

Bed Bugs 101: the Basics of *Cimex lectularius*.

Harold J. Harlan

Common bed bugs, *Cimex lectularius* L., and a few closely-related species of blood-feeding true bugs (Hemiptera: Cimicidae) have been persistent pests of humans throughout recorded history. They may have evolved from cave-dwelling ectoparasites of mammals (especially bats). As humans moved from caves to tents and then into houses, the bugs went with them. Bed bugs have been mentioned in the literature and folk remedies of many cultures and countries since the times of ancient Greece (Usinger 1966).

Bed bugs became very rare in many industrialized countries soon after World War II because of the widespread use of synthetic insecticides. By 1997, they were so scarce in the United States that it was hard to find specimens to use in college entomology classes (Snetsinger 1997). Similar trends had been reported for Britain, with a relatively constant or slightly declining level of public requests for control from 1967 to 1972 (Cornwell 1974). Many current pest management professionals (PMPs) with years of experience have never seen an active bed bug infestation. During the past 8 years, a resurgence of bed bugs has been reported in the United States, Canada, some European countries, Australia, and parts of Africa (Cooper and Harlan 2004, Doggett et al. 2004, Hwang et al. 2005, Johnson 2005).

Biology

Adult bugs are 6–7 mm long, broadly oval, flat, brown to reddish-brown true bugs, with a 3-segmented beak, 4-segmented antennae, and vestigial wings. They have dorso-ventrally flattened bodies covered with short, golden-colored hairs. They give off a distinctive, musty, sweetish odor containing various aldehydes which are produced by glands located in the ventral metathorax (Weatherston and Percy 1978). They deposit undigested parts of prior blood meals in their harborages as tarry or “rusty” spots. The tips of the abdomen are usually pointed in males and more rounded in females.

Bed bugs feed only on the blood of mammals or birds and mate by traumatic insemination (Usinger 1966, Stutt and Siva-Jothy 2001). One life cycle from egg to egg is 5 wk at 75–80% RH and 28–32°C. They can survive and remain active at temperatures as low as 7 °C if they are held at intermediate temperatures for a few hours, but

their thermal death point is 45 °C. They have five nymphal instars, each needing at least one blood meal to develop to the next stadium. Bed bugs are nocturnal



This photo courtesy Gary Alpert. All others courtesy Harold J. Harlan.

but will feed in the daytime when hungry. Females attach their 1-mm long whitish eggs to substrate surfaces wherever the bugs hide in loose groups or clusters. Each female may lay 200–500 eggs in her lifetime, which can be 2 yr or longer (Usinger 1966, Krinsky 2002).

Distribution

Common bed bugs can be found almost anywhere humans have established homes and cities. They thrive in conditions of temperature and humidity that are comfortable for humans, who also usually provide them ample blood meals and plenty of good harborage (Usinger 1966).

Bed Bug Resurgence

The United States has had steep increases over the past few years in bed bug infestations (Cooper and Harlan 2004, Potter 2004, Gooch 2005). In 2003, public health experts in Toronto reported 100% increases in phone complaints about bed bugs, in numbers of pest management company treatments for bed bugs in private homes, and a more than 50% increase in incidence of bed bugs





in public shelters in the last half, as compared with the first half, of the year (Hwang et al. 2005). In Great Britain, reported infestations more than quadrupled each year from 1998 to 2002 (Burgess 2002). In Berlin, Germany, a 10-fold increase in bed bug infestations has been reported, rising from 5 reported cases in the 1992 to 76 cases in 2004 (Bauer-Dubau 2004). An Australian government public health agency reported a 400% increase in bed bugs submitted in 2001–2004 compared with 1997–2000. They

also reported increased interceptions of bed bugs in luggage by quarantine inspectors from 1986 to 2003, with 74% of those occurring from 1999 to 2003 (Doggett et al. 2004). The continued spread and increased problems due to bed bugs seem to be inevitable.

Public Health Aspects

Bed bugs consume only blood from mammals (e.g., humans) or birds. Adults need at least one blood meal of adequate volume for nutrition and reproduction. Each active instar may feed multiple times if hosts are readily available. Adults may feed every 3–5 d throughout their typical 6–12-mo life span.

Vector Potential

Although 28 human pathogens have been found naturally occurring in common bed bugs, they have never been proven to biologically or mechanically transmit any of them (Usinger 1966, Jupp et al. 1991, Blow et al. 2001).

Health Effects of Bites

Bed bug bites can cause physical and psychological discomfort. Although their feeding usually is never felt, the saliva contains biologically active proteins, which may cause progressive, allergenic, visible symptomatic skin reactions to repeated bites. Typical symptoms include a raised, inflamed, reddish wheal at each bite site, which may itch in-

tensely for several days. Immediate reactions may appear from 1 to 24 h after a bite and may last 1–2 d; delayed reactions usually appear 1–3 d (or more) after a bite and may last 2–5 d (Feingold et al. 1968). There can also be a social stigma attached with having a bed bug infestation (Usinger 1966, Krinsky 2002). There is no current requirement to report bed bug infestations to any public health or government agency.

Importance as Pests

Bed bugs are often hard to control because they are nocturnal, seek cryptic harborages, are very small and elusive, and can detect and avoid many chemicals, including cleaning agents. They are easily transported on or in luggage, furniture, boxes, and clothes. Because they are very thin, except just after a blood meal, they can fit through or hide in very narrow cracks. Adults can live for several months (some more than a whole year), and nymphs can survive for 3 mo or longer without feeding. Complete elimination of an established infestation is almost impossible to accomplish in a single service visit by most PMPs. The bed bug's importance as a pest has increased because of its biting and associated effects, its characteristic odor, and the public fear of them.

Conditions in which bed bugs thrive include an adequate supply of available hosts, abundant cracks or harborages within about 1.5 m of a host, and ambient temperatures between 28 and 32 °C and 75–80% RH. Currently occupied, cluttered bedrooms with little air movement are ideal. Although sanitation alone will not eliminate an infestation, eliminating clutter, removing accumulated dirt and debris, and sealing cracks and crevices reduce available harborages, make it easier to detect remaining bug populations, and increase the probability of successful treatment.

Detailed inspection is essential to any effective control effort. The bugs must be found promptly and correctly identified; and their harborage sites and extent of infestation, including a rough estimate of the population size, must be determined as rapidly as possible. Currently, there is no known device or technique to effectively attract or trap

bed bugs, so a thorough visual inspection must be conducted. Certain pyrethrin-based products can be used to flush out bugs and make small populations much easier to detect.

References Cited

Bauer-Dubau, K. 2004. Invasion in deutschen Betten: Bettwanzen. *Ärzte Zeitung*, 30.09.2004.

Blow, J., M. Turell, A. Silverman, and E. Walker. 2001. Stercorarial shedding and transtadial transmission of hepatitis B virus by common bed bugs (Hemiptera: Cimicidae). *J. Med. Entomol.* 38: 694–700.

Burgess, I. 2002. Bedbugs bite back. *New Scientist*, Mar 3. Website: www.newscientist.com

Cooper, R., and H. Harlan. 2004. Ectoparasites, Part3: bed bugs & kissing bugs, pp. 494–529. *In* S. Hedges [Ed.]. 9th ed., *Mallis' handbook of pest control*. GIE Publishing, Cleveland.

Cornwell, P. 1974. The incidence of fleas and bedbugs in Britain. *Int. Pest Contr.* Jul/Aug: 17–20.

Doggett, S., M. Geary, and R. Russell. 2004. The resurgence of bed bugs in Australia: with notes on their ecology and control. *Environ. Health* 4(2): 30–38.

Feingold, B. F., E. Benjamini, and D. Michaeli. 1968. The allergic responses to insect bites. *Ann. Rev. Entomol.* 13: 137–158.

Gooch, H., 2005. Hidden profits: there's money to be made from bed bugs—if you know where to look. *Pest Contr.* 73(3): 26–32.

Hwang, S., T. Svoboda, I. DeJong, K. Kabasele, and E. Gogosis. 2005. Bed bug infestation in an urban environment. *Emerg. Infect. Dis.* 11: 533–538.

Johnson, A. 2005. The hotel industry is beginning to wake up to bedbug problem. *Wall Street Journal*, April 21, vol. 245, No. 78: A-1, A-12.

Jupp, P., R. Purcell, M. Shapiro, and J. Gerin. 1991. Attempts to transmit hepatitis B virus to chimpanzees by arthropods. *S. Afr. Med. J.* 79: 320–322.

Krinsky, W. 2002. True bugs, pp. 67–86. *In* G. Mullen and L. Durden [Eds.]. *Medical and veterinary entomology*. Academic Press, Orlando, FL.


Potter, M. 2004. Your guide to bed bugs. *PCT Mag.* Vol. 32 (8) [6-page “pull out” section between pages 12 and 13, August 2004].

Snetsinger, R. 1997. Bed bugs & other bugs, pp. 392–424. *In* S. Hedges [Ed.]. 9th ed., *Mallis' handbook of pest control*. GIE Publishing, Cleveland.

Stutt, A., and M. Siva-Jothy. 2001. Traumatic insemination and sexual conflict in the bed bug *Cimex lectularius*. *Proc. Natl. Acad. Sci. U.S.A.* 98: 5683–5687.

Usinger, R. 1966. *Monograph of Cimicidae*. Thomas Say Foundation, vol. 7. Entomological Society of America, College Park, MD.

Weatherston, J., and J. E. Percy. 1978. Venoms of Rhynocota (Hemiptera), vol. 48, pp. 489–509. *In* S. Bettini [Ed.]. *Athropod venoms. handbook of experimental pharmacology*. Springer-Verlag. Berlin.

Harold J. Harlan has been a Board Certified (BCE) medical entomologist since 1973, retired after 25 years as an active duty Army entomologist, and now works as a contract analyst for the Armed Forces Pest Management Board. He has raised and observed bed bugs for over 32 years. 

BioQuip[®]

PRODUCTS

SINCE 1947

*Equipment, Supplies, and Books
for Entomology, Ecology,
& Related Sciences*













Contact us to request the 2006 CD catalog **at no charge**. There is a \$10.00 charge to cover costs of printing & mailing printed version of the catalog to the U.S., Canada & Mexico (\$15.00 other countries).

BioQuip Products
 2321 Gladwick St., Rancho Dominguez, CA 90220
 Phone: (310) 667-8800 • Fax: (310) 667-8808
 E-mail: bqinfo@bioquip.com
 Web: www.bioquip.com