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PRENSIP

Seasonal Variation in Fish Diversity and Abundance in Stratum VII of Lake Volta, Ghana

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ABSTRACT

Lake Volta, the largest man-made reservoir in Africa supports one of West Africa's most important inland fisheries, yet ecological studies on seasonal variation of fish assemblages remain limited. The study assessed seasonal variation of fish assemblages in Stratum VII of Lake Volta, Ghana. Fish samples were obtained during wet and dry seasons from January to December 2023 and analysed for diversity indices, species composition and multivariate analysis using Primer 6. A total of 42 species, with slightly higher richness in the dry season (37 species) compared to the wet season (35 species) was recorded. Shannon diversity index values (2.05–2.06) and evenness (0.997–0.999) showed no significant seasonal differences, suggesting a stable distribution of individuals among species despite fluctuations in species abundance. Species abundance recorded during the wet season (1580 individuals) was higher than recorded during the dry season (722 individuals), showing functional recruitment driven by flood inflows. SIMPER analysis revealed that *Chrysichthys walkeri*, *C. auratus*, *Schilbe mystus*, and *Synodontis sorex* were the main contributors to seasonal dissimilarity (> 10%) in species abundance. More than 25 species were rare, potentially supporting ecological heterogeneity in Stratum VII of Lake Volta. Based on the findings, management measures such as seasonal closures, habitat protection, and livelihood diversification are recommended to mitigate seasonal shocks.

INTRODUCTION

Reservoirs and large lakes are critical aquatic ecosystems that support biodiversity, fisheries, and human livelihoods. In tropical regions, seasonal variation in rainfall, inflows, and water levels strongly affects fish diversity and abundance, with wet and dry seasons regulating productivity and recruitment (Agostinho et al., 2007). Information on these dynamics is crucial for adaptive management, biodiversity conservation, and the sustainability of artisanal fisheries. Lake Volta, formed in 1965 in the wake of the Akosombo Dam, is the largest man-made reservoir in Africa, covering approximately 8,482 km^2 and spanning several regions of Ghana. It sustains one of West Africa's most important inland fisheries, producing an estimated 150,000–200,000 metric tonnes of fish annually and contributing significantly to national food security and rural livelihoods (Braimah, 2000; FAO, 2022).

Seasonal variation in Lake Volta is driven by distinct wet and dry seasons in Ghana. Wet season inflows enhance nutrient availability and breeding habitats, whereas dry season reductions constrain productivity (Kolding, 1993). Rainfall and temperature shifts affect spawning, recruitment, and survival rates (Kolding & van Zwieten, 2012). Decline in catch per unit effort (CPUE) during the dry season are further exacerbated by overexploitation, illegal fishing practices, and habitat degradation. Cutting submerged trees for firewood during drawdown periods reduces periphyton, a key food source for fish, while underreporting of catches and the use of illegal fishing gear facilitate the rate of seasonal declines (Braimah, 2000; Nunoo et al., 2015). Anthropogenic stressors in littoral zones, such as vegetation loss, further reduces nursery grounds during dry periods (Agostinho et al., 2007). Despite the evident seasonal variation, empirical ecological studies remain limited in specific strata of Lake Volta. Documented impacts of anthropogenic pressures in Lake Volta include shifts in species composition, declines in CPUE, conflicts among fishers, and heightened vulnerability of dependent communities, reducing household income and food security (Kolding, 1993; Braimah, 2000; Nunoo et al., 2015).

Stratum VII, centred along Yeji, is one of the active fishing zones which serve as a hub for landings, processing, and trade in freshwater fishes (Braimah, 2000). Seasonal changes disproportionately affect thousands of households that depend on fishing and other fishing related activities (Ameworwor, 2014; Gürkan et al., 2025). However, most research activities have focused on catch statistics, gear selectivity, and socio-economic aspects, with limited ecological studies on seasonal variation in fish diversity and abundance in Stratum VII. In addition, fisheries management in Ghana has historically emphasised gear regulation rather than ecological cycles, leaving communities exposed to seasonal shocks (Fisheries Commission Ghana, 2023). In view of limited scientific information on ecological cycles in relation to species abundance, the study aimed to determine seasonal variation in fish species diversity and abundance in Stratum VII of Lake Volta. Information from the study will address a critical knowledge gap in tropical reservoir ecology and contribute to sustainable inland fisheries management in Ghana.

MATERIAL AND METHODS

Study Area

Lake Volta is one of the world's largest reservoirs whose major tributaries are the Rivers White and Black Volta and Rivers Oti and Afram (Abban & Dankwa, 2006) which drain from the north, west, east and south, respectively, into the Lake. The lake has been partitioned based on its ecology into eight strata for stock assessment purposes (Abban & Dankwa, 2006; Béné et al., 2009). It lies within a tropical zone characterized by two major seasons: the wet season which occurs when the warm and humid maritime air blows over Ghana which is characterized by rainfall (moderate to high) and the dry season which occurs when the hot and dry continental air dominates (van Zwieten et al., 2011). The annual temperature ranges between 26°C and 30°C with high temperatures in the dry season with two hydrological seasons, the dry (November–February) and wet seasons (March–October) (Mensah et al., 2019). Four fishing communities, namely Tonka, Vutideke, Brekente, and Fante Akura within the Stratum VII of Lake Volta (8°14′5.53″ N, 0°39′2.63″ W) were selected as fishing communities for the study (Figure 1). The major fishing crafts used by fishermen in these study areas were mostly made of wooden planks, which may be motorized. The geographical coordinates for these study areas are presented in Table 1. The main livelihoods in these study areas are fishing and fishing related activities including fish trading, processing and marketing. However, few of the inhabitants are into other forms of livelihoods such as farming, masonry, petty trading, among others.

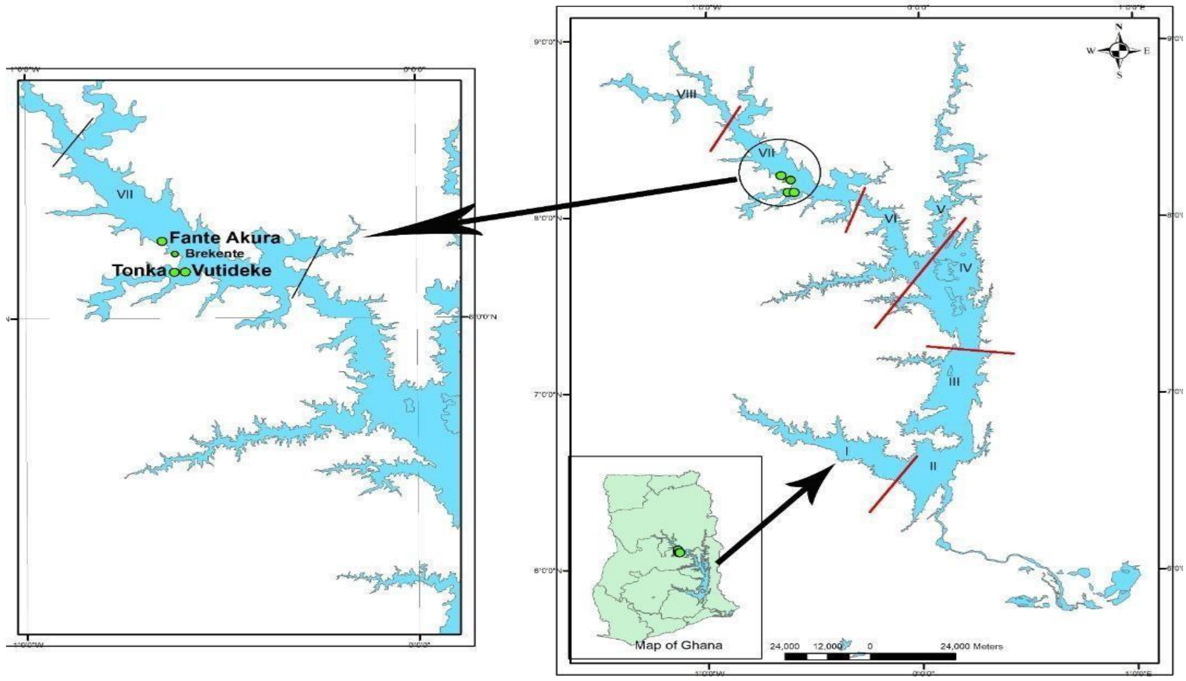

Figure. 1. A map showing the study areas along Volta Lake, Ghana

Data Collection

Fish sampling in the study areas was done monthly, from January to December, 2023. Fish species were purchased from fishermen who used fishing gears such as gillnet and traps and identified to species level based on keys of Paugy et al. (2003a, 2023b) and Dankwa et al. (1999). Species belonging to the same family were pooled together for further analysis.

Methods

Mean monthly abundance and relative abundance (%) were calculated for each species obtained during the dry and wet season.

The Shannon index is widely applied in aquatic ecology to quantify diversity by incorporating both species richness and relative abundance (Magurran, 2004; Clarke & Warwick, 2001). Shannon–Wiener Index (H') which considers both the number of species and the distribution of individuals among species was calculated as follows (Eq. 1) (Shannon & Wiener, 1963):

$$H = \sum (P_i) \times \ln(P_i) \tag{1}$$

where P_i = proportion of each species in a sample and $ln()$ = natural logarithm.

Species evenness was calculated to assess the distribution of individuals among species (Pielou, 1969). Pielou's Evenness index (J) was estimated using the following equation (Eq. 2) (Pielou, 1969):

$$J = \frac{H'}{\ln(S)} \tag{2}$$

where H' is the species diversity index, and S is the number of species.

Data Analysis

Normality of continuous dataset including species diversity indices, number of species and abundance of species (p > 0.05) was done to determine the exact statistical tests to use (i.e., parametric or non-parametric test). Seasonal differences in total abundance were tested using independent sample t-tests (Kolding, 1993). Independent sample t-test was applied to test for significant differences in diversity and evenness between wet and dry seasons (Zar, 2010). To determine variation in fish assemblage composition, Bray–Curtis similarity matrices were generated from square-root transformed abundance data, a transformation recommended to reduce the influence of highly abundant species while retaining ecological information (Clarke & Gorley, 2015). Non-metric multidimensional scaling (NMDS) was employed to visualise ordination of monthly samples. This is a technique widely used in fisheries ecology to detect community-level patterns (Legendre & Legendre, 2012). Similarity percentage (SIMPER) analysis was used to assess species contributing most to within-season similarity and between-season dissimilarity. SIMPER is useful in fisheries studies as it shows dominant and indicator species that structure assemblages (Braimah, 2000; Clarke & Gorley, 2015). Analysis of similarity (ANOSIM) was done to test for significant differences in assemblage composition between wet and dry seasons, using 999 permutations (Clarke & Warwick, 2001; Kolding & van Zwieten, 2012). PRIMER 6 was used to estimate the diversity indices and perform the multivariate analysis including ANOSIM, SIMPER and NMDS.

RESULTS

Species Abundance and Diversity Indices

A total of 42 fish species representing 12 families and 21 genera was recorded in Stratum VII of Lake Volta during the study period. Figure 2 shows the abundance of species with more than 10 individuals recorded. The assemblage was dominated by Claroteidae (*Chrysichthys walkeri, C. nigrodigitatus,* and *C. auratus*), Mochokidae (*Synodontis sorex, S. ocellifer,* and *S. clarias*), and Cichlidae (*Coptodon zillii, Sarotherodon galilaeus, Oreochromis niloticus, Hemichromis bimaculatus,* and *H. fasciatus*). These dominant families collectively accounted for more than 70% of total catches. Four species including *Chrysichthys walkeri* (5,409 individuals), *C. nigrodigitatus* (1,901), *Schilbe mystus* (1,780; Schilbeidae), and *Coptodon zillii* (1,599) were consistently dominant, each contributing over 10% of the total catch (Figure 2). Rare taxa, including representatives of Mormyridae (*Marcusenius senegalensis, Mormyrus macrophthlamus, Mormyrops anguilloides, Brienomyrus niger, Hyperopisus bebe,* and *Penollula leonensis*), Polypteridae (*Polypterus senegalus*), Arapaimidae (*Heterotis niloticus*), and Malapteruridae (*Malapterurus electricus*), accounted for less than 1% of total abundance.

Thirty fish species were recorded during both wet and dry seasons with dry and wet seasons recording 37 species and 35 species, respectively (Table 1). Species such as *Synodontis violaceus, Marcusenius psittaccus, Barbus callipterus,* and *Brycinus macrolepidotus* were absent during the wet season but present in the dry season. However, *Heterotis niloticus, Distichodus brevipinnis, Malapterurus electricus, Synodontis gambiensis, Marcusenius abadi, Hyperopisus bebe* and *Brienomyrus niger* were only recorded during the dry season.

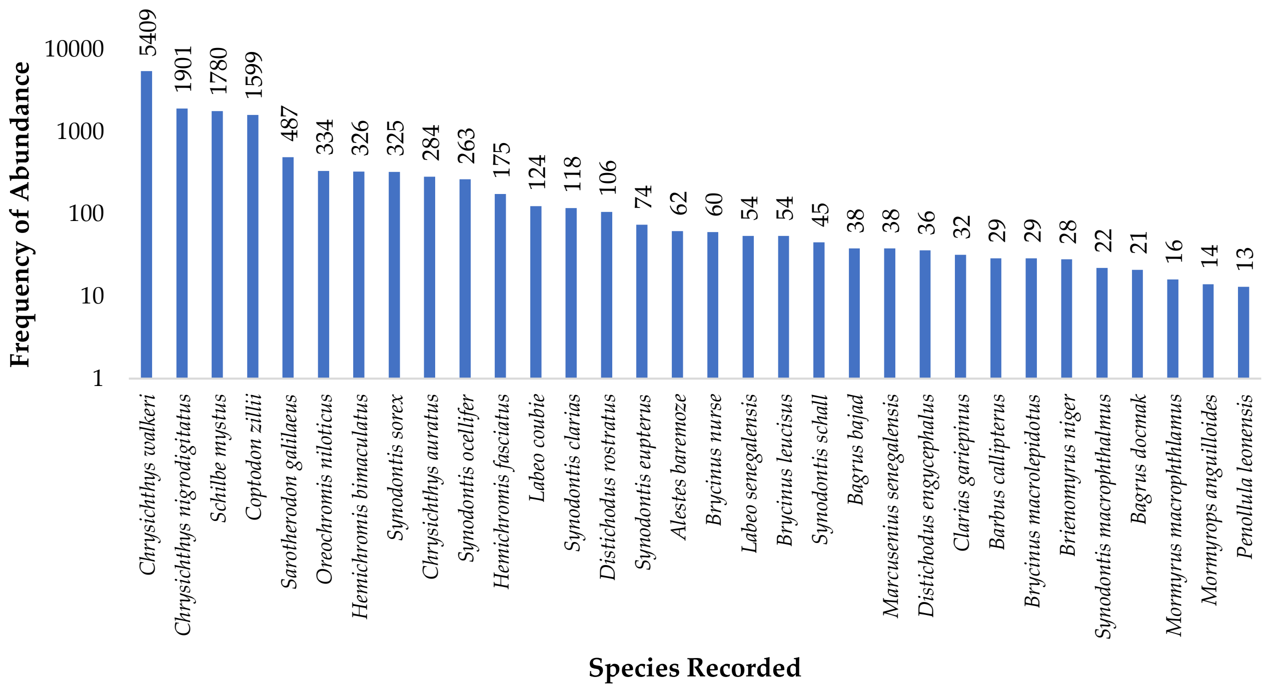

Figure 2. Frequency of abundance for species record during the study period (n > 10)

Table 1. List of available freshwater fishes during the seasonal periods, wet and dry. Each species is identified by its scientific name, common English name, percentage abundance and the presence (+) and absence (-) in each season

Order	Family	Species	English Name	Abundance (%)	Wet	Dry
Characiformes	Alestidae	*Alestes baremoze*	Pebbly fish	0.44	+	+
		Brycinus nurse	Nurse Tetra	0.43	+	+
		Brycinus leucisus	Yellow Tetra	0.39	+	+
		Brycinus macrolepidotus	True big scale tetra	0.21	+	-
Osteoglossiformes	Osteoglossidae	*Heterotis niloticus*	African Arowana	0.03	-	+
Siluriformes	Bagridae	*Bagrus bajad*	Black nile catfish	0.27	+	+
		Bagrus docmak	Bayad catfish	0.15	+	+
Perciformes	Cichlidae	*Coptodon zillii*	Redbelly tilapia	11.46	+	+
		Sarotherodon galilaeus	Mango tilapia	3.49	+	+
		Oreochromis niloticus	Nile tilapia	2.39	+	+
		Hemichromis bimaculatus	African jewelfish	2.34	+	+
		Hemichromis fasciatus	Five spot cichlids	1.25	+	+
Siluriformes	Clariidae	*Clarias gariepinus*	African Sharptooth catfish	0.23	+	+
	Claroteidae	*Chrysichthys walkeri*	Claroteid catfish	38.77	+	+
		Chrysichthys nigrodigitatus	African forktail catfish	13.63	+	+
		Chrysichthys auratus	Golden Nile perch	2.04	+	+
Cypriniformes	Cyprinidae	*Labeo coubie*	African carp	0.89	+	+
		Labeo senegalensis	Senegal carp	0.39	+	+
		Barbus callipterus	Clipper Barb	0.21	+	-
Characiformes	Distichodontidae	*Distichodus rostratus*	Grass eater	0.76	+	+
		Distichodus engycephalus	Perch	0.26	+	-
		Distichodus brevipinnis	Shortfin Distichodus	0.01	-	+
Siluriformes	Malapteruridae	*Malapterurus electricus*	Electric catfish	0.01	-	+
	Mochokidae	*Synodontis sorex*	Upside down catfish	2.33	+	+
		Synodontis ocellifer	Ocellated Synodontis	1.89	+	+
		Synodontis clarias	Red tailed Synodontis	0.85	+	+
		Synodontis eupterus	Featherfin Synodontis	0.53	+	+
		Synodontis schall	Nile squeaker	0.32	+	+
		Synodontis macrophthalmus	Squeaker catfish	0.16	+	+
		Synodontis batensoda	Giant upside-down catfish	0.05	+	+
		Synodontis violaceus	Upside down catfish	0.04	+	-
		Synodontis gambiensis	Upside down catfish	0.04	-	+
Mormyriformes	Mormyridae	*Marcusenius senegalensis*	Djebba mormyrid	0.27	+	+
		Brienomyrus niger	Elephantfish	0.20	-	+
		Mormyrus macrophthlamus	Elephant snout	0.11	+	+
		Mormyrops anguilloides	Cornish jack	0.10	+	+
		Penollula leonensis	Guinean sprat	0.09	+	+
		Marcusenius abadi	Djebba moryrid	0.06	-	+
		Hyperopisus bebe	Bebe mormyrid	0.04	-	+
		Marcusenius psittaccus	Psittacus elephantfish	0.04	+	-
Polypteriformes	Polypteridae	*Polypterus senegalus*	Senegal Bichir	0.06	+	+
Siluriformes	Schilbeidae	*Schilbe mystus*	African Butter fish	12.76	+	+

Table 2. Similarity percentage (SIMPER) analysis of species contributing to similarity and dissimilarity of the total catch (Average dissimilarity = 35.29)

Species	Group Dry	Group Wet				
	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Synodontis sorex	1.57	0.36	4.61	2.11	13.06	13.06
Chrysichthys auratus	1.23	0.38	4.24	1.23	12.02	25.07
Chrysichthys walkeri	1.61	2.5	3.99	0.88	11.29	36.37
Schilbe mystus	1.5	1.59	3.73	1.05	10.58	46.95
Hemichromis fasciatus	0.32	1.02	3.33	2.09	9.45	56.39
Synodontis ocellifer	0.92	0.1	3.16	1.27	8.96	65.35
Hemichromis bimaculatus	0.6	0.77	3.1	1.2	8.77	74.12
Sarotherodon galilaeus	1.05	1.29	2.44	1.06	6.92	81.04
Chrysichthys nigrodigitatus	2.04	1.97	2.37	1.23	6.72	87.76
Oreochromis niloticus	1	1.06	2.3	1.08	6.52	94.27

Species Diversity Indices

The mean species evenness for the wet and dry seasons was 0.997 ± 0.0003 and 0.998 ± 0.0002, with no significant difference (Sample t-test, df = 9, p = 0.058). Mean Shannon index for both wet and dry seasons was 2.05 ± 0.05 and 2.06 ± 0.13, with no significant difference (Sample t-test, df = 9, p = 0.483). Significantly, higher number of fish individuals ($p < 0.05$) were observed during the wet season (1580 ± 350 individuals), while a lower number of fish individuals was recorded during the dry season (722 ± 438 individuals). Sample t-test showed no significant difference in abundance of species between the wet and dry seasons (df = 6, p = 0.176).

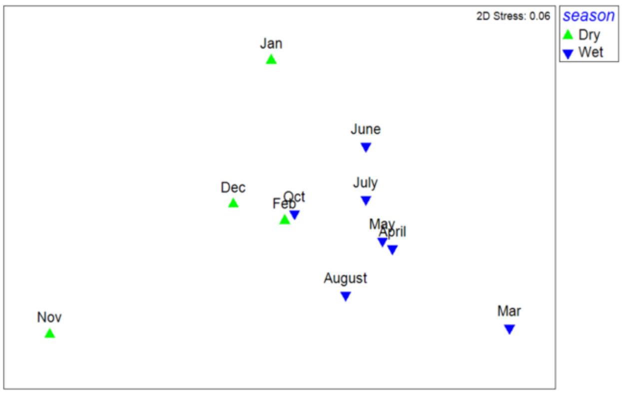

Figure 3. Non metric multidimensional scaling plot (NMDS) of species abundance data from stratum VII of Lake Volta, transformed using fourth root and analyzed using Bray-Curtis similarity resemblance.

Multivariate Analysis

A two-dimensional nonmetric multidimensional scaling (2D NMDS) analysis showed that fish samples from dry and wet seasons were grouped into two distinct groups (Figure 3). The first group represented fish samples from both wet season and dry seasons with the exception of samples from November. In contrast, the second group consisted of the fish samples from November which is part of the dry season (Figure 3). The configuration pattern was supported by an excellent stress value of 0.06.

Dominant And Rare Species Driving Seasonal Differences

The SIMPER analysis was done to assess seasonal variation in fish community between the dry and wet seasons. The average dissimilarity between the dry and wet seasons was 35.29% (Table 2). Four species that greatly contributed to the dissimilarity were *Synodontis sorex* (13.06%), *Chrysichthys auratus* (12.02%), *Chrysichthys walkeri* (11.29%) and *Schilbe mystus* (10.58 %). Analysis of similarity (ANOSIM) between wet and dry seasons indicated a significant difference in abundance of species between the two seasons with a correlation of 35.9% at p-value of 0.015 at 330 permutations (Table 2).

DISCUSSION

A total of 42 fish species was recorded across Stratum VII of Lake Volta, with 37 species in the dry season and 35 in the wet season. Comparable studies on species diversity have been reported from Lake Volta, with 42 fish species (37 dry, 35 wet) and 41 species (36 dry, 34 wet) by Akongyuure et al. (2017) and Mensah et al. (2019), respectively. The slightly higher richness in the dry season may be linked to habitat contraction, which tends to concentrate fish populations and increase the likelihood of detecting more species in catches (Akongyuure et al., 2017). In contrast, during the wet season, flood pulses expand habitats and disperse fish across wider areas, thereby reducing catch diversity despite ongoing recruitment (Mensah et al., 2019). Overall, the species richness reflects the ecological heterogeneity of tropical reservoirs, where seasonal hydrological cycles strongly influence recruitment and productivity (Kolding, 1993; Agostinho et al., 2007).

The Shannon diversity and evenness indices for wet and dry seasons showed no significant seasonal differences. This aligns with studies by Mensah et al. (2019) and FAO (2003) from Ghana, as well as Scarabotti et al. (2017) from South America, who reported Shannon diversity values around 2.0 and high species evenness (>0.8). These scholars also documented no significant seasonal differences between wet and dry seasons. This may suggest that while abundance varies, the distribution of individuals among species remains relatively stable. Such stability could indicate resilience within fish assemblages in Lake Volta, even in the presence of human activities that may affect aquatic ecosystems (Braimah, 2000). Furthermore, while diversity indices remained stable, previous studies have cautioned that sustained fishing pressure on dominant taxa in Lake Volta may alter assemblage structure over time (Braimah, 2000; Nunoo et al., 2015). From an ecological standpoint, the stable diversity indices suggest that management strategies should not only focus on overall species richness but also integrate rare species into conservation measures to prevent declines in these fewer common taxa.

There was a high seasonal variation in species abundance between seasons. From the study, wet season catches were consistently higher than those recorded during the dry season. This finding was similar to observations from Lake Volta by Mensah et al. (2019), Béné (2007), and FAO (2003), as well as other tropical reservoirs (Agostinho et al., 2007). A potential explanation may be the influence of flood pulses, which enhance recruitment and productivity during the wet season, while dry season restrictions in habitats limit catches (Kolding & van Zwieten, 2012). Similarly, Mensah et al. (2019) documented that fish catches in Lake Volta peak in the wet season (July to October) as a result of post-flood recruitment pulses, whereas during the dry season (November, December, January, and February), reduced catches are predominant due to lower inflows and contraction of aquatic habitats. These findings align with ecological theory that connects tropical reservoir productivity to seasonal hydrology (Agostinho et al., 2007; FAO, 2022). Although wet season catches were consistently higher, studies have shown that fishing effort in Lake Volta tends to concentrate during these periods, which may compound natural hydrological effects (FAO, 2003; Béné, 2007).

Variation in climatic patterns, evinced through irregular rainfall, prolonged droughts, or unpredictable flood timing, can destabilize catches, income, and food security for fishing communities (Halls & Welcomme, 2004; Agostinho et al., 2007). In tropical reservoirs such as Lake Volta, hydrological cycles driven by rainfall and flood pulses determine recruitment success, habitat availability, and catch composition (Béné, 2007; Mensah et al., 2019). Thus, any disruption in hydrological cycles, whether from climate change or dam regulation, may translate into livelihood vulnerability. Overall, the seasonal fluctuations observed in Lake Volta not only indicate ecological processes but also highlight the socio-economic vulnerability of artisanal fisheries under changing climatic regimes (Scarabotti et al., 2017). To support the sustainability of catches and stabilize household incomes, precautionary measures such as seasonal closures or effort adjustments during low-abundance months could be considered by the Fisheries Commission.

Multivariate analyses (NMDS, ANOSIM) revealed significant seasonal differences in assemblage composition. This was consistent with studies showing that variation in seasonal hydrology and environmental drivers influence fish community shifts in tropical and subtropical floodplain systems (Halls & Welcomme, 2004; Arias et al., 2014; Scarabotti et al., 2017). From the multivariate analysis, November emerged as an outlier, clustering separately from other months, likely reflecting transitional hydrological conditions. According to Scarabotti et al. (2017), transitional months often coincide with shifts in water level, turbidity, and dissolved oxygen, which can change assemblages by favouring floodplain specialists or newly recruited juveniles. Similar findings in Lake Volta have been documented, where seasonal hydrology influences significant changes in catch composition and abundance, especially during post-flood periods (Mensah et al., 2019). Thus, the distinct clustering of November samples potentially indicates that species assemblages restructure in response to changing hydrological drivers.

SIMPER analysis showed *Synodontis sorex*, *Chrysichthys auratus*, *Schilbe mystus*, and *Hemichromis fasciatus* as key contributors to seasonal dissimilarity. Studies from Ghanaian inland waters reported that *Synodontis* spp. and *Chrysichthys* spp. were dominant contributors to seasonal differences in assemblage composition in the White Volta River (Abobi et al., 2014), while *Schilbe mystus* and tilapiine cichlids (*Coptodon* spp., *Hemichromis* spp.) were key contributors to seasonal dissimilarity in Lake Volta catches (Mensah et al., 2019). The prominence of these seasons in driving seasonal dissimilarity aligns with reports that these species are both ecologically sensitive and heavily exploited in Lake Volta (Abobi et al., 2014; Mensah et al., 2019). The dominance of a few taxa does not only highlight their ecological importance but also reflects patterns of selective exploitation reported in Lake Volta (Braimah, 2000; Nunoo et al., 2015). In other tropical reservoir studies, Agostinho et al. (2007) and Scarabotti et al. (2017) also recorded *Synodontis* spp., *Chrysichthys* spp., *Schilbe* spp., and *Hemichromis* spp. as major contributors to seasonal dissimilarity, underscoring the role of hydrology in shaping fish assemblages. These species are known to be sensitive to water level fluctuations and habitat shifts, reinforcing the importance of hydrological cycles in structuring fish communities (Kolding, 1993).

Seasonal hydrological cycles in tropical lakes and rivers alter littoral vegetation, floodplain connectivity, and dissolved oxygen concentration, which directly affect the distribution and abundance of these species. Abobi et al. (2014) and Agostinho et al. (2007) documented that *Synodontis* spp. and *Chrysichthys* spp. are benthic catfishes with strong reliance on floodplain habitats for feeding and reproduction; hence their abundance tends to increase during rising water levels when food resources expand, but declines during drawdown periods. *Schilbe mystus* is a pelagic species that feeds in open water habitats during floods, while *Hemichromis* spp. are cichlids that inhabit vegetated littoral zones for spawning and juvenile recruitment, making them more susceptible to seasonal habitat contraction (Mensah et al., 2019). Given these ecological dynamics, fisheries monitoring programmes could incorporate indicators such as assemblage composition of these species to detect early signs of ecosystem stress. Such monitoring would enable managers to anticipate seasonal shocks and design precautionary, sustainable interventions for managing these fish populations.

Ecological and Management Implications

The dominance of a few taxa, coupled with seasonal declines in abundance, highlights the ecological importance of certain species and the potential vulnerability of assemblages to recruitment variability. Artisanal fisheries in Stratum VII rely heavily on *Chrysichthys* spp. and tilapiine cichlids, which may be sensitive to recruitment failures during dry seasons (Braimah, 2000; Nunoo et al., 2015). The presence of rare species further emphasizes the need for habitat protection, particularly littoral vegetation and submerged structures that serve as nursery grounds (Agostinho et al., 2007; Kolding & van Zwieten, 2012). From a management perspective, these results underscore the importance of incorporating ecological cycles into fisheries governance. Current policies in Ghana emphasize gear regulation, yet seasonal dynamics remain under-addressed (Fisheries Commission Ghana, 2023). Adaptive measures such as seasonal closures, habitat restoration, and diversification of livelihoods could help buffer inland fisheries against seasonal shocks when carefully implemented (Ameworwor et al., 2019; FAO, 2022). Policymakers may consider: i) integrating ecological cycles into fisheries management plans, ii) restructuring credit schemes to align with ecological cycles, and iii) identifying and implementing alternative livelihoods and post-harvest technologies that coincide with seasonal fluctuations.

Limitation to Study

The outcomes of this study should be interpreted with caution, as catch and effort data were not collected. This limitation prevented the derivation of catch per unit effort (CPUE), a widely recognized index of fish abundance. Without CPUE, the results primarily reflect species composition and relative abundance patterns rather than standardized measures of stock size, underscoring the need for future studies to integrate effort-based metrics for more robust assessments of fishery dynamics.

CONCLUSION

This study provides the first detailed ecological assessment of seasonal variation in fish species diversity and abundance in Stratum VII of Lake Volta, Ghana. A total of 42 species was recorded, with assemblages dominated by Claroteidae, Mochokidae, and Cichlidae. Four species, including *Chrysichthys walkeri, C. nigrodigitatus*, *Schilbe mystus*, and *Coptodon zillii*, accounted for more than half of total catches. Seasonal abundance patterns revealed significantly higher catches during the wet than dry season. Diversity indices remained stable, with Shannon diversity index values marginally exceeding 2.0 and evenness consistently above 0.99. Multivariate analyses confirmed moderate but significant seasonal differences in community composition, driven largely by *Synodontids*, *Chrysichthyines*, and *Tilapiines* spp. The findings from the study present three key implications for Lake management. Firstly, the dominance of a few taxa highlights the ecological importance of these species and their potential vulnerability to recruitment variability, suggesting the need for precautionary monitoring and adaptive effort management. Secondly, the persistence of rare families such as Mormyridae, Polypteridae, Arapaimidae, and Malapteruridae underscores the importance of protecting littoral habitats and nursery grounds that sustain ecological heterogeneity. Thirdly, the primacy of richness in shaping diversity indicates that conservation strategies should prioritize maintaining species counts through habitat restoration, seasonal closures, and regulation of destructive gears, implemented in ways that align with ecological cycles.

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Compliance with Ethical Standards

Authors’ Contributions

SKKA: Conceptualization, Investigation, Data curation, Writing – original draft

AO: Investigation, Formal analysis, Writing – original draft

PKOD: Methodology, Formal analysis

AKA: Writing – original draft

All authors critically reviewed and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

Funding

Not applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author, SKKA, upon reasonable request.

AI Disclosure

The authors confirm that no generative AI was used in writing this manuscript or creating images, tables, or graphics.

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