

## Research Article

# Species Complexity of Order Odonata in District Dir Upper, Khyber Pakhtunkhwa, Pakistan

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**Abstract** | With an important palearctic biogeographical position, district Dir Upper is located at Latitude 35.3356°N, Longitude 72.0468°E and altitude of 1840.57m within the Himalayan foothills in the northwestern Pakistan. Present study brought forward first data for the Odonata fauna inhabiting Dir Upper since inception of Pakistan. The areas represent one of the many ecologies that remain ignored and neglected for insect faunal surveys due to multiple factors like lack of education, awareness, social barriers and uncertain ground conditions being representing Pak-Afghan border territories in many of its valleys and villages. Such areas have a strong potential to come-up with important scientific records. Current study revealed four families, eleven genera and seventeen species and added new geographic range to Odonata fauna of the country. Among recorded fauna, family Libellulidae appeared to be the dominant group, representing 14 species, followed by family Aeshnidae, Calopterygidae and Coenagrionidae representing single species each. Being a flying insect group, seasonal surveys and temporal data for Odonata in this ecologically rich and geopolitically important area are highly suggested that can surely bring forward important information for the migratory species between Afghanistan and Pakistan.

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## Introduction

Dragonflies are an ancient group of insects that evolved long before dinosaurs (Zia *et al.*, 2009). They are strong flyers that spend dual life style, aquatic as naiads and terrestrial as adults (Zia, 2010). Some species are tolerant to brackish and saline waters; while mostly live-in fresh waters (Din

*et al.*, 2013). Yet, many species have small ranges and are specific to certain habitats such as alpine mountain bogs or deserts and are thus frequently used as indicators of environment health. Their sensitivity to habitat quality makes them well-suited agents for environment monitoring (Dijkstra and Lewington, 2006). Their presence or absence is taken as signs and symbols to represent quality of aquatic

microhabitats (Kefford *et al.*, 2003). Dragonflies are also valued for being used as bio control agents in insect pest management programs (Rowe, 2003).

It is estimated that there are more than 6500 Odonata species throughout the globe (Kalkman *et al.*, 2020). However, when compared against its neighbors, Pakistan's known Odonata fauna is comparatively smaller (Kalkman *et al.*, 2020). The Initial works on Odonata fauna of Pakistan were conducted by Yousaf (1972) and Khaliq (1990), documenting first data for country's Anisoptera and Zygoptera fauna and bringing forward a record of 46 species and 34 species respectively. However, the last known country-wide surveys for Anisoptera and Zygoptera were carried out by Chaudhry (2010), who reported 68 Anisoptera species and Zia (2021) who documented 52 species. Lots of small scale faunistic studies were however carried out by various workers in Pakistan, time to time. These works were reflected in Kalkman *et al.* (2020), who produced a thorough faunal work and checklist for the Odonata species of Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. The list included 588 taxa found in the region and Pakistan's Anisoptera fauna is represented by count of 73 species while Zygoptera is represented by 54 species. Pakistan's known Anisoptera record however became 74 species in 2021 by the addition of *S. hypomelas* (Nur-ul-Islam *et al.*, 2021). In all previous faunal works on Odonata in Pakistan, few pockets of the country remained unexplored and ignored due to variable factors like uncertain ground conditions, lack of easy access, traveling hardships and social barriers etc. Among these, district Upper is an important area. The region is densely populated, which has resulted in the diminishing of natural vegetation cover, with an increasingly deleterious effect on freshwater resources. The impact of climate change, places the freshwater fauna and flora of South Asia under extreme pressure. Dir Upper (DU) is spread over 3699 square kilometers. Topography of District Dir Upper is mainly hilly and mountainous. It is located within Malakand Division of the Khyber Pakhtunkhwa Province of Pakistan and shares 40 to 50 kilometers border with Afghanistan on the northwest, thereby representing a house of migratory Odonata species between the two countries (Islam, 2023). Dir Upper is located at Latitude of 35.3356°N, Longitude of 72.0468°E and an altitude of 1840.57m, with an area of 3,699 Sq. km. The climate of Upper Dir is temperate having a maximum temperature with an annual rainfall of 630mm (Islam, 2023).

Being located in an area with erratic ground conditions in many of its pockets, few areas of district Dir Upper remained unexplored for research surveys. It was therefore determined to thoroughly investigate the area for the species complex of dragonflies, taking into consideration the area's unknown status, ecology, and aquatic reservoirs such as springs, streams, rivers, snowfall, precipitation, and lakes in district Dir upper, which naturally support Odonata biology and population.



Figure 1: Map of the study area- Dir upper, KP, Pakistan.

### Materials and Methods

Adult Odonata were collected during successive summer seasons of the years 2022–2023 from 36 localities (09 Union Councils) of district Dir Upper (Figure 1). Samples were collected during the months of May to October during sunny days between 09:00 hrs 16:30 hrs. Methods of sampling were based on Chaudhry (2010) and Zia (2010) and being a faunistic study, random sampling was undertaken. Specimens were collected during their active period using aerial nets and killed by placing in jars having ethyl acetate-soaked butter paper. The specimens after killing were kept in paper pockets and brought to the laboratory, where they were softened and rehydrated by keeping in a humid chamber. Once the specimens became soft enough, they were set over appropriate setting boards

and mounted properly with tags and labels attached. The specimens were transferred to storage boxes, as they became dried. Naphthalene balls were mounted and anti-ant powder was sprinkled in boxes to prevent the attack of ants and other insectivorous pests. Specimens were identified up to species level through Fraser (1933-1936), Chaudhry (2010) and Zia (2010), by studying under Olympus (SZX7) stereoscope in National Insect Museum (NIM), NARC. Help in confirmation of specimens was also taken from the reference collection of National Insect Museum (NARC), Islamabad. All identified specimens were deposited at the Department of Zoology, Shaheed Benazir Bhutto University, Sheringal, Upper Dir, and their representatives were kept at National Insect Museum NARC for future reference and record.

### Results and Discussion

Extensive field surveys carried out to collect Odonata fauna in district Upper Dir revealed a collection that spread to four families, 11 genera and 17 species. The study area, Upper Dir (Dir Kohistan) is administratively divided into two Tehsils, i.e. Sheringal and Kalkot. These are mountainous zone representing lots of natural water resources and receive snowfall as well. Locality wise details for the recorded fauna is provided in Table 1. Within the recorded

fauna, family Libellulidae appeared to be a dominant group, representing 14 species, followed by family Aeshnidae, Calopterygidae and Coenagrionidae, each representing single species each (Figure 2). According to Silsby (2001), family Libellulidae is the largest family of order Odonata and suborder Anisoptera that represents more than 1000 species worldwide. In Pakistan as well, it is the most common and dominant group among all known Odonata families. In many previous works like Mehmood *et al.* (2021) and Naeem *et al.* (2022), conducted in various ecologies of the country, family Libellulidae was observed as the most common and abundant group. Results of the present study further endorse these findings and confirmed family Libellulidae as a dominant group among Odonata.

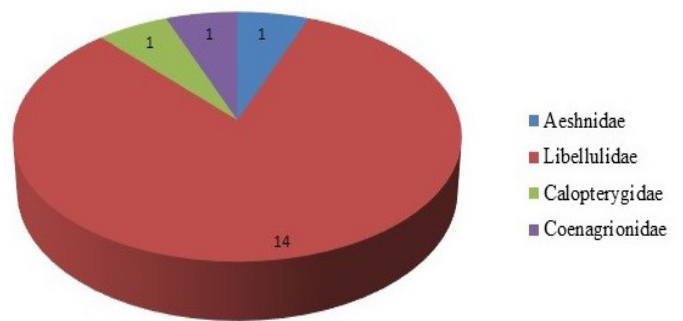


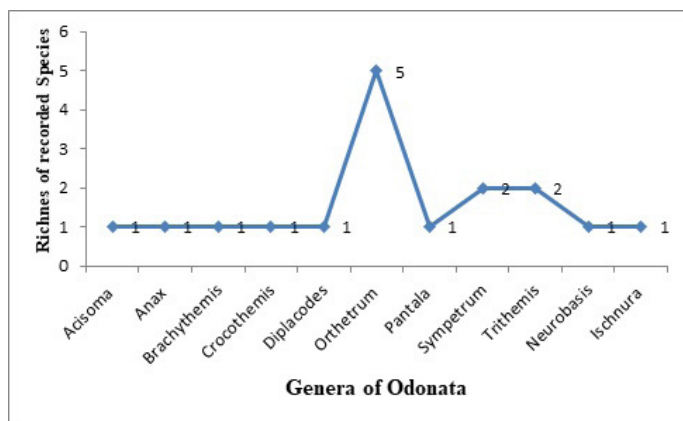
Figure 2: Family wise richness of recorded Odonata species in Dir Upper.

Table 1: Locality wise details for the recorded Odonata fauna.

Family	Species	Localities								
		Sawani	She- ringal	Gwaldi	Doagdara	Patrak G	Patrak S	Barikot	Kalkot	Thall
Aeshnidae	<i>Anax nigrofasciatus</i>	-	+	+	-	-	-	-	-	-
Libellulidae	<i>Acisoma panorpoides panorpoides</i>	+	+	-	-	-	-	-	-	-
	<i>Brachythemis contaminata</i>	-	+	-	-	-	-	-	-	-
	<i>Crocothemis erythraea</i>	-	+	+	-	-	-	-	-	-
	<i>Diplacodes trivialis</i>	-	+	-	-	-	-	-	-	-
	<i>Orthetrum brunneum brunneum</i>	-	+	-	+	-	-	-	+	+
	<i>Orthetrum chrysostigma luzonicum</i>	-	+	+	-	+	-	-	+	-
	<i>Orthetrum purinosum neglectum</i>	-	+	-	-	-	-	-	+	-
	<i>Orthetrum sabina</i>	+	-	-	-	-	-	-	-	+
	<i>Orthetrum triangulare triangulare</i>	-	-	+	-	-	-	-	-	+
	<i>Pantala flavescens</i>	-	+	-	-	-	-	-	-	-
	<i>Sympetrum commixtum</i>	-	+	-	-	-	-	-	-	-
	<i>Sympetrum fonscolombeii</i>	-	-	-	-	+	-	+	+	-
	<i>Trithemis aurora</i>	-	-	-	-	-	-	+	-	+
	<i>Trithemis festiva</i>	-	-	-	-	-	-	+	+	-
Calopterygidae	<i>Neurobasis chinensis</i>	+	+	-	-	-	-	-	-	
Coenagrionidae	<i>Ischnura forcipata</i>	-	+	+	-	-	-	-	-	

+, indicates presence; -, indicates absence.

Dragonflies are insects that prefer undisturbed and pollution free ecologies. According to Zia *et al.* (2011a), their population is decreasing due to rapid increase in air and water pollution within recent decade. In Pakistan, Malakand Division generally and the area under district Dir Upper, specifically, present an ecology that can bring forward complex of Odonata species, if explored thoroughly and extensively, deep in the valleys and villages. The Division is blessed with unlimited water resources in the form of seasonal streams, perennial rivers and natural springs and lots of small lakes and ponds. Whole valley becomes snow covered in winters, that feed hundreds of streams and rivers in summers, ultimately supporting Odonata biology and population.

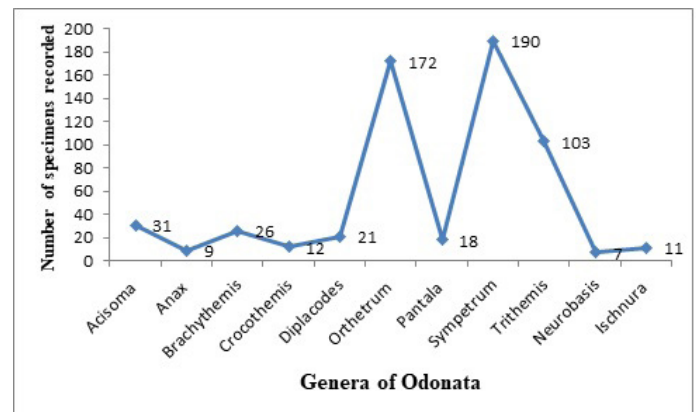


**Figure 3:** Genera wise richness of Odonata species in Dir Upper.

During the present work, richness of species in each recorded genus was also studied. It was observed that genus *Orthetrum* with its five species is significantly dominant over all other recorded taxa (Figures 3, 4). Within the subfamily Libellulinae, *Orthetrum* is a big genus representing 80 known species worldwide. It is a common observation that members of this genus are more readily adjustable in different types of climates and ecologies than any other genus of the same anisopterous family. Similar observations were observed by various workers like Din (2012), Raza (2015), Ahsan (2015) and Mehmood (2016). In all these studies genera *Orthetrum* dominated among all the recorded taxa.

The present manuscript is based on a study that was undertaken to record Odonata fauna of the district Dir Upper for the first time. District Upper Dir lies at the border of Afghanistan. The Durand Line between Afghanistan and Pakistan possesses an important geographic position. The area of Upper Dir therefore

holds a transitional position along Afghanistan and Pakistan. China also lies further next, and north to it. It is a known fact that members of order Odonata travel long in search of their food and ideal climatic conditions (Zia *et al.*, 2019). Both the countries serve as home to lot of migratory Odonata species of Afghanistan, Pakistan and China (Zia *et al.*, 2011b). So, both the territories should be thoroughly surveyed for exploring new and important records of migratory Odonata. The present manuscript, by reporting 17 species of Odonata from district Upper Dir in its initial and baseline survey, presents a good picture for inhabiting Odonata by reporting the fauna of Upper Dir.



**Figure 4:** Sample based richness of Odonata in recorded genera.

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### Novelty Statement

The study is based on first ever research survey conducted recording Odonata faunistics in district Dir Upper.

### Author's Contribution

II: Conducted field survey and recorded samples. RU: Conceived and supervised whole study. AZ: Did taxonomic identification and confirmation of all samples. ARB: Data interpretation, analysis and write-up. MI: Financed the study and survey. SH and KH: Contributed equally.

## Conflict of interest

The authors have declared no conflict of interest.

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