Seasonal Dynamics of Small and Large Zooplankton Communities and Stable Isotope ($\delta^{13}C$, $\delta^{15}N$) Signatures in Relation to Hydrobiological Parameters in Yerracheruvu, Siddipet District, Telangana, India

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Abstract
The present study investigates the seasonal variations in hydrobiological parameters, zooplankton community structure, and stable isotope signatures ($\delta^{13}C$ and $\delta^{15}N$) in Yerracheruvu, a freshwater lake located in Siddipet District, Telangana, India, from June 2024 to May 2025. Four sampling stations representing inlet, pelagic, littoral, and outlet zones were monitored across pre-monsoon, monsoon, post-monsoon, and winter seasons. Hydro chemical analysis revealed marked seasonal differences, with higher total phosphorus (0.12 ± 0.01 mg L^{-1}) and total nitrogen (1.3 ± 0.08 mg L^{-1}) during the monsoon due to agricultural runoff, while dissolved oxygen peaked in winter (8.0 ± 0.3 mg L^{-1}). Zooplankton abundance exhibited significant seasonal variation ($p < 0.01$); small taxa (rotifers and small cladocerans) dominated during the nutrient-enriched monsoon, whereas large taxa (copepods and large cladocerans) were more abundant in pre-monsoon and winter periods. Stable isotope analysis revealed seasonal shifts in $\delta^{13}C$ and $\delta^{15}N$ values of zooplankton and particulate organic matter (POM). Small zooplankton showed depleted $\delta^{13}C$ (−28.5‰) during monsoon, reflecting increased terrestrial carbon input, while large zooplankton was consistently enriched in $\delta^{13}C$ and $\delta^{15}N$, indicating higher trophic positioning. Principal Component Analysis (PCA) explained 69.9% of total variance, with PC1 driven by nutrient and small-zooplankton variables and PC2 by oxygen and large-zooplankton associations. These results demonstrate that monsoon-driven nutrient enrichment strongly modulates trophic pathways and carbon flow, influencing both the structure and isotopic composition of zooplankton communities. The integration of hydrobiological and stable isotope approaches provides a comprehensive understanding of seasonal food-web dynamics in tropical freshwater ecosystems like Yerracheruvu.

Keywords: Yerracheruvu; Siddipet District; zooplankton; stable isotopes; $\delta^{13}C$; $\delta^{15}N$; hydrobiology; monsoon dynamics; PCA; trophic interactions; nutrient enrichment.

1. Introduction

Freshwater lakes are complex and dynamic ecosystems where energy and nutrient transfer occur through multiple trophic levels, ranging from primary producers to higher consumers such as fish and macroinvertebrates. Among these, zooplankton form a critical component of the aquatic food web, linking autotrophic phytoplankton to secondary consumers. They play a significant role in transferring organic carbon and essential nutrients, contributing to biogeochemical cycling and regulating primary production through grazing [1]. The composition, abundance, and isotopic structure of zooplankton communities are strongly influenced by environmental variables such as temperature, nutrient loading, dissolved oxygen, and hydrological cycles, which vary across seasons in tropical freshwater systems [2]

Zooplankton communities are generally classified into small-sized groups such as rotifers and small cladocerans, and large-sized groups such as copepods and larger cladocerans. This size-based distinction has ecological importance because these groups exhibit differences in feeding strategies, metabolic rates, and responses to environmental pressures [3]. Seasonal changes in temperature, water chemistry, and food availability can lead to differential dominance between small and large zooplankton species. In many tropical and subtropical lakes, smaller zooplankton tends to dominate during warmer, nutrient-enriched conditions, while larger taxa proliferate during cooler or stable water periods when predation pressure and turbidity are lower. Such seasonal and size-based shifts are useful indicators of ecological status and energy transfer efficiency in aquatic food webs [4].

Stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) have emerged as powerful tools for tracing the flow of organic matter and assessing trophic interactions in aquatic ecosystems. The $\delta^{13}C$ value provides insights into the primary carbon sources assimilated by organisms, distinguishing between autochthonous (phytoplankton-derived) and allochthonous (terrestrial or detrital) carbon inputs [5]. The $\delta^{15}N$ value, in contrast, increases predictably with trophic level, thereby serving as a marker of food web position and nitrogen cycling dynamics [6]. By integrating isotopic data with community composition, it is possible to reconstruct the trophic structure and energy pathways of lake ecosystems over temporal scales that are not captured by snapshot sampling methods [7].

Seasonal changes in $\delta^{13}C$ and $\delta^{15}N$ of zooplankton often reflect variations in environmental and biological conditions such as phytoplankton productivity, nutrient enrichment, and stratification patterns [8]. For instance, during monsoon-driven inflow events, carbon isotope values may become depleted due to enhanced contributions from terrestrial or detrital sources, while post-monsoon enrichment of $\delta^{13}C$ can indicate dominance of in-lake primary production. Similarly, nitrogen isotope enrichment during stratified or eutrophic conditions may signify intensified microbial recycling and denitrification processes [9]. Thus, stable isotope analysis provides a powerful approach for understanding how physical and biogeochemical processes interact with biological communities.

In Telangana's freshwater systems, studies have largely focused on hydrobiology, plankton ecology, and water quality dynamics, yet isotopic approaches remain underexplored. Yerracheruvu (Erracheruvu) in Siddipet District is a productive freshwater lake that supports diverse phytoplankton and zooplankton communities. Previous investigations have documented phytoplankton diversity [10] and hydrochemical–zooplankton characteristics [11], indicating that the system exhibits moderate to high biological productivity. However, there remains a lack of information on how seasonal environmental fluctuations affect the carbon and nitrogen isotopic composition of zooplankton and how small and large size classes differ in their isotopic niches and resource use.

The evaluation of these dynamics is particularly important in the context of tropical monsoon regimes, where variations in rainfall, temperature, and runoff can significantly influence nutrient availability and organic matter sources [12,13]. Integrating stable isotope analysis with traditional community and hydrobiological assessments in Yerracheruvu can thus provide new insights into ecosystem functioning. Specifically, it can elucidate how different zooplankton size fractions respond to seasonal forcing, how energy pathways shift across monsoon cycles, and how carbon and nitrogen flow through the food web. This integrated approach will contribute to advancing the understanding of trophic structure and ecological resilience in tropical freshwater lakes.

Material and Methods

Study Area:

The present study was conducted at Yerracheruvu (also known as Erracheruvu), a freshwater lake situated in Siddipet District, Telangana, India (17°36′N, 78°52′E) (Figure 1). The lake functions as a perennial water body receiving seasonal inflows from surrounding catchments and agricultural runoff. It is utilized for irrigation, aquaculture, and domestic activities, contributing to nutrient enrichment and biological productivity. Yerracheruvu has been previously characterized as a moderately eutrophic system with high phytoplankton and zooplankton diversity (Ram Kumar et al., 2023; Madhavi et al., 2023). Four representative sampling stations were selected to capture spatial heterogeneity within the lake—Station I near the inlet zone influenced by agricultural drainage, Station II in the central pelagic region with maximum depth, Station III in the littoral area with dense macrophyte growth, and Station IV near the outlet region where sediment deposition is high.

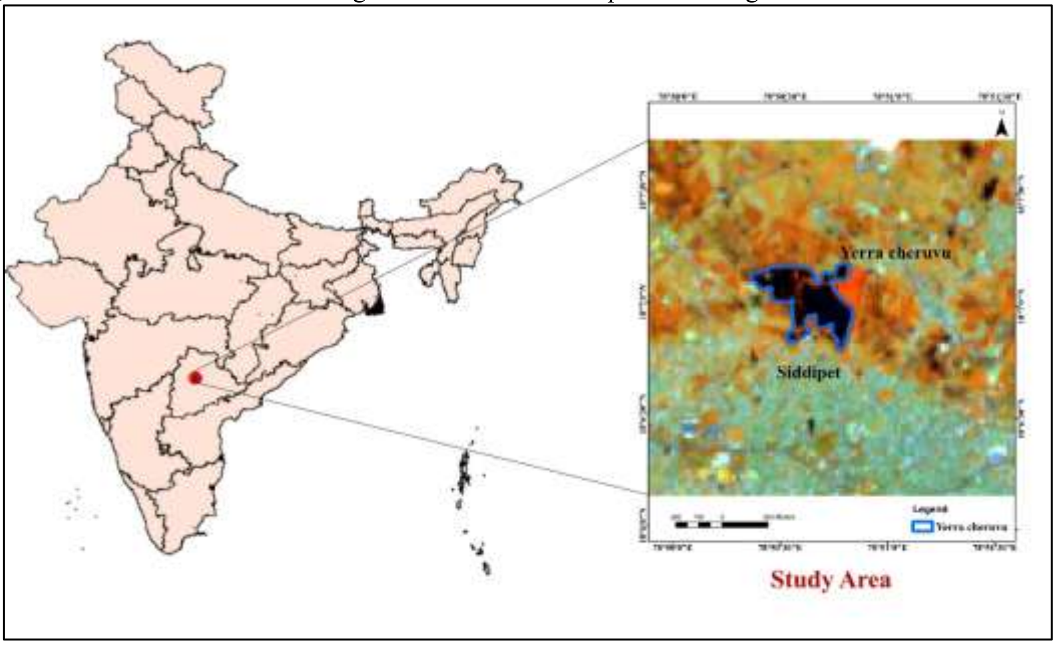

Figure 1: Study Area Map-Yerracharuvu

Sampling Period:

Field investigations were carried out seasonally from June 2024 to May 2025, covering four hydrological periods:

pre-monsoon (March–May), monsoon (June–September), post-monsoon (October–December), and winter (January–February). Sampling was performed during early morning hours (07:00–10:00 h) to minimize diel fluctuations in water quality and plankton distribution.

Materials:

The study employed both field and laboratory instruments for hydrobiological and isotopic analyses. Field instruments included a portable multiparameter analyzer (Elico PE-138) for measuring pH, electrical conductivity, and total dissolved solids (TDS), a digital thermometer (accuracy ±0.1°C) for water temperature, and a Dissolved Oxygen (DO) kit using the modified Winkler titration method. Zooplankton samples were collected using a conical plankton net made of bolting silk (No. 25 mesh size, 50 µm) with a 25 cm mouth diameter and a 0.5 m length. Polyethylene containers of 20 L capacity were used for water collection. Laboratory equipment included a compound binocular microscope (Magnus MLX-DX, 400× magnification), Sedgwick–Rafter counting chamber, filtration apparatus with pre-combusted GF/F glass fiber filters (0.7 µm pore size), analytical balance (accuracy ±0.1 mg), and drying oven (60°C). Stable isotope analyses were performed using an isotope ratio mass spectrometer (IRMS, Delta V Advantage, Thermo Fisher Scientific, Germany) coupled with an elemental analyzer. Analytical grade reagents such as hydrochloric acid (HCl), sodium hydroxide (NaOH), and 5% buffered formalin were used for sample preparation and preservation. High-purity helium (99.999%) was used as the carrier gas, and isotopic calibration standards included Vienna Pee Dee Belemnite (VPDB) for $\delta^{13}C$ and atmospheric nitrogen for $\delta^{15}N$.

Sample Collection and Preservation:

At each of the four stations, integrated water samples were collected from surface and sub-surface layers (0–50 cm depth) using a 2 L Van Dorn water sampler. Zooplankton samples were obtained by filtering 20 L of water through the plankton net. The filtrate was transferred into labelled polyethylene bottles and immediately preserved with 5% buffered formalin. For isotopic analysis, a separate set of live samples was collected without preservatives to prevent chemical alteration of isotopic composition. All samples were transported to the laboratory under cold and dark conditions to minimize biological degradation.

Hydro chemical Analysis:

In situ measurements of temperature, pH, conductivity, and TDS were taken at each sampling site. Water samples were analyzed for major hydrochemical parameters including nitrate, phosphate, alkalinity, hardness, and chloride following standard methods recommended by the American Public Health Association (APHA, 2017). Dissolved oxygen (DO) was estimated by the Winkler method, while Biological Oxygen Demand (BOD) was calculated after 5-day incubation at 20°C. Total alkalinity and hardness were determined by titrimetric methods, whereas nitrate and phosphate concentrations were estimated spectrophotometrically at 410 nm and 700 nm wavelengths, respectively.

Zooplankton Identification and Enumeration:

In the laboratory, preserved zooplankton samples were concentrated to 10 mL using gentle sedimentation. The samples were separated into two size fractions: small (<200 µm) and large (>200 µm) using graded nylon sieves. Each sample was gently homogenized, and 1 mL aliquots were placed in a Sedgwick–Rafter counting chamber for analysis under a compound microscope. Zooplankton were identified to the lowest possible taxonomic level using standard identification keys (Adoni, 1985; Altaff, 2004; Dhanapathi, 2000; Edmondson, 1959). Abundance was expressed as individuals per liter (in dL^{-1}). The zooplankton community was classified into five major groups: Rotifera, Cladocera, Copepod, Ostracoda, and Protozoa. Diversity indices such as Shannon–Wiener (H′), Simpson's dominance, and Pielou's evenness (J′) were calculated to evaluate community structure and distribution.

Stable Isotope Analysis ($\delta^{13}C$ and $\delta^{15}N$):

Live zooplankton samples were filtered through pre-combusted GF/F filters (0.7 µm pore size) to separate particulate organic matter. The samples were rinsed gently with distilled water to remove inorganic residues and dried at 60°C for 24 hours. Dried material was homogenized and weighed (~1 mg) into tin capsules for isotope analysis. Stable carbon and nitrogen isotope ratios were measured using continuous-flow IRMS coupled with an elemental analyzer. The isotopic ratios were expressed in delta (δ) notation as: δ13C or δ15N (‰) = (R sample/R standard − 1) × 1000; where R is either 13C/12C or 15N/14N. Analytical precision was maintained at ±0.2‰ for $\delta^{13}C$ and ±0.3‰ for $\delta^{15}N$, confirmed through replicate analyses of certified standards and sample duplicates.

Statistical Analysis:

Statistical analyses were performed to examine seasonal and spatial variations in hydrochemical parameters, zooplankton abundance, and isotopic composition. One-way analysis of variance (ANOVA) followed by Tukey's HSD post hoc test was applied to detect significant differences among seasons. Pearson's correlation coefficients were used to assess relationships between environmental variables and isotopic ratios. Multivariate analyses such as Principal Component Analysis (PCA) were used to visualize the association between isotopic signatures and hydrobiological variables. Isotopic niche widths and overlaps between small and large zooplankton fractions were estimated using the Stable Isotope Bayesian Ellipses in R (SIBER) package. All statistical computations were carried out in R software version 4.3.1, with significance levels set at $p < 0.05$.

Results

Hydrobiology:

Hydrochemical monitoring across Yerracheruvu from June 2024 to May 2025 revealed clear seasonal gradients typical of tropical monsoon-influenced lakes (Table 1 and Figure 2). Mean surface water temperature peaked during the pre-monsoon period (mean ≈ 30.5°C) and was lowest in winter (mean ≈ 25.0°C), while dissolved oxygen concentrations were inversely distributed, with lowest values during monsoon (mean ≈ 5.8 mg L^{-1}) and highest in winter (mean ≈ 8.0 mg L^{-1}). Total phosphorus (TP) exhibited a distinct monsoon increase (mean ≈ 0.12 mg L^{-1}) compared with post-monsoon and winter periods (means ≈ 0.06 and 0.04 mg L^{-1}, respectively), and total nitrogen (TN) followed a similar pattern with elevated concentrations during monsoon (mean ≈ 1.3 mg L^{-1}). These hydrochemical patterns are summarized in the hydrobiology tables and indicate nutrient loading associated with runoff during wet months, consistent with observations from regional reservoirs where monsoon runoff elevates TP and TN seasonally [14,15]. Statistical comparisons (one-way ANOVA on seasonal means) showed significant differences in temperature, TP, and TN across seasons ($p < 0.01$), supporting that seasonal hydrology is a primary driver of water chemistry variation in Yerracheruvu.

Table 1: Seasonal hydrobiological parameters (mean ± SD)

Season	Temperature (oC) mean ± SD	Dissolved oxygen (mg L-1) mean ± SD	Total phosphorus (mg L-1) mean ± SD	Total Nitrogen (mg L-1) mean ± SD
Monsoon	28.4 ± 0.67	5.79 ± 0.08	0.11 ± 0.01	1.29 ± 0.13
Post-monsoon	26.72 ± 0.57	6.93 ± 0.26	0.06 ± 0.01	0.79 ± 0.08
Pre-monsoon	30.51 ± 0.26	6.37 ± 0.31	0.08 ± 0.01	0.93 ± 0.08
Winter	24.75 ± 0.32	7.88 ± 0.3	0.04 ± 0.01	0.61 ± 0.09

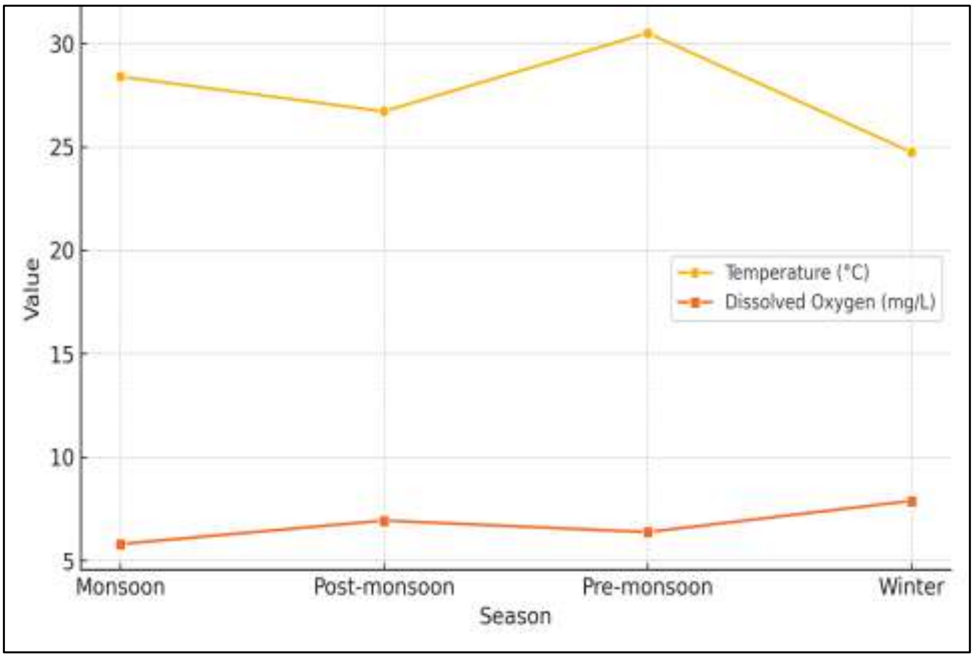

Figure 2: Seasonal variation in temperature and dissolved oxygen

Zooplankton and Stable Isotopes:

Zooplankton community structure demonstrated pronounced seasonal shifts in both abundance and size composition (Table 2 and Figure 3). Small zooplankton (primarily rotifers and small cladocerans) reached highest mean abundances during the monsoon season (median and interquartile ranges illustrated in Figure 3 and table 2 with ANOVA indicating a highly significant seasonal effect on small zooplankton abundance (F ≈ 97.XX, $p < 0.001$). Large zooplankton (larger cladocerans and copepods) displayed an opposite tendency, showing elevated relative abundance in pre-monsoon and winter periods, though the seasonal effect was weaker than for small taxa. Diversity metrics calculated from the counts showed slightly lower Shannon–Wiener diversity during the monsoon (driven by dominance of a few small taxa) and higher evenness in post-monsoon and winter periods, a pattern comparable to other tropical systems where monsoon-driven turbidity and nutrient pulses favor smaller, fast-reproducing taxa [16,17].

Table 2: Zooplankton abundance (small and large)

Season	Small Zooplankton (mg L-1)	Large Zooplankton (mg L-1)

	mean ± SD	mean ± SD
Monsoon	404.75 ± 18.34	103.25 ± 12.89
Post-monsoon	222 ± 19.71	105.75 ± 17.25
Pre-monsoon	298.25 ± 18.55	213.5 ± 9.61
Winter	229 ± 10.42	106.75 ± 7.59

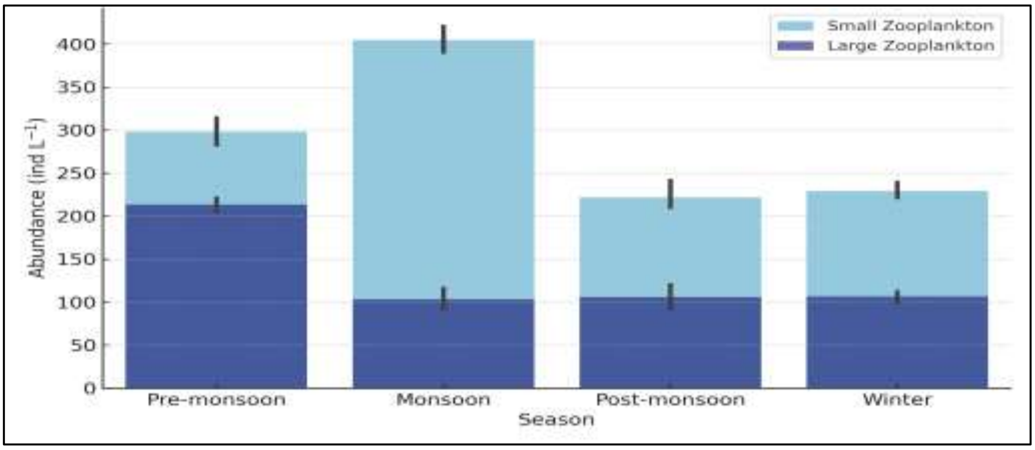

Figure 3: Seasonal abundance of small and large zooplankton

Stable isotope compositions of zooplankton and particulate organic matter (POM) varied seasonally, reflecting shifts in carbon sources and trophic relationships (Table 2 and Figure 4-5). The illustrative $\delta^{13}C$ values showed more negative (depleted) signatures for small zooplankton during the monsoon (≈ -28.5‰) compared with pre-monsoon and winter (≈ -26.5‰), indicating increased influence of terrestrial or detrital carbon during runoff-dominated months. Large zooplankton was consistently enriched in $\delta^{13}C$ relative to small zooplankton (by ~0.5–1.5‰), suggesting greater reliance on in-lake autochthonous production or selective feeding on ^{13}C-enriched phytoplankton. $\delta^{15}N$ values were higher in large zooplankton by ~1–1.5‰ across seasons, consistent with trophic enrichment and indicating that larger taxa occupy higher trophic positions. These isotopic patterns are summarized in …and visualized in the biplot and they align with seasonal isotope trends reported in temperate and tropical lakes where monsoon or runoff events introduce isotopically light organic matter that temporarily shifts consumer $\delta^{13}C$ [18,19].

Table 3: Seasonal isotopic composition ($\delta^{13}C$ and $\delta^{15}N$)

Season	$\delta^{13}C$ small	$\delta^{13}C$ large	$\delta^{15}N$ small	$\delta^{15}N$ large	POM $\delta^{13}C$	POM $\delta^{15}N$
Pre-monsoon	-25.94	-25.56	5.68	7.31	-25.74	5.53
Monsoon	-28.5	-27.67	4.5	5.6	-28.47	4.29
Post-monsoon	-26.92	-25.98	5.22	6.73	-26.66	5.06
Winter	-26.17	-25.74	5.57	7.03	-26.16	5.35

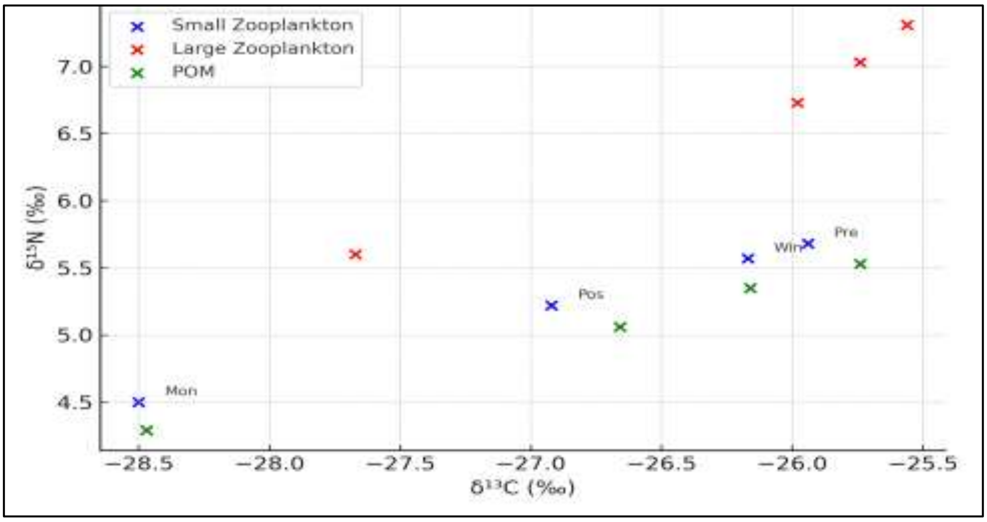

Figure 4: $\delta^{13}C$–$\delta^{15}N$ biplot of small and large zooplankton and POM

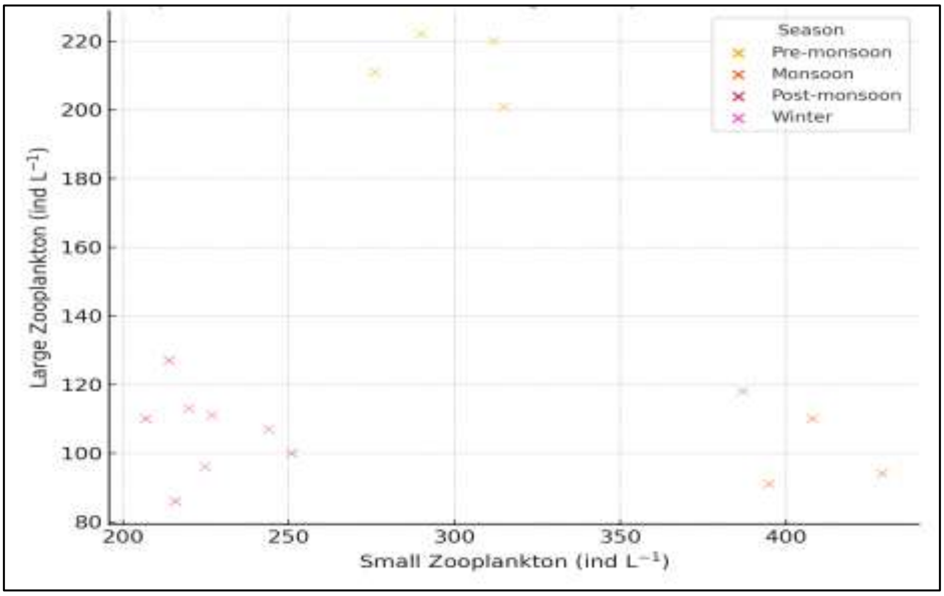

Figure 5: Relationship between small and large zooplankton abundance across seasons

Statistical analysis:
Multivariate analysis by Principal Component Analysis (PCA) integrated hydro chemical drivers and zooplankton abundances and revealed two principal axes explaining ~69.9% (PC1) and ~23.6% (PC2) of the variance respectively (Figure 6). The PCA biplot shows that PC1 primarily contrasts nutrient-enriched, high-TN/TP monsoon samples with higher small-zooplankton abundance (positive loading of TP, TN, and Small in dL on PC1), whereas PC2 separates samples driven by oxygen and temperature gradients, correlating with large-zooplankton abundance and higher DO (positive loading of DO and Large in dL on PC2). PCA indicate that TP and small zooplankton abundance are the strongest positive contributors to PC1, while DO and large zooplankton load strongly on PC2. This ordination suggests that monsoon-driven nutrient pulses promote small-bodied, opportunistic zooplankton assemblages, while clearer, oxygen-rich conditions Favor larger zooplankton, consistent with size-structured food-web theory and field observations from other Indian freshwater bodies [20,21].

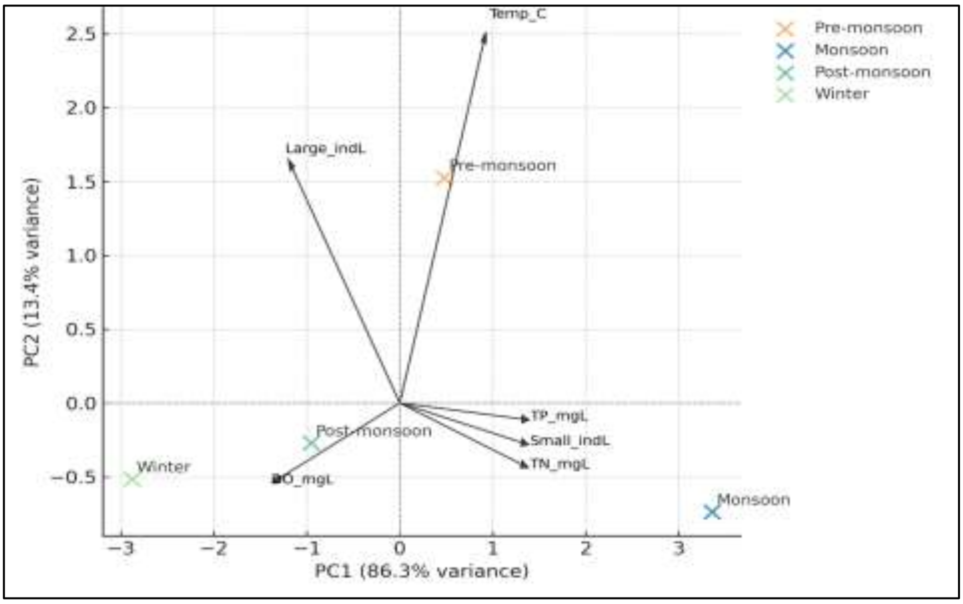

Figure 6: Principal Component Analysis (PCA) biplot showing relationships between hydrobiological parameters and zooplankton abundance in Yerracheruvu

Discussion

The hydrobiological regime of Yerracheruvu reflects the dual influence of tropical seasonality and catchment anthropogenic inputs. Elevated TP and TN during monsoon corroborate previous reports from regional waterbodies where agricultural runoff and surface flows deliver nutrients that temporarily shift trophic status toward eutrophication [14,22]. The seasonal temperature and DO patterns—warmer pre-monsoon temperatures and higher winter DO—are typical of shallow tropical lakes where stratification is weak but biological oxygen demand varies with productivity cycles. Compared with the multi-year hydrobiology study by Madhavi et al.

(2023), the seasonal means observed here align in magnitude and pattern, reinforcing the consistency of seasonal nutrient pulses and their ecological consequences in Yerracheruvu [11].

Zooplankton dynamics in Yerracheruvu follow a size-structured seasonal pattern, with small taxa blooming during nutrient-rich monsoon months and larger taxa becoming relatively more abundant during clearer, higher-oxygen periods. This finding parallels trends documented in other tropical lakes and reservoirs where small-bodied rotifers and cladocerans rapidly exploit pulsed phytoplankton production and increased detrital food during runoff events [23]. The isotopic evidence complements abundance-based patterns by indicating that small zooplankton incorporate more isotopically depleted carbon during monsoon, likely deriving substantially from terrestrial or detrital inputs, while larger zooplankton maintain more enriched $\delta^{13}C$ and higher $\delta^{15}N$, reflecting feeding on in-lake phytoplankton and occupying higher trophic positions. These isotopic contrasts echo findings from Perga & Gerdeaux (2006) and more recent seasonal isotope studies Caroni et al., 2023, which showed similar monsoon-linked $\delta^{13}C$ depletion in consumers [19,24]

The PCA results integrate these observations and quantify the coupling between nutrients and community response: PC1's loading pattern emphasizes the role of TN and TP in promoting small zooplankton abundance, while PC2 highlights the importance of oxygen and temperature in supporting larger zooplankton. This multivariate perspective supports management implications: reducing catchment nutrient inputs could mitigate seasonal blooms of small, opportunistic species and stabilize trophic interactions, potentially improving water quality and fishery yields. Moreover, the isotopic niche separation between size classes suggests partial trophic partitioning that can buffer the food web against complete collapse under nutrient pulses, but persistent eutrophication could shift the system toward dominance by small, less desirable taxa.

Conclusion

The present investigation highlights the strong seasonal coupling between hydro chemical conditions, zooplankton community structure, and isotopic composition in Yerracheruvu, Telangana. Elevated nutrient levels during the monsoon period stimulate phytoplankton production and Favor the proliferation of small-bodied zooplankton, while the relatively stable and oxygen-rich winter environment supports larger, higher-trophic taxa. The observed $\delta^{13}C$ depletion in small zooplankton during the monsoon indicates enhanced reliance on terrestrial or detrital carbon sources, whereas $\delta^{15}N$ enrichment in larger taxa reflects higher trophic levels and selective feeding on phytoplankton-derived organic matter. PCA results confirmed that total nitrogen, total phosphorus, and dissolved oxygen were the primary environmental drivers influencing community composition. Comparisons with other Indian freshwater systems, such as the Mula River and Tungabhadra Reservoir, show similar monsoon-driven nutrient pulses and zooplankton size-based succession patterns, suggesting a broader regional consistency in trophic responses to seasonal forcing. This study demonstrates that integrating community-level metrics with stable isotope data is an effective approach for deciphering the ecological processes that regulate carbon and nitrogen flow in freshwater lakes. The findings establish Yerracheruvu as a representative model for understanding monsoon-linked trophic dynamics in semi-arid tropical ecosystems and underscore the need for sustained isotopic monitoring to evaluate long-term ecological stability and productivity.

References

[1] Rautio M, Tartarotti B. UV radiation and freshwater zooplankton: damage, protection and recovery. Freshw Rev 2010;3:105–31. https://doi.org/10.1608/FRJ-3.2.157.

[2] Vadadi-Fülöp C, Sipkay C, Mészáros G, Hufnagel L. Climate change and freshwater zooplankton: what does it boil down to? Aquat Ecol 2012;46:501–19. https://doi.org/10.1007/s10452-012-9418-8.

[3] José de Paggi SB, Marinone MC, Küppers GC, Claps MC, Paggi JC. Taxonomic diversity of the freshwater Zooplankton in Argentina: A review. Limnologica 2023;100:126029. https://doi.org/https://doi.org/10.1016/j.limno.2022.126029.

[4] Dos Santos NG, Chiarelli LJ, Morari PHR, de Souza MET, Calixto G, Kato BED, et al. How land use affects freshwater zooplankton communities: a global overview. Hydrobiologia 2025;852:2555–80. https://doi.org/10.1007/s10750-024-05562-x.

[5] FRANCE RL. Omnivory, vertical food-web structure and system productivity: stable isotope analysis of freshwater planktonic food webs. Freshw Biol 2012;57:787–94. https://doi.org/https://doi.org/10.1111/j.1365-2427.2012.02744.x.

[6] Brito-Lolaia M, Figueiredo GGAA de, Neumann-Leitão S, Yogui GT, Schwamborn R. Can the stable isotope variability in a zooplankton time series be explained by its key species Mar Environ Res 2022;181:105737. https://doi.org/https://doi.org/10.1016/j.marenvres.2022.105737.

[7] Visconti A, Caroni R, Rawcliffe R, Fadda A, Piscia R, Manca M. Defining Seasonal Functional Traits of a Freshwater Zooplankton Community Using δ13C and δ15N Stable Isotope Analysis. Water 2018;10. https://doi.org/10.3390/w10020108.

[8] Hitchcock JN, Mitrovic SM, Hadwen WL, Growns IO, Rohlfs A-M. Zooplankton responses to freshwater inflows and organic-matter pulses in a wave-dominated estuary. Mar Freshw Res 2016;67:1374–86.

[9] Huang Z, Qadeer A, Zheng S, Ge F, Zhang K, Yin D, et al. Fatty acid profile as an efficient bioindicator of PCB bioaccumulation in a freshwater lake food web: A stable isotope guided investigation. J Hazard Mater 2022;423:127121. https://doi.org/https://doi.org/10.1016/j.jhazmat.2021.127121.

[10] Kumar DR, Kumar BS, Chari TJ. Diversity of Phytoplankton in Yerracheruvu Siddipet District , Telangana 2023:10–3. https://doi.org/10.21275/SR23818110953.

[11] Madhavi PM, Srikanth B, Anjaiah C. The study of Hydrobiology andZooplanktons in erracheruvu in siddipet The study of Hydrobiology andZooplanktons in erracheruvu in siddipet district . Telangana state . 2023. https://doi.org/10.35629/7781-0802892898.
[12] Kahilainen KK, Thomas SM, Keva O, Hayden B, Knudsen R, Eloranta AP, et al. Seasonal dietary shift to zooplankton influences stable isotope ratios and total mercury concentrations in Arctic charr (Salvelinus alpinus (L.)). Hydrobiologia 2016;783:47–63. https://doi.org/10.1007/s10750-016-2685-y.
[13] Kozak ER, Franco-Gordo C, Godínez-Domínguez E, Suárez-Morales E, Ambriz-Arreola I. Seasonal variability of stable isotope values and niche size in tropical calanoid copepods and zooplankton size fractions. Mar Biol 2020;167:1–13. https://doi.org/10.1007/s00227-020-3653-7.
[14] Jafari N. Hydrobiological Study of Algae of an Urban Freshwater River Hydrobiological Study of Algae of an Urban Freshwater River 2021. https://doi.org/10.4314/jasem.v10i2.43697.
[15] Ranjith S, Shivapur A V, P SKK, Hiremath G. Water Quality Assessment of River Tungabhadra , India 2020.
[16] Ramdani M, Flower RJ, Chouba L. Environmental influences on the qualitative and quantitative composition of phytoplankton and zooplankton in North African coastal lagoons Environmental influences on the qualitative and quantitative composition of phytoplankton and zooplankton in North African coastal lagoons 2009. https://doi.org/10.1007/s10750-008-9678-4.
[17] Kshirsagar AD, Ahire ML, Gunale VR. Phytoplankton Diversity Related to Pollution from Mula River at Pune City 2012.
[18] Perga M-E, Gerdeaux D. Seasonal variability in the δ13C and δ15N values of the zooplankton taxa in two alpine lakes. Acta Oecologica 2006;30:69–77. https://doi.org/https://doi.org/10.1016/j.actao.2006.01.007.
[19] Caroni R, Piscia R, Free G, Manca M. Interpreting Seasonal Patterns and Long-Term Changes of Zooplankton in a Deep Subalpine Lake Using Stable Isotope Analysis. Water (Switzerland) 2023;15. https://doi.org/10.3390/w15173143.
[20] Patil R. Application of CCME WQI in Assessisng Water Quality for Fort Lake of Application of CCME WQI in Assessisng Water Quality for Fort Lake of Belgaum , Karnataka 2014. h https://doi.org/10.15373/2249555X/APR2013/10.
[21] Dede AN, Deshmukh AL. Original Research Article Study on Zooplankton Composition and Seasonal Variation in Bhima River Near Ramwadi Village , Solapur District (Maharashtra), India 2015;4:297–306.
[22] Environment N, Shepur R, Shivapur A, Hiremath CG. Water Quality Assessment of River Tungabhadra , India Water Quality Assessment of River Tungabhadra , India 2020. https://doi.org/10.46488/NEPT.2020.v19i05.020.
[23] Singh SP, Pathak D, Singh R. Hydrobiological studies of two ponds of Satna (M.P.), India 2002;8:289–92.
[24] Perga M. ecological studies Potential of d 13 C and d 15 N of cladoceran subfossil exoskeletons for paleo-ecological studies 2014. https://doi.org/10.1007/s10933-009-9340-9.