From Forest Trails to Tourism Tales: Habitat Preferences of *Cercocebus torquatus*in Southwest Nigeria

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Abstract

This study examined the range and habitat preferences of the red-capped mangabey (*Cercocebus torquatus*) inside the Omo Biosphere Reserve and Idanre Forest Reserve in southwestern Nigeria, with the objective of enhancing conservation and ecotourism efforts. Data were obtained from 36 plots (25 m × 25 m) across six habitat types using Total Enumeration Count (TEC). The analysis encompassed vegetation structure, species diversity, and stratification in conjunction with mangabey encounter data. The findings indicated a pronounced predilection for the middle canopy layer, which contained more than 65% of fruit-bearing trees and recorded the largest number of mangabey sightings. The Omo Reserve demonstrated a significantly higher mean tree diameter at breast height ($p \leq 0.05$), signifying structural maturity, although Sørensen's similarity index (0.83) indicated important ecological overlap between the two sites. Seasonal trends revealed enhanced visibility of mangabeys during the dry season, coinciding with greater fruit availability. The principal plant families that support the species are Fabaceae, Moraceae, and Sterculiaceae. The findings underscore the essential importance of mid-canopy structure and fruiting species in the distribution of mangabeys. Conservation measures must focus on replanting fruit-bearing trees, regulating forest utilisation, and establishing sustainable ecotourism infrastructure to safeguard this vulnerable primate.

Introduction

Primate-based tourism in protected areas offers a unique opportunity for tourists to observe primate species, even when these species are not the primary focus of their travel. These encounters often contribute indirectly to primate conservation, as tourists are drawn to umbrella species—flagship animals that benefit broader ecosystems through focused conservation efforts. Nigeria is among the top fifteen countries globally recognised for its high diversity of primate species (Chapman et al., 2006; Orimaye et al., 2016). However, it also holds Africa's largest human population, with a significant concentration in the Southwest region (Oates & Adeleke, 2003). In this region, biodiversity is heavily utilised to meet the livelihood demands of both rural and urban populations.

Much of Nigeria's remaining forest cover is found within forest reserves, which are increasingly relied upon for ecological tourism and natural resource exploitation (Greengrass, 2006). Like many developing nations, Nigeria depends greatly on its natural ecosystems to generate revenue. However, this dependence has led to unsustainable exploitation and a high rate of forest conversion. Although forest-dependent communities are key stakeholders in biodiversity conservation, their roles and challenges in sustainably managing wildlife populations remain poorly studied in Nigeria. Forested regions that retain significant populations of flora and fauna serve not only as conservation priorities but also as critical sites for ecological and scientific research. The primary threat to biodiversity conservation in Nigeria remains habitat loss and modification resulting from anthropogenic activities (Skorupa, 1987; Orimaye et al., 2016, 2017). The country's rainforest ecosystems have suffered extensive degradation and mismanagement (Agbelusi et al., 1999; Ogunjemite et al., 2007). Afolayan et al. (2004) reported that approximately 75% of Nigeria's original wildlife habitats have been destroyed, leading to significant

declines in native wildlife populations. Thus, understanding habitat structure and primate distribution in the remaining forest fragments is crucial for developing effective ecotourism and conservation strategies.

The red-capped mangabey (*Cercocebus torquatus*), a semi-terrestrial primate endemic to Nigeria, exemplifies a species with significant ecotourism potential. Despite limited population data, evidence suggests the species persists in some protected areas, though it may now be critically endangered or locally extinct in others (Agbelusi et al., 1999; Persson & Warner, 2003; Ogunjemite et al., 2007; Orimaye et al., 2017). Populations have been reported in several forest reserves, including Cross River National Park, Okomu National Park, Omo Biosphere Reserve, Idanre Forest Reserve, Ise Forest Reserve, and Oluwa Forest Reserve (Ogunjemite, 2000; Orimaye et al., 2017). In 2008, the IUCN listed the species as Vulnerable (Oates et al., 2008); it was reclassified as Endangered in 2017 due to continued habitat loss (Wallis, pers. comm.). Its distinctive appearance, vocalisation, and size make it a flagship species for ecotourism initiatives. While previous studies have explored red-capped mangabey population estimates (Orimaye, 2017), limited research has investigated habitat-specific use and its implications for ecotourism potential in the face of increasing anthropogenic pressures.

The habitats of red-capped mangabeys (*Cercocebus torquatus*) in southwestern Nigeria are undergoing significant fragmentation, primarily due to unsustainable land-use policies and increasing human encroachment. These pressures have also led to the widespread removal of fruit-bearing trees that are crucial for the species' foraging and survival. Despite these challenges, pockets of ecologically viable habitat persist within certain protected areas. In light of these conditions, this study aims to investigate the habitat preferences and distribution patterns of red-capped mangabeys within two key conservation zones: the Idanre Forest Reserve and the Omo Biosphere Reserve. It represents one of the first rigorous quantitative assessments of red-capped mangabey habitat use across different forest strata within these reserves. The outcomes of this research are anticipated to support strategic ecotourism development while simultaneously contributing to enhanced species visibility and long-term conservation planning.

Methodology

Study Areas

This study was conducted across three forest sites in southwestern Nigeria: the Idanre Forest Reserve (IFR) in Ondo State and the Omo Biosphere Reserve (OBR) in Ogun State. These sites were selected due to confirmed occurrences of *Cercocebus torquatus* and their potential for conservation.

Idanre Forest Reserve (IFR) lies between latitudes 6°58'N and 7°15'N and longitudes 4°89'E and 5°62'E, covering approximately 527.1 km². The reserve experiences a bimodal rainfall pattern, with annual precipitation averaging 1,654 mm and peaking between July and September. The predominant vegetation is classified as a Guinea-Congo lowland rainforest, a highly diverse ecological zone that supports species such as *Cola spp.*, *Mansonia altissima*, *Nesogordonia papaverifera*, *Triplochiton*

scleroxylon, *Pterygota spp.*, and *Sterculia spp.* (Werre, 2001; Oates et al., 2008). The reserve also supports *Milicia excelsa*, *Antiaris africana*, and *Ficus spp.*, which contribute significantly to forest structure and faunal sustenance.

Omo Biosphere Reserve (OBR) is located between latitudes 6°35'N and 7°05'N, and longitudes 4°19'E and 4°40'E. Annual rainfall ranges from 1,600 to 2,000 mm, with peaks in June and September. The reserve comprises a mosaic of humid tropical forest types, including dry evergreen and wet evergreen forests, plantations (e.g., *Gmelina arborea*, *Theobroma cacao*), agroecosystems, and residential areas (Isichei, 1995). Native species such as *Khaya ivorensis*, *Diospyros spp.*, and *Cordia millenii* dominate the flora. The Omo River watershed drains approximately 80% of the reserve, playing a crucial role in maintaining soil fertility and ecological balance (Dondeyne, 2024).

Observations were conducted by two trained field assistants and one primatologist between 07:00 and 17:00 over four months each, for the years 2017 and 2024 (February–May and July–8tober). Each habitat type was surveyed for a minimum of 24 observation hours across both dry and wet seasons. Mangabey encounters were defined as direct visual sightings within a 30-meter radius by trained observers.

Habitat Classification

Habitat types were classified based on land-use patterns and vegetation structure following Nielsen's (1965) approach, modified by Longman and Jenik (1987) and adopted by Ogunjemite (2006).

Omo Biosphere Reserve (OBR) habitats were grouped as follows:

- **Secondary Forest (SF)** Coordinates: 6°55.05'N, 4°19.014'E
- Moist semi-evergreen rainforest with canopy heights of 20–25 m. Upper-layer trees ≥30 m are present. Dominated by large trees (DBH ≥ 60 cm), abundant lianas, and a continuous canopy with minimal saplings and herbs.
- **Regenerating Forest (RF)** Coordinates: 6°54.95'N, 4°19.125'E
- Mixed vegetation dominated by medium-sized trees (DBH 20–50 cm). Features a partially open canopy, few large fruit trees, and a high density of shrubs and saplings.
- **Fallow Forest (FF)** Coordinates: 6°54.852'N, 4°10.92'E
- Degraded forest dominated by grasses, vines, and shrubs due to young trees and tree fall gaps.

Idanre Forest Reserve (IFR) habitat classifications included:

- **Undisturbed Forest Area (UFA)** Coordinates: 6.817705°N, 5.199307°E
- Mixed, moist semi-evergreen rainforest with limited human disturbance due to topographic inaccessibility. Canopy heights range from 25 to 40 m, with trees ≥30 m and DBH 30–60 cm. Dominated by mature forest species with few herbs and saplings.

- **Fallow Forest (FF)** Coordinates: 6.820928°N, 5.204214°E
- Mixed broad-crowned trees (mostly fruit species), open canopy, and medium-sized trees. Shrubs and saplings are abundant.
- **Farmland (FL)** Coordinates: 6.816921°N, 5.198070°E
- Degraded forest transitioning from agricultural use, dominated by grasses, vines, herbs, and shrubs.

Data Collection

Vegetation and primate habitat data were collected using the Total Enumeration Count (TEC) method as described by Ogunjemite et al. (2005). The TEC method was selected due to its suitability for habitat-focused studies in restricted and uneven terrains where line transects are logistically challenging. This approach ensured a comprehensive inventory of tree species used by red-capped mangabeys across various habitat types. To reduce observer bias, field assistants underwent two weeks of training to calibrate species identification and measurement techniques.

At each study site, a total of 18 plots (25 m × 25 m) were established across different habitat types. Three transects were laid per habitat type, with plot placement approximately 1 km apart, alternating along transects with high *Cercocebus torquatus* encounter rates.

Within each plot, the following data were collected:

- Enumeration of all tree species ≥1 m in height and ≥10 cm basal diameter.
- Botanical identification of each species and family.
- Measurement of tree diameter at breast height (DBH) for individuals >3 m.
- Height estimation using a relascope, recorded to the nearest meter.

Tree species were stratified according to vegetation layers (understorey, middle, and upper canopy) based on Longman and Jenik's (1987) classification.

Data Analysis

Data were analysed using **PAST version 3** to determine habitat preferences of red-capped mangabeys. The following ecological indices were calculated:

a. **Tree species density (per hectare)** was calculated using the formula

$$\text{Species Density } (ha^{-1}) = \frac{x}{25*25} \times 1000$$

Where x = number of tree species

b. **Shannon Wiener's diversity index** is related to the number of different species and the number of individuals of each species within a community. Shannon Wiener index was calculated using the formula.

$$H^1 = \sum(Pi) \ln Pi$$

Where H^1 = diversity index

P_i = the proportion of the ith species in the sample

$\ln Pi$ = is the natural logarithm of the species proportion

c. **Species Richness (Menhinick's index)** measures the number of species found in a sampled area. The more species present in a sampled area, the "richer" the area and is calculated using the formula

$$D = \sqrt[s]{N}$$

Where 's' = the number of different species represented in the sample area,

N = the total number of individual organisms in the sample area.

d. **Sorenson's coefficient** $(\beta) = \frac{2c}{S1+S2}$

Where C = the number of species in the two study areas

S1 = Total Number of species found in community 1

S2 = Total Number of species found in community 2

e. The student's T-test was used to compare the means of the data between sites,

f. *Kruskal-Wallis* and *Kolmogorov-Smirnov tests* were used to assess the significance of the mean data within and between sites.

g. Descriptive statistics such as frequency tables and percentages were used to describe the results.

Results

Habitat Structure and Forest Characteristics of Red-capped Mangabey in the Study Area

Table 1 below provides a comparative overview of habitat structure and forest composition between the Omo Biosphere Reserve (OBR) and the Idanre Forest Reserve (IFR), with implications for the red-capped mangabey (*Cercocebus torquatus*) habitat use. The results show that OBR exhibits a more structurally mature forest, evidenced by a higher mean diameter at breast height (DBH) in both the upper (120 cm) and middle (61 cm) layers compared to IFR (58 cm and 45 cm, respectively). Although differences in DBH across forest strata were not statistically significant ($p > 0.05$), ecological patterns indicate that red-capped mangabeys preferentially use the middle layer. This preference likely reflects fruit availability rather than structural size differences alone.

In both reserves, the middle layer hosted the highest proportion of tree individuals—55.97% in OBR and 75.11% in IFR—indicating its ecological dominance. This stratum also supported the greatest abundance of fruit-bearing species, aligning with the highest frequency of red-capped mangabey sightings. Conversely, both the understorey and upper canopy were least utilised by the species, likely due to lower

fruit availability and reduced canopy cover. OBR demonstrated greater diversity across all layers, including a higher number of tree taxa and fruit-bearing species, which may account for its slightly higher observed species richness. These structural and compositional differences suggest that the middle forest stratum, enriched with fruiting trees and dense foliage, plays a pivotal role in determining the distribution and foraging behaviour of red-capped mangabey across the two study sites.

Table 1
Habitat Structure and Forest Characteristics of Red-capped Mangabey in Omo Biosphere Reserve and Idanre Forest Reserve.

Variables	**Omo Biosphere Reserve**		**Idanre Forest Reserve**	
	Taxa	Values	Taxa	Values
Upper layer trees (≥ 22 m and above)	**5**	**1, 312 (07.41%)**	**09**	**864(6.16%)**
Mean DBH (cm)		120		58
Mean height (m)		25		25
Middle layer trees (≤ 13 m ≤ 21 m)	**21**	**9, 904 (55.97%)**	**32**	**10, 528 (75.11%)**
Mean DBH (cm)		61		45
Mean height (m)		17		18
Understory layers of trees (≤ 12 m)	**23**	**6, 480 (36.62%)**	**04**	**2, 624 (18.72%)**
Mean DBH (cm)		40		27
Mean height (m)		11		12
Source: Field survey				

Tree Species Diversity and Composition

Tree species diversity was slightly higher in OBR (17,696 individuals/ha, 49 taxa, 23 families) than IFR (14,016 individuals/ha, 45 taxa, 21 families), though the t-test revealed no statistically significant difference ($p \geq 0.05$). Shannon diversity indices (OBR: 3.74; IFR: 3.69) and Menhinick's richness indices (OBR: 1.52; IFR: 1.47) also support this minor variation. Dominance index values (OBR: 0.033; IFR: 0.026) suggest that a few dominant species are more prevalent in OBR. Despite the differences, Sorenson's coefficient (0.83) indicates a high degree of species similarity between sites. These findings imply broadly comparable habitats, but slight compositional differences may influence the distribution and behaviour of the red-capped mangabey.

Habitat Utilisation of Red-capped Mangabey in the Study Areas

Comparative observations of habitat utilisation (Fig. 4) by the red-capped mangabey (*Cercocebus torquatus*) in the Omo Biosphere Reserve (OBR) and Idanre Forest Reserve (IFR) reveal a consistent

preference for the middle forest stratum, underscoring the ecological significance of this vertical layer in both reserves. In OBR, the majority of individuals were recorded within the middle strata, particularly in secondary forests characterised by a high density of fruit-bearing trees and continuous canopy cover. Seasonal variation was notable, with more individuals observed during the dry season (34) than the wet season (19), possibly reflecting changes in food availability, forest visibility, or both.

Similarly, in IFR, mangabey sightings were concentrated in the middle canopy, particularly within undisturbed forest patches, where 20 individuals were recorded during the dry season and 11 during the wet season. The preference for this stratum aligns with the spatial distribution of key fruiting tree species and the availability of cover from predators and human activity. Although occasional sightings on rocks and in association with Mona monkeys were documented—likely indicative of habitat disturbance or behavioural adaptation—the overall use of the forest floor, understorey, and upper layers remained limited in both reserves.

These parallel patterns in habitat use suggest that the middle forest stratum serves as a critical ecological zone for red-capped mangabey populations, offering optimal conditions for foraging and refuge. Conservation strategies across both sites should therefore prioritise the protection and restoration of middle canopy habitats, limit logging of fruit-bearing trees, and mitigate anthropogenic disturbances to ensure the long-term viability of this vulnerable primate species.

Tree Diameter and Height Distribution

Table 1 presents the distribution of tree diameter and height in the study areas. The Omo Biosphere Reserve displayed generally larger trees, with *Ceiba pentandra* reaching the highest DBH (3,650 cm) and mean height (38 m), compared to the IFR, where the same species had lower DBH (2,050 cm) and height (30 m). T-test results showed a significant difference in mean DBH ($p \leq 0.05$) but no significant difference in mean height ($p \geq 0.05$) between the reserves. These data suggest that OBR supports more mature tree stands, potentially providing better arboreal pathways and fruiting opportunities for arboreal primates, such as the red-capped mangabey. Structural differences in forest composition between sites could influence primate movement, food access, and predator avoidance.

Table 1
Mean DBH and Mean height of tree species in the habitat of Red-capped Mangabey in Omo Biosphere Reserve and Idanre Forest Reserve, Southwestern Nigeria

SPECIES	FAMILIES	Omo Biosphere Reserve			Idanre Forest Reserve		
		Freq. (n)	Mean DBH (cm)	Mean Height (m)	Freq. (n)	Mean DBH (cm)	Mean Height (m)
Anthocleista nobilis	Loganiaceae	30	230	14	0	0	0
Anthonotha macrophylla	Fabaceae	17	260	13	12	400	17
Antiaris Africana	Moraceae	21	500	20	22	520	18
Alstonia boonei	Apocynaceae	15	1, 100	27	14	230	10
Alstonia congolensis	Apocynaceae	31	1, 290	29	0	0	0
Baphia nitida	Fabaceae	30	830	20	13	350	23
Baphia pubescens	Fabaceae	11	520	19	17	260	16
Berlinia grandiflora	Fabaceae	17	500	13	19	260	16
Blighia sapida	Sapinadaceae	21	860	22	16	390	20
Bombax brevicuspe	Bombacaceae	29	420	17	18	130	10
Brachystegia nigerica	Fabaceae	15	3, 380	34	21	140	29
Catunaregam hispicum	Rubiaceae	25	670	23	14	140	18
Ceiba pentandra	Bombacaceae	16	3, 650	38	18	2,050	30
Celtis grandifolia	Ulmaceae	22	320	14	26	230	14
Celtis mildibraedii	Ulmaceae	43	520	18	17	110	18
Celtis zenkeri	Ulmaceae	18	180	12	0	0	0
Chrysophyllum albidum	Sapotaceae	15	870	23	8	760	19
Cola acuminata	Sterculiaceae	9	2, 020	17	15	190	19
Cola gigantiae	Sterculiaceae	14	860	18	13	320	23
Cordia millenii	Boraginaceae	0	0	0	20	410	20
Daniellia ogea	Caesalpiniaceae	21	1, 410	23	15	380	14
Entandrophragma angolensis	Meliaceae	15	2, 500	27	17	210	17

SPECIES	FAMILIES	Omo Biosphere Reserve			Idanre Forest Reserve		
		Freq. (n)	Mean DBH (cm)	Mean Height (m)	Freq. (n)	Mean DBH (cm)	Mean Height (m)
Fagara macrophylla	Rutaceae	13	400	28	0	0	0
Ficus asperifolia.	Moraceae	18	540	23	16	630	17
Ficus exasperate	Moraceae	12	550	25	14	850	20
Ficus thonningii	Moraceae	0	0	0	23	790	19
Funtumia elastic	Apocynaceae	28	1, 230	26	22	230	11
Hannoa klaineana	Simaroubaceae	31	1, 920	14	20	450	23
Hidegardia bateri	Sterculiaceae	0	0	0	21	830	19
Holoptelia grandis	Ulmaceae	0	0	0	17	810	23
Irvingia gaboneensis	Irvigiaceae	11	90	13	17	340	21
Irvingia grandifolia	Irvigiaceae	26	280	19	26	120	23
Khaya ivorensis	Meliaceae	0	0	0	35	230	16
Khaya senegalensis	Meliaceae	12	1, 180	26	0	0	0
Lophira alata	Olaeaceae	19	780	22	0	0	0
Lovoa trichilioides	Meliaceae	26	870	19	43	350	21
Mansonia altissima	Sterculiaceae	13	150	10	33	120	19
Milicia excels	Moraceae	14	220	12	19	230	22
Monodora myristica	Annonaceae	21	1, 130	28	0	0	0
Musanga cercropioides	Moraceae	14	980	26	12	240	16
Massularia acuminata	Olaeaceae	13	330	11	12	360	20
Nuclea derrichi	Rubiaceae	16	1, 290	22	0	0	0
Oxytenanthera abyssinica	Rubiaceae	20	390	17	17	760	22
Pterocarpus osun	Papilionaceae	13	280	23	23	430	20
Pterygota macrocapa	Sterculiaceae	11	390	22	22	440	10
Pycnanthus angolensis	Mystristicaceae	25	1, 180	23	48	850	17

SPECIES	FAMILIES	Omo Biosphere Reserve			Idanre Forest Reserve		
		Freq. (n)	Mean DBH (cm)	Mean Height (m)	Freq. (n)	Mean DBH (cm)	Mean Height (m)
Ricinodendron heudelotii	Euphorbiaceae	17	780	25	17	270	21
Spondias mombin	Anacardiaceae	*23*	740	21	17	880	20
Strombosia pustulata	Olaeaceae	109	870	17	18	760	14
Strombosia grandifolia	Olaeaceae	96	150	17	22	660	15
Terminalia ivorensis	Combretaceae	20	220	18	0	0	0
Terminalia superba	Combretaceae	24	1, 130	12	20	430	14
Tetrapleura tetraptera	Fabaceae	0	0	0	9	1,100	18
Trema orientalis	Cannabaceae	14	330	17	18	120	17
Triplochiton scleroxylon	Sterculiaceae	12	1, 290	22	0	0	0
Total		1, 106	42,560	998	876	20,760	831

Family Composition (Table 4.8)

OBR had a more diverse tree family composition (23) than IFR (21), with Fabaceae and Moraceae dominating both sites in terms of taxa and individual trees. These families include key fruiting species frequently utilised by red-capped mangabeys. Moraceae, with its soft fruits and large canopy trees, is especially important for primate diets. OBR's Fabaceae taxa (5) contributed 90 individuals, while IFR had six taxa and 91 individuals, showing relatively even distribution. The presence and abundance of fruit-bearing families influence habitat suitability for mangabeys. Thus, conservation should prioritise preserving these key families to maintain ecological functionality and primate foraging stability.

Discussion

Seasonal Distribution of the Red-capped Mangabey

The findings of this study indicate a greater distribution of Red-capped Mangabeys (Cercocebus torquatus) during the dry season in both the Omo Biosphere Reserve and Idanre Forest Reserve. This seasonal variation is likely attributable to the availability and distribution of food resources. During the dry season, fruiting trees—particularly those belonging to families such as Fabaceae, Moraceae, and Sterculiaceae—produce fruits in higher quantities and quality, prompting increased foraging activity by mangabeys. As omnivorous primates (Waser, 1976; Fonteyn et al., 2022), Red-capped Mangabeys rely

heavily on fruits as a primary component of their diet (Ogunjemite, 2006) (McGraw et al., 2010; Wahungu, 1998), and the scarcity of these resources during the rainy season likely reduces their activity and visibility. Moreover, the effects of anthropogenic disturbances such as logging, which removes important fruiting trees, may further influence their distribution (Oates et al., 2008). These findings reinforce the ecological link between fruiting patterns and seasonal habitat use among primates.

Habitat Preference and Vertical Stratification

The structural and compositional similarities between Omo and Idanre Reserves—reflected in a high Sørensen's similarity coefficient of 0.83—suggest that both habitats are ecologically suitable for sustaining Red-capped Mangabey populations (Fasona et al, 2024). The vegetation in both sites comprises ecologically important plant families, including Fabaceae (e.g., *Cola gigantiae*, *Mansonia altissima*), Moraceae (e.g., *Ficus thonningii*, *Milicia excelsa*), and Sterculiaceae (e.g., *Triplochiton scleroxylon*), many of which are fruit-bearing species found predominantly in the middle canopy layer. These layers (55.97% in Omo and 75.11% in Idanre) coincided with the most frequent sightings of Red-capped Mangabeys during the study period, reinforcing the hypothesis that mid-canopy strata with abundant fruiting trees are critical for habitat utilisation (Turner & Laliberté, 1999; Edwards et al., 2010).

Red-capped Mangabeys exhibit semi-terrestrial and diurnal behaviours (Mitani, 1989; Gautier-Hion et al., 1999), utilising vertical forest strata from ground level up to 40 meters in the canopy. Although a significant difference was observed in the mean diameter at breast height (DBH) of trees between Omo and Idanre ($p \leq 0.05$), tree height did not differ significantly ($p \geq 0.05$). This reinforces the conclusion that the structural characteristics of these forests, particularly their vertical stratification and fruit availability, are vital to mangabey distribution. Previous research (Bell et al., 1991; Ogunjemite et al., 2007) supports the assertion that forest architecture has a direct impact on the spatial distribution of arboreal primates.

Conservation and Ecotourism Implications

Historically, Red-capped Mangabey populations have shown a declining trend from west to east across their West and Central African range (Dempsey et al, 2024; Orimaye et al, 2017; Matthews & Matthews, 2002; Davenport & Usongo, 1997; Mitani, 1990). This pattern is consistent with our observation of diminishing populations in Idanre compared to Omo, largely attributed to habitat degradation caused by logging and agricultural encroachment. According to Maisels (2007), the species' range extends east of the Dahomey Gap along the West African coast; however, habitat fragmentation poses a threat to the viability of existing populations. Given their semi-terrestrial behaviour, mangabeys may be more susceptible to human disturbance, reinforcing the need for buffer zones and restrictions on guided tours.

The vulnerability of the Red-capped Mangabey has been highlighted in conservation reports by IUCN (2012) and CITES (2012), calling for urgent conservation strategies. As Steinitz et al. (2002) suggested, community compositional data such as those derived in this study can inform evidence-based conservation planning. Therefore, protecting the structurally complex habitats in both reserves is imperative for maintaining viable mangabey populations. Integrated management strategies that involve

ecological monitoring, restoration of fruit-bearing tree species, and mitigation of human-induced pressures are essential for sustainable conservation outcomes.

Beyond ecological significance, both study areas offer substantial potential for ecotourism. The rich biodiversity—comprising endemic plant families and flagship species such as the Red-capped Mangabey—can serve as a cornerstone for ecotourism initiatives. Promoting sustainable tourism practices, such as wildlife observation and environmental education, could generate economic benefits for local communities while fostering biodiversity conservation (Honey, 2008; Buckley, 2009; Weaver, 2001). Properly structured ecotourism programs would not only raise public awareness about the ecological value of these forests but also encourage local stewardship of natural resources.

Limitation

Despite the strengths of the TEC methodology, this study did not include behavioural observations or dietary analysis, which may further elucidate the ecological drivers behind vertical habitat use. Future studies could incorporate camera trapping and faecal analysis to better understand foraging patterns and interspecific interactions.

Conclusion

This study has demonstrated that the Omo Biosphere Reserve and Idanre Forest Reserve in Southwestern Nigeria possess similar forest structures and species compositions, notably within the Fabaceae, Moraceae, and Sterculiaceae families. These families contain fruit-bearing species concentrated in the middle canopy layer, which has been identified as the most utilised habitat stratum by the Red-capped Mangabey (*Cercocebus torquatus*). The species' preference for fruit-rich environments underscores the role of forest composition and vertical stratification in its distribution and habitat utilisation.

The Red-capped Mangabey, being an omnivorous and semi-terrestrial primate, depends heavily on habitats rich in fruit-bearing woody species. Its distribution is more prominent during the dry season, likely due to increased foraging activity in search of scarce fruit resources. The Sorenson's similarity index of 0.83 between the two reserves highlights their ecological compatibility in supporting similar fauna, including the Red-capped Mangabey.

Despite their ecological value, both reserves face increasing anthropogenic pressures, particularly logging and agricultural expansion, which threaten the integrity of the habitat and the survival of this vulnerable primate species. These findings support the urgent need for improved habitat management and conservation strategies. As recognised by both IUCN (2012) and CITES (2012), the Red-capped Mangabey requires targeted conservation actions to prevent further population decline. Protecting the mid-canopy stratum and associated fruiting species is not only vital for the survival of this endangered primate but also a strategic entry point for community-based ecotourism in Southwest Nigeria to safeguard this vulnerable primate and promote site-specific ecotourism planning, a strategic entry point

for community-based ecotourism in Southwest Nigeria, contributing to both biodiversity goals and rural development.

Recommendations

Given the findings of this study, the following recommendations are proposed to support the conservation of the Red-capped Mangabey and the sustainable management of the Omo Biosphere and Idanre Forest Reserves:

1. **Research and Monitoring**:

Further research should be conducted to understand how remaining Red-capped Mangabey populations are adapting to ongoing anthropogenic pressures. Long-term ecological monitoring will inform evidence-based conservation strategies and guide habitat restoration efforts.

2. **Reforestation and Tree Replacement**:

The Ministry of Agriculture, Forestry, and Environment should implement reforestation programs that prioritise the planting of native fruit-bearing and economically valuable tree species, especially those used by the Red-capped Mangabey for food and shelter. This will mitigate the effects of deforestation and enhance habitat quality.

3. **Public Awareness and Community Engagement**:

While hunting is a relatively minor threat, raising public awareness about the ecological importance of protected areas is essential. Government and conservation NGOs should educate residents, hunters, and forest users about the benefits of biodiversity conservation, encouraging broad-based support for protected area management.

4. **Regulation of Human Settlements**:

Human settlements within and around protected areas should be strictly regulated. The establishment of infrastructure such as schools and hospitals within forest reserves should be reconsidered. The government should formulate and enforce policies that discourage further encroachment and promote sustainable rural development, thereby reducing migration into protected areas.

5. **Community-based Conservation Initiatives**:

Establishing Village Conservation Associations (VCAs) can foster local participation in biodiversity conservation. VCAs can act as liaison bodies between local communities and conservation agencies, promoting sustainable practices and co-management of forest resources.

6. **Incentive-based Conservation Policies**:

Appropriate incentive mechanisms—such as compensation for conservation-related opportunity costs or support for eco-friendly livelihoods—should be introduced to encourage community support for conservation. Such policies would help strike a balance between human welfare and environmental sustainability.

7. **Policy Reforms and Institutional Strengthening**:

Conservation laws, land use policies, and institutional frameworks should be reviewed and updated to reflect current realities. Strengthening the capacity of conservation agencies through improved training, funding, and administrative support is crucial for effective reserve management.

8. **Consideration of Macroeconomic Policies**:

Broader economic policies, including those related to land tenure, subsidies, and privatisation, should be assessed for their impact on conservation outcomes. Integrating conservation objectives into national economic planning can create enabling environments for sustainable resource management.

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Figures

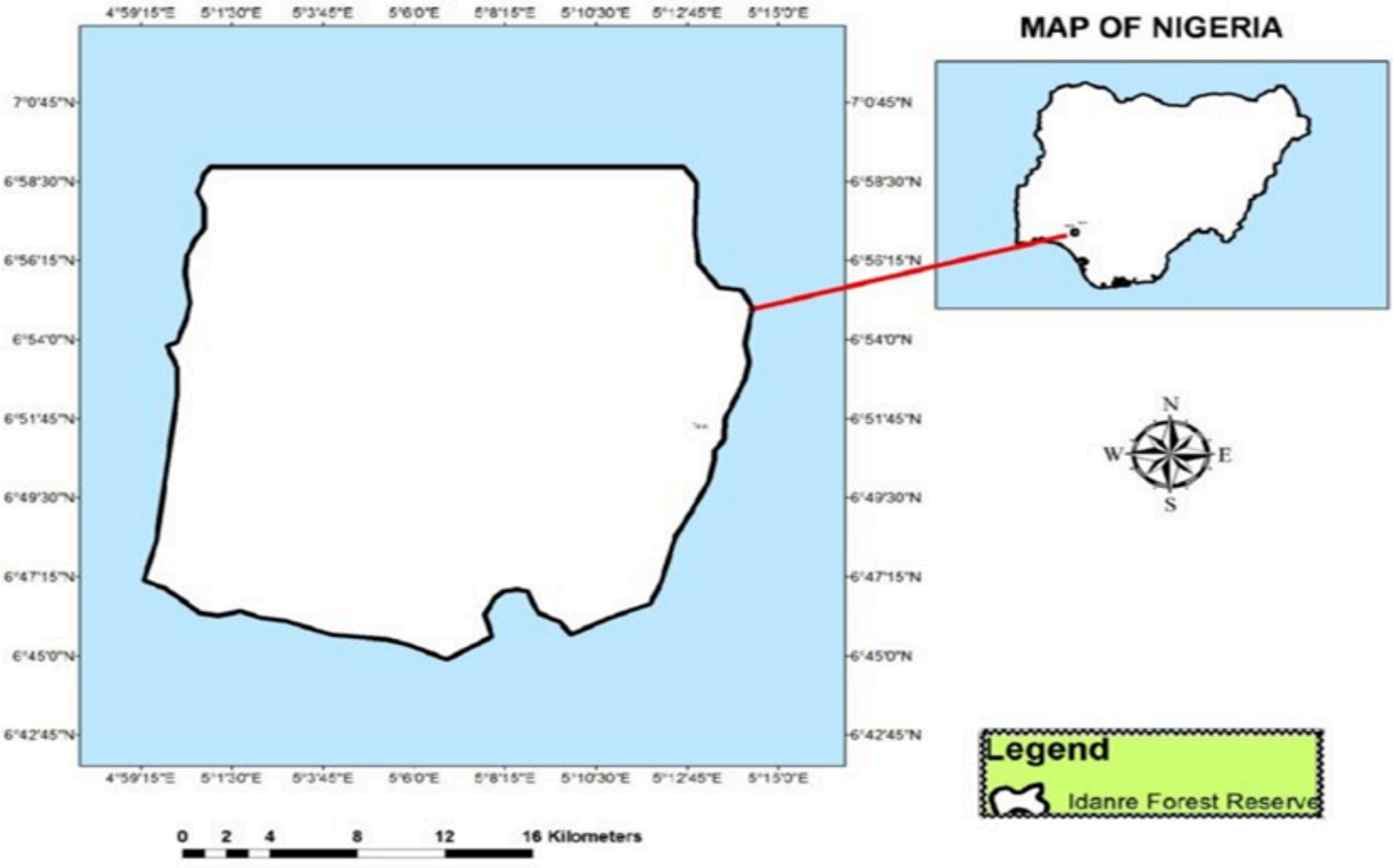

Figure 1

Idanre Forest Reserve

Source: Awoku & Ogunjemite (2019)

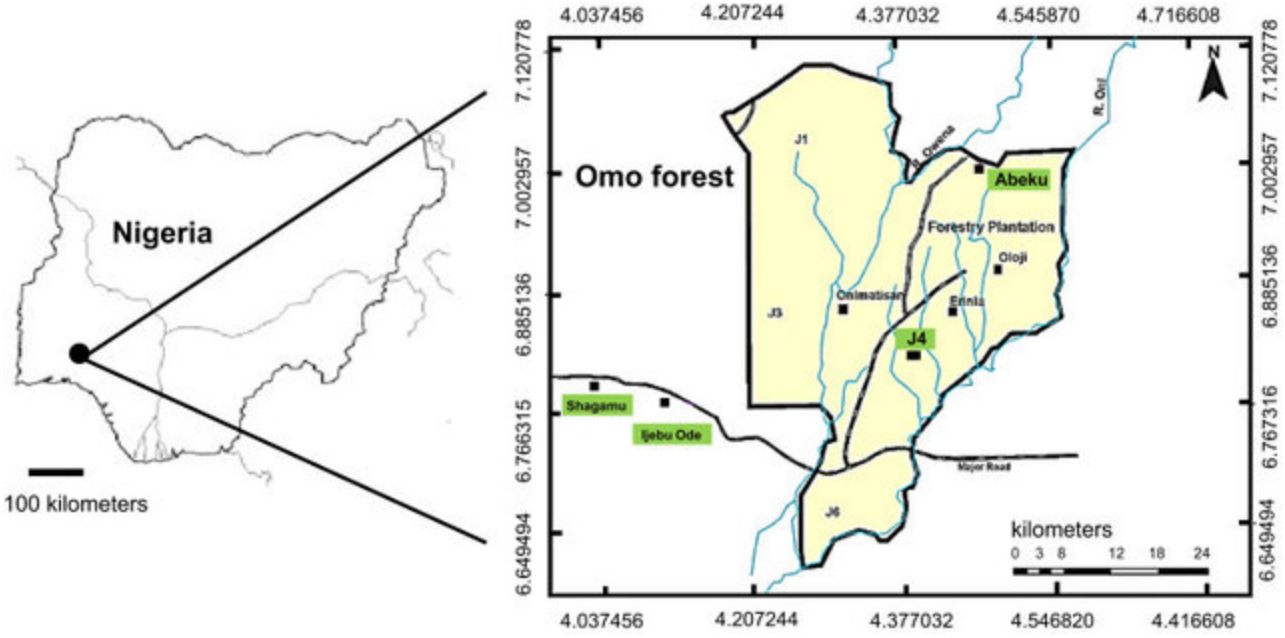

Figure 2

Omo Biosphere Reserve

Source: Attah et al (2016).

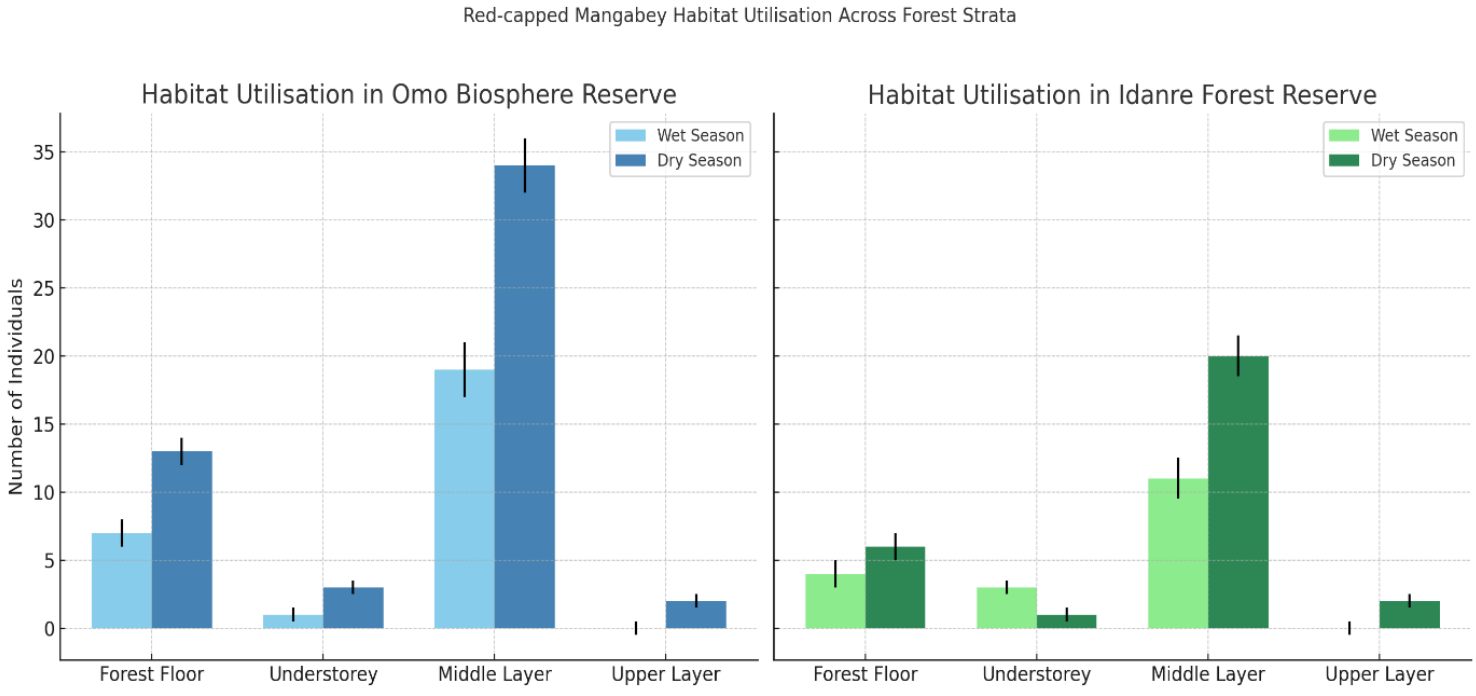

Figure 3

Habitat Utilisation in the Study Areas

Figure 5 titled: "Seasonal variation in Red-capped Mangabey sightings across study sites.

Source: Field survey