Assessing species diversity and abundance in farm fallow: Seasonal dynamics across wet and dry seasons

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Abstract

Nigeria is endowed with exceptional ecological diversity, which supports a broad spectrum of wildlife species. Despite this richness, escalating anthropogenic pressures have accelerated habitat loss. Ecologically valuable yet understudied landscapes, such as fallow farmlands, remain overlooked in biodiversity assessments and conservation planning. This study examines the potential for wildlife diversity in fallow farmlands. A systematic line transect was employed across 11 transects to record wildlife presence across wet and dry seasons. A total of 253 individual organisms representing 23 taxonomic families were documented, with avian species comprising the majority (60%), followed by insects (28%), mammals (9%), amphibians (2%), and reptiles (1%). Species abundance exhibited substantial seasonal variation, with higher abundance and variability during the wet season. Conversely, diversity indices (Shannon H′, Simpson's 1-D) indicated a more even species distribution in the dry season. Overall, diversity was high (Shannon H′ = 2.839; Simpson's 1-D = 0.9249), and low dominance values (Berger-Parker = 0.1462; dominance = 0.0751) affirmed the presence of a functionally balanced community. These findings highlight the ecological value of fallow farmlands as supplementary habitats that support diverse wildlife assemblages. Integrating fallow lands into conservation strategies through agroecological practices and biodiversity-sensitive land management can enhance habitat connectivity and resilience.

Keywords: species diversity, farm fallow, abundance, season.

Avaliação da diversidade e abundância de espécies em pousios agrícolas: Dinâmica sazonal entre as estações chuvosa e seca

Resumo

A Nigéria é dotada de uma diversidade ecológica excepcional, que sustenta uma ampla variedade de espécies da fauna silvestre. Apesar dessa riqueza, o aumento das pressões antrópicas tem acelerado a perda de habitats. Paisagens ecologicamente valiosas, mas pouco estudadas — como os terrenos agrícolas em pousio — continuam sendo negligenciadas nas avaliações de biodiversidade e no planejamento da conservação. Este estudo investiga o potencial de diversidade da fauna silvestre em áreas agrícolas em pousio. Um transecto linear sistemático foi utilizado em 11 faixas para registrar a presença da fauna durante as estações chuvosa e seca. Um total de 253 organismos individuais representando 23 famílias taxonômicas foi documentado, sendo que as aves constituíram a maioria (60%), seguidas por insetos (28%), mamíferos (9%), anfíbios (2%) e répteis (1%). A abundância das espécies apresentou variação sazonal significativa, com maior abundância e variabilidade durante a estação chuvosa. Por outro lado, os índices de diversidade (Shannon H', Simpson 1-D) indicaram uma distribuição mais equilibrada das espécies na estação seca. De modo geral, a diversidade foi alta (Shannon H' = 2,839; Simpson 1-D = 0,9249), e os baixos valores de dominância (Berger-Parker = 0,1462; dominância = 0,0751) confirmaram a presença de uma comunidade funcionalmente equilibrada. Esses resultados destacam o valor ecológico dos terrenos em pousio como habitats suplementares que sustentam conjuntos diversos de fauna silvestre. A integração dessas áreas nas estratégias de conservação, por meio de práticas agroecológicas e manejo do uso da terra sensível à biodiversidade, pode fortalecer a conectividade e a resiliência dos habitats.

Palavras-chave: diversidade de espécies, pousio agrícola, abundância, sazonalidade.

1. Introduction

Nigeria is endowed with a remarkable diversity of wildlife species, distributed across various ecosystems ranging from the lush rainforests and extensive mangroves of the southern region to the vast savanna landscapes in the north (Lameed, 2007; Abere; Lateef, 2015; Olajesu et al., 2022). This ecological richness supports a wide variety of flora and fauna, many of which are of significant conservation value. However, in recent decades, the country has faced increasing threats to its biodiversity, primarily due to habitat destruction. Rapid urbanization, industrial expansion, deforestation for agriculture, and unsustainable hunting practices have led to the degradation and fragmentation of critical wildlife habitats. These challenges are further exacerbated by climate change and economic instability, both of which have intensified the pressure on natural resources, leading to increased reliance on wildlife for sustenance and trade.

Despite Nigeria's commitment to biodiversity conservation, exemplified by the establishment of approximately ten national parks and numerous game reserves, the effectiveness of these protected areas has been undermined by persistent security threats, including banditry, insurgency, and encroachment. These issues not only disrupt conservation efforts but also deter research and ecotourism activities, which are essential for sustainable conservation and economic growth. Consequently, much of the research on wildlife diversity in Nigeria has remained concentrated within these protected areas, leaving other ecologically significant landscapes largely understudied.

One such underexplored habitat is fallow farmland, which has been observed to support various wildlife species, particularly birds (McMahon et al., 2010). Fallow habitat is extremely variable in terms of structure and composition, thus allowing for the existence of different microhabitats within the same habitat type (Fried et al., 2012). Agricultural expansion over centuries has led many wild species to adapt to human-managed landscapes, making farmland an integral part of biodiversity conservation (Cardador et al., 2014; Moreno et al., 2010). Studies have shown that fallow lands, where agricultural activity has been temporarily abandoned, can provide critical habitat for bird populations and other wildlife (Gillings et al., 2010; McMahon et al., 2010; Huusela-Veistola et al., 2011; Cardador et al., 2014). These areas often exhibit a mosaic of vegetation types, offering nesting sites, food resources, and refuge from human disturbances. However, the role of farm fallows in supporting biodiversity remains insufficiently documented in Nigeria, warranting further research to understand their ecological significance and potential contribution to conservation efforts (Benton et al., 2002; Boatman et al., 2011; Toivonen et al., 2013).

Addressing the conservation challenges posed by agricultural expansion requires a holistic approach that integrates biodiversity conservation with sustainable land-use practices. The development of effective frameworks to assess both the threats and opportunities associated with agricultural land conversion is essential. Establishment of temporary habitat patches such as fallow land is one of the most promising approaches to compensate for the loss of semi-natural habitat and mitigate the negative effects of agricultural intensification (Huusela-Veistola et al., 2011). A multifunctional agricultural system that balances the needs of food production with environmental protection goals can serve as a viable strategy for ensuring biodiversity conservation outside formally protected areas. By adopting low-intensity, traditional farming methods and implementing conservation-friendly agricultural policies, Nigeria can enhance habitat connectivity and safeguard its wildlife resources (Farinloye et al., 2024).

This study aims to examine wildlife diversity in fallow farmlands. Understanding the ecological value of these landscapes could contribute to the formulation of evidence-based policies that promote biodiversity conservation within agricultural regions, ultimately fostering a more sustainable coexistence between agriculture and wildlife conservation.

2. Materials and Methods

2.1 Study area

The study was conducted in Odo Onasa, a rural community in Agbowa town within Epe Local Government Area, Nigeria. The site is in an agricultural landscape with a stream running parallel to its boundary and a densely vegetated marsh dominated by palm trees adjacent to the water body. The study area covers 10 acres and consists of abandoned farmland that has remained fallow for an extended period, with an active agricultural farm located nearby.

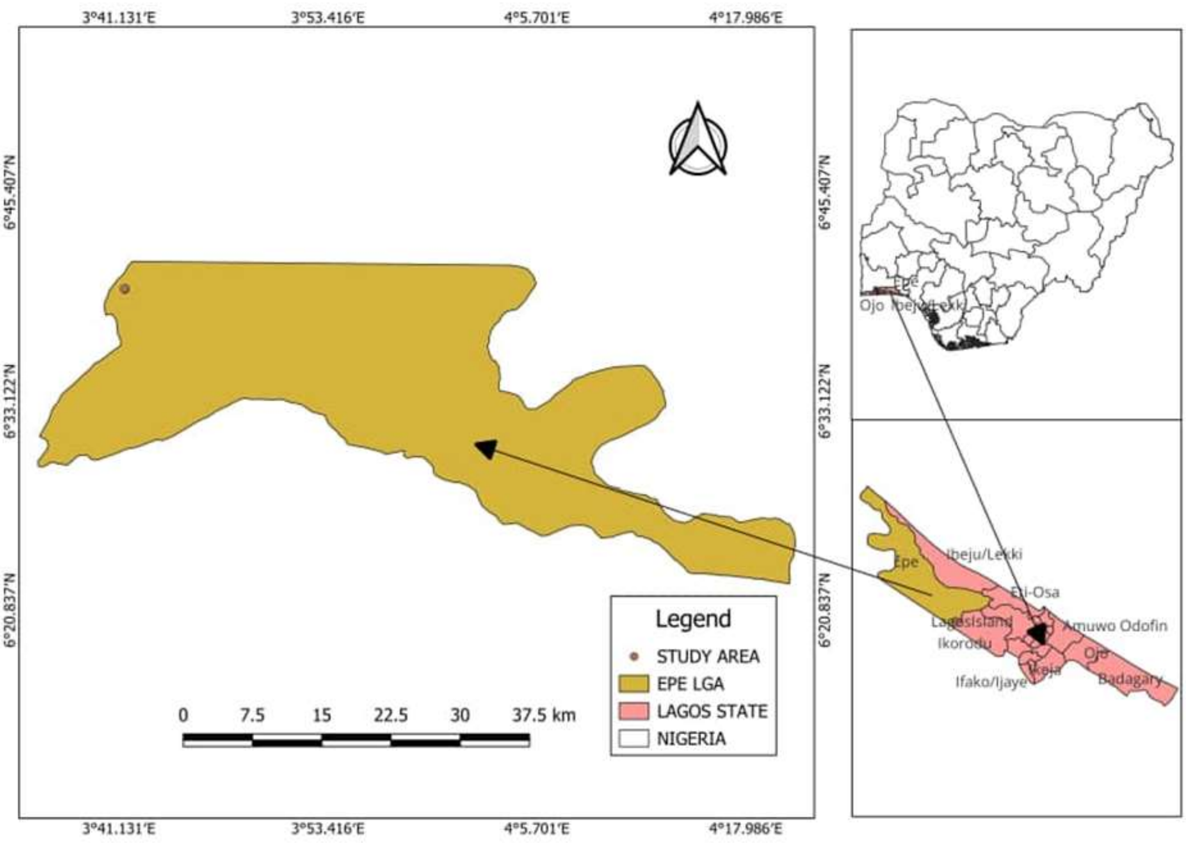

Figure 1. Study area. Source: Authors, 2025.

2.2 Data collection

A systematic line transect survey was used to assess wildlife species. A total of 11 evenly spaced transects were established, leaning parallel to the longest axis of the land to maximize spatial coverage. Each transect measured 200 m in length and was spaced at regular intervals to minimize sampling bias and ensure comprehensive coverage of species distribution. Wildlife surveys were conducted during peak activity periods—between 06:00 and 10:00 h in the morning and 16:00 and 18:30 h in the evening—to optimize species detection rates for three days in each season (wet and dry) over two months (November-December and June-July). Each transect was walked on slowly while recording wildlife species observed, recording both visual and auditory detections of wildlife within a fixed width of 10 meters on either side, resulting in a total survey width of 20 meters per transect. Field guides and expert consultations were utilized as needed. Number of individuals per species: Population estimates were based on direct observations.

2.3 Data analysis

Species diversity was analyzed using the Shannon-Weiner Index (H') and Simpson's Diversity Index (D) to quantify species richness and evenness for each season using PAST software.

3. Results

3.1 List of wildlife species

A total of two hundred and fifty-three (253) individual species belonging to twenty-three families (23) were recorded, with a mean abundance of 9.73 per species (Table 1).

Table 1. A list of wildlife species recorded in the farm follows.

Family	Common Name	Scientific Name	Abundance
Accipitridae	Yellow-billed Kite	*Milvus aegyptius*	11
Ardeidae	Little Egret	*Egretta garzetta*	22
Bovidae	Blue Duiker	*Philantomba monticola*	3
Bovidae	Bushbuck	*Tragelaphus scriptus*	1
Bucerotidae	African Pied Hornbill	*Lophoceros fasciatus*	17
Bufonidae	African Tree Toad	*Nectophryne afra*	3
Corvidae	Piapiac	*Ptilostomus afer*	2
Cisticolidae	Whistling Cisticola	*Cisticola lateralis*	14
Dicruridae	Square-tailed Drongo	*Dicrurus ludwigii*	5
Elapidae	Green Mamba	*Dendroaspis angusticeps*	2
Estrildidae	Bronze Mannikin	*Spermestes cucullata*	14
Gryllidae	African Field Cricket	*Gryllus bimaculatus*	8
Hirundinidae	Lesser Striped Swallow	*Cecropis abyssinica*	22
Malaconotidae	Sooty Boubou	*Laniarius leucorhynchus*	2
Nectarinidae	Splendid Sunbird	*Cinnyris coccinigastrus*	6
Nesomyidae	Gambian Giant Rat	*Cricetomys gambianus*	10
Nymphalidae	Little Pansy (Butterfly)	*Junonia Sophia*	13
Papilionidae	Swallowtail Butterfly	*Papilio spp.*	33
Phasianidae	Hazel Grouse (Bonasia)	*Tetrastes bonasia*	45
Phyllastrephidae	Leaflove	*Phyllastrephus scandens*	2
Ploceidae	Rachael's Malimbe	*Malimbus racheliae*	4
Ploceidae	Red-vented Malimbe	*Malimbus scutatus*	6
Pycnonotidae	Chestnut-bellied Starling	*Lamprotornis pulcher*	10
Thryonomyidae	Grasscutter (Greater Cane Rat)	*Thryonomys swinderianus*	3
Total	—	—	253

Source: Authors, 2025.

3.2 Distribution of wildlife species based on taxonomic class

Species abundance varies widely (standard deviation = 9.69), with values ranging from 1 to 37. At least half of the species have relatively low abundances (Mean value = 6). Aves (60%) were the highest class of animals recorded, followed by insecta (28%), Mammals (9%), Amphibians (2%), and the least was reptiles (1%) (Figure 2).

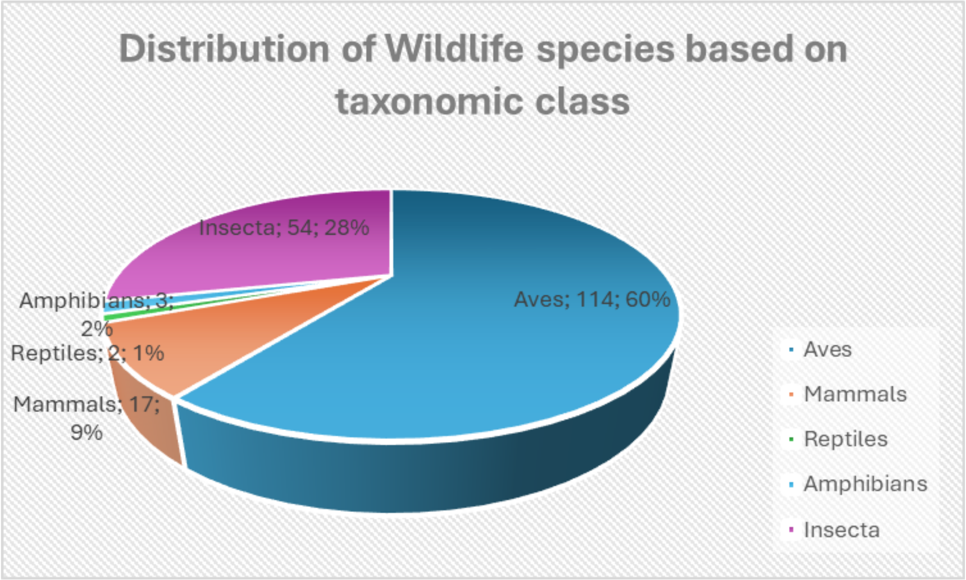

Figure 2. Distribution of species by classification. Source: Authors, 2025.

3.3 Seasonal variation

Seasonal variation in species abundance was higher during the wet season (sum = 158, mean = 6.08) compared to the dry season (sum = 95, mean = 3.65) (Figure 3). Variability is also greater in the wet season (standard deviation = 8.23) than in the dry season (4.51). Few species. (wet = 1.94, dry = 1.57) were highly abundant, while most remain low in number. The maximum recorded abundance is significantly higher in the wet season (33) than in the dry season (15).

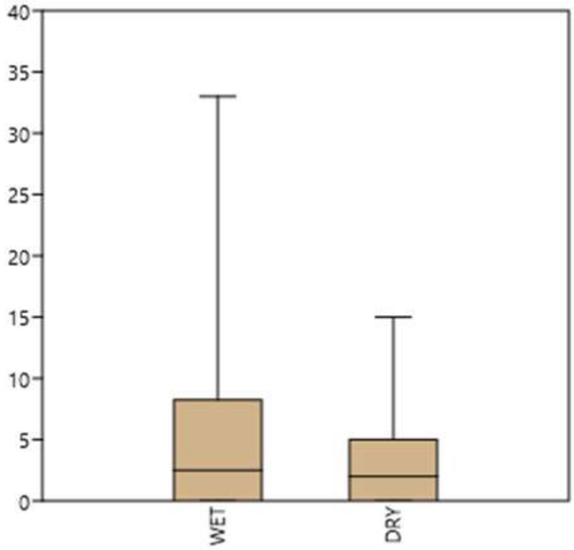

Figure 3. Wildlife species distribution across seasons. Source: Authors, 2025.

Diversity indices were high (Shannon H: 2.839, Simpson's 1-D: 0.9249) with moderate evenness (0.684). No single species (0.0751) overwhelmingly dominated the assemblage. Species richness was slightly higher in the wet season (19) than in the dry (18), with more individuals recorded (158 vs. 95) (Figure 4). However, diversity indices (Shannon H': 2.518 vs. 2.582, Simpson's 1-D: 0.8937 vs. 0.9053) indicate a more even species distribution in the dry season. Evenness (J: 0.8552 vs. 0.8932) and Margalef's index (3.555 vs. 3.733) were also higher in the dry season, suggesting better species balance.

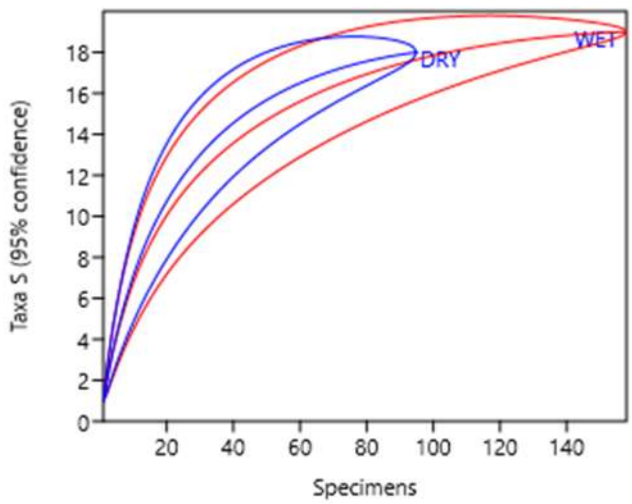

Figure 4. Species richness across seasons. Source: Authors, 2025.

The wet season showed greater dominance (Berger-Parker: 0.2089 vs. 0.1579), indicating a few species were more abundant (Figure 5). Overall, diversity remained stable across seasons but was more evenly distributed in the dry season.

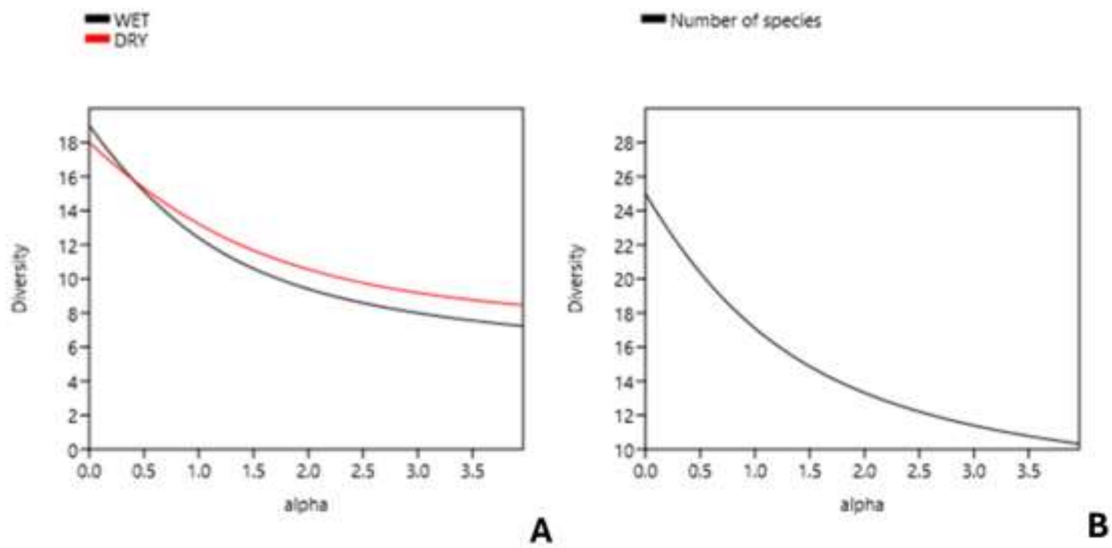

Figure 5. Diversity Profile. Source: Authors, 2025.

4. Discussion

Understanding species composition in the fallow lands can inform land-use practices, encourage sustainable farming, and biodiversity management. Our study shows that farm fallows exhibited a diverse assemblage of wildlife, with a total of 24 species recorded across multiple taxa, including birds, mammals, reptiles, amphibians, and insects. Species abundance varied widely, with certain species dominating the landscape while others were relatively scarce. The most abundant species was the bonasia, followed by the Swallowtail butterfly, reflecting the prevalence of generalist species that can adapt to changing environmental conditions. The high bird and insect diversity suggests that these areas still provide essential ecosystem services, such as pollination and pest control.

However, the low mammalian and reptilian abundance raises concerns about habitat fragmentation, human disturbance, and potential trophic imbalances. To enhance biodiversity conservation, strategies such as agroforestry, habitat restoration, and controlled hunting policies should be implemented. Protecting wetland patches, reducing pesticide use, and promoting community-based conservation initiatives can further support species diversity. By improving habitat quality and connectivity, farm fallows can serve as crucial corridors for wildlife, promoting a more resilient and ecologically balanced landscape.

Our result mirrors that of Benton et al., (2002) suggesting that traditional agricultural systems based on low intensive farming and extensive grazing can result in highly heterogeneous landscapes capable of supporting species-rich communities. Sustainable agricultural practices are required to limit the decline of farmland biodiversity and portions of the world's species that are threatened with extinction, to preserve the ecosystem services, they can provide (Butler et al., 2007; Tscharntke et al., 2007).

Intensification at field scale has been related with species loss and biotic homogenization due to the high intensity of farm management by fertilizers application, use of agro- chemicals (herbicides and pesticides), intensive mechanization or plantation of monocultures, among others (Nicholls et al., 2012; Gámez- Virués et al., 2015). Allowing land to fallow will not only restore lost species but it can provide an heterogenous habitat. Bird species such as the Little Egret and Lesser Striped Swallow exhibited moderate frequencies, indicating their ability to exploit available resources in the farm fallow environment. However, mammalian and reptilian species were recorded in lower numbers, with the Bushbuck and Green Mamba representing the least frequent species. Even though the study reveals the potential for other large mammals to reside in the farm fallow if the environment continues to be suitable and rid of any potential danger on their population, the farm fallow habitat itself also plays a critical role in species diversity by providing essential resources such as food, nesting sites, and cover from predators (Boatman et al., 2011; Toivonen et al., 2013).

Variations in habitat structure and human disturbances, such as agricultural activities or encroachment, may have influenced the presence or absence of certain species. The absence of larger mammals, such as the Bushbuck and other species that were poorly present, could also indicate limited habitat suitability or the impacts of human-induced pressures (Nicholls et al., 2012).

The overall species distribution, with a few dominant species and numerous less common ones, aligns with typical ecological community structures where resource competition, habitat preferences, and predator-prey dynamics influence population sizes. The diversity indices obtained from our study further confirmed the presence of a well-structured and ecologically balanced plant community, although our study did not measure plant species presence or diversity, plant species and other environmental factors have always being a proxy to animal presence in any habitat (Whittingham et al., 2006; Kattge et al., 2011; Sanza et al., 2012). The high values of both the Shannon and Simpson indices point to a considerable level of biodiversity within the study area, indicating that species richness and abundance are notably high. This implies that the ecosystem supports a considerable number of species, each contributing to the structural and functional dynamics of the environment that they are found.

The evenness score shows a moderate distribution of individuals among the species found in the farm fallow. While some species were more abundant, the population sizes were not heavily skewed, affirming that no single species overwhelmingly dominated the community. This balanced distribution supports ecosystem stability, as it trims down the likelihood of resource monopolization and improves ecological interactions. Furthermore, the low values of the Berger-Parker index and species dominance indicate an insignificant prevalence of any single species over the others which support several findings (Myers; Harms 2009; Moreno et al., 2010; Batary et al., 2011; Cardador et al., 2014) that farm fallow ecosystem maintains a healthy level of functional diversity. Such a structure is typically associated with greater ecosystem resilience, enhanced habitat quality, and improved nutrient cycling as a variety of species contributes to balancing ecological roles.

Seasonality, which strongly affected species abundance and distribution, is a factor that contributes to the observed patterns of wildlife diversity in the farm fallow. The total number of recorded individuals was considerably higher in the wet season compared to the dry season. The higher species richness in the wet season compared to the dry season further emphasizes the role of seasonal resource availability in shaping wildlife diversity.

The observed greater fluctuation in species numbers during the wet season, as indicated by the higher standard deviation, suggests that temporary increases in food, water, and shelter availability contribute to population growth in certain species. This seasonal abundance of resources likely supports the proliferation of opportunistic or fast-reproducing species, resulting in higher variability in species counts. These findings suggest that seasonal changes in resource availability not only influence species abundance but also affect community structure and balance, with implications for ecosystem stability and species interactions across different temporal scales.

With the current rate of insecurities in the Nigeria National Parks and other protected area, protecting and managing fallow lands as semi-natural habitats can improve their role in biodiversity conservation while maintaining their agricultural productivity (Myers; Harms 2009; Batary et al., 2011). To enhance biodiversity conservation in farming fallow lands, a combination of policy-driven, community-based, and science-informed strategies is necessary (Cardador et al., 2014; Moreno et al., 2010). One of the most effective approaches is sustainable land-use planning, which promotes the integration of conservation principles into agricultural practices. By adopting techniques such as agroforestry, mixed cropping, and rotational fallowing, farmers can create habitats that support wildlife while maintaining soil fertility and crop productivity (Butler et al., 2009; Cardador et al., 2014). These practices can help sustain populations of key species and prevent habitat fragmentation.

5. Conclusions

The findings emphasize the critical role of farm fallow lands as an alternative habitat for wildlife conservation. The observed species' diversity and abundance show the ecological value of these landscapes in supporting functionally diverse communities essential for ecosystem balance. Seasonal variations in species richness and distribution further emphasize the need for dynamic habitat management that accounts for changes in resource availability.

To safeguard these ecosystems, conservation efforts should be encouraged at all levels. Such as by encouraging sustainable agricultural practices through strengthened environmental regulations, land-use planning, and multi-stakeholder collaboration. Ongoing scientific monitoring is also vital to track biodiversity trends and guide evidence-based conservation strategies. Ultimately, promoting farm fallows as multifunctional landscapes can advance biodiversity, improve ecosystem resilience, as well as contribute to sustainable land use in agricultural regions.

6. Authors' Contributions

Fumilayo Lewiska Oni: designed the study design and conducted the data processing, and analyzed the data. *Gbolagede Akeem Lameed*: designed the study design and conducted the data. *Kolawole Farinolye*: processed and analyzed the data. All contributing authors actively engaged in revising and reaching consensus on the final version for publication.

7. Conflicts of Interest

No conflicts of interest.

8. Ethics Approval

Not applicable.

9. References

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