

A study on diversity of odonata at Ramdhari, Bhavnagar, India

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Abstract

The order Odonata, comprising dragonflies and damselflies, represents an ecologically significant group of amphibiotic insects closely associated with freshwater ecosystems. Due to their sensitivity to environmental changes, odonates serve as valuable bioindicators for assessing habitat quality and freshwater ecosystem health. The present study investigates the diversity and distribution of odonates in the Ramdhari, located near Sihor Taluka, approximately 40 km from Bhavnagar, Gujarat (Latitude 21°41'–21°43'N; Longitude 71°47'–71°50'E). The study region covers an area of approximately 13.5–15.0 km² with a total perimeter of about 18.5–21.0 km, comprising a heterogeneous landscape of agricultural fields, wetlands, and semi-natural habitats. Field surveys were conducted twice a month using fixed transects for direct visual observations and photographic documentation. A total of 15 species of odonates were recorded, encompassing 12 genera and 3 families. The family Libellulidae was the most dominant, represented by the highest number of genera and species, followed by members of Orthetrum and Trithemis. This study constitutes the first systematic survey of dragonfly and damselfly diversity in the Ramdhari region and provides baseline data for future ecological monitoring and conservation planning in this freshwater ecosystem.

Keywords: Damselfly, diversity, dragonfly, habitat, habitat characterisation, odonata, Ramdhari, Bhavnagar, Gujarat

Introduction

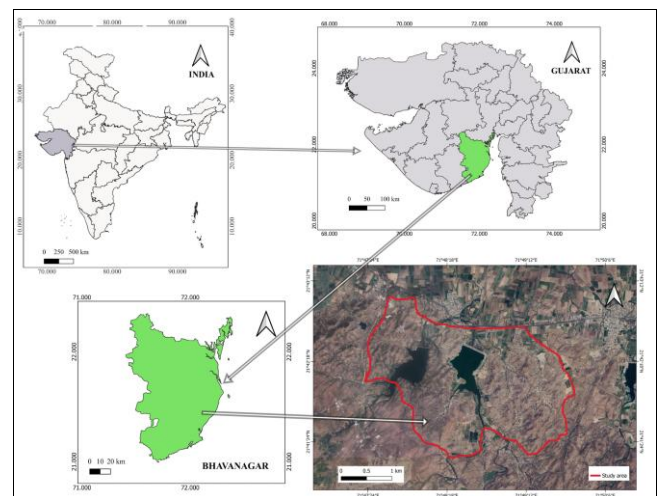
Odonata, an order of insects comprising dragonflies (suborder Anisoptera) and damselflies (suborder Zygoptera), represents one of the most ancient groups of winged insects with evolutionary roots tracing back to the Permian and Carboniferous periods (Grimaldi and Engel, 2005) [4]. Habitats like ponds, lakes, coastal marshes, irrigation canals and paddy fields have common and widespread species (Mitra *et al.*, 2010; Subramanian, 2009, 2012; Subramanian *et al.*, 2011) [7, 18, 20, 21]. The word “Odonata” is derived from the Greek word “odontos” meaning the toothed, which highlights the toothed nature of mandibles of this insect group (Subramanian & babu, 2024) [17]. Dragonflies are amongst the most ancient of winged insects, dating back well into the Permian period (Grimaldi and Engel, 2005) [4]. These insects are amphibiotic, meaning they depend on freshwater ecosystems for the majority of their life span, specifically during their egg and larval (nymph) stages, before transitioning to an aerial adult life (Mokaria & Jethva, 2019) [8]. The factors that mainly influence dragonflies and damselflies diversity and assemblage composition are habitat structure and complexity predation, pollution and water chemistry (Crowley & Johnson, 1992; Schridde & Suhling, 1994; McPeck M. A., 1998; Worthen W. B., 2002) [2, 6, 12, 22]. Odonates play a pivotal ecological role as voracious predators; while larvae prey on aquatic organisms, adults provide natural biological control by devouring winged pests such as mosquitoes and flies. Furthermore, due to their sensitivity to habitat degradation, water quality, and climatic shifts, they are widely recognised as reliable bioindicators of healthy aquatic ecosystems (Dolny & Asmera, 1989).

Globally, approximately 6392 extant species of Odonates have been described (Paulson *et al.*, 2023) [10]. In India a total 504 species belong to 157 genera, seventeen families,

three Genera and three suborders are known (Kalkman *et al.*, 2020) [5]. Very few studies have been carried out on the diversity of Odonates in Gujarat. ZSI scientists during general survey of Gujarat enlisted 48 species (Prasad, 2004) [11] But at 2024 ZSI data Gujarat enlisted 63 species recorded (Subramanian & babu, 2024) [17]. Previous studies in the Bhavnagar district have primarily focused on the Victoria Park Reserved Forest, where 17 Dragonfly and 10 damselfly species were identified. (Sukla, 2014 & Patel, 2016) [9].

Materials and Methods

Study Area



The research was conducted at the Ramdhari, a village-adjacent landscape located approximately 40 km from Bhavnagar city near Sihor taluka, Gujarat. The study site spans an area of approximately 13.5–15.0 km² with a total perimeter ranging between 18.5 and 21.0 km.

geographically. The area is situated within the coordinates 21°41'N to 21°43'N latitude and 71°47'E to 71°50'E longitude. The landscape is characterised by a matrix of seasonal wetlands, scrublands, and riparian zones typical of the Saurashtra coast. The region receives an average annual rainfall of approximately 600 mm, which supports ephemeral water bodies that serve as essential habitats for both Odonata larvae and adults.

Field surveys were performed using the Direct Visual Encounter Survey (VES) method. Systematic observations were carried out through transect walks conducted twice a month to account for temporal variations in species presence. To capture maximum Odonata activity, surveys were targeted during peak periods in the morning (07:00–10:00) and evening (17:00–19:00) across various wetlands and their respective edges.

Species were documented in their natural habitat through photography using digital cameras. In-field identification was conducted using standard taxonomic keys and field guides. Primary identification was based on the work of Subramanian (2009) [18, 20] and cross-verified against established regional checklists. To ensure minimal disturbance to the local ecosystem and biodiversity, no physical collections of specimens were made during the study period. The taxonomic nomenclature used for all recorded species follows the revised standards of Subramanian and Babu (2017) [19]

Result

This study represents the first systematic survey of dragonfly and damselfly diversity in Ramdhari. By characterising the available habitats and documenting the presence of the 15 recorded Odonate species, this research aims to provide a baseline for the conservation of seasonal wetlands and to enhance our understanding of insect community dynamics in semi-arid Western India.

The systematic survey conducted via twice-monthly transects recorded a total of 15 Odonate species. These 15 species are distributed across 12 genera and 3 families. All recorded species are amphibiotic invertebrates, which rely on the local freshwater ecosystems for the majority of their life cycle.

The recorded Odonata fauna shows a clear dominance by the Libellulidae family, which accounts for the maximum number of both genera and species in the study area.

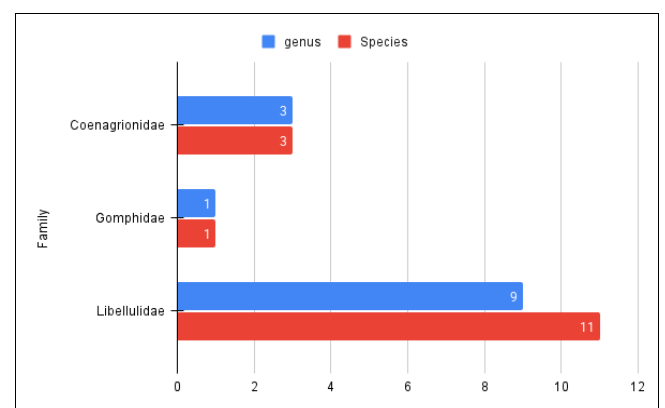
- **Libellulidae:** This family is the most diverse, with prominent representation from the genera *Orthetrum* and *Trithemis*. Specific species include the Ditch Jewel (*Brachythemis contaminata*), Slender Skimmer (*Orthetrum sabina*), Crimson Marsh Glider (*Trithemis aurora*) and Ruddy Marsh Skimmer (*Crocothemis servilia*).
- **Coenagrionidae:** Represented by species such as the Pygmy Dartlet (*Agriocnemis pygmaea*) and Coromandel Marsh Dart (*Ceriagrion coromandelianum*).
- **Gomphidae:** Represented by a single species, the Indian Common Clubtail (*Ictinogomphus rapax*).

They are strictly carnivorous, serving as beneficial predators that provide natural biological control of insect populations. Every recorded species undergoes incomplete metamorphosis, transitioning from an aquatic larval stage to an aerial adult stage. While the adults are aerial, the species are classified as aquatic due to their dependency on freshwater for breeding and larval development.

The Ramdhari area provides a viable habitat consisting of a matrix of seasonal wetlands, scrublands, and riparian zones (Gohil, *et al.*, 2024; Brijrajsinh, *et al.*, 2024) [1, 3]. The landscape receives approximately 600 mm of annual rainfall, which sustains ephemeral water bodies. These seasonal pools are critical for supporting Odonata and providing foraging grounds for adults.

Table 1: Odonata Checklist of Ramdhari, Bhavnagar

No.	Species Name	Common Name
Order - Odonata - Family - Coenagrionidae		
1	<i>Agriocnemis pygmaea</i>	Pygmy Dartlet
2	<i>Ceriagrion coromandelianum</i>	Coromandel Marsh Dart
3	<i>Pseudagrion decorum</i>	Three-lined Dart
Order - Odonata - Family - Gomphidae		
4	<i>Ictinogomphus rapax</i>	Indian Common Clubtail
Order - Odonata - Family - Libellulidae		
5	<i>Brachythemis contaminata</i>	Ditch Jewel
6	<i>Bradinopyga geminata</i>	Granite Ghost
7	<i>Crocothemis servilia</i>	Ruddy Marsh Skimmer
8	<i>Diplacodes trivialis</i>	Blue Ground Skimmer
9	<i>Orthetrum sabina</i>	Slender Skimmer
10	<i>Orthetrum taeniolatum</i>	Little skimmer
11	<i>Rhyothemis variegata</i>	Common Picture Wing
12	<i>Tramea basilaris</i>	Red Marsh Trotter
13	<i>Trithemis aurora</i>	Crimson Marsh Glider
14	<i>Trithemis kirbyi</i>	Scarlet Rock Glider
15	<i>Trithemis pallidinervis</i>	Long-legged Marsh Glider



Discussion

The results of the systematic survey at the Ramdhari provide critical insights into the Odonata community within a semi-arid landscape. This discussion evaluates the significance of the recorded diversity, the role of specific habitats.

The documentation of 15 Odonate species across 12 genera and 3 families represents the first surveyed systematic record for this specific landscape. The clear dominance of the Libellulidae family followed by Coenagrionidae and Gomphidae, aligns with findings in other regional studies across Gujarat such as Victoria Park and Vadodara (Sukla, 2014, Sharma, 2020) [13], where Libellulids typically

constitute the most species-rich group. This dominance often suggests that Libellulids are highly adaptable to a variety of environments, including the seasonal wetlands and scrublands found in Ramdhari.

The Ramdhari area serves as a viable habitat due to its matrix of ephemeral water bodies and riparian zones. Odonates are amphibiotic, meaning they require these freshwater ecosystems for the majority of their life cycle. The approximately 600 mm of annual rainfall in the region is essential for sustaining these temporary pools, which act as critical nursing grounds for larvae and foraging areas for adults. The presence of these insects indicates a functional aquatic food chain where the larvae serve as both predators of smaller invertebrates and prey for larger vertebrates.










Ecological Importance as Bioindicators Because Odonates are highly sensitive to habitat degradation and changes in water quality, their presence at Ramdhari is a positive indicator of the current ecological health of the local wetlands. All 15 recorded species are beneficial predators that provide natural biological control by preying on disease-carrying insects such as mosquitoes and agricultural pests like aphids. This ecological service is particularly vital in a landscape like Ramdhari, where agricultural lands are interspersed with natural forest patches.







The systematic assessment of the Ramdhari resulted in the first recorded documentation of 15 Odonata species belonging to 12 genera and 3 families. The clear dominance of the Libellulidae family suggests that these species are well-adapted to the seasonal wetlands and scrublands characteristic of the Bhavnagar landscape. As amphibiotic invertebrates, these Odonates rely on the region's ephemeral water bodies for larval development and adult foraging, making the maintenance of these aquatic niches essential for their survival. The presence of these beneficial predators indicates a functional food web where they provide natural biological control of insect pests while serving as a reliable bioindicator of the ecosystem's health.

However, the sustainability of this Odonata community is threatened by anthropogenic pressures such as livestock grazing and water extraction, which mirror habitat degradation patterns observed in other regional wetlands. Conservation strategies must prioritise the protection of these seasonal wetlands to prevent the decline of species that depend on the delicate balance of vegetation and water quality.

Ultimately, this study establishes a baseline for biodiversity monitoring and underscores the ecological necessity of managing human activities to preserve the dual-life cycle of these ancient winged insects

Conclusion

		
Pygmy Dartlet <i>Agriocnemis pygmaea</i>	Coromandel Marsh Dart <i>Ceriatagrion coromandelianum</i>	Three-lined Dart <i>Pseudagrion decorum</i>
		
Indian Common Clubtail <i>Ictinogomphus rapax</i>	Ditch Jewel <i>Brachythemis contaminata</i>	Granite Ghost <i>Bradinopyga geminata</i>
		
Ruddy Marsh Skimmer <i>Crocothemis servilia</i>	Blue Ground Skimmer <i>Diplacodes trivialis</i>	Slender Skimmer <i>Orthetrum sabina</i>

		
Little Skimmer <i>Orthetrum taeniolatum</i>	Common Picture Wing <i>Rhyothemis variegata</i>	Red Marsh Trotter <i>Tramea basilaris</i>
		
Crimson Marsh Glider <i>Trithemis aurora</i>	Scarlet Rock Glider <i>Trithemis kirbyi</i>	Long-legged Marsh Glider <i>Trithemis pallidinervis</i>

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