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DATA ARTICLE

Diversity of Woody Species in Djamde Wildlife Reserve, Northern Togo, West Africa

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Djamde Wildlife Reserve, with an area of about 8,000 ha, is located in Kozah prefecture (Kara region in northern Togo), between 9°31′ and 9°35′ N latitude and 1°01′ and 1°05′ E longitude. This reserve was created by the merger in 2003 of the classified forests of Djamde and Kindja. These two forests were classified respectively by Decision No. 766-54/EF and No. 765-54/EF signed on July, 29th 1954 by the colonial authority. To date, there is still no legislative enactment that establishes Djamde's reserve status. Since 2003, its management has been granted to TOGO-FAUNE Company.

Different plant communities identified are: clear forests, gallery forests, shrubby savannas and a mosaic of wooded/tree savannas. The inventory of woody species carried out on circular plots, allowed to identify 126 ligneous species distributed in 40 botanical families and 94 genera. Eleven of these species are classified in the IUCN Red List with the status of "extinction risk".

The pressures on the biodiversity of Djamde's reserve include poaching, wood fuel production and vegetation fires. Aim of this project is to create an Ecological Corridor between Wildlife Reserve and Sarakawa's Park and to promote public-private partnership in protected area management.

Keywords: biodiversity; woody species; Djamde; wildlife reserve; Togo; poaching; wood fuel; vegetation fires; vulnerable species

Introduction

Tropical forests, which cover less than 10% of the Earth's total land area, are hosting 50–90% of the known terrestrial plant and animal species, and forest biodiversity underpins most of the forest ecosystem services (FAO 2010; Seppala et al. 2009; MEA 2005). They are the world's richest biological communities and these forests have been recognized to harbor a significant percentage of the global biodiversity (Baraloto et al. 2013; Myers et al. 2000) and also provide livelihood systems and wood to about 1.6 billion people (FAO 2010; World Bank 2004). These forests provide many ecosystem services such as species conservation, soil erosion prevention, and plants and animals habitat preservation (Armenteras et al. 2009).

According to the mapping carried out on satellite imagery data from the 2013 National Forest Inventory (IFN), forest cover in Togo represents 24.24% of the country's total area (MERF, 2016). This forest cover consists mainly of dense forests, riparian forests, open forests, dense woodlands and forest relics. Changes in land use have led to the vulnerability of the country's forest ecosystems, whose area is decreasing significantly each year, in favour of savannas and farmland (MERF, 2018).

Overexploitation has brought about the rapid loss of forests and is recognized as one of the world's greatest environmental and economic challenges (Mani and Parthasarathy, 2006). Tropical forests are disappearing at an alarming rates worldwide, reducing their current area by 1–4% each year (Laurance, 1999). The relative increase in anthropogenic pressures has led to the expansion of agriculture and overgrazing of livestock (Anitha et al. 2010).

In fact, between 1975 and 2010, Togo's forests have lost nearly 33% of their land area (USGS EROS, 2013) and Togo is among the countries with the highest net loss as a percentage of forests (FAO, 2011). These

growing deforestation and degradation phenomena limit the ability of forest ecosystems to provide their vital goods and services to the population. In order to conserve biological diversity, Togo has, since the colonial period, established a vast network of protected areas, including national parks, classified forests and wildlife reserves. This network of 83 protected areas is estimated at about 14% of the national territory (UICN, 2010; Wala, 2004).

Thus, habitats protection and restoration, which improves biodiversity and productivity, could directly benefit communities dependent on these forest resources (Reddy & Ugle 2008; Heywood 1995). But in 1990, as a result of socio-political unrest, these protected areas suffered a major degradation resulting in flooding, overgrazing, illegal and excessive resources exploitation of these protected areas. To reverse the trend, the Government has adopted in 2003 a standard protected area management framework aimed at restoring and securing about 10.21% of the national territory (MERF, 2008). Identified as a priority protected area and to strengthen its management, Djamde wildlife reserve was granted to TOGO-FAUNE, for 99 years.

It is in the context of this lease that the company named TOGO-FAUNE, with technical assistance of the Ministry of the Environment and Forestry Resources (MERF) commissioned studies, including the forestry inventory of Djamde reserve, for the drafting of its management plan.

The dataset used in this data paper carry out tree inventory obtained from a survey plan drawn from the cartographic databases. On a mesh, plots were made to cover various vegetation of the reserve. The dataset was developed to 1) show Djamde Wildlife Reserve importance in term of biodiversity conservation in Togo, 2) promote public-private partnership in protected areas management, and 3) launch a fundraising for the development and management plan for this protected area.

Project description

Collection of the data in the field was funded by TOGO-FAUNE with technical support of the Forestry Resources Office (DRF). Indeed, since the concession of the reserve management to a private company, many achievements have been made in terms of management. Among others, let's mention:

- the fauna enrichment with two white rhinos, twenty-eight zebras, thirty-five wildebeest coming from South Africa; three elephants from Burkina Faso and fifteen Nyala, buffaloes and sable antelope (*Hippotragus niger*) from Sarakawa ranching;
- the fence of the reserve with electrified wire over 44.6 km of perimeter; the construction of an automobile workshop, a shed, an administrative building, ten visitors houses, two boreholes, an animal sick-bay and seven guard posts along the perimeter of the reserve.
- The company TOGO-FAUNE invests monthly more than 36K €, for the infrastructures maintenance and the workers' salaries.

Implementation of this project is scheduled to run for ten years (2014–2023), with an estimated budget of 750K€.

Study area description

Djamde Reserve is located in the narrowing zone of Atakora Chain. There are two mountain ranges: Djamde Mountains whose highest point called Kéléza, has an altitude of about 670 m, and Bounoh-bou mountain range. It belongs to the structural unit of the Atakora with dominant muscovite quartzites, quartzose micaschists and chloritic schists. There are little evolved soils with gravelly or stony horizons, stones and boulders. It is crossed by the medium-size Rivers namely Klikpèn and Lamboua.

According to the ecofloristic distribution proposed by Ern (1979), Djamde Wildlife Reserve is localized in Togo Ecological Zone II (**Figure 1**) which is typified by a mosaic of dry forests of mountain and forest galleries. The climate is Sudano-Guinean. It is targeting by one rainy season (April–October) and one dry season (October–March). The rainy season is characterized by the Harmattan that is a dry and cold wind. Rainfall is irregular and reaches 1200–1300 mm of water per year. The soils are thin and contain a high proportion of coarse elements. Ferruginous tropical soils are also present.

Design description: Based on the reserve's potential and constraints, the management plan aims to ensure the sustainable management of its resources; particularly wildlife resources, through their valorization and efficient monitoring with a view to ensuring the harmonious development of local communities. Specifically, it's about: (i) strengthen the organizational and institutional backbone of the reserve's management, (ii) consolidate the monitoring system for biological resources, (iii) develop tourism, hunting sport

and alternative socioeconomics activities, that are both sustainable and beneficial to local people; with minimal environmental impact on the resources; iv) promote research and ecological monitoring system.

The dataset is published through http://ipt-togo.gbif.fr/resource?r=reserve_djamde# under the Licences: Creative Commons Attribution (CC-BY) 4.0 License.

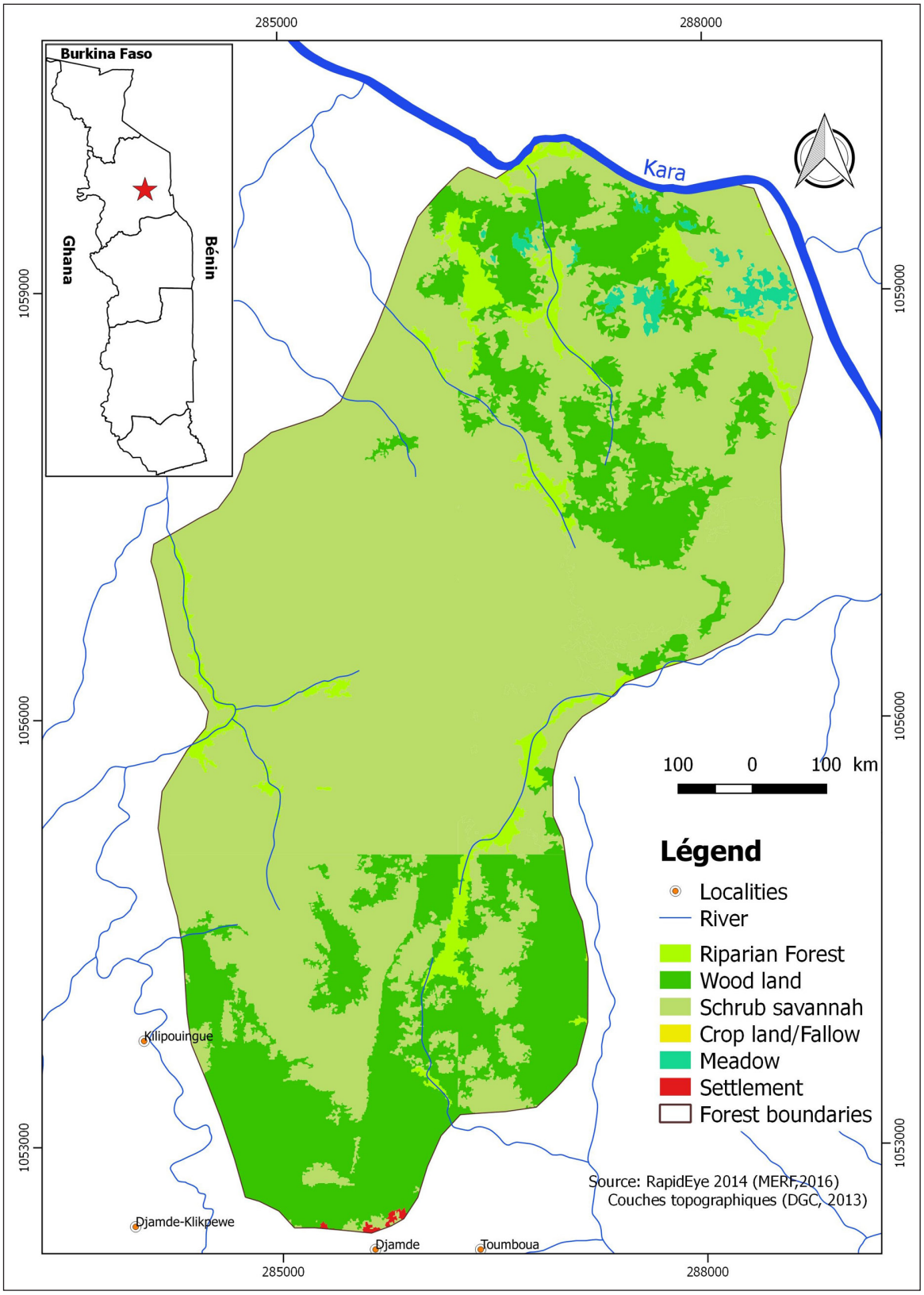

Figure 1: Djamde Wildlife Reserve Position.

Methodology

The dataset described in this paper was collected from May 2014 and May 2018. A sampling scheme was developed for Djamde Wildlife Reserve from cartographic holdings. A square mesh was created using Arcview 3.2 software. Vegetation stratification was carried out in order to identify the main plant assemblages on the basis of the national classification updated by the nomenclature of land uses and typologies of plant assemblages (MERF 2016). This mesh made it possible to place the random transects equidistant by 2 km in order to cover the whole study area. Data collection sheets were manually undressed and the raw data are then compiled using Excel software. Frequency calculations of species number per family were made on the basis of data compiled through analysis of pivot tables in Excel.

Floristic inventory was carried out according to the phytosociological stigmatism method of Braun-Blanquet (1932) used in many phytosociological studies in the West African subregion (Dourma 2008; Wala 2004; Kokou, 1998, Sinsin 1993, Akpagana 1989). Sixty (60) survey plots were installed along 10 transects, and positioned on these transects taking into account the different layers and the existing pathways in the reserve. The size of each plot is 30 m * 30 m and 50 m × 5 m along the streams. All plant species present in each plot were noted and assigned an abundance-dominance coefficient according to the Braun Blanquet scale (1932), to identify the characteristic and therefore dominant species of plant communities and, to determine the spatial distribution of the communities studied. (+: rare species, recovery of 0–1%, 1 = recovery of 1–5%, 2 = recovery of 5–25%, 3 = recovery of 25–50%, 4 = recovery of 50–75%; = recovery from 75–100%).

Dataset described was updated to match APG classification of angiosperm families (APGIII, 2009). Identification, spelling and authorship of collected species was checked using Togo (Brunel et al. 1984) and Benin (Akoègninou et al. 2006) flora and confirmed against online databases (www.ipni.org; http://www.theplantlist.org/, http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php).

IUCN status of each species was obtained using www.iucnredlist.org.

Spatial coverage

Description: Djamde Wildlife Reserve is located in the Kozah prefecture (Kara region in northern Togo) (**Figure 1**), between 9°31′ and 9°35′ north latitude and 1°01′ and 1°05′ longitude East. The area of this faunal Reserve is characterized by a Sudano-Guinean climate, marked by two distinct seasons: a dry one from November to April with high temperatures reaching 38–40°C between March and a rainy season from April to October, with maximum rainfall in August and September. The average annual rainfall is around 1,300 mm and the average temperature is 26°C (Atsri, 2013; Atutonu, 2013).

Coordinates: 9°26′31.2″N and 9°34′51.6″N Latitude; 1°1′30″E and 1°6′28.8″E Longitude, Altitude 520 m.

General taxonomic coverage

Four plant patterns have been identified with the following characteristics:

- The rainforests of *Isoberlinia doka* and *Isoberlinia tomentosa* associated with *Monotes kestingii* and *Anogeissus leiocarpa*. Their surface area is estimated at 2068.78 ha, representing 25.86% of the reserve.
- The gallery forests are poorly represented with an area of 267.46 ha, representing 3.35%. These plant formations, linked to watercourses, are poorly provided in the reserve. The most dominant woody species are *Millettia thoningii, Marguaritaria discoidea* and *Khaya senegalensis*.
- The mosaics of tree savannah are made up of: wooded savannah with *Pterocarpus erinaceus, Afzelia africana* and *Burkea africana*; tree savannah with *Terminalia macroptera* in floodable and poorly drained areas, and tree savannah with *Ostryoderris stulhmannii* on mountain plateaus. The area of this complex is estimated at 3478.56 ha, representing 43.48% of the total area of the reserve.
- Shrub savannahs with an area of 2185.85 ha or 27.31% are dominated by species such as *Daniellia oliveri, Vitellaria paradoxa* and *Terminalia spp*.

Harvested woody plants have been identified up to species level and IUCN status.

The dataset contains 126 woody species belonging to 34 families (**Figure 2**) and 94 genera, according to APG III classification (2009). The most represented families in terms of species are: Fabaceae (29), Combretaceae (12), Rubiaceae (11), Moraceae (9), Verbenaceae and Anacardiaceae (5). Alphabetically, others are: Arecaceae (only one Commelinids), Annonaceae, Apiaceae, Apocynaceae, Araliaceae, Bignoniaceae, Bixaceae, Celastraceae, Chrysobalanaceae, Combretaceae, Connaraceae, Dipterocarpaceae, Ebenaceae, Euphorbiaceae, Hypericaceae, Loganiaceae, Malvaceae, Meliaceae, Myrtaceae, Ochnaceae, Olacaceae, Oleaceae, Proteaceae, Salicaceae, Sapindaceae, Sapotaceae, Simaroubaceae, Thymeleaceae, Ulmaceae, Vitaceae.

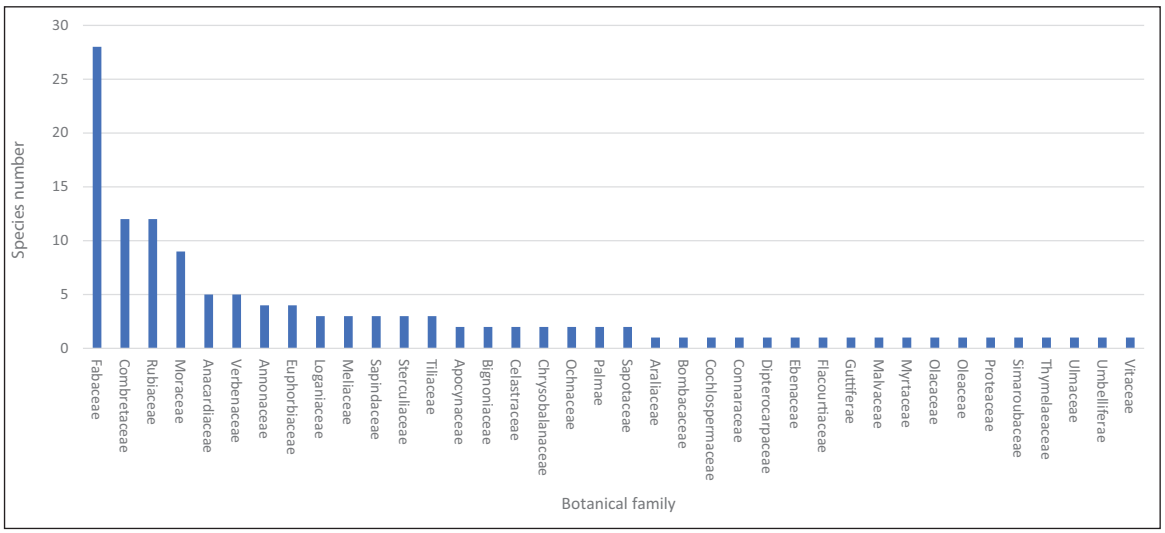

Figure 2: Distribution by family of woody species in Djamde Wildlife reserve.

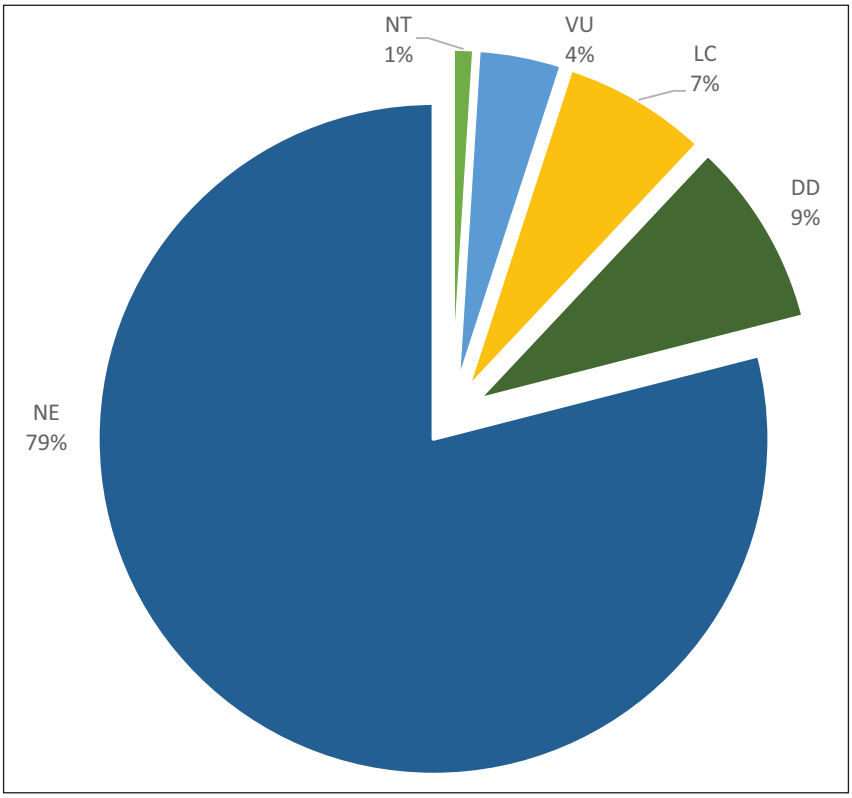

Figure 3: Distribution of woody species in Djamde reserve according to IUCN status (NE = *Not Evaluated*; LC = *Least Concern*; NT = *Near threatened*; VU = *Vulnerable*; DD = *Data Deficient*).

Dominant genera are Ficus (7 species), Combretum (5) and Terminalia (4).

According to the IUCN Red List, 11 (8.73%) of the listed species have an extinction risk status (**Figure 3**). In detail, these are 4 vulnerable species (*Khaya senegalensis, Pouteria alnifolia, Afzelia africana* and *Albizzia ferruginea*), 1 near threatened species (*Milicia excelsa*) and 5 species of minor concern (*Acacia hockii, Detarium microcarpum, Dichrostachys cinerea, Pterocarpus santalinoides, Isoberlinia doka*).

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Competing Interests

The authors have no competing interests to declare.

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