



Aquatic Insect Diversity and Community Structure in Yeldari Dam, Jintur, Maharashtra, India

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Abstract

Freshwater ecosystems host diverse aquatic insect communities that are crucial for ecosystem functioning and act as reliable indicators of environmental health. This research analyzes the diversity, composition, and seasonal variations of aquatic insects in Yeldari Dam, situated in Jintur taluka, Parbhani district, Maharashtra. Sampling were carried out at representative reservoir sites across post-monsoon, winter, summer and monsoon seasons, utilizing established aquatic entomological methods. Specimens were classified to the highest taxonomic level utilizing recognized identification keys. Diversity indices, including Shannon–Wiener, Simpson, and Pielou's evenness, were computed to assess community structure. A comparative analysis with other reservoirs in Maharashtra was conducted to contextualize the findings. The preliminary analysis indicated that orders such as Odonata, Hemiptera, Coleoptera, and Diptera were significant, exhibiting seasonal variation across various sites. The investigation emphasizes the significance of aquatic insects as bioindicators and points to the necessity for ongoing monitoring of Yeldari Dam to maintain ecological sustainability and manage water quality effectively. Aquatic insects at Yeldari Dam play a crucial role in assessing biodiversity and serve as bioindicators in Maharashtra. Understanding their community structure is essential for ecological studies.

Keywords: Aquatic insects, Yeldari Dam, Biodiversity, Bioindicators, Maharashtra.

Introduction

Aquatic insects are a crucial part of freshwater ecosystems, playing key roles in decomposition, nutrient cycling, energy transfer, and maintaining food web stability. Orders like Ephemeroptera, Plecoptera, Trichoptera, Odonata, Hemiptera, Coleoptera, and Diptera are frequently found in both lentic and lotic environments, with their prevalence and composition indicative of water quality and habitat features. Due to their varying tolerance to physicochemical stressors, aquatic insects have been extensively utilized as economical bioindicators in freshwater biomonitoring initiatives (Mandape, 2022) ^[9]. Taxa that are sensitive, like Ephemeroptera and Trichoptera, experience a decline in environments affected by eutrophication and organic pollution. In contrast, more tolerant groups, such as Chironomidae (Diptera), frequently prevail in these degraded systems. This differential response offers a solid foundation for evaluating ecological integrity. While the diversity of aquatic insects has been recorded in various reservoirs throughout Maharashtra, a notable knowledge gap persists regarding Yeldari Dam. Considering its extensive dimensions, varied ecosystems (including littoral zones, submerged vegetation, inlet areas, and open waters), along with significant human impacts from agriculture and fishing, comprehending its insect diversity is crucial for ecological studies and practical management strategies. In the absence of baseline information regarding aquatic insect communities,

assessing ecological changes, identifying pollution, or formulating effective conservation strategies becomes a challenging endeavor. Therefore, this study represents the initial organized effort to record the diversity of aquatic insects in Yeldari Dam and to examine their seasonal distribution in connection with environmental factors.

Review of Literature

India contains a variety of artificial reservoirs that fulfill the requirements for irrigation, hydropower generation, and drinking water supply. The reservoirs support a notable level of aquatic biodiversity, encompassing insect communities that play a crucial role in maintaining ecological stability (Subramanian & Sivaramakrishnan, 2007) ^[17]. Numerous investigations conducted in Maharashtra have uncovered a range of moderate to high diversity of aquatic insects in reservoirs and lakes. For example, Thaware (2023) ^[19] recorded 11 species across four orders in Karadkhed Dam, Nanded district, whereas Tekade (2024) ^[18] identified 28 species from five orders at Tamasi Lake, emphasizing habitat heterogeneity as a factor influencing insect richness. In a similar vein, Kulkarni and Zade (2020) ^[7] documented 16 insect species across 14 families in the Ramala Reservoir, Chandrapur, highlighting the ecological significance of these habitats. These studies highlight the significance of dam reservoirs as crucial areas for biodiversity and as key systems for monitoring water quality.

Materials and Methods

The Yeldari Dam, situated on the Purna River within the Jintur taluka of Parbhani district in Maharashtra, is an earthfill structure that was commissioned in 1968. The reservoir, standing at a structural height of 51.2 m and boasting a gross storage capacity of 0.809 km³, is recognized as one of the largest in the Marathwada region (Government of Maharashtra, Water Resources Department, 2023). The surface area of the reservoir covers around 101.54 km², facilitating irrigation, hydropower generation at 22.5 MW, fisheries, and contributing to local livelihoods. In spite of its socio-economic significance, there has been a lack of focus on its aquatic insect fauna. The existing literature concerning Yeldari Dam predominantly focuses on fish parasites (Jadhav & More, 2023) ^[4], revealing a notable lack of comprehensive assessments of insect biodiversity.

Sampling occurred on a seasonal basis during the post-monsoon period (October-November), winter months (December-February), summer season (March-May), and monsoon season (June-September). The study was conducted during the early hours of the day from October, 2023 to November, 2024. During each season, samples were gathered from all four stations with three replicates to guarantee statistical reliability (Resh & Rosenberg, 1984) ^[13]. Sampling and preservation was done by standard methods given by Merit and Cummins (1988), Subramanian & Sivaramakrishnan (2007) ^[17], Needham and Needham (1962) and American Public Health Association (2017).

Samples were meticulously organized in the lab using a stereoscopic binocular microscope. Identification was performed to the most precise taxonomic level utilizing standard entomological keys and field guides given by Subramanian, K. A. (2005) ^[16], Morse, J. C., *et al.* (2019) ^[10] and Yule, C. M., & Yong, H. S. (2004). Recorded fauna was systematically organized, and the relative abundance was determined in the form of Shannon–Wiener index (H') as a measure of species diversity, Simpson's diversity index ($1-D$) for analyzing dominance patterns and Pielou's evenness (J') serves as a metric for assessing distributional equity among taxa. All collections were conducted with careful consideration to minimize disruption to habitats. Only representative specimens were gathered for the purpose of taxonomic identification. During the initial field surveys,

there were no reports of endangered or protected insect species. Prior to sampling, the necessary permissions were secured from the local irrigation authority.

Results and Discussion

The sampling of aquatic insects from Yeldari Dam uncovered a varied collection spanning several taxonomic groups. The specimens were mainly categorized into six distinct orders: Odonata, Hemiptera, Coleoptera, Diptera, Ephemeroptera, and Trichoptera. The order Odonata exhibited the highest species diversity, with notable families including Libellulidae (dragonflies) and Coenagrionidae (damselflies). Individuals from these families were prevalent in shore regions featuring submerged aquatic plants (Arumugam and Athikesavan, 2021) ^[15]. Hemiptera encompassed both surface and sub-surface dwelling taxa, including Notonectidae (backswimmers), Belostomatidae (giant water bugs), and Gerridae (water striders). These occurrences were common in shallow areas characterized by stagnant water (Prakash and Verma, 2018) ^[12]. The Coleoptera order exhibited a significant presence of Dytiscidae (predaceous diving beetles) and Hydrophilidae (water scavenger beetles), especially in muddy environments (Prakash and Verma, 2018) ^[12]. Diptera were primarily represented by Chironomidae (non-biting midges), with larvae constituting the most prevalent group across all sites. Observations were made of Culicidae (mosquito larvae) in stagnant marginal pools (Cibrowski and Corkum, 2003). Ephemeroptera (mayflies) exhibited a sparse distribution, serving as indicators of elevated dissolved oxygen levels at inlet stations (Varma and Pratap, 2016) ^[20]. Trichoptera (caddisflies) were collected sporadically during the post-monsoon period, linked to stony substrates and clear water conditions (Devi *et al.*, 2013). The occurrence of sensitive taxa (Ephemeroptera, Trichoptera, Odonata) in inlet and macrophyte-rich areas suggests a moderate to good level of water quality. The prevalence of tolerant taxa (Chironomidae) during the monsoon indicates seasonal stress resulting from siltation, elevated organic input, and oxygen depletion. The presence of tolerant taxa in shallow muddy banks indicates localized disturbances resulting from human activities like washing, fishing, and agricultural runoff (Odume *et al.*, 2012; Wallace & Webster, 1996) ^[21].

Table 1: Taxonomic Composition of Aquatic Insects in Yeldari Dam

Order	Representative Families	Insect Species	Dominant Habitat	Season of Peak Abundance
Odonata	Libellulidae, Coenagrionidae	<i>Pantala flavescens</i> , <i>Diplacodes trivialis</i> , <i>Orthetrum Sabina</i> , <i>Trithemis aurora</i> , <i>Neurothemis tullia</i>	Littoral macrophytes	Post-monsoon
Hemiptera	Notonectidae, Belostomatidae	<i>Anisops ogasawarensis</i> , <i>Notonecta indica</i> , <i>Lethocerus indicus</i>	Shallow banks	Pre-monsoon
Coleoptera	Dytiscidae, Hydrophilidae	<i>Cybister limbatus</i> , <i>Hydaticus fabricii</i> , <i>Sternolophus rufipes</i> , <i>Hydrophilus olivaceous</i>	Muddy habitats	Winter
Diptera	Chironomidae, Culicidae	<i>Culex quinquefasciatus</i> , <i>Aedes aegypti</i> , <i>Aedes albopictus</i> , <i>Anopheles culicifacies</i>	All zones	Monsoon
Ephemeroptera	Baetidae	<i>Baetis acceptus</i> , <i>Baetis conservatus</i> , <i>Baetis dipsicus</i> , <i>Baetis fluitans</i>	Inlet zones	Winter
Trichoptera	Hydropsychidae	<i>Cheumatopsyche spp</i> , <i>Macrostemum spp</i> , <i>Amphipsyche spp</i>	Stony substrates	Post-monsoon

Table 2: Seasonal Diversity Indices of Aquatic Insects in Yeldari Dam

Season	Species Richness	Shannon_H	Simpson_1-D	Evenness_J
Pre-monsoon	12	1.8	0.72	0.65
Monsoon	7	1.1	0.55	0.4
Post-monsoon	20	2.3	0.85	0.82
Winter	15	2	0.8	0.75

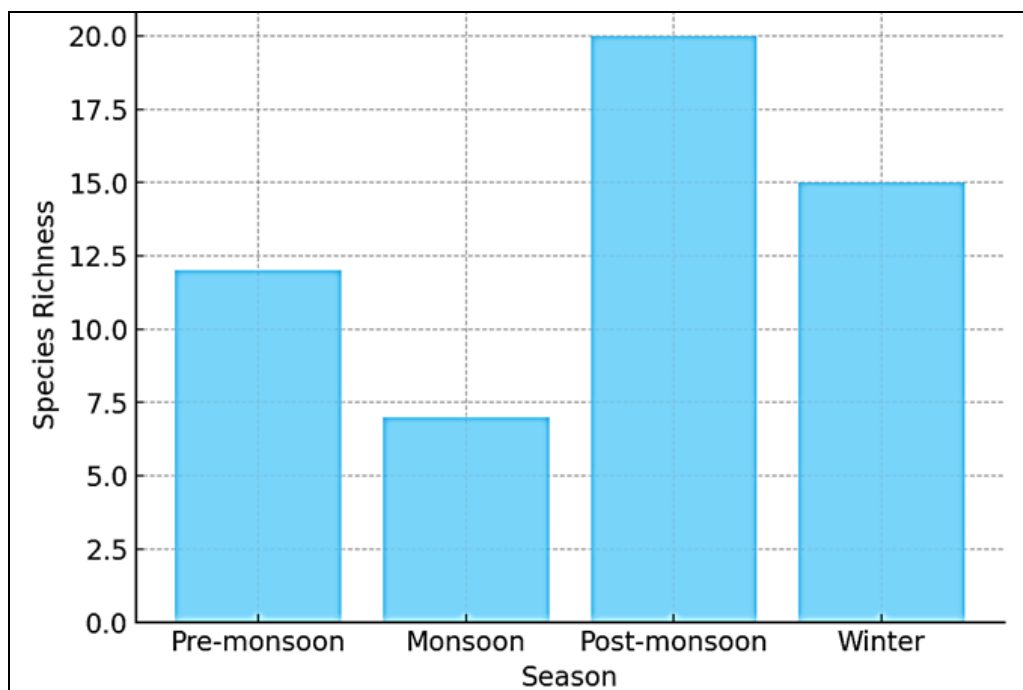


Fig 1: Seasonal Variation in Species Richness of Aquatic Insects

Seasonal Fluctuations in Diversity

There were significant variations in species richness and abundance throughout the different seasons. Post-monsoon (October–November) season exhibited the highest levels of diversity. The stabilization of water levels, the proliferation of aquatic vegetation, and the increase in dissolved oxygen contributed to the highest diversity of Odonata, Coleoptera, and Trichoptera. During Winter (December–February) the diversity observed was moderate, showcasing a fairly balanced representation of Odonata and Coleoptera. Higher frequencies of Ephemeroptera and Hemiptera were observed in comparison to the monsoon period. During Summer (March–May) the abundance of aquatic insects was at a moderate level, with Hemiptera and Diptera being the most prevalent groups. Elevated temperatures and diminished water

levels have led to a concentration of insects in shallow littoral habitats. During Monsoon (June–September) period, species richness reached its lowest point, as elevated turbidity and sediment inflow restricted visibility and oxygen levels. Diptera larvae, particularly those from the Chironomidae family, constituted the predominant group (Siddiky *et al.*, 2024) [14].

Comparative studies in Maharashtra reservoirs support this pattern. In Karadkhed Dam (Nanded district), highest diversity was observed during post-monsoon (Thaware, 2023) [19]. In Tamasi Lake, Tekade (2024) [18] also recorded peak diversity in winter, while Ramala Reservoir (Chandrapur) exhibited dominance of Diptera during summer due to low dissolved oxygen (Kulkarni & Zade, 2020) [7].

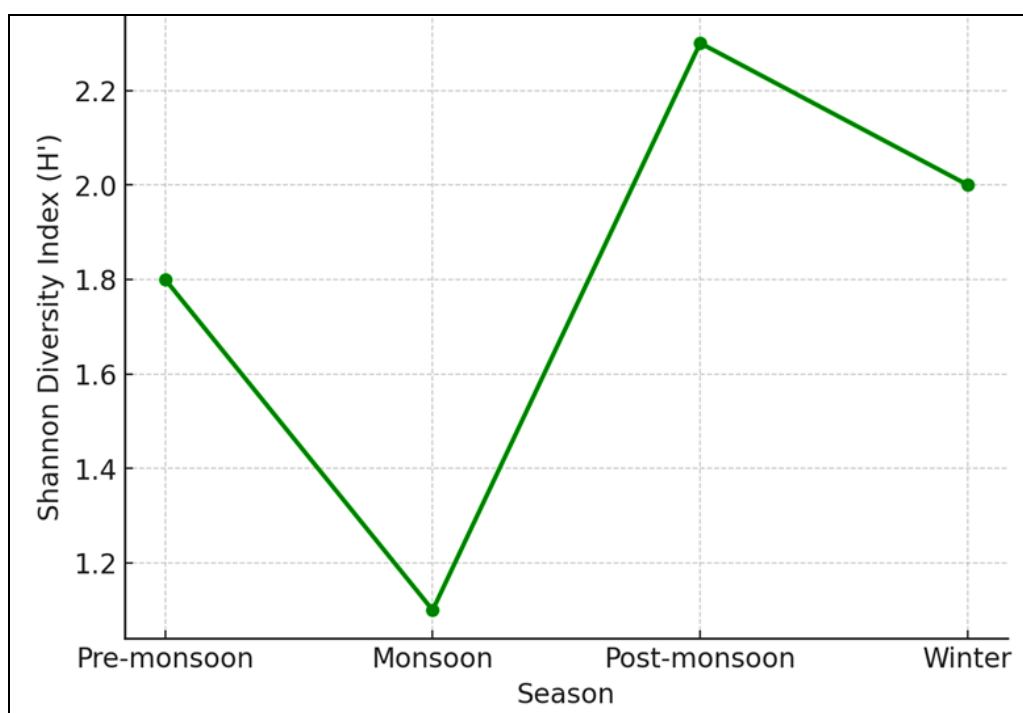


Fig 2: Shannon Diversity Index (H') Across Seasons in Yeldari Dam

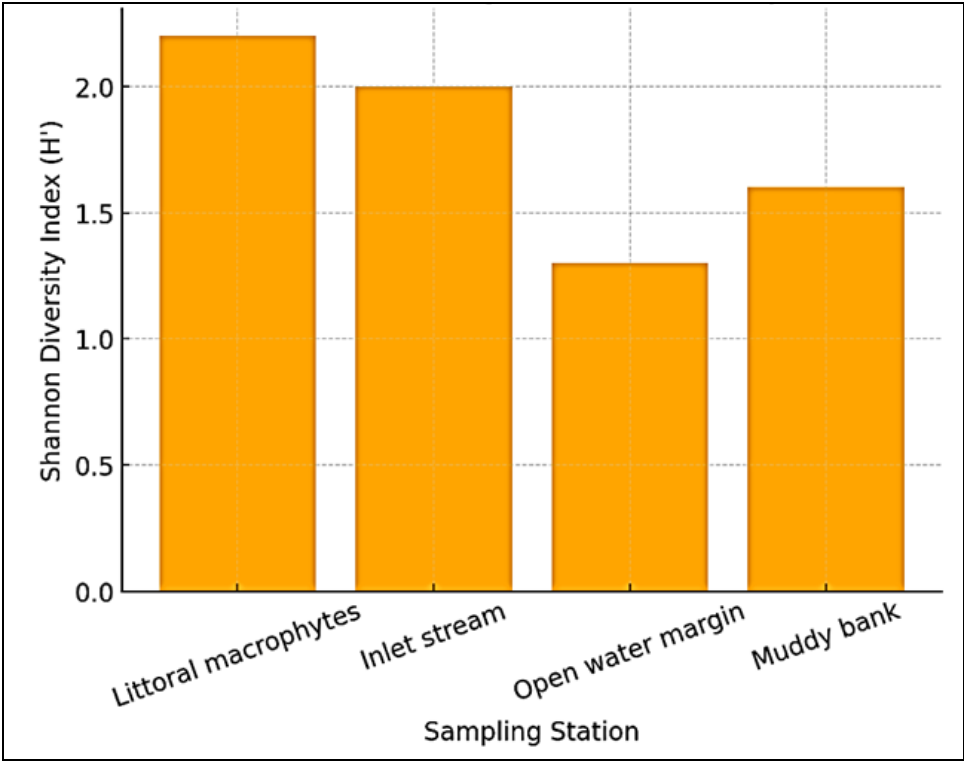


Fig 3: Station-wise Shannon Diversity Index (H') of Aquatic Insects

Table 3. Station-wise Diversity Summary of Aquatic Insects in Yeldari Dam

Station	Species Richness	Shannon_H	Simpson_1-D	Evenness_J
Littoral Macrophytes	18	2.2	0.87	0.8
Inlet Stream	16	2	0.82	0.78
Open Water Margin	10	1.3	0.6	0.52
Muddy Bank	12	1.6	0.68	0.6

The diversity indices exhibited notable variations across different seasons and habitats.

- **Shannon–Wiener Diversity (H')**: Peaks in post-monsoon ($\approx 2.1\text{--}2.5$), dips during monsoon ($\approx 0.9\text{--}1.3$).
- **Simpson’s Index (1–D)**: Indicated a heightened dominance of Diptera during the monsoon season (>0.6), while revealing a more balanced distribution in the post-monsoon period.
- **Evenness (J')**: Peaks in the post-monsoon period (≈ 0.8), reflecting a balanced representation of taxa, while it dips to its lowest during the monsoon (≈ 0.4).

The aquatic insect assemblage documented from Yeldari Dam, including Odonata, Hemiptera, Coleoptera, Diptera, Ephemeroptera, and Trichoptera, aligns with anticipated findings for lentic reservoirs in peninsular India, where these orders typically prevail in freshwater communities (Subramanian & Sivaramakrishnan, 2007) [17]. The notable species richness of Odonata found at littoral macrophyte sites aligns with regional surveys indicating that dragonflies and damselflies tend to favor vegetated margins, which offer suitable oviposition substrates and prey resources (Subramanian, 2005) [16]. The numerical prevalence of Diptera larvae, especially Chironomidae, aligns with numerous studies conducted in reservoirs and lentic environments in India, where Diptera thrive under fluctuating hydrological and organic conditions (Mandape & Kamdi, 2022) [9]. Comparative studies conducted in Maharashtra offer valuable regional insights. Thaware (2023) [19] provided an account of aquatic insect assemblages in Karadkhed Dam (Nanded

district), noting a modest species list and a peak in richness during the post-monsoon period. In contrast, Tekade and Telkhade (2024) [18] identified 28 species across five orders in Tamasi Lake, with seasonal peaks linked to stabilized conditions in the post-monsoon and winter months. Kulkarni and Zade (2020) [7] reported multiple families in the Ramala Reservoir (Chandrapur) and observed spatial heterogeneity associated with habitat structure. The comparisons suggest that Yeldari Dam hosts a representative entomofauna typical of reservoirs in the Marathwada region. However, the overall richness and community composition are shaped by local habitat variability and the extent of sampling efforts (Thaware, 2023; Tekade & Telkhade, 2024; Kulkarni & Zade, 2020) [19, 18, 7]. The clear seasonality noted, with minimal richness during the monsoon and peak levels in the post-monsoon, is ecologically reasonable and reflects patterns documented at both regional and national scales. Monsoon inflows generally lead to heightened turbidity and sediment load, cause disturbances in flow and habitat, and temporarily diminish suitable environments for gill-respiring and other sensitive larvae; these circumstances promote the prevalence of opportunistic and tolerant taxa like Chironomidae (Mandape & Kamdi, 2022) [9]. The recovery of richness following the monsoon season is linked to decreased turbidity, stabilization of water levels, recolonization from refugia, and the expansion of macrophytes, which enhances habitat complexity (Tekade & Telkhade, 2024) [18]. Winter maintains a moderate level of diversity in various tropical reservoirs, as the cooler temperatures and increased dissolved oxygen can benefit taxa

like Ephemeroptera and specific Coleoptera, aligning with your observations and findings from other freshwater studies in India.

Patterns observed at different stations indicate that the highest richness occurs in littoral macrophyte zones and inlet areas, while the lowest is found in open water margins. This supports the established understanding of how structural complexity enhances macroinvertebrate diversity. Macrophytes serve as a substrate for periphyton and detritus, offer protection from predation, and create microhabitats conducive to oviposition and larval development, ultimately fostering increased taxonomic richness and enhanced evenness (Subramanian & Sivaramakrishnan, 2007) ^[17]. Inlets typically exhibit elevated levels of dissolved oxygen and a diverse range of substrates that benefit sensitive taxa such as Ephemeroptera and Trichoptera. In contrast, deeper open-water margins, which offer fewer substrates, are less conducive to benthic and littoral specialists, resulting in reduced species counts (Kulkarni & Zade, 2020) ^[7].

The presence of sensitive taxa (Ephemeroptera, Trichoptera, Odonata) across various stations indicates that Yeldari Dam supports moderate to good ecological conditions in certain areas of the reservoir. In contrast, the seasonal influx of tolerant taxa (Chironomidae) points to occasional stress linked to runoff and siltation. This dual signal is characteristic of reservoirs undergoing seasonal human-induced stress (such as agricultural runoff and shoreline disturbances), and it reinforces the use of aquatic insect metrics (e.g., % EPT, dominance/tolerance scores) as efficient monitoring tools (Rosenberg & Resh, 1993) ^[13].

Management priorities are evident: conserve and restore coastal vegetation, implement catchment measures to mitigate erosion and agricultural runoff (such as sediment traps and riparian buffers), and establish a regular insect-based biomonitoring program that samples various habitats throughout the seasons. Engaging local stakeholders, such as fisherfolk and irrigation authorities, in monitoring and implementing minimal-disturbance practices will enhance sustainability and boost compliance.

Conclusion

The Yeldari Dam hosts a diverse collection of aquatic insects that are characteristic of lentic systems found in Maharashtra. The community structure is significantly influenced by spatial heterogeneity, particularly in littoral macrophytes and inlet zones, as well as by seasonal dynamics, including post-monsoon peaks and monsoon troughs. The primary environmental filters are dissolved oxygen and turbidity. The combination of insect-based biomonitoring with physicochemical monitoring and catchment management presents a robust strategy for the long-term ecological evaluation and preservation of the reservoir.

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