BIODIVERSITY AND SEASONAL PREVALENCE OF MOSQUITOES FROM TERAI REGION OF UTTARAKHAND

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ABSTRACT

An intensive survey on the seasonal prevalence and biodiversity of mosquitoes (Culicidae: Diptera) of Terai region of Uttarakhand was conducted. Amongst the total collected 1245 individuals of three species, 608 mosquitoes from outdoor and 437 from indoor environments. This reveals that significantly high percentage of species was recorded from outdoor environments. Three sampled species from these environments were *Anopheles culicifacies, Culex quinquefasciatus,* and *Aedes aegypti*. The biodiversity indices in terms of Shannon-Wiener and Evenness indices were also evaluated. It was 1.7251 and 1.6534 during April and May, 2018 respectively, while the Evenness index was 0.9755 and 0.9153 during April and May, 2018 respectively. We infer that mosquito populations outnumbered in the month of April, 2018 and the biodiversity skewed towards April as the conditions become more warm and damp, which favours the population growth of mosquitoes. We conclude that outdoor environments, *viz*. open type drainage, sewage canal, ditches, cattle sheds, rice fields and construction sites are better habitats for the sustenance of mosquitoes.

Key words: Biodiversity, *Anopheles culicifacies*, *Culex quinquefasciatus*, *Aedes aegypti*, Shannon–Weiner index

INTRODUCTION

Mosquito-diversity (Culicidae: Diptera) is consistently getting enriched with a global estimate of 3541 species (Tyagi *et al.,* 2015). Its north Indian fauna was first of all studied by Thomson (1009), with special reference to the providing mosquito-diversity in Dehradun district. Relatively, terai regions of Uttarakhand are hot-spots of mosquito-diversity than the hilly ones (Pemola Devi and Jauhari, 2005), as the climatic conditions are warmer and damper. Information pertaining to their occurrence, distribution, prevalence and species composition is largely significant with respect to public health. Vector-borne diseases are issues of major concern today and probably represent the highest proportionate disease burden in the near future. Currently, the insect-transmitted diseases are highly fatal and the prime cause of illness and death, the world over (Borah *et. al.,* 2010). Mostly, these mosquitoes inculcate adverse effects on human and animal health, as they are vectors of transmitting protozoan and viral pathogens (Dutta *et al.,* 2010). Tyagi *et al.* (2015) catalogued all the known Indian mosquito species with much emphasis on their identifying characters. They listed 404 mosquito-species belonging to 50 genera. This eases the identification of such species and helped the entomologists to draw logical conclusions by comparing the species along with their impact on the human populations in terms of public health and disease. Hence, intensive survey was made to collect and identify the mosquito-diversity in the terai region of Uttarakhand.

MATERIALS AND METHODS

This study was carried out for the period of two months, *i.e.* April & May 2018. The location of the study area was closely associated with water bodies which including fresh water, polluted water and irrigated fields. We selected four sites for this study, which included cultivated and stagnant water-bodies, barren lands and small scale industries near the city Kashipur, Uttarakhand (29.13°N 78.57°E to 29.22°N 78.95°E). This city is located in the south-west of the Kumaon region of Uttarakhand in the Terai – an area of relatively low-lying land, ranging between 500 and 1,000 feet (150 and 300 metres) above sea level and crossed by Kumaun's main north-south watershed between the basins of the rivers *Ramganga* and *Kosi*.

We collected the mosquitoes from both indoor human-dwelling and outdoor human-dwelling using pyrethrum spray method as described by Service (1976) in the morning between 7 am to 9 am and 4 pm to 6 pm. Mosquitoes were collected at outdoor using sucking tube and torch light following the methodology of Smart (2003).

(i) Collecting the Biting Adult Female Mosquitoes

To record the diversity of mosquitoes, we collected the biting female mosquitoes by man-landing method adopted by Pandian and Chandrashekaran (1980). Immature larvae obtained from different breeding sites were reared in laboratory and the newly emerged adults were preserved in plastic vials for identification.

Adults were also collected while biting and swarming near the biting sites, cattle sheds and human dwellings. Identification keys (Das *et al.,* 1990) and the perusal of literature (see Tyagi *et al.,* 2015) were used to identify the species of mosquitoes.

(ii) Data Analysis

Mosquitoes sampling resulted in enormous number of individuals, which was used to assess the diversity index and behavioural aspects including pattern of occurrence following the methodology of Anandh and Sevarkodiyone (2017). Both Shannon-Weiner index and Evenness index were calculated following the below mentioned formulae.

Shannon-Weiner index $H = -\sum Pi \log Pi$ ---------- **(1)**

, where H= Shannon-Weiner index, Pi= ni/N,

$\sum$ = Sum, ni = Number of individuals of each species in the sample, N= Total number of individuals of all species in the sample.

Evenness index $J = H / H_{max}$ ---------- **(2)**

Where, J= Evenness index, H is Shannon-Weiner index, H_{max}= log S, 'S' is the number of species.

The percentage of indoor and outdoor percentage of different mosquito species were subjected to Chi square Test using statistical software, MINITAB 13.0 on our personal computer.

RESULTS

We collected a total of 608 mosquitoes from outdoor and 437 mosquitoes from the indoor and outdoor environments of Kashipur (Plate-1). The sampling survey of mosquitoes from both outdoor and indoor revealed three species, *viz*. *Anopheles culicifacies, Culex quinquefasciatus,* and *Aedes aegypti* (Table-1). The data presented in Figure-1 revealed that percentage of *Anopheles culicifacies* was much high outdoor (64.82%, 56.75%) as compared to those in indoor (35.18%, 43.25%) during the months, April 2018 and May 2018. The data was also found to be statistically significant (χ^2 = 4.22; P<0.05; d.f. = 1). The data in parentheses is the monthly data of two consecutive months. Similarly, *Culex quinquefasciatus* has significantly high percentage of outdoor females (63.75%, 58.40%) than recorded in indoor (36.25%, 41.60%) (χ^2 = 4.56; P<0.05; d.f. = 1). *Aedes aegypti* also followed the similar trend in terms of percentage, *i.e.* 62.45% and 59.08% at outdoor environments and 37.55% and 40.92% at indoor during the months, April 2018 and May 2018. The data on percentage of *Aedes aegypti* in outdoor and indoor collections were also found to be statistically significant (χ^2 = 5.56; P<0.05; d.f. = 1). The mosquitoes collected from various outdoor environmental arenas are also presented, which show that all three mosquito species was mostly enriched in open drainage, sewages and ditches (Table-2).

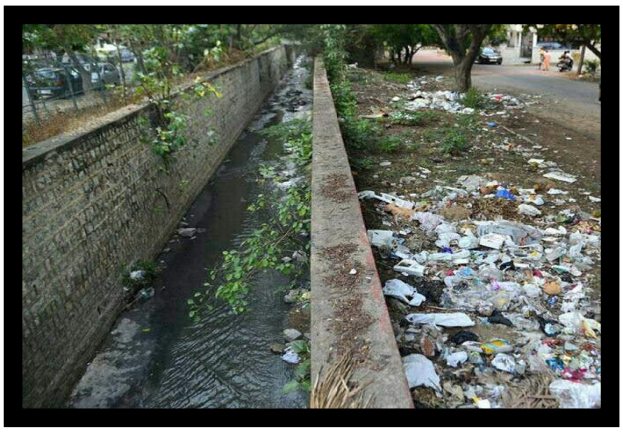
Shannon-Wiener (H) and Evenness (J) indices were evaluated to estimate the level of biodiversity. The values of Shannon–Weiner index was 1.7251 and

1.6534 during April and May, 2018 respectively. The Evenness index was 0.9755 and 0.9153 during April and May, 2018 respectively.

Plate – 1

Different habitats of mosquitoes species in Kashipur urban environment

Collection of mosquitoes in rice field



Open type drainage canal

Plastic container

Flower pots

Cattle shed

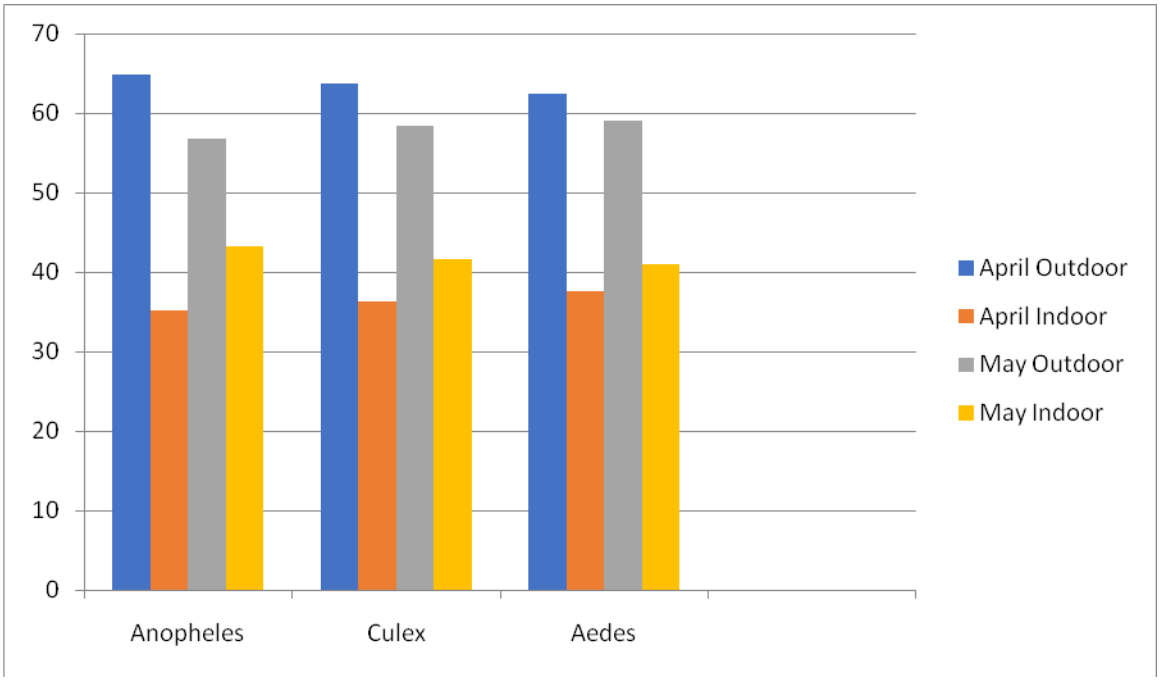
Table 1: Diversity of mosquitoes in urban environment of terai region of Uttarakhand.

FAMILY	SUB- FAMILY	SPECIES
Culicidae	Anophelinae	*Anopheles culicifacies*
	Culicinae	*Culex quinquefasciatus*
		Aedes aegypti

T**able 2: Mosquitoes collected from different outdoor habitats.**

HABITAT	Anopheles %		Culex %		Aedes %	
	Apr	**May**	**Apr**	**May**	**Apr**	**May**
Open type drainage	22.50	20.33	19.61	21.86	12.94	13.04
Sewage canal	14.24	24.23	22.20	23.12	11.77	11.48
Ditches	24.21	17.82	20.17	21.42	9.92	9.53
Cattle sheds	12.06	11.76	14.12	11.93	10.96	13.52
Rice fields	9.72	13.27	10.20	8.20	0.00	0.00
Construction site	7.05	5.22	7.52	7.42	0.00	0.00
Plastic container	10.22	7.37	6.18	6.05	13.75	10.47
Tires	0.00	0.00	0.00	0.00	18.62	19.63
Flower pots	0.00	0.00	0.00	0.00	12.12	1262
Mud pots	0.00	0.00	0.00	0.00	9.92	9.71

Figure- 1: Percentage of mosquitoes present in both indoor and outdoor habitats of terai region of Uttarakhand.



DISCUSSION

Diversity of mosquitoes recorded in the study area showed the three species of mosquito belong to three genera namely, *Aedes, Anopheles* and *Culex*. These three species are largely responsible for the major mosquito-borne diseases in the Indian subcontinent. *Aedes* sp. are known to spread the fatal diseases, like *chikungunya* and dengue fever, and these preferably live in plastic containers, cement tank, and pots (Wangkoon *et al.,* 2005). *Anopheles* sp. largely inhabits in the shady vegetation and cool water at outdoor habitat in urban ecosystems and spread malaria (Anonymous, 2007; Dash *et al.,* 2007). *Culex* species preferably inhabit cattle sheds, rice fields, ditches, and open drainage system and carry viruses responsible for filariasis and encephalitis (Thongsripong *et al.,* 2013). All three mosquito-species outnumbered in the outdoor environments, open drainage, sewage and ditches, which shows that these places are more prone to the infections. However, a few studies advocate that the disease transmission is more at the lower biodiversity zones (Ezenwa *et al.,* 2006; Pongsiri *et al.,* 2009).

High values of biodiversity indices, *viz*. Shannon-Wiener and Evenness indices were evaluated, which show biodiversity richness. Similar high values of these indices were also recorded by Suhasini and Sammaiah (2014). We infer that mosquito populations outnumbered in the month of April, 2018 and the biodiversity skewed towards April as the conditions become more warm and damp, which favours the population growth of mosquitoes. We conclude that outdoor environments, *viz*. open type drainage, sewage canal,

ditches, cattle sheds, rice fields and construction sites are better habitats for the sustenance of mosquitoes.

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