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Seasonal variation and abundance of dragonflies and damselflies in Painganga Wildlife Sanctuary, Maharashtra, India

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Abstract
The aim of the present study is the evaluation of the diversity and abundance of dragonflies and damselflies (Class Insecta, phylum Arthropoda) from the Painganga Wildlife Sanctuary of the Yavatmal region. The Painganga forest is situated in the eastern Vidarbha region, within the Umarkhed Tehsil of Yavatmal district, Maharashtra. This area is known for its rich and diverse flora and fauna, providing an ideal environment for studying the diversity and abundance of odonates. Therefore, the current research aims to explore the previously unstudied diversity and abundance of odonates in the Painganga forest of Yavatmal district. The present study was conducted during three seasons (winter, summer, and monsoon) from November 2022 to December 2023 in three different ranges of Painganga Wildlife Sanctuary. The present study deals with the examination of the seasonal variations and abundance of dragonfly and damselfly species in Painganga Wildlife Sanctuary. A total of 25 odonate species from 2 suborders and 6 families were recorded. In the suborder Anisoptera, 10 species from the family Libellulidae, 2 from the family Gomphidae, and 3 from the family Aeshnidae were identified. In the suborder Zygoptera, 6 species from the family Coenagrionidae, 3 from the family Platycnemididae, and 1 from the family Chlorocyphidae were observed. This study provides a thorough investigation into the odonate diversity within Painganga Wildlife Sanctuary, located in Yavatmal District, Maharashtra.

Keywords: Abundance, Diversity, Odonata, Painganga Wildlife Sanctuary, Seasonal Variation.

Introduction

Odonates are one of the most common insects flying over forests, fields, meadows, ponds, and rivers. Odonates have a very remarkable image and are among the most well-known aquatic insects. Order odonata is classified in three main groups: Zygoptera are more tiny and delicate creatures, Anisoptera with extra fatty shapes, and the last one, a relict group, Anisozygoptera, an ancient group of dragonflies, is thought to include two living species from the genus *Epiophlebia*, along with many fossil species [1]. Their eggs and larvae are aquatic while the adults are terrestrial [2]. Silsby [2] reported that there are eight super families, 29 families, and around 58 subfamilies of dragonflies, encompassing roughly 600 genera and 6,000 described species worldwide. In India, the diversity of odonata is also notable, with over 500 species identified [3].

Due to their amphibious habits and sensitivity to structural habitat quality (such as forest cover and water), dragonflies are ideally suited for assessing environmental changes both above and below the water surface in the short term (conservation biology) and long term (biogeography, climatology). Studying the diversity of dragonflies and damselflies [4] in the sanctuary will provide insights into the intricate food webs and ecological interactions within the region [5]. It will also highlight the importance of preserving these insects as part of the broader biodiversity of the study area, i.e., Painganga Wildlife Sanctuary in this case.

The study of odonata diversity in the Painganga Wildlife Sanctuary, located in the Yavatmal District of Maharashtra, is of immense importance for several reasons, ranging from ecological significance to conservation and education. By studying odonata diversity in the Painganga Wildlife Sanctuary, researchers can assess the overall health of the sanctuary's ecosystems, including its rivers, streams, and wetlands. This information is crucial for monitoring environmental changes and implementing effective conservation strategies. The Painganga Wildlife Sanctuary is a unique habitat with diverse flora and fauna, including potentially endemic or rare odonata species. Documenting the diversity of dragonflies and damselflies in this region can help identify species that are endemic, threatened, or endangered [6]. Such information is critical for developing targeted conservation programs to protect these species and their habitats [7]. Additionally, the sanctuary's odonata diversity can contribute to the global understanding of insect distribution and evolution, especially in understudied regions like central India [8, 9].

The present study is a small effort to assess the diversity and abundance of dragonfly and damselfly species in Painganga Wildlife Sanctuary, located in the Yavatmal District of Maharashtra. By documenting the species composition, distribution, and population dynamics of odonates, this research seeks to provide a comprehensive understanding of their ecological roles and the factors influencing their presence and abundance.

Materials and Methods

Study Area

The Painganga Wildlife Sanctuary is situated in the eastern Vidarbha region, within the Umarkhed tehsil of Yavatmal district, Maharashtra. It spans the geographic coordinates of 19°36' to 19°70' North latitude and 77°42' to 77°7' East

longitude. The reserve forest spans an area of 325 sq. km. and consists of diverse habitats. The Painganga Wildlife Sanctuary experiences a significant amount of rainfall, typically ranging between 1000 mm and 1500 mm annually, with the majority falling during the monsoon season (July to October). Temperatures are generally pleasant throughout the year, with hot summers and mild winters. These diverse habitats make the area suitable for a wide variety of dragonfly and damselfly (Order: Odonata) species.

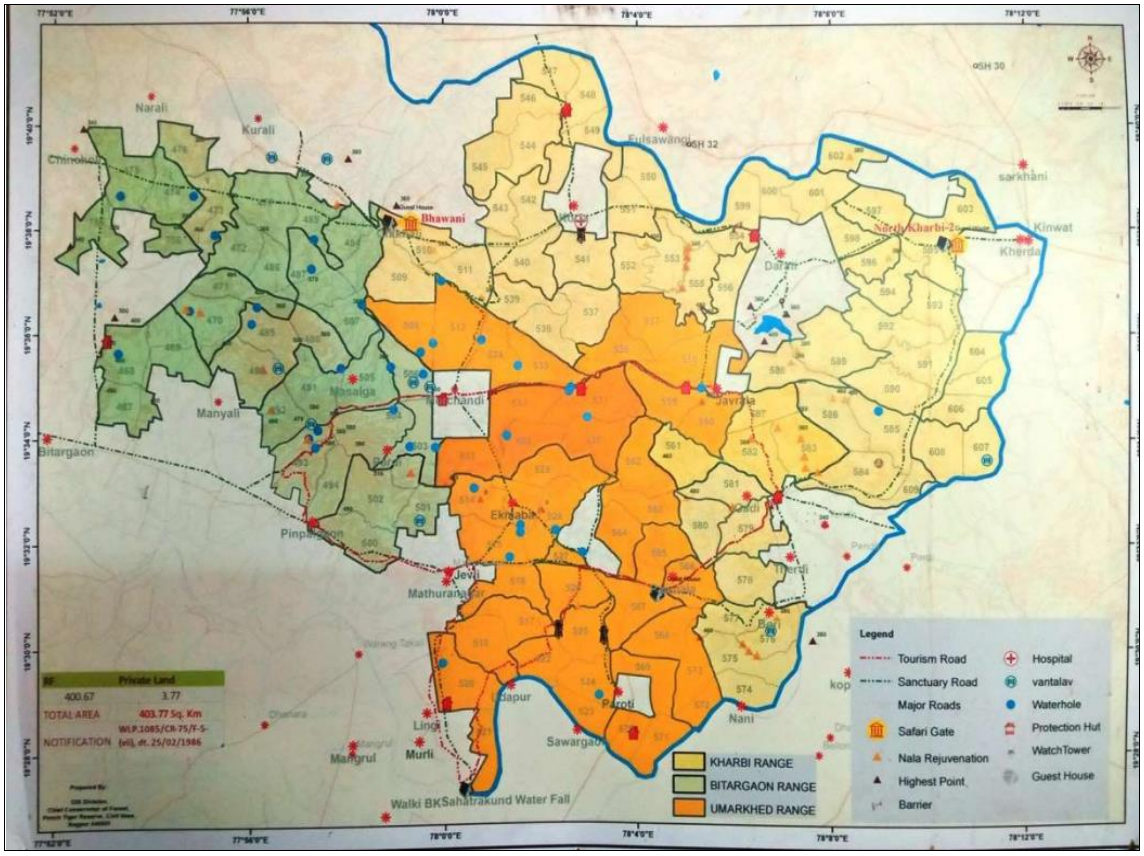

Fig 1: Map of Painganga Wildlife Sanctuary

Study Period

The study was conducted during three seasons (winter, summer and monsoon) of November -2022 to December-2023 to capture seasonal variation in dragonfly and damselfly diversity. Surveys were carried out during each season in three distinct areas of the Painganga Wildlife Sanctuary, which are Kharabi range, Umarkhed range, and Bitargaon range, with each survey lasting approximately 4-5 hours during peak of dragonfly and damselfly activity times i.e. 07:00 am to 12:00 pm. Every month species were observed, captured, photographed and identified from the particular place. Monthly records of humidity as well as temperature were also kept.

Site Selection

To ensure comprehensive coverage of the reserve forest, the study area was stratified into different habitat types. Sampling sites were selected based on habitat diversity-ensuring representation of key habitats (e.g., ponds, streams, wetlands, open meadows, forest edges). Accessibility – Practical consideration for fieldwork accessibility while minimizing disturbance. Presence of water bodies – As dragonflies are closely associated with aquatic ecosystems, sites near standing and flowing water bodies were prioritized.

A total of 25 sites were selected, covering all major habitats within the reserve forest. Dragonfly and damselfly diversity was assessed using Visual Encounter Surveys, a standard method for dragonfly sampling. At each site, timed surveys of 30 minutes to 1 hour were conducted. Surveyors (researcher along with a colleague) walked slowly through the site, visually detecting dragonflies and recording observations. Species were identified in the field using standard identification guides. For difficult-to-identify species, photographs were taken using digital camera (Make-Sony model No. W-310) for further confirmation.

Species Identification

Species were identified to the lowest possible taxonomic level using authoritative field guides and keys, such as Dragonflies and Damselflies of India by Subramanian [10] and Andrew *et al.*, [11]. Also consultation with expert taxonomists was carried out, whenever it was deemed necessary. Voucher photographs were archived for future reference and confirmation.

Results and Discussions

During the present study, a total of 25 species of odonates belonging to 2 suborders and 6 families were recorded. The 15 species of dragonflies (suborder Anisoptera) and 10 species of damselflies (suborder Zygoptera) were among the identified species. Under the order Odonata and suborder Anisoptera, 10 species belonging to family Libellulidae, 2 species belonging to family Gomphidae, and 3 species belonging to family Aeshnidae were recorded. In the suborder Zygoptera, 6 species belonging to the family

Coenagrionidae, 3 species belonging to the family Platycnemididae, and 1 species belonging to Chlorocyphidae were recorded (Table 1). Libellulidae has the highest species richness (10 species, 40%), followed by Coenagrionidae (6 species, 24%), Aeshnidae (3 species, 12%), Platycnemididae (3 species, 12%), Gomphidae (2 species, 8%), and Chlorocyphidae (1 species, 4%) recorded during the study period.

Table 1: Odonates species recorded in different ranges of Painganga Wildlife Sanctuary

Sub-order	Family	Scientific Name	Common Name
Anisoptera	Libellulidae	*Diplacodes trivialis*	Ground Skimmer
		Diplacodes lefebvrii	Black Percher
		Trithemis aurora	Crimson Marsh Glider
		Orthetrum Chrysis	Brown-backed Red Marsh Hawk
		Orthetrum sabina	Slender Skimmer
		Orthetrum glaucaum	Blue Marsh Hawk
		Trithemis festiva	Black Stream Glider
		Bradinopyga geminata	Granite Ghost
		Acisoma panorpoides	Trumpet Tail
		Brachythemis contaminata	Ditch Jewel
	Gomphidae	*Ictinogomphus rapax*	Common Clubtail
		Paragomphus lineatus	Lined Hooktail
	Aeshnidae	*Anax immaculifrons*	Magnificent Emperor
		Anax guttatus	Blue-tailed green Darner
		Anax imperator	Emperor Darner
Zygoptera	Coenagrionidae	*Aciagrion pallidum*	Pale slender darlet
		Ischnura aurora	Golden Dartlet
		Agriocnemis femina	Senegal golden dartlet
		Agriocnemis pygemia	Pygmy dartlet
		Ceriagrion rubiae	Orange marsh dart
		Aciagrion occidentale	Green striped slender dartlet
	Platycnemididae	*Caconeura ramburi*	Indian Blue Bambootail
		Copera vittata	Blue bush dart
		Copera marginipes	Yellow bush dart
	Chlorocyphidae	*Aristrocypha quadrimaculata*	Black Emperor

Table 2: Seasonal abundance of odonates recorded in different ranges Painganga Wildlife Sanctuary

Family	Name of the Species	Seasonal Abundance			Total Annual Abundance
		Winter (Nov-Feb)	Summer (Mar-June)	Monsoon (July-Oct)	
Libellulidae	*Diplacodes trivialis*	6	2	8	16
	Diplacodes lefebvrii	5	3	4	12
	Trithemis aurora	8	3	4	15
	Orthetrum Chrysis	8	3	5	16
	Orthetrum sabina	4	1	5	10
	Orthetrum glaucaum	5	3	6	14
	Trithemis festiva	10	4	8	22
	Bradinopyga geminata	3	1	4	08
	Acisoma panorpoides	2	-	2	04
	Brachythemis contaminata	6	2	7	15
Gomphidae	*Ictinogomphus rapax*	2	1	3	06
	Paragomphus lineatus	-	-	4	04
Aeshnidae	*Anax immaculifrons*	-	1	2	03
	Anax guttatus	1	1	3	05
	Anax imperator	4	3	2	08
Coenagrionidae	*Aciagrion pallidum*	2	1	-	03
	Ischnura aurora	3	2	4	09
	Agriocnemis femina	-	-	2	02
	Agriocnemis pygemia	3	2	4	09
	Ceriagrion rubiae	-	-	1	01
	Aciagrion occidentale	2	3	6	11
Platycnemididae	*Cacosneura ramburi*	1	-	2	03
	Copera vittata	2	1	1	04
	Copera marginipes	2	2	1	05
Chlorocyphidae	*Aristrocypha quadrimaculata*	4	3	3	11
Total number of odonates in all three Seasons		83	42	91	216

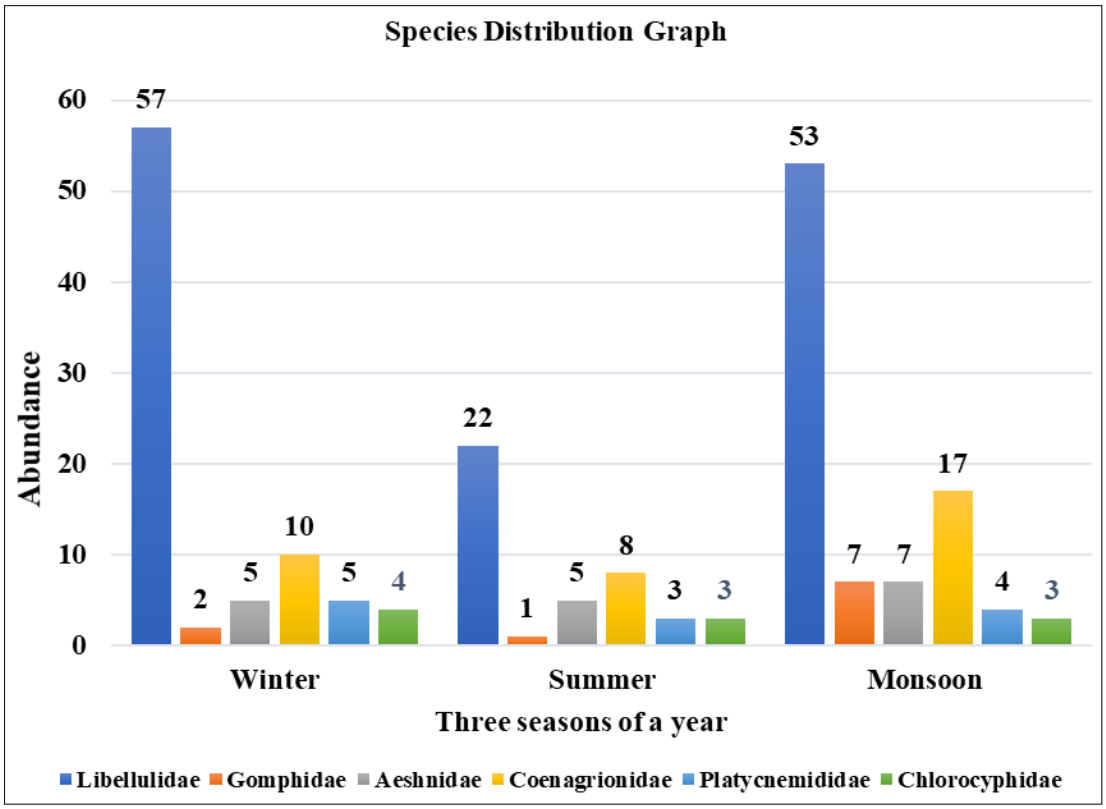

Fig 1: Seasonal variation and abundance of odonates from Painganga Wildlife Sanctuary

Seasonal Variation and Family Abundance

During the winter season, a total of 21 species were recorded, and the total number of individuals was 83; among them, 57 were individuals from the Libellulidae family, 10 were individuals of the Coenagrionidae family, 5 were individuals of the Ashnidae family, 2 were individuals of the Gomphidae family, 5 were individuals of the Platycnemididae family, and 4 were individuals of the Chlorocyphidae family. During the summer season, a total of 20 species were collected, and a total number of individuals was 42; among them, 22 were individuals of the Libellulidae family, 8 were individuals of the Coenagrionidae family, 5 were individuals of the Ashnidae family, 1 was an individual of the Gomphidae family, 3 were individuals of the Platycnemididae family, and 3 were individuals of the Chlorocyphidae family. During the monsoon season, a total of 24 species were collected, and a total number of individuals was 91; among them, 53 were individuals of the Libellulidae family, 17 were individuals of the Coenagrionidae family, 7 were individuals of the Ashnidae family, 7 were individuals of the Gomphidae family, 4 were individuals of the Platycnemididae family, and 3 were individuals of the Chlorocyphidae family (Table 2 and Fig. 1).

In all three seasons, the family Libellulidae is the most abundant family with a greater number of species, followed by the Coenagrionidae family and three other families. Ashnidae, Gomphidae, and Platycnemididae are distributed about equally, and in the Chlorocyphidae family, a few species are distributed. Seasonality is a well-known characteristic of insect populations, and this was observed in the odonate species at Painganga Wildlife Sanctuary, with marked seasonal variations across all transects. The study found that the highest diversity of odonate species occurred during the monsoon season, accounting for 42%, followed by the winter season represented by 38% and the summer period represented by 20%, respectively. Environmental factors like temperature, humidity, rainfall, vegetation, and food availability play a crucial role in shaping the diversity and distribution of insect populations. The monsoon, as a key factor influencing plant density and distribution, contributes to an increase in the abundance of herbivorous insects, which serve as prey for odonates. Therefore, the impact of rainfall and associated humidity on environmental density and diversity appears to be an indirect effect, primarily mediated through its influence on food availability. In this study, Anisoptera (dragonflies) were found to be more abundant than Zygoptera (damselflies). However, previous studies by Fraser [12] and Subramanian [13] suggested that shaded areas and aquatic vegetation might benefit Zygoptera more than Anisoptera. The higher abundance of Anisoptera in most water bodies may be attributed to their superior dispersal capabilities [14-17]. Our findings are consistent with the study by Thomas *et al.* [18], who examined dragonfly species diversity along the Kallar River in the Pathanamthitta district of Kerala. They identified 15 species of dragonflies during a six-month study period. Similarly, research on dragonfly and damselfly (Odonata) species diversity was conducted in the Bor Wildlife Sanctuary, Wardha, where 72 Odonate species from 8 families were recorded [19]. A comparable study in the Murtizapur taluka of Akola district identified 19 species of dragonflies across 2 families and 10 genera. Among the Odonata, 18 species from the Libellulidae family and one species from the Gomphidae family were documented under the suborder Anisoptera [20].

Conclusion

The present study indicates that Painganga Wildlife Sanctuary has a robust variety of odonate populations. The

highest abundance of species was found during the monsoon season, and during the summer season, it was lowest. The Libellulidae are the most dominant family with the most species across all three seasons. Additional research is needed to explore the potential of this group of insects as bioindicators for managing different water bodies and monitoring environmental changes. The current study provides a modest contribution by documenting the odonata species and their seasonal variations in the Painganga Wildlife Sanctuary, located in Yavatmal District, Maharashtra, India.

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Conflict of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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