The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 4 | Issue 5 | May 2026
ISSN: 2583-973X (Online), SJIF IF: 5.6
Website: www.theacademic.in

Changing Behaviour of Aedes Aegypti: An Evidence-Based Overview

Dr. Debashis Biswas

Ph.D, OSD & Ex-Officio Chief Vector Control Officer, Kolkata Municipal Corporation, Kolkata, West Bengal, India, Email: debashis.megh@gmail.com

DOI : https://doi.org/10.5281/zenodo.20606573

ARTICLE DETAILS

Research Paper

Accepted: 19-05-2026

Published: 10-06-2026

Keywords:

Aedes aegypti; dengue vector; behavioural plasticity; urban ecology; climate change; insecticide resistance; vector adaptation

ABSTRACT

Aedes aegypti, the principal vector of dengue virus, has traditionally been characterised as a highly anthropophilic mosquito that feeds predominantly during daylight hours and breeds in artificial containers associated with human habitation. However, increasing scientific evidence suggests that this mosquito species is behaviourally dynamic and capable of rapid ecological adaptation. Over recent decades, *Aedes aegypti* populations have exhibited measurable changes in biting rhythms, host-seeking behaviour, environmental tolerance, breeding ecology and susceptibility to insecticides. These adaptations appear to be driven largely by anthropogenic environmental pressures such as urbanisation, artificial illumination, climate change and intensive vector-control interventions. Such behavioural shifts are reshaping dengue transmission dynamics and increasingly challenging traditional vector-control strategies that rely on predictable mosquito activity patterns. This chapter synthesises current scientific evidence on behavioural plasticity in *Aedes aegypti* and examines how human-modified environments are influencing mosquito ecology. Understanding these adaptive responses is essential for designing effective, evidence-based dengue-control strategies capable of responding to a rapidly evolving vector.

Introduction

Dengue fever has emerged as one of the most rapidly expanding mosquito-borne viral diseases worldwide. The disease is transmitted primarily by *Aedes aegypti*, a mosquito species that has evolved a close ecological association with humans (1). Rapid urbanisation, population growth, increased human mobility and climate variability have contributed to the global expansion of dengue during the past several decades (2).

Global estimates suggest that approximately 390 million dengue infections occur annually, of which nearly 96 million manifest clinically (3). The continuing global spread of dengue reflects not only the dissemination of the virus but also the remarkable ecological adaptability of its mosquito vector.

Historically, *Aedes aegypti* was considered a relatively predictable mosquito species. Classical entomological descriptions characterised it as a daytime-biting mosquito that feeds predominantly on humans and breeds primarily in artificial containers located in urban environments (4). These behavioural traits enabled vector-control programmes to design interventions based on relatively stable assumptions regarding mosquito activity patterns.

However, accumulating evidence indicates that *Aedes aegypti* is capable of considerable behavioural plasticity. Urbanisation, climate change, artificial lighting and vector-control interventions have created new environmental pressures that appear to be driving behavioural and ecological changes in mosquito populations (5).

Understanding these adaptive responses is crucial because they directly influence dengue transmission dynamics and the effectiveness of vector-control strategies.

Shifts in Biting and Host-Seeking Behaviour

Aedes aegypti has traditionally been described as a **diurnal mosquito** with peak biting activity during morning and late afternoon hours (6). Early entomological studies identified two principal feeding peaks: shortly after sunrise and again before sunset (7).

Recent investigations, however, suggest increasing flexibility in biting behaviour. Field studies conducted in several urban environments indicate that *Aedes aegypti* may extend its biting activity into early evening hours, particularly in densely populated areas where artificial lighting and human activity continue beyond daylight (8).

In Kolkata, field observations indicate that biting activity may begin as early as 5 a.m. and continue until approximately 10 p.m., extending well beyond the traditional daylight window (9).

Another dimension of behavioural adaptation relates to the influence of dengue virus infection on mosquito behaviour. Experimental studies have demonstrated that dengue-infected mosquitoes exhibit increased locomotor activity and heightened responsiveness to human odours during the infectious phase, thereby increasing the probability of successful host location and virus transmission (10).

Influence of Artificial Illumination

Artificial lighting has become a defining feature of modern urban environments. Residential areas, hospitals, transport hubs and commercial centres frequently remain illuminated well after sunset.

Laboratory experiments indicate that low-intensity artificial light can stimulate host-seeking activity in *Aedes aegypti* beyond natural daylight hours (11). In densely populated urban environments where artificial illumination is widespread, this phenomenon may extend the effective biting period and increase opportunities for mosquito–human contact.

Artificial lighting therefore represents an anthropogenic environmental factor capable of modifying mosquito behaviour and potentially influencing dengue transmission patterns.

Climate Change and Temperature-Driven Adaptation

Temperature is a critical determinant of mosquito development, survival, reproduction and virus replication (12). Rising global temperatures accelerate larval development and shorten the mosquito life cycle. Under favourable conditions mosquito populations can increase rapidly.

Higher temperatures also shorten the gonotrophic cycle, allowing female mosquitoes to obtain blood meals more frequently and potentially increasing dengue transmission intensity (13).

Climate change has also influenced the geographic distribution of *Aedes aegypti*. Regions previously considered unsuitable for mosquito survival are becoming increasingly favourable (14).

Studies have documented the expansion of *Aedes* mosquitoes into higher altitudes and temperate regions where dengue transmission was historically rare (15).

Mosquitoes may also modify their behaviour to cope with thermal stress by seeking cooler resting habitats during periods of extreme heat (16).

Enhanced Urban Adaptation and Breeding Flexibility

Aedes aegypti has become highly specialised for urban environments. The mosquito exploits a wide variety of artificial breeding habitats created by human activity (17).

Common breeding sites include:

- overhead water storage tanks
- plastic containers and buckets
- discarded tyres
- construction materials
- flower pots
- underground reservoirs

The eggs of *Aedes aegypti* are highly resistant to desiccation and can survive for months in dry conditions (18). This adaptation enables mosquito populations to persist during unfavourable periods and rapidly re-emerge following rainfall.

Urban ecological studies further demonstrate that mosquito populations readily exploit artificial breeding habitats created by human activity, including discarded containers, water storage systems and construction materials. Even in environments where overall mosquito densities appear relatively low, the close association between breeding sites and human habitation can sustain dengue transmission (19, 20).

Evolutionary Responses to Vector-Control Pressure

Vector-control programmes themselves may exert strong selective pressure on mosquito populations.

Decades of insecticide use have resulted in widespread insecticide resistance in *Aedes aegypti* populations worldwide (21).

Resistance to commonly used insecticides including pyrethroids and organophosphates has been documented across Asia, Latin America and Africa (22).

Genetic studies indicate that mosquitoes may develop mutations affecting insecticide target sites or increase production of detoxifying enzymes capable of degrading chemical compounds (23).

Behavioural resistance has also been observed, whereby mosquitoes avoid resting on treated surfaces or modify their activity patterns to reduce insecticide exposure (24).

The interaction between behavioural plasticity and physiological resistance represents a major challenge for vector-control programmes (25, 26).

Table: Behavioural Adaptation of *Aedes aegypti* Across Regions

Region	Behavioural change observed	Key drivers	References
Southeast Asia	Extended evening biting	Artificial lighting	(8,11)
South Asia	Flexible biting rhythms	Urbanisation	(9,17)
Latin America	Insecticide resistance	Chemical control pressure	(22,23)
Africa	Altered resting behaviour	Insecticide pressure	(24,26)
Global	Expansion into new climatic zones	Climate change	(14,15)

Behavioural Plasticity and Survival Under Human Pressure

The behavioural flexibility of *Aedes aegypti* reflects its ability to respond rapidly to environmental pressures created by human activity.Urbanisation, climate change, artificial lighting and insecticide exposure represent powerful selective forces shaping mosquito populations (27).

Increasing evidence suggests that mosquito populations can undergo rapid evolutionary adaptation under anthropogenic pressure (28).Such behavioural and ecological changes may influence mosquito–human contact patterns and complicate traditional vector-control strategies (29).

Increasing evidence suggests that mosquito populations can undergo rapid evolutionary and behavioural adaptation under anthropogenic pressure (28).

Key Messages for Dengue Control

Adaptive vector control is essential: Control strategies must consider expanded mosquito biting windows and changing activity patterns.

Surveillance should be continuous: Local monitoring of mosquito populations and breeding habitats is critical for early detection of behavioural shifts.

Chemical control alone is insufficient: Increasing insecticide resistance requires integrated vector management approaches.

Climate intelligence must guide planning: Temperature and rainfall patterns should inform dengue preparedness strategies.

Community participation remains central: Household-level source reduction and environmental management remain the most sustainable preventive measures.

Implications for Dengue Control

The evolving behaviour of *Aedes aegypti* has significant implications for dengue prevention. Traditional vector-control strategies were developed under assumptions of relatively predictable mosquito behaviour. For example, daytime fogging operations were historically scheduled on the premise that mosquito biting activity occurs mainly during daylight hours.

However, increasing evidence suggests that biting activity may extend into early morning and evening periods. If this expanded activity window is not considered, conventional interventions such as daytime fogging may fail to target a substantial proportion of mosquito activity.

Similarly, the emergence of insecticide resistance reduces the effectiveness of chemical control strategies.

Understanding behavioural plasticity is therefore essential for designing adaptive vector-control programmes (30). Integrated approaches that combine environmental management, biological control methods and community participation are increasingly recommended for sustainable dengue prevention (31).

Recent global reviews of dengue epidemiology and control emphasise that future vector-control strategies must account for the evolving ecology and behaviour of *Aedes aegypti*, integrating improved surveillance, climate-informed planning and community engagement in environmental management (32).

Conclusion

Aedes aegypti can no longer be regarded as a static or predictable vector. Increasing scientific evidence demonstrates that mosquito populations are capable of modifying their behaviour and ecology in response to environmental pressures created by human activity.

Changes in biting behaviour, climate responsiveness, urban adaptation and insecticide resistance illustrate the remarkable ecological plasticity of this species and its capacity to persist in rapidly changing environments. These adaptive traits complicate traditional vector-control strategies that rely on predictable mosquito activity patterns.

Future dengue-control programmes must therefore move beyond conventional approaches and adopt adaptive, evidence-based vector-management strategies supported by strengthened surveillance, ecological monitoring and climate-informed planning.

Integrated vector management—combining environmental management, biological approaches, judicious insecticide use and sustained community participation—will remain essential for reducing mosquito populations and interrupting dengue transmission.

Recognising the dynamic nature of *Aedes aegypti* is critical for designing resilient public-health strategies capable of keeping pace with the evolving ecology of this important vector.

References

- Gubler DJ. Dengue and dengue hemorrhagic fever. Clin Microbiol Rev. 1998;11:480-496.
- Murray NEA, Quam MB, Wilder-Smith A. Epidemiology of dengue. Clin Epidemiol. 2013;5:299-309.
- Bhatt S et al. The global distribution and burden of dengue. Nature. 2013;496:504-507.
- Scott TW, Morrison AC. Vector dynamics and dengue transmission. Curr Top Microbiol Immunol. 2010;338:115-128.
- Kraemer MUG et al. Global distribution of *Aedes aegypti*. eLife. 2015;4:e08347.
- Christophers SR. *Aedes aegypti*. Cambridge University Press; 1960.
- Harrington LC, Scott TW. Dispersal of *Aedes aegypti*. Am J Trop Med Hyg. 2005;72:209-220.
- Scott TW, Takken W. Feeding strategies of mosquito vectors. Annu Rev Entomol. 2012;57:293-313.
- Biswas D. Bionomics of *Aedes aegypti* of Calcutta. PhD Thesis, University of Calcutta; 1993.
- Tallon AK et al. Dengue infection modulates host seeking. PLoS Negl Trop Dis. 2020.
- Rund SSC et al. Flight activity and response to light in *Aedes aegypti*. Insect Biochem Mol Biol. 2012.
- Brady OJ et al. Temperature constraints on *Aedes aegypti*. Parasites Vectors. 2014.
- Watts DM et al. Temperature effects on dengue transmission. J Med Entomol. 1987.
- Kraemer MUG et al. Spread of arbovirus vectors. Nat Microbiol. 2019.
- Messina JP et al. Global spread of dengue vectors. Trends Microbiol. 2014.

- Carrington LB et al. Temperature effects on dengue transmission. PNAS. 2013.
- Morrison AC et al. Control of *Aedes aegypti*. PLoS Med. 2008.
- Juliano SA, Lounibos LP. Ecology of invasive mosquitoes. Annu Rev Entomol. 2005.
- LaDeau SL et al. Ecological foundations of dengue. Environ Health Perspect. 2015.
- Bowman LR et al. Dengue vector control effectiveness. PLoS Negl Trop Dis. 2016.
- Hemingway J, Ranson H. Insecticide resistance in vectors. Annu Rev Entomol. 2000.
- Moyes CL et al. Status of insecticide resistance in dengue vectors. PLoS Negl Trop Dis. 2017.
- Liu N. Insecticide resistance in mosquitoes. J Pestic Biochem Physiol. 2015.
- Vontas J et al. Insecticide resistance mechanisms. Pestic Biochem Physiol. 2012.
- Ranson H, Lissenden N. Insecticide resistance. Lancet Infect Dis. 2016.
- Dusfour I et al. Management of insecticide resistance. PLoS Negl Trop Dis. 2019.
- Powell JR, Tabachnick WJ. Domestication of *Aedes aegypti*. Trends Parasitol. 2013.
- Gloria-Soria A et al. Genetic diversity of *Aedes aegypti*. Nat Commun. 2016.
- Weaver SC, Reisen WK. Arboviral threats. Antiviral Res. 2010.
- Bowman LR et al. Vector indices and dengue transmission. PLoS Negl Trop Dis. 2014.
- World Health Organization. Global strategy for dengue prevention and control. WHO; 2012.
- Wilder-Smith A et al. Dengue. Lancet. 2019.