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Imtiaz Ali Khan
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

Mir Manzar Ud Din
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

Sajjad Hussain
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

Rasheed Akbar
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

Walija Fayaz
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

Muhammad Saeed
Department of Agricultural
Sciences, University of Haripur,
Haripur, Pakistan.

Abid Farid
Entomology Section, ARI
Tarnab, Peshawar-Pakistan.

Ruidar Ali Shah
Entomology Section, ARI
Tarnab, Peshawar-Pakistan.

Correspondence:
Imtiaz Ali Khan
Department of Entomology, the
University of Agriculture,
Peshawar, Pakistan.

A Study of Mosquito Fauna of District Upper Dir, Khyber Pakhtunkhwa-Pakistan

Imtiaz Ali Khan, Mir Manzar Ud Din, Sajjad Hussain, Rasheed Akbar, Muhammad Saeed, Abid Farid, Walija Fayaz, Ruidar Ali Shah

Abstract

A research study was conducted to determine the species composition, relative abundance and seasonal variation of mosquito fauna of District Upper Dir in 2014. The mosquito species recorded were *Culex quinquefasciatus*, *Culex mimeticus*, *Culex theileri*, *Anopheles maculatus*, *Anopheles stephensi*, *Anopheles annularis*, *Aedes albopictus*, *Aedes shortii* and *Culiseta longiareolata*. The results revealed that at Brawal *Cx. quinquefasciatus* dominated the other species (30.21%) while *Ae. shortii* was least abundant (3.24%). At Dir city, *Cx. mimeticus* was highly abundant (27.87%) while *Ae. shortii* was least abundant (3.24%). At Sheringal *Cx. quinquefasciatus* dominated (26.25%) while *Cu. longiareolata* least abundant (0.79%). At Warai *An. maculatus* was highly abundant (32.86%) while *Ae. albopictus* least abundant (3.09%). The present results might be helpful in devising pest management techniques against the mosquito species of District Dir Upper.

Keywords: Mosquito fauna, Relative abundance, Species composition.

1. Introduction

Mosquitoes are vectors for a number of infections like malaria, dengue, yellow fever etc., which affect millions of people annually. Several factors affect the role of mosquitoes as vectors and in disease transmission [1]. Mosquitoes are distributed worldwide, where they breed in a variety of habitats [2]. Mosquitoes are spatially and temporally distributed on the basis of species, climatic conditions and environment [3].

Mosquito larval distribution is greatly affected by several factors such as elevation, water movement, water condition (polluted, fresh etc.), water temperature, vegetation, types of water source etc. [4]. Mosquito oviposition, development of larva, adult emergence and many other processes take place in larval habitats, which play an important role in determining adult distribution and abundance [5].

Earlier researchers had carried out mosquito faunistic studies in Khyber Pakhtunkhwa, e.g. in Kohat-Hangu valley [6], Gilgit [7], Abbottabad [8] and Peshawar valley and adjacent areas [9] to determine species composition and relative abundance of mosquitoes.

There are about 3,500 species of mosquitoes in the world [10]. Mosquito transmitted diseases like malaria, dengue fever and filariasis cause enormous life threatened problems across the world [11]. Mosquitoes' adult females lay eggs in water or near to water's edge.

Two species of *Anopheles*, *An. stephensi* and *An. culicifacies* are considered to be mainly responsible for the transmission of malaria in Pakistan. *An. culicifacies* is thought to be the primary vector, especially in rural areas, whereas *An. stephensi* is considered to be of secondary importance in rural areas and only partially responsible for urban malaria transmission [12, 13, 14], however, *An. stephensi* is an important vector in other parts of its range, such as the Persian/Arabian Gulf [15, 16], KP province of Pakistan and eastern Afghanistan [17, 18, 19]. *An. stephensi* being the main malaria vector in KP is evident in a study [20] where they demonstrated that *Plasmodium falciparum* malaria cases in the KP peaked in October, when *An. culicifacies* had completely disappeared but *An. stephensi* was still present.

Mosquitoes are responsible for the transmission of various pathogens, such as viruses, bacteria, protozoans and nematodes. Mosquito vectored diseases include malaria, chikungunya, filariasis, dengue fever, West Nile virus, encephalitis, tularemia and yellow fever. Various species of mosquitoes are estimated to transmit various types of diseases to more than 700 million people annually in Africa, South America, Central America, Mexico, Russia, and much of Asia, with millions of resultant deaths. At least two million people annually die of these diseases, and the morbidity rates are many times higher still [21].

Dengue fever is increasingly becoming an epidemic in Pakistan. The last year due to the long and optimum environmental conditions for *Aedes* spp. breeding season, the disease spread more rapidly than in previous years. Swat Valley was badly affected with 29 deaths and more than 9000 infections the last year [22].

Keeping in view the importance of mosquitoes as medical pests, the present study aimed to study mosquito species composition and relative abundance in District Upper Dir, Khyber Pakhtunkhwa-Pakistan in 2014.

2. Materials and Methods

2.1 Study Area Description

District Upper Dir is one of the 25 districts in Khyber Pakhtunkhwa Province of Pakistan. The district is spread over 3,699 square kilometers. It is situated at Latitude 35° 06 51" N and Longitude 72° 01 59" E. The climate of Upper Dir is cold and damp. Its mountains are usually covered with snow and receives snow fall in the months of December, January and February. The average rainfall in the district is 700 mm and the temperature varies from -6 °C to 38 °C [23].

2.2 Research Methodology

The research study was conducted from April to November 2014. Adult mosquitoes were collected from four localities; Barawal, Sheringal, Wari and Dir City. The mosquitoes were collected by means of hand net, aspirator and light trap. Light trap was used for night collection and hand net for day time collection. Sampling was regularly made two times in a month for 3-4 hours each time. The collection was made from 7:00 am to 9:00 am and 5:00 pm to 7:00 pm regularly for three days in a week.

Adult mosquitoes were collected indoor as well as outdoor. Indoor collection was made from homes and cattle-sheds. Outdoor collection was made from plants, water habitats and water-containing automobile tires. During indoor collection pyrethrum-spray method was used. Indoor resting mosquitoes were sprayed with pyrethrum. Paper sheets were spread before spraying. Mosquitoes were collected from sheets by using

entomological forceps.

Hand net, aspirator and light trap were used during outdoor collection. The collected species were killed in the killing jar with the help of cotton swab impregnated with ethyl acetate. The killed mosquitoes were transferred to glass tubes containing dry silica gel before identification in order to prevent desiccation of the mosquito body.

The collected species were identified on morphological features by using binocular microscope, model and taxonomic identification was carried out by using taxonomic keys provided in "The fauna of British India, including Ceylon and Burma" [24]. The identification was made up to species level. Identification work was carried out at the Entomology Laboratory of the University of Agriculture, Peshawar and Department of Zoology, Shaheed Benazir Buttho University Sheringal, Dir. The identified species were then labeled, mounted and pinned. These labeled species were preserved in the insect collection box and deposited at the Entomology Museum of the University of Agriculture, Peshawar.

There was no published information regarding species composition and abundance of mosquitoes in District Upper Dir. With the aim of contributing to this knowledge, species composition and relative abundance of mosquito species were investigated in District Dir Upper in 2014.

3. Results and Discussion

3.1 Number and Percent of Mosquito Species

The results of mosquito species composition in four localities of District Dir Upper is given Table 1. It is clear from the results that out of 278 samples collected at Brawal, *Cx. quinquefasciatus* was the dominant species (84 number, 30.21%) and *Ae. shortii* was the minor species (9 number, 3.24%). At Dir City, out of 226 samples collected 63 (27.87%) were that of *Cx. mimeticus* and 3 (1.33) of *Ae. shortii*. At Sheringal, out of 381 samples collected *An. maculatus* was found in higher number of 101 (26.50%) and *Cu. longiareolata* in lower number of 3 (0.79). Of the total no. of 356 samples collected at Warai, higher number of 117 (32.86%) were that of *An. maculatus* and lower number of 11 (3.09%) of *Ae. albopictus*.

Table 1. Number and percent of mosquito species in District Dir Upper during 2014.

Species	Brawal		Dir City		Sheringal		Warai	
	No	%	No	%	No	%	No	%
<i>An. maculatus</i>	56	20.14	29	12.83	101	26.50	117	32.86
<i>An. stephensi</i>	22	7.91	23	10.17	58	15.22	33	9.26
<i>An. annularis</i>	71	25.54	----	----	69	18.11	41	11.51
<i>Cx. quinquefasciatus</i>	84	30.21	60	26.55	100	26.25	113	31.74
<i>Cx. mimeticus</i>	----	----	63	27.87	----	----	41	11.51
<i>Cx. theileri</i>	36	12.95	26	11.50	50	13.12	----	----
<i>Ae. albopictus</i>	----	----	22	9.73	----	----	11	3.09
<i>Ae. shortii</i>	9	3.24	3	1.33	----	----	----	----
<i>Cu. longiareolata</i>	----	----	----	----	3	0.79	----	----
Total No.	278	----	226	----	381	----	356	----

Nine species belonging to two genera *Culex* and *Anopheles* were reported from Peshawar [25]. A total of fifteen species were recovered during the survey, including which 31 from Peshawar [9] and 17 from Charsadda [26].

The findings of the present study had similarities with those of [27]. They had reported fifteen species of five genera in Swat-Ranizai of District Malakand. Sixteen more species were reported from Swat in addition to the one which we had already been recorded [28].

Four anopheline and nine culicine mosquito species have been reported from Murree Hills. *Culex raptor* has been recorded for the first time from Pakistan. All other species, *Anopheles*

stephensi, *An. maculatus*, *An. theobaldi*, *An. fluviatilis*, *Aedes aegypti*, *Ae. Albopictus*, *Culex fatigans*, *Cx. vagans*, *Cx. nilgircicus*, *Cx. Cx. fuscitarsis*, *Cx. raptor*, *Culiseta longiareolata* and *Armigeres obturbans* were recorded from new localities like Baroha, Terrat, Ghora Gali, Pindi Point, Kashmir Point and Jhika Gali during 2012-2013 [29].

Two hundred fifty two *Culex* species and 43 *Anopheles* species of mosquitoes had been identified in Indian subcontinent including 66 *Culex* species and 34 *Anopheles* in Pakistan [30, 31]. Three *Culex* species and one *Anopheles* species were added in mosquito fauna of Pakistan from 1934 to 1971 [32]. Sixteen species of mosquito were recorded from Pakistan [33]. Twenty-

four Anopheline (seventeen species of subgenus *Cellia* and seven species of subgenus *Anopheles*) were recorded from Pakistan^[34]. Thirty species of mosquito were identified from Changa Manga Lahore, and described *Cx. tritaeniorhynchus*, *Cx. quinquefasciatus* and *Aedes lineatopennis* responsible in the transmission of West Nile virus^[35]. Twenty nine species of mosquito were recorded for the first time in Lahore, Pakistan^[36]. Various species of mosquitoes were reported from Peshawar Valley and adjoining areas along with their relative abundance^[9].

There was no published data available on the mosquito fauna of District Upper Dir. The present research was the first of its kind to investigate the species composition, relative abundance of the mosquito fauna of the district. Mosquito fauna was represented by 3 species of *Anopheles*; *An. maculatus*, *An. stephensi* and *An. annularis*, 3 species of *Culex*; *Cx. quinquefasciatus*, *Cx. mimeticus* and *Cx. theileri*, 2 species of *Aedes*; *Ae. Albopictus* and *Ae. Shortii* and 1 species of *Culiseta*; *Cu. longiareolata*.

Cu. longiareolata was the only species recorded from Sheringal in the month of April and May. *Ae. Albopictus* was the only species recorded from water containers and water-containing automobile tires in Dir City and Warai. During the study the most preferred habitats of adult mosquitoes were found to be water and human dwellings.

Fifteen species belonging to five genera; *Culex*, *Anopheles*, *Aedes*, *Culiseta* and *Armigeres* were identified. The species were *Cx. quinquefasciatus* Say (79.43%), *Cx. tritaeniorhynchus* Giles (4.43%), *Cx. tritaeniorhynchus* Giles (0.59%), *Cx. theileri* Theobald (2.14%), *Cx. mimeticus* Noe (2.14%), *Cx. vishnui* Theobald (0.22%), *An. stephensi* Liston (6.22%), *An. fluviatilis* James (0.39%), *An. maculatus* Theobald (1.34%), *An. culicifacies* Giles (0.32%), *An. subpictus* Grassi (0.17%), *An. lindesayi* Giles (0.02%), *Ae. vittatus* Bigot (3.93%), *Cu. longiareolata* Macquart (0.59%) and *Ar. subalbatus* Coquillett (0.04%). *Cx. Quinquefasciatus* (79.4%) and *An. stephensi* (6.2%) were the dominant and constant species, regarding relative abundance and distribution recorded in most of the months and from majority of the habitats^[27]. The overall abundance of *Culex* species was high as compared with *Aedes* and *Anopheles* species collected from various outdoor breeding habitats^[37].

Aedes aegypti, *Armigeres obturbans* and *Cx. fuscitarsis* were the most abundant species in the surveyed localities followed by *Cx. nilgircus* and *Cx. vagans*. Maximum number of species were recorded from Baroha viz., *An. maculatus*, *An. stephensi*, *An. theobaldi*, *An. fluviatilis*, *Armigeres obturbans*, *Ae. aegypti*, *Ae. albopictus*, *Cx. nilgircus*, *Cx. fatigans*, *Cx. fuscitarsis* and *Cx. vagans*. Minimum species were recorded from Kashmir Point viz., *Armigeres obturbans*, *Cx. vagans*, *Cx. fuscitarsis* and *Ae. aegypti*^[29].

The variation in the number and species composition recorded in the present and earlier studies might be due to differences in sampling procedures and ecological conditions. However, many species identified in the present and earlier study were similar along with their habitats.

The findings of the present research revealed that District Dir Upper is rich in mosquito fauna of the genera *Anopheles*, *Culex*, *Aedes* and *Culiseta*, containing also the *Anopheles stephensi* which is a malarial vector. Further research work may explore diversity in the mosquito fauna of District Dir Upper.

Summary and recommendation

The mosquito species recorded were *Cu. quinquefasciatus*, *Cu. mimeticus*, *Cu. theileri*, *An. maculatus*, *An. stephensi*, *An.*

annularis, *Ae. Albopictus*, *Ae. Shortii* and *Cu. longiareolata*. *Cx. Quinquefasciatus* dominated the other species at many localities of the district. Surveillance of the mosquito species should be conducted round the year and in more habitats.

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