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***Research Article** (Open Access)*

SEASONAL BREEDING PREFERENCES OF *CULEX* MOSQUITO IN UDAIPUR DISTRICT OF SOUTHERN RAJASTHAN

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ABSTRACT
Two consecutive years' worth of seasonal research (April, 2021–March, 2023) to ascertain *Culex* mosquito breeding preferences. From the following breeding sites: river bed, sewage water, tyre, cement tank, tree hole and rock hole, were *Culex* larvae gathered. The gathered larvae were taken to the lab and then identified as adults emerged. Following identification, eight species were discovered whose names are as follows *Culex quinquefasciatus*, *Culex edwardsi, Culex whitei, Culex pseudovishnui, Culex vishnui, Culex vagans*, *Culex pipiens* and *Culex gelidus.* The maximum 22.61% preference was reported for puddle in the rainy season, 26.08% for sewage water in the summer season and 21.42% for puddle in the winter season while evaluating the breeding inclination of *Culex* mosquitoes.

Keywords: *Culex, Breeding Preference, Mosquito Larva, Adult Emergence, Species*

INTRODUCTION
Mosquitoes are found all over the world except Antarctica. They belong to the order Diptera of the class Insecta. Members of the genera *Anopheles, Culex* and *Aedes* bite primarily humans. Mosquitoes impact human welfare both directly as a nuisance and through transmission of pathogens that cause diseases such as malaria, filariasis, chikungunya, Japanese encephalitis, dengue fever and variety of other diseases in animals. They spread diseases to more than seventy crore people each year and will be responsible for the death of 1 out of every 17 people currently alive. Therefore, to control mosquitoes, many states and agencies have established mosquito control programs (Williams, 2000; Reuda and Kline, 2007; Manguin and Boete, 2011; Naseem *et al.,* 2016).

Various ecological characteristics affect the abundance, structure and density of mosquito larvae can be divided into different parameters, biotic (vegetation and predators) and abiotic (other factors such as shade, turbidity etc.) (Ammar *et al.,* 2013). The physical and chemical nature of water determines the selection of breeding sites. Mosquitoes generally breed in different types of water (Seghal and Pillai, 1970). The quality of breeding water is an important determinant of whether female mosquitoes will lay their eggs, and whether the resulting immature mosquitoes will successfully complete their development to adult mosquitoes (Piyaratnea *et al.,* 2005).

Interestingly, a small portion of all collected specimens in our study were identified as *Culex torrentium. Culex torrentiu*m in Carbon dioxide baited traps are commonly under represented (Beck *et al.,* 2003; Weitzel *et al.,* 2011). The proportional abundance of *Culex torrentium* may potentially be under estimated. This is particularly notable as Carbon dioxide containing traps have been described as attracting and catching a wider range of different types of mosquitoes than other commonly used traps (Pezzin *et al.,* 2016). The differential efficiency of CO2 - containing traps was related to the relatively lower attraction of CO2 for strictly ornithophilic species compared to anthropophilic or mamelophilic species (Weitzel *et al.,* 2011).

MATERIALS AND METHODS

Study Area

Udaipur is located at 24.525049"N to 73'67 7116"., the city occupies an area of 64 km². The city occupies an area of 64km² and rising 598.00 meters (1962 feet) above sea level. Udaipur is located in the southern part of Rajasthan sharing boundary with Gujarat. Udaipur district covers an area of 11724 km². The district is defined by its hilly landscape, which includes lowlands in the east, hills in the west and south, and an elevated plateau in the north. Udaipur typically experiences 24.2°C (75.7°F) temperatures and 689 mm of rain falls on average each year. In monsoon season, humidity levels can reach up to 90%.

Sample collection

The survey was scheduled to run from April 20, 2021 to March 20, 2022, and from April 20, 2022 to March 2023. At each of the chosen sites, sample collections were done three times per season. Based on information about Culex prevalence from the Chief Medical Officer of Udaipur, the survey site was chosen. For the duration of the research, three distinct seasons were chosen: Rainy (July to October), Winter (November to February), and Summer (March to June).

Larval collection

In areas with a lot of dissolved organic matter, including septic tanks and sewage waste, female *Culex* mosquitoes prefer to lay their eggs. On the other hand, artificial containers containing contaminated or biologically enriched water are frequently home to the embryonic stages of this mosquito. Because of its significant role in the spread of diseases to humans, the *Culex* mosquito, also known as the Southern house mosquito, has been the subject of extensive research in recent years. Using pipettes, droppers, and dippers, larvae were collected from a variety of water sources, including puddles, sewage, water tanks, river beds, tires, cement tanks, tree holes, and rock holes. Little plastic wide mouth bottles bearing date and location markings were used to carry the larvae to the laboratory.

Identification

Culex stay parallel to the surface. It profusely breeds in dirty water contaminated with sewage. This identification features were used and visualized using stereoscopic microscope in the laboratory. The collected mosquitoes were brought to the laboratory and further identified using standard keys (Rattanarithikul *et al.,* 2005).

RESULTS AND DISCUSSION

The study of breeding preference of *Culex* mosquito, larva collection was conducted for rainy, winter and summer seasons in two localities for two consecutive years from April, 2021 to March, 2022 and April, 2022 to March, 2023.

A total of 8 species of *Culex* mosquitoes were recorded during the study in the locality-I which are as follows: *Culex quinquefasciatus, Culex edwardsi, Culex whitei, Culex vagans, Culex pseudovishnui, Culex vishnui, Culex gelidus,* and *Culex pipiens.*

Ecological features that influence the abundance, structure and density of mosquito larvae can be classified into two major parameters, biotic (vegetation and predators) and abiotic (other factors such as shade, turbidity etc. (Ammar *et al.,* 2013).

In the same way, *Culex quinquefasciatus* was found in six breeding sites, followed by *Culex pseudovishnui* four breeding sites, *Culex vishnui* and *Culex vagans* three breeding sites and all other species were found in two breeding sites. Similarly, in the second year also 8 species of *Culex* mosquito were recorded and the maximum number of *Culex quinquefasciatus* mosquitoes were seen in the breeding sites. Highest number of *Culex* species was found in tree hole, followed by puddle and least number was observed in rock hole.

Generally, mosquito breed in a wide range of habitats containing different types of water. The physical and chemical nature of water probably determines reproductive selection (Seghal and Pillai, 1970).

Five species of *Culex* mosquitoes were found in the winter season, whose names are as follows: *Culex quinquefasciatus, Culex vagans, Culex pseudovishnui, Culex pipiens* and *Culex whitei*. Thus, even in the

summer season, five species of *Culex* mosquitoes were found, *Culex vagans* was not recorded in the summer season whereas *Culex gelidus* was not recorded in the winter season. It is worth nothing here that *Culex quinquefasciatus* was recorded in the highest number of breeding sites in all three seasons.
Data of Breeding preferences (Locality-I) of Year April, 2021 to March, 2022 and April, 2022 to March, 2023 is given in following Table (1 and 2).

Table 1: Seasonal breeding preference of *culex* mosquito from different habitats of Locality-I (April, 2021 to March, 2022).

Seasons	Mosquitoes	Puddle	Sewage water	River bed	Tyre	Cement tank	Tree hole	Rock hole	Total
Rainy	*Culex quinquefasciatus*	+	+	+	+	+		+	06
	Culex edwardsi	+				+			02
	Culex whitei						+	+	02
	Culex pseudovishnui	+	+	+		+			04
	Culex vishnui	+				+	+		03
	Culex vagans	+			+	+			03
	Culex pipiens	+			+				02
	Culex gelidus		+	+					02
	Total	06	03	03	03	05	02	02	
Winter	*Culex quinquefasciatus*	+		+		+			03
	Culex vagans				+				01
	Culex pseudovishnui	+	+						02
	Culex pipiens					+	+		02
	Culex gelidus				+				01
	Culex vishnui			+					01
	Culex whitei					+			01
	Total	02	01	02	02	03	01	00	
Summer	*Culex quinquefasciatus*	+	+			+			03
	Culex pseudovishnui		+						01
	Culex pipiens	+			+				02
	Culex gelidus		+						01
	Culex whitei		+					+	02
	Total	02	04	00	01	01	00	01	

Table 2: Seasonal breeding preference of *culex* mosquito from different habitats of Locality-I (April, 2022 to March, 2023).

Seasons	Mosquitoes	Puddle	Sewage water	River bed	Tyre	Cement tank	Tree hole	Rock hole	Total
Rainy	*Culex quinquefasciatus*	+	+	+	+	+			05
	Culex edwardsi				+	+	+		03
	Culex whitei						+	+	02
	Culex pseudovishnui	+		+			+		03
	Culex vishnui	+				+	+		03
	Culex vagans		+		+				02
	Culex pipiens	+					+		02
	Culex gelidus		+			+			02
	Total	04	03	02	03	04	05	01	
Winter	*Culex quinquefasciatus*		+		+	+			03
	Culex vagans				+			+	02
	Culex pseudovishnui		+				+		02
	Culex pipiens	+		+		+			03
	Culex whitei		+						01
	Total	01	03	01	02	02	01	01	
Summer	*Culex quinquefasciatus*	+	+		+	+			04
	Culex pseudovishnui		+	+					02
	Culex pipiens				+		+		02
	Culex gelidus		+						01
	Culex whitei		+		+			+	03
	Total	01	04	01	03	01	01	01	

Water quality determines *Culex* mosquitoes reproduction. Whether female mosquitoes will lay eggs or whether immature mosquitoes will be able to successfully develop into adults (Piyaratnea *et al.,* 2005).
A total of 8 species of *Culex* mosquitoes were found during the survey of locality-II which are as follows: *Culex quinquefasciatus, Culex edwardsi, Culex whitei, Culex pseudovishnui, Culex vishnui, Culex vagans, Culex pipiens* and *Culex gelidus.* During the rainy season, a maximum of four species were recorded in puddles and cement tanks, followed by three species each in river beds and tyres and minimum of one species in rock holes. In the same way, *Culex quinquefasciatus* was recorded in five breeding sites, followed

by *Culex vishnui* four breeding sites, *Culex pseudovishnui* and *Culex pipiens* three breeding sites, *Culex gelidus* two breeding sites, *Culex edwardsi* and *Culex* whitei were found one breeding sites. Similarly, in the second year also 8 species of *Culex* mosquitoes were recorded and the maximum number of *Culex quinquefasciatus* were recorded in the breeding sites. Highest number of *Culex* species was reported in puddle, followed by rock hole and sewage water, least number was recorded in river bed.

Table 3: Seasonal breeding preference of culex mosquito from different habitats of Locality-II (April, 2021 to March, 2022).

Seasons	Mosquitoes	Puddle	Sewage water	River bed	Tyre	Cement tank	Tree hole	Rock hole	Total
Rainy	*Culex quinquefasciatus*	+	+	+	+	+			05
	Culex edwardsi					+			01
	Culex whitei	+							01
	Culex pseudovishnui			+			+	+	03
	Culex vishnui	+			+	+	+		04
	Culex vagans		+						01
	Culex pipiens	+			+	+			03
	Culex gelidus			+			+		02
	Total	04	02	03	03	04	03	01	
Winter	*Culex quinquefasciatus*	+	+	+					03
	Culex vagans	+		+					02
	Culex pseudovishnui		+		+	+		+	04
	Culex pipiens	+							01
	Culex gelidus						+	+	02
	Culex vishnui	+		+	+	+			04
	Culex whitei	+			+				02
	Total	05	02	03	03	02	01	02	
Summer	*Culex quinquefasciatus*	+	+			+		+	04
	Culex pseudovishnui		+		+				02
	Culex pipiens	+					+		02
	Culex gelidus					+			01
	Culex whitei	+		+		+			03
	Total	03	02	01	01	03	01	01	

It was accounted for that temperature influences the abundance and movement of mosquitoes; for example higher temperature accelerates mosquitoes development from egg to adult and increases their abundance (Tun-Lin *et al.,* 2000; Hopp and Foley, 2001; Al Shehri, 2013).

Table 4: Seasonal breeding preference of culex mosquito from different habitats of Locality-II (April, 2022 to March, 2023).

Seasons	Mosquitoes	Puddle	Sewage water	River bed	Tyre	Cement tank	Tree hole	Rock hole	Total
Rainy	*Culex quinquefasciatus*	+	+						02
	Culex edwardsi						+	+	02
	Culex whitei	+	+	+		+			04
	Culex pseudovishnui				+		+		02
	Culex vishnui	+							01
	Culex vagans		+		+	+		+	04
	Culex pipiens	+							01
	Culex gelidus	+						+	02
	Total	05	03	01	02	02	02	03	
Winter	*Culex quinquefasciatus*	+					+		02
	Culex vagans	+						+	02
	Culex pseudovishnui		+	+					02
	Culex pipiens						+		01
	Culex gelidus	+		+		+		+	04
	Culex vishnui					+		+	02
	Culex whitei	+			+		+		03
	Total	04	01	02	01	02	03	03	
Summer	*Culex quinquefasciatus*	+		+				+	03
	Culex pseudovishnui		+		+				02
	Culex pipiens	+	+			+			03
	Culex gelidus	+		+					02
	Culex whitei	+				+	+		03
	Total	04	02	02	01	02	01	01	

Seven species of *Culex* mosquitoes were recorded in the winter season, which names are as follows: *Culex quinquefasciatus, Culex vagans, Culex pseudovishnui, Culex pipiens, Culex gelidus, Culex vishnui* and *Culex whitei.* In such a way in the summer season, five species of *Culex* mosquitoes were recorded. When the summer season was studied, *Culex vagans* and *Culex vishnui* were not found, whereas in the winter season they were found.

Relative humidity influences the quantity of females laying eggs, the quantity of eggs laid, feeding frequency, survival, flight and subsequent host seeking behaviour of mosquitoes (Day and Curtis, 1989; Reiter, 2001; Ceccato *et al.,* 2005).

Data of Breeding preferences (Locality-II) of Year April, 2021 to March, 2022 and April, 2022 to March, 2023 is given in Tables 3 and 4.

Breeding habitats of *Culex* mosquitoes

Breeding habitats of *Culex* mosquitoes

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