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Dragonflies (Odonata: Anisoptera) of Pakistan

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ABSTRACT

Dragonflies are important predators of wetland and agro ecosystem. Existing information on Anisoptera fauna of the country is updated by extensive field surveys during 2006-2011.The current study reportssixty eight species of Anisoptera belonging to 05 families and 39 genera. Of this, seven species are new report to the country. A detailed checklists of dragonflies of Pakistan has also been presented in this paper.

Article Information

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Authors' Contributions

MTC conceived and designed the study and wrote the article. MTC, FAS and MA collected and identified dragonflies. MTC and AZ collected and analyzed the data, odonates.

Key words

Anisoptera, dragonflies, agro-ecological zones.

INTRODUCTION

Pakistan is situated between the 32.0162°N, 71.6926°E stretching over 1600 Km North to South and 885 Km East to West with a total area of 796095 square kilometers (Zia, 2010). Pakistan is a discerning mixture of landscapes, beauty fluctuating from plains to deserts, hills, forests and plateau starting from the coastal areas of the Arabian Sea in the south to the peaks of the Karakoram Range in the north (Saeed, 2012).

Dragonflies are key components of freshwater ecosystem. The larvae serve as food for freshwater fish, and the soft bodies of the teneral are fed by birds (Jens and Runyan, 2006). Odonates are ecologically important as both predators and prey. Their larvae constitute a natural biological control over mosquito larvae and thus help to control several epidemic diseases like malaria, dengue, filaria etc. (Mitra, 2002; Din *et al*., 2013). The adults of some species visit important crop fields like cotton and rice in search of their food and in this way help in controlling insect pests of these crops. Females of all the species consume much greater number of insect pests as compared with male (Khaliq and Saddique, 1995; Yousaf *et al*., 1995, 1998). Current information of Odonata fauna of Pakistan is very limited and outdated. Last comprehensive study on the group was condcucted by Yousaf (1972) who collected and identified 46 species of anisoptrous dragonflies from various localities of Pakistan. The current study aims to comprehensively document the Anisoptera fauna of Pakistan by conducting systematic field surveys in all agro-ecological zones of the country.

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MATERIALS AND METHODS

Study area

Survey was conducted during summer seasons of 2006-11 to collect adult dragonflies from different agro-ecological zones (Dost, 1998) of Pakistan (Fig. 1). The following localities of the country were visited for this purpose. Agro-ecological zones and areas visited are as follows.

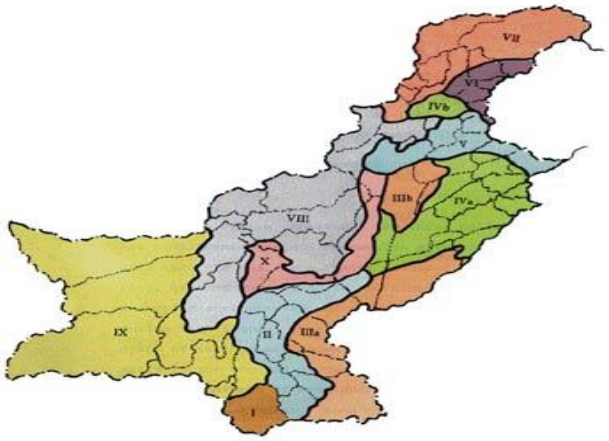

Fig. 1. Map of Pakistan showing various agro-ecological zones.
I, Indus Delta; II, Southern Irrigated Plain; III, Sandy Desert (a&b); IV, Northern Irrigated Plain (a&b); V, Barani Lands; VI, Wet Mountains; VII, Northern Dry Mountains; VIII, Western Dry Mountains; IX, Dry Western Plateau; X, Sulaiman Piedmont.

The Indus delta

The area is a network of dead and dying rivers. The climate is arid tropical marine with moderately hot summers and very mild winters. The mean daily

maximum temperature range is 34-40°C in summer and 19-20°C in winter. The mean monthly summer rainfall (July-September) is approximately 75 mm and in winter (December-February) it is less than 5 mm. Relative humidity is high ranging 67-87 percent throughout year in morning and 37-35% in afternoon except monsoon, when it raises 55-60 percent. The localities visited were Thatta, Badin and Tando Muhammad Khan (Hyderabad).

The southern irrigated plains

This zone has been formed by the meandering and shifting courses of the Indus river. The climate is arid subtropical and continental with hot summers and mild winters. The mean daily temperature range is 40-45°C during May to July. The mean daily minimum temperature in winter is about 8.5°C. The mean monthly rainfall is only about 16-20 mm in summer, with little rain in winter. The localities visited were Sanghar, Dadu, Larkana, Sukkar and Rahim Yar Khan.

The sandy desert

The zone is covered with various forms of sand ridges and dunes. The climate is arid (desert) subtropical with very hot summers and mild winters. The mean daily summer maximum temperature range is 39-41°C and in winter, the mean daily minimum temperature is about 7°C. The monthly rainfall varies from 32 mm in the north to 46 mm in the south. The winter is practically rainless. Dust storms are common during summer. The localities visited were Bahawalpur, Fort Abbas, Kot Addu, Bhakar and layyah.

The northern irrigated plains

This zone is one of the most intensively cultivated areas of the country. This zone has a semi-arid subtropical continental climate. The mean daily maximum temperature in summer is 39.5°C, and in winter, the mean daily minimum temperature is 6.2°C. The mean annual rainfall range is 300-500 mm. Mean monthly summer (July, August, September) rainfall varies from 108 mm in the east to 75 mm in the southwest, while in winter, it varies from 14-22 mm per month. The localities visited were Lahore, Faisalabad, Multan, Mianwali, Sargodha, Peshawar, Charsada and Mardan.

The barani lands

Rain fed cultivation is the main land use of this area. The climate of this zone is semi-arid with hot summers and cold winters and with a short dry season in early summer. In summer, the mean daily temperature is 38°C. In winter, the mean daily temperature range is 3-6°C. The mean monthly rainfall is approximately 200 mm in summer and 36-50 mm in winter (December-February). The localities visited were Rawalpindi, Attock, Chakwal, Jhelum, Sialkot, Narowal, Khushab and Mirpur (A.J.K).

The wet mountains

This zone has various type of forest. The extreme eastern part of this zone could be classified as humid, with mild summers and cold winters. In summer, the mean daily maximum temperature is about 35°C. The monthly rainfall in summer is about 236 mm and in winter 116 mm. The western part of the zone is sub humid Mediterranean, with dry summers and rainfall confined to the winter and spring seasons only. The localities visited were Murree, Abbotabad, Kotli, Bagh, Rawalakot (A.J.K) and Muzafarabad (A.J.K).

The northern dry mountains

This zone consists of high mountains covered with snow. The mean daily minimum temperature varies from 1-7°C. The mean monthly rainfall ranges from 25-75 mm in winter and from 50-100 mm in spring. In summer, it varies from 10-20 mm. The localities visited were Kohat, Swat, Dir, Skardu, Gilgit and Chitral.

The western dry mountains

It is the zone of mountain and valleys. The greater part of this area is semi-arid highland with mild summers and cold winters. Rainfall and snowfall is confined mostly to the winter season. The mean monthly rainfall in summer varies from 5-15 mm increasing to 45-95 mm in the northern region. In summer, the mean daily maximum temperature range is 30 to 39°C and in winter, the mean daily minimum temperature varies from -3°C to +8°C. The localities visited were Quetta, Khuzdar, Zhob, Loralai and Parachanar.

The dry western plateau

The vegetation is xerophytic in the lower region and forest on high altitude. This region has an arid (desert) tropical climate with constant dry season. The mean monthly maximum temperature range is 38-44°C. In winter, the mean daily minimum temperature range is 3-6°C in the north and 11.5-15°C along the coast. The mean monthly rainfall in summer is (2-4 mm) except in the extreme south-eastern part where it is about 36 mm. The localities visited were Karachi, Lasbela, Turbat and Panjgur.

The Suleiman piedmont

Torrent-watered cultivation is the main land use of the region. The climate of this region is sub-tropical continental, arid and hot. The mean daily maximum temperature in summer is 40-43°C. The mean daily minimum temperature in winter varies from 6-8°C. The

Table I.- Checklist of dragonflies of Pakistan is being presented.

Families	Species	Z 1	Z 2	Z 3	Z 4	Z 5	Z 6	Z 7	Z 8	Z 9	Z 10
Aeshnidae	***Aeshna* Fabricius, 1775**										
	Aeshna juncea (Linnaeus, 1758)	-	-	-	-	-	+	+	-	-	-
	***Anaciaeschna* Selys, 1878**										
	Anaciaeshna jaspidea (Burmeister, 1839)	+	-	-	-	-	-	-	-	-	-
	***Anax* Leach, 1815**										
	Anax indicus Lieftinck, 1942	-	-	-	-	+	-	-	-	-	-
	Anax immaculifrons Rambur, 1842	-	-	-	-	+	+	-	-	-	-
	Anax nigrofasciatus Fraser, 1935	-	-	-	-	-	-	+	-	-	-
	Anax parthenope (Selys, 1839)	-	+	-	+	+	+	+	+	+	-
	***Cephalaeschna* Selys, 1883**										
	Cephalaeschna masoni (Martin, 1909)	-	-	-	-	-	-	+	-	-	-
	***Gynacanthaeschna* Fraser, 1921**										
	Gynacanthaeshna sikkima (Karsch, 1891)	-	-	-	-	+	-	-	-	-	-
	***Hemianax* Selys, 1883**										
	Hemianax ephippiger (Burmeister, 1839)	-	-	-	-	+	-	-	-	-	-
Cordulegastridae	***Cordulegaster* Leach, 1815**										
	Cordulegaster brevistigma (Selys, 1854)	-	-	-	-	-	+	+	-	-	-
Corduliidae	***Epophthalmia* Burmeister, 1839**										
	Epopthalmia vittata vittata Burmeister, 1839	-	-	-	-	+	-	-	-	-	-
	***Macromia* Rambur, 1842**										
	Macromia cingulata Rambur, 1842	-	-	-	+	+	-	-	-	-	-
	Macromia moorei Selys, 1874	-	-	-	-	-	+	-	-	-	-
Gomphidae	***Anormogomphus* Selys, 1854**										
	Anormogomphus kiritschenkoi Bartenef, 1913	-	-	-	+	+	-	-	-	+	-
	***Burmagomphus* Williamson, 1907**										
	Burmagomphus pyramidalis Laidlaw, 1922	-	-	-	-	-	+	-	-	-	-
	Burmagomphus sivalikensis Laidlaw, 1922	-	-	-	-	-	+	-	-	-	-
	***Gomphidia*Selys, 1854**										
	Gomphidia t-nigrum Selys, 1854	-	-	-	+	+	-	-	-	-	-
	***Ictinogomphus* Cowley, 1934**										
	Ictinogomphus angulosus (Selys, 1854)	-	-	-	-	+	+	-	-	-	-
	Ictinogomphus rapax (Rambur, 1842)	+	-	-	+	+	+	-	-	-	+
	Paragomphus										
	Paragomphus lineatus (Selys, 1850)	-	-	-	+	+	+	-	-	-	-
	***Nepogomphus*Fraser, 1934**										
	Nepogomphus modestus (Selys, 1878)	-	-	-	-	+	+	-	-	-	-
	***Onychogomphus*Selys, 1854**										
	Onychogomphus bistrigatus (Selys, 1854)	-	-	-	-	+	+	+	-	-	-
	Onychogomphus biforceps (Selys, 1878)	-	-	-	-	-	+	-	-	-	-
	***Ophiogomphus* Selys, 1854**										
	Ophiogomphus reductus Calvert, 1889	-	-	-	-	-	-	+	-	-	-
	***Platygomphus* Selys, 1854**										
	*Platygomphus dolabratus*Selys, 1854	-	-	-	-	-	+	-	-	-	-
Libellulidae	***Acisoma* Rambur, 1842**										
	Acisoma panorpoides panorpoides Rambur, 1842	+	+	-	+	+	+	+	-	+	-
	***Brachydiplax* Brauer, 1868**										
	Brachydiplax sobrina (Rambur, 1842)	-	+	+	-	+	+	+	-	-	+
	***Brachythemis* Brauer, 1868**										
	Brachythemis contaminata (Fabricius, 1793)	+	+	+	+	+	+	+	+	-	+
	***Bradinopyga* Kirby, 1893**										
	Bradinopyga geminata (Rambur, 1842)	-	-	-	-	+	-	-	-	-	-
	***Crocothemis* Brauer, 1868**										
	Crocothemis erythraea (Brulle, 1832)	+	+	-	+	+	+	+	+	+	+
	Crocothemis servilia (Drury, 1770)	+	+	+	-	+	+	+	+	+	-

Continued

Families	Species	Z 1	Z 2	Z 3	Z 4	Z 5	Z 6	Z 7	Z 8	Z 9	Z 10
	***Diplacodes* Kirby, 1889**										
	Diplacodes lefebvrei (Rambur, 1842)	+	+	+	+	+	+	+	+	+	-
	Diplacodes trivialis (Rambur, 1842)	+	+	-	+	-	+	-	-	-	-
	***Libellula* Linnaeus, 1758**										
	Libellula quadrimaculata Linnaeus, 1758	-	-	-	-	-	-	+	-	-	-
	***Neurothemis* Brauer, 1867**										
	Neurothemis fluctuans (Fabricius, 1793)	-	-	-	-	+	-	-	-	-	-
	Neurothemis tullia tullia (Drury, 1773)	+	-	+	+	+	-	-	-	-	+
	***Orthetrum* Newman, 1833**										
	Orthetrum anceps (Schneider, 1845)	-	-	-	-	-	+	+	+	-	-
	Orthetrum brunneum brunneum (Fonscolombe, 1837)	-	-	-	-	-	-	+	+	+	-
	Orthetrum cancellatum cancellatum (Linnaeus, 1758)	-	-	-	-	-	-	+	-	-	-
	Orthetrum chrysis (Selys, 1891)	-	-	-	+	-	-	-	-	-	-
	Orthetrum luzonicum (Brauer, 1868)	-	-	-	-	+	+	+	+	-	-
	Orthetrum glaucum (Brauer, 1865)	-	-	-	-	-	+	-	-	-	-
	Orthetrum japonicum internum MacLachlan, 1894	-	-	-	-	-	+	-	-	-	-
	Orthetrum purinosum neglectum (Rambur, 1842)	-	+	+	+	+	+	+	-	-	+
	Orthetrum sabina (Drury, 1770)	+	+	+	+	+	+	+	+	+	-
	Orthetrum taeniolatum (Schneider, 1845)	-	-	-	-	+	+	+	+	-	-
	Orthetrum testaceum testaceum (Burmeister, 1839)	-	-	-	-	-	+	-	-	-	-
	Orthetrum triangulare triangulare (Selys, 1878)	-	-	-	-	+	+	+	-	-	-
	***Palpopleura* Rambur, 1842**										
	Palpopleura sexmaculata sexmaculata (Fabricius, 1787)	+	-	-	+	+	+	+	-	-	-
	***Pantala* Hagen, 1861**										
	Pantala flavescens (Fabricius, 1798)	+	+	+	+	+	+	+	+	+	+
	***Rhodothemis*Ris, 1909**										
	Rhodothemis rufa (Rambar, 1842)	-	-	-	-	-	+	-	-	-	-
	***Rhyothemis* Hagen, 1867**										
	Rhyothemis variegata variegata (Linnaeus, 1763)	-	+	+	+	+	-	+	-	-	+
	***Selysiothemis*Ris, 1897**										
	Selysiothemis nigra (Vander Linden, 1825)	+	+	-	-	+	-	-	+	+	-
	***Sympetrum* Newman, 1833**										
	Sympetrum commixtum (Selys, 1884)	-	-	-	-	-	+	-	+	-	-
	Sympetrum decoloratum (Selys, 1884)	-	-	-	-	+	+	+	-	-	-
	Sympetrum fonscolombei (Selys, 1840)	-	-	-	-	-	-	-	+	-	-
	Sympetrum haematoneura Fraser, 1924	-	-	-	-	-	+	-	-	-	-
	Sympetrum meridionale (Selys, 1841)	-	-	-	-	-	+	-	-	-	-
	***Tramea* Hagen, 1861**										
	Tramea basilaris burmeisteri Kirby, 1889	+	-	-	-	-	-	-	-	-	-
	Tramea virginia (Rambur, 1842)	-	-	-	-	+	+	+	-	-	-
	***Trithemis* Brauer, 1868**										
	Trithemis aurora (Burmeister, 1839)	-	+	-	+	+	+	+	-	-	-
	Trithemis festiva (Rambur, 1842)	-	-	-	+	+	+	+	-	-	-
	Trithemis kirbyi kirbyi Selys, 1891	-	-	-	-	+	+	-	+	-	-
	Trithemis pallidinervis (Kirby, 1889)	+	+	+	-	+	-	-	-	-	-
	***Tholymis* Hagen, 1867**										
	Tholymis tillarga (Fabricius, 1798)	+	-	-	-	-	-	-	-	-	-
	***Urothemis*Brauer, 1868**										
	Urothemis signata signata (Rambur, 1842)	+	-	-	+	+	-	-	-	-	+
	***Zygonyx* Hagen, 1867**										
	Zygonyx torrida isis Fraser, 1924	-	-	-	-	+	+	-	-	-	-
	***Zyxomma* Rambur, 1842**										
	Zyxomma petiolatum Rambur, 1842	-	-	-	-	+	+	-	-	-	-

Z 1, Indus Delta; Z 2, Southern Irrigated Plain; Z 3, Sandy Desert (a & b); Z 4, Northern Irrigated Plain (a & b); Z 5, Barani Lands; Z 6, Wet Mountains; Z 7, Northern Dry Mountains; Z 8, Western Dry Mountains; Z9, Dry Western Plateau; Z 10, Sulaiman Piedmont.

monthly rainfall in winter is about 13 mm, whereas in summer it is about 21-38 mm. The localities visited were D. G. Khan, D. I. Khan and Taunsa.

Collection and identification

The dragonflies were collected by aerial nets, killed in the cyanide bottle, pinned and their body parts were set on appropriate setting boards. Specimens were identified up to species following Fraser (1933-1936). The identified specimens were deposisted Biosystematics Lab., Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi.

RESULTS AND DISCUSSION

A total of 1349 specimens belonging to 05 families, 39 genera and 68 species were collected and identified. Family Aeshnidae has 09 species belonging to 06 genera; Cordulegasteridae has only one species, Corduliidae has 03 species of 02 genera, Gomphidae has 12 species of 09 genera and Libellulidae has 43 species belonging to 21 genera. Seven species of dragonflies were collected for the first time from the country.

Reviewing the previous research work done on dragonflies in Pakistan. Yousaf (1972) collected and identified 46 species and subspecies belonging to 24 genra of 6 subfamilies of anisoptrous dragonflies from various localities of Pakistan.

Khaliq *et al.* (1992) recorded 6 anisopterous species from districts Mansehra (Khyber Pakhtonkhwa province of Pakistan). In an other study, Khaliq *et al.* (1993) recorded 22 dragonfly species from Murree hills (District Rawalpindi, Pakistan).

Ahmad (1994) identified 21 dragonfly species belonging to 14 genera and 4 families from Khyber Pakhtonkhwa province of Pakistan. Khaliq *et al.* (1994) recorded 13 dragonflies species from Gilgit, Baltistan and Kashmir region. Rehman (1994) described 35 species of dragonflies belonging to 22 genera of 12 subfamilies in 3 families from Punjab.

In an other stdy, Khaliq *et al*. (1995) recorded 6 anisopterous species from the rice fields in the districts Poonch and Bagh, Azad Jammu and Kashmir, while Luqman (1995) collected 35 species of Odonata from district Muzaffarabad (Azad Kashimir). Jehangir (1997) collected and identified 20 dragonflies species belonging to 13 genera from Gilgit and Baltistan areas. Khaliq *et al.* (1999) collected and identified 20 Anisoptera species from Swat valley, Pakistan.

The aforementioned review of research work is a scattered work of different scientists in some areas of Paksiatn whereas, the present study was a unique and comprehensive in its nature that it was carried out in all provinvces (covering all agro-ecological zones) of Paksiatn. This effort yielded a record of 68 species of Anisoptera from Paksiatn whereas previous record is 46 species of dragonflies at national level.

Figure 2 shows number of dragon fly species identified from various agro-ecological regions. Checklist of dragonflies of Pakistan is presented in Table I.

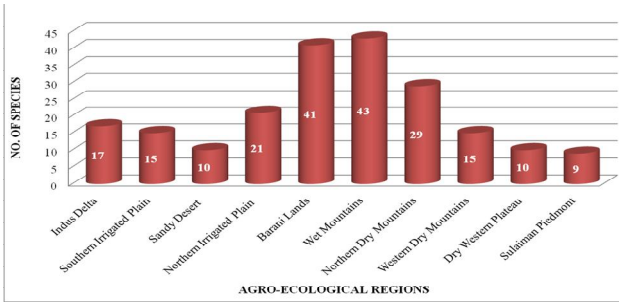

Fig. 2. Dragonflies species identified from different agro-ecological regions.

CONCLUSIONS

On completion of study, Anisopterous fauna of Pakistan has explored with a total of 68 species, thereby adding seven new records to earlier reported data. Collected specimens have been reposited at Biosystematics laboratory, Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi as reference collection for future taxonomic studies.These studies will be very important to combat against misuse of pesticides by replacing the use of isects as biological control and other field of biological research.

Statement of conflict of interest

Authors have declared no conflict of interest.

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