



Biodiversity of Dragonflies and their Life Threatening Factors in Tehsil Chamla and Daggar of District Buner, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

The study was aimed at determining species composition, relative abundance and habitat preference of adult dragonflies in relation to increasing aquatic and air pollution in Tehsils Daggar and Chamtala of district Buner, Khyber Pakhtunkhwa. For this, surveys were conducted during May to October, 2013 and eleven species with seven genera were recorded. Among these, three species (*Trithemis festiva*, *Orthetrum pruinosum neglectum* and *Trithemis aurora*) were found constant, while three (*Orthetrum anceps*, *Sympetrum commixta* and *Orthetrum triangulare*) were observed to be moderate and two (*Onychogomphus bistrigatus* and *Palpopleura sexmaculata*) were found to be infrequent in their occurrence. Perennial riverine habitats represented four species, seasonal streams with inhabiting three species and springs with only two dwelling species. Only one species was recorded from crop fields and ponds. For seasonal occurrence, 119 dragonflies were observed in July while seven in October. The aquatic and air pollution from huge number (n=600) of marble factories in Daggar and more use of pesticides in Chamla were observed to affect drastically the dragonfly population in the area. Present study therefore emphasizes conservation of Odonata fauna by implanting proper treatment plant for marble and pesticidal wastes.

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Authors' Contribution

JK and AZ conceived and designed the project and wrote the article. S performed the experimental work. AZ identified the dragonflies.

Key words

Dragonfly, biodiversity, conservation.

INTRODUCTION

Dragonflies are not only an important component of terrestrial ecosystem but also act as indicator of the condition of wetland ecosystem (Din *et al.*, 2013). Pakistan is blessed with more than 225 manmade and natural wetlands spread over approximately 10% of the country (PWP, 2008). These conditions combined with suitable ecology favors broad spectrum of Odonata species. A lot of work has already been carried out exploring species complex of Odonata. Up till now a record of more than 120 species is known for the country (Choudhry *et al.*, 2010; Zia, 2010; Dow *et al.*, 2014). However, Odonata population in Pakistan has been observed to be decreasing at a rapid rate during country wide surveys conducted for five consecutive years (Zia, 2010). In a recent study, Zia *et al.* (2011a) reported Odonata population and its trends over a period of one decade. A noticeable reduction in species mass has been fore-grounded in reaction to increased population and pollution. Din *et al.* (2011) also stressed to conduct fresh surveys recording threatened Odonata species and

stepping towards their conservation in Pakistan. According to Dudgeon (2010) deforestation, urbanization and the sequential change in waters are the biggest threats to Odonata. His study emphasized that forested streams and rivers have been badly affected by human activities over recent decades.

District Buner is an important region of the Khyber Pakhtunkhwa, with variable habitats and unlimited resources of water in the form of streams, springs, and rivers. Hill tops here receive snowfall and thus streams and rivers continue to flow throughout the year, thereby supporting Odonata activities for prolonged time period. Distribution and species composition of dragonflies in Buner district has never been studied in detail. Present study was therefore planned to study Odonata population in two Tehsils (Chamla and Daggar) of Buner district affected by marble factories and pesticidal wastes.

MATERIALS AND METHODS

Type and area of study

The study is descriptive in nature. Surveys were conducted during summer months (May to October) of the year 2013 during their active period (0700 h to 1800 h). As a whole fifteen localities (*i.e.*, Jehan Abad, Sura, Nawagai, Kawga, Ambela, Nagrai, Agarai and Jangai in Tehsil Chamla, while Sunigram Barando, Elai, Anghapur, Shalbandi, Krapa, Daggar River and Torwarsak in Tehsil

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Daggar) were surveyed (Fig. 1). Adult dragonflies were collected from variable aquatic spots ranging from rivers and streams to stagnant ponds, marshes and field crops. Collected specimens were identified following Choudhry *et al.* (2010), Zia (2010) and Fraser (1933-34). However help was also taken from housed Odonata collection of National Insect Museum at National Agriculture Research Centre, Islamabad. Identified specimens are deposited in Zoology laboratory, Abdul Wali Khan University Mardan, Buner Campus for future studies.

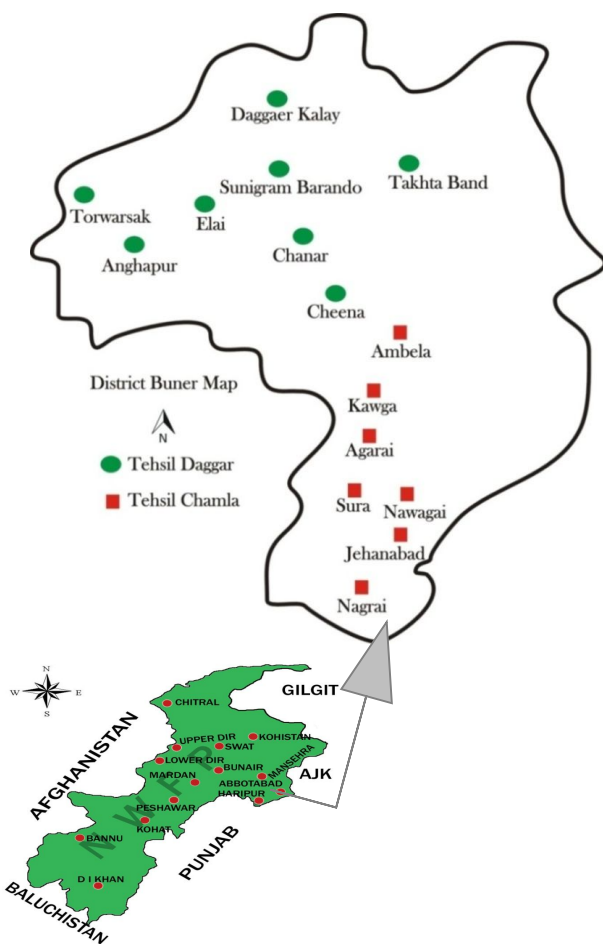


Fig. 1. Map of KPK (old NWFP) with collection sites in district Buner.

Data analysis

Seasonal variation of dragonflies was analyzed by calculating relative abundance and distribution following (Khan and Zaman, 2015; Ali *et al.*, 2013) and using the following formula:

$$\text{Relative abundance} = I/L \times 100$$

where 'I' is number of specimens of each dragonfly

species and L is the total number of specimens. Recorded species were classified in following relative abundance classes, relative abundance <5% = satellite species; relative abundance <10% = sub-dominant species and Relative abundance >10% = dominant species.

Distribution was calculated as:

$$\text{Distribution (C)} = n/M \times 100$$

where "n" is number of sites where species were recorded and "M" represents the number of sites visited for collection.

The following classes were used to represent distribution status of different species. C1 = Sporadic (0-20%); C2 = Infrequent (20.1-40%); C3 = Moderate (40.1-60%); C4 = Frequent (60.1-80%); and C5 = Constant (80.1-100%).

RESULTS

A total of 300 adult dragonfly individuals (210 male and 90 female) were collected. Taxonomic identification revealed eleven species (*Trithemis festiva*, *Orthetrum pruinosum neglectum*, *Trithemis aurora*, *Orthetrum anceps*, *Sympetrum commixta*, *Orthetrum triangulare triangulare*, *Onychogomphus bistrigatus*, *Palpopleura sexmaculata*, *Pantala flavescens*, *Anax immaculifrons*, *Orthetrum Sabina*) under seven genera (*Orthetrum*, *Palpopleura*, *Anax*, *Pantala*, *Onychogomphus*, *Trithemis*, *Onychogomphus*) of a single family i.e. Libellulidae. Among these, genus *Trithemis* and *Orthetrum* represented six species whereas each of the other five genera represented single species each. Details for the recorded specimens are as follows:

Orthetrum triangulare triangulare

Material examined: Daggar: Sunegram River (34°28'50.53N, 72°29'11.74 E), 10. viii. 2013, 20♂5♀, leg. Saifullah; Chamla: Ambela (34°22'50.98N, 72°25'46.19E), Kowga (34°22'38.97N, 72°30'35.01E), 26. vi. 2013, 18♂10♀, leg. Saifullah.

Orthetrum anceps

Material examined: Daggar: Anghapur (34°29'39.47 N, 72°23'57.06 E), 25. viii. 2013, 15♂13♀, leg. Saifullah.

Orthetrum sabina

Material examined: Daggar: Elai (34°30'35.56N, 72°25'53.83E), 05. ix. 2013, 3♂, leg. Saifullah; Krapa (34°29'12.61N, 72°27'30.18 E), 05. ix. 2013, 4♂, leg. Jehngir.

Palpopleura sexmaculata

Material examined: Daggar: Shalbandai (34°29'57.71N, 72°31'17.98 E), 09. vi. 2013, 4♂3♀, leg. Saifullah; Daggar river (34°30'38.87 N, 72°29'30.27 E), 09. vi. 2013, 6♂1♀, leg. Saifullah.

Pantala flavescens

Material examined: Daggar: Torwarsak (34°30'46.97 N, 72°22'09.49 E), 12. v. 2013, 10♂2♀, leg. Saifullah.

Anax immaculifrons

Material examined: Chamla: Sura (34°23'16.46 N, 72°32'52.29 E), 28. vii. 2013, 8♂2♀, leg. Saifullah.

Onychogomphus bistrigatus

Material examined: Chamla: Agarai (34°23'22.53N, 72°32'12.46E), 21. vi. 2013, 4♂5♀, leg. Jehangir; Nawagai (34°24'16.89 N 72°34'20.56 E), 21. vi. 2013, 9♂3♀, leg. Jehangir.

Orthetrum pruinosum neglectum

Material examined: Chamla: Jangai (34°31'22.92 N 71°58'23.92 E), 15. viii. 2013, 35♂15♀, leg. Saifullah.

Trithemis festiva

Material examined: Chamla: Jehan Abad (34°49'03.51 N, 72°27'56.34 E), 05. vii. 2013, 41♂19♀, leg. Saifullah.

Trithemis aurora

Material examined: Chamla: Nagrai (34°23'22.53N, 72°32'12.46E), 20. vii. 2013, 33♂12♀, leg. Saifullah.

Sympetrum commixta

Material examined: Daggar: Sunigram river (34°28'50.53N, 72°29'11.74E), 10.viii.2013, 30♂5♀, leg. Saifullah.

Relative abundance of all recorded species was calculated (Table I). It shows that three species were dominant, four were sub-dominant and four appeared to be satellite species. Whereas on the basis of distribution, three species were found constant, three were moderate, two were infrequent and three were observed to be sporadic. Seasonal pattern of recorded dragonflies was also studied (Table II). It was observed that highest number of dragonflies (*i.e.*, 119 = 39.66%) were collected during July while lowest population (*i.e.*, 07 = 2.33%) was observed during October, yet in both periods almost all the individuals belonged to different species. Among these, *Trithemis festiva* was common species represented by highest number (n=60, making percentage of 20) and observed throughout the study period followed by

Orthetrum pruinosum neglectum (n=50 with percentage of 16.6%) and *Trithemis aurora* (n=45 with 15%) recorded throughout surveys. Rests of the species represented relatively less number of individuals and were mostly collected in colder months. It is noticeable that during October, least number of individuals and species were recorded (Fig. 2).

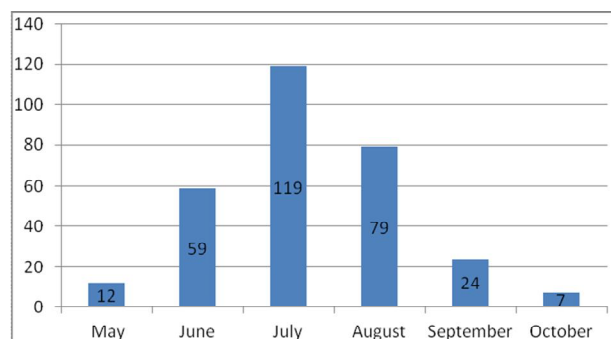


Fig. 2. Seasonal variation of dragonflies in district Buner.

Habitat preferences of dragonfly species were also studied (Table III). It was observed that perennial rivers were preferred sites (representing four species) followed by streams (3 species), springs (2 species), and crop fields and ponds (with one species each). Crop fields and ponds thus indicate least preference for recorded odonates. However rivers inhabited highest number of individuals (*i.e.* 100) as well as species (04) indicating a clear preference. During the surveys, data was also recorded for different factors that may affect odonate biodiversity. It is important to mention that more than 600 marble factories are working in this small district of KPK. It is the highest number of marble factories operating in any district of KPK province. On getting further narrowed, it was observed that among these more than 50% of the factories are present in Tehsil Daggar. This much high numbers of marble factories discharging their effluents regularly in natural streams and rivers are drastically affecting biota of this region. The sewages of these industries having high density metals, minerals, stones and even chemicals are directly flushed in aquatic bodies due to which aquatic fauna like fishes, amphibians and dragonflies larvae have become scuppered. In addition, these factories are major cause of air pollution too. Heavy dust particles and toxic chemicals are continuously exhausted in the air and are affecting respiration of terrestrial adults of Odonata.

The scourges in Tehsil Chamla are even more alarming for dragonflies. Due to suitable climatic conditions the tobacco is a popularly grown crop here and it has become a major cause for using injudicious use of

Table I. Relative abundance and distribution of dragonfly species in different areas of Buner.

Species	Total	Relative abundance	Distribution	Relative abundance status	Distribution status
<i>T. festiva</i>	60	20	86	Dominant	Constant
<i>O. pruinosum neglectum</i>	50	16	6	Dominant	Constant
<i>T. aurora</i>	45	15	86	Dominant	Constant
<i>O. anceps</i>	28	9.33	43	Subdominant	Moderate
<i>S. commixta</i>	25	8.33	43	Subdominant	Moderate
<i>O. triangulare triangulare</i>	28	9.33	43	Subdominant	Moderate
<i>Ony. bistrigatus</i>	21	7	43	Subdominant	Infrequent
<i>Pal. sexmaculata</i>	14	4.66	29	Satellite species	Infrequent
<i>P. flavescens</i>	12	4	14	Satellite species	Sporadic
<i>An. immaculifrons</i>	10	3.33	14	Satellite species	Sporadic
<i>O. sabina</i>	7	2.33	14	Satellite species	Sporadic

Table II.- Seasonal variation of different dragonfly species.

Species	May	June	July	August	September	October	Total
Streams							
<i>T. festiva</i>	2	8	9	7	3	0	29
<i>Ony. bistrigatus</i>	0	2	4	2	1	0	9
<i>O. pruinosum neglectum</i>	1	2	4	1	1	0	9
<i>O. anceps</i>	0	2	3	1	0	0	6
<i>Pal. sexmaculata</i>	0	0	1	2	0	0	3
<i>An. immaculifrons</i>	0	0	1	1	0	0	2
Total	3	14	22	14	5	0	58
Rivers							
<i>T. festiva</i>	1	5	8	6	1	0	21
<i>T. aurora</i>	0	3	5	4	1	0	13
<i>S. commixta</i>	0	4	12	6	3	0	25
<i>P. flavescens</i>	1	2	4	3	1	1	12
<i>An. immaculifrons</i>	0	0	5	3	0	0	8
<i>O. triangulare triangulare</i>	2	4	7	6	1	1	21
Total	4	18	41	28	7	2	100
Springs							
<i>O. pruinosum neglectum</i>	1	8	12	10	4	1	36
<i>Pal. sexmaculata</i>	0	2	5	3	1	0	11
<i>T. aurora</i>	2	4	10	6	2	1	25
Total	3	14	27	19	7	2	72
Fields crops							
<i>T. festiva</i>	0	1	2	2	1	0	6
<i>T. aurora</i>	0	1	2	1	0	0	4
<i>O. sabina</i>	0	0	3	2	1	1	7
<i>O. triangulare triangulare</i>	0	1	2	2	1	1	7
<i>O. anceps</i>	1	5	10	6	0	0	22
Total	1	8	19	13	3	2	46
Ponds							
<i>O. pruinosum neglectum</i>	0	1	3	1	0	0	5
<i>T. festiva</i>	0	1	2	1	0	0	4
<i>T. aurora</i>	0	1	1	1	0	0	3
<i>O. bistrigatus</i>	1	2	4	2	2	1	12
Total	1	5	10	5	2	1	24
Grand total	12	59	119	79	24	7	300

Table III.- Dragonflies recorded from variable habitats.

Species ↓	Habitats ⇨	Streams (%)	Rivers (%)	Springs (%)	Fields crops (%)	Ponds (%)	Total (%)
<i>T. festiva</i>		29 (50)	21 (21)	0	6(13)	4 (16.6)	60 (20)
<i>O. prunosum neglectum</i>		9 (15.5)	0	36 (50)	0	5 (20.8)	50 (16.6)
<i>T. aurora</i>		0	13 (13)	25 (34.7)	4 (8.6)	3 (12.50)	45 (15)
<i>O. anceps</i>		6 (10.3)	0	0	22 (47.8)	0	28 (9.3)
<i>S. commixta</i>		0	25 (25)	0	0	0	25 (8.3)
<i>O. tri. triangulare</i>		0	21 (21)	0	7 (15.2)	0	28 (9.3)
<i>O. bistrigatus</i>		9 (15.5)	0	0	0	12 (50)	21 (7)
<i>Pal. sexmaculata</i>		3 (5.1)	0	11 (15.27)	0	0	14 (4.6)
<i>P. flavescens</i>		0	12 (12)	0	0	0	12 (4)
<i>An. immaculifrons</i>		2 (3.4)	8 (8)	0	0	0	10 (3.33)
<i>O. sabina</i>		0	0	0	7 (15.2)	0	7 (2.33)
No. of individuals		58 (19.33)	100 (33.3)	72 (24)	46 (15.3)	24 (8)	300 (100)
No. of species		3	4	2	1	1	11

pesticides. Because of increased demand in pesticide for controlling pests of tobacco, many companies have erupted that are spilling their discharges in natural wetlands. Spraying of pesticides itself increased air pollution that is badly impacting dragonfly adults and their discharge in aquatic bodies has affected their naiads as well.

DISCUSSION

Pakistan possesses an important global position with respect to flora and fauna. It represents insect fauna of three bio-geographical (Oriental, Palearctic and Afro-tropical) regions (Zia *et al.*, 2011a). It is surrounded by China, Afghanistan, Iran, India and disputed Kashmir territories. Dragonflies, being a group of strong fliers travel long in search of food, water and ideal climatic conditions. They have a migration record of over thousands of miles and thus their adults are sometimes found in different ecologies as that from their immature (Din *et al.*, 2011). Taxonomic studies on Anisoptera fauna of Pakistan were initiated during 1972 by Yousuf and latest available information for this fauna at country level has been reported by Chaudhry *et al.* (2010). However information on KPK's fauna has been poorly collected during both of these studies. Although the favorable climatic conditions and presence of unlimited natural water resources in the form of snow, streams, rivers, lakes, springs favors biology of Odonata and thus attract odonatologists from all over the world but due to uncertain ground conditions in many of the KPK's area, Anisopterous fauna of this province remained under explored with very few records available up till now. Some short term studies exploring Anisopterous species of Khyber Pakhtunkhwa were conducted by (Ahmad and

Yousuf, 1994; Khaliq and Maula, 1999; Perveen *et al.*, 2014). Yet in all of these studies, district Buner is badly ignored and no detailed information is available on record for dragonfly species of this important district up till now.

Present study by reporting a record of eleven species from just two Tehsils of district Buner, not only opens door for more faunistic surveys to be undertaken in the whole district but also thirsts for taking steps towards their protection and survival. Dragonfly population in Pakistan is already decreasing at a rapid rate because of increased urbanization and pollution (Zia *et al.*, 2011b). Dudgeon (2010) and Balzan (2012) also reported subsequent alteration of water objects as greatest threat to dragonflies in Africa. He also emphasized that deforestation, urbanization, agricultural interference and commove landscapes have badly affected dragonflies during last decade. Similar situation has been pointed out in district Buner during the current study. Drastically huge numbers of operating marble factories in Tehsil Daggar and emerging pesticide companies in Tehsil Chamla are serious issues to be addressed. It is worth mentioning that Odonates are taken as popular symbols to reflect condition of climate (Rafi *et al.*, 2009; Zia *et al.*, 2008) and have been used as indicators for assessment of water quality for human consumption in past (Zia, 2010). Thus, if their population is getting affected by these factors in district Buner then it will sooner or later affect human lives as well. Immediate steps must be taken for their protection by keeping a check over operating marble and pesticide factories and their sewage spillages in whole district.

CONCLUSION

Dragonflies, a very important component of

ecosystem and effective biocontrol agent of crop pests are at threat in district Buner of KPK because of continuous spills of marble and pesticide factories in fresh water bodies. Immediate attention from Environmental Protection and Law Enforcement Agencies is thus required.

Statement of conflict of interest

Authors have declared no conflict of interest.

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