

Bed Bugs: Biology, Behavior and Control

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Adult



First instar nymph

Order Heteroptera (True bugs)

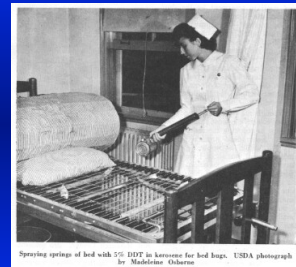
- Family Cimicidae
- 35,000 years ago lived in caves and were ectoparasites of bats
- When humans moved into the caves bed bugs fed on humans
- Humans have transported bed bugs all over the world



Piercing-sucking mouthparts

US History of the Bed Bug

- Common pest in the US at the turn of the century
- Essentially eradicated in 1940-50 due to DDT
- Resistance documented to DDT, malathion, carbamates and pyrethroids



Spraying springs of bed with 5% DDT in kerosene for bed bugs. USDA photograph by MacLennan Osborne

Why are Bed bugs back?

- International travel?
- Reduced baseboard spraying?
- Misidentification?
- We don't know how to treat?
- Wartime pest?
- Increased pressure of resistant populations?



World-wide resurgence: Pest control operators report a 100-600% increase in bed bug jobs in US, Europe, and Singapore

So What Are They Doing?

- Aggregate in cracks and crevices all day
- If hungry they become active between midnight and 5:00 am
- Stimulated by and increase of CO₂ in the room
- Will travel many yards to get to a host
- We still don't know exactly how a bed bug finds the host



Bed Bug Feeding

- Probe the skin to find a capillary space that allows the blood to flow rapidly
- May probe the skin several times before feeding.
- Feeds for 5-10 minutes
- After feeding, leaves the host to aggregate
- Bed bugs usually feed every 3-7 days



Right After Feeding?

- Right after adults take a blood meal they become very interested in mating.
- They engage in traumatic insemination.
- Females may be mated with as many as 5 different males.
- Females leave aggregations after being mated several times.



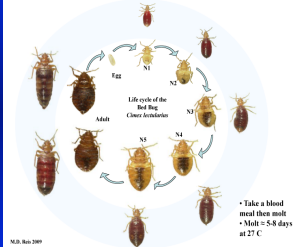
Why do you care?

- Females that mate only once will produce 25% more eggs than multi-mated females.
- A single mated female can cause an infestation
- After taking a blood meal the females produce 5-20 eggs over ~12 days.
- Average females produces ~131 eggs in her lifetime



What is the bed bug lifecycle?

- Bed bugs go through 5 nymphal instars before they become adults
- Each instar must have a blood meal to molt (5-8 days)
- First instar to adult in ~37 days
- Under optimal conditions the population can double in ~16 days




The Signs of Bed Bug Presence

- Bed bugs have to be brought in
 - Traveling
 - Used furniture
- First indicator is unexplained itching red welts
- Bites suggest bed bugs but are not definitive
- Medical doctors are terrible about diagnosing bites!




Bite Reactions (the first indicator)


- My technician's arm one week after feeding 1000s of bed bugs.
- My arm one week after feeding 60 2-3rd instar bed bugs.
- My student's arm 1 year after feeding mixed stage bed bugs.



- **Bites**
 - One study found only 30% had a reaction when bitten by a bed bug.
 - Another study indicated that 96% (of refugees in Sierra Leone) had reactions.
 - Reaction will vary depending on your immune system and number of bites
 - More evidence is needed than bites to confirm bed bugs




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 - More evidence is needed than bites to confirm bed bugs
 - No disease transmission!!!




Bed Bug Evidence

- Fecal spots (bed bug poop)
 - Mattress seams and on the tag
 - Wood frame of the box springs
 - Behind the head board
 - Along the tops of baseboards or the edge of carpeting
 - Ceiling/wall junctions and behind pictures on the wall
 - At electrical outlets
 - In curtain seams
- This is blood that has gone through the gut of the bed bug
- Looks like cockroach feces but *feels* very different




Fecal Crusts



Bed Bug Evidence

- Molted skins (exuvia)
- The molted skins can be found in bed bug aggregations or by themselves
- In a new infestation, bed bug evidence may be very hard to find.
- Yet, because a large percentage of any bed bug population is immature, there is always potential to find molted skins.

Molted Skins



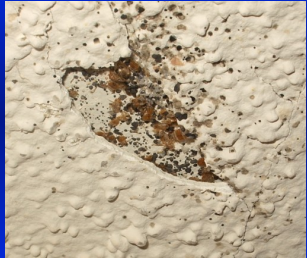
Hard to Find but Obvious



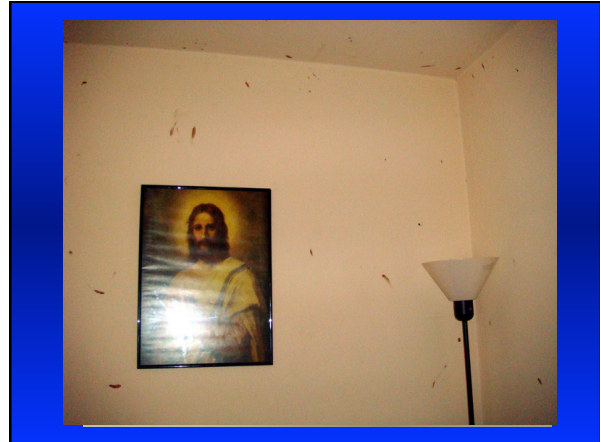
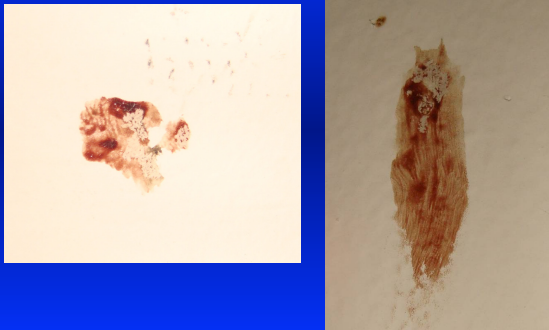



Less Obvious Unless You Know

- What does this look like to the untrained eye?
- Is it a moisture leak upstairs?
- Mildew that is getting out of control?
- Look closer and see what is really there.
- Bed bug aggregations



What is this?



What is this?



Where is this?



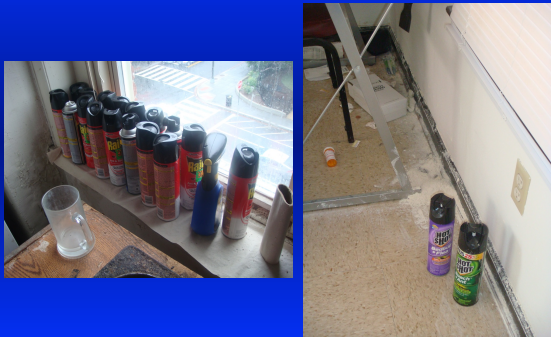
What is this?



What does this mean?



What does this mean?



**Last One,
What is this?**



Why We Don't have "the Answer"

- Most products will kill some bed bugs if you apply them directly.
- Consumers do not realize that killing bed bugs *we can see* is not the problem.
- Our problem is stopping the infestations.



Why not just hit each bug with a hammer?

Common Bed Bug Treatments

- Multiple applications of insecticides.
- Crack and crevice applications.
- Resistance to pyrethroid products is very high.
- Not all populations are equally resistant or resistant to the same products.
- No residual spray product



Many Legitimate Products

- Novel pesticide formulations
 - Temprid (B-cyfluthrin & imidacloprid)
 - Transport (Bifenthrin & acetamiprid)
 - Tandam (λ-cyhalothrin & thiomethoxam)
- Chlorfenapyr
 - pyrolle; "pro-insecticide"
- Alpine Dust
 - Dinotefuran and DE



Will New Chemistry Save Us?

- EPA is "encouraging the development of new AIs"
 - ~\$200 million in toxicological data collection and 10 years
- Urban market is small
- Structural market is smaller
- New product will go off patent in 10-15 years and competitors will have access to the AI
- State of the art.....

“Alternative Methods”

- **Becoming the primary methods used in combination with chemical methods**
 - Need a plan to get you through the next 10 years
 - Preparation
 - Monitoring
 - Heat/Cold
 - Vacuuming
 - Mattress encasements
 - Other



Prevention: No furnishings from the dumpster

Treatment Preparations

- Most companies that do a provide tenants with preparation instructions
- If instructions are followed treatment is much easier for the PMP
- Difficult for the resident: laundry bill and living out of bags
- **Number one complaint is lack of tenant cooperation**



New way of thinking!
Leave the infestation in place
Bag only belongings that are
in the way.

Canine Detection

\$36700.00 (AED)

- Excellent detectors for hotels and office buildings
- Can distinguish between live and dead bed bugs
- Good for lawsuit defense
- Expensive and require constant training
- You must maintain live bed bugs
- Are only as good as their handler

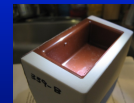


Active Monitors

NightWatch



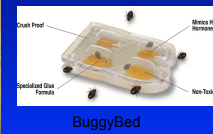
Verifi



CDC 3000



2 Bed Bug First Response



BuggyBed



Bed Bug Beacon

Passive Monitors/Traps

4 Climb Up Interceptors



4 Bed Moat





BB Alert

4 CVT BB Trap






6 BB Detection System

Vacuuming

- The value of vacuuming is that it makes inspections easier.
- In large infestations, bed bug harborages are not only filled with live bed bugs, but also with dead bed bugs, molted skins, hatched egg shells, and feces.




The Clothes Dryer is Our First Line of Defense



Steam Cleaning

- Steam temperature (at the bed bug) must be 130° F (54° C) or greater
- The steam head must be large
- Steam power will kill bed bugs and their eggs
- Steaming is slow and labor intensive



Upholstery and bedding can disperse steam heat
Thermal death point 48°C

What is this man doing?



Heat Chambers

Do it Yourself



Pack Tite®



Whole Home Heat

- Propane or electric.
- Temperature ~132°F, fans turned on to heat items in the room to 120°F.



Cryonite®

- Bed bugs exposed to CO₂ snow at -42° C. The snow mixture is pressurized through a nozzle that forms vapors.
- The snow freezes the cells of the bed bug
- This system will not eliminate a bed bug infestation if used alone. Other control methods will still have to be used.



\$7000.00
\$25,690.00 AED

Mattress Covers

- Encasements for both mattress and box springs!
- Improved version has a zipper protector sewn in
- Traps bed bugs and eggs, bite proof and escape proof



Protected Zipper

Not all covers protect



Where the zipper closes and the zipper teeth are vulnerable to bed bug escape

Desiccant Dusts

- Desiccant dusts are ultimately more effective than sprays
- Resistant strain died in ~36 hours
- Diatomaceous Earth – insecticide grade 2-3 days
- Silica dust – 2-3 days
- Lasts unchanged in wall voids for years in low humidity



Bed Bug Prevention: Training



Questions?

