Bangladesh J. Zool. ***53****(2): 185-199, 2025* *Article*
ISSN: 0304-9027
eISSN: 2408-8455

DIVERSITY AND ABUNDANCE OF MOSQUITOES IN SELECTED AREAS OF DHAKA: IMPLICATIONS FOR PUBLIC HEALTH

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ABSTRACT: The observation on the diversity and abundance of mosquito species was conducted at 33 and 34 no. wards of Dhaka South City Corporation during March 2022 to February 2023. About 2297 mosquito larval samples of five species under three genera were recorded. Among five mosquito species *Culex quinquefasciatus* showed a high abundance (45%) and *Aedes albopictus* showed the lowest abundance (6%). Among the eight study spots, Aga Sadek Lane showed the highest abundance (15.06%) and Siddiq Bazar showed the lowest (8.23%). The Shannon diversity index H' was the highest (1.292) for Abdul Hadi Lane and the lowest (0.929) for Nazira Bazar, the Simpson index for diversity was the maximum (0.993) for the Siddiq Bazar and the minimum (0.978), for the Aga Sadek Lane, species evenness was the highest (0.049) at Aga Sadek Lane and the minimum was (0.039) at Siddiq Bazar, the highest community dominance was for Nazira Bazar (82.8%) and the lowest for Abdul Hadi Lane (64.2%). The representation of species richness was done using rarefaction curves. Canonical Correspondence Analysis (CCA) was used to find out the relationship with the abiotic factors of habitat water. This study also revealed the relationship between mosquito vectors and diseases especially the impact of the abundance of dengue vectors (*Ae. aegypti* and *Ae. albopictus*) on occurrence of dengue cases and deaths. *Ae. aegypti* and *Ae. albopictus* populations were in peak at the months of October and September, respectively. Cases and dies were the highest in the month of December when the whole procedure from larvae to the end of incubation period completes.

Key words**:** Abundance, Diversity, Mosquitoes, Habitats' abiotic factors, Public health

INTRODUCTION

Mosquitoes belong to the order Diptera of the family Culicidae and become a particular problem as a disease-causing vector (Bates, 1949). Approximately 3500 mosquito species are identified around the world (Leisnham *et al.*, 2007). In Bangladesh, 123 mosquito species were recorded (Irish *et al.*, 2016). About 25

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 DOI: https://doi.org/10.3329/bjz.v53i2.85044

mosquito species in our country that belong to the genus *Culex*. The most prevalent of these 25 species are *Culex quinquefasciatus* (Irish *et al.*, 2016). It utilizes almost all type of aquatic habitats for oviposition, larval development, emergence, resting, swarming and breeding (Overgaard *et al.*, 2002). Depending on the region, different mosquito species have different densities and abundance (Simon-oke *et al.*, 2012). Climate, seasonality, water supply geography, and human-related factors have all been linked to mosquito abundance and their distribution in warm and tropical areas of the world (Simon-oke and Olofintoye, 2015). Dhaka is the largest metropolitan city in the country which is densely populated. The capital city with an annual average temperature of 25° C and annual average humidity of 74%, and annual average precipitation of 207.31 mm, which is more suitable for the diversity of mosquitoes. Even though some mosquito-borne diseases have been found in this region. Each year, the people of Dhaka city are being affected with Dengue, malaria, lymphatic filariasis, Japanese encephalitis and chikungunya (Hossain *et al.*, 2000). Some noticeable investigation on the studies of mosquito larval abundance and diversity in the city of Dhaka's urban areas made by Ahmed *et al.* (1990), Sultana *et al.* (2016), Sharower *et al.* (2017) and Islam *et al.* (2021). From March 2022 to February 2023, entomological surveillance was conducted in Ward No. 69 of Old Dhaka, Osmani Uddan, Fullbaria Bus Station and Sohrawardi Uddan to identify the mosquito fauna from various habitats, as well as their current status and distribution in the city of Dhaka (Karim *et al.*, 2013). However, the lack of studies on mosquitoes may limit our grasp of how diseases spread. Given the significance of larval affluence in a mosquito control strategy, the current research was carried out to record the larval abundance and diversity, observe the categorization of different mosquito larval habitats, examine the relationship of larval abundance and abiotic factors of habitat water. Moreover, the impact of the abundance of dengue vectors (*Ae. aegypti* and *Ae. albopictus*) on the occurrence of dengue cases and deaths in the selected spots of the two wards of Dhaka south city corporation was recorded.

MATERIALS AND METHODS

Study area: The study was carried out from March 2022 to February 2023, including two wards (33 and 34) of Dhaka south city corporation, where eight spots were selected for larval sampling. The global positioning system (GPS) location for ward no. 33 and 34 was recorded.

Identification of breeding places: In most cases, mosquitoes reproduce in the habitat of stagnant water. Therefore, priority was given to collecting larvae in these kinds of locations. Mosquitoes found in drains, coconut shells, fruit shells, ground tanks, mud pools, one-time plastic bowls, polluted groundwater and rainwater.

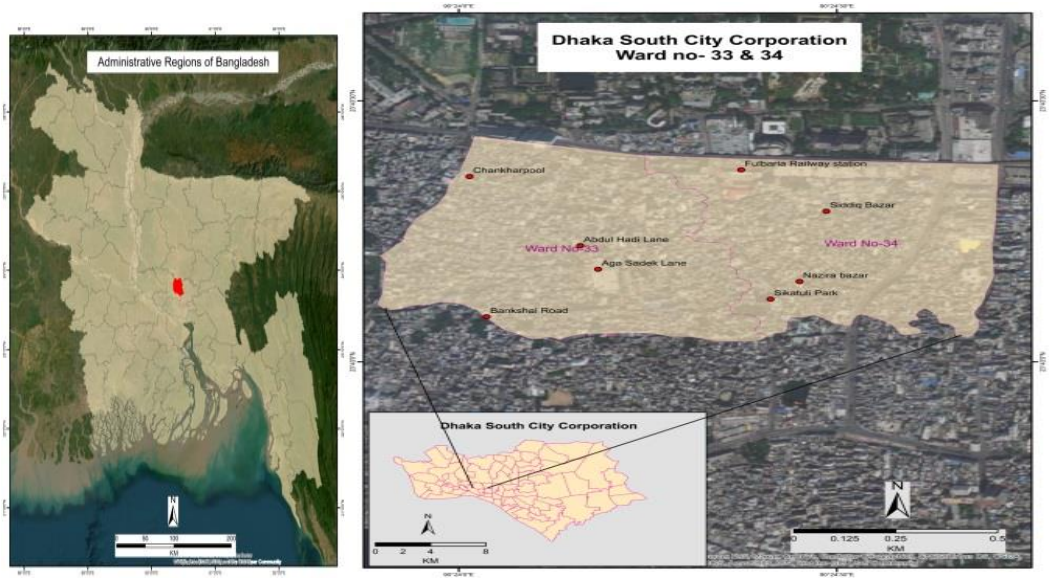

Fig. 1. Sampling areas of this study.

Techniques for sampling: The standard dipping methods were used on the open sources and ground pools to gather the larval mosquito species using a semi-circular disc of 13 cm diameter with a handle of 1 m long and a dipping net (Khan et al., 2014). In coconut shells and several container habitats, the larvae were collected by plastic pipette. The collected larvae were bought into small plastic jars with their habitat water.

Emergence of adult and their preservation: After sampling, some of the sampled larvae were placed in cases of the garden of Zoology, University of Dhaka, for adult emergence to enable precise identification. The emerging adult mosquitoes were killed by the use of sprays, chloroform and aspirator. Adult samples were dried in the open air and preserved in a small plastic pot with soft tissue paper placed on its floor and a naphthalene ball. The rest of the sampled larvae were preserved with 95% ethyl alcohol in regular refrigerator and with distilled water in a deep refrigerator.

Identification of the collected samples: The samples were identified following the keys of Farajollahi and Price (2013), Reuben *et al.* (1994) and Rueda (2004) for *Aedes, Culex and Armigeres* genera, respectively. Euromax edublue dissecting microscope was used to identify the samples in the laboratory of the entomological research of the department of Zoology, University of Dhaka.

Measurement of water quality: Water from the larval environment was taken from the study location to analyze the quality and to find out the relationship with the abiotic factors with the larvae. The quality of the water was analyzed

using Hach HQD digital multi meter. The parameters which were measured using this device are Dissolve Oxygen (DO) mg/L, pH, Conductivity (µs/L), Total Dissolved Solids (TDS) mg/L, Salinity (%) and Temperature (◦C).

Analysis of data: As a measure of diversity, the study used Shannon's Diversity Index (H') (Shannon and Wiener, 1949) and Simpson's Index (λ) (Simpson, 1949). The following are the equations for the two indices: Shannon's Diversity Index:

$H' = -\sum_{i=1}^{s} Pi \ln Pi$.

Where p denotes the proportion (n/N) of individuals of one species discovered (n) divided by the total number of individuals discovered (N), is the natural log, is the sum of the calculations and S denotes the number of species discovered. In most ecological research, optimal H values range between 1.5 and 3.5, with the index rarely exceeding 4. The value of the similarity index ranges from 0 to 1.

Simpson's Diversity Index (1-λ): It functions as a diversity indicator. Simpson's Index:

$\lambda = \sum_{i=1}^{s} Pi^2$

Two individuals chosen randomly from a community is more likely to fall into different categories. The value of 1-λ ranges from 0 to 1, with high scores (choose to 1) indicating high diversity and low scores (close to 0) indicating low diversity (Simpson, 1949).

Species evenness (*J'*): It describes the number of species in each environment. The equation is:

$J' = \frac{H'}{\ln(S)}$

Where, j'= Species evenness, H= Species Diversity and S= Number of the species (Pielou, 1966). *J'* has arranged 0 to 1. When the value of *J'* approaches zero, the species is evenly distributed (Shannon and Wiener, 1949).

Community Dominance (CD): The simple community dominance index is the percentage of abundance contributed by the two most abundant species. The equation is as follows:

$CD\ (\%) = \frac{y1+y2}{y} \times 100$.

Where, y_1 = number of individuals of the most dominant species or the rank-1 species, y_2 = number of individuals of second dominant species or the rank-2 species and y = total number of species individuals (McNaughton, 1968).

The ordination plot diagram of Canonical Correspondence Analysis (CCA) and Rarefaction Curves was done using biodiversity analysis software 'PAST' version 4.3 (Hammer et al., 2001).

RESULTS AND DISCUSSION

A total number of 2297 samples of 5 species under three genera were collected, of which two species belong to the genus *Aedes*, two species belong to the genus *Culex* (Linnaeus) and one species belongs to the genus *Armigeres*. The

identified species were *Ae. aegypti*, *Ae. albopictus*, *Cx. quinquefasciatus*, *Cx. Fuscocephala* and *Ar. subalbatus*. Although, 11 distinct mosquito species from the six study locations were found by Sharower *et al.* (2017).

Table 1. Global positioning system (GPS) locations of the eight study spots

Study spots	Latitudes	Longitudes	Study spots	Latitudes	Longitudes
Spot A (Bangshal Road)	23°43'5.18''N	90°24'2.22''E	Spot E (Siddiq Bazar)	23°43'17.30''N	90°24'29.17''E
Spot B (Chankhar pool Lane)	23°43'5.18''N	90°24'2.22''E	Spot F (Shikkatuly park)	23°43'7.20''N	90°24'24.74''E
Spot C (Abdul Hadi Lane)	23◦43'13.35''N	90◦24'9.64''E	Spot G (Fulbaria Old Railway Station)	23°43'22.06''N	90°24'22.41''E
Spot D (Aga Sadek Lane)	23◦43'10.64''N	90◦24'11.06''E	Spot H (Nazira Bazar)	23°43'9.23''N	90°24'27.04''E

Identification of mosquito genus and species: *Aedes* - Body at the angle of 45 from the surface during resting and white bands present in the abdomen. *Armigeres* - Proboscis is lateralized and curved. *Culex*- At rest body almost parallel to the surface and not have any white band on the abdomen. Species: *Ae. aegypti* - The clypeus has two patches of white colored scale; scutum black or white with sub median longitudinal white stripes. *Ae. albopictus* - Clypeus without white scale patches; scutum bears a narrows median white stripe. *Ar. subalbatus* - Slim, typically straight, and usually not laterally compressed trophoscis. *Cx. quinquefasciatus* - Absence of pale bands in the abdominal terga, Terga in the abdomen having pale bands, Post spiracular area lacking pale scale patch. *Cx. fuscocephala* - Pleuron with eye-catching stripes in dark and light colors.

Mosquito abundance: Among five mosquito species the *Cx. quinquefasciatus* (45%) followed by *Ar. subalbatus* (23%), *Ae. aegypti* (19%), *Cx. fuscocephala* (7%) and *Ae. albopictus* (6%) (Fig. 2). Hossain *et al.* (2017) stated that the Dhaka Cantonment was home to three important genera, including *Anopheles, Culex* and *Aedes*. On the spot A, the highest abundance was for *Cx. fuscocephala* (28.57%) during the month of November and January. On the other hand, the lowest population was for *Ae. aegypti* (3.30%) in the month of January. On the spot B, whereas the maximum number for *Cx. fuscocephala* (28.57%) during the month of March and was low for *Ae. aegypti* (2.7%) in the month of August. On the spot C, in January the topmost abundance was for *Cx. fuscocephala* (36.84%) and low abundance for *Ae. aegypti* (3.45%) in the month of February; On the spot D, the peak abundance was for *Cx. fuscocephala* (43.33%) during the month of

Ae. aegypti (Larva) | *Ae. albopictus* (Larva) | *Ar. Subalbatus* (Larva) | *Cx. quinquefasciatus* (Larva) | *Cx. fuscocephala* (Larva)

Ae. aegypti (Adult) | *Ae. albopictus* (Adult) | *Ar. subalbatus* (Adult) | *Ar. subalbatus* (Adult) | *Cx. fuscocephala* (Adult)

Plate 1: Identified mosquito species.

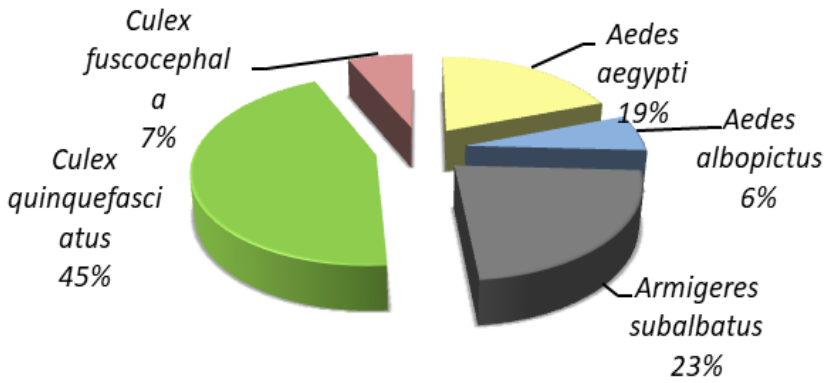

Fig. 2. Percentage of species wise abundance.

December and lowest for *Ae. aegypti* (4.35%) in the month of December; On the spot E, the highest abundance was for *Ae. aegypti* during the month of November and the lowest for *Ae. aegypti* (3.25%) in the month of December; On the spot F, the maximum abundance was for *Cx. quinquefasciatus* (30.14%) during the month of October and the lowest for *Ar. subalbatus* (3.77%) in the month of January; On the spot G, the highest population was for *Ar. subalbatus* (21.52%) during the month of January and lowest in March for *Ae. aegypti* (2.38%); On the spot H, the highest abundance was for *Ae. albopictus* (66.67%) during the month of August and lowest in the month August for *Ar. subalbatus* (0.33%) (Table. 2). However, in the Bashar *et al.* (2016) observed 84 sampling sites yielded a total of 6088 mosquito larvae from 12 species and 5 genera. Where *Cx. Quinquefasciatus was the maximum* (32.93%) *and Mansonia uniformes* was the minimum (1.23%).

Mosquito diversity: In this study mosquito diversity was calculated by using Shannon's diversity index (H') and Simpson's diversity index (1-λ). The highest value of H' was 1.292 for spot C and the lowest was 0.929 for spot H. In addition to, the maximum value of 1-λ was 0.993 for spot E and the minimum value was 0.977 for spot D. De-Freitas *et al.* (2017) showed that the highest H' was 2.16 conducted in Brazil. Whereas, the maximum value of H' was 1.7 in another study in Iran observed by Keshavarzi *et al.* (2017). Since the value of H' typically falls between 1.5 and 3.5 in actual ecological units, McDonald (2002) stated that a lower value makes it challenging to understand actual species diversity. By analysing the current study, it is clear to state that the variations from earlier studies result from the various climatic conditions, group sizes, and data analysis techniques. The highest species evenness (*J'*) 0.489 was for spot D and the lowest was 0.039 for spot E. An understanding of the relative abundance of species in the community can be gained from the evenness index. When *J'* tends to zero, it means that a community's main species are becoming more prevalent. *J'* having a significant value, which means the species are distributed evenly (Sanjayan et al., 1995). The maximum species richness (SR) was high 102.64 for spot D and the lowest was 55.93 for spot E. The value of community dominance (CD) was the highest 82.8 for spot H and the lowest 64.2 for spot C (Table. 3). According to the study of Islam *et al.* (2023) at four selected areas of Dhaka city, the highest community dominance (76.11%) was observed at Sutrapur and the lowest (49.66%) was observed at Demra. Ganeshaih *et al.* (1997) stated that taking species richness into consideration, the diversity indices H' and 1-λ appear to be helpful (Ganeshaih *et al.,* 1997). From the findings of sampling, species richness is evaluated using rarefaction curves. According to figure 3, The curves of spot F, B and C rose more quickly which means species richness was higher at those spots. The curves of spot A, D and G remained at mid-level (closer to upper curves) and the Curves of spot E and H remain into lower position which means species richness was low at those spots. Nikookar *et al.* (2015) conducted a similar analysis of rarefaction curves were used to estimate mosquito species richness in a study of mosquito biodiversity in northern Iran. Magurran (2004) also stated that if the rarefaction curve flattens out to the

Table. 2. Species-wise total mosquito populations (%) collected from eight study spots during the study period

Spot Name			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total
Spot A (Bangshal Road)	Serial No.	Name of The Mosquito Species													
	1	*Aedes aegypti*	11.67	8.33	0	0	3.33	18.33	18.33	18.33	15	3.33	3.3	0	60
	2	*Aedes albopictus*	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	*Culex quinquefasciatus*	0	8.73	17.46	0	0	5.56	0	19.84	8.73	20.63	10.32	8.73	126
	4	*Culex fuscocephala*	21.43	7.14	0	0	0	0	0	0	28.57	7.15	28.57	7.14	28
	5	*Armigeres subalbatus*	0	13.11	11.84	0	0	4.92	0	4.92	14.75	11.48	11.48	27.87	61
Spot B (Chankharpool Lane)	1	*Aedes aegypti*	0	0	0	6.76	9.46	2.7	12.16	29.73	14.87	14.86	0	9.46	74
	2	*Aedes albopictus*	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	*Culex quinquefasciatus*	17.46	20.83	6.94	0	0	7.64	0	8.33	11.81	6.94	14.58	5.56	144
	4	*Culex fuscocephala*	28.57	19.05	0	0	0	0	0	0	16.67	23.81	0	11.9	42
	5	*Armigeres subalbatus*	21.79	21.79	3.85	0	0	8.97	0	8.97	5.13	16.67	6.41	6.41	78
Spot C (Abdul Hadi Lane)	1	*Aedes aegypti*	0	0	0	12.07	0	29.31	25.86	29.31	0	0	0	3.45	58
	2	*Aedes albopictus*	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	*Culex quinquefasciatus*	0	5.6	12	0	0	10.4	0	8	24	14.4	8.8	16.8	125
	4	*Culex fuscocephala*	12.28	0	0	0	0	0	0	0	17.54	19.3	36.84	11.04	57
	5	*Armigeres subalbatus*	0	4.44	11.11	0	0	4.44	0	4.44	22.22	15.56	22.22	15.56	45
Spot D (Aga Sadek Lane)	1	*Aedes aegypti*	0	0	0	0	15.94	14.49	26.09	14.49	7.25	4.35	10.14	7.25	69
	2	*Aedes albopictus*	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	*Culex quinquefasciatus*	20.39	14.47	9.21	0	0	14.47	0	11.18	8.55	7.24	14.47	0	152
	4	*Culex fuscocephala*	6.67	0	0	0	0	0	0	0	6.67	43.33	43	0	30
	5	*Armigeres subalbatus*	23.16	7.37	7.37	0	0	13.64	0	5.26	5.26	10.53	13.68	13.68	95
Spot E (Siddiq Bazar)	1	*Aedes aegypti*	0	0	0	0	0	0	32.26	22.58	35.48	3.25	0	6.45	31
	2	*Aedes albopictus*	0	0	0	0	0	0	5	0	0	0	0	0	5
	3	*Culex quinquefasciatus*	7.07	6.06	6.06	0	0	0	0	9.09	10.1	7.07	33.33	21.21	99
	4	*Culex fuscocephala*	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	*Armigeres subalbatus*	5.56	9.26	7.41	0	0	9.26	0	9.26	12.96	9.26	18.52	18.52	54
Spot F (Shikkatuly Park)	1	*Aedes aegypti*	0	8.33	12.5	0	0	12.5	0	8.33	8.33	8.33	12.5	29.17	24
	2	*Aedes albopictus*	5.1	10.2	7.14	0	12.27	15.31	17.35	15.31	9.18	5.1	5.1	7.14	98
	3	*Culex quinquefasciatus*	0	0	9.59	0	0	10.96	0	30.14	27.38	0	9.59	12.32	73
	4	*Culex fuscocephala*	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	*Armigeres subalbatus*	15.09	0	9.43	0	0	5.66	0	18.87	13.21	24.53	3.77	9.43	53
Spot G (Fulbaria Old Railway Station)	1	*Aedes aegypti*	2.38	0	0	0	20.24	20.24	2.38	13.1	13.1	14.29	5.95	8.33	84
	2	*Aedes albopictus*	0	0	0	0	0	15.79	47.37	36.84	0	0	0	0	19
	3	*Culex quinquefasciatus*	6.43	8.77	20.47	0	0	5.26	0	9.94	3.51	19.88	6.43	19.3	171
	4	*Culex fuscocephala*	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	*Armigeres subalbatus*	3.8	11.39	13.92	0	0	3.8	0	13.92	12.66	12.66	21.52	6.33	79
Spot H (Nazira Bazar)	1	*Aedes aegypti*	0	0	0	0	8.11	18.92	5.41	27.03	5.41	0	5.41	29.73	37
	2	*Aedes albopictus*	0	0	0	0	0	66.67	33.33	0	0	0	0	0	3
	3	*Culex quinquefasciatus*	12.78	14.29	14.29	0	0	12.78	0	3.76	24.06	8.27	9.77	0	133
	4	*Culex fuscocephala*	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	*Armigeres subalbatus*	18.33	11.67	15	0	0	0.33	0	21.67	3.33	5	3.33	18.33	60

right, a sufficient number of individual samples have been collected, and more intensive sampling is probably going to produce only a small number of new species. *Larval habitats and abiotic factors of breeding habitats*: Eight larval habitats were observed for sampling during the study period. The *Ae. aegypti* larvae were found in coconut shells, fruit shells, mud pools, one-time plastic bowls and rainwater. However, the *Ae. albopictus* larvae were discovered in coconut shell, one-time plastic bowl and rain water (Table. 4). In Bangladesh, Ahmed *et al.* (1990) and Hossain *et al.* (2000) observed that *Ae. aegypti* and *Ae. albopictus* larvae were found on many natural containers in Dhaka city, Srimangal tea garden and Thakurgaon. In the current study, the *Ar. subalbatus* larvae were found in drain, ground tank, mud pool and polluted ground

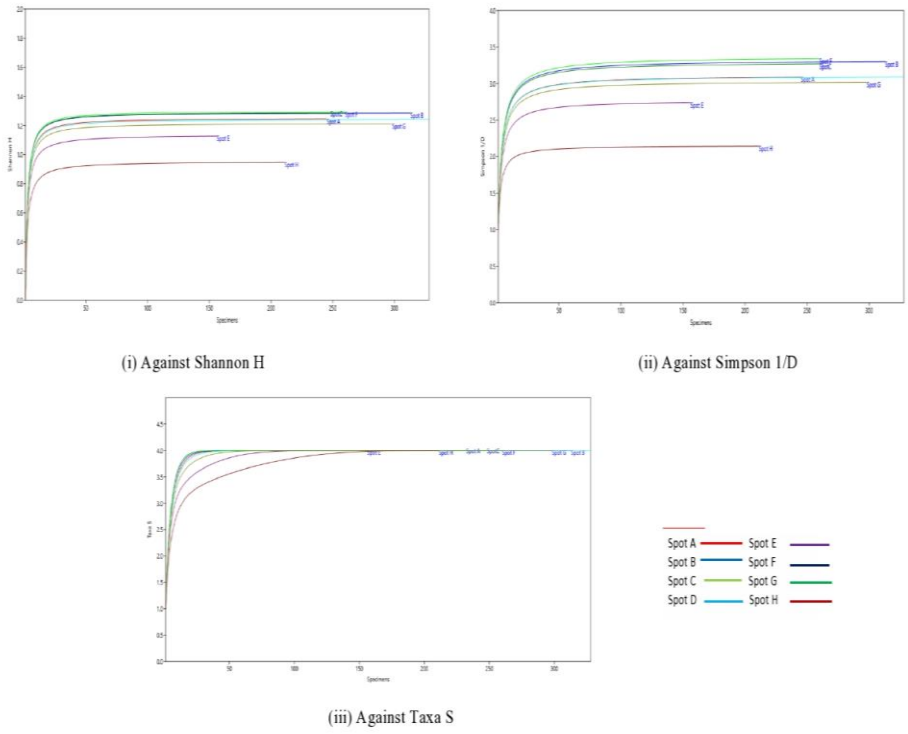

Fig. 3. Rarefaction curves for eight study spots as per Shannon H value, Simpson 1/D value and Taxa S.

Table 3. Different indices at sampling spots of the study areas

Name of the spots	H'	1-λ	J'	SR	CD
Spot A (Bangshal Road)	0.254119	0.985667	0.045243	81.51945	68.0
Spot B (Chankharpool Lane)	0.281983	0.978347	0.048425	100.26297	65.7
Spot C (Abdul hadi Lane)	0.258928	0.984605	0.045808	84.49461	64.2
Spot D (Aga Sadek Lane)	0.285133	0.97731	0.048770	102.64310	71.4
Spot E (Siddiq Bazar)	0.205507	0.99323	0.039206	55.93305	81.0
Spot F (Shikkatuly Park)	0.260341	0.98428	0.045973	85.38716	74.3
Spot G (Filbaria Old Railway Station)	0.283961	0.977702	0.048642	101.75056	74.3
Spot H (Nazira Bazar)	0.23212	0.989711	0.042583	69.02377	82.8
Total (N)	2.062091	7.870852	0.364650	681.01469	581.8

water (Plate. 2). Rajavel (1992) mentioned *Ar. subalbatus* breeding overall in urban areas was considerably higher than in rural areas. In the present research, the *Cx. quinquefasciatus* larvae were found on drains, coconut shells, ground tanks, Mud pools and polluted ground water. On the other hand, the larvae of *Cx. fuscocephala* were found in drains, coconut shells, ground tanks and polluted ground water (Plate. 2). The larvae of *Cx. quinquefasciatus* and *Cx. fuscocephala* were also found in polluted ground water sites like blocked drains,

Ae. aegypty larvae with its habitat | *Ae. albopictus* larvae with its habitat | *Ar. subalbatus* larvae with its habitat | *Cx. quinquefasciatus* larvae with its habitat | *Cx. fuscocephala* larvae with its habitat

Plate. 2. Larval habitats.

Table 4. Abiotic parameters of habitat water (Mean ± SE)

Habitat Types	Temperature(◦C)	pH	Dissolved Oxygen (mg/L)	Conductivity (µs/cm)	TDS (mg/L)
Coconut shell	28.5 ± 0.73	6.75 ± 0.17	5.61 ± 0.07	195.5 ± 2.27	88.8 ± 1.48
Drain	27.9 ± 0.67	6.46 ± 0.10	3.54 ± 0.06	259.4 ± 3.24	157.1 ± 3.59
Fruit Shell	29.1 ± 0.32	7.42 ± 0.09	7.50 ± 0.09	274.3 ± 5.22	109.4 ± 3.15
Ground Tank	26.4 ± 0.87	5.40 ± 0.09	1.37 ± 0.08	266.4 ± 3.25	152.8 ± 3.48
Mud Pool	26.9 ± 0.53	7.43 ± 0.08	7.21 ± 0.03	274.3 ± 5.22	126.1 ± 4.09
One-time plastic bowl	29.0 ± 0.54	7.49 ± 0.11	6.77 ± 0.04	280.7 ± 8.95	182.6 ± 2.60
Polluted ground water	27.2 ± 0.71	5.60 ± 0.01	1.18 ± 0.02	526.3 ± 5.33	333.6 ± 5.53
Rain water	24.9 ± 0.25	4.50 ± 0.08	0.60 ± 0.08	696 ± 8.04	338 ± 2.45

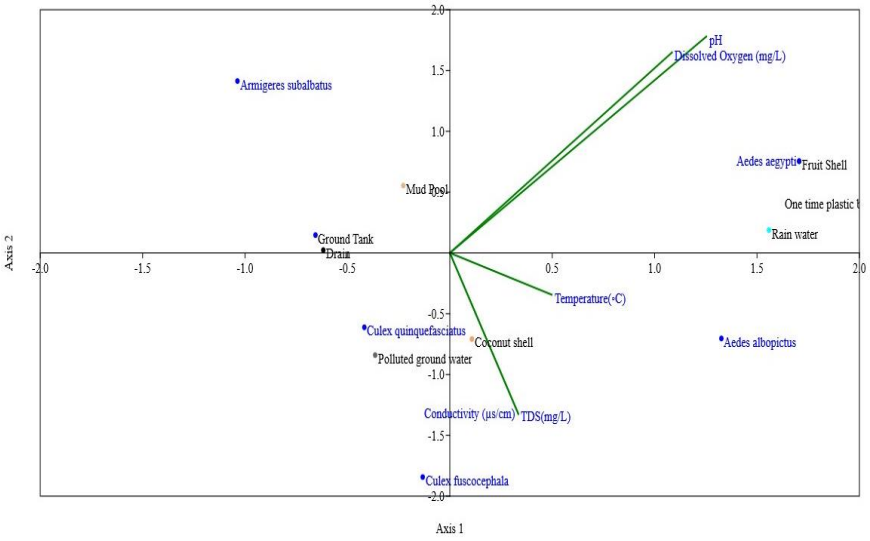

Fig. 4. Canonical Correspondance Analysis (CCA) ordination plot diagram.

cesspools, around the open latrines, shallow ditches, pond ground pools, pits and in containers like cemented tanks, big jars and tree holes (Ahmed *et al.*, 1990). The abiotic parameters i.e., temperature (°C), pH, Dissolved oxygen (mg/L), Conductivity (µs/cm) and total dissolved solids (mg/L) associated with the larval breeding water, were also measured in this study (Table 4). According to CCA findings, *Aedes* species probably prefer to lay their eggs in the habitats of more or less transparent water where dissolved oxygen and pH are associated with *Ae. aegypti* and *Ae. Albopictus,* respectively and *Ae. albopictus* was related with pH. The habitats characterized by muddy bottoms and emergent flora were positively related with *Culex* and *Armigeres* species, but none of the physico-chemical criteria were related (Fig. 4). More or fewer same findings were observed in the study of Sultana *et al.* (2016).

Relation to disease: As per current study *Ae. aegypti*, *Ae. albopictus, Ar. subalbatus, Cx. quinquefasciatus* and *Cx. fuscocephala* were found to be most common in selected study sites at Dhaka city. Most members of these species have been implicated in or thought to be responsible for the spread of numerous epidemic illnesses. In the present study out of four species are strong vector for transmission of disease where *Cx. fuscocephala* is probably less efficient vectors (Burke and Leake, 1988, Gregg, 1996). The dreadful *Culex* mosquito-borne disease, filariasis or elephantiasis as it is known on account of the disfiguring swelling of the limbs and genital organs is reportedly grounding many people in at least five northern districts of Bangladesh. Eighty countries in the world and some 30 districts in Bangladesh are known to be prone to this particular disease. It is transmitted by *Cx. quinquefasciatus* (Wolfe and Aslamkhan, 1972, Dolo *et al.*, 2004). *Cx. quinquefasciatus* was found maximum in number (45%) during the study period (Fig. 2). So, *Cx. quinquefasciatus* is an important causing vector of brugian filariasis in Dhaka City. In South East Asia, dengue is the most significant arboviral illness. It is transmitted by *Aedes* mosquitoes. Dengue infection is acquired through the bite of certain species of mosquitoes, primarily *Ae. aegypti* but also *Ae. albopictus* both of which are present in Florida (Kyle and Harris, 2008). In Dhaka city the outbreak of Dengue occurred since 1980 and disease carried by *Ae. aegypti* (Hossain et al., 2000). During the study period March 22 to January 23, *Ae. aegypti* (19%) and *Ae. albopictus* (6%) were found included in the total mosquito species (Fig. 2). According to Fig. 5, the larval sample number of *Ae. aegypti* and *Ae. albopictus* were in peak at the months of October and September, respectively. The development of a *Aedes* mosquito species from larvae to adult, it takes approximately 8-10 days (CDC, 2022). Dengue fever usually occurs after an incubation period of 4-10 days after the bite of an infected *Aedes* mosquito (Ailan, 2019). Case reports and dies were higher in the month of December when the whole procedure from larvae to the end of incubation period completes.

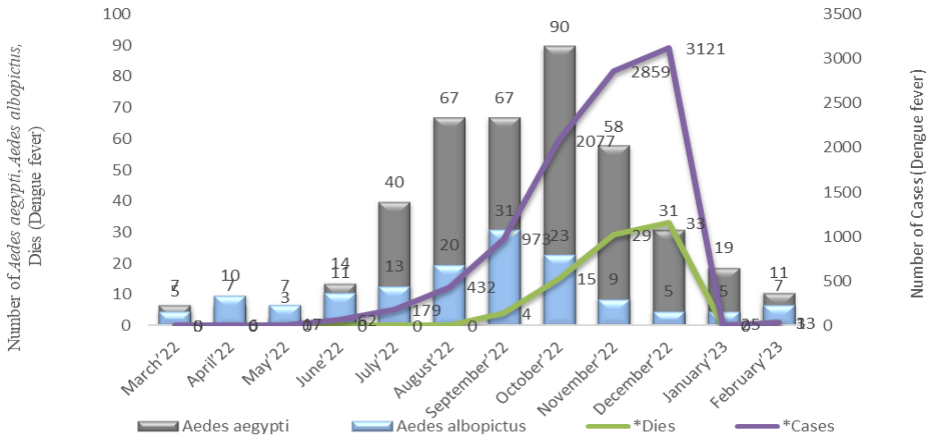

Fig. 5. Relationship of monthly dies and cases of dengue fever with the abundance of *Ae. aegypti* and *Ae. albopictus* samples (larvae) found at the study areas.

CONCLUSION

The updated works of the study regarding with the diversity, abundance and habitat types will hopefully serve as a basis for the development of future research works. It will also help for proper management of the larval habitats and effective control of mosquitoes in Dhaka city. The population of mosquitoes in these regions can be reduced and vector-borne diseases can be avoided by properly managing the mosquito breeding sites.

Acknowledgements: The authors of this research work are grateful to the Ministry of Science and technology, Govt. of the people's Republic of Bangladesh for providing financial support for this research work through national Science and Technology Fellowship program.

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(Manuscript received on 1 January 2025 revised on 21 April 2025)