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Diversity of Mosquito Fauna in different Habitats of District Dehradun, Uttarakhand

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A B S T R A C T

In the present study a total of 2822 specimens of 25 species of mosquitoes belonging to 6 genera viz., *Anopheles, Culex, Aedes, Armigeres, Toxorhynchites* and *Uranotaenia* from distt Dehradun between January 2019 to December 2020 were recovered. Of these, 12 species of *Anopheles*, 5 species each of *Culex* and *Aedes* were main species, in which *Anopheles* form 48.12%, *Culex* 22.89% and *Aedes* 18.85% respectively. Shannon and Evenness index for *Anopheles* (2.212, 0.839) *Culex* (1.642, 0.746) and *Aedes* (1.625. 0.657) during entire study period were obtained. Overall highest Shannon index were 1.9358 during September 2020 and lowest 1.0781 during January 2020.

Introduction

India has rich biological diversity and one of the 12 mega diverse countries of the world (the biological diversity act, 2003). Diversity of insects is of great importance to the environmentalist as they are bio-indicators. Among the insects, mosquitoes are medically important group of insects and they transmit many vector borne disease (VBDs) like Malaria, Dengue, Chikungunya, Filariasis and Japanese Encephalitis (JE) in India. In the recent years, the distribution range of both mosquitoes and mosquito borne disease are proliferating in large number everywhere due to rapid urbanization, excessive deforestation and resistant among mosquitoes to pesticides, construction of dams and development of new agro-ecosystem (Edillo *et al.*, 2004).

Earlier records of mosquitoes from Dehradun are shown by various workers (Theobald, 1902; Thomson, 1903 ; Christophers, 1916; Covell (1927, 1931) mentioned a list of 13 species of *Anopheles* in a monograph on the distribution of Anopheline mosquitoes in India. Since then there was almost no record of mosquitoes until 1957 from this region.

Wattal *et al.,* (1958) made observation on the mosquitoes from the Dehradun and collected 25 species of mosquitoes belonging to the seven genera. Rao *et al.,* (1973) undertook the extensive survey of haematophagous arthropods including mosquitoes from western Himalayas and recorded 70 species of mosquitoes belonging to 8 different genera, of these 16 species belonged to genus *Anopheles*.

Thereafter, Bhat (1975), in a study on haematophagous arthropods in the Himalayan region recorded 63 species of mosquitoes under 10 genera.

An update list of the Tribe Aedini has been provided by Kaur (2003) which also included mosquito species from Garhwal including this region. Pemola and Jauhari (2004) while studying on mosquito record from Garhwal region (Uttaranchal) recorded 47 species of mosquitoes. In a survey for haematophagous insects occurring in different zones of district Dehradun (Uttarakhand) Pemola and Jauhari (2009) obtained 36 species of mosquitoes. After four year Pemola and Jauhari (2013) in a study on dipterous haematophagous insects occurring in Dehradun district and its adjoining areas in Uttarakhand, India recovered 38 species of mosquitoes.

Recently, Sadeura (2018) worked on mosquito diversity from kempty falls near mussoorie, Uttarakhad and found 20 species of mosquito belonging to four genera i.e. *Aedes*, *Armigeres*, *Anopheles* and *Culex*.

Keeping in view that an overview of mosquito faunal diversity is a necessary prelude for proper understanding of occurrence of a particular species at a particular time as well as for planning strategy for control of vectors borne diseases. Further, during the last 3-4 years there has been drastic changes in the climate due to rapid urbanization as a result of which an increase in dengue cases and other VBDs. Hence, it is proposed to understand survey work towards mosquito occurrence in district Dehradun.

Materials and Methods

The sites selection for sampling purposes is based on the geographical division of the distt Dehradun as six blocks where 10 different sites were selected. In each sampling site, there were fixed collection spots while random sampling was also performed. Mosquitoes were sampled using aspirator and light trap (WHO, 1975), The identification of mosquitoes is based on adult characters using standard taxonomic keys and catalogues (Das *et al.,* 1990; Nagpal and Sharma, 1995; Tyagi *et al.,* 2015) and WHO, 2020). In certain cases, the immature forms were emerged into adults under laboratory conditions and then the species was identified.

Data analysis

Species diversity is represented through Species richness (S), Shannon -wiener index (H) and Shannon Evenness index (E) by the following formulae:

Species richness (S) = Total number of species

Shannon index (H)

$$= \sum_{i=1}^{s} - (Pi * \text{in } Pi)$$

Where

H = the Shannon diversity index

Pi = fraction of the entire population made up of a species i

S = numbers of species encountered

$\sum$ = Sum from species 1 to species S

Shannon Evenness Index (E)
= H/In (S)

Where

H= Shannon diversity index

In (S) = Natural logarithm of species richness (S)

Results and Discussion

A total of 2822 specimens of mosquitoes belonging to 25 species under 6 genera viz., *Anopheles*(S=12: n=1358), *Culex* (S=05: n=646), *Aedes* (S=05: n=532), *Armigeres* (S=01, n=227), *Toxorhynchites* (S=01,: n=52) and *Uranotaenia* (S=01, n= 07).were captured. Rank abundance showed the percentage of species abundance. Species in first rank being the most abundant, second being the second most abundance and so on (Table 1).

The most dominant mosquitoes were *Anopheles* (48.12 %) followed by *Culex* (22.89%), *Aedes* (18.85%), *Armigeres* (8.04%), *Toxorhynchites* (1.84%) and *Uranotaenia* (0.25%) in succeeding order.

Genera wise Species diversity is represented through Species richness (S), Shannon Weiner index (H) and Shannon Evenness Index (E) in Table 2. The species richness (S) and Evenness (E) were found as 12, 0.84; 05, 0.75 and 05, 0.66 for *Anopheles*, *Culex* and *Aedes* mosquitoes respectively. Highest Shannon index was shared by *Anopheles* (2.212) followed by *Culex* (1.642) and *Aedes* (1.625).

Overall, month wise the value of Shannon-Wiener index was found in the range of 1.0782 to 1.9348 and 1.0781 to 1.9358 during 2019 and 2020 respectively. The lowest value (1.0782) was recorded in December and the highest (1.9348) in September during 2019 and during 2020 the lowest value (1.0781) was recorded in January and highest value (1.9358) in September. The Shannon index showed high resemblance to each other during the study period for both the years. The values of Evenness index were between 0.9142 to 0.9944 and 0.9136 to 0.9846 during 2019 and 2020 respectively. The lowest value was recorded in September and highest value in March (Table 3).

Anopheles species showed higher species richness and greater species evenness than *Culex* species followed by *Aedes* species. The genera i.e. *Armigeres*, *Toxorhynchites* and *Uranotaenia* shared one species each.

Keeping in view the diversity of mosquitoes in district Dehradun, since, the studies made from this region were limited and was conducted by Pemola and Jauhari (2004, 2005, 2009 and 2013) and Sadeura (2018). Rao *et al.*, (1973) and Bhat (1975) recorded 31 and 30 species of mosquitoes respectively under 4 genera. But, during the present study 25 species of mosquitoes have been recorded under six genera. There are marked difference in the composition of Anopheline mosquitoes as reported by various workers (Wattal *et al.*, 1958; Kalra and Wattal, 1965; Bhat, 1975). The present observations are at variance with the studies made by Kalra and Wattal (1965) in not having *An. aitkenii* in the collection. Present study also shows similarity with the findings made by Jauhari *et al.*, (1992) and Mahesh and Jauhari (2000) in respect of different mosquito species. Further various species of *Anopheles* recorded by them have not been found in the present study. From district Dehradun Pemola and jauhari (2009) obtained 36 species of mosquito but in present study only 25 species of mosquito were obtained. It is due to environmental change, increasing urbanization and other factors. So many mosquito species become disappear.

Table.1 List of Mosquitoes collected from district Dehradun between January 2019 to December 2020.

S.No	Name of Species	Abundance Rank
A.	***Anopheles***	
1.	*An. culicifacies* (Giles, 1901)	1
2.	*An. fluviatilis* (James, 1902)	6
3.	*An. stephensi* (Liston, 1901)	2
4.	*An. subpictus* (Grassi , 1899)	3
5.	*An. maculates* (Theobald, 1901)	4
6.	*An. aconitus* (Doenitz, 1902)	5
7.	*An. annularis* (Van der wulp, 1884)	7
8.	*An. vagus* (Deonitz, 1902)	8
9.	*An. gigas* (Giles, 1901)	9
10.	*An. minimus* (Theobald, 1901)	10
11	*An. splendidus* (Koidzumi, 1920)	11
12.	*An. pulcherrimus* (Theobald, 1902)	12
B.	***Culex***	
1.	*Cx . quinquefasciatus* (Say, 1823)	1
2.	*Cx. mimeticus* (Noe, 1899)	4
3.	*Cx. vishnui* (Tjeobald, 1901)	2
4.	*Cx. raptor* (Edwards, 1922)	3
5.	*Cx. ramakrishnii* (Wattal and Kalra, 1965)	5
C.	***Aedes***	
1.	*Ae. aegypti* (Linnaeus, 1762)	1
2.	*Ae. albopictus* (Skuse , 1894)	2
3.	*Ae. vittatus* (Bigot, 1861)	3
4.	*Ae. pseudotaeniatus* (Giles, 1901)	4
5.	*Ae. albolateralis* (Theobald, 1908)	5
D.	***Armigeres***	
1.	*Ar. Durhami* (Edwards,1917)	
E.	***Toxorhynchites***	
1.	*T. splendens* (Weidemann, 1819)	
F.	***Uranotaenia***	
1.	*U. nivipleura* (Leicester, 1908)	

Table.2 Species diversity of the mosquitoes collected from district Dehradun.

Genera / group	S (Species richness)	E (Evenness Index)	H (Shannon Index)	N (No of specimens)
Anopheles	12	0.839	2.212	1358
Culex	05	0.746	1.642	646
Aedes	05	0.657	1.625	532

Table.3 Diversity indices of mosquito species in District Dehradun during January 2019 to December, 2020.

Month	2019		2020	
	H	E	H	E
Jan.	1.0791	0.9824	1.0781	0.9832
Feb.	1.0796	0.9858	1.0784	0.9846
March	1.6750	0.9966	1.6746	0.9908
April	1.6760	0.9842	1.6766	0.9844
May	1.7815	0.9944	1.7818	0.9938
June	1.8216	0.9940	1.8224	0.9928
July	1.8923	0.9912	1.8926	0.9922
Aug.	1.8998	0.9706	1.8992	0.9712
Sep.	1.9348	0.9142	1.9358	0.9136
Oct.	1.8892	0.9768	1.8896	0.9772
Nov.	1.7407	0.9902	1.7437	0.9958
Dec.	1.0782	0.9822	1.0784	0.9820

H= Shannon Weiner diversity index, E = Evenness diversity index

The result of present study is similar with the result observed in Taml Nadu (Kumar *et al.*, 2011; Amala *et al.,* 2011) and in Warangal urban environment (Suhasini and Sammaiah, 2014) all reported that most dominant species was *Culex quinquefasciatus, Ades albopictus, Anopheles subpictus*.

The biodiversity indices in terms of Shannon and evenness indices were also similar with other workers (Suhasini and Sammaiah, 2014; Tyagi and Pervez, 2018).

Based on present findings, many species are common, it is due to the fact that there could be certain climatic conditions, which establishes their adaptability best suited for growth and development.

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