INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print); 2222-5234 (Online)
Website: https://www.innspub.net
Email contact: info@innspub.net
Vol. 28, Issue: 5, p. 76-83, 2026

RESEARCH PAPER OPEN ACCESS

Seasonal variations in bed bug (*Cimex* spp.) populations in several public places in Korhogo (Ivory Coast): Ecological approaches and epidemiological perspectives

Toure Donatie Serge[*1], Traore Issouf[1], Traore Mamadou[2], Ouattara Manzara[1], Ouattara Foungoye Allassane[3], Kone Mouhamadou[1], Doumbia Mamadou[3]

[1]*Department of Animal Biology, Environment-Climate-Health Engineering and Sustainable Development Laboratory, Peleforo Gon Coulibaly University, Korhogo, Côte d'Ivoire*
[2]*Medical and Veterinary Entomology Center, Alassane Ouattara University, Bouaké, Côte d'Ivoire*
[3]*Department of Animal Production, Nangui Abrogoua University, Abidjan, Côte d'Ivoire*

Key words: Bed bugs, Public places, Korhogo

Received: April 24, 2026 **Accepted:** May 07, 2026 **Published:** May 11, 2026

DOI: https://dx.doi.org/10.12692/ijb/28.5.76-83

ABSTRACT

This study investigated the seasonal variation in bed bug (*Cimex* spp.) populations in public places in Korhogo, northern Côte d'Ivoire. Entomological surveys were conducted from August to December 2024 in 31 public sites, including transport stations, markets, schools, restaurants, and garages. Bed bugs were collected through direct inspection of potential hiding places and identified according to species, sex, and feeding status. A total of 4,518 bed bugs belonging to two species, *Cimex hemipterus* and *Cimex lectularius*, were collected. *Cimex hemipterus* was the predominant species, representing 96.76% of all specimens. Overall abundance was significantly higher during the rainy season (52.61%) than during the dry season (47.39%). Infestations were recorded exclusively in transport stations, with Dianra Station showing the highest infestation level. The proportion of engorged bed bugs was also significantly higher during the rainy season (54.77%) compared with the dry season (44.70%), indicating increased blood-feeding activity during humid periods. Seasonal variation was particularly pronounced in *C. hemipterus*, especially among males. These findings suggest that climatic conditions, particularly humidity, strongly influence bed bug proliferation and feeding activity in urban public environments. The study highlights the importance of strengthening surveillance and control measures in transport stations, especially during the rainy season, to reduce infestation risks and limit the spread of bed bugs in Korhogo.

***Corresponding author:** Toure Donatie Serge ✉ touredonaties@gmail.com

INTRODUCTION

Bed bugs (*Cimex* spp.) are hematophagous ectoparasites that have re-emerged worldwide as an important public health concern, particularly in densely populated urban environments. Their resurgence over recent decades has been associated with increased human mobility, urbanization, population density, and the growing movement of goods and travelers. Although bed bugs are not currently recognized as major vectors of infectious diseases, their infestations can cause considerable physical discomfort and psychological distress, including skin irritation, allergic reactions, insomnia, anxiety, and reduced quality of life. Consequently, bed bug infestations have become a significant social, economic, and sanitary problem in many urban settings.

Public places characterized by frequent human movement and prolonged occupancy provide favorable conditions for the dispersal and establishment of bed bug populations. Transport stations, markets, schools, restaurants, and other crowded infrastructures may serve as important infestation hotspots because they facilitate passive transportation of bed bugs through clothing, luggage, furniture, and other personal belongings. Environmental conditions such as temperature and humidity may also influence the survival, reproduction, and feeding activity of these insects, leading to seasonal fluctuations in infestation intensity.

In tropical regions, particularly in West Africa, information on the ecology and seasonal dynamics of bed bug populations remains limited despite increasing reports of infestations in urban areas. In Côte d'Ivoire, a few studies have documented the occurrence of *Cimex hemipterus* and *Cimex lectularius* in human environments, especially in large urban centers. However, little information is available on their distribution and seasonal abundance in northern regions of the country, including the city of Korhogo.

Korhogo is one of the main urban and commercial centers of northern Côte d'Ivoire and is characterized by intense commercial activity, high population mobility, and rapid urban expansion. These factors may create environmental conditions favorable to the proliferation and dissemination of bed bugs in public places. Nevertheless, no detailed investigation had previously been conducted to evaluate the extent of infestation and the influence of seasonal variation on bed bug populations in this city.

The present study was therefore undertaken to assess the seasonal variation in bed bug abundance in selected public places in Korhogo. Specifically, the study aimed to identify the bed bug species present, evaluate their abundance according to season and collection site, and determine seasonal variation in infestation and feeding activity. The findings of this work provide useful ecological and epidemiological information that may contribute to the development of effective surveillance and control strategies against bed bug infestations in urban public environments.

MATERIALS AND METHODS

Study area

The study was conducted in the department of Korhogo (9°26′-9°46′ N and 5°38′-6°01′ W), located in northern Côte d'Ivoire, approximately 635 km from Abidjan. The department covers an area of about 12,500 km² and has an estimated population of 440,926 inhabitants (INS, 2022). Korhogo is the administrative capital of both the Poro Region and the Savanes District.

The region is characterized by a tropical Sudanese climate with two major seasons: a long dry season extending from November to March and a rainy season from April to October. Rainfall is bimodal, with peaks generally observed in June and September. Annual rainfall ranges between 800 and 1,500 mm (SODEXAM, 2018). The dry season is strongly influenced by the Harmattan wind, occurring mainly between December and February, while the hottest temperatures are recorded from March to April. Average annual temperatures range from 21°C to 35°C, with minimum temperatures occasionally reaching 16°C during the Harmattan period. The vegetation is predominantly wooded savanna composed of shrubs and scattered trees (Traoré, 2019).

Sampling sites

Sampling sites were selected based on their high human frequentation and their potential suitability for bed bug infestation. A total of 31 public sites were investigated, including transport stations, markets, schools, restaurants, and garages distributed across the city of Korhogo.

The transport stations surveyed included Dianra, Diawala, Mali, Boundiali, Dikodougou, Ferkessédougou, UTRAKO, UTNA, UTS, Chonco, and the TKB stations of Yamoussoukro and Bouaké (Fig. 1). Markets included the Grand Marché of Korhogo and several neighborhood markets such as Haoussabougou, Petit-Paris, Sinistré, and Tchékélezo. Educational establishments included Houphouët-Boigny High School and Logokaha Primary School. Restaurants and automobile garages were also selected because of their high daily human activity and frequent public use.

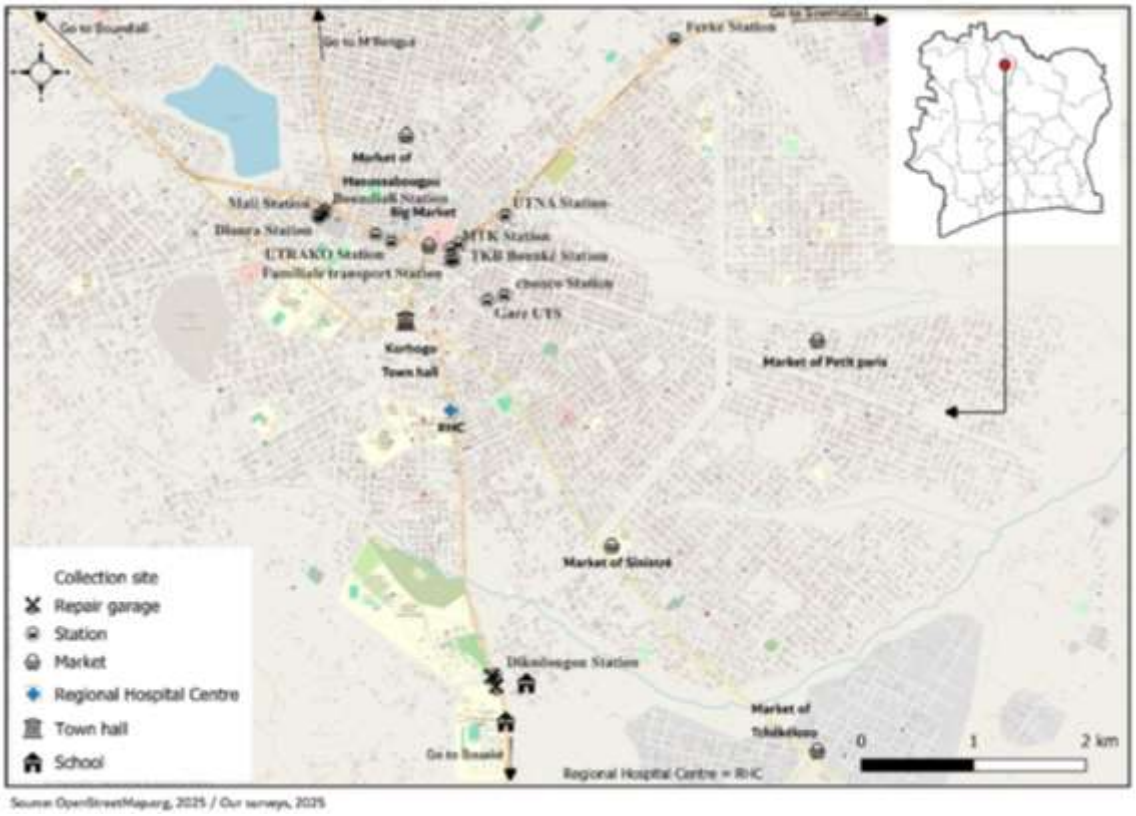

Fig. 1. Location of the study area

Bed bug sampling and collection

Entomological surveys were conducted over a four-month period covering two distinct climatic seasons: the rainy season (August–September 2024) and the dry season (November–December 2024). Investigations were carried out in 13 transport stations, five markets, two schools, six restaurants, and five garages throughout Korhogo city (Fig. 1). Each site was visited three times per month during the study period.

Bed bug collection was performed following the protocol described by Fofana *et al.* (2023). Inspections consisted of direct visual searches for evidence of infestation, including live bed bugs, eggs (hatched and unhatched), nymphs, exuviae, fecal spots, and blood stains in potential hiding sites.

At transport stations, passenger benches, walls, resting mats, and bus seats were inspected. In schools, desks and benches were examined. In garages, vehicle seats and upholstery were inspected, whereas in markets, shop shelves and market stalls were searched. In restaurants and public administrative areas, tables and benches were

inspected, while beds, walls, and furniture were examined in university residences.

When signs of infestation were detected, aerosol insecticide sprays were applied to flush out bed bugs from their hiding places. The collected specimens were preserved in 50 mL plastic containers containing 70% ethanol for subsequent laboratory identification.

Species identification was carried out using a binocular stereomicroscope and dichotomous identification keys described by Masini *et al.* (2019) and Benkacimi *et al.* (2020). Specimens were identified according to species, sex, developmental stage, and feeding status.

Data analysis

Data were recorded and organized using Microsoft Excel 2013 for descriptive analyses, including the calculation of abundance and proportional distribution of bed bug species.

Statistical analyses were performed using R software (version 4.2.5). Seasonal differences in bed bug abundance and infestation rates were assessed using Pearson's Chi-square test or Fisher's exact test when expected frequencies were low. Statistical significance was considered at $p < 0.05$.

RESULTS

Seasonal variation in the abundance of bed bug species

A total of 4,518 bed bugs were collected during the study period from the surveyed public places in Korhogo. Two species were identified: *Cimex hemipterus* and *Cimex lectularius*. Overall, *C. hemipterus* was by far the dominant species, representing 96.76% of all collected specimens, whereas *C. lectularius* accounted for only 3.23% of the total population (Table 1).

The abundance of *C. hemipterus* varied significantly according to season. Out of 4,372 specimens collected, 2,301 individuals (52.63%) were recorded during the rainy season compared with 2,071 individuals (47.37%) during the dry season. This seasonal difference was highly significant ($\chi^2 = 23.99$; $p < 0.001$). Female abundance remained relatively stable between seasons, with 1,415 females (50.52%) collected during the rainy season and 1,386 (49.48%) during the dry season, showing no significant difference ($\chi^2 = 0.56$; $p = 0.454$). In contrast, males were significantly more abundant during the rainy season, accounting for 886 individuals (56.40%) compared with 685 individuals (43.60%) during the dry season ($\chi^2 = 50.92$; $p < 0.001$).

For *C. lectularius*, a total of 146 specimens were collected, including 76 individuals (52.06%) during the rainy season and 70 individuals (47.94%) during the dry season. Seasonal variation in this species was not statistically significant ($\chi^2 = 0.34$; $p = 0.558$). Females represented the majority of specimens, with 76 individuals (55.47%) collected during the rainy season and 61 individuals (44.53%) during the dry season. Male specimens were scarce, with only nine individuals recorded, all during the dry season.

Overall, the total number of bed bugs collected was slightly higher during the rainy season (2,377 specimens; 52.61%) than during the dry season (2,141 specimens; 47.39%). This difference was statistically significant ($\chi^2 = 24.45$; $p < 0.001$) (Table 1).

Seasonal abundance of bed bugs according to collection sites

The distribution of bed bugs varied markedly among the different public places surveyed (Table 2). All collected specimens originated exclusively from transport stations, where a total of 4,518 bed bugs were recorded. Of these, 2,377 individuals (52.61%) were collected during the rainy season and 2,141 individuals (47.39%) during the dry season, indicating a significantly greater infestation during the rainy season ($\chi^2 = 24.45$; $p < 0.001$).

No bed bugs were detected in garages, markets, restaurants, schools, or hospitals during either season.

Table 1. Seasonal abundance of bed bug species collected

Species	Season		Total	χ^2	*p*-value
	Rainy season (%)	Dry season (%)			
Cimex hemipterus	2301 (52.63)	2071 (47.37)	4372 (100)	23.99	9.686e-07
Female	1415 (50.52)	1386 (49.48)	2801 (100)	0.56	0.4543
Male	886 (56.40)	685 (43.60)	1571 (100)	50.92	9.606e-13
Cimex lectularius	76 (52.06)	70 (47.94)	146 (100)	0.34	0.5584
Female	76 (55.47)	61 (44.53)	137 (100)	2.86	0.09073
Male	0	9 (100)	9 (100)		
Total	2377 (52.61)	2141 (47.39)	4518 (100)	24.45	7.64e-07

Table 2. Seasonal abundance of bed bugs in collection sites

Collection points	Season		Total (%)	χ^2	*p*-value
	Rainy season (%)	Dry season (%)			
Garages	0	0	0		
Transport stations	2377 (52.61)	2141 (47.39)	4518 (100)	24.45	7.64e-07
Markets	0	0	0		
Restaurants	0	0	0		
Schools	0	0	0		
Hospitals	0	0	0		
Total	2377 (52.61)	2141 (47.39)	4518 (100)	24.45	7.64e-07

Table 3. Seasonal abundance of bed bugs in the various transportation stations surveyed

Prospective stations	Season		Total (%)	χ^2	*p*-value
	Rainy season (%)	Dry season (%)			
Boundiali station	0	1	1		
Chonco station	0	0	0		
Dianra station	1766 (58.85)	1235 (41.15)	3001 (100)	187.2	2.20e-16
Diawala station	0	1	1		
Dikodougou station	0	0	0		
Family transport station	0	0	0		
Ferké station	0	0	0		
Léopard transport station	0	0	0		
Mali station	262 (30.97)	584 (69.03)	846 (100)	243.6	2.20e-16
TKB Bouaké station	349 (52.17)	320 (47.83)	669 (100)	2,34	0.1258
TKB Yamoussoukro station	0	0	0		
UTNA station	0	0	0		
UTRAKO station	0	0	0		
UTS station	0	0	0		
Total	2377 (52.61)	2141 (47.39)	4518 (100)	24.45	7.64e-07

Seasonal abundance of bed bugs in transport stations

Marked differences in infestation levels were observed among transport stations (Table 3). Dianra Station was the most heavily infested site, with 3,001 bed bugs collected during the study period. Among these, 1,766 individuals (58.85%) were collected during the rainy season, whereas 1,235 individuals (41.15%) were collected during the dry season. The difference between seasons was highly significant ($\chi^2 = 187.2$; $p < 0.001$).

Mali Station recorded 846 specimens, with infestation levels being considerably higher during the dry season. A total of 584 bed bugs (69.03%) were collected during the dry season compared with 262 individuals (30.97%) during the rainy season ($\chi^2 = 243.6$; $p < 0.001$).

At TKB Bouaké Station, 669 bed bugs were collected, including 349 individuals (52.17%) during the rainy season and 320 individuals (47.83%) during the dry season. However, the seasonal difference at this station was not statistically significant ($\chi^2 = 2.34$; $p = 0.126$).

Only isolated specimens were found at Boundiali and Diawala stations, while no bed bugs were recorded at Chonco, Dikodougou, Familiale Transport, Ferké, Léopard Transport, TKB Yamoussoukro, UTNA, UTRAKO, or UTS stations.

Table 4. Seasonal variation in the rate of engorged bed bugs

Parameters	Season		Total	χ^2	*p*-value
	Rainy season	Dry season			
N *Cimex hemipterus*	2301	2071	4372		
n engorged	1289	946	2235		
Rate of engorged bedbugs	56,02	46,68	51,12	46.23	1.051e-11
N *Cimex lectularius*	76	70	146		
n engorged	13	11	24		
Rate of engorged bedbugs	17,1	15,71	16,44	9.32	0.9976
Total	2377	2141	4518		
Engorged	1302	957	2259		
Rate of engorged bedbugs	54,77	44,7	50	45.34	1.653e-11

Seasonal variation in the proportion of engorged bed bugs

The proportion of engorged bed bugs differed between seasons and species (Table 4). In *C. hemipterus*, 1,289 engorged individuals were recorded during the rainy season compared with 946 during the dry season. Consequently, the engorgement rate was higher during the rainy season (56.02%) than during the dry season (46.68%).

For *C. lectularius*, engorgement rates remained relatively low and showed little seasonal variation. During the rainy season, 13 engorged individuals were recorded, corresponding to a rate of 17.10%, whereas 11 engorged individuals were observed during the dry season, representing 15.71%.

Considering both species together, a total of 2,259 engorged bed bugs were recorded. The overall engorgement rate reached 54.77% during the rainy season compared with 44.70% during the dry season. This seasonal difference was highly significant (χ^2= 45.34; $p < 0.001$), indicating greater blood-feeding activity during the rainy season.

DISCUSSION

The present study revealed the occurrence of two bed bug species, *Cimex hemipterus* and *Cimex lectularius*, in public places in Korhogo, with a clear predominance of *C. hemipterus*. This finding is consistent with previous studies conducted in Côte d'Ivoire and other tropical regions, where *C. hemipterus* is generally reported as the dominant species in urban environments (Fofana *et al.*, 2023). The strong predominance of this species may be related to its greater ecological adaptability to tropical climatic conditions characterized by relatively high temperatures and seasonal humidity.

The results also demonstrated a significant seasonal variation in bed bug abundance, with higher infestation levels during the rainy season than during the dry season. This pattern suggests that climatic factors, particularly humidity, play an important role in the population dynamics of bed bugs. Increased humidity during the rainy season may improve egg viability, nymphal development, survival rates, and overall reproductive success, thereby favoring population growth. Similar observations have been reported in other hematophagous insects, where warm and humid conditions promote insect activity and reproduction (Lorenzo and Lazzari, 1999).

Among the surveyed public places, transport stations were the only sites where infestations were recorded. Their high infestation rates may be explained by intense human movement, frequent turnover of passengers, and the continuous movement of luggage and personal belongings, all of which facilitate passive dispersal of bed bugs. Transport stations also provide numerous hiding places, including seats, benches, cracks, and resting mats, which create favorable microhabitats for bed bug survival and reproduction. These findings support the hypothesis that human mobility is one of the principal drivers of bed bug dissemination in urban areas (Hwang *et al.*, 2005; Masini *et al.*, 2019).

Marked differences were observed between transport stations. Dianra Station showed the highest infestation level, particularly during the rainy season,

whereas Mali Station exhibited greater infestation during the dry season. These variations may reflect differences in sanitation conditions, passenger density, cleaning frequency, structural characteristics of the stations, and local microclimatic conditions. The absence or near absence of bed bugs in several other stations may indicate either effective maintenance practices or environmental conditions less suitable for infestation establishment.

Sex-related analysis revealed that females were generally more numerous than males, especially in *C. hemipterus*. Female predominance in bed bug populations has frequently been reported and may be associated with reproductive strategies and differential survival between sexes. Interestingly, males of *C. hemipterus* were significantly more abundant during the rainy season, suggesting that environmental conditions during this period may enhance mating activity and reproductive dynamics. Previous studies have shown that humidity and temperature strongly influence the reproductive performance and survival of bed bugs (Rukke *et al.*, 2018).

The study further showed that the proportion of engorged bed bugs was significantly higher during the rainy season. More than half of the collected specimens during this season were blood-fed, indicating intensified feeding activity. Increased feeding rates during humid periods could be associated with enhanced metabolic activity and greater host-seeking behavior under favorable environmental conditions. In contrast, *C. lectularius* exhibited relatively low and stable engorgement rates between seasons, suggesting weaker seasonal sensitivity compared with *C. hemipterus*. Similar observations were reported by Cannet *et al.* (2015), who highlighted the influence of environmental conditions on the feeding behavior and physiological activity of bed bugs.

Overall, the findings of this study emphasize the important role of seasonal climatic conditions in shaping the ecology and infestation dynamics of bed bugs in urban public places. The rainy season appears particularly favorable for both the proliferation and feeding activity of bed bugs in Korhogo. These results underline the need for reinforced surveillance and control measures during periods of high humidity, especially in transport stations where the risk of infestation and dissemination is greatest.

CONCLUSION

This study highlighted the seasonal dynamics of bed bug infestations in public places in Korhogo, Côte d'Ivoire, and revealed the presence of two species, *Cimex hemipterus* and *Cimex lectularius*, with a clear predominance of *C. hemipterus*. Bed bug infestations were observed exclusively in transport stations, emphasizing the role of human mobility and crowded environments in their dissemination. The results demonstrated significantly higher infestation levels and feeding activity during the rainy season, suggesting that humid climatic conditions favor the proliferation and survival of bed bug populations. These findings underline the importance of strengthening surveillance, sanitation measures, and control interventions, particularly during the rainy season, in order to limit the spread and public health impact of bed bugs in urban environments.

REFERENCES

Benkacimi L, Gazelle G, El Hamzaoui B, Bérenger JM, Parola P, Laroche M. 2020. MALDI-TOF MS identification of *Cimex lectularius* and *Cimex hemipterus* bedbugs. Infection, Genetics and Evolution **85**, 1–17.

Cannet A, Akhoundi M, Bérenger JM, Michel G, Marty P, Delaunay P. 2015. A review of data on laboratory colonies of bed bugs (Cimicidae), an insect of emerging medical relevance. Parasite **22**, 21. DOI:10.1051/parasite/2015021.

Fofana D, Yao KP, Koné N, Beugré JMV, Acapovi-Yao GL, Koné BA, Konan KL, Ouattara K, Koné S. 2023. Diagnosis of Cimicidae, ectoparasites linked to human habitat in Côte d'Ivoire. Journal of Parasitology and Vector Biology **15**(1), 21–25.

Hwang SW, Svoboda TJ, De Jong IJ, Kabasele KJ, Gogosis E. 2005. Bed bug infestations in an urban environment. Emerging Infectious Diseases **11**(4), 533–538.

INS. 2022. Répertoire des localités: RGPH (Recensement Général de la Population et de l'Habitat), 2021. Résultats globaux. Institut National de la Statistique, Côte d'Ivoire, 37 p.

Lorenzo MG, Lazzari CR. 1999. Temperature and relative humidity affect the shelter choice behavior of *Triatoma infestans*. Acta Tropica **72**, 241–249.

Masini P, Zampetti S, Llera MG, Biancolini F, Moretta I, Romani R, Tramontana M, Mathilde S. 2019. Punaise de lit : invasion, piqûre, comment s'en débarrasser. Édition 1. ALLO FRELONS Éditions, Paris, France, pp. 45–60.

Rukke BA, Sivasubramaniam R, Birkemoe T, Aak A. 2018. Temperature stress deteriorates bed bug (*Cimex lectularius*) populations through decreased survival, fecundity and offspring success. PLOS ONE **13**(3), e0193788. DOI:10.1371/journal.pone.0193788.

SODEXAM. 2018. Climat et météorologie en Côte d'Ivoire : données régionales 1980–2015. Abidjan, Côte d'Ivoire, 30 p.

Traoré M. 2019. Étude de la dynamique climatique et de la végétation dans le nord de la Côte d'Ivoire: cas de la région de Korhogo. Mémoire de Master, Université Peleforo Gon Coulibaly de Korhogo, pp. 15–20.