Original Article

Entomological Surveillance of *Aedes* Mosquitoes at the International Entry Points in West Azerbaijan Province, Iran, 2025

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Abstract

Background: The rapid spread of *Aedes* mosquitoes has raised global concerns about arboviral infections. Although West Azerbaijan Province holds significant ecological and geopolitical importance, it has received limited entomological research focused on the establishment and distribution of *Aedes* species.

Methods: From March to November 2025, we conducted an extensive entomological survey at ten international points of entry across West Azerbaijan Province. Our monitoring program included ovitrap surveillance, inspections of larval habitats and collections of adult mosquitoes. For each breeding site, environmental characteristics such as vegetation type, water quality, sunlight exposure and habitat stability were recorded. Statistical analyses were performed using SPSS version 27, applying binomial tests with 95% confidence intervals to evaluate species dominance and ecological associations.

Results: We collected a total of 1,789 mosquito specimens, of which 184 (10.3%) belonged to the genus *Aedes*. The majority of these were *Aedes caspius* s.l. (n=175), while a smaller number were *Aedes flavescens* (n=9). Approximately 85% of the habitats that tested positive for *Aedes* were natural environments and 70% of these were vegetated, typically containing clear, stagnant water. No evidence was found for the presence of *Aedes aegypti* or *Aedes albopictus*.

Conclusion: The dominance of *Ae. caspius* s.l. highlights its ecological adaptation to vegetated natural habitats. Although urban *Aedes* species were absent, the occurrence of *Ae. caspius* s.l. underscores the importance of continued ovitrap-based monitoring and site-specific habitat management. Sustainable and integrated surveillance programs in border areas are important for early detection of vector entry, given the potential for cross-border movements.

Keywords: *Aedes caspius* s.l.; Ovitrap surveillance; Arboviral risk; West Azerbaijan; Iran

Introduction

Mosquitoes belonging to the genus *Aedes* are significant vectors of human viral pathogens, transmitting dengue, Zika, chikungunya and yellow fever viruses that continue to pose major global public health and economic challenges (1). The increasing incidence of these *Aedes*-

borne infections results from a complex interaction of environmental, biological and social factors, including climate variability, urban expansion, intensified global travel and insufficient vector control systems (2, 3). Among *Aedes* species, *Aedes aegypti* and *Aedes albopictus* are recognized as the principal vectors of dengue viruses (DENV). *Aedes aegypti* shows a strong preference for feeding and resting indoors, thriving in densely populated urban areas, while *Ae. albopictus* displays greater ecological flexibility, tolerating cooler conditions and colonizing peri-urban and rural settings. Both species utilize artificial containers, such as used tires, flowerpots and water storage tanks, as breeding sites, a behavior that facilitates their persistence in diverse environments. Their drought-resistant eggs can remain viable during long-distance transport, allowing these mosquitoes to spread across borders through trade and human mobility (4–6).

Originally confined to tropical and subtropical climates, *Aedes* mosquitoes have now established populations in temperate zones of Europe, the Americas and the Middle East (7). Modeling studies suggest that ongoing climate change and altered rainfall patterns may expand suitable habitats by up to 30% by 2050. At the same time, rapid unplanned urbanization and poor waste management create numerous artificial microhabitats that support *Aedes* proliferation (8). As a result, dengue has become the most widespread arboviral disease worldwide (9). The World Health Organization (WHO) estimates that nearly 390 million infections occur each year, with about one-quarter being clinically apparent. By 2024, over 7.6 million confirmed cases of dengue were reported worldwide, marking an unprecedented increase that highlights the expanding transmission of the virus (10). Despite progress in vaccine development, challenges related to coverage, cost and immune response variability highlight the need for strong surveillance and vector control programs, which remain essential for dengue prevention (11).

In the Middle East, dengue transmission has been sporadic or limited to localized outbreaks. However, the growing detection of competent vectors, combined with increased travel and imported infections, has raised legitimate concerns about regional emergence (12). In Iran, invasive *Aedes* species have been recorded from both southern and northern provinces, revealing a gradual expansion of ecological boundaries likely driven by climatic shifts and cross-border trade (13–17). The International Health Regulations (IHR) are designed to provide maximum security against the spread of diseases internationally with minimal disruption to global travel. One of the main issues emphasized in the IHR is the need for capacity building in vector control at points of entry. This is because there is a constant risk of vectors and diseases being spread from one country to another by ships, aircraft and other means of transport (18, 19).

Additionally, the health system should pay attention to non-invasive species within the genus *Aedes*. These species may not be a priority in terms of transmitting dangerous diseases, but the nuisance caused by their painful bites should be taken seriously and properly addressed by public health authorities (2).

West Azerbaijan Province, situated in the northwest of the country and sharing borders with Turkiye, Iraq and the Republic of Azerbaijan, occupies a strategically important position for vector monitoring. The province's diverse topography, from humid lowlands to semi-arid highlands, offers multiple potential breeding habitats, while its international entry points facilitate the accidental introduction of *Aedes* eggs or larvae through human movement, vehicles, or cargo.

In this province, various activities have been conducted following the IHR format and adhering to the country's protocols. These activities encompass entomological surveillance, disease screening for travelers, collecting samples from ill travelers, providing rest zones for those unwell and enforcing quarantine measures. Additionally, there has been training and re-training for personnel, public awareness campaigns about self-care, outreach to private sector workers, production and distribution of educational materials and facilitation of external meetings with relevant departments and organizations to assess assigned tasks. Cross-border meetings have been held to address and eliminate larval habitats along the border, along with the procurement of diagnostic and control equipment and materials, among other initiatives (5, 20, 21).

Yet, baseline data on *Aedes* occurrence and distribution in this region remain limited. Given the public health significance of early detection, systematic entomological surveillance in northwestern Iran is essential. This research aimed to examine the presence, prevalence and geographical distribution of *Aedes* mosquitoes at international entry points in West Azerbaijan Province during the 2025 activity season, which spans from March to November. The results can provide foundational evidence for evaluating the potential risk of *Aedes*-borne diseases and to support national surveillance and control strategies aimed at preventing future arboviral introductions.

Materials and Methods

Study area

This study was conducted in West Azerbaijan Province, located in northwestern Iran (from 36.11° to 39.40° N, from 44.30° to 45.19° E) at an average elevation of approximately 1,330 m above sea level. The province shares about 15% (850 km) of Iran's international borders with Turkiye, the Republic of Azerbaijan and Iraq, making it one of the country's most important frontier regions.

West Azerbaijan is an important international transit corridor with several official points of entry (PoEs). These include Urmia International Airport and the land crossings at Sero, Bazargan, Poldasht, Razi, Kileh and Tamarchin. The Razi railway terminal connects directly to Turkiye's rail network, facilitating cross-border transportation of passengers and goods. Urmia Customs Depot serves as a major trade and inspection hub, while the Shahidan Kameli Passenger Terminal accommodates travelers from both domestic and neighboring countries.

Almostone-fifth of Iran's border terminals are located in this province, leading to continuous movement of people and goods that could unintentionally facilitate the spread of mosquitoes. Field operations were conducted throughout the vector season of 2025, from March to November. The geographical and operational details of the ten surveyed entry points are outlined in Table 1 and Fig. 1.

Sample collection

Aedes mosquito egg collection

Longitudinal monitoring of *Aedes* populations was implemented across all PoEs through a standardized ovitrap surveillance program. Throughout the mosquito season, at each location, 50–100 ovitraps were deployed every two weeks to detect container-breeding *Aedes* species. Each ovitrap consisted of a one-liter black polypropylene container fitted with an overflow hole and lined with Whatman® filter paper serving as the oviposition substrate. The traps were filled to two-thirds of their volume with a 10% (w/v) hay infusion, prepared by fermenting 100 g of dried hay in 10 L of dechlorinated water for seven days in shaded conditions to enhance attractiveness (16, 17).

Traps were placed in shaded or semi-shaded sites near human activity areas, ensuring exposure to gravid females and easy access for inspection. Every three days, oviposition papers were collected and kept in moist chambers to prevent them from drying out. They were then transported to the laboratory under insulated conditions. After each collection, we provided fresh infusion and new papers. During each trap inspection, we recorded the ambient temperature, relative humidity and specific features of the microsite.

Egg-positive papers were conditioned at 25±1 °C for 48–72 hours to allow embryonation. After this period, they were submerged in dechlorinated water supplemented with 1 g/L yeast extract to encourage hatching. The larvae were reared in insectary conditions (29 ±1 °C, 70±5% RH, 12:12 L:D photoperiod) at the Pathogens and Vectors Research Center, Urmia University of Medical Sciences. Emerging adults were identified morphologically using a standard identification key (21). Laboratory colonies were maintained in cages measuring 30×30×30 cm, which were enclosed with fine mesh for observation and care.

Larval sampling and identification

Larval surveys were conducted biweekly during the active vector season at various aquatic habitats. Both artificial and natural breeding sites were examined, including discarded containers, tires, puddles, vehicle wash basins and small pools. Sampling tools were tailored to suit each habitat type: 350 mL dippers for large pools, a dropper for small cavities and buckets for wells or reservoirs. In more confined habitats, narrow droppers were used to minimize disturbance.

Larvae were collected from different microhabitat zones at each site to capture spatial variation. Late third- and fourth-instar larvae were preserved in 70% ethanol and later cleared in lactophenol for 48–72 hours before being slide-mounted using either Hoyer's or Berlese medium. Identification was performed under a compound microscope using a validated identification key (21). Metadata, including sampling date, GPS coordinates, habitat type, environmental conditions and collection method, were recorded to ensure traceability and comparability.

Adult mosquito collection and processing

Adult *Aedes* mosquitoes were collected at ten selected locations that corresponded with the larval survey sites. The collections were conducted using aspirators during the crepuscular hours, shortly after sunrise and before sunset, which are peak times for host-seeking activity. Additional methods included total catches and human landing collections, carried out in accordance with ethical guidelines (19).

Community members who took part in local health education campaigns were encouraged to submit any mosquito specimens they encountered, which helped to enhance overall detection efforts. The collected adult mosquitoes were either pinned or point-mounted according to standard entomological procedures. All specimens collected by local people and experts were identified and archived under a stereomicroscope using valid identification keys (21).

Physical and biological features of larval habitats

For each larval habitat, we carefully recorded physical and biological characteristics to assess their ecological suitability. The physical factors included habitat type (natural or artificial), hydrological status (temporary, permanent, stagnant, or slow-flowing) and sunlight exposure (full sun, partial shade, or full shade). Biological parameters included the presence and type of aquatic vegetation (emergent, submerged, or floating), which may influence oxygen levels and oviposition behavior. Field assessments were conducted visually and when necessary, supported by light meters and portable water-quality probes. This data provided a comprehensive ecological profile for comparing habitat preferences and mosquito productivity across different sites.

Statistical analysis

All data in this study were analyzed using SPSS version 27. Descriptive statistics were applied to summarize the dominant genus of mosquitoes, growth stages and habitat characteristics. Differences in proportions were evaluated using binomial tests with 95% Wilson confidence intervals. The relative dominance of *Aedes* species and their association with key environmental factors (such as habitat type, vegetation cover and water retention) were assessed using exact binomial comparisons. Logistic models were used as needed to explore relationships between habitat variables and *Aedes* presence and site-to-site variations were also considered when appropriate. The statistical significance level was set at α=0.05 and all tests were two-sided.

Results

During this study, a total of 1,789 mosquito specimens belonging to the family Culicidae were collected from various sites across West Azerbaijan Province. 83 (4.6%) of the mosquitoes were caught by people. Of these, 184 individuals (10.3%) were identified as members of the genus *Aedes*, while the remainder belonged to *Anopheles* (0.2%), *Culiseta* (29.8 %) and *Culex* (59.7%).

This uneven distribution reflects a community structure that is predominantly composed of non-*Aedes* species ($p< 0.05$). However, *Aedes* mosquitoes were consistently found in a limited number of ecologically distinct habitats. This suggests that, although they are not abundant overall, *Aedes* mosquitoes can thrive in specific environmental niches.

Within the *Aedes* assemblage, two species were identified through morphological identification: *Ae. caspius* s.l. and *Ae. flavescens*. *Aedes caspius* s.l. was the dominant species, accounting for 175 individuals (95%), while *Ae. flavescens* was recorded only occasionally, with 9 individuals (5%) ($p< 0.05$). Most of the *Aedes* specimens were collected as eggs (108 specimens, 58.7%), followed by larvae (74 specimens, 40.2%) and a few adults (2 specimens, 1.1%) (Table 2).

Geographically, *Aedes* mosquitoes were found only in the northern part of the province, specifically within the Bazargan, Razi and Poldasht areas. No *Aedes* specimens were collected from the central or southern regions (Table 3). This presence-absence pattern observed creates a distinct geographic gradient that aligns with the distribution of wetland habitats, vegetation density and stagnant water sources in the northern part of the province. No significant differences were found in the abundance of *Aedes* mosquitoes between the central and southern zones, which is consistent with limited detections in these areas. Statistical significance was determined at α= 0.05, with all tests two-tailed.

All *Ae. flavescens* larvae were collected from natural stagnant-water habitats in vegetated wetland areas. Two adult *Ae. caspius* s.l. specimens were collected from different locations: one actively collected from a restroom used by border personnel at Bazargan, while the other was passively collected and submitted by a resident of Bazargan City.

Rearing experiments showed that all hatched eggs in the laboratory produced *Ae. caspius* s.l. adults, confirming the species' dominance among local floodwater mosquitoes. Other arthropods occasionally found in the ovitraps included flies (families Muscidae, Phoridae), lacewings (family Chrysopidae) and small ants (family Formicidae). Interestingly, a single specimen of the soft tick *Argas reflexus* and a flea *Ctenocephalides canis* were detected, probably introduced through domestic animals or birds.

Analysis of larval habitats revealed that the majority (85%) were natural environments, while only 15% were artificial ($p< 0.05$). Furthermore, the relationship between habitat type and the presence of *Aedes* shows that natural habitats are approximately six times more likely to support *Aedes* compared to artificial ones. This substantial difference, even without the use of a regression model, is ecologically significant and confirms the role of "natural structure and habitat complexity" in creating favorable conditions for the growth and development of *Aedes*.

Approximately 70% of all positive habitats contained aquatic vegetation, primarily in the form of emergent or floating types. Light levels varied among these habitats: half of the habitats were partially sunlit, 10% were fully exposed to sunlight and the remaining 40% were completely shaded. Most breeding waters were clear and stagnant, with 65% exhibiting low turbidity and moderate organic matter. Logistic regression analyses revealed a strong association between the presence of *Aedes* and natural, vegetated and stagnant water habitats (OR=2.5, 95% CI: 0.6–6.3, p=0.012). Both habitat type and vegetation cover were statistically significant predictors of *Aedes* occurrence. Even without formal multivariate models, there is a clear logical correlation among three factors: (1) natural habitat, (2) presence of vegetation and (3) stagnant water. Together, these three features create optimal conditions for the *Aedes* growth cycle and were found exactly where the species was observed, specifically in the northern zone.

The results indicate that the distribution of *Aedes* mosquitoes is spatially limited to the northern ecological belt of West Azerbaijan Province. Within this area, *Ae. caspius* s.l. is the dominant species in the *Aedes* community, while *Ae. flavescens* is found sporadically in shaded wetland microhabitats.

Table 1. Geographical and operational attributes of international border entry points surveyed in West Azerbaijan Province, Iran, 2025

Entry Point ID	Designation of Border Terminal	Functional Classification	County	Settlement Context	Latitude (°N)	Longitude (°E)	Altitude (m)
P1	Tamarchin	Land crossing	Piranshahr	Rural	36.65	45.07	1808
P2	Bazargan	Land crossing	Maku	Urban	39.40	44.37	1571
P3	Razi (railway)	Rail terminal	Khoy	Rural	38.48	44.33	2055
P4	Razi (road)	Land crossing	Khoy	Rural	38.47	44.30	2055
P5	Sero	Land crossing	Urmia	Rural	37.72	44.62	1578
P6	Shahid Bakeri Airport	Air gateway	Urmia	Suburban	37.65	45.05	1318
P7	Poldasht	Land crossing	Poldasht	Urban	39.35	45.07	1581
P8	Urmia Customs Depot	Cargo and inspection facility	Urmia	Urban	37.57	45.12	1332
P9	Kileh	Land crossing	Sardasht C	Rural	36.11	45.19	2054
P10	Shahidan Kameli Passenger Terminal	Bus Terminal	Urmia	Urban	37.33	45.05	1327

Table 2. Distribution of *Aedes* species according to their developmental stages in West Azerbaijan Province, Iran, 2025

***Aedes* spp.**	**Egg**	**Larvae**	**Adults**	**Total**
Ae. caspius s.l.	108 (%61.7)	65 (%37.2)	2 (%1.1)	175 (%100)
Ae. flavescens	0 (%0)	9 (%100)	0 (%0)	9 (%100)
Total	108 (%58.7)	74 (%40.2)	2 (%1.1)	184 (%100)

Table 3. Distribution of *Aedes* species across surveyed locations in West Azerbaijan Province, Iran, 2025

Region / County	***Aedes caspius* s.l.**	***Aedes flavescens***
Northern zone (P2, P3, P4 and P7)	+	+
Central zone (P5, P6, P8 and P10)	-	-
Southern zone (P1 and P9)	-	-

+= present, -= absent

Fig. 1. Map of study area, West Azerbaijan Province, Iran, 2025, from Google Maps

Discussion

There are ten PoEs for the international arrival of people and goods in West Azerbaijan Province. These PoEs need to implement surveillance processes to identify exotic and invasive mosquito species, particularly the invasive *Aedes*. Monitoring and detecting these dangerous species is a critical concern for all states. To minimize the public health risks associated with their entry, establishing an effective mosquito surveillance system is vital. Vector-borne diseases transmitted by invasive *Aedes* mosquitoes, including dengue, chikungunya and Rift Valley fever, remain a serious public health challenge in many regions. In the absence of universally accessible vaccines or specific antiviral treatments, early detection and control of *Aedes* populations remain the cornerstone of prevention programs (22). Ovitraps have proven to be effective and sensitive tools for the surveillance and monitoring of invasive mosquitoes, particularly in areas with low mosquito densities (23). In this study, the use of ovitraps successfully captured over one hundred *Aedes* eggs, demonstrating both the cost-effectiveness and operational simplicity of this method. Similar findings have been reported in several other regions, confirming the reliability of ovitraps for early detection and monitoring (24).

The proportion of *Aedes* mosquitoes recorded in this study (10.3%) represents an intermediate level when compared with previous surveys conducted in northwestern Iran, ranging from 0.7% in 2014 to 15.8% in 2020 (25, 26). It aligns with results reported from neighboring provinces such as Ardabil (7.2%) (27) and East Azerbaijan (12.1%) (28). None of these studies used ovitraps; however, the method for capturing larvae and adults was consistent. A concurrent study in East Azerbaijan Province also utilized ovitraps alongside the collection of larvae and adults (29). In this study, we focused on PoEs in accordance with the national surveillance program, whereas in similar studies, samples have collected from different parts of the city and villages. In addition, the differences observed between the studies probably reflect differences in local hydrology, rainfall, temperature regimes and the intensity of sampling. Environmental gradients significantly affect the development of floodwater *Aedes* species, which thrives in areas where temporary pools and marshlands are periodically replenished by rainfall.

As seen in other parts of Iran, *Ae. caspius* s.l. emerged as the dominant species, accounting for approximately 95% of the *Aedes* population, while *Ae. flavescens* was detected only occasionally. This dominance pattern is consistent with earlier entomological reports from northwestern Iran (25–28). In a recent study conducted in the northwest of the country, 106 *Ae. albopictus* were captured, while 22 *Ae. caspius* s.l. were reported in the same study, which could raise alarm bells (29).

Aedes caspius s.l. is a highly adaptable species that can exploit temporary, sunlit pools, an ability that supports its persistence under fluctuating hydrological conditions. In contrast, *Ae. flavescens* prefers shaded, tree-hole habitats that ovitraps rarely replicate (30, 31).

Spatial analysis of our findings revealed a clearly localized distribution of *Aedes* mosquitoes, specifically confined to the northern wetlands of the province. Similar patterns related to habitat distribution have also been observed in Ardabil and nearby regions (27). The central and southern zones of West Azerbaijan, which are characterized by lower humidity and reduced surface water, seem to be less suitable for *Aedes* colonization. This north-south gradient suggests that surveillance programs should be geographically stratified and focused on ecologically favorable areas, particularly during the rainy season.

The characterization of larval habitats in this study further supports these conclusions. A large majority of *Aedes*-positive sites were natural and vegetated, often containing clear, stagnant water under partial sunlight. Such conditions are typical of the seasonal wetlands preferred by *Ae. caspius* s.l. These observations correspond well with previous ecological descriptions from northwestern Iran (27).

Unlike *Ae. aegypti* and *Ae. albopictus*, which thrives in artificial containers and urban environments, the populations of *Ae. caspius* s.l. and *Ae. flavescens* in this study were found exclusively in natural settings (32).

Most specimens were collected in the form of eggs and larvae, indicating that *Aedes* populations in the study area are established and actively breeding rather than being transient introductions. It is important to note that the ovitrap was the main method used for collecting samples in this study, resulting in the majority of the samples obtained being eggs. This finding is consistent with the study conducted by Abbasi et al. They collected 17,803 mosquito specimens along the Aras River in East Azerbaijan Province, with the largest number of samples being at the egg stage by ovitrap (82%), followed by larvae collected from various types of breeding sites (15%) and adult mosquitoes collected by human-baited double net traps (3%) (29).

In this study, 4.6% of samples were collected by trained residents, highlighting the critical role of community participation and public health education in increasing entomological surveillance. With adequate training, people protected the deployed ovitraps. In particular, educating people on how to identify and eliminate *Aedes* mosquito breeding sites in their surroundings is the best way to prevent the establishment of this vector species (5). Habitat modification or manipulation of *Aedes* mosquitoes is a complex task that demands community collaboration, as government agencies cannot handle it alone. In PoEs, there is a greater focus on cross-border cooperation, with governments working together to implement vector control initiatives (20).

From an epidemiological viewpoint, the prominence of *Ae. caspius* s.l. is significant. This species is a proven vector of the Tahyna virus and has shown experimental competence for the Rift Valley fever virus. It has also been linked to the transmission of the West Nile virus in northwestern Iran (33, 34). Genetic studies of *Ae. caspius* s.l. populations in Iran have uncovered considerable haplotype diversity, indicating long-term establishment and local adaptation. These factors could influence both virus susceptibility and vector competence (35). These findings emphasize the need to integrate molecular diagnostics into existing surveillance programs.

The absence of *Ae. aegypti* and *Ae. albopictus*, the two primary vectors of dengue fever, should not lead managers and policymakers to overlook the importance of vector control programs. Our neighboring province detected the arrival of *Ae. albopictus* by implementing entomological checks at points of entry (29). These invasive species could enter the province at any time. Therefore, it is crucial to prioritize strengthening entomological surveillance programs and ensuring the availability of vector control equipment during this preparatory phase. Additionally, it is highly recommended to educate the public and relevant departments on how to eliminate potential larval habitats. This proactive approach will facilitate a swift and effective response in the event of a crisis.

The presence of competent floodwater *Aedes* species underscores the potential for arboviral circulation, particularly under shifting climatic and hydrological conditions (36). Predictive climate models suggest that habitat suitability for *Aedes* mosquitoes may increase substantially in the coming decades, making proactive surveillance an urgent necessity (3).

Recent technological advances have expanded the options for *Aedes* control. Autocidal gravid ovitraps (AGOs) and lethal ovitraps have proven to be highly effective in reducing *Ae. aegypti* populations in urban areas. However, their effectiveness against floodwater species such as *Ae. caspius* s.l. has yet to be evaluated (37, 38). Field studies indicate that the widespread AGOs deployment can reduce adult populations by 50–70% (38). Additionally, advancements in trap optimization, such as the use of attractive infusions and modified entrances, continue to enhance their sensitivity (39). A global review of *Aedes* surveillance notes that integrating ovitraps, gravid traps, and genetic monitoring is essential for establishing robust monitoring systems (40). The introduction of safe larvicides, such as *Bacillus thuringiensis* serotype M-H-14 (Bioflash®), offers an alternative to chemical larvicides. Research in this area can significantly enhance the development of a comprehensive program for controlling vector-borne diseases, particularly in the fight against insecticide resistance (41).

The current study offers valuable baseline data, but it has some limitations that should be acknowledged. The sampling period, which focused on seasonal activity, was restricted to the PoEs. As a result, we may have missed mosquito populations in broader areas.

Additionally, the small number of adult specimens limited analyses of age structure and parity rates. While morphological identification was reliable, future studies would benefit from incorporating DNA barcoding and molecular confirmation techniques. To gain a more comprehensive understanding of *Aedes* ecology in the region, it is essential to expand surveillance through multi-year monitoring, the use of molecular tools and diverse trapping methods, such as the BG-Sentinel trap.

This study documents a localized *Aedes* mosquito population primarily consisting of *Ae. caspius* s.l., found mainly in the vegetated northern wetlands of West Azerbaijan Province. These findings provide a solid foundation for targeted mosquito control and risk assessment efforts. To improve early detection and rapid response capabilities, it is essential to establish a specialized arbovirology laboratory within West Azerbaijan Province. Such a facility would facilitate the timely identification of arboviral infections locally, reducing reliance on distant reference laboratories in the capital and speeding up public health interventions. Overall, an effective framework for preparing for arboviral threats in this strategically important area relies on integrated environmental monitoring, molecular characterization, community engagement, and enhanced diagnostic capacity.

Conclusion

The study identifies *Ae. caspius* s.l. as the dominant floodwater mosquito species in the northern wetlands of West Azerbaijan Province, while *Ae. flavescens* is present at lower levels. *Aedes caspius* s.l. is strongly associated with natural, vegetated and sunlit stagnant water habitats, indicating a dependence on specific environmental conditions rather than urban containers. Monitoring and Entomological surveillance at PoEs is crucial for managing and preventing the introduction and spread of vectors within a country and region. This can be achieved through prompt identification and timely interventions. The two primary vectors of dengue fever, *Ae. aegypti* and *Ae. albopictus*, may enter the province from neighboring countries or regions at any time. Therefore, it is essential to ensure collaboration both internally and across borders, along with providing human resources and equipment, to promptly control these mosquito vectors. Additionally, the presence of competent arbovirus vectors emphasizes the need for ongoing targeted habitat surveillance and adaptive vector control measures. These steps are crucial to prevent the emergence of arboviral diseases.

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Ethical consideration

This study has been ethically approved (IR. UMSU.REC.1404.496).

Conflict of interest statement

The authors have declared that no competing interests exist.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Grammarly AI and Perplexity in order to improve the readability and language of the work. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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