

Diversity of Libellulidae (Odonata: Anisoptera) in Bhavnagar, Gujarat, India

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Abstract

This study documents the diversity of the dragonfly family Libellulidae in Bhavnagar, a semi-arid region in western India. Field surveys conducted across various freshwater habitats from June to October 2023 recorded 22 Libellulidae species representing 14 genera. The assemblage was dominated by the genera Trithemis, Orthetrum, Tramea, and Diplacodes, reflecting the prevalence of generalist and habitat-flexible taxa typical of tropical freshwater systems. Standardized transect and point count methods were used for sampling, and species identification was performed using established taxonomic keys. The high species richness observed aligns with regional patterns reported in similar studies, highlighting the ecological adaptability and bioindicator value of Libellulidae. These findings provide essential baseline data for future biodiversity monitoring and conservation planning in Bhavnagar's freshwater ecosystems, emphasizing the importance of habitat heterogeneity in supporting odonate diversity.

Keywords: Libellulidae, dragonflies, wetland ecosystems, bhavnagar, freshwater biodiversity

Introduction

Dragonflies and damselflies (order Odonata) are widely recognized as important bioindicators of freshwater ecosystem health due to their sensitivity to environmental changes and their reliance on aquatic habitats for larval development (Athira & Dhivya, 2021; Adu *et al.*, 2022)^[1, 2]. Among Odonata, the family Libellulidae is the most speciose and widely distributed, dominating odonate assemblages in a variety of freshwater environments across tropical and subtropical regions (Khan *et al.*, 2025; Kannagi *et al.*, 2016; Emrose *et al.*, 2024)^[7, 10, 11]. Libellulids are known for their ecological versatility, with many species exhibiting tolerance to habitat disturbance and fluctuating water quality, which enables them to thrive in both pristine and anthropogenically altered landscapes (Adu *et al.*, 2022)^[1].

The diversity and community structure of Libellulidae are shaped by a combination of habitat heterogeneity, climatic conditions, and landscape patterns (Letsch *et al.*, 2016; Dolný *et al.*, 2021)^[6, 13]. Studies have shown that the colonization of lentic (standing water) habitats by Libellulidae has contributed to increased speciation rates within the family, likely due to the availability of diverse microhabitats and the potential for niche differentiation (Letsch *et al.*, 2016)^[13]. Furthermore, recent genomic research highlights the expansion of gene families related to immune and desiccation responses in Libellulidae, supporting their adaptability to a range of environmental conditions, including low-quality or disturbed water bodies (Tolman *et al.*, 2025).

Despite their ecological significance, regional studies on Libellulidae diversity remain limited in many parts of India, including the semi-arid landscapes of Bhavnagar. Documenting the species richness and assemblage composition of Libellulidae in such areas is essential for understanding local biodiversity patterns, assessing ecosystem health, and informing conservation strategies (Khan *et al.*, 2025; Supanekar *et al.*, 2021)^[11, 18]. This study aims to provide a comprehensive assessment of Libellulidae

diversity in Bhavnagar, contributing valuable baseline data for future ecological and conservation research.

Materials and Methods

Study Area

The study was conducted in Bhavnagar, a region characterized by semi-arid tropical freshwater ecosystems. Sampling sites were selected to represent a range of aquatic habitats, including ponds, lakes, marshes, irrigation channels, and temporary water bodies, to capture the diversity of Libellulidae across different microhabitats (Khan *et al.*, 2025)^[11].

Field Sampling

Field surveys were carried out during the peak activity period for dragonflies, from June to October 2023, coinciding with the monsoon and post-monsoon seasons. Sampling was conducted between 09:00 and 16:00 hours, when adult Libellulidae are most active (Khan *et al.*, 2025; Darshetkar *et al.*, 2023)^[5, 11]. Standardized belt transects and points count methods were employed along the margins of water bodies, with transects measuring 100–300 meters in length and 5–10 meters in width, depending on site size and accessibility (Darshetkar *et al.*, 2023; Batista *et al.*, 2021)^[3, 5].

Adult dragonflies were observed and, when necessary, captured using aerial insect nets with a mesh size of 1.5 mm for close examination and identification. Each specimen was photographed in situ for documentation. Captured individuals were temporarily stored in labeled envelopes with details of location, date, and habitat type (Khan *et al.*, 2025)^[11].

Specimen Handling and Identification

Specimens were euthanized using ethyl acetate-soaked tissue in a killing jar, then transferred to labeled envelopes for transport. In the laboratory, specimens were pinned and preserved following standard entomological protocols to prevent damage and pest infestation (Khan *et al.*, 2025)^[11].

Identification was performed using a standard taxonomic keys and literature (Subramanian, 2009) [17] ensuring accuracy with recent taxonomic updates (Khan *et al.*, 2025; Supanekar *et al.*, 2021) [11, 18].

Results

A total of 22 species belonging to the family Libellulidae were documented from Bhavnagar. The recorded assemblage represents a diverse composition of libellulid taxa distributed across 14 genera, indicating notable species richness within the study landscape (Table 1). Genera with the highest representation included *Trithemis* (4 species), *Orthetrum* (3 species), *Tramea* (2 species), *Diplacodes* (2 species), and *Brachydiplax-Brachythemis-Neurothemis* (1 species each), highlighting a dominance of both generalist and habitat-flexible taxa typical of semi-arid tropical freshwater ecosystems.

The presence of widely distributed and ecologically adaptable species such as *Pantala flavescens*, *Crocothemis servilia*, and *Brachythemis contaminata* emphasizes the prevalence of open-water and anthropogenic wetland

habitats in the region. Conversely, species like *Potamarcha congener*, *Tholymis tillarga*, and *Tramea basilaris*, although less frequently encountered, reflect the availability of ephemeral wetlands, vegetated ponds, and woodland-associated freshwater bodies.

The recorded diversity demonstrates that Bhavnagar supports a functionally dynamic odonate community, with representation from both percher-type and glider-type libellulids, indicative of a mosaic of aquatic habitats ranging from marshes, agricultural reservoirs, village ponds, and coastal wetlands. The detection of multiple *Trithemis* and *Orthetrum* species suggests effective colonization in disturbed and semi-natural wetlands, aligning with known ecological patterns of these genera in South Asia.

Overall, the findings confirm that Bhavnagar harbours rich libellulid diversity, contributing significantly to regional Odonata records for Gujarat. This baseline inventory establishes a reference framework for long-term monitoring programs, ecological health assessments of freshwater systems, and future conservation-oriented odonate research in the Saurashtra coastal landscape.

Table 1: Taxonomic checklist of Family Libellulidae (Anisoptera: Odonata) recorded from Bhavnagar, Gujarat

Sr No.	Sub Order	Family	Scientific Name	Common Name
1	Anisoptera	Libellulidae	<i>Acisoma panorpoides</i>	Trumpet Tail
2	Anisoptera	Libellulidae	<i>Brachydiplax sobrina</i>	Little Blue Marsh Hawk
3	Anisoptera	Libellulidae	<i>Brachythemis contaminata</i>	Ditch Jewel
4	Anisoptera	Libellulidae	<i>Bradinyopyga geminata</i>	Granite Ghost
5	Anisoptera	Libellulidae	<i>Crocothemis servilia</i>	Ruddy Marsh Skimmer
6	Anisoptera	Libellulidae	<i>Diplacodes trivialis</i>	Blue Ground Skimmer
7	Anisoptera	Libellulidae	<i>Diplacodes lefebvrei</i>	Black Ground Skimmer
8	Anisoptera	Libellulidae	<i>Neurothemis tullia</i>	Pied Paddy Skimmer
9	Anisoptera	Libellulidae	<i>Orthetrum sabina</i>	Slender Skimmer
10	Anisoptera	Libellulidae	<i>Orthetrum taeniolum</i>	Little skimmer
1	Anisoptera	Libellulidae	<i>Orthetrum pruinosum</i>	Crimson-tailed Marsh Hawk
2	Anisoptera	Libellulidae	<i>Pantala flavescens</i>	Wandering Glider
3	Anisoptera	Libellulidae	<i>Potamarcha congener</i>	Yellow-tailed Ashy Skimmer
4	Anisoptera	Libellulidae	<i>Rhyothemis variegata</i>	Common Picture Wing
5	Anisoptera	Libellulidae	<i>Selysiothemis nigra</i>	Black Pennant
6	Anisoptera	Libellulidae	<i>Tholymis tillarga</i>	Twister
7	Anisoptera	Libellulidae	<i>Tramea basilaris</i>	Red Marsh Trotter
8	Anisoptera	Libellulidae	<i>Tramea limbata</i>	Black Marsh Trotter
9	Anisoptera	Libellulidae	<i>Trithemis pallidinervis</i>	Long-legged Marsh Glider
10	Anisoptera	Libellulidae	<i>Trithemis aurora</i>	Crimson Marsh Glider
21	Anisoptera	Libellulidae	<i>Trithemis festiva</i>	Indigo Dropwing
22	Anisoptera	Libellulidae	<i>Urothemis signata</i>	Greater Crimson Glider

Discussion

The present study documents 22 species of Libellulidae across 14 genera in Bhavnagar, reflecting notable species richness and a diverse taxonomic composition. This pattern is consistent with findings from other South Asian and tropical regions, where Libellulidae is frequently the most speciose and dominant family among Odonata (Khan *et al.*, 2025; Manikandan *et al.*, 2022; Suwarno *et al.*, 2025) [11, 14, 19].

Genera such as *Trithemis*, *Orthetrum*, *Tramea*, and *Diplacodes*, which were most represented in Bhavnagar, are also commonly reported as dominant in various freshwater habitats across India and Southeast Asia (Khan *et al.*, 2025; Manikandan *et al.*, 2022; Laltanpuii *et al.*, 2017; Suwarno *et al.*, 2025) [11, 12, 14, 19]. Their prevalence is attributed to ecological flexibility and adaptability to a range of aquatic environments, including both permanent and temporary water bodies (Letsch *et al.*, 2016; Brito *et al.*, 2020) [4, 13].

This adaptability is a key factor in the evolutionary success and widespread distribution of Libellulidae, as lentic (standing water) habitats promote speciation and niche diversification (Letsch *et al.*, 2016) [13].

The observed assemblage structure, with a mix of generalist and habitat-flexible taxa, suggests that Bhavnagar's semi-arid tropical freshwater systems provide a mosaic of microhabitats supporting high odonate diversity (Brito *et al.*, 2020; Suwarno *et al.*, 2025) [4, 19]. Similar patterns of dominance by generalist genera have been reported in rice fields, coffee ecosystems, and natural parks, where environmental heterogeneity supports both species richness and evenness (Manikandan *et al.*, 2022; Pavithran *et al.*, 2020; Ilhamdi *et al.*, 2020) [8, 14, 15].

Regionally, the diversity and dominance of Libellulidae in Bhavnagar mirror broader biogeographical trends, with the family forming the core of Odonata communities in tropical and subtropical Asia (Kalkman *et al.*, 2007; Laltanpuii *et al.*

al., 2017) [9, 12]. The ecological role of Libellulidae as bioindicators further underscores the importance of conserving freshwater habitats in the region, as changes in water quality and habitat structure can significantly impact community composition (Khan *et al.*, 2025; Silva *et al.*, 2024) [11, 16].

The high diversity and assemblage structure of Libellulidae in Bhavnagar are shaped by the family's ecological plasticity, habitat heterogeneity, and evolutionary history, aligning with patterns observed across tropical Asia.

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