Seasonality and Diversity of Four Monkey Species within Okomu National Park, Nigeria

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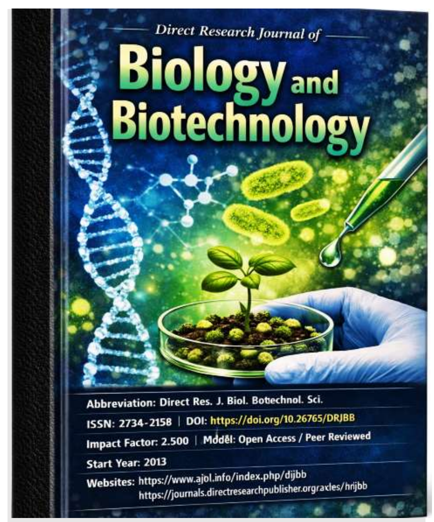
ABSTRACT

Primates play a critical role in maintaining tropical forest ecosystems, yet their populations are increasingly threatened by habitat disturbance and hunting pressures. The objective of this paper to assess the species occurrence, seasonal variation, and diversity of four species of monkeys in Okomu National Park, Edo State, Nigeria using appropriate standard methods. A total of 1,391 individuals belonging to four species (Cercopithecus mona, Cercocebus torquatus, Cercopithecus erythrogaster, and Cercopithecus nictitans) were recorded. C. mona was the most abundant species overall (41.29%), followed by C. erythrogaster (27.12%), while C. nictitans was least represented (12.73%). Seasonal variation showed that C. mona and C. erythrogaster dominated in the wet season (46.68% and 26.74%, respectively), whereas C. torquatus increased in prominence during the dry season (22.63%). Diversity indices revealed C. erythrogaster as the richest and most diverse species, with strong representation across adult and juvenile stages, while C. torquatus displayed higher calf diversity. These findings show the ecological importance of C. erythrogaster as a conservation priority and underscore the vulnerability of C. nictitans to population decline.

Keywords: *Mona monkey; C. nictitans; biodiversity; Primates; C. erythrogaster*



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INTRODUCTION

The order Primates, with over 300 recognized species, is the third most diverse order of mammals after rodents (Rodentia) and bats (Chiroptera) (Napier & Groves, 2019). It encompasses monkeys, apes, and humans, and derives its name from the Latin word *Primus*, meaning “first” or “foremost,” reflecting their advanced cognitive capacity (Burton, 1985). Unlike other mammalian groups, primates do not share a single unifying trait but exhibit a suite of adaptations including mobile fingers and toes, opposable digits, nails instead of claws, forward-facing eyes that allow binocular vision, and flatter faces with reduced snouts compared to other mammals (Ojo, 2016; Biegert, 2017). These traits are largely linked to arboreal lifestyles, where flexible hands and feet enable climbing and grasping. Their relatively large brains promote complex behavior, communication, genetic frameworks, and social systems, which makes them critical for ecological, virological, and evolutionary studies (Nchioua et al., 2025; Rylands & Mittermeier, 2024). Furthermore, understanding their peaceful social dynamics, such as pacific between-group interactions, offers profound insights into evolutionary primatology (Grueter & Pozzi, 2025; Pebsworth et al., 2025).

Monkeys, nearly 200 species of tailed primates, represent a significant portion of primate diversity. They differ from apes in having narrower chests, flatter faces (except in baboons and mandrills), and tails (Groves, 2018). Most reside in tropical forests, moving quadrupedally and filling vital ecological roles such as seed dispersal, though some introduced populations can behave as opportunistic predators impacting local biodiversity (Guedes et al., 2026). Taxonomically, monkeys are grouped into Old World monkeys (Africa and Asia) and New World monkeys (Americas). Old World monkeys are marked by downward-facing nostrils, non-prehensile tails, calloused rumps, and a dental formula of 2.1.2.3. In contrast, New World monkeys have outward-facing nostrils, lack cheek pouches, often possess prehensile tails used as “third hands,” and display a dental formula of 2.1.3.2 or 2.1.3 (Ojo, 2016). Among Old World primates, species like the Mona monkey (*Cercopithecus mona*) are frequently studied across varied habitats, ranging from wild reserves to zoos and sanctuaries, though they remain susceptible to diverse helminthic and protozoan gastrointestinal parasites of potential zoonotic importance (Kwansa-Bentum et al., 2025; Pattikawa et al., 2025).

Nigeria is one of Africa’s biodiversity hotspots, harboring varied ecosystems ranging from mangroves and rainforests to savannahs and montane zones (Gbadegesin et al., 2023). The country’s natural heritage includes national parks, reserves, and sanctuaries that support both wildlife conservation and ecotourism (Adegoroye et al., 2024). Nigeria has seven national parks: Old Oyo, Kainji Lake, Chad Basin, Gashaka-Gumti, Cross River, Okomu, and Kamuku; together protecting about 20,156 km² of land, roughly 3% of the nation’s area. Critical population assessments continue across these ranges, such as preliminary distribution estimates of Mona monkeys within the Erukut Range of Cross River National Park (Bukie et al., 2025). Among these protected areas, Okomu National Park in Edo State is particularly noteworthy as a remnant of lowland rainforest which was once a continuous belt from the Niger River to the Dahomey Gap in Benin. Initially established as Okomu Wildlife Sanctuary, it shelters endangered species within a shrinking forest block now less than one-third of its original size, requiring advanced tree volume modeling to monitor its structural degradation (Aigbe et al., 2025; Digun-Aweto et al., 2019; Olaleru & Egonmwan, 2014).

Okomu National Park holds special importance for monkey conservation. It provides habitat for several species, including the rare white-throated monkey (*Cercopithecus erythrogaster*), and supports rich bird and crocodile communities that enhance its ecotourism and regional biodiversity value (Digun-Aweto et al., 2019; Ogorode et al., 2025). However, the park faces severe pressures from illegal logging, oil palm and rubber plantations, farming, and hunting for bushmeat (Aigbe et al., 2021). These activities cause habitat loss and fragmentation, threatening primate survival and broader ecosystem integrity (Ogorode et al., 2025).

Conservation challenges across West Africa are further compounded by the lack of reliable, updated data on monkey diversity, seasonal variation, and population sizes. While community-based wildlife conservation efforts show promise across various regions and municipal centers in Nigeria and neighboring countries (Adeyemi et al., 2025; Gandaho, 2025), many large polyspecific assemblages of threatened primates persist in overlooked or completely unprotected hotspots (Nguimdo et al., 2025). In Nigeria, the last wide-scale wildlife census dates back to the colonial era and merely recorded presence without quantifying numbers. As such, systematic studies to assess species diversity, population density, and distribution are essential. The objective of this paper is to assess the species occurrence, seasonal variation, and diversity of four species of monkeys in Okomu National Park, Edo State, Nigeria.

MATERIALS AND METHODS

Description of study area

The study was conducted in Okomu National Park, located in Ovia South-West Local Government Area of Edo State, Nigeria (6°15´–6°25´N, 5°9´–5°23´E). Covering about 200 km², it is the smallest of Nigeria’s seven national parks, carved from the Okomu Forest Reserve (gazetted in 1935) and upgraded to national park status in 1999. The park lies 45 km west of Benin City and derives its name from the Okomu River, a tributary of the Osse River. Rainfall exceeds 2,500 mm annually, with temperatures ranging between 21–25°C. Vegetation is predominantly lowland rainforest with freshwater swamp forests along rivers, dominated by species such as *Khaya ivorensis*, *Milicia excelsa*, and *Terminalia ivorensis*. The park is divided into three ranges: Arakhuan (66.5 km²), Igwuowan (38.3 km²), and Julius Creek (41 km²) (Figure 1). Okomu harbours diverse wildlife, including monkeys, birds, reptiles, and amphibians, but faces threats from logging, farming, and poaching.

Reconnaissance and ecological surveys

A reconnaissance survey was conducted in March 2015 to familiarize with the terrain of Okomu National Park. This involved reviewing the park’s wildlife checklist, consulting previous literature on the family *Cercopithecidae*, and gathering verbal information from

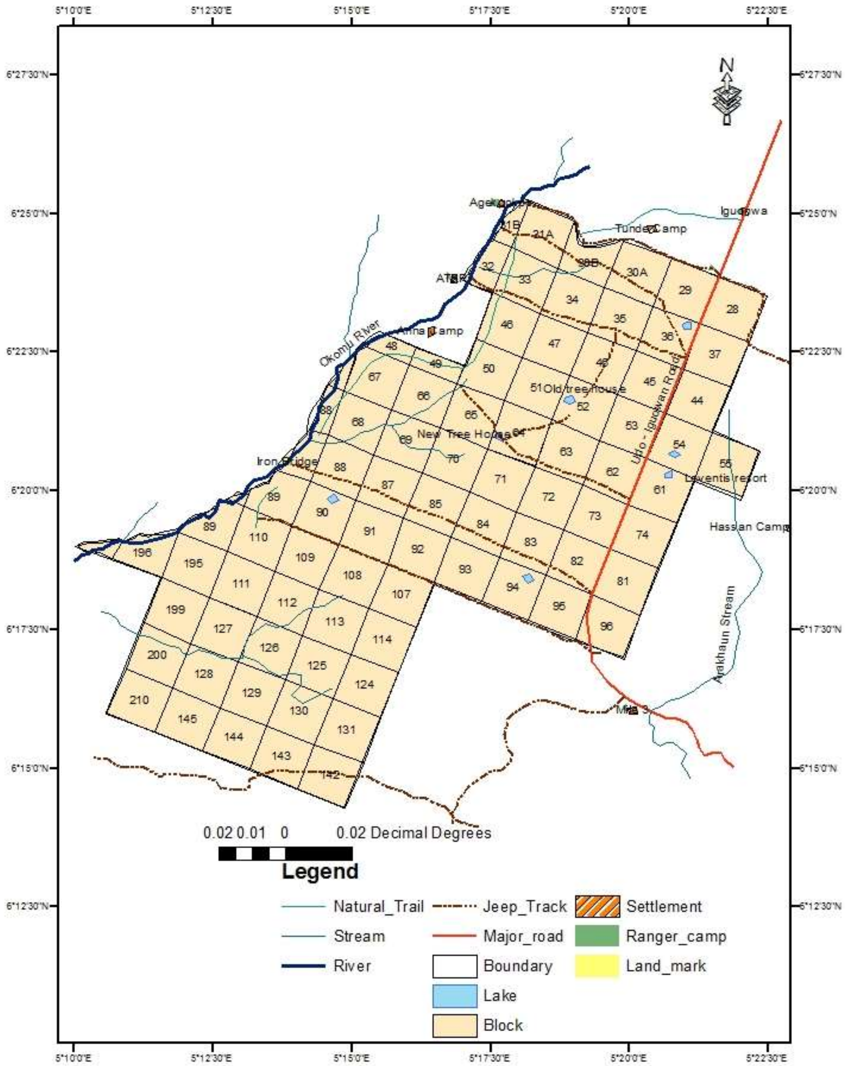

Figure 1: Map of Okomu National Park showing blocks and compartments

tour guards. Following this, ecological surveys were carried out in April 2016 (wet season) and November 2016 (dry season). Monkeys including *Cercopithecus erythrogaster*, *Cercopithecus mona*, *Cercocebus torquatus*, and *Cercopithecus nictitans* were surveyed daily between 8:00 am and 6:00 pm for three months in each season. The surveys were undertaken in selected compartments and blocks of the park with the assistance of a research officer and a park ranger.

Sampling design

Sampling was conducted in 10 selected blocks of Okomu National Park during both the wet and dry seasons. The geographic coordinates of each block were recorded using GPS. Within each block, observations focused on the four most abundant monkey species, with the number of adults, juveniles, and calves documented for seasonal comparison.

Data collection

Data collection followed the approach of Jayaraman (1999), enabling estimation of troop density and size within each selected block. Standardized documentation ensured consistency across both wet and dry season surveys, providing reliable datasets for population assessment.

Conceptual design

A vector data model was employed to represent spatial entities in the study area. Real-world features were captured as line and polygon objects, with defined

Table 1: Entities, attributes, description and class (Manley *et al.,* 2006).

ENTITIES	ATTRIBUTES	DESCRIPTION	ENTITIES CLASS
PRIMATE	P_Id	Primate identifier	Point
	P_name	Primate Name	
	P_Northing	Coordinate	
	P_Easting	Coordinate	
	P_Status	Number of beds	
HABITAT	Hab_Id,	Settlement identifier	Polygon
	Hab_Name	Settlement name	
	Hab_Area	Settlement type	
	Hab_pop	Settlement population	

Table 2: Attributes and their declarations.

ENTITY	ATTRIBUTE	DESCRIPTION	DATA TYPE	WIDTH
PRIMATES	P_ID	Primates Identification Number	Short Integer	10
		Facilities name	Text	
	P_NAME	Easting Coordinate	Short Integer	20
	P_EASTING	Northing Coordinate	Short Integer	10
	P_NORTHING			10
RIVER	P_ID	Primates Identification Number	Short Integer	10
		River Type	Text	
	P_TYPE	River Length	Short Integer	20
	P_LENGTH	River Name	Text	10
	P_NAME			15
HABITAT	HAB_ID	Habitat Identification Number	Short Integer	10
		Habitat Name	Text	
	HAB_NAME	Habitat Area	Text	20
	HAB_AREA	Habitat Population	Short Integer	20
	HAB_POP			10

relationships and attribute data assigned to each entity. This approach allowed effective integration and analysis of spatial and ecological data for the surveyed species.

Relational Database Architecture and Logical Design

To systematically manage, query, and analyze the spatial relationship between the observed primate populations, their structural habitat variants, and local hydrographic networks, a relational GIS database was constructed following standard database normalization protocols. The systemic layout of this architecture is grounded in a two-stage structural schema consisting of a logical entity-relationship classification framework and a detailed data dictionary validation profile.

The initial macro-design phase established the geospatial abstractions, structural behaviors, and relational classes governing the primary features within the Okomu National Park matrix. As outlined in (**Table 1)**, spatial entities are segmented by their geometric dimensionality (e.g., discrete vector points versus continuous vector polygons) to preserve thematic integrity during spatial overlay analyses (Manley et al., 2006).

Following the macro-level entity classification, a granular data dictionary was deployed to enforce strict data integrity, define constraints, and allocate data-type parameters within the database management system (DBMS). Table 2 delineates the specific attribute declarations, exact storage allocations, field widths, and numeric precisions assigned to each table schema. This technical structuring ensures optimized computational parsing during complex spatial queries and statistical analysis.

Data analysis

Data were analyzed to estimate the population structure (adults, juveniles, and calves) of the four most abundant species. Statistical tests applied included the Chi-square test, Simpson's Dominance Index (D), Margalef's Species Richness, and the Shannon-Weiner Diversity Index (H') to assess species richness and diversity. Paleontological Statistical Software was employed for the analyses, while bar graphs were generated in Microsoft Excel (2007).

RESULTS AND DISCUSSION

Species occurrence, composition and abundance of monkeys

A census of the primate population within the study area yielded 1,391 total sightings (Table 3). Four species were consistently identified: *Cercopithecus mona*, *Cercocebus*

Table 3: Mean number, sightings and percentage composition of monkeys.

Species	No of monkeys	Mean number	No of sighting	% composition
Cercopithecus mona	575	11.7	49	41.29
Cercocebus torquatus	262	8.13	31	18.85
Cercopithecus erythrogaster	377	11.8	32	27.12
Cercopithecus nictitans	177	7.34	24	12.73
Total	1391	10.22	136	100

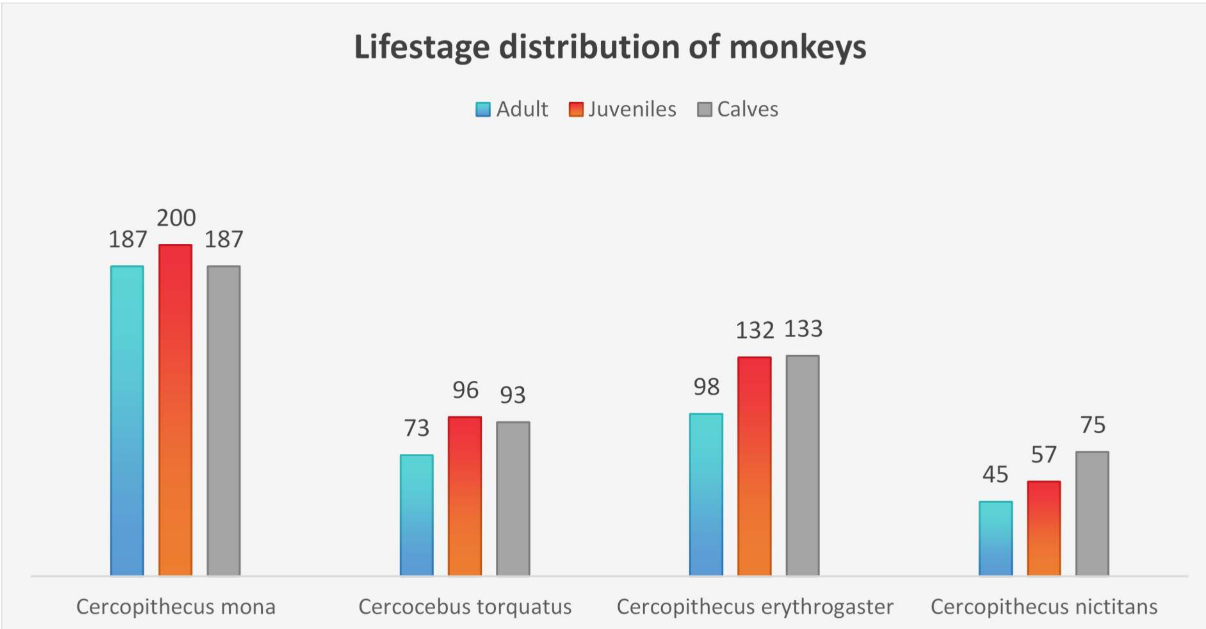

Figure 2: Distribution of the different life stages of monkey species

torquatus, *Cercopithecus erythrogaster*, and *Cercopithecus nictitans*. The demographic stratification across the surveyed blocks categorized by developmental stage (Adults: 237 wet / 176 dry; Juveniles: 208 wet / 281 dry; Calves: 216 wet / 272 dry)—is detailed in (Figure 2). Quantitative analysis of the mean detection rates and percentage composition (Table 3) establishes a clear hierarchy of relative abundance: *C. mona* (41.29%) > *C. erythrogaster* (27.12%) > *C. torquatus* (18.85%) > *C. nictitans* (12.73%). The pronounced numerical dominance of *Cercopithecus mona* (575 individuals; Table 3) suggests a high degree of ecological plasticity and tolerance for the anthropogenic habitat fragmentation that currently characterizes Okomu National Park. As dietary generalists, *C. mona* effectively exploits both primary and anthropogenically modified secondary forest matrices, providing them with a significant competitive advantage over more specialized congeners (Fashing & Cords, 2000; Krause et al., 2019). This trend aligns with broader observations of synanthropic primate adaptation in West African mosaic landscapes, where niche flexibility facilitates population persistence despite external environmental stressors (Pebsworth et al., 2025).

Conversely, the lower density of *C. nictitans* (177 individuals, Mean number: 7.34; Table 3) appears to be a function of its physiological specialization; the species exhibits a heightened sensitivity to canopy disturbance and environmental degradation (Ogorode et al., 2025). This vulnerability is exacerbated by the loss of intact forest architecture, a common conservation crisis across West African biodiversity hotspots (Nash & Oates, 2011). While demographic data indicate ongoing recruitment across all four species, the heavy skew toward *C. mona* indicates a looming risk of primate community homogenization. To mitigate the potential displacement of more vulnerable taxa, such as *C. erythrogaster*—which is currently listed as a high conservation priority by the IUCN (Oates et al., 2020) it is imperative to implement management strategies that incorporate community-based conservation frameworks and improved forest inventory monitoring (Adeyemi et al., 2025; Aigbe et al., 2025).

The predominance of *Cercopithecus mona* across the surveyed blocks underscores its remarkable ecological adaptability and high tolerance to habitat fragmentation within Okomu National Park. Mona monkeys are generalist feeders capable of exploiting both primary and secondary degraded forests, which explains their numerical dominance over more specialized taxa like *Cercopithecus erythrogaster* and *Cercocebus torquatus* (Fashing & Cords, 2000; Krause et al., 2019).

Table 4: Wet season composition of monkeys in the study area.

Species	No. of monkeys	Mean number	No of sighting	% composition
Cercopithecus mona	309	8.94	34	46.68
Crcocebus torquatus	97	6.04	16	14.65
Cercopithecus erythrogaster	177	9.83	18	26.74
Cercopithecus nictitans	79	7.90	10	11.93
Total	662	8.47	78	100

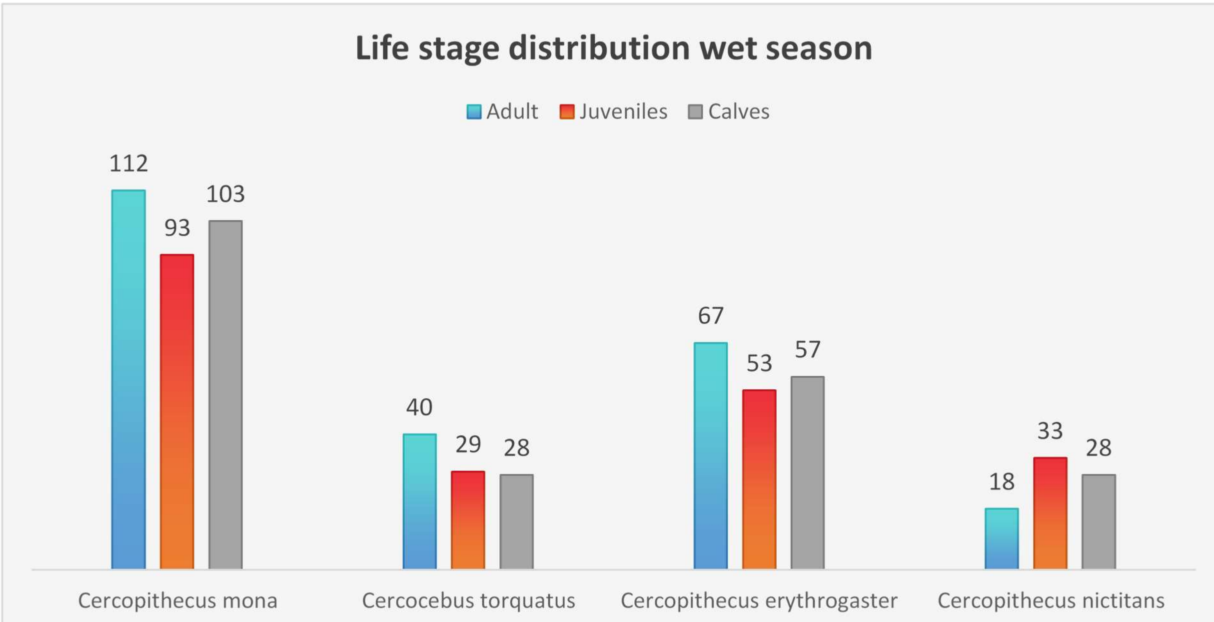

Figure 3: Wet season distribution of monkey life stages

This resilience is further mirrored across West African forest fragments and managed landscapes where synanthropic primates successfully navigate anthropogenic adjustments (Pebsworth et al., 2025).

The relatively low abundance of *C. nictitans* may reflect its acute sensitivity to anthropogenic pressures, environmental degradation, and its explicit preference for less disturbed canopy habitats a worrying trend also observed in other rapidly changing West African ecosystems (Nash & Oates, 2011; Ogorode et al., 2025). Similar patterns of *C. mona* predominance have been historically documented in regional reserves, indicating that localized hunting pressures, dietary flexibility, and tree volume variations shape contemporary population structures (Aigbe et al., 2025; Bukie et al., 2025).

The balanced representation of juveniles and calves across all four species indicates ongoing recruitment. However, the heavy numerical skew toward *C. mona* may signal a potential future homogenization of the primate community if structural pressures on rarer, more specialized taxa persist. These findings highlight the urgent need for focused conservation interventions targeting the vulnerable *C. erythrogaster* and *C. nictitans*, which are of critical concern under the IUCN Red List (Oates et al., 2020), potentially leveraging localized framework designs seen in modern community-based wildlife conservation models within Nigerian metropolises (Adeyemi et al., 2025).

Seasonal Dynamics in Primate Populations

Seasonal comparisons reveal distinct fluctuations in detectability and group cohesion, likely mediated by shifts in phenological availability of forage resources. During the wet season, the primate community comprising 662 recorded individuals across 78 sightings (Table 4) demonstrated a clear preference for canopy-foraging species. The heightened visibility of *C. mona* (46.68% composition; (Table 4) and *C. erythrogaster* (26.74% composition; (Table 4) during this period is likely indicative of increased fruit abundance in the upper strata, which promotes social cohesion and elevated inter-group interactions (Chapman et al., 2013; Grueter & Pozzi, 2025). This wet-season pulse across specific life stages is graphically mapped in (Figure 3).

The dry season witnessed a notable shift in community composition (729 individuals across 58 sightings; Table 5), characterized by an increase in *C. torquatus* sightings (165 individuals, Mean number: 11.00; Table 5). This trend is consistent with the species' semi-terrestrial foraging behavior, which allows for niche partitioning at the forest floor when canopy-level fruit availability

Table 5: Dry season composition of monkeys in the study area.

Species	No. of monkeys	Mean number	No. of sighting	% composition
Cercopithecus mona	266	17.73	15	36.49
Crcocebus torquatus	165	11.00	15	22.63
Cercopithecus erythrogaster	200	14.28	14	27.43
Cercopithecus nictitans	9	7.00	14	13.40
Total	729	12.57	58	100

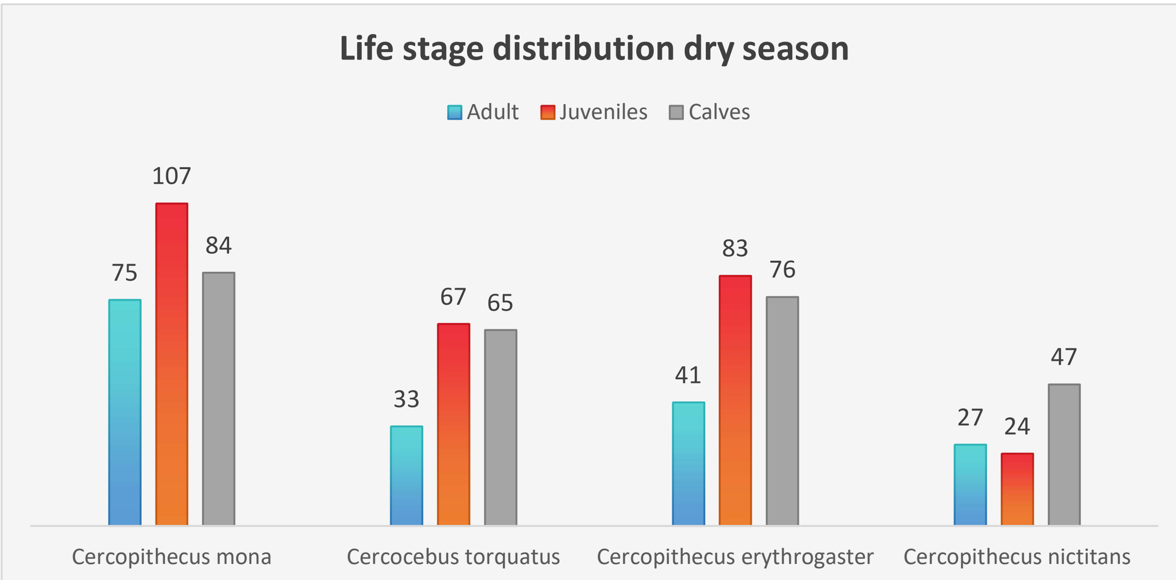

Figure 4: Dry season distribution of monkey life stages

Table 6: Overall species richness and abundance.

	Cercopithecus mona	*Cercocebus torquatus*	*Cercopithecus erythrogaster*	*Cercocebus nictitans*
Shannon H	1.7360	1.6120	2.0270	1.6460
Simpson 1-D	0.8009	0.7717	0.8529	0.7806
Evenness E	0.8108	0.8353	0.8436	0.8644
Simpsons D	0.1991	0.2283	0.1471	0.2194
Margalef d	0.9442	0.8979	1.3490	0.9660
Menhinick	0.2919	0.3707	0.4635	0.4510

declines (Fashing, 2001; Olaleru & Agbelusi, 2017). Furthermore, recent studies on opportunistic predator behavior suggest that dietary stress in primates can drive shifts in niche exploitation, with generalist species occasionally engaging in non-traditional feeding behaviors when standard resources are limited (Guedes et al., 2026). While reproductive stability remains evident through steady infant recruitment (Figure 4), the lower relative abundance of *C. nictitans* (13.40% composition; Table 5) underscores a lower tolerance for resource-limited conditions, reinforcing the species' status as a sensitive bio-indicator of forest health (Nash & Oates, 2011).

Species richness and diversity of monkeys in Okomu National Parks

From Table 6, the most diverse and richest specie overall was *Cercopithecus erythrogaster*, while *Cercocebus torquatus* was the least diverse and least rich. *Cercopithecus nictitans* showed the highest evenness, while *Cercopithecus mona* was the least even.

Analysis of Species Diversity and Community Structure

Ecological indices provide a high-resolution view of community diversity. *Cercopithecus erythrogaster* consistently exhibited the highest indices of overall richness and diversity across aggregate parameters (Shannon H: 2.0270, Simpson 1-D: 0.8529, Margalef d: 1.3490; Table 6), confirming its role as a keystone frugivore whose presence is likely essential for forest regeneration pathways (Chapman et al., 2013). Conversely, *Cercocebus torquatus* retained the lowest baseline diversity levels overall (Shannon H: 1.6120, Simpson 1-D: 0.7717; Table 6).

Table 7: Species richness and abundance in the wet season.

	Cercopithecus mona	*Cercocebus torquatus*	*Cercopithecus erythrogaster*	*Cercocebus nictitans*
Shannon H	1.7150	1.5460	1.5890	1.3330
Simpson 1-D	0.8098	0.7393	0.7546	0.7258
Evenness E	0.9859	0.7819	0.8164	0.9477
Simpsons D	0.1902	0.2607	0.2454	0.2742
Margalef d	0.8721	1.0930	0.9660	0.6866
Menhinick	0.3413	0.6092	0.4510	0.4500

Table 8: Species richness and abundance in the dry season.

	Cercopithecus mona	*Cercocebus torquatus*	*Cercopithecus erythrogaster*	*Cercocebus nictitans*
Shannon H	1.498	1.688	1.500	0.6788
Simpson 1-D	0.7597	0.8017	0.7501	0.4857
Evenness E	0.8941	0.9017	0.8965	0.9857
Simpsons D	0.2403	0.1983	0.2499	0.5143
Margalef d	0.7164	0.9446	0.7557	0.2396
Menhinick	0.3066	0.4253	0.3544	0.2481

Seasonal fluctuations altered these dynamics dramatically. In the wet season, *C. mona* emerged as the most diverse and evenly distributed species (Shannon H: 1.7150, Evenness E: 0.9859; Table 7). In contrast, the dry season witnessed a structural pivot where *Cercocebus torquatus* exhibited the highest diversity and richness values (Shannon H: 1.6880, Margalef d: 0.9446; Table 8), while *C. nictitans* dropped to critical statistical depths (Shannon H: 0.6788, Simpson 1-D: 0.4857; Table 8).

Granular evaluation of developmental stages confirms that *C. erythrogaster* maintained the highest diversity across adult and juvenile levels (Shannon: 2.1313 and 1.9421 respectively; Table 9). However, looking at the calves stage specifically, *Cercocebus torquatus* demonstrated the highest diversity value (Shannon: 2.2988; Table 9). These developmental partitions show sensitive seasonal adjustments, as highlighted by the extreme drop in wet-season calf diversity for *C. mona* (Shannon: 0.3242, Evenness E: 0.1809; Table 10) compared to its more balanced dry-season calf cohort distribution (Shannon: 1.4133, Evenness E: 0.8781; Table 11).

While *C. nictitans* maintained high evenness indices where present (Aggregate Evenness E: 0.8644; Table 6), this structural stability may be precarious due to low numbers. Specialists with such limited niche breadth are often disproportionately affected by synergistic threats, including the prevalence of zoonotic helminthic infections and pathogenic viral loads common in isolated West African monkey populations (Kwansa-Bentum et al., 2025; Nchioua et al., 2025; Pattikawa et al., 2025).

The data suggest that the primate assemblage within Okomu National Park is structured by the complex interplay between seasonal phenology, dietary specialization, and the park's current degradation trajectory. The significant diversity profiles maintained by *C. erythrogaster* and the resilient recruitment potential of *C. torquatus* offer a promising baseline for future conservation policy. However, the reliance on overlooked or unprotected corridors for these polyspecific assemblages remains a critical vulnerability (Gandaho, 2025; Nguimdo et al., 2025; Olaleru et al., 2020). Future management must prioritize the maintenance of forest connectivity to support the complex demographic needs of these assemblages within the Niger Delta ecosystem.

Diversity indices revealed that *C. erythrogaster* exhibited the highest overall species richness and diversity, particularly among adults and juveniles, whereas *C. torquatus* was consistently the least diverse. This result highlights the ecological significance of *C. erythrogaster* as a keystone frugivore in maintaining forest regeneration (Oates, 2011; Chapman *et al*., 2013). The higher evenness observed for *C. nictitans*, despite its low abundance, suggests stable group structure where present, reflecting its reliance on intact canopy habitats (Struhsaker, 2010).

Seasonal variation further indicated that *C. mona* dominated wet-season diversity, while *C. torquatus* gained prominence in the dry season, mirroring adaptive shifts in foraging niches. Comparable findings from Nigerian and Cameroonian forests show that primate community diversity is shaped by the interplay of food availability, competition, and anthropogenic disturbance (Ikemeh *et al*., 2017; Olaleru *et al*., 2020). The strong calf representation of *C. torquatus* suggests robust recruitment potential, although its limited diversity highlights vulnerability to stochastic events. In contrast, the sustained diversity of *C. erythrogaster* affirms its conservation importance as an indicator species for forest health.

Table 9: Overall species richness and abundance in developmental stages.

	Cercopithecus mona			*Cercocebus torquatus*			*Cercopithecus erythrogaster*			*Cercopithecus nictitans*		
	Adult	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**
Shannon	1.7279	1.6748	1.7603	1.3442	1.6391	2.2988	2.1313	1.9421	1.8511	1.5752	1.7133	1.4762
Shannon-Weiner	0.7504	0.7274	0.7645	0.5838	0.7118	0.0176	0.9256	0.8435	0.8039	0.6841	0.7441	0.6411
Evenness	0.8879	0.8607	0.9046	0.7502	0.9148	1.2829	0.9700	0.8839	0.8902	0.8912	0.9560	0.8239
Simpsons	0.1983	0.2172	0.1945	0.3466	0.2153	0.3535	0.1264	0.1696	0.1749	0.2464	0.1918	0.2772
Margalef	1.1469	1.1324	1.1469	1.1654	1.0954	1.1031	1.7086	1.6284	1.4314	1.3135	1.2367	1.1581
Menhinick	3.0606	3.0411	3.0606	2.8967	2.8084	2.8182	4.1593	4.0605	3.6176	3.0152	2.9839	2.8876

Table 10: Developmental stage species richness and abundance in the wet season.

	Cercopithecus mona			*Cercocebus torquatus*			*Cercopithecus erythrogaster*			*Cercopithecus nictitans*		
	Adult	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**
Shannon	1.6709	1.6539	0.3242	1.4929	1.6791	1.4155	1.7063	1.4645	1.3169	1.334	1.3098	1.2721
Shannon-Weiner	0.7257	0.7183	0.7433	0.5181	0.7292	0.6147	0.7410	0.6360	0.5719	0.5795	0.5668	0.5525
Evenness	0.9326	0.9231	0.1809	0.6658	0.9371	1.2829	0.9523	0.8173	0.8183	0.9625	0.9448	0.9176
Simpsons	0.1974	0.2172	0.0416	0.4138	0.2009	0.2832	0.1958	0.3115	0.3155	0.2778	0.2874	0.2959
Margalef	1.0590	1.1030	1.0790	1.3554	1.4849	1.2004	1.1891	1.2593	0.9894	1.0379	0.8579	0.9003
Menhinick	2.7620	2.8182	2.7870	3.1239	3.2690	2.7391	2.9261	3.0112	2.4867	2.3528	2.1392	2.1913

Table 11: Developmental stage species richness and abundance in the dry season.

	Cercopithecus mona			*Cercocebus torquatus*			*Cercopithecus erythrogaster*			*Cercopithecus nictitans*		
	Adult	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**	**Adult**	**Juvenile**	**Calves**
Shannon	1.4557	1.5033	1.4133	1.2819	1.4199	1.3964	1.5703	1.4105	1.4743	1.0406	1.0835	0.9583
Shannon-Weiner	0.6322	0.6529	0.6138	0.5567	0.6167	0.6064	0.6819	0.6126	0.6403	0.4519	0.4706	0.4162
Evenness	0.9045	0.9000	0.8781	0.7965	0.8822	0.8676	0.9757	0.8764	0.9161	0.9472	0.9863	0.8723
Simpsons	0.2651	0.2385	0.2687	0.3259	0.2756	0.2649	0.2148	0.2922	0.2586	0.3689	0.3438	0.4106
Margalef	0.9265	0.8560	0.9028	1.1440	0.9513	0.9582	1.0771	0.9052	0.9236	0.6068	0.6293	0.5195
Menhinick	2.4063	2.6739	2.3754	2.6739	2.4354	2.4472	2.5946	2.3786	2.4026	1.6525	1.6828	1.5289

CONCLUSION

This study provides a comprehensive assessment of the occurrence, abundance, and diversity of four primate species in Okomu National Park. The results show clear seasonal variations, with *Cercopithecus mona* dominating in abundance and sightings overall, accounting for 41.29% of the aggregate 1,391 sightings (575 individuals). Conversely, the habitat-specialist *Cercopithecus nictitans* demonstrated a more precarious footprint, representing only 12.73% of total observations (177 individuals) with a low mean detection rate of 7.34.

Seasonality exerted a profound structural pivot on community composition. The wet season (662 individuals across 78 sightings) favored canopy-level foraging matrices, driven largely by *C. mona* (46.68% composition) and the high-conservation-priority *Cercopithecus erythrogaster* (26.74% composition). The dry season (729 individuals across 58 sightings) triggered a behavioral shift that highlighted the dominance of the semi-terrestrial *Cercocebus torquatus*, whose sightings climbed to 165 individuals (mean: 11.00) as it exploited forest-floor resources. During these resource-limited dry months, *C. nictitans* dropped to critical statistical depths (Shannon H: 0.6788, Simpson 1-D: 0.4857), validating its status as a sensitive bio-indicator of forest health.

Overall, *Cercopithecus erythrogaster* exhibited the highest aggregate species richness and diversity (Shannon H: 2.0270, Margalef d: 1.3490), underscoring its role as a vital keystone frugivore. In contrast, *Cercocebus torquatus* remained the least diverse overall (Shannon H: 1.6120, Simpson 1-D: 0.7717). Distribution across developmental stages revealed important ecological dynamics and sensitive reproductive shifts. Adults and juveniles of *C. erythrogaster* were the most diverse within their respective age classes (Shannon: 2.1313 and 1.9421, respectively), while calves of *C. torquatus* dominated among the younger cohorts, achieving the highest calf diversity value (Shannon: 2.2988). Furthermore, *C. mona* exhibited extreme structural volatility in its youngest demographic, showing a severe drop in wet-season calf diversity (Shannon: 0.3242) compared to a far more balanced distribution during the dry-season cohort (Shannon: 1.4133). These findings reveal the ecological importance of Okomu's primate populations and the need for strengthened, targeted conservation strategies, especially for species with lower diversity, narrow niche breadths, and low absolute abundance. Continued monitoring, forest corridor preservation, and intact canopy protection will help guide adaptive management to safeguard primate biodiversity and maintain ecosystem balance in the park.

Ethical Approval

This study did not involve human participants or animal experimentation and therefore did not require formal ethical approval. All procedures involving data handling and analysis were conducted responsibly and in accordance with standard academic and institutional guidelines.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that no generative Artificial Intelligence (AI) technologies such as Large Language Models (ChatGPT, COPILOT, XLNet, Ernie 3.0 Titan etc.) and text-to-image generators were not used during writing or editing of this manuscript.

Declaration of Conflict of Interest

The authors declare that no known conflict of interest or personal relationships that could have influence the work reported in this paper.

Declaration of Data Availability: Data are available upon request from the first author.

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