International Journal of Research in Agricultural Sciences
Volume 12, Issue 6, ISSN (Online): 2348 – 3997

Biodemographic Traits of the Vector *Culex quinquefasciatus* Mosquito: Insights from Indoor and Rice-Field-Associated Habitats

Niloy Kundu
Department of Zoology, Jagannath Kishore College, Purulia-723101, West Bengal, India.
Corresponding author email id: nkundu78@gmail.com

Date of publication (dd/mm/yyyy): 12/12/2025

***Abstract* – Aims: Mosquito-borne diseases such as Japanese encephalitis, dengue, and lymphatic filariasis continue to pose serious public health challenges in eastern India. *Culex quinquefasciatus,* a predominant vector in this region, thrives across a wide range of habitats-including indoor containers and partially shaded outdoor sites such as rice-field-associated environments-which are abundant in districts like Purulia. Understanding its developmental biology under varying environmental conditions is essential for designing effective vector-control strategies. This study investigated the survivorship, instar duration, and life-table characteristics of *Cx. quinquefasciatus* collected from field sites in Purulia, India. Methods: First-instar larvae were reared separately under controlled indoor conditions and partially shaded outdoor conditions that represent typical semi-natural habitats. The duration of each larval instar, pupal period, mortality patterns, adult emergence, and life expectancy were recorded and analyzed through regression-derived population estimates and survivorship curves. Result: Larvae required 14.98 days indoors and 13.71 days outdoors to reach adulthood, with the fourth instar being the longest in both environments. Early instar mortality was highest across both settings, while late larval and pupal mortality varied between environments, reflecting ecological pressures associated with habitat type. Adult emergence was higher indoors (27.87%) than outdoors (18.33%). Life-table analyses indicated a type III survivorship curve, with life expectancy at hatching estimated at 8 days indoors and 5 days outdoors. These results align with earlier studies but also highlight the influence of local habitat features-especially nutrient-rich rice-field–linked outdoor sites-on mosquito development and population structure. Overall, climatic conditions, habitat characteristics, and resource availability were found to collectively shape the developmental dynamics of *Cx. quinquefasciatus*. The findings offer valuable insights into vector ecology in Purulia and may support more targeted strategies for controlling Japanese encephalitis and other Culex-borne diseases.**

***Keywords* – *Culex quinquefasciatus*, Life Table, Survivorship, Life Expectancy, Habitat Heterogeneity.**

I. Introduction

Mosquito-borne illnesses such as encephalitis, dengue, and malaria can spread rapidly and cause numerous deaths if not properly managed. Globally, more than 7×10^6 individuals are infected with mosquito-borne diseases each year, and 2×10^6 die [1]. In 2016, the Directorate of Health Service (DHS), Government of West Bengal, reported 2004 cases of acute encephalitis syndrome (AES) with 275 deaths, highlighting the seriousness of mosquito-borne diseases in eastern India [2]. Members of the *Culex* species are important vectors of lympha--tic filariasis, Japanese encephalitis, and West Nile encephalitis [3]. Since 1973, Japanese encephalitis epidemics have been recorded in several states [4], and sporadic reports from West Bengal confirm its endemicity [5], with higher incidences during monsoon and post-monsoon months due to increased vector abundance.

Culex quinquefasciatus is a strongly endophagic and peridomestic mosquito with high mammalian affinity [6]. Effective management of *Culex*-borne diseases depends on understanding biological traits such as larval development time, adult survival, and lifespan under varying environmental conditions. Biodemographic studies provide essential life-table information that links life-history strategies with vector management [7, 8]. Life tables offer analytical insights into mortality, survival, and life expectancy [9-11], and mortality between eggs and larval instars is especially important for understanding population build-up [12, 13].

The increasing abundance of encephalitis vectors [14, 15] emphasizes the need to estimate life-table parameters. Information on survivorship and larval development in indoor and outdoor (wild) conditions is crucial for interpreting life-history patterns and implementing precise control strategies.

Although mosquito habitats vary across ecological zones, most aquatic breeding sites fall into four types: indoor containers (flower pots, jars, stored water), semi-shaded sites such as old tires or rice fields, heavily shaded areas like banana plantations, and open sunlit habitats including drainage channels. Adult *Culex quinquefasciatus* occupies a similarly wide range of environments. Studies on Anopheles species show that these habitat types influence larval growth, adult survival, and reproductive capacity. Nutritional resources within habitats strongly affect larval development and subsequent mosquito productivity [14, 15].

To understand the population dynamics and life-history features of *Cx. quinquefasciatus* in and around Purulia, life-table studies of field-collected immature stages are essential. The present study examined how different environmental settings-such as indoor spaces and partially shaded outdoor areas, including rice-field-associated habitats-shape larval development and adult lifespan of *Culex quinquefasciatus* in a tropical region. The findings will enhance understanding of growth and survival patterns and support more effective vector control strategies.

II. Materials and Methods

Primarily, the *Culex* mosquito larval habitats were identified and egg rafts were collected from Purulia town and adjacent rice fields, following [14] for three consecutive years, between 2023 and 2025, mainly during June-September. The unaltered habitats were continuously monitored for the following consecutive 15 days.

Within the Purulia town, eggs of *Culex* mosquitoes were collected from artificial larval habitats, mainly earthen and plastic containers, and put into the glass beakers (with proper marking) (Borosil® India, 1000 ml capacity) using paint brush. After hatching, the 0-day old 1st instar larvae were separated in 3 large plastic containers each containing 30 L of tap water and 1000 individuals and fed with yeast granules. The larvae in each experimental containers were allowed to pupate using *ad libitum* food resources, in the form of field-collected detritus and fish food (Tokyu®, Malaysia). Every newly emerged pupa was collected and weighed from the respective experimental containers and were individually placed into a small glass vial (Borosil® India) (50 × 15 mm) with ~2 ml of water. The vials were covered with fine cloth and the pupae were allowed to emerge to adults. Upon eclosion, the water was drawn from the vials with the help of a sterile syringe (Dispovan®, India, 10 ml), and the mosquito was identified up to the species level following the identification keys and was identified as *Culex quinquefasciatus* species, and were considered for the present study. The survi--val of adults after eclosion from pupae was recorded as adult longevity (in days) and calculated by subtracting the day of eclosion from the day of individual's death. During this stage of the life cycle, the adults were not fed, and hence, their survival was solely dependent on the resources acquired during larval development.

In case of field-generated data, three similar submerged agricultural rice-fields habitats were selected, curated with 1′ x 1′ enclosure, covered with mosquito net and 3 *Culex* egg raft were placed in them. Care was taken so that the enclosures does not dry out or the extra water after rain goes out of the containers without the larvae getting washed off. The larvae in their natural habitats were fed with natural food resource like detritus and allowed to pupate. They were similarly separated in marked glass vials after weighing individually. Identificati--on of emerged adults and measurement of wing lengths were done accordingly.

During the experiments, the instar duration of all larval and pupal stages of immature mosquitoes was recorded and the average value was considered for the present analysis. The dataset was used to deduce and plot the age distribution graph of the immature individuals of *Culex* sp. The number/day values were plotted against the corresponding instar duration to obtain age distribution graphs following [16]. The number of individuals at the beginning of each instar was obtained from the regression equation, which was derived from number/day (y axis) and instar duration (x axis) separately for *Cx. quinquefasciatus* in indoor and agricultural rice-field habitats. Life tables were constructed for immature and adult mosquitoes of *Culex* in both conditions [17]. A regression equation of age-specific survivorship was constructed using in transformed data of l_x (survivorship) as a function of age (x, in days) [18]. Two sample t-tests [19] were used to deduce any significant variations between the survival of immature and adult individuals of *Culex* mosquito both in indoor and outdoor conditions.

The survivorship and the life expectancy data were derived from the formula, where: x = age interval or age class; N_x = number of survivors at the start of age interval x; l_x = proportion of organ organisms surviving to the start age interval x; d_x = proportion of the organisms dying during the age interval x to x + 1, $[l_x - (l_x + 1)]$; q_x = rate of mortality during the age interval x to x + 1, $[d_x/l_x]$; L_x = the average number of individuals alive during the age interval x to x + 1, $[(l_x + l_x+1)/2]$; T_x = the total time period (in days) to be lived by individuals of age x in the population; e_x = the mean life expectancy of an individual alive at the start of the age interval x, $[T_x/l_x]$.

III. Results

The field survey revealed that all immature stages (egg, four larval stages, and pupa) of mosquitoes were present in the selected study areas of Purulia, India, including sampling points near rice fields, which serve as seasonal breeding grounds. Only eggs were collected for experimentation; the remaining stages were discarded before the onset of experiments.

In indoor conditions, the instar duration of *Cx. quinquefasciatus* was: instar I-1.997 days, instar II-1.937 days, instar III-2.103 days, instar IV-4.773 days, and pupa-4.167 days. In outdoor conditions, the respective durations were: instar I-1.61 days, instar II-0.887 days, instar III-2.33 days, instar IV-4.943 days, and pupa-3.943 days.

The second set of observations showed that in indoor conditions instar durations were: I-3.33 days, II-4.67 days, III-5 days, IV-9.67 days, and pupa-7.33 days; while in outdoor conditions they were: I-2.33 days, II-2 days, III-5.33 days, IV-10 days, and pupa-7 days (Figure 1). Although age-distribution graphs differed slightly in shape, both conditions showed the same pattern, with instar IV being the longest and instar I the shortest.

Larval survival (y) at each age (x) followed two regression equations: indoors, $y = -2.0927x + 0.1219$ ($R^2 = 0.986$); outdoors, $y = -0.1502x + 0.0431$ ($R^2 = 0.954$). In indoor conditions, the number of individuals entering each stage was: instar I-1000, instar II-705.33, instar III-279, instar IV-42.667, pupa-14, and adults-310. In outdoor conditions, the numbers were: instar I-1236, instar II-208.67, instar III-157.67, instar IV-94.33, pupa-65, and adults-208.

Survivorship and life expectancy (e_x) of immature stages are shown in Table 1 and Figure 2. Life expectancy of 0-day-old instar I larvae was 8 days indoors and 5 days outdoors. No significant difference was observed between surviving immature individuals ($t_{2,18} = -0.002$; $p = 0.499$). Life-table estimates for adult individuals are presented in Table 2 and Figure 2. Similarly, no significant difference was observed between adult survivors in indoor and rice-field habitats ($t_{2,4} = 1.498$; $p = 0.209$). Mortality among immature stages was 69% indoors and 83.172% in rice-field habitats, the latter likely due to habitat drying and resource shortage (Table 3).

Table 1. Life table data of the immature stages of the *Culex quinquefasciatus* mosquitoes, (A) in indoor and (B) in agricultural rice-field habitats from Purulia, India. The mean value of immatures from each environment was considered for the analysis.

(a) In indoor habitats							
Day (*x*)	**No. of immatures (*N_x*)**	***l_x***	***d_x***	***q_x***	***L_x***	***T_x***	***e_x***
0	1000	1	0.076	0.076	0.962	8.244	8.244
1	924	0.924	0.071	0.077	0.888	7.282	7.881
2	852.667	0.853	0.03	0.036	0.838	6.394	7.498
3	822.333	0.822	0.069	0.084	0.788	5.556	6.757
4	753	0.753	0.101	0.135	0.702	4.769	6.333
5	651.667	0.652	0.043	0.066	0.63	4.066	6.24
6	608.667	0.609	0.08	0.132	0.569	3.436	5.645
7	528.333	0.528	0.028	0.052	0.515	2.868	5.427
8	500.667	0.501	0.081	0.161	0.46	2.353	4.7
9	420	0.42	0.044	0.104	0.398	1.893	4.506
10	376.333	0.376	0.026	0.068	0.364	1.495	3.971
11	350.667	0.351	0.018	0.052	0.342	1.131	3.225
12	332.333	0.332	0.019	0.057	0.323	0.79	2.376
13	313.333	0.313	0.003	0.011	0.312	0.467	1.489
14	310	0.31	0.31	1	0.155	0.155	0.5
15	0	0	0		0	0	
(B) In agricultural rice field habitats							
Day (*x*)	**No. of immatures (*N_x*)**	***l_x***	***d_x***	***q_x***	***L_x***	***T_x***	***e_x***
0	1236	1	0.104	0.104	0.948	5.31	5.31
1	1107	0.896	0.145	0.162	0.823	4.362	4.87
2	928	0.751	0.185	0.246	0.658	3.539	4.713
3	699.333	0.566	0.104	0.184	0.514	2.881	5.091
4	571	0.462	0.074	0.159	0.425	2.367	5.123
5	480	0.388	0.058	0.15	0.359	1.941	4.999
6	408	0.33	0.066	0.2	0.297	1.582	4.793

7	326.333	0.264	0.036	0.137	0.246	1.285	4.868
8	281.667	0.228	0.022	0.098	0.217	1.039	4.56
9	254	0.206	0.014	0.068	0.198	0.823	4.003
10	236.667	0.191	0.008	0.042	0.187	0.624	3.259
11	226.667	0.183	0.007	0.037	0.18	0.437	2.381
12	218.333	0.177	0.008	0.047	0.172	0.257	1.453
13	208	0.168	0.168	1	0.084	0.084	0.5
14	0	0	0		0	0	

Table 2. Life table estimates of the adult individuals that have emerged from pupae of *Culex quinquefasciatus* mosquitoes in (A) in indoor and (B) in agricultural rice-field habitats. Here the data of the newly emerged adults were considered.

(A) In indoor habitats							
Day (x)	**No. of adult (N_x)**	l_x	d_x	q_x	L_x	T_x	e_x
0	278.667	1	0	0	1	6.33	6.33
1	278.667	1	0	0	1	5.33	5.33
2	278.667	1	0.072	0.072	0.964	4.33	4.33
3	258.667	0.928	0.116	0.125	0.87	3.366	3.626
4	226.333	0.812	0.179	0.221	0.722	2.496	3.073
5	176.333	0.633	0.11	0.174	0.578	1.773	2.802
6	145.667	0.523	0.163	0.311	0.441	1.196	2.287
7	100.333	0.36	0.121	0.336	0.3	0.754	2.095
8	66.667	0.239	0.065	0.27	0.207	0.455	1.9
9	48.667	0.175	0.078	0.445	0.136	0.248	1.418
10	27	0.097	0.048	0.494	0.073	0.112	1.154
11	13.667	0.049	0.035	0.707	0.032	0.039	0.793
12	4	0.014	0.014	1	0.007	0.007	0.5
13	0	0	0		0	0	
(B) In agricultural rice field habitats							
Day (x)	**No. of adult (N_x)**	l_x	d_x	q_x	L_x	T_x	e_x
0	183.333	1	0	0	1	5.52	5.52
1	183.333	1	0	0	1	4.52	4.52
2	183.333	1	0.093	0.093	0.954	3.52	3.52
3	166.333	0.907	0.156	0.172	0.829	2.566	2.829
4	137.667	0.751	0.176	0.235	0.663	1.737	2.314
5	105.333	0.575	0.153	0.266	0.498	1.075	1.87

6	77.333	0.422	0.207	0.491	0.318	0.576	1.366
7	39.333	0.215	0.105	0.492	0.162	0.258	1.203
8	20	0.109	0.08	0.733	0.069	0.096	0.883
9	5.333	0.029	0.016	0.563	0.021	0.027	0.938
10	2.333	0.013	0.013	1	0.006	0.006	0.5
11	0	0	0		0	0	

Table 3. Instar mortalities of *Cx. quinquefasciatus* in (A) indoor and (B) agricultural rice field habitats during instar stages.

Habitat Types	Instars / Life Stage	Age in Days at the beginning of Instars (t_{i-1})	No. of Individuals Entering Instar Stage ($S_{t\,i-1}$)	Death during Instar Stages (D_i)	Relative Proportion of Individuals dying in Instar Stage (D_i / $S_{t\,i-1}$)	Proportion of Individuals dying Daily in Instar Stages [1- ($S_{t\,i}$ / $S_{t\,i-1}$)$^{1/d}$]
(A) Indoor	I	0	1000	80	0.08	0.041
	II	1.997	920	142.333	0.155	0.083
	III	3.934	777.667	121.667	0.156	0.077
	IV	6.037	656	304	0.463	0.035
	Pupa	10.81	352	42	0.119	0.139
	Adult	14.977	310			
(B) Agricultural rice-field	I	0	1236	154.667	0.125	0.080
	II	1.61	1081.333	186.667	0.173	0.192
	III	2.497	894.667	331.667	0.371	0.180
	IV	4.827	563	292.333	0.519	0.138
	Pupa	9.77	270.667	62.667	0.232	0.065
	Adult	13.713	208			

*d = instar duration in days.

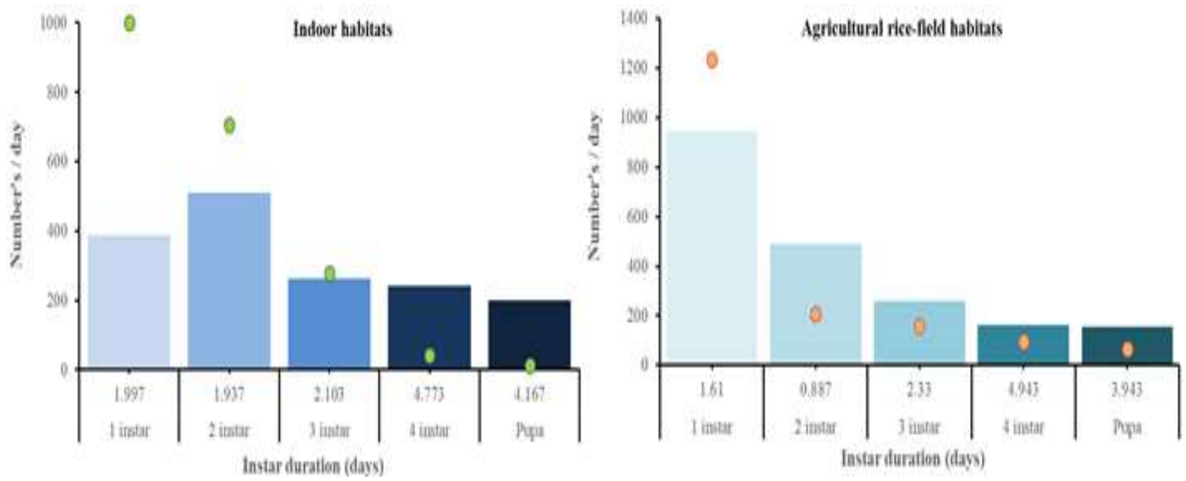

Fig. 1. Age distribution of the immature stages of indoor and rice-field-collected *Cx. quinquefasciatus*. The coloured round symbols represent numbers of individuals at the beginning of each instar.

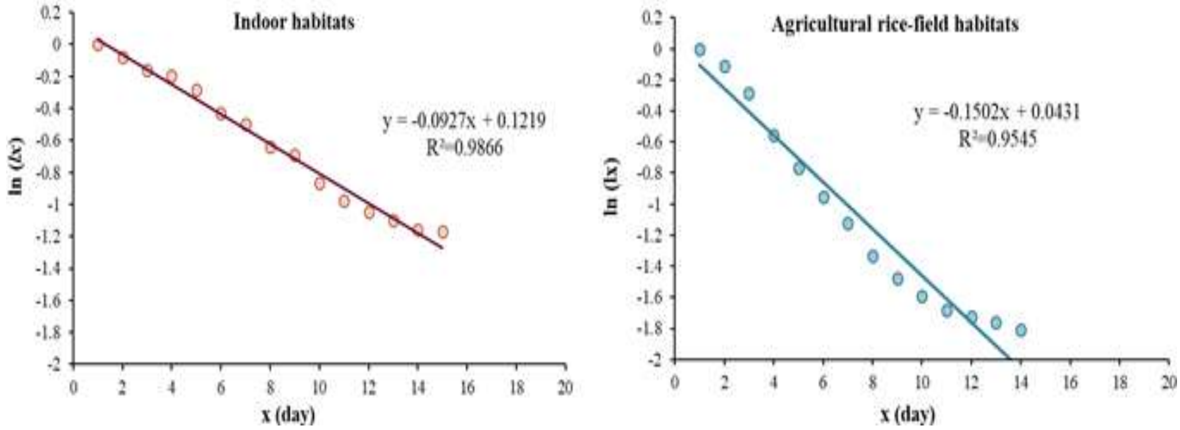

Fig. 2. Survivorship curves of the immature stages of indoor and rice-field-collected *Cx. quinquefasciatus*. The mean value of larvae from each habitat was considered for the analysis.

IV. Discussion

Cx. quinquefasciatus is highly adapted to urban ecosystems, where its abundance contributes substantially to the risk of arboviral transmission, including Japanese encephalitis. The duration of the immature stages of this mosquito holds considerable epidemiological significance, as it determines the pace at which new adults enter the population. Rapid development generally reflects low parasitism, limited predator pressure, and reduced risk of habitat desiccation, and it facilitates quicker population turnover; however, it may also yield smaller pupae when nutrient reserves are inadequate.

In the present investigation, larvae collected as first instars required 14.98 days indoors and 13.71 days in rice-field habitats to complete development to the adult stage. These values fall within the range documented by earlier studies [20]. Nonetheless, several authors have recorded considerably longer developmental periods under different ecological scenarios [21], reinforcing the influence of habitat conditions on larval growth.

A comparison of mortality patterns showed that indoor habitats experienced the highest mortality among fourth-instar larvae, whereas rice-field margins of Purulia, where water depth, predators and organic load fluctuate considerably, exhibited peak mortality in the third instar. Pupal mortality was also more pronounced in rice-field settings (Table 1, Figure 2). Elevated mortality during late larval and pupal stages has been well documented and is often recognized as a key regulatory component of mosquito population dynamics [22]. Larger body size at these stages likely increases susceptibility to predators and other mortality pressures [22]. Moreover, environmental drivers-particularly temperature, which plays a decisive role in shaping mosquito growth rates, host-seeking behaviour, reproductive activity, and even pathogen amplification-can modulate how these mortality patterns manifest across contrasting habitats [23].

Adult emergence was 27.87% indoors and 18.33% in rice fields. These differences follow trends observed previously, where emergence success is shaped by larval crowding, habitat capacity, and overall habitat quality. The dominance of early-instar mortality in both habitat types is characteristic of a type III survivorship curve [12]. The life-table parameters recorded here (Table 2, Table 3) are comparable to those reported for numerous mosquito species-including *Anopheles* spp. [24-26], predatory *Toxorhynchites* [27], *Aedes aegypti* and *Ae. albopictus* [20], and many other taxa worldwide. These interspecific variations are generally attributed to differences in life-history strategies, ecological adaptation, larval nutrition, and habitat features. Because newly emerged adults rely entirely on larval nutrient reserves, suboptimal larval feeding conditions commonly restrict adult longevity.

Culex larvae possess notable dietary flexibility and can exploit a broad spectrum of organic resources. Growth rate, pupal yield, and population expansion depend heavily on the quality and quantity of available food, which vary considerably across habitat types-including rice fields of Purulia districts where microbial productivity, detritus load, and water quality fluctuate seasonally. Habitat-dependent food availability has therefore been recognized as a major driver of larval performance and overall population structure [28].

V. Conclusion

Overall, the present study demonstrates that climatic variables, habitat characteristics-including rice-field environmental conditions-larval density, and food resources act synergistically to shape the developmental patterns and demographic structure of *Cx. quinquefasciatus*. The insights generated here may contribute to more effective management strategies for vectors of Japanese encephalitis and related pathogens [29].

Acknowledgements

The author is thankful to Dr. S. Chattopadhyay, Principal, Jagannath Kishore College, Purulia for the facilities provided.

References

[1] World Health Organization. A global brief on vector-borne diseases. 2014, 2014, 1–56.
[2] State Bureau of Health Intelligence, Directorate of Health Services, Government of West Bengal, 2015–2016; 119–198.
[3] T.E. Erlanger, S. Weiss, J. Keiser, J. Utzinger, & K. Wiedenmayer, Past, present, and future of Japanese encephalitis. *Emerging Infectious Diseases*, 2009, 15(1), 1-7.
[4] R. Reuben, & A. Gajanana, Japanese encephalitis in India. *Indian Journal of Pediatrics*, 1997, 4(2), 243-51.
[5] B. Bandyopadhyay, I. Bhattacharyya, S. Adhikary, S. Mondal, J. Konar, N. Dawar, A. Biswas, & N. Bhattacharya, Incidence of Japan--ese encephalitis among acute encephalitis syndrome cases in West Bengal, India. *Biomed Research International*, 2013. 2013, 1-5.
[6] S. Roy, S. Roy, & B.K. Modak, Diversity, seasonality and relative abundance of mosquitoes (Insecta: Diptera) in selected urban and rural areas of Purulia, West Bengal. *Records of Zoological Survey of India*, 2024, 124(iS), 653-660.
[7] J.R. Carey, Insect biodemography. *Annual Review of Entomology*, 2001, 46, 79–110.
[8] G.R. Okogun, Life-table analysis of *Anopheles* malaria vectors: generational mortality as tool in mosquito vector abundance and control studies. *Journal of Vector Borne Diseases*, 2005, 42(2), 45–53.
[9] Y.A. Afrane, G. Zhou, B.W. Lawson, A.K. Githeko, & G. Yan, Life table analysis of *Anopheles arabiensis* in western Kenya highlands; effects of land covers on larval and adult survivorship. *The American Journal of Tropical Medicine and Hygiene*, 2007, 77(4), 660–666.
[10] A. Carron, L. Bichaud, N. Platz, & D. Bicout, Life history traits of *Aedes caspius* (Diptera: Culicidae): a laboratory study of larval stages. *Bulletin of Entomological Research*, 2008, 98(5), 431–436.
[11] L.E. Hugo, J.A. Jeffery, B.J. Trewin, L.F. Wockner, T.Y. Nguyen, H.L. Nguyen, L.T. Nghia, E. Hine, P.A. Ryan, & B.H. Kay, Adult survivorship of the dengue mosquito *Aedes aegypti* varies seasonally in central Vietnam. *PLoS Neglected Tropical Diseases*, 2014, 8(2), e2669.
[12] T.R.E. Southwood, & P.A. Henderson, *Ecological Methods*. 3rd ed. Blackwell Science Ltd., London, UK, 2000, pp. 575.
[13] N.A. Hashim, A.H. Ahmad, C.S. Md Rawi, N.A. Tahir, & N. Basari, Life tables study of immature *Aedes albopictus* (Skuse) (Diptera: Culicidae) during the wet and dry seasons in Penang, Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health*, 2008, 39(1), 39–47.
[14] S. Banerjee, G. Aditya, & G.K. Saha, Household disposables as breeding habitats of dengue vectors: linking wastes and public health. *Waste Management*, 2013, 33, 233–239.
[15] S. Banerjee, G. Aditya, & G.K. Saha, Household wastes as larval habitats of dengue vectors: comparison between urban and rural areas of Kolkata, India. *PLoS One*, 2015, 10(10), e0138082.
[16] M.W. Service, Studies on sampling larval populations of the *Anopheles gambiae* complex. *Bulletin of the World Health Organization*, 1971, 45, 169–180.
[17] R.L. Smith, *Ecology and Field Biology*. 5th ed. Harper and Collins, New York, USA, 1996, pp 311.
[18] M.S. Beier, J. Beier, A.A. Merdan, B. El Sawaf, & M.A. Kadder, Laboratory rearing techniques and adult life table parameters for *Anopheles sergentii* from Egypt. *Journal of the American Mosquito Control Association*, 1987, 3(2), 266–270.
[19] J.H. Zar, *Biostatistical Analysis*. New Delhi, India: Pearson Education, Singapore Pte. Ltd (Indian Branch), 1999, pp. 663.
[20] S. Banerjee, D. Das, S. Brahma, S. Pramanik, G.K. Saha, & G. Aditya, Life table estimates for two common *Aedes* mosquito species: observations from larval habitats of Kolkata, India. *Zoology and Ecology*, 2022, 32(2), 91-100.
[21] P. Tripathi, & R.B. Gupta, Life table attributes study of vector of Dengue (*Aedes aegypti*) from Gwalior, Madhya Pradesh, India. *International Journal of Entomology Research*, 2018, 3(1), 52–55.
[22] C. Casonova, & A.P. Do Prado, Key factor analysis of immature stages of *Aedes scapularis* (Diptera: Culicidae) populations in south-eastern Brazil. *Bulletin of Entomological Research*, 2002, 92, 271–277.

[23] M.E. Meuti, Environmental factors that regulate mosquito physiology and behavior. *Annual Review of Entomology*, 2025, 71.

[24] H. Yurttas, & B. Alten, Geographic differentiation of life table attributes among *Anopheles sacharovi* (Diptera: Culicidae) populations in Turkey. *Journal of Vector Ecology*, 2006, 31(2), 275–284.

[25] J.P. Grieco, N.L. Achee, I. Briceno, R. King, R. Andre, D. Roberts, & E. Rejmankova, Comparison of life table attributes from newly established colonies of *Anopheles albimanus* and *Anopheles vestitipennis* in northern Belize. *Journal of Vector Ecology*, 2004, 28, 200–207.

[26] F.E. Edillo, Y.T. Touré, G.C. Lanzaro, G. Dolo, & C.E. Taylor, Survivorship and distribution of immature *Anopheles gambiae* s.l. (Diptera: Culicidae) in Banambani village, Mali. *Journal of Medical Entomology*, 2004, 41, 333–339.

[27] D.D. Amalraj, & P.K. Das, Life-table characteristics of *Toxorhynchites splendens* (Diptera: Culicidae) cohorts reared under controlled food regimes. *Journal of Vector Ecology*, 1996, 21(2), 136–145.

[28] S. Mohan, S. Banerjee, S.P. Mohanty, G.K. Saha, & G. Aditya, Assessment of pupal productivity of *Aedes* and co-occuring mosquitoes in Kolkata, India. *Southeast Asian Journal of Tropical Medicine and Public Health*, 2014, 45(6), 1279–1291.

[29] N. Kundu, Larvicidal efficacy of freshwater prawn *Macrobrachium lamarrei* H. Milne Edwards, 1837: a perception for mosquito bio control. *Journal of Scientific Enquiry*, 2024, 4(1), 57-74.

AUTHOR'S PROFILE

Dr. Niloy Kundu, is an Assistant Professor in the Department of Zoology at Jagannath Kishore College, Purulia. With over 20 years of research experience, he specializes in population dynamics, life-history patterns, and biological control of vector mosquitoes, along with extensive work on ichthyofaunal diversity, trophic ecology, and estuarine ecosystem assessment. Dr. Kundu has served as a Senior and Junior Research Fellow at the University of Calcutta, contributing significantly to studies on mosquito biocontrol, fish ecology, feeding guilds, and metacommunity structures. He has participated as a resource person in international biodiversity assessments in Bhutan and has been actively involved in organizing UGC-sponsored seminars and workshops. His technical expertise spans ecological estimation, biostatistics, hi--stology, microscopy, biochemical assays, and freshwater and estuarine habitat analysis. Dr. Kundu has published multiple research papers in reputed national and international journals.