Water Quality Assessment And Distribution And Diversity Of Aquatic Insect In Bandha Pond Durg (C.G.) State Of India

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Abstract: This study investigates the distribution and diversity of aquatic insects in Bandha Pond located in Durg district, Chhattisgarh. Aquatic insects play a vital role in freshwater ecosystems, serving as indicators of water quality and contributing to nutrient cycling. The research was conducted through seasonal sampling, using a combination of dip nets, Surber samplers, and emergence traps to collect aquatic insects from both sites. A total of 17 families of aquatic insects were identified, with varying distribution patterns across the pond. The Bandha Pond exhibited a higher diversity of insect species, particularly in the warmer months. Factors such as water temperature, pH, dissolved oxygen levels, and substratum type were found to be significantly influencing the distribution and abundance of different insect species. The study highlights the ecological importance of both freshwater habitats in supporting aquatic insect populations and emphasizes the need for conservation efforts to maintain biodiversity in these water bodies. Overall, the findings contribute to a better understanding of aquatic insect dynamics in freshwater ecosystems in the Durg region of Chhattisgarh.

Keywords:-Aquatic insects, Bandha Pond, Distribution, Diversity, Durg, Populations.

Introduction: Aquatic insects are integral to the health of aquatic ecosystems. They occupy a wide range of ecological niches, from detritivores breaking down organic matter to predators controlling populations of smaller organisms [1]. They are also essential as prey for amphibians, fish, and birds, thereby linking the aquatic food web to terrestrial ecosystems [2]. The presence

and abundance of various insect species can provide valuable information about the water quality, sedimentation patterns, and the overall ecological health of water bodies [3].

Moreover, aquatic insects are sensitive to environmental changes such as pollution, habitat destruction, and climate change, making them useful bioindicators [4]. The study of aquatic insects in the Bandha Pond is timely, given the increasing pressures on freshwater ecosystems due to urbanization, agricultural practices, industrialization, and climate change. In particular, the Durg district of Chhattisgarh has been undergoing significant changes in land use and water resource management [5]. As a result, monitoring the health of its water bodies, including the diversity and distribution of aquatic insects, is essential for conservation efforts [6]. Freshwater ecosystems, such as ponds and rivers, are among the most biodiverse habitats on Earth [7]. These water bodies support a wide variety of organisms, including aquatic insects, which play a crucial role in the functioning and health of aquatic ecosystems [8]. Aquatic insects contribute significantly to energy flow, nutrient cycling, and serve as bioindicators of water quality [9]. In India, rivers and ponds are often utilized for domestic, agricultural, and industrial purposes, leading to alterations in their water quality and ecosystem dynamics [10]. However, despite the ecological importance of aquatic insects, comprehensive studies on their diversity and distribution in different regions of India remain scarce [11]. The Bandha Pond located in the Durg district of Chhattisgarh, is important water body that provide a habitat for diverse aquatic organisms, including insects. Bandha Pond, a relatively smaller freshwater body, has been subjected to various anthropogenic pressures, natural and human-induced factors, including seasonal water flow variations and pollution.[12] These sites offer an opportunity to explore how water quality, habitat characteristics, and environmental changes impact the distribution and diversity of aquatic insect populations [13]. This study aims to investigate the distribution and diversity of aquatic insects in Bandha Pond in Durg (C.G.), with a focus on identifying species diversity, seasonal variation, and environmental factors that influence their populations [14]. Understanding the diversity of aquatic insects in these water bodies is essential not only for biodiversity conservation but also for the broader ecological health of the region [15]. Moreover, such studies are crucial in providing baseline data for future ecological monitoring and management strategies for freshwater ecosystems in Chhattisgarh and similar regions in India

[16]. Aquatic insects are an essential component of freshwater ecosystems, contributing significantly to the biodiversity, structure, and functioning of aquatic habitats [17].

These organisms are found in a variety of water bodies, including rivers, ponds, streams, and lakes, where they play vital roles in nutrient cycling, organic matter decomposition, and serving as a food source for higher trophic levels [18]. The diversity of aquatic insects is a reflection of the quality and health of aquatic ecosystems, making them valuable indicators for monitoring water quality and environmental changes [19]. Understanding the distribution and diversity of aquatic insects in different aquatic ecosystems provides critical insight into ecological interactions and biodiversity conservation [20]. Additionally, while there have been studies on aquatic insects in various parts of India, detailed research on the distribution and diversity of aquatic insects in the Durg region, particularly in Bandha Pond remains limited [21]. This study addresses this gap by providing a comprehensive inventory and analysis of aquatic insect species, which could inform future conservation policies and management strategies for freshwater ecosystems in the region [22, 23, 24, 25, 26,27].

Study Area: Bandha Pond is a small, seasonal freshwater body located in the central part of Durg, characterized by shallow water and a rich array of submerged vegetation. The pond experiences fluctuating water levels throughout the year, influenced by seasonal monsoon rains and human activities. During the monsoon season, the water body receives increased nutrient influx, fostering an environment conducive to higher insect diversity, particularly in areas with dense aquatic plants and organic detritus. The pond provides a relatively stable environment for aquatic species, supporting a wide range of microhabitats for insects at various developmental stages.

Fig.01: Map of study area

Materials and Methods:

Sample Collections

A. **Water sample collection -**Samples were collected clean air tight plastic bottles of 1000ml capacity during rainy and winter season from Bandha Pond and were kept under normal room temperature and subjected to further physico-chemical analysis.

Collection of Aquatic Insects: Aquatic insects were collected from Bodha pond including submerged vegetation, mud, and organic detritus.Insects were collected by various sampling methods like Surber sampler, Kick net sampling, Sweep net sampling and light trap method during rainy (R) and winter season (W) and preserved in 70% alochol further identification.

B. **Identification of Aqutic insects-**Collected aquatic insects were indentified with the help of standard taxonomic keys (Kumar,1973a, 1973b; Bal and Babu, 1994a, 1994b, and Epler,2010) and literature including**.**

Physico-chemical analysis: Physico-chemical parameters likeTemperature, Turbidity, pH, Alkalinity, Dissolved Oxygen, Chloride, Hardness, and Total Phosphorus were analysed from collected water samples.

S.N.	Parameters	Units	Method
1.	Temperature	^{0}C	Thermometer
2.	Turbidity	mg/L	Turbidity meter
3.	pH	mg/L	pH meter
4.	Alkalinity	mg/L	Titrimetric
5.	Dissolved Oxygen	mg/L	Alkali-azide modificaton
6.	Chloride	mg/L	Argentometric
7.	Hardness	mg/L	EDTA titrimetric
8.	Total Phosphorus	mg/L	Vanado-molybdophosphoric acid

Result and Discussion:

(i) Physico-Chemical parameter: The physico-chemical characteristics of water samples from Bandha Pond during rainy season and winter season were analysed. Physicochemical parameters were temperature, turbidity, pH, Alkalinity, Dissolved Oxygen, Chloride, Hardness, Total phosphorus.

The Temperature recorded from water sample of Bandha pond were 26.5^{0}C respectively during rainy season whereas decline in temperature 21.4^{0}Cwere observed in Bandha respectively during winter season.. Turbidity of water sample recorded were 26.6 mg/l (Rainy Season) and 27.3mg/l. pH values measured were 6.69 mg/l and 7.63mg/l. Similarly Alkalinity recorded were 90.1 mg, and 93.2 mg/l. Dissolved oxygen recorded were 6.72 mg/l and 6.79 mg/l. Chloride content were 64.0 mg/l and 67.0 mg/l. Total Hardness observed were 46.0mg/l, and 49.0 mg/l. Total phosphorus recorded were 0.32 mg/l and 0.39 mg/l. Above data were recorded from both the study sites that is Bandha pond during Rainy (R) and Winter season (W) respectively which was listed in the table given below.

***Table 01:*Physico-chemical characteristics of water samples from Bandha Pond in (July 2023-Jan 2024)**

S.N.	Physico-chemical parameter	Season		Standard value	
		Rainy (R)	Winter (W)	WHO (2009)	BIS (1991)
		Bandha Pond	Bandha Pond	****	*****
1.	Temperature ^{0}C	26.5	21.4	<35.0	-
2.	Turbidity(mg/l)	26.6	27.3	-	1-5
3.	pH (mg/l)	6.69	7.63	6.5-9.2	6.5-8.5
4.	Alkalinity (mg/l)	90.1	93.2	200	50-200
5.	Dissolved Oxygen(mg/l)	6.72	6.79	6	6.0
6.	Chloride(mg/l)	64.0	67.0	250	250

7.	Hardness(mg/l)	46.0	49.0	100-500	300
8.	Total Phosphorus(mg/l)	0.32	0.39	-	-

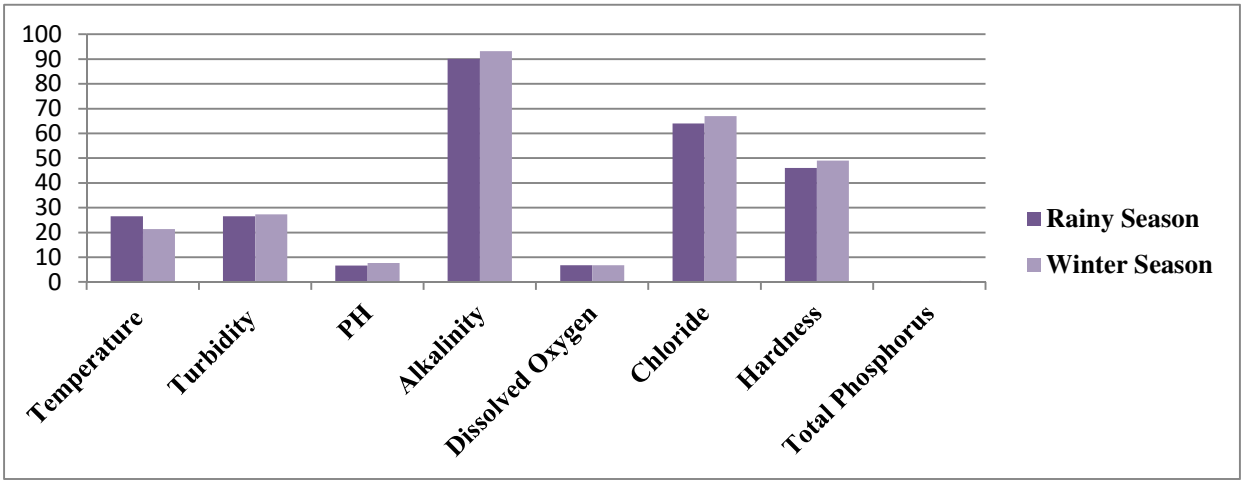

Fig. 02: Physico-chemical characteristics of water samples from Bandha Pond.

The diversity of aquatic insects in relation to Physico-chemical water quality were studied by Krishnan *et al.,* 2023 and observed that physico-chemical variations of streams were found to be influencing the distribution of aquatic insects. Sarsavan*et al.,* 2023 reported that the Odonates diversity and abundance highly depends on the seasonality and humidity is influenced by variation in rainfall patterns. Seasonal dynamics of Odonates species diversity and abundance were studied by Mallick *et al.,* 2025.

(ii) Distribution and diversity of aquatic insect: The study of aquatic insects in Bandha Pond revealed a total of 16 families and 20 species of aquatic insects across one site. Total 08 orders have been reported from the study sites during rainy and winter seasons which includes order Odonata, Hemiptera, Coleoptera, Neuroptera, Dermaptera, Diptera, Hymenoptera, Orthoptera. The majority of the species belongs to order Hemiptera which includes 10 species followed by Odonata which includes 03 species followed by Coleoptera including 02 species and remaining 01 each of Neuroptera, Dermaptera, Diptera, Hymenoptera, Orthoptera. of the 20 species observed, the most dominant species were *Didymops transversa, Cybistertripunctalus* (Coleoptera), *Hydrometra greeni* (Hemiptera), *Laccotrephes griseus* (Hemiptera), *Neocurtillahexadactyla* (Orthoptera)followed by *Diployuchusrusticus, Lethocerusinsulans,*

Sarcophaga carnaria(Diptera), *Abeduslutarium* (Hemiptera), *Euborelliaannulipes* (Dermaptera), *Ischnuraheterostica* (Odonata),*limnogonus nitidus,limnogonusfluviorum, Anisopskuroiwae*(Hemiptera), and least dominated species were *Glenurusgratus* (Neuroptera), *Notonecta glauca* (Hemiptera), *Solenopsisinvicta* (Hymenoptera), *Ancyronyxschillhammeri*(Coleoptera), *Mosaic Darners* (Odonata),*Anisops barbatus* (Hemiptera).

Table 02 : **List of Aquatic insects found during study period (July 2023-Jan 2024)**

S.N.	**Name of the species**	**Family**	**Order**	**Season**	
				Rainy(R)	**Winter (W)**
1.	*Diplonychusrusticus*	Belostomatidae	Hemiptera	+	-
2.	*Lethocerusinsulanus*	Belostomatidae	Hemiptera	+	-
3.	*Abeduslutarium*	Belostomatidae	Hemiptera	-	+
4	*Notonecta glauca*	Notonectidae	Hemiptera	-	+
5.	*Anisops barbatus*	Notonectidae	Hemiptera	+	+
6.	*Anisopskuroiwae*	Notonectidae	Hemiptera	-	+
7.	*Limnogonus nitidus*	Gerridae	Hemiptera	+	-
8.	*Limnogonusfluviorum*	Gerridae	Hemiptera	+	+
9.	*Hydrometagreeni*	Hydrometridae	Hemiptera	+	+
10.	*Laccotrephes griseus*	Nepidae	Hemiptera	+	+
11.	*Didymops transversa*	Corduliidae	Odonata	+	+
12	*Ischnuraheterosticta*	Calopterygide	Odonata	+	+
13	*Mosaic darners*	Ashnidae	Odonata	+	-
14	*Cybistertripunctatus*	Dytiscidae	Coleoptera	+	+
15.	*Ancyronyxschillhammeri*	Elmidae	Coleoptera	+	-
16	*Glenurusgratus*	Myrmeleontidae	Neuroptera	-	+
17.	*Sarcophga carnaria*	Sarcophagidae	Diptera	+	+
18.	*Solenopsis invicta*	Formicidae	Hymenoptera	-	+
19.	*Euborelliaannulipes*	Anisolabididae	Dermaptera	+	-
20.	*Neocurtillahexadactyla*	Gryllotalpidae	Orthoptera	+	+

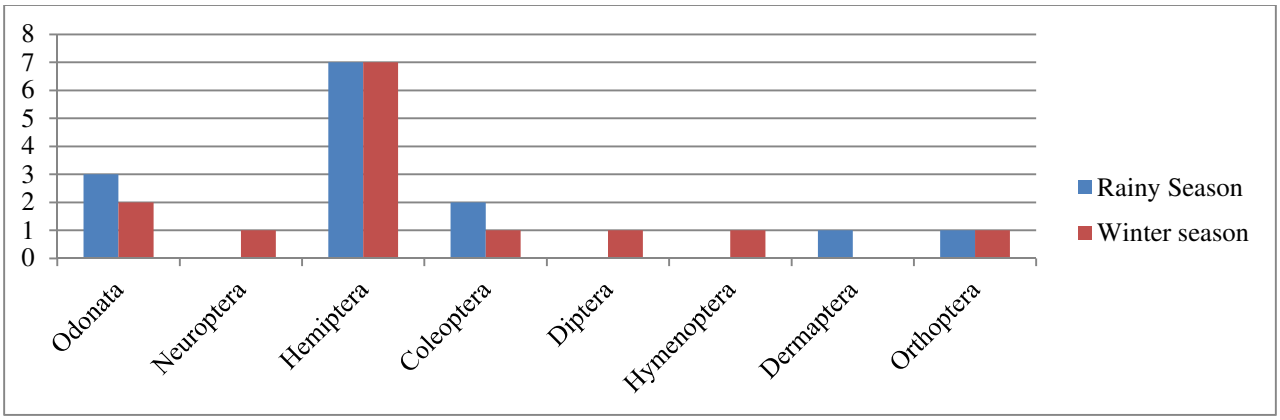

Fig. 03: Order of Aquatic insects found during study period (July 2023-Jan 2024)

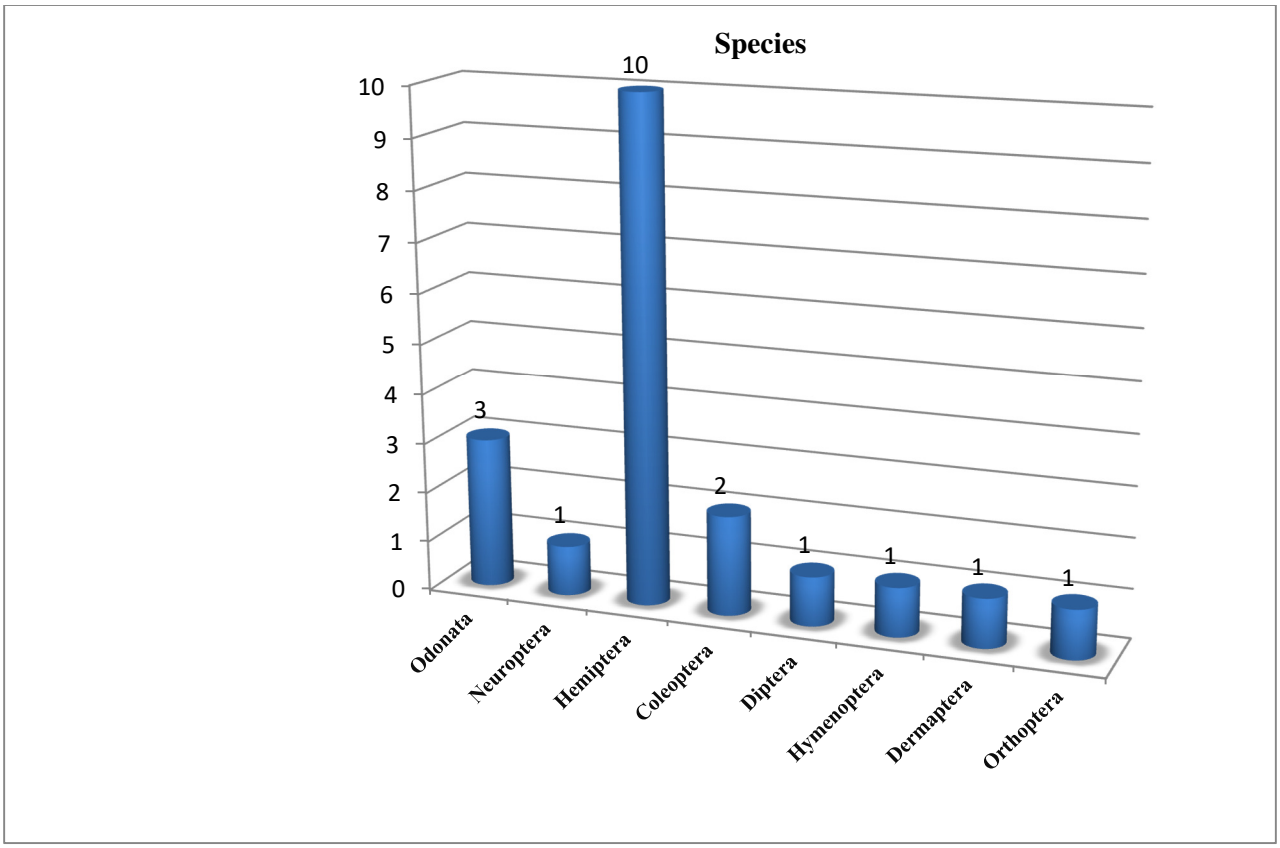

Fig. 04: Order of Aquatic insects found during study period (July 2023-Jan 2024)

From the above data it was clear that maximum species observed were belong to order Hemiptera. Bandhav*et al.,* 2025, reported about diversity and distribution of aquatic insects in Sagar Lake India in relation to physico-chemical parameters across different seasons, the most

dominant order being the Hemiptera. Most dominating species in this order were *Hydrometra greeni* (Hydrometridae), *Laccotrephes griseus* (Nepidae), which were observed in both rainy and winter season from Bandha pond. Buzzetti *et al.*, 2006 recorded species such as *Hydrometra greeni, limnogonus nitidus* from south east Asia and Australia. Other dominating species obtained were *Diplonychusrusticus*of order Hemiptera which were similar to the findings of *Bandhav et al.,* 2025 in which he studied 5,352 aquatic insects from sagar lake India in relation to Physico-chemical parameters across different seasons and reported that*Diplonychusrusticus* being the most dominant species recorded across all the seasons. *Das & Gupta* 2012 also recorded species such as*limnogonus nitidus, Diplonychusrusticus, Diplonychus annulatus, Anisopslundbladiana* of Hemiptera families like Gerridae, Aphidae, Notonectidae, Nepidae, Belostomidae. Other studies on giant water bugs of order Hemiptera, Heteroptera, Belostomatidae were made by Saha *et al*., 2007. Highest population of Hemiptera were recorded during the monsoon and lowest in winter which suggests that Hemiptera donot depend entirely on water quality (Mackie, 2001). *Limnogonus nitidus, limnogonus sp., limnogonusfossarum* were reported by Anamika *et al.,* (2021); Sharma & Agarwal, (2012) and Mitra *et al.,* (2016). *Anisops barbatus* and other *Anisops*species were reported by Anamika *et al.,* 2021; Bourah& Gupta, (2016), Pahari *et al.,* (2016) .

Among Odonata, the most dominated species recorded were *Didymops transversa* reported from Bandha Pond in both winter and rainy season.Other species reported were *Ischnuraheterostica* found maximum in rainy season, least in winter season and *Mosaic darners* were the least reported during both the seasons from Bandha Pond. Kietzka *et al.,* 2019 stated that Odonata play a very important role in maintaining ecological balance and functioning as bioindicators of environmental quality. Sarvasan *et al.,* 2023 studied climate change effects on tropical Odonata community and stated that Odonates diversity and abundance highly depends on the seasonality and humidity influenced by variations in rainfall patterns. Species such as *Ischnura aurora* and *Ischnuranursei* reported by Sarvasan *et al.,* (2023). Other species of order Odonata reported from our sites were *Mosaic darners* belonging to family Aeshnidae. Beatty *et al.,* 2010 studied the distribution of Odonates belonging to order Anisoptera, Zygoptera and families Aeshnidae, Corduliidae, Calopterygidae, testidae. with respect to temperature and climate change.Similarly, the composition and diversity of Dragonflies were studied by Konneri

et al., 2020. According to Paulson, 2001 climate change is responsible for shifts in the distribution of Dragonfly species.

Species such as *Cybistertripunctatus* (Coleoptera, Dytisidae) and *Ancyronyxschillhammeri* (Coleoptera, Elmidae) were also reported in our findings. Elango *et al.,* 2021 also studied about the aquatic insect biodiversity belonging to order Hemiptera, Coleoptera, Odonata, Diptera, Tricoptera. Species like *Solenopsis invicta* of Hymenoptera, was least observed during both the season. Some other species like *Anisops barbatus,* Hemiptera; *Glenurusgratus*, Neuroptera; *Mosaic darners*, Odonata were also least observed in both the seasons suggesting their sensitivity to temperature, turbidity, oxygen levels and other physico-chemical parameters according to Elango *et al.*, 2021; Bourah and Gupta, 2016.

Conclusion: The findings of this study have important implications for the conservation and management of freshwater ecosystems in Durg and similar regions. Efforts to mitigate pollution, reduce sedimentation, and maintain stable water levels in both Bandha Pond could help preserve the diversity of aquatic insect populations. Additionally, habitat restoration initiatives, such as the replanting of aquatic vegetation and the creation of riffle-pool sequences in the river, could enhance the habitat availability for a wide range of species. The study of aquatic insect distribution and diversity in Bandha Pond has provided valuable insights into the ecological dynamics of these freshwater systems. The majority of species observed were from the orders Hemiptera, Odonata, and Coleoptera which are characteristic of healthy freshwater environments. Environmental factors such as dissolved oxygen (DO), turbidity, and substrate type were found to significantly influencing the distribution and abundance of aquatic insect species. The findings highlight the complex interactions between aquatic insects and their environment, underscoring the importance of both biotic and abiotic factors in shaping species distribution.

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