Short Communication

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Diversity of Libellulidae (Insecta: Odonata) in Harsul and Slim Ali Lake, Chhatrapati Sambhajinagar (Maharashtra) India

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About 6,000 species of odonates are known all over the world. In India, a total of 470 species of odonates belonging to 139 genera and 19 families have been recorded [1]. According to Prasad [2] Odonata are characterized by their long and slender abdomen, short antennae, large spherical eyes, long wings, and a prominent nodus and pterostigma. These fascinating creatures play a significant role in various types of assessment and monitoring, especially in measuring biodiversity. Their life cycle is complex, with an aquatic larval stage and terrestrial adults. They have different habitat requirements at the species level, which can be utilized to identify local hotspots or degraded sites [3-4]. In their larval and adult stages, odonates are voracious predators, feeding exclusively on living prey [5]. When it comes to libellulids, their hindwings have a rounded base, the anal loop is boot-shaped, and the triangles in the forewings and hindwings vary in shape and location. The antenodal cross veins are mostly complete [6]. The diverse species of odonates and their unique characteristics make them an important subject of study for understanding and conserving ecosystems around the world.

Libellulidae, commonly known as skimmers, are a remarkably diverse group of odonata, making them the most prominent and abundant species within the odonate fauna across the globe. Their dominance extends to various regions, where they play a crucial role in wetland ecosystems. Odonates, including the Libellulidae family, serve as integral components of these ecosystems, contributing to their overall health and vitality. Moreover, due to their remarkable presence and sensitivity to environmental changes, they serve as reliable indicators of the ecosystem's overall well-being and ecological balance. This family, known as Family Libellulidae, has a widespread distribution across the globe. It is home to more than 1000 species, with 85 of them found within the borders of India. One particular region where these species thrive is Chhatrapati Sambhajinagar, also known as Aurangabad. Located at latitude 19.8762° N and longitude 75.3433° E, Chhatrapati Sambhajinagar covers an expansive area of 141 km². The average altitude of this region is 568 meters above sea level. When it comes to the climate in Chhatrapati Sambhajinagar, it can be described as predominantly arid and semi-arid. The region experiences three distinct seasons throughout the year. Let's take a closer look at each of them:

Summer (March to June): During the summer months, the temperatures in Chhatrapati Sambhajinagar soar to extreme levels, often surpassing 40°C (104°F). The weather is dry and arid during this time, making it quite challenging to bear the heat.

Monsoon (July to September): The monsoon season brings some respite from the scorching heat. Aurangabad receives moderate rainfall during this period, which helps in cooling down the temperature. However, the weather becomes slightly humid during these months.

Winter (October to February): Winter in Aurangabad is relatively mild and pleasant. The temperatures drop to around 10-15°C (50-59°F), creating a more comfortable environment for exploring the city.

Overall, Chhatrapati Sambhajinagar experiences extreme temperatures during the summer, while the rest of the year offers a more temperate climate. This diverse climate pattern adds to the uniqueness of the region and provides a variety of experiences for both locals and visitors. In the present study, the focus is on the exploration of the biodiversity in the Two Lakes located in Chhatrapati Sambhajinagar. These lakes, namely Harsul Lake and Salim Ali Lake, serve as important habitats for various species. To properly identify and document the adult specimens found in these lakes, photographs were taken as voucher specimens. In order to accurately identify the species, identification keys provided by experts such as Frazer [7], Prasad [2] and Subramanian [1] were consulted.

During the survey conducted between 2022 and 2023, the numbers of species observed in the sampling areas were recorded. The libellulids, a type of dragonfly, were then categorized based on their abundance in the surveyed areas. The categorization included the following classifications: VC (very common), C (common), R (rare), and VR (very rare). This classification was maintained throughout the entire study period, following the methods outlined by Tiple *et al*. [8-9].

To quantify the diversity of libellulidea in Chhatrapati Sambhajinagar at both lake regions, the Shannon-Weaver index [10] was utilized. This index takes into account the proportion

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of the important value of each species present in the area. The Shannon index of diversity (H') is calculated using the formula:

$$H' = -\Sigma\ pi\ In\ pi$$

Where pi represents the proportion of important value of the i^{th} species (pi = ni / N, ni is the important value index of the i^{th} species and N is the important value index of all the species). Furthermore, Shannon's equitability (J) can be calculated by dividing H by H_{max}. In this case, H_{max} is equal to lnS, where S represents the total number of species observed.

The present survey recorded a total of 11 species belonging to 8 genera. This provides valuable insights into the biodiversity of the district Chhatrapati Sambhajinagar (Table 1). It is worth noting that two of these species, *Brandinopyga geminata* and *Orthetrum sabina*, are dominant and have not been previously reported in this district. This finding adds to our understanding of the local dragonfly population. In a previous study conducted by Prasad [2], 11 species of libellulidae belonging to 8 genera were recorded from Chhatrapati Sambhajinagar. It is important to mention that all 11 species were actually examined in that study, with the examined specimens being made by ZSI Pune. Additionally, the present study has contributed to the checklist by identifying one more species, *Tramea limbata*, that was found to be common in both lakes. This further expands our knowledge of the dragonfly species in the area. These findings highlight the importance of continued research and monitoring to better understand and conserve the dragonfly diversity in the district Chhatrapati Sambhajinagar.

Table 1 List of Libellulidae recorded at different Lakes from Chhatrapati Sambhajinagar

	Name of species	Harsul Lake	Salim Ali Lake
1.	*Brachythemis contaminata*	Nil	Common
2.	*Bradinopyga geminata*	Very rare	Nil
3.	*Diplacodes trivialis*	Nil	Very rare
4.	*Lathrecista asiatica*	Very rare	Very rare
5.	*Orthetrum sabina*	Common	Nil
6.	*Orthetrum taeniolatum*	Very rare	Common
7.	*Pantala Flavescens*	Common	Very rare
8.	*Tramea basilaris*	Very common	Very common
9.	*Tramea Limbata*	Common	Common
10.	*Trithemis aurora*	Nil	Common
11.	*Trithemis kirbyi*	Nil	Very common

Brachythemis contaminata, Trithemis kirbyi, Diplacodes trivialis, and *Trithemis aurora* were found exclusively in Salim Ali Lake. The presence of these libellulids in these areas might have been influenced by higher temperatures, as local or regional species diversity tends to increase with higher temperatures [4]. In all the surveyed areas, *Brachythemis contaminata, Orthetrum sabina, Tramea Limbata*, and *Trithemis aurora* were among the most common species. *Tramea limbata* was common in all survey sites, while *B. geminata* and *Diplacodes trivialis* were very rare, despite the fact that *B. contaminata* and *Trithemis kirbyi* are known for their ability to migrate long distances. Tramea species only come to water for breeding and can be found above patches of grass at some distance from water or in forest clearings [3].

Bradinopyga geminata and *Orthetrum sabina* were only found in Harsul lake, even though they are common species found throughout the year. *Tramea limbata* was found to be common in both surveyed sites.

Table 2 Shannon diversity index and equitability of the libellulids at different zones

Zone	Shannon diversity index 'H'	Equitability or evenness 'J'
Harsul lake	1.65	0.7439
Salim Ali Lake	1.916	0.7545

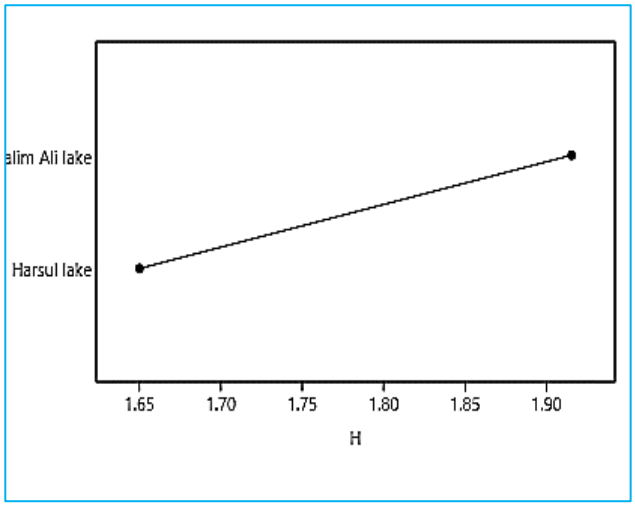

Fig 1 Graph showing Shannon diversity index for libellulids species at both zones

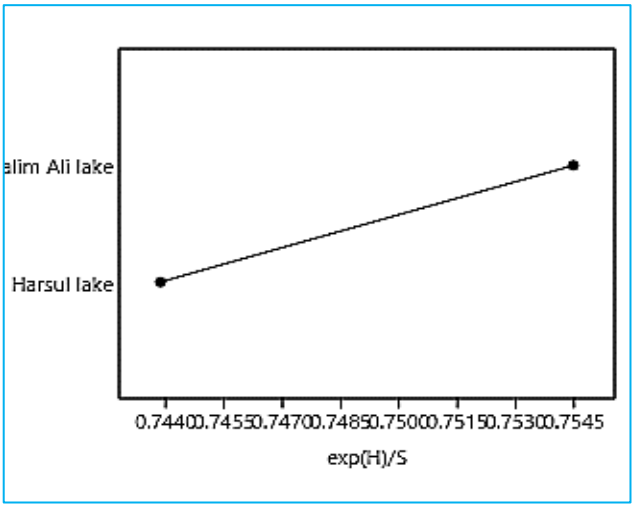

Fig 2 Graph showing evenness index for libellulids species at both zones

Shannon's diversity index result indicated that the level of diversity was significantly higher in Salim Ali Lake compared to other areas. Salim Ali Lake stood out as a prime example of a diverse ecosystem, showcasing a wide range of species and habitats. On the other hand, Harsul Lake demonstrated a lower level of diversity, suggesting a more limited variety of species and habitats in that area. It is important to note that while Salim Ali Lake exhibited the highest diversity, there may still be room for improvement in enhancing diversity in other areas such as Harsul Lake. Therefore, efforts should be made to promote and preserve biodiversity across all lakes and ecosystems.

The complete evenness or equitability was found to be the highest in Salim Ali Lake, which indicates a balanced distribution of species. This finding is supported by the graph presenting the Shannon diversity index in (Fig 1), which demonstrates the overall species richness and evenness in the lake ecosystem. Additionally, (Fig 2) showcases the equitability or evenness specifically for all the libellulids species, providing a more detailed perspective on the distribution patterns within this group. Overall, the data from both figures highlight the importance of Salim Ali Lake as a habitat that supports diverse and evenly distributed populations of libellulids.

SUMMARY

In the present study, we collected a total of 11 species of libellulidea from the Both Lakes range in Chhatrapati Sambahjinagar. These species belong to the genera Bradinopyga, Brachythemis, Diplacodes, Orthetrum, Pantala, Tetrathemis, Tramea, and Lathrecista. This study also marks the first recorded distribution of these species in Chhatrapati Sambhajinagar.Among the species documented in this study, 11 species from 8 different genera were recorded for the first time in Chhatrapati Sambhajinagar. Notably, Brandinopyga geminata and Orthetrum sabina were found to be the dominant species in both surveyed sites. Additionally, four species - Branchythemis contaminata, Trithemis kirbyi, Diplacodes trivialis, and Trithemis aurora - were exclusively found in Salim Ali Lake. On the other hand, Orthetrum sabina was only observed in Harsul Lake.These findings provide valuable insights into the distribution and presence of various libellulidea species in the Both Lakes range. The discovery of new species in Chhatrapati Sambhajinagar adds to our understanding of the local biodiversity and highlights the importance of further research in this area. This is the first study that takes into account the species diversity and lake distribution of libellulids in Chhatrapati Sambhajinagar, which indicates the species richness. Salim Ali Lake had the highest species richness, according to the Shannon index diversity. The Harsul Lake has the most evenly distributed population distribution of all the zones studied. Only the 11 species of the libellulidea family were studied in this study.

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