Octoknema borealis</i>	0	7	0
<i>Omphalocarpum ahia</i>	0	3	2
<i>Omphalocarpum procerum</i>	0	1	1
<i>Ongokea gore</i>	1	0	1
<i>Ophiobotrys zenkeri</i>	0	0	1
<i>Osonotokwefo sp.</i>	0	0	2
<i>Pachypodanthium staudtii</i>	0	0	1
<i>Pachystela msolo</i>	0	3	0
<i>Pancovia turbinata</i>	0	2	0
<i>Panda oleosa</i>	2	0	5
<i>Parinari excelsa</i>	0	2	0
<i>Parkia bicolor</i>	8	3	2
<i>Pellegriniodendron diphyllum</i>	0	0	1
<i>Pentadesma butyracea</i>	0	14	0
<i>Petersianthus macrocarpus</i>	2	0	4
<i>Phyllocosmus africanus</i>	0	0	2
<i>Phyllocosmus sessiliflorus</i>	0	3	0
<i>Picalima nitida</i>	0	1	0
<i>Pierreodendron kerstingii</i>	1	1	0

Species name	Dadieso	Bia	Ankasa
<i>Piptadeniastrum africanum</i>	5	3	3
<i>Piptostigma fasciculatum</i>	0	4	0
<i>Piptostigma fugax</i>	0	7	0
<i>Plecodiscus attenuatus</i>	0	3	0
<i>Pleiocarpa mutica</i>	0	6	0
<i>Pouteria altissima</i>	2	0	3
<i>Pouteria robusta</i>	0	0	1
<i>Protomegabaria stapfiana</i>	0	67	0
<i>Pterygota bequaertii</i>	0	0	2
<i>Pterygota macrocarpa</i>	0	0	12
<i>Pycnanthus angolensis</i>	5	1	10
<i>Raphia Palma-pinus</i>	0	0	2
<i>Rhodognaphalon brevicuspe</i>	0	0	4
<i>Ricinodendron heudelotii</i>	2	0	9
<i>Rinorea prasina</i>	0	1	0
<i>Rothmannia hispida</i>	0	0	1
<i>Rothmannia longiflora</i>	0	0	1
<i>Rothmannia withefieldii</i>	0	0	1
<i>Sacoglottis gabonensis</i>	0	2	0
<i>Samanea dinklagei</i>	0	1	0
<i>Sarcocephalus pobeguinii</i>	0	1	0
<i>Scaphopetalum amoenum</i>	0	12	0
<i>Scottellia klaineana</i>	9	7	10
<i>Scyttopetalum tieghemii</i>	0	19	0
<i>Sericanthe toupetou</i>	0	1	0
<i>Smeathmannia pubescens</i>	2	0	0
<i>Soyauxia grandifolia</i>	0	4	0
<i>Soyauxia velutina</i>	0	1	0
<i>Spathandra blakeoides</i>	0	3	0
<i>Spondianthus preussii</i>	0	1	0
<i>Sterculia oblonga</i>	4	0	29
<i>Sterculia rhinopetala</i>	6	0	20
<i>Sterculia tragacantha</i>	2	0	2
<i>Strephonema pseudocola</i>	0	38	0
<i>Strombosia glaucescens</i>	19	0	11
<i>Strombosia pustulata</i>	0	32	18
<i>Suregada ivorensis</i>	0	1	0
<i>Synsepalum afzelii</i>	0	2	0
<i>Synsepalum brevipes</i>	0	1	0
<i>Synsepalum msolo</i>	0	2	0
<i>Synsepalum ntimii</i>	0	1	0
<i>Syzygium guineense</i>	0	3	0
<i>Syzygium rowlandii</i>	0	2	0
<i>Tabernaemontana africana</i>	3	0	1
<i>Tabernaemontana sp.</i>	0	13	1

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Species name	Dadieso	Bia	Ankasa
<i>Terminalia superba</i>	5	0	5
<i>Tetrapleura tetraptera</i>	0	0	1
<i>Tieghemella heckelii</i>	2	5	0
<i>Treculia africana</i>	1	0	0
<i>Trema orientalis</i>	1	0	0
<i>Tricalysia pallens</i>	0	0	1
<i>Trichilia heudelotii</i>	0	1	0
<i>Trichilia monadelpha</i>	4	0	8
<i>Trichilia priureana</i>	4	0	6
<i>Trichilia tessmannii</i>	4	1	2
<i>Trichoscypha beguei</i>	0	1	0
<i>Trichoscypha blydeniae</i>	0	1	0
<i>Triclisia gilletii</i>	0	1	0
<i>Trilepisium madagascariense</i>	1	0	0
<i>Triplochiton scleroxylon</i>	4	0	11
<i>Turraeanthus africanus</i>	4	0	0
<i>Uapaca corbisieri</i>	0	22	0
<i>Uapaca guineensis</i>	4	3	0
<i>Vitex ferruginea</i>	1	1	0
<i>Vitex micrantha</i>	0	3	2
<i>Warneckea cinnamomoides</i>	0	3	0
<i>Warneckea guineensis</i>	0	1	0
<i>Xylia evansii</i>	3	0	3
<i>Xylopiya quintasii</i>	0	2	5
<i>Xylopiya rubescens</i>	0	1	0
<i>Xylopiya staudtii</i>	0	2	0
<i>Xylopiya villosa</i>	0	2	2
<i>Zanthoxylum gilletii</i>	1	3	7