Epidemiology and Health System Journal
doi:10.34172/ehsj.26691 2026;13(2):118-122 http://ehsj.skums.ac.ir

Short Communication

First Record of *Anopheles Stephensi* (Diptera: Culicidae) in Chaharmahal and Bakhtiyari Province, Iran: Implications for National Antimalaria Antimalaria Programs

Raha Pirmohammadi[1], **Seyed-Mohammad Omrani**[1*]

[1]Department of Medical Parasitology, School of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran

Abstract

Anopheles stephensi is a primary urban malaria vector in South Asia, the Middle East, and parts of Africa. It is also widespread in southern Iran. Its recent geographical expansion is likely influenced by climate change. Its ability to breed in artificial water containers raises serious public health concerns regarding the potential re-establishment of local malaria transmission.

This study reports the first record of *An. stephensi* in Chaharmahal and Bakhtiyari Province, Iran. Larval collections were conducted in the Naghan District from August to October 2025. A total of 1352 adult mosquitoes were collected from Sarrok Village, among which 21 (9 males and 12 females) were identified as *An. stephensi*.

This finding confirms the expansion of this Key malaria vector into a new mountainous region in central Iran. It underscores the need for enhanced entomological surveillance and vector control strategies in these areas to mitigate the risk of malaria resurgence.

Keywords: *Anopheles stephensi*, New record, Climate change, Iran

***Corresponding Author:**
Seyed-Mohammad Omrani,
Email: omranism@skums.ac.ir

Received: February 3, 2026
Revised: June 16, 2026
Accepted: June 17, 2026
ePublished: July 30, 2026

Introduction

Anopheles stephensi is recognized as one of the highly competent vectors of *Plasmodium falciparum* and *Plasmodium vivax* in urban environments across South Asia, the Middle East, and recently parts of Africa.[1] Additionally, this species is known to transmit other medically and veterinarily important pathogens, including *Dirofilaria repens,*[2] *Plasmodium berghei*, African horse sickness virus, chikungunya virus, Chandipura virus, Tahyna virus, Venezuelan Equine Encephalitis virus, and an unnamed Cypovirus.[3]

This species is considered the primary vector of malaria in the Persian Gulf region[4] and is the most prevalent anopheline species in the malaria-endemic southern regions of Iran. *Anopheles stephensi* has been reported to be present in Sistan and Baluchestan, Hormozgan, Fars, southern Kerman,[5] Khuzestan,[6] Lorestan,[7] Hamedan,[8] Ilam, Bushehr, Kermanshah, and Kohgiluyeh and Boyerahmad Provinces.[9]

Recent reports indicate that *An. stephensi* is expanding into new areas of Iran, particularly in coastal regions and foothills of southern provinces. This expansion could be influenced by multiple factors, including climate change variables such as rising temperatures and altered rainfall patterns, which create suitable habitats for this species. The emergence of *An. stephensi* in new regions poses a growing public health concern due to its ability to breed in artificial water containers such as tanks, barrels, and rooftop cisterns.[10] This adaptability increases the risk of re-establishing indigenous malaria transmission, even in some areas previously free of effective vectors.[11]

Previous studies conducted in Chaharmahal and Bakhtiyari Province have already reported the presence of *An. maculipennis* s.l., *An. superpictus s.l.*, *An. dthali*, *An. claviger*, *An. marteri*, *An. pulcherrimus*, *An. apoci*, *An. sergentii*, *An. stephensi*, and *An. multicolor,*.[12,13] However, the presence of *An. stephensi* has not been documented in this region.

In the present study, we report the first record of *An. stephensi* during a routine surveillance program for microsporidia infections in mosquitoes in Chaharmahal and Bakhtiyari Province. We present entomological evidence, describe the confirmation methods, and discuss the implications of this finding for public health and vector control strategies.

Materials and Methods

The sampling sites were located in the Naghan District of Kiar County and included Sarrok, Maadan, and Darreh Eshgh Villages (Table 1). These villages are situated in mountainous regions along the slopes of the central Zagros Mountains of Iran. This region, considering factors such as temperature, precipitation, solar radiation, and its geographic location, falls within the warm semi-humid climate zone, one of the five climatic zones identified in Chaharmahal and Bakhtiyari Province.[14]

Mosquito larvae were collected using the dipping technique. The specimens were collected from small

© 2026 The Author(s); Published by Shahrekord University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

water pools formed alongside the river and stagnant water accumulated around rice paddies at the edge of the river, under full sunlight conditions (Figure 1). The collected samples were transferred to the insectary and maintained at 28 ± 2°C, with a relative humidity of 80 ± 5% and a photoperiod of 8:16 (L: D) until they emerged as adults.

The sampling process was conducted 6 times over the local mosquito season (August–October, 2025). The specimens were morphologically identified using a valid identification key.[15]

Results

Anopheles stephensi was detected and identified in the vicinity of Sarrok Village (Figure 1). Some distinctive morphological characteristics of this species are illustrated in Figure 2. The total number of adult mosquitoes collected from Sarrok was 1352, of which 21 were *Anopheles stephensi* (9 males and 12 females), 1150 were *Anopheles superpictus*, and 181 were *Anopheles dthali*. The remaining data are presented in detail in Table 2.

Table 1. Geographic Coordinates of Sampling Sites in the Naghan District, Kiar County, Chaharmahal and Bakhtiyari Province, Iran

Village	Elevation (m)	Longitude	Latitude
Dareh Eshgh	1399	31° 49′ 51.8″	50° 40′ 20.1″
Maadan	1155	31° 40′ 53.2″	50° 53′ 22.0″
Sarrok	1243	31° 43′ 40.4″	50° 52′ 24.2 ″

Discussion

This study reports an exotic anopheline mosquito from the southwestern part of Iran for the first time. Few studies in Iran have modeled the future distribution of malaria vectors under the influence of climate change. These models indicate a gradual expansion of climatically suitable areas for the urban-adapted species *An. stephensi*, particularly in the southern and western regions of the country in recent decades.[16,17] While some predictions suggest that the distribution patterns of main vectors may remain relatively stable in the short term,[18] these models have primarily focused on climatic variables and have less frequently considered the direct role of land-use changes and human activities as faster drivers of vector establishment.

Chaharmahal and Bakhtiari Province, a high-altitude mountainous region in the central Zagros range and a natural ecological corridor, encompasses diverse climatic zones that are particularly vulnerable to global environmental change.[19] In recent decades, this province has experienced pronounced climatic impacts, including

Figure 1. Geographical Map of *Anopheles stephensi* Collection Site, the Vicinity of Sarrok Village, Chaharmahal and Bakhtiari Province, Iran

Figure 2. Morphological characteristics of *Anopheles stephensi* collected from Chaharmahal and Bakhtiyari Province, Iran, August 2025. **(A)** Three distinct pale bands, two broad white bands alternating with dark segments **(B),** femora and tibiae with pale spots **(C),** and the anterior margin of the wing exhibit four alternating dark and light bands

Table 2. Anopheline Mosquitoes Collected from collection sites in Chaharmahal and Bakhtiyari Province from August to October, 2025

Date	Collection site	*An. superpictus*	*An. dthali*	*An. stephensi*
August 3	Sarrok	91 (45M, 46F)	6 (1M, 5F)	7 (1M, 6F)
	Darreh Eshgh	183 (90M, 93F)	1 (1M, 0F)	0 (0M, 0F)
August 19	Sarrok	317 (154M, 163F)	6 (2M, 4F)	12 (6M, 6F)
	Darreh Eshgh	106 (55M, 51F)	6 (3M, 3F)	0 (0M, 0F)
September 1	Sarrok	347 (154M, 193F)	10 (5M, 5F)	2 (2M, 0F)
	Darreh Eshgh	98 (49M, 49F)	24 (12M, 12F)	0 (0M, 0F)
	Maadan	80 (43M, 37F)	53 (22M, 31F)	0 (0M, 0F)
September 21	Sarrok	196 (93M, 103F)	110 (61M, 49F)	0 (0M, 0F)
	Maadan	100 (43M, 57F)	171 (86M, 85F)	0 (0M, 0F)
October 5	Sarrok	154 (73M, 81F)	42 (21M, 21F)	0 (0M, 0F)
	Maadan	143 (77M, 66F)	96 (58M, 38F)	0 (0M, 0F)
October 21	Sarrok	45 (25M, 20F)	7 (4M, 3F)	0 (0M, 0F)
	Maadan	69 (32M, 37F)	38 (23M, 15F)	0 (0M, 0F)

M: Male, F: Female

rising temperatures, reduced precipitation, increased frequency of drought periods, and prolonged dry seasons.[20] Ecologically, these changes could potentially facilitate the introduction of new vector species through two primary mechanisms: the upward shift of altitudinal limits suitable for the survival and activity of mosquitoes as a result of warming and the creation of temporary aquatic habitats (such as puddles and small water bodies) generated by intense and irregular rainfall events, which are ideal for larval development.[21]

Within this changing climatic context, land-use change is another key factor.[22] The development of activities such as rice cultivation and, notably, the increasing number of fish farms along the rivers has led to the creation of a network of stable human-made aquatic habitats. These water bodies not only create suitable microclimates but can also serve as pathways for the unintentional displacement of mosquito eggs or larvae.

During routine annual surveillance for microsporidia infection in mosquitoes conducted at the foothills of Sabz-Kooh in Kiar County, the presence of *An. stephensi* was reported for the first time in Sarrok Village. This species was identified based on distinctive morphological characters. Although morphological keys are a standard and reliable method for identifying Iranian mosquitoes, molecular methods should be employed in future studies to confirm the presence of *An. stephensi* in this region. However, notably, previous faunistic surveys and long-term entomological investigations in this province had not documented the occurrence of this species.[12,13,23] The concurrent effects of regional temperature increase, expansion of aquatic habitats associated with fish farming, and intensified rice cultivation represent a possible explanation for the detection of this invasive species deep within a mountainous province and far from international border areas.

The initial and temporal detection of the invasive *An. stephensi* in an area historically dominated by native *An. superpictus* and *An. dthali* populations may raise important questions regarding interspecific competition and increased epidemiological risk. Although subsequent surveys confirmed only native species, this finding should not be interpreted as evidence of ecological insignificance or failure of establishment by the invasive vector.

From an ecological perspective, the stability of native populations may be temporary, indicating initial resistance or a lag phase in the establishment of the invader.[24] If *An. stephensi* becomes established, niche partitioning is possible, whereby this species, with its preference for human-made urban habitats, could occupy a niche not heavily utilized by the native vectors, which are dependent on natural habitats. However, this does not necessarily preclude competition, and long-term monitoring is essential to observe changes in the vector community structure.

The key distinction of *An. stephensi* lies in its unique adaptation to urban habitats, high reproductive capacity in such settings, higher population density, and endophagic and endophilic behaviors. These combined traits not only differentiate it from most other primary vectors of malaria but also confer upon it a stronger vectorial capacity. Consequently, from an epidemiological point of view, even the temporary and low-density presence of this species warrants serious concern.[25]

The limited capture of *An. stephensi* from stagnant water habitats along riverbanks should not be interpreted as its absence from other sites in the area. This species possesses high ecological plasticity for exploiting small human-made habitats (such as water containers, artificial puddles, and water sources related to agriculture). Since the sampling in this study focused on natural habitats preferred by native species, the actual distribution of this urban invader may not have been accurately captured. This could be explained by seasonal population patterns (peak in August–early September), incomplete microhabitat sampling, and the exclusion of container samples where the species may survive year-round. Given the absence of *An. stephensi* in recent faunistic surveys conducted in Chaharmahal and Bakhtiyari Province and its previous documentation in neighboring

highland provinces, continuous monitoring is needed. The experience of the expansion of this species in Africa also confirms its uneven multifocal dispersal pattern.[26]

The present observation is an ecological warning sign that reveals the necessity of expanding surveillance areas. It is strongly recommended that future surveillance systematically cover all potential aquatic habitat types (natural, agricultural, and urban) to obtain an accurate picture of the potential establishment and distribution of *An. stephensi* and its interaction with native species.

Beyond local public health significance, this report can also be considered a regional alert. The potential of the species to spread through human activities (goods transport, travel, and agricultural exchange) raises concerns that the risk of its introduction into uninvaded neighboring provinces may increase. Therefore, establishing or strengthening inter-provincial collaboration in vector surveillance, training health personnel, and shared reporting systems is recommended. A coordinated approach at the regional level could prevent the unintended spread of this invasive species.

Conclusion

The first record of *An. stephensi* in Chaharmahal and Bakhtiyari Province, together with previous reports from other mountainous regions of western Iran, confirms that even high-altitude areas are not immune to the introduction of this invasive vector. Although the observed occurrence was limited and temporary, and our sampling was primarily focused on natural habitats, this incidental finding suggests that a combination of factors, including climate warming and the expansion of rice cultivation and fish farms, may have facilitated the temporary presence of this species. However, confirming the main drivers of its potential establishment requires targeted sampling of human-made habitats (such as water containers, artificial ponds, and urban water sources) and longer-term monitoring. Early detection and timely intervention remain critical for preventing stable establishment and safeguarding regional malaria control achievements.

Acknowledgments

The authors would like to express their sincere gratitude to Nooshafarin Nematollahi, the technical staff of the Department of Medical Parasitology at Shahrekord University of Medical Sciences, for her valuable cooperation in maintaining and rearing the specimens in the insectary.

Authors' Contribution

Conceptualization: Seyed-Mohammad Omrani, Raha Pirmohammadi.
Investigation: Seyed-Mohammad Omrani, Raha Pirmohammadi.
Methodology: Seyed-Mohammad Omrani, Raha Pirmohammadi.
Project Administration: Raha Pirmohammadi.
Supervision: Seyed-Mohammad Omrani.
Writing–Original Draft: Raha Pirmohammadi.
Writing–Review & Editing: Seyed-Mohammad Omrani.

Artificial Intelligence Disclosure

During the preparation of this manuscript, the authors used AI-assisted language-editing tools to improve clarity and quality of the English text. The scientific content, analysis, and conclusions remain solely the responsibility of the authors.

Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

This study was approved by the Research Ethics Committee of Shahrekord University of Medical Sciences (IR.SKUMS.REC.1405.001).

Funding

None.

References

1. World Health Organization (WHO). Regional Data and Trends Briefing Kit: World Malaria Report 2024. WHO; 2024. Available from: https://www.who.int/publications/i/item/WHO-UCN-GMP-2024.09. Accessed February 10, 2025.
2. Anderson RC. Nematode Parasites of Vertebrates: Their Development and Transmission. 2nd ed. Wallingford: CABI Publishing; 2000. p. 45-67.
3. Wilkerson RC, Linton YM, Strickman D. Mosquitoes of the World. Baltimore: Johns Hopkins University Press; 2021. p. 123-45.
4. Zahar AR. Review of the ecology of malaria vectors in the WHO Eastern Mediterranean region. Bull World Health Organ 1974;50(5):427-40.
5. Oshaghi MA, Yaaghoobi F, Vatandoost H, Abaei MR, Akbarzadeh KJ. *Anopheles stephensi* biological forms; geographical distribution and malaria transmission in malarious regions of Iran. Pak J Biol Sci 2006; 9(2):294-8. doi:10.3923/pjbs.2006.294.298
6. Maghsoodi N, Ladonni H, Basseri HR. Species composition and seasonal activities of malaria vectors in an area at reintroduction prevention stage, Khuzestan, south-western Iran. J Arthropod Borne Dis 2015;9(1):60-70.
7. Amani H, Yaghoobi-Ershadi MR, Kassiri H. The ecology and larval habitats characteristics of anopheline mosquitoes (Diptera: Culicidae) in Aligudarz county (Lorestan province, western Iran). Asian Pac J Trop Biomed 2014;4(Suppl 1): S233-41. doi:10.12980/apjtb.4.2014c186
8. Zahirnia AH, Zendehfili H. Mosquito fauna (Diptera: Culicidae) of Hamedan county, western Iran. J Arthropod Borne Dis 2014;8(2):212-8.
9. Hanafi-Bojd AA, Azari-Hamidian S, Vatandoost H, Charrahy Z. Spatio-temporal distribution of malaria vectors (Diptera: Culicidae) across different climatic zones of Iran. Asian Pac J Trop Med 2011;4(6):498-504. doi:10.1016/s1995-7645(11)60134-x
10. Takken W, Lindsay S. Increased threat of urban malaria from *Anopheles stephensi* mosquitoes, Africa. Emerg Infect Dis 2019;25(7):1431-3. doi:10.3201/eid2507.190301
11. Acosta AL, Castro MC, Laporta GZ, Conn JE, Sallum MA. Future global distribution and climatic suitability of *Anopheles stephensi*. Sci Rep 2025;15(1):22268. doi:10.1038/s41598-025-07653-8
12. Saebi M. Morphological Study on Anopheline Larvae and Their Distribution in Iran [dissertation]. Tehran: Tehran University of Medical Sciences; 1987.
13. Omrani SM, Azari-Hamidian S, Pourshahbazi G, Taghipour S. Fauna and the distribution of mosquitoes (Diptera: Culicidae) in Chaharmahal and Bakhtiari province, 2011-2012. J Shahrekord Univ Med Sci 2015;16(6):73-86.
14. Soltani S, Yaghmaei L, Khodagholi M, Saboohi R. Bioclimatic classification of Chaharmahal and Bakhtiari province using multivariate statistical methods. J Water Soil Sci 2011;14(54):53-68.
15. Azari-Hamidian S, Harbach RE. Keys to the adult females and fourth-instar larvae of the mosquitoes of Iran (Diptera: Culicidae). Zootaxa 2009;2078(1):1-33. doi:10.11646/zootaxa.2078.1.1
16. Pakdad K, Hanafi-Bojd AA, Vatandoost H, Sedaghat MM,

Raeisi A, Salahi Moghaddam A, et al. Predicting the potential distribution of main malaria vectors *Anopheles stephensi*, *An. culicifacies* s.l. and *An. fluviatilis* s.l. in Iran based on maximum entropy model. Acta Trop 2017;169:93-9. doi:10.1016/j.actatropica.2017.02.004

17. Hanafi-Bojd AA, Vatandoost H, Yaghoobi-Ershadi MR. Climate change and the risk of malaria transmission in Iran. J Med Entomol 2020;57(1):50-64. doi:10.1093/jme/tjz131
18. Saberi N, Raeisi A, Gorouhi MA, Vatandoost H, Bozorg Omid F, Hanafi-Bojd AA. Modeling the effect of climate change on the distribution of main malaria vectors in an endemic area, southeastern Iran. Iran J Public Health 2023;52(5):1061-70. doi:10.18502/ijph.v52i5.12724
19. Davoudian Dehkordi A, Torabi Farsani N, Hairapetian V. Geotourism potential in the Zagros simply folded zone: Chaharmahal and Bakhtiari province. Geoconserv Res 2025;8(1):1-14. doi:10.57647/j.gcr.2025.0801.08
20. Dargahian F, Razavizadeh S. Climate change and precipitation characteristics in Zagros, an opportunity to adapt and reduce the oak decline. J Agric For Meterol Stud 2024;3(1):1-15.
21. Nili S, Asadgol Z, Dalaei H, Khanjani N, Bakhtiari B, Jahani Y. The effect of climate change on malaria transmission in the southeast of Iran. Int J Biometeorol 2022;66(8):1613-26. doi:10.1007/s00484-022-02305-2
22. Franklinos LH, Jones KE, Redding DW, Abubakar I. The effect of global change on mosquito-borne disease. Lancet Infect Dis 2019;19(9): e302-12. doi:10.1016/s1473-3099(19)30161-6
23. Omrani SM, Moosavi SF, Manouchehri K. Microsporidium infecting *Anopheles supepictus* (Diptera: Culicidae) larvae. J Arthropod Borne Dis 2016;10(3):413-20.
24. Sinka ME, Pironon S, Massey NC, Longbottom J, Hemingway J, Moyes CL, et al. A new malaria vector in Africa: predicting the expansion range of *Anopheles stephensi* and identifying the urban populations at risk. Proc Natl Acad Sci U S A 2020;117(40):24900-8. doi:10.1073/pnas.2003976117
25. Sinka ME, Bangs MJ, Manguin S, Chareonviriyaphap T, Patil AP, Temperley WH, et al. The dominant *Anopheles vectors* of human malaria in the Asia-Pacific region: occurrence data, distribution maps and bionomic précis. Parasit Vectors 2011;4:89. doi:10.1186/1756-3305-4-89
26. Abebe W, Sisay A, Mihret Y, Setegn A, Asmare Z, Woldesenbet D, et al. Prevalence of *Anopheles stephensi* in Horn of Africa: a systematic review and meta-analysis. BMC Infect Dis 2025;25(1):614. doi:10.1186/s12879-025-11022-1