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Spatial distribution and abundance of selected exploited non-timber forest products in the Takamanda National Park, Cameroon

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This study investigated the spatial distribution and abundance of selected non-timber forest products (NTFPs) exploited in the Takamanda National Park, Cameroon. The distribution, abundance, encounter rates, species condition, seasonality and human impacts were assessed in the 217 km reconnaissance survey. The most dominant species recorded were *Afrostyrax kamerunensis* (44%) and *Gnetum africanum* (11%) while the least dominant species observed was *Ricinodendron heudelottii* (1%). Immature NTFPs were dominant (79.44%) while matured NTFPs were the least (20.55%). A total of 58% of the selected species were encountered with 79.44% representing immature NTFPs, while 20.56% represented matured NTFPs. *A. kamerunensis*, *Masularia acuminate*, *Carpolobia* spp. and *Irvingia gabonensis* showed random distribution patterns. *Gnetum* spp. equally showed a random pattern of distribution but their occurrence was limited in the Centre and Southern parts. *R. heudelotii* had clump distribution pattern in the Northern, Centre and Southern parts of the park. Anthropogenic influences such as footpaths (425), farmland, (71) local timber exploitation (9) affected distribution. Harvesting pressure was high for *Carpolobia* spp. and *Garcina mannii* because the whole plant were harvested, thus leading to their low regeneration capacity. Information on spatial distribution, seasons of availability and recruitment ability of NTFPs would aid to educate and enforce conservation regulations.

Key words: Distribution, encounter rate, non-timber forest products (NTFPs), human impacts, Takamanda rainforest, abundance, conservation

INTRODUCTION

Forests ecosystem management have received much attention in development and environmental issues within the last decade, due to their role in biodiversity conservation, climate change mitigation and livelihood support to natural resource dependent communities. The biodiversity of forest ecosystems is rich in plants and animal species that sustain humanity. Forest products encompass macro level products, timber and micro level forest products and non-timber forest products (NTFPs). NTFPs include fruits, nuts, seeds, flowers, leaves, twigs, tree barks, stems, spices, medicinal plants, ornamental plants, bamboo, rattans, ropes, resins, oil, dyes, mushrooms and wildlife (Clark and Sunderland, 2004; Ndah et al., 2013).

People worldwide depend on NTFPs for nutritional, medicinal and cultural purposes. They also serve as a source of income, as well as ‘safety nets’ in periods of shortages or poor harvest of main crops (Chamberlain et al., 2004). They provide security to billions of people in the form of building materials, foods, fuels and medicines.

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Increase in value and commercialization of NTFPs has increased pressure on NTFPs exploitation with subsequent impacts on the biodiversity. This situation is more complex in the context of biodiversity hot spots being managed as protected areas where unsustainable collection and commercialization of NTFPs is always in conflict with the conservation concerns of protected areas such as National Parks, Forest Reserves and Wildlife Sanctuaries. Recently, due to the importance of these species being known for their medicinal properties, economic and social uses worldwide, the demand for non timber forest products in local markets and international markets have increased (Ndah et al., 2013; Plotkin and Famolare, 1992). These current situations have led to indiscriminate harvesting of forest products and destruction of other plant species within the ecosystem. The poor harvesting of most of these species have led to the modification of habitat, pushing most of these species into small stands and is difficult for species to adapt into new conditions (Ndah et al., 2013; Sunderland et al., 2003).

Managing and protecting biodiversity in protected areas simultaneously with sustaining forest livelihoods is challenging. Major challenges involved in the management of forests for NTFPs are: the lack of substantial knowledge on population biology, standing stocks, life cycle of plants, yields of plants species and harvesting techniques (Chamberlain et al., 2004). Peters (1994) placed emphasis on the importance of a constant flow of information on the ecological response of species to different levels of exploitation which is essential for stabilizing sustainable harvesting through continuous adjustments. Knowledge on the structure and dynamics of plant populations being exploited is also essential for sustainable exploitation of NTFPs (Peters, 1994).

Furthermore, understanding spatial distribution pattern, seasons of availability and regeneration status of NTFPs are important to create, educate and enforce conservation regulations (Schaafsma, 2011).

The aim of this study was to evaluate the spatial distribution and abundance of exploited NTFPs within the Takamanda National Park (TNP) of Cameroon. The information from this study is expected to provide commu-nity authorities, conservators, managers and decision makers with information which would enable them take concrete decisions on monitoring and sustainable exploitation of NTFPs in the Takamanda National Park. In addition, this study will be a good platform for different stakeholders to support the establishment of small scale plantation of NTFPs, while reducing pressure on protected areas.

MATERIALS AND METHODS

Study site

The Takamanda National Park lies between latitudes 05°59'- 06°21' North and longitudes 09°11- 09°30'E, and has a land area of 67,599 ha. It is located in the Akwaya subdivision in the South West Region of Cameroon and is bounded by Nigeria to the west (Figure 1). The Takamanda National Park is surrounded by 43 villages and has a population of about 15,700 people. The area has two seasons (raining and dry season) with rainfall occurring in the months of April to November. Peak rainfall occurs in July and August (Groves and Maisel, 1999). Total annual rainfall has been estimated at 4500 mm per year (WWF, 1990). The dry season starts in November and ends in April. The mean annual temperature is 27°C with colder weather in the rainy season than in the dry season.

The Takamanda National Park constitutes a species rich formation whose diversity is enhanced by the confluence of several habitats in the area (Comiskey et al., 2003). The park presents a sharp gradation from lowland forest to sub-montane (highland) forest with the associated floristic variations still intact. These forests are home to a wide range of biological taxa that also exhibit remarkable diversity. The collection and commercialization of NTFPs plays a vital role in the livelihoods and local economies of communities in and around the TNP, with about 75% of households involved in NTFP related activities (Sunderland et al., 2003).

Description of species

The nine NTFP species selected (Table 1) for this study is amongst the fifteen most important NTFPs to the communities in the Takamanda rainforest. Species were chosen based on their multipurpose uses (food, medicinal and cultural values). The exploitation aspects and the income generated for the species were taken into consideration. This process was guided by a review of existing knowledge generated by socio-economic and ethnobotanical surveys carried out in and around the Takamanda rainforest (Zapfact et al., 2001; Ndah et al., 2013).

Field survey

This study was carried out in the Takamanda National Park and communities around the periphery of the park. The survey was conducted from February 2010 to March 2011. This period enabled the evaluation of the effect of seasonality on the distribution and abundance of species. The survey technique implemented during this inventory was the reconnaissance (Recce) survey. The aim of the recce walk was to estimate abundance and distribution patterns of NTFPs; species flowering; fruiting; and human influences in the TNP. The recce transects (Figure 2) consisted of a series of temporary, parallel, 2 m wide transects which were established running from the Northern to the Southern parts of the park. A total path length of 217 km was covered during the survey.

A survey team walked these paths along a baseline at predetermined intervals and varied in length. The survey team consisted of two plant taxonomists, two field guides (hunter and plant gatherer) with basic knowledge of the flora and fauna of the area and four researchers. The team walked along transects and identified all selected NTFPs. Voucher specimens of all the species identified were collected and deposited in the Limbe Botanical Garden Herbarium (SCA). The harvested parts of the different NTFPs species were recorded and information on human activities such as local timber exploitation, farmland, foot path, bush huts, bullet shells and animal traps were recorded as well as seasons of availability. The flowering, fruiting periods and stages of growth of the different species were observed and recorded during the recce walk.

Data analysis

Data collected were entered into excel work sheets where species abundance and human influences were determined by their encounter rates recorded during survey. The encounter rates of

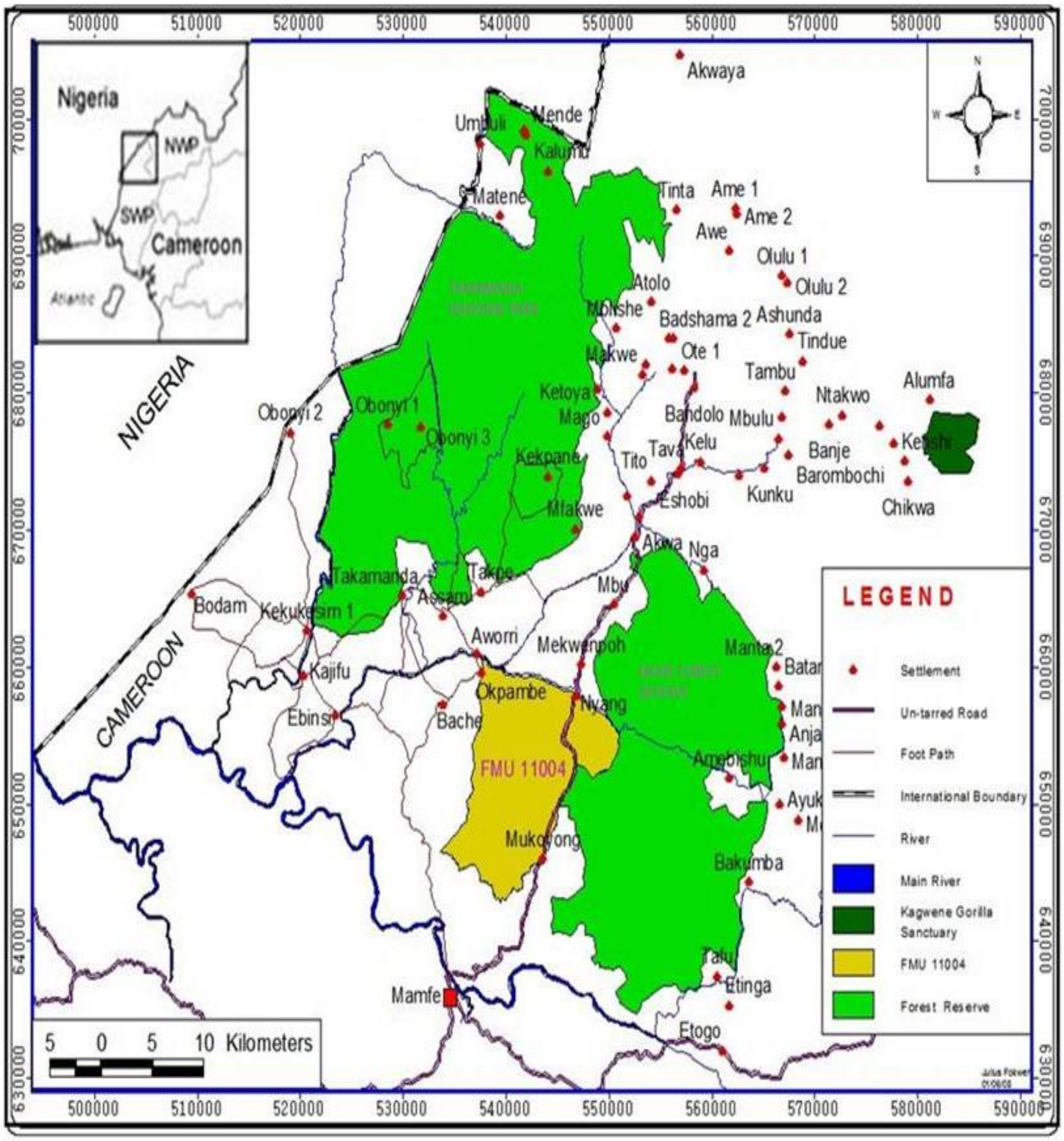

Figure 1. Map of the study area.

species were determined using method described by White et al. (2000). Encounter rate (ER) = given as Nt/Lt, where Nt = number of objects observed and Lt = length of transect (Km). Coordinates of species were exported into a global information system (GIS) environment (Arc View 3.2) and (Arc GIS) for spatial analysis. Regeneration of NTFPs were assessed on a scale of 1 to 3 (3 = good, 2 = fair and 1 = poor). In which 3 stands for a species with seedlings, poles and mature trees, 2 for species with poles and mature trees and one for species which exist only as mature trees.

RESULTS

Distribution and density of NTFP species

Nine (9) NTFP species belonging to seven (7) families were studied in this survey (Table 1). The most dominant species recorded were *Afrostyrax kamerunensis (*44%) and *Gnetum africanum* (11%) with encounter rates of 25.04 and 6.10, respectively (Table 2). The least observed species were *Ricinodendron heudelottii* (1%) with encounter rate of 0.4 (Table 2).

Immature NTFPs (seedlings and saplings with diameter <8cm with exception of liana) were dominant (79.44%), while matured (Tree species >9 cm) NTFPs recorded the least abundance (20.55%) (Table 2). The species with the highest abundance of matured NTFPs were *A. kamerunensis* (21.97%), *G. africanum* (17.68%) and *Garcinia mannii* (17.18%), while the least abundance was recorded for *R. heudelottii*, 1.70% (Table 2). The species with the most abundant immature species were *A. kamerunensis* (48.74%) and this was followed by *Carpolobia alba* 10.52%, while the least was *R. heudelottii* (0.46%) (Table 2). A record of 79.44% was encountered for the

Table 1. Species of non-timber forest products and their uses.

Family	Species	Morphological characteristic	Parts used	Medicinal uses	Other uses
Huaceae	*Afrostyrax kamerunensis* Perkins and Gilg	Medium size forest tree of about 35 m	Seeds and bark	Appetizer, pain killer, cure for rheumatism	Condiment
Irvingiaceae	*Irvingia gabonensis* Wolfram/Alpha	Large forest tree of about 35 m	Seeds	Weight loss	Condiment
Polygalaceae	*Carpolobia alba* G Don Carpolobia lutea G Don	Shrub tree of about 5 m, white flowers	Roots, leaves and stem	Cure for sterility and bone facture	Native torch Hausa stick (cane to control cattle)
Rubiaceae	*Massularia acuminata* (G.Don) Bullock	Shrub of about 12 m high, leaves are sessile, red flowers, narrow ovoid fruits	Leaves, stem and twigs	Dental hygiene, dysentery treatment,	Fish poisoning
Guttiferae	*Garcinia mannii* Heck	Shrub of about 9 m tall	Stem	Sterility, potency	Dental hygiene, gum hardening
Euphorbiaceae	*Ricinodendron heudelotii (Baillon) Pax*	Large deciduous tree of about 30 m,digitate leaves and lobed and indehiscent fruits	Seeds	Appetizer	Condiments
Gnetaceae	*Gnetum africanum* Welw. and *Gnetum buccholzianum* Engl.	Liana, ovate and oblong leaves of 3.5 to 5 cm width	Leaves	Anemia treatment regulation	Edible vegetable

selected immature NTFPs during the survey, while 20.56% was encountered for matured species (Table 2).

Spatial distribution of NTFPs species

Among the nine (9) species studied for the survey in the Takamanda National Park (TNP), eight (8) species were used in the spatial analysis (Figure 3). The spatial patterns of each of these species in the Takamanda National Park were recorded from the northern to the southern parts of the park (Figure 3). The pattern of distribution for *A. kamerunensis*, *Masularia acuminate*, *Carpolobia lutea, C. alba* and *Irvingia gabonensis* showed random distribution patterns from the northern to southern parts of the Takamanda National Park (Figure 3b, c, d, g and h). *G. africanum* and *Gnetum buccholzianum* equally showed a random pattern of distribution but their occurrence were limited in the centre and the southern parts of the park (Figure 3e and f). Clump patterns of distribution of *R. heudelotii* were observed in the northern, centre and southern parts of the Takamanda National Park (Figure 3a), but there were fewer clumps in the northern part as compare to the centre and southern parts of the park (Figure 3).

Harvesting situation and impacts

Table 3 shows the species phenologies (flowering and fruit production), seasonal availability; harvest situation and regeneration status of the different NTFPs species during the study. 381 individuals of *A. kamerunensis* and 225 individuals of *G. mannii* were observed to produce the highest number of flowering individuals (Table 3). There were 119 individuals of *Irvingia gabonensis* fruiting, while *A. kamerunensis* and *G. africanum* had both 38 individuals fruiting. *A. kamerunensis, R. heudelottii* and *I. gabonensis* generally flowered and fruited only in rainy season. *Masularia acuminate*, *Carpolobia lutea*, *C. alba*, *G. africanum*, *Gnetum buccholzianum* and *G. mannii* had flowers and fruits in both rainy and dry seasons (Table 3).

A. kamerunensi and I. gabonensis showed good regeneration, while *C. lutea, G. africanum, and M. acuminate* showed poor regeneration abilities (Table 3).

Human influence on the park

Anthropogenic features (foot path, animal traps, farmland local timber exploitation and bullet shells) and distribution level in the park were observed and recorded during the recce walks (Figure 5). Signs of local timber exploitation, footpaths, farmland, bush huts, bullet shells and animal traps were recorded (Figure 4). A total of 425 footpaths crossings were recorded and the active footpaths linked the villages while the inactive footpaths were used by hunters, NTFPs harvesters and local timber exploiters. Bush huts were also encountered which were built mainly by hunters and bush mango harvesters and temporal residential sites have had been created in areas where mature bush mangoes occurred in larger numbers (Figure 5). Local timber exploitation sites were observed with most of them located along the banks of major rivers for easy transportation to Nigeria (Figure 5).

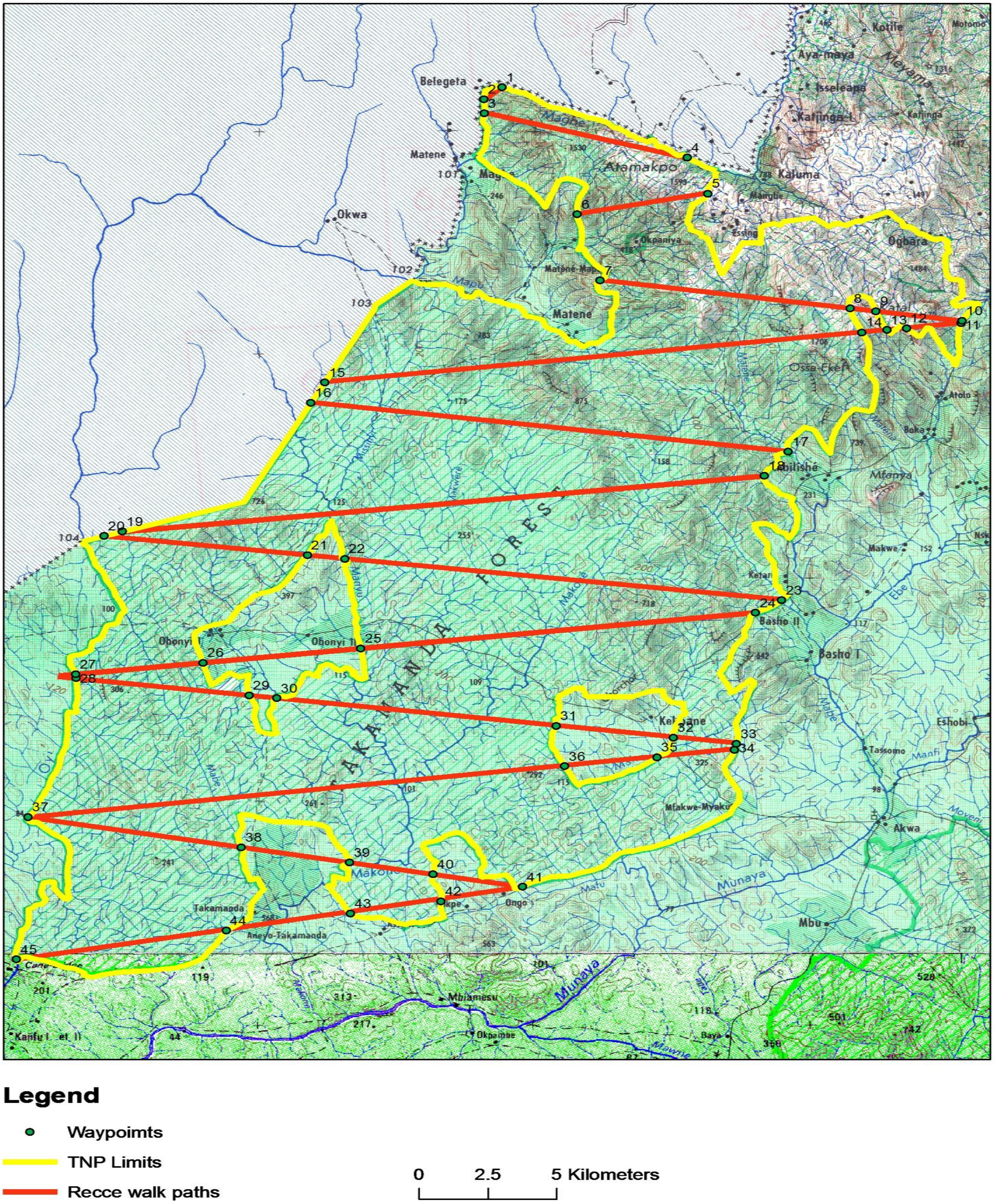

Figure 2. Transect path of the reconnaissance survey from Northern to Southern part of the Takamanda National Park.

Table 2. Abundance and encounter rates of species across the Takamanda National Park.

Specie	Common name	Matured individual	Immature individual	Total	Abundance (%)	Encounter rate
Afrostyrax kamerunensis	Country onion	568 (21.97)	4866 (48.74)	5434	44	25.04
Masularia acuminata	Chewing Stick 2	144 (5.57)	768 (7.69)	912	7	4.20
Ricinodendron heudelottii	Njansang	44 (1.70)	46 (0.46)	90	1	0.41
Carpolobia lutea	Hausa stick 1	273 (10.56)	1003 (10.04)	1276	10	5.88
Carpolobia alba	Hausa stick 2	112 (4.33)	1051 (10.52)	1163	9	4.84
Irvingia gabonensis	Rainy Season Mango	237 (3.54)	141 (1.42)	378	3	1.74
Gnetum africanum	Long leaf Eru	457 (17.68)	868 (8.69)	1325	11	6.10
Gnetum bucholzianum	Round leaf Eru	305 (11.80)	492 (4.93)	797	6	3.67
Garcinia mannii	Chewing Stick 1	444 (17.18)	750 (7.51)	1194	9	5.5

* Figures in brackets are in percentages.

Seventy-one (71) farmlands were observed with a majority found within village enclaves (Figure 5). Farms were mainly slashed and burn agriculture with substantial destruction of some NTFPs and other tree species. In general, human influence observed along the transect walk indicated a high impact of human activities in the centre and southern parts of the Takamanda National Park (Figure 5).

Harvesting situation and impacts

The harvesting impact, regeneration status and the different plant parts harvested for the different NTFPs species is shown in Table 3. Harvesting pressure was high for *C. alba, C. lutea* and *G. mannii*, in addition, these same species had poor regeneration potential (Table 3). Furthermore, harvesting of these species was always unsustainable with the whole plants harvested in the process (Table 3). Less harvesting pressure were observed for *A. kamerunensis*, *I. gabonenses* and *R. heudelottii*. These species showed good recruitment (Table 3).

DISCUSSION

Non-timber forest products (NTFPs) play a paramount role in the livelihoods of forest dependent communities. The utilization of non-timber forest products for food, health care, cultural practices and income generation have become a major way of life of most forest dwellers.

Distribution and abundance of NTFP species

Species distribution and abundance in ecosystems are generally influenced by several parameters. Habitat type, altitude, climatic conditions, edaphic factors, human impact, plant and animal interactions within the ecosystems influence species distribution and abundance (Hiremath et al., 2004; Ndangalasi et al., 2007). The high abundance and distribution of individuals observed in this study may be related to the favourable climatic conditions and rich soil which enabled plants to absorb available nutrients for growth. Similar findings were observed by Flangliang et al. (1997) who discussed patterns of distribution and absorption of nutrients in rainforest.

The high abundance of 79.44% immature tree (NTFPs) in the ecosystem could be attributed to over exploitation of the matured NTFPs for timber and fuel wood as compared to that of immature. This finding is in line with Ndah et al. (2013) and Ndangalasi et al. (2007) who noted that most non-timber forest products have multiple uses (medicines, construction materials and food) and it was mainly the matured ones that were overexploited for the different uses.

Among the nine species, *A. kamerunensis* was the most dominant NTFP and had a corresponding high encounter rate in all the habitat types of the park. This may be due to high viability of seeds and rapid recruitment of species in the ecosystem. This could be attributed to the dispersal of fruits or seeds by animals such as *Loxodonta africana*, *Potamochoerus porcus* and *Synerus caffer* which feed on the fruits and seeds. This finding is in accordance with the report of Ndah et al. (2012) who mentioned that mammals move long distances in search of food and drop dung on forest floor sometimes contain seeds of plants. This finding was similar to works of Ndah et al. (2013), Sunderland et al. (2003) and Ayuk et al.

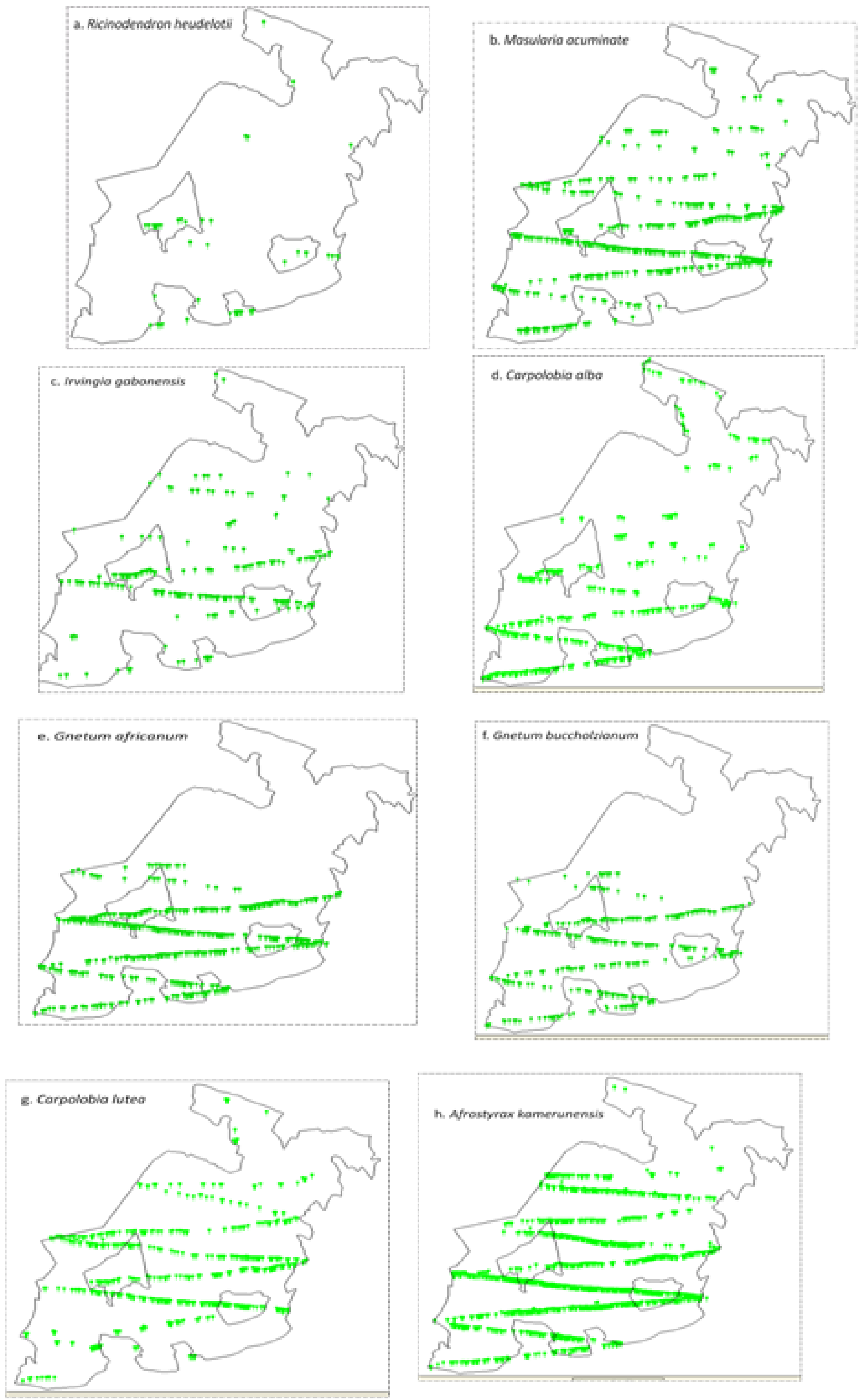

Figure 3. Spatial distribution of selected NTFPs in the Takamanda National Park.

Table 3. Species situation, seasons and regeneration of plants in Takamanda National Park.

Specie	Common name	Number of individuals flowering	Number of individuals Fruiting	Season	Harvest situation (part harvested)	Regeneration
Afrostyrax kamerunensis	Country onion	381	38	Rainy	Medium (seed/ bark)	Good
Masularia acuminate	Chewing Stick 2	10	18	Rainy/Dry	High (whole)	Fair
Ricinodendron heudelottii	Njansang	0	12	Rainy	Low (seed)	Good
Carpolobia lutea	Hausa stick 1	151	11	Rainy/Dry	High (whole)	Poor
Carpolobia alba	Hausa stick 2	43	7	Rainy/Dry	High (whole)	Poor
Irvingia gabonensis	Bush mango	21	119	Rainy	Low (seed)	Good
Gnetum africanum	Long leaf Eru	7	38	Rainy/Dry	Low/Medium (whole)	Fair/Poor
Gnetum bucchholzianum	Round leaf Eru	6	11	Rainy/Dry	Low/Medium (whole)	Fair/Poor
Garcinia manii	Chewing Stick 1	225	33	Rainy/Dry	High (whole)	Poor

(1999) on utilization and sustainability of forest products; uses and management of *I. gabonensis*, respectively. *G. africanum* (17.68%) had an encounter rate of 6.10. It was dominant particularly in the southern part of the park.

The abundance of *Gnetum* spp. in the southern part of the park can be attributed to the fact that *G. spp* performed better in disturbed or secondary forest which was clearly seen by the level of human influences in the Southern part of the park. This result is in accordance with the work of Van Dijk and Wiersum (1999). *R. heudelottii* (1%) and *I. gabonenses (*3%) were the least abundance in the Takamanda National Park.

This might be due to the fact that most of the fruits that fall on the forest floor were gathered by community members for market or subsistence, thus giving little room for regeneration. It is also possible that mammals (*Loxodonta africana*, *Potamochoerus porcus* and *Synerus caffer*) within the system ate most of the fruits and give little or no chance for germination (Sunderland-Groves and Maisel 2003). The low encounter rates and abundance of *R. heudelottii* and *I. gabonenses* could also be linked to the findings of Ayuk et al. (1999), Sunderland et al. (2003) and Ndangalasi et al. (2007) who observed that species were more in farmlands and secondary forests than in primary forest with little disturbance.

Spatial distribution of species (NTFPs)

The spatial distribution of NTFP species generally varied from species to species. Species had different requirements and particular habitats would favour different species based on their ecological needs and abilities to adapt in the system (Chao, 2007b). Any population in a community, at a given scale of observation, presents one of the following distributions: aggregated, regular or random, depending on the underlying processes. It had been found that few species in nature are distributed in a regular fashion; on the contrary, most of them are clumped, or appeared to be randomly distributed at some given observation scale (Fangliang et al., 1997).

A. kamerunensis, *M. acuminate*, *C. lutea, C. alba* and *I. gabonenses* showed random distribution patterns from the Northern to Southern parts of the Takamanda National Park. This might be as a result of homogeneity in the soil compositions and climatic factors which allowed the growth of these species in a wider scope. This may be probably due to the topography of the terrain which provided suitable conditions for growth of species at different parts of the park. This is in conformity with findings of Sunderland et al. (2003), Ndangalasi et al. (2007) and Chao et al. (2008) that worked on distribution pattern of species in lowland and rainforest in the tropics.

The *Gnetum* spp. showed random pattern of distribution but were abundant in the Southern parts as compared to the centre and northern parts of the park. This might be due to environmental conditions (humidity, temperature, moisture, light and pH of soil) which favoured the growth of these species in the area. *R. heudelotii* showed a clumped distribution pattern across the park (Figure 3). This was perhaps due to gaps in the

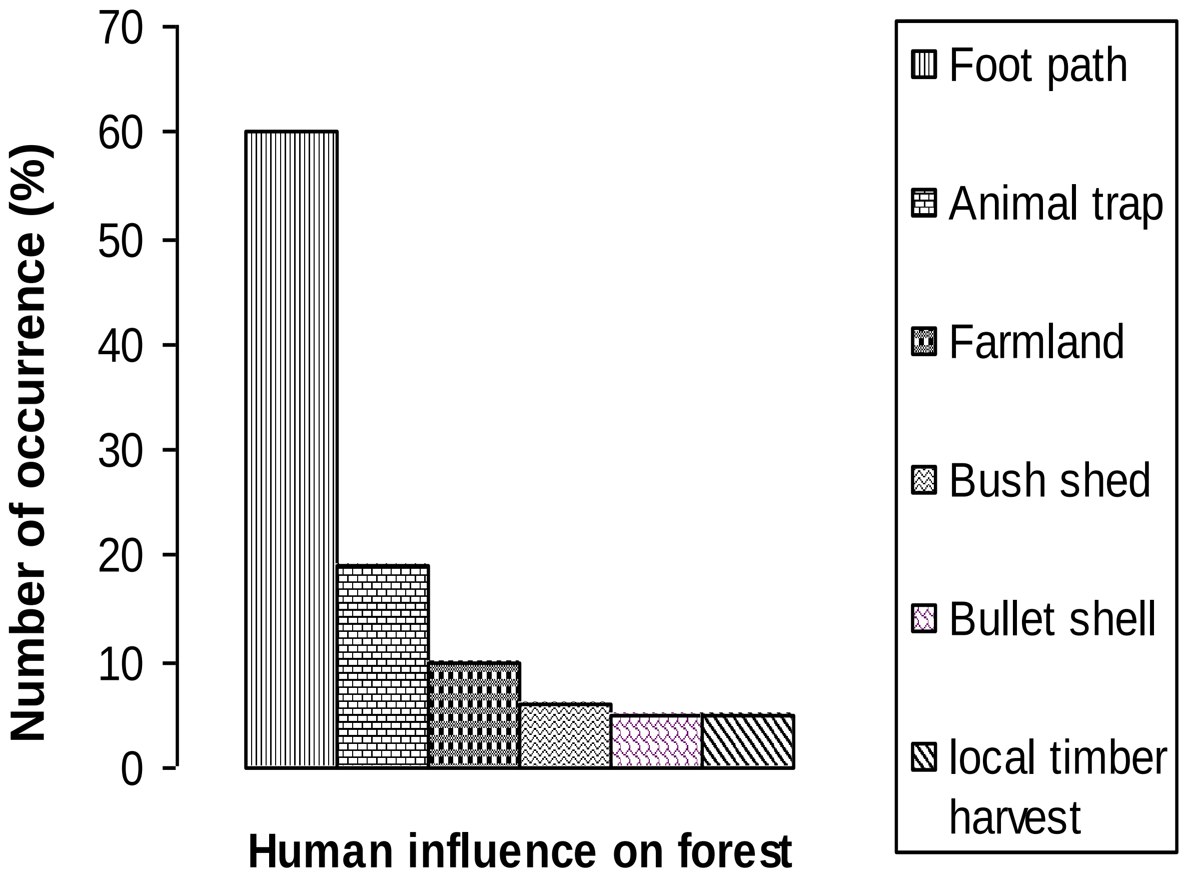

Figure 4. Human influence in the National Park.

forest caused either by natural (wind and landslide) and anthropogenic (bush fire or timber harvest) activities which enabled the species to colonize most disturbed areas, based on the fact that they are fast growing species that easily colonized disturbed areas. This corroborates the findings of Egbe et al. (2012) on gaps and recruitment of species at disturbed and Korup national park.

Harvesting situation and impacts

NTFPs harvesting affects the plant population in terms of growth, reproductive capacity, demographic structure and long-term dynamics. The direct effects of intensive NTFP harvesting may include decline in productivity, regeneration, used parts and endangerment or extinction of species (Peters, 1994; Cunningham, 2001; Hiremath et al., 2004). The NTFPs harvested in the TNP have different harvesting impacts and regeneration ability due to differences in used plant parts and harvesting techniques. This aspect also described the level of sustainability as far as harvesting and regeneration was concerned.

NTFPs with whole plants being harvested (*C. lutea, C. alba* and *G. mannii*) were subjected to unsustainable exploitation since stems and roots were removed leading to poor regeneration and distribution of species. Unsustainable harvesting of these species was also shown by the differences between the flowering species and matured fruit producing species. This indicated that these species were harvested before maturity and thus allows less opportunity for regeneration. Sunderland et al. (2003) asserted that for these same species, the removal of individuals before maturity posed a threat to the local population because the reproductive individuals would significantly affect the regenerative potential of the population which had considerable long term effects on capacity of species to replace itself. Most often, species were harvested while they were flowering or fruiting, thus affecting the species dynamics and structure of the ecosystem (Ayuk et al., 1999; Ndangalasi et al., 2007).

The harvesting of whole plant was also responsible for the existence of more immature than matured species for the species harvested. This was due to the harvesting technique implored. Davenport and Ndangalasia (2002) acknowledged that harvesting roots, bulbs and barks usually killed plant species population. This observation was contrary for NTFP (*A. kamerunensis* and *I. gabonensis*) in which only plant parts such as seeds, fruits were harvested. This harvesting technique is more sustainable, shown by the large number of matured and

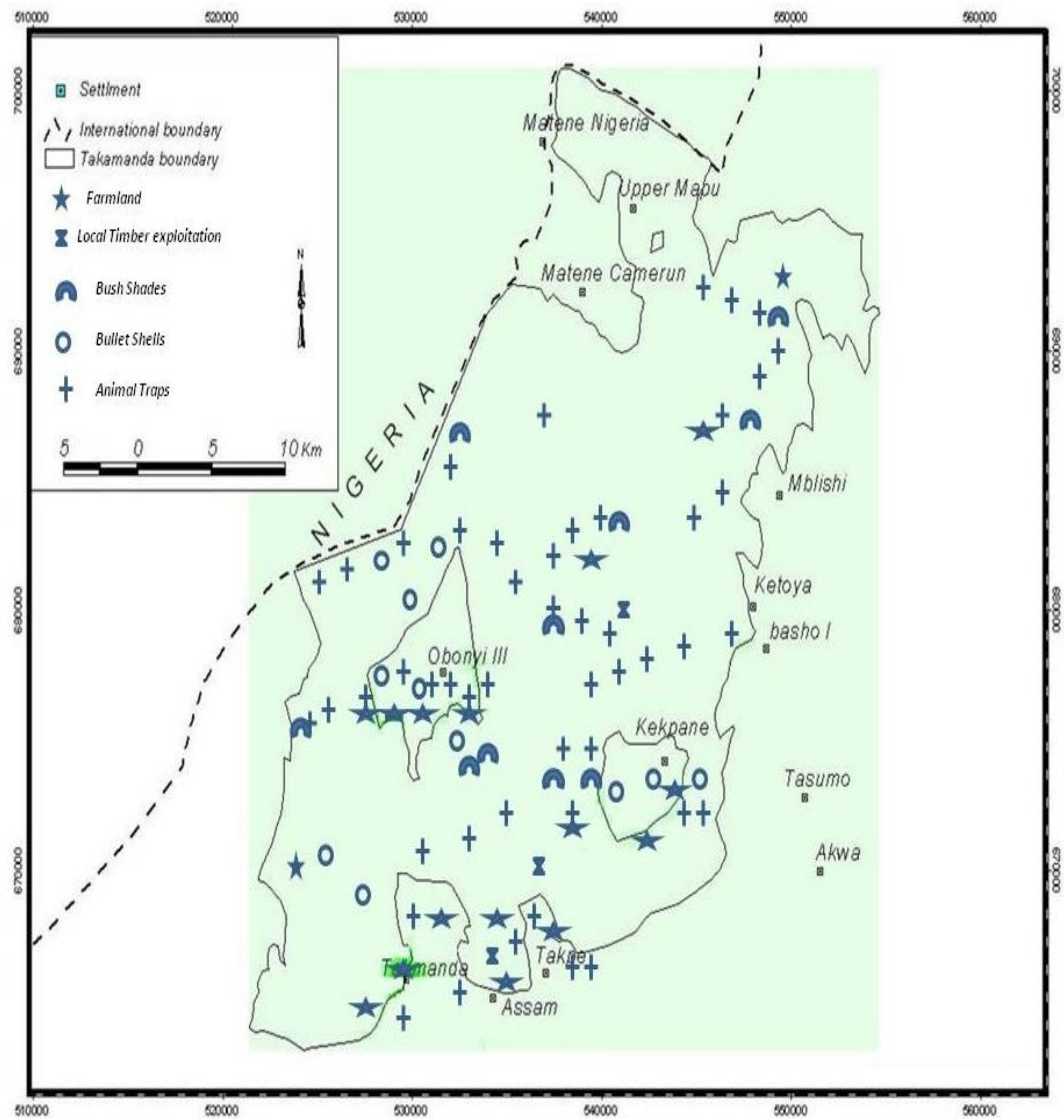

Figure 5. Map showing human influence in Takamanda National Park.

immature species recorded with corresponding good regeneration. Sustainable harvesting of *A. kamerunensis* and *I. gabonensis* was shown by its large number of flowering and fruit producing species identified during the survey. Ticktin (2004) confirmed that plant population was adversely affected by the extent of extraction and plants parts harvested and this reduces plant population in protected areas (Shahabuddin and Prasad, 2004).

Human influence in the park

Forest use practices such as tree cutting and bush fires (commonly done using slash and burn techniques) and hunting and trapping practices in the TNP also have impacts on regeneration of plant population. These impacts probably affect growth and distribution since most of the seeds will be destroyed by fire or carried by inefficient dispersal agents to different sites for establishment. Shahabuddin and Prasad (2004) acknowledged this argument by highlighting that forest use practices may lead to selective extinction of plant species in the long term.

Harvesting pressure on some species was also influenced by seasonality linked to socio-economic changes in the exploiting communities. *G. africanum* was available all year round, but experienced less harvesting pressures during early rains as communities get involved more in farming activities during this period. Besides, impractical nature of transportation networks during rainy seasons (Ndah et al., 2013, Ndah et al., 2012 and Panayolou and Ashton, 1992) also reduced harvesting pressure as communities are discouraged by the difficulties in accessing suitable markets.

Conclusion

The Takamanda National Park is one of the most biologically rich parts of the Guineo-Congolean forest and it is noted for its diversity in both plants and animal species. The Takamanda rainforest is experiencing increasing NTFPs gathering and anthropogenic activities. Some of these species, especially those with multiple uses, appeared to be heavily and unsustainably exploit-ted. The high demand for NTFPs in the country and from neighbouring countries has exacerbated the depletion of these flora and faunas in the forests ecosystem (TNP).

The unsustainable harvest and human influences seriously impacted species abundance and distribution pattern within the TNP. Habitats modification has restricted species to particular ecological types and this influences the distribution and abundance of species resulting to possible species being endangered. For management to support livelihoods and protect forests species, efforts such as planting of the most utilized species in secondary forest and adjacent farms should be encouraged in order to reduce the pressure on NTFPs extraction from the wild. Indigenous practices of community gathering which are sustainable should be enhanced. Forest enrichment through planting and the setting of harvesting quantities and regulating the types of collections will limit depletion and encourage diversity.

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