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Limnological Insights from Aquatic Insect Assemblages at Sina Dam, India

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Abstract: ***Insects are the most ecologically diverse and numerically dominant group of animals on Earth, occupying nearly all habitats from aerial and terrestrial to aquatic and parasitic. Their remarkable adaptive radiation enables them to thrive in extreme environments ranging from deserts to deep seas. Aquatic insects, in particular, are crucial indicators of water quality and ecosystem health. Globally, around 45,000 species of aquatic insects are reported, with approximately 5,000 species inhabiting inland wetlands in India. Despite India's rich biodiversity, ranked 9th globally in terms of megadiversity, the aquatic entomofauna of many freshwater systems remains poorly documented. The present study was conducted at Sina Dam in Karjat Tehsil, Ahmednagar district, Maharashtra, from January to May 2022. A total of 849 aquatic insect specimens were collected from five locations using standard pond nets (WP2 pattern, 60 µm mesh size). Specimens were preserved in alcohol and identified under a stereo zoom microscope using standard taxonomic keys. The collected insects represented*** *6 orders and 15 families****, with the most abundant orders being*** *Odonata (14.99%)* ***and*** *Coleoptera (7.77%). Dominant families included*** *Nepidae* ***(137 individuals, 20.45%),*** *Culicidae* ***(260 individuals, 13.09%),*** *Libellulidae* ***(66 individuals, 10.80%), and*** *Corixidae* ***(90 individuals, 14.75%). The findings provide baseline data on insect diversity in the Sina Dam region and contribute to broader limnological studies by highlighting the importance of aquatic insects as ecological indicators and components of freshwater biodiversity.***

Keywords: Aquatic Insects, Biodiversity, Sina Dam, Ecological Indicators, Entomofauna

1. Introduction

Insects are the most diverse and ecologically successful group of organisms on Earth, surpassing all other animal groups in both number and distribution. Their remarkable ability to undergo adaptive radiation has enabled them to colonize almost every conceivable habitat—terrestrial, aerial, aquatic, and even parasitic. In their quest for survival and resources, insects often come into conflict with humans by competing for food and shelter, transmitting diseases, and causing significant damage to crops, livestock, and property. Despite these conflicts, the ecological significance of insects is profound, particularly in aquatic ecosystems where they play essential roles in nutrient cycling, food web dynamics, and water quality assessment. Aquatic insects are widely distributed across diverse habitats—from the polar regions to the tropics, in freshwater and marine systems, deserts, caves, mountains, and even the deep sea. Estimates suggest there are approximately 45,000 species of aquatic insects globally, with about 5,000 species inhabiting India's inland wetlands (Amaravathi et al., 2018; Rao et al., 2020). India, ranked ninth in the world for megabiodiversity (Mittermeier & Mittermeier, 1997), hosts a rich variety of aquatic insect fauna. These insects demonstrate a wide range of morphological and behavioral adaptations for survival in aquatic environments. While only a few species are permanently aquatic, most pass through aquatic larval or nymphal stages and emerge as aerial adults. Their presence or absence is often indicative of water quality, with some species serving as bioindicators of pollution or pristine conditions. Despite their ecological importance, the entomofauna of many freshwater bodies in India remains underexplored. Previous studies by Sharma and Rai (1991), Thirumalai (1999), Sivaramakrishnan (2005), and Dinakaran & Anbalagan (2007) have contributed to our understanding of aquatic insect diversity, but more localized and updated surveys are required. The present investigation was carried out at Sina Dam, an irrigation reservoir located in Karjat Tehsil, Ahmednagar district of Maharashtra. The study aimed to document the abundance and diversity of aquatic insects in this region. A total of 849 individuals, belonging to six insect orders and fifteen families, were collected from multiple sampling sites between January and May 2022. The study provides new insights into the limnological health and entomological diversity of this agriculturally significant and climatically monsoonic region, contributing valuable baseline data for further ecological and environmental research.

2. Materials and Methods

The study was conducted at **Sina Dam**, an earthen irrigation reservoir located near **Nimgaon Gangarda** in **Karjat Tehsil**, Ahmednagar district, Maharashtra (18°50′1″N, 74°55′1″E; 450 m a.s.l.). The region experiences a **monsoonic climate** with three seasons: summer (Feb–May), monsoon (June–Oct), and winter (Nov–Feb). **Sampling** was carried out during the **pre-monsoon period** (January–May 2022) at **five representative sites** across the dam. Aquatic insects were collected between **6:30 AM and 9:30 AM** using a **standard WP2 pond net** (60 µm mesh), targeting different microhabitats (shallow banks, open water, vegetation zones). Specimens were preserved in **95% alcohol** in the field. Initial identification was done on-site, while most samples were examined under a **Carl Zeiss Stereo Zoom Microscope (Stemi DV4)** in the laboratory. Identification followed standard taxonomic keys (Sharma & Rai, 1991; Thirumalai, 1999; Sivaramakrishnan, 2005; Dinakaran & Anbalagan, 2007). Collected insects were classified into **orders and families**, and data on **species richness, abundance**, and **percentage composition** were analyzed to assess aquatic insect diversity and ecological indicators of water quality.

3. Results and Discussion

A total of **749 aquatic insect individuals** were recorded from the Sina Dam during the study period (January–May 2022), representing **5 orders** and **15 families**. The dominant insect orders observed were:
Odonata – 14.99%
Coleoptera – 7.77%
Hemiptera – 5.99%
Diptera and Plecoptera – each 3.33%

These findings indicate a **moderately rich aquatic entomofaunal composition**, with notable dominance of predatory and pollution-tolerant insect groups.

Order and Family-Level Distribution
At the family level, the **Nepidae** family (Water scorpions) was the most dominant, comprising **137 individuals (20.45%)** across **4 species**. This is followed by:
Culicidae (Mosquitoes): 260 individuals (13.09%)
Libellulidae (Dragonflies): 66 individuals (10.80%) across 7 species (23.33% of total species)
Corixidae (Water boatmen): 90 individuals (14.75%) across 2 species
Hydrophilidae: 50 individuals across 3 species
Dytiscidae: 50 individuals from 4 species
Families with lower representation included: **Belostomatidae**, **Coenagrionidae**, **Lampyridae**, **Mesoveliidae**, **Notonectidae**, **Tipulidae**, **Chironomidae**, and **Nemouridae**

The dominance of **Nepidae** and **Culicidae** suggests the presence of **still or slow-moving water with abundant organic matter**, which supports such species. The significant presence of **Libellulidae** and **Coenagrionidae** (suborders of Odonata) indicates **relatively good water quality**, as these taxa are typically found in moderately clean aquatic systems.

These results are **consistent with findings** from other regions. For example, **Dinakaran and Anbalagan (2007)** observed a similar dominance of Nepidae and Libellulidae in the southern Western Ghats, attributing their abundance to vegetation-rich microhabitats and moderate pollution levels. Similarly, **Sivaramakrishnan (2005)** reported that Odonates were the most prevalent group in Western Ghats hill streams, serving as key ecological indicators.

In a survey conducted by **Sharma and Rai (1991)** in the Ganga River at Patna, Hemiptera and Diptera families were found in higher numbers in polluted waters, reinforcing the current findings where Diptera (Culicidae and Chironomidae) were moderately present, suggesting some eutrophication at certain sites. **Thirumalai (1999)**, in his taxonomic work on Indian Hemiptera, documented widespread distribution of aquatic bugs like Nepidae, Corixidae, and Notonectidae in lentic water bodies. Our findings align with his work, with these families being consistently represented in the Sina Dam ecosystem.

The low abundance of **Plecoptera** and **Nemouridae**, which are typically associated with high oxygen and pristine environments, indicates that such conditions are limited or localized within the dam ecosystem.

Ecological Implications:
The insect community structure at Sina Dam reflects a **mixed aquatic habitat**—moderately impacted by agriculture yet retaining zones of ecological balance. The presence of bioindicator taxa like Libellulidae, combined with tolerant taxa like Culicidae, provides insight into the **limnological health of the water body**. Overall, this study contributes valuable baseline data on aquatic insect diversity in a **less-studied region of Maharashtra**. These findings support the need for **long-term biomonitoring**, as insect communities are sensitive to climatic and anthropogenic disturbances.

Table 1: Species and relative abundance of aquatic insects recorded in the *Sina Dam* waterbodies

Order	Family	Common name	Zoological name	Number of insects
Odonata	**Coenagrionidae**	Golden dartllet	*Ischnuraauroa* (Brauer)	28
		Pigmy dartlet	*Agricnemispygmaea*(Rambur)	10
	Libellulidae	Brown-backed red marsh hawk	*Orthetrumchrysis*	04
		Blue-tailed forest hawk	*Orthetrum triangular* (Selys)	11
		Blue marsh hawk	*Orthetrumglaucaum*(Brauer)	10
		Green marsh hawk	*Orthetrum Sabina* (Drury)	20
		Ground skimmer	*Diplocodustrivialis*(Rambur)	12
		Pied paddy skimmer	*Neurothemis intermedia*(Drury)	06
		Blue-tailed yellow skimmer	*Palpupleurasexmaculata*(F.)	03
Coleoptera	**Dytiscidae**	Diving beetle	*Ciliatus*sp.	32
			*Laccophilus*sp.	10
			*Sandracottus*sp.	05
		Unidentified sp1	----------	03
	Hydrphilidae	Water scavenger beetle	*Berosus indicus*	50
		Giant water scavenger beetle	*Hydrophilus triangularis* Say	50
	Lampyridae	Fire fly	*Photinus* sp.	08
Hemiptera	**Belostomatidae**	Giant water bug	*Lethocerus indicus*	22
		Small water bug	*Diplonychusrusticus*	04
	Corixidae	Water boat man	*Ccorixa*sp.	10
		Common pond skater	*Gerris. Sp.*	80
	Mesoveliidae	Water treaders	*Mesoveliavittigera*Horvath	16
	Notonectidae	Water back swimmer	*Notonecta*sp.	22
	Nepidae	Giant water scorpion	*Ranatraelongata*	78

		Giant water scorpion	*Ranatravaripea*Stal	33
		Water scorpion	*Laccotrephesruber*(L.)	10
	Garridae	Striders	*Striders sp*	12
Diptera	**Culicidae**	Mosquitoes	*Culex* sp.	260
	Tipulidae	Crane flies	*Tipula*sp.	11
	Chironomidae	Midges	*Chironomidae* sp.	21
Plecoptera	**Nemouridae**	Stone fly	unidentified Sp.	08
		Total species =	**30**	
			Total Individuals =	849

Table 2: Family-wise distribution of aquatic insects showing number of species and individuals

Order	Family	Species (% occurrence)	Individuals (% occurrence)
Odonata	Coenagrionidae	02 (6.66%)	38 (6.21%)
	Libellulidae	07 (23.33%)	66 (10.80)
Coleoptera	Dytiscidae	04 (13.33%)	50(8.18%)
	Hydrphilidae	02 (6.66%)	100(16.36 %)
	Lampyridae	01 (3.33%)	08(1.30)
Hemiptera	Belostomatidae	02(6.66%)	26(4.25%)
	Corixidae	02(6.66%)	90(14.75%)
	Mesoveliidae	01(3.33%)	16(2.60%)
	Notonectidae	01(3.33%)	22(3.60%)
	Nepidae	04(10.00%)	121(19.80%)
	Garridae	01(3.33%)	12(1.96%)
Diptera	Culicidae	01(3.33%)	260(26.18.%)
	Tipulidae	01(3.33%)	11(1.80%)
	Chironomidae	01(3.33%)	21(3.43%)
Plecoptera	Nemouridae	01 (3.33%)	08(1.30%)
	Total =	**32 (100%)**	**849 (100%)**

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