BioOne COMPLETE

Resurgence of Bed Bugs (Hemiptera: Cimicidae) in Mainland China

Authors: Wang, Lei, Xu, Yijuan, and Zeng, Ling

Source: Florida Entomologist, 96(1) : 131-136

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.096.0117

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

RESURGENCE OF BED BUGS (HEMIPTERA: CIMICIDAE) IN MAINLAND CHINA

Lei Wang, Yijuan Xu* and Ling Zeng
Department of Entomology, South China Agricultural University, Guangzhou 510642, China

*Corresponding author; E-mail: xuyijuan@scau.edu.cn

Abstract

Bed bugs were common pests worldwide before World War II. They were almost completely eradicated in many countries by good hygienic conditions and application of insecticides. These pests are currently reemerging in many developed countries. We conducted a literature review and an internet search using the key word, bed bugs, to evaluate the status of bed bug resurgence in China. The results showed that the occurrence of bed bugs dramatically increased from 4 reports in 2007 to 67 in 2012. Bed bug infestations were reported from 23 provinces of China, with the most severe infestations occurring in Guangdong Province. Bed bugs were reported to commonly invade dormitories, private homes, rented houses, and public transportation facilities. Based on internet reports, about half of the people bitten by bed bugs claimed to have developed clinical reactions, and approximately 5% required medical treatment. This study demonstrates that China also has undergone a bed bug resurgence, which should be addressed by the multidisciplinary actions involving both governments and the public.

Key Words: *Cimex* spp., insecticide resistance, clinical reactions

Resumen

Los chinches de cama eran una plaga común por todo el mundo antes de la Segunda Guerra Mundial. Tras ésta, la plaga fue prácticamente erradicada en muchos países debido a unas condiciones higiénicas adecuadas y a la aplicación de insecticidas. En la actualidad, estos insectos están resurgiendo en muchos países desarrollados. Para conocer la situación en China de esta plaga se ha realizado una revisión bibliográfica y una búsqueda en Internet utilizando como palabra clave, "bed bugs". Los resultados obtenidos mostraron que la presencia de chinches ha aumentado drásticamente, de 4 informes encontrados en el año 2007 a 67 en el 2012. Estas infestaciones de chinches de cama se registraron en 23 provincias de China, dándose la infestación más grave en la provincia de Guangdong. Los chinches de cama fueron mayoritariamente encontrados en dormitorios, casas particulares, casas de alquiler y en servicios de transporte público. Según los informes encontrados en Internet, alrededor de la mitad de las personas picadas por estos insectos afirmaron haber desarrollado reacciones clínicas y aproximadamente el 5% requirió de tratamiento médico. Este estudio demuestra que China también ha experimentado un resurgimiento de chinches de cama, que debería ser abordado mediante acciones multidisciplinares que involucren tanto a los gobiernos como al público.

Palabras Clave: Cimex spp, resistencia a insecticidas, reacciones clínicas

Bed bugs (Hemiptera: Cimicidae) are small blood-sucking insects (Thomas et al. 2004). Two species, namely, the common bed bug *Cimex lectularius* L. and the tropical bed bug *Cimex hemipterus* (Fabricius), feed upon human blood (Delaunay et al. 2011). All nymphal stages and both genders of adults need to feed on blood to grow and reproduce (Reinhardt & Siva-Jothy 2007). Many people are sensitive to their bites (Reinhardt & Siva-Jothy 2007) such that a skin reaction often occurs after one is bitten and red itchy welts emerge. Secondary bacterial infections may occur because of scratching (Kolb et al. 2009), although bacterial infections are rare in otherwise healthy individuals (Doggett et al. 2012). Although transmission of disease agent from bed bugs to humans has not been reported to date (Doggett et al. 2012), bed bug infestations may impact the mental health of individuals. People can experience discomfort, anxiety, lack of sleep, and ostracism because of bed bug bites (Davies et al. 2012; Thomas et al. 2004; Romero et al. 2007). Bed bugs can cause severe anemia (Paulke-Korinek et al. 2012; Pritchard & Hwang 2009; Venkatachakam & Bekvadt 1962), also their allergens may induce asthmatic reactions (Doggett et al. 2012).

Bed bugs afflicted people for millennia before 1940s (Kolb et al. 2009). Reductions in the incidence of these parasites in developed countries after World War II were believed to be the re-

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

sult of improvements in sanitation and the use of pesticides (Doggett et al. 2004; Delaunay et al. 2011). Nevertheless, in the past decade bed bugs have resurged in many parts of the world, including Southeast Asia, Japan, Europe, North America, Australia, and Africa (Davies et al. 2012). Therefore the medical community's interest in bed bugs has increased dramatically over the past 10 yr (Delaunay et al. 2011). In Australia and the United States, hotels, apartments, private homes, and rented properties are at risk of bed bug infestation (Doggett & Russell 2008; Potter et al. 2010). The recent reemergence of these pests is likely to be caused by: (1) major increases in international travel including travel by middle income people, (2) high levels of insecticide resistance among bed bugs, and (3) poor or non-existent pest management practices (Williams & Willis 2012; Doggett et al. 2012). Szalanski et al. (2008) indicated that high levels of gene flow in bed bug populations result in the rapid spread of insecticide resistance.

Bed bugs have largely been ignored in mainland China because of the success of the Patriotic Public Health Campaign undertaken under Chinese Government. Bed bug populations in China were dramatically reduced by the Government-led campaigns conducted from 1960 to the early 1980s (Wang & Wen 2011). However, in recent years, bed bug control has become the primary business of pest control companies in some cities in South China (Shen 2011). The increasing prevalence of bed bug populations in recent decades highlights the importance of understanding the potential harm to public health caused by *C. lectularius* and *C. hemipterus* and more importantly the economic impact on China, which appears to be far more significant than human health impact. To this end we performed an internet search and reviewed the literature to explore the status of bed bug resurgence in mainland China. We also analyzed the clinical reactions associated with bites in humans based on research reports published on the China National Knowledge Infrastructure (CNKI) website, http://www.cnki.net.

Methods

Internet Search and Literature Review

We obtained relevant data on the distribution of bed bugs and other information related to their attacks on humans using the Chinese language search platform Baidu (www.baidu.com) and the CNKI website http://www.cnki.net/. We searched for reports about bed bugs between 2000 and Oct 2012 using "bed bugs" in Chinese as the key word and obtained 21 news reports and journal articles about biting events (Dong et al. 2000; Zhou et al. 2000; Chen et al. 2001; Wen et al. 2001; Chen et al. 2002; Hao 2002; Diwu et al. 2003; Jiang et al. 2003; Xu et al. 2003; Wang et al. 2006; Cao et al. 2007; Li et al. 2007; Fang 2008; Sun et al. 2008; Zhou et al. 2009; Qin et al. 2010; Zhang et al. 2010; Li et al. 2011; Bo et al. 2012; Chen et al. 2012; Yu et al. 2012). Based on the data from these reports, we analyzed the distribution and resurgence of bed bugs in mainland China.

Statistical Analysis

All statistical data were tested for normal distribution using the Shapiro-Wilk test and for homogeneity of variances using Levene's test with SPSS 18.0. χ^2 analysis was used to compare the major places that had been infested by bed bugs. Differences in percentages of clinical reactions and non-reaction of people bitten by bed bugs were evaluated using the *t* test.

Results

The number of reports in China documenting bed bug plagues of *C. lectularius* was 24 (21 literature reports from CNKI and 3 internet-based news reports), which was higher than the number for *C. hemipterus* ($\chi^2 = 16.333$, $P < 0.0001$) (Fig. 1). However, bed bug outbreaks were distributed in 23 provinces across China, and Guangdong Province, located in the tropics of South China, had the highest proportion of bed bug reports (Fig. 2). These data warrant further investigation of specific occurrences of the different bed bug species.

Based on internet research, we found that public concern about the reemergence of bed bugs has increased dramatically since 2007. More than 70% of the 21 literature reports in China on bed bug plagues occurred during 2010-2012. Only 4 outbreaks were reported in 2007; by contrast, 64 outbreaks were reported in only the first half of 2012. These findings suggested that bud bugs had recently become more common in mainland

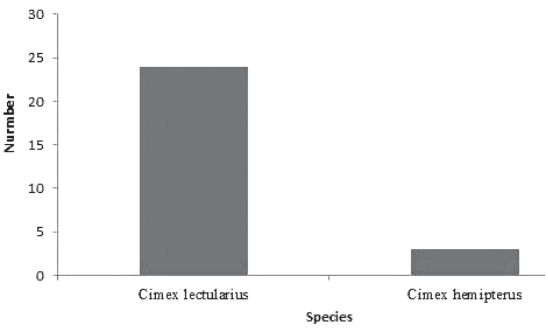


Fig. 1. Recorded numbers of reports of *Cimex lectularius* and *C. hemipterus* in China ($\chi^2 = 16.333$, $P = 0.000$). The data were derived from reports found by searching Baidu and the CNKI website (http://www.cnki.net/).

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use



Fig. 2. Frequency of reports of bed bugs in various provinces of mainland China. Abbreviations: AH, Anhui; BJ, Beijing; FJ, Fujian; GS, Gansu; GD, Guangdong; GX, Guangxi; GZ, Guizhou; HN, Hainan; HLJ, Heilongjiang; HB, Hebei; HN, Henan; HB, Hubei; JL, Jilin; JS, Jiangsu; LN, Liaoning; SC, Sichuan; SD, Shandong; SH, Shanghai; SN, Shanxi, SX, Shanxi; XJ, Xinjiang; YN, Yunnan; ZJ, Zhejiang. Data on the distribution of bed bugs were collected by searching Baidu and the CNKI Web site (http://www.cnki.net/) for reports covering the period of 2000-2012.

China (Fig. 3). Dormitories, private homes, and rented houses have become the most frequently infested sites ($\chi^2 = 102.436$, $P < 0.0001$; Fig. 4).

We obtained 21 journal articles about events related to bed bugs biting humans by searching the CNKI website (http://www.cnki.ent/) and then we screened out 8 (Wen et al. 2001; Chen et al. 2001; Diwu et al. 2003; Zhang & Diwu 2003; Li et al. 2007; Cao et al. 2007; Su et al. 2008; Zhou et al. 2009) that gave accounts of physical reactions to the bites. The data showed that more than 50% of people bitten had clinical reactions, a rate not significantly different from that documented for people who did not exhibit any reaction (t = -0.653, P = 0.524; Fig. 5). The literature review showed that 56.71%, 9.62%, and 2.84% of affected individuals experienced pruritus and dermatitis, sleeplessness, and dizziness, respectively. Furthermore, 5.1% of people who were bitten by bedbugs requested treatment (Fig. 5).

Discussion

Cimex spp. is a minor threat to human health because they do not transmit agents of human disease. Our study indicates that the incidence of bed bug outbreaks have increased and especially in recent years. Temperature and latitude are key factors determining the geographical distribution of the 2 *Cimex* spp. (Deng & Meng 1952; Zhou et al. 2000). Doggett et al. (2011) indicated that *C. hemipterus* were widespread in the subtropical and tropical regions north of the 29 °S in Australia. Newberry & McHunu (1989) reported that both

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

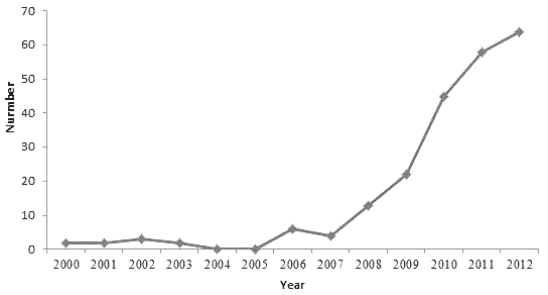


Fig. 3. Incidents of harm to humans caused by bed bugs as reported in all internet reports for the period of 2000-2012. The data were derived from reports found by searching Baidu and the CNKI website (http://www.cnki.net/).

C. hemipterus and *C. lectularius* were common in the Nkundusi-Mfekayi area of South Africa (S 28° 15'). These results are similar to those of Deng & Meng (1952) in China. The survey of Deng & Meng (1952) indicated that *C. lectularius* was widely distributed in regions from Heilongjiang province (N 48° 16') to Yunnan province (N 23° 23'), and the natural northern boundary of *C. hemipterus* distribution in China is Sichuan province (N 30° 41'). Zhou et al. (2000) reported that the tropical bed bug was distributed only south of the Tropic of Cancer, and that the common bed bug occurred mainly north of the Tropic of Cancer in Guangxi province. Also *C. hemipterus* was recently found in Fujian province (N 26° 07') (Li et al. 2011). The results showed that N 30° latitude may be the natural northern boundary of *C. hemipterus* in China.

Our study shows that bed bugs annoyed people in 23 of 34 provinces and regions in China during 2000-2012. Previous research also indicated that bed bug issues had been registered in 40% of the counties in Shaanxi and 90% of the counties in Guangxi (Zhou et al. 2000; Diwu et al. 2003). Furthermore, bed bugs have been found in some vehicles, such as passenger trains and ships (Dong et al. 2000; Qin et al. 2010; Li et al. 2011; Chen et al. 2012; Zhang et al. 2010; Bo et al. 2012). These indicate that bed bugs have been spread from infested to uninfested regions through public transportation. Dormitories, private homes, and rented houses have been found to be the most infested places in mainland China, as was also reported for Australia (Doggett 2007) and the USA (Potter 2010). The results demonstrate that bed bugs had not been not completely eradicated in China, but had merely become very uncommon, as in many developed nations around the world. If not controlled well, these pests have the potential cause severe plagues throughout the country.

We found that the occurrence of bed bugs reports is more frequent in Pearl River Delta region than in interior areas. Wang and Wen (2011) also revealed the same phenomenon through telephone interviews of Health and Epidemics Prevention Stations and pest control companies. Moreover, the probability of detecting bed bugs in workers' dormitories is very high. This phenomenon can be attributed to the following 3 reasons. (1) Increased population migration in the Pearl River Delta region, which is economically well-developed and thus has much domestic and international communication. Bed bugs may have spread to Pearl River Delta region through human migration and

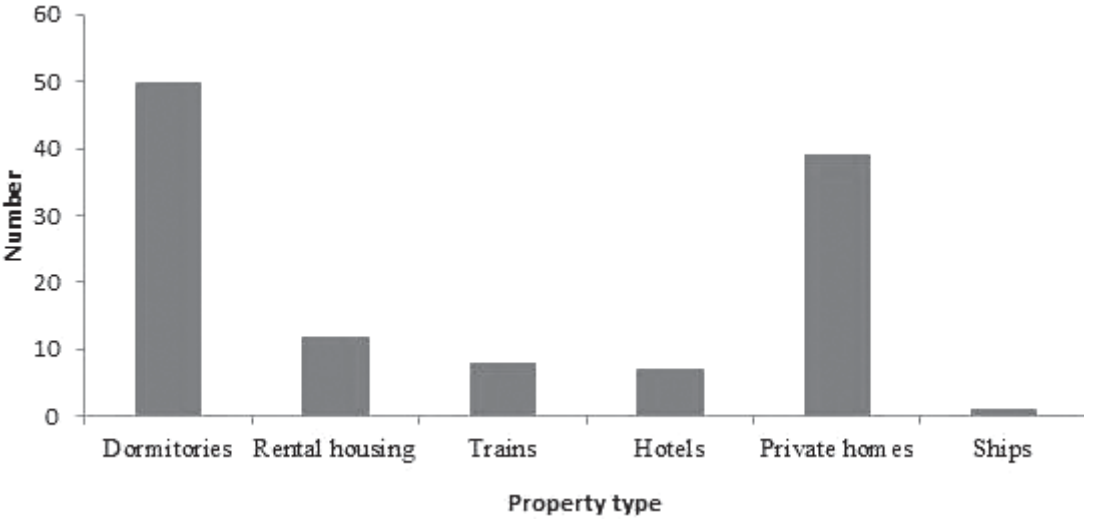


Fig. 4. Types of properties where bed bugs have been commonly detected in China ($\chi^2 = 102.436$, $P = 0.000$). The data were derived from reports found by searching Baidu and the CNKI website (http://www.cnki.net/).

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

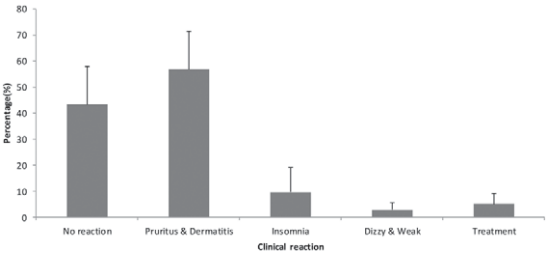


Fig. 5. Clinical reactions of people to bed bug bites in mainland China (sample numbers: $n1$ = 143 (Wen et al. 2001); $n2$ = 30 (Chen et al. 2001); $n3$ = 1246 (Diwu et al. 2003); $n4$ = 1780 (Zhang & Diwu) 2003; $n5$ = 96 (Li et al. 2007); $n6$ = 297 (Cao et al. 2007); $n7$ = 60 (Su et al. 2008) and $n8$ = 148 (Zhou et al. 2009).

product transportation. (2) Poor housing conditions associated with the frequent migration of workers, which provides favorable conditions for the survival and reproduction of bed bugs. In addition, widespread ignorance of bed bug biology, ecology and control favors their survival and buildup. Apartment tenants may conceal bedbug infestations from dormitory managers for fear of financial penalties or eviction (Moore & Miller 2009); and, industrialists are often not willing to pay the additional costs of preventing and controlling bed bugs and other pests in worker dormitories. By contrast, inland regions have less communication with the outside world and less dynamic industrialization than Pearl River Delta region, and these factors impede the buildup of bed bug populations. However, the acceleration of urbanization in China is attended by accelerating large-scale population movement and transportation of materials, and these dynamic conditions favor the increased dissemination and buildup of bed bug populations. Therefore, the public must learn to recognize these pests and signs of their presence, and become familiar with the fundamentals of their biology and ecology in order to forestall or eliminate infestations. For example, the purchase or acceptance of unregulated sale, donation, importation, and smuggling of second-hand clothing and mattresses, which serve as hiding places of bed bugs (Potter et al. 2010), should be avoided and an efficient "search-and-destroy" operation must be imposed on anything possibly infected by bed bugs (Delaunay et al. 2011). The relevant government departments must focus more attention on groups and situations with a high risk for bed bug infestation and provide pest control companies and the public with science-based technology and training to cope with this scourge. Professional cooperation in the inspection, identification, and bed bug eradication programs will result in successful elimination of these pests. Tighter quarantine procedures for products and people from bed bug-infested regions should be implemented. Chinese entomologists must investigate the specific ecological conditions which currently facilitate build ups of bed bug populations and develop more practical and efficacious control options. A carefully developed and widely disseminated program bed bug biology, ecology, prevention and control could greatly limit the health and economic impacts of bed bugs in China.

References Cited

Bo, J. X., Zhu, S. Y., Nie, W. Z., Yang, C. G., Zhao, B., Li, D. X., and Wang, R. J. 2012. Disinsecting results analysis of introduced bedbugs (Hemiptera: Cimicidae) and other medical vectors invasion on an entry ship. Chinese Pest Control Commun. 1: 130-132.

Cao, D. Q., Li, L. J., Chu, M. W., Liu, Y., and Liu, X. F. 2007. Infestation condition of bedbug in a building site in Mentougou district of Beijing. Chinese J. Vector Biol. Control 18(1): 14.

Chen, D. P., Qian,W. P., Zhou, Y. Z., Gao,Y. L., and Zhou, M. S. 2001. Investigation and chemical control of bedbugs in an army troop in Chengdu. Chinese J. Vector Biol. Control 12(5): 344.

Chen, S. M., Tang, S. X., Zheng, J. M., Wan, Y. H., Jiang, X., and Wang, G. 2012. Study on the roosting habit of bedbug and the effect of control measure in the passenger train. Chinese J. Vector Biol. Control 23(1): 86-87.

Chen, X. G., Shen, J. Z., and Yang, M. J. 2002. Effect of dichlorphos on bugs in a prison in Jiangsu province. J. Med. Pest Control 18(10): 540-541.

Diwu, J. X., Zhou, L., Yang, J., Liang, K., and Qi, F. X. 2003. A investigative report of bedbugs in the army in Shanxi province. Chinese J. Vector Biol. Control 14(2): 134.

Davies, T. G., Field, L. M., and Williamson, M. S. 2012. The re-emergence of the bed bug as a nuisance pest: implications of resistance to the pyrethroid insecticides. Med. Vet. Entomol. 26: 241-254.

Delaunay, P., Blanc, V., Del, G. P., Levy-Bencheton, A., Chosidow, O., Marty, P., and Brouqui, P. 2011. Bedbugs and infectious diseases. Clin. Infect. Dis. 52: 200-210.

Deng, G. F., and Meng, L. Z. 1952. The geographical distribution of the two species of bedbugs, *Cimex lectularius* L. and *C. hemiptera* F., in China. Acta Entomol. Sinica 2(4): 253-264.

Doggett, S. L., Dwyer, D. E., Penas, P. F., and Russell, R. C. 2012. Bed bugs: clinical relevance and control options. Clin. Microbiol. Rev. 25: 164-192.

Doggett, S. L., Geary, M. J., and Russell, R. C. 2004. The resurgence of bed bugs in Australia: with notes on their ecology and control. Environmental Health 4: 30-38.

Doggett S. L., and Russell, R. C. 2008. The resurgence of bed bugs, *Cimex* spp. (Hemiptera: Cimicidae) in Australia: experiences from down under, pp. 407-425 *In* W. H. Robinson and D. Bajomi [eds.]. Proceedings of the 6th International Conference on Urban Pests, Budapest, Hungary, 13 to 16 July 2008. OOK-Press, Pápai, Hungary.

Dong, W. M., Zhao, L. N., and Bai, Y. Q. 2000. Effect of fenthion on bedbugs in trains. Chinese J. Vector Biol. Control 11(2): 90.

Fan, D. H. 2008-7-31. Suifenhe import and export inspection and quarantine bureau helps hotels to be-

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

siege blood-sucking bugs. China Insp. Quar. Times. pp. 3.

Hao, W. H. 2002. Should Railway Company gives its compensations to you when you were bitten by bedbugs in a train? [EB/OL]. http:www.people.com.cn/GB/shehui/46/20020312/685394.html.

Jiang, H., Zhang, S. J., Zhan, Y. B., Kong, Q. G., and Zhao, L. M. 2003. Study on the occurrence of cockroaches, bedbugs in Fengcheng county of Liaoning province and their control strategy. J. Med. Pest Control 19(3): 164-165.

Kolb, A., Needham, G. R., Neyman, K. M., and High, W. A. 2009. Bedbugs. Dermatol. Therapy 22: 347-352.

Li, G., Cao, X. J., and Huang, C. P. 2007. The study of a bug-bites in an army of Henan Province. Practical J. Med. Pharm. 24(2): 226.

Li, G. M., Wang, X. L., and Zhang, S. M. 2011. Investigation and study of the bugs in the sleeping cars of passenger trains. J. Med. Pest Control 27(9): 813-814.

Newberry, K., and Mchunu, Z. M. 1989. Changes in the relative frequency of occurrence of infestations of two sympatric species of bedbug in northern Natal and KwaZulu, South Africa. Trans. R. Soc. Trop. Med. Hyg. 83: 262-264.

Paulke-Korinek, M., Széllmarton, L. H., Auer, H. B., and Wenisch, C. 2012. Bed bugs can cause severe anaemia in adults. Parasitol. Res. 110: 2577-2579.

Paul, J., and Bates, J. 2000. Is infestation with the common bedbug increasing? BMJ 320: 1141.

Potter, M. F., Rosenberg, B., and Henriksen, M. 2010. Bugs without borders - executive summary. Natl. Pest Mgt. Assoc., Inc., Fairfax, VA, http://www.npmapestworld.org/documents/BBSurveyexecsummaryjuly26.pdf [Accessed 5 Oct. 2012].

Pritchard, M. J., and Hwang, S. T. 2009. Severe anemia from bedbugs. CMAJ 18(5): 287-288.

Qin, L., Ding, H. Y., Huo, W., Wang, J. H., Li, X. Y., and Jiang, H. B. 2010. Survey of bedbug infestation in passenger trains. Chinese J. Hygienic Insecticides Equip. 16(3): 241.

Reinhardt, K., and Siva-Jothy, M. T. 2007. Biology of the bed bugs (Cimicidae). Annu. Rev. Entomol. 52: 351-374.

Romero, A., Potter, M. F., Potter, D. A., and Haynes, K. F. 2007. Insecticide resistance in the bed bug: A factor in the pest's sudden resurgence? J. Med. Entomol. 44(2): 175-178.

Shen, P. Y. 2011. Research progress and prospects for bedbugs in China. Chinese J. Hygienic Insecticides Equip. 17(4): 300-303.

Szalanski, A. L., Austin, J. W., Mckern, J. A., Steelman, C. D., and Gold, R. E. 2008. Mitochondrial and ribosomal internal transcribed spacer 1 diversity of *Cimex lectularius* (Hemiptera: Cimicidae). J. Med. Entomol. 45: 229-236.

Su, X., Wang, B. C., Ding, J., Cai, W., Pu, Y. L., and Wang, L. 2008. Infestation condition of bedbug in a building site in Haidian district of Beijing. Chinese J. Vector Biol. Control. 19(6): 587.

Thomas, I., Kihiczak, G .G., and Schwartz, R. A. 2004. Bedbug bites: a review. Intl. J. Dermatol. 43: 430-433.

Venkatachalam, P. S., and Belavady, B. 1962. Loss of haemoglobin iron due to excessive biting by bed bugs. A possible aetiological factor in the iron deficiency anaemia of infants and children. Trans. R. Soc. Trop. Med. Hyg. 56: 218-221.

Wang, G., Wang, M. B., Tian, W. W., and Wang, Z. Y. 2006. Investigation and chemical control of bedbugs in a hotel. Chinese J. Hygienic Insecticides Equip. 12(4): 312.

Wang, C. L., and Wen, X. J. 2011. Bed bug infestations and control practices in China: implications for fighting the global bed bug resurgence. Insects 2: 83-95.

Wen, W. S., Chen, J. Q., Deng, X. R., and Huang, K. H. 2001. Investigation report of a bug outbreak on the farm of Fujian province. J. Med. Pest Control 17(5): 233-234.

Williams, K., and Willis, M. S. 2012. Bedbugs in the 21st Century: The reemergence of an old foe. Lab Med. 43: 141-148.

Xu, J., Li, J., Zhu, T., Zhou, G. Z., Wu, G. W., and Cui, X. F. 2003. Infestation condition and control of bedbug in an army. Chinese J. Hygienic Insecticides Equip. 9(4): 36-37.

Yu, Y. K., Zhao, H. J., and Yu, Z. C. 2012. Investigation and chemical control of bedbugs in a hotel in Hefei, China. Chinese J. Hygienic Insecticides Equip. 18(3): 268.

Zhang, L. W., Qian, J. X., and Shu, H. C. 2010. Survey and control measures of bedbug infestations in passenger trains. Chinese J. Vector Biol. Control 21(5): 523.

Zhou, G. Z., Cheng, X. H., Fu, Y., Yang, X. J., Li, P., and Wen, Y. 2009. Bedbugs harm investigation to servicemen and effective observation of extermination in an archery ground. Chinese J. Vector Biol. Control 15(4): 281-282.

Zhou, Z. Z., Bin, Z. F., Liao, J. Y., and Li, M. D. 2000. Distribution of bugs in Guangxi, China. Chinese J. Hygienic Insecticides Equip. 6(2): 38-40.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use