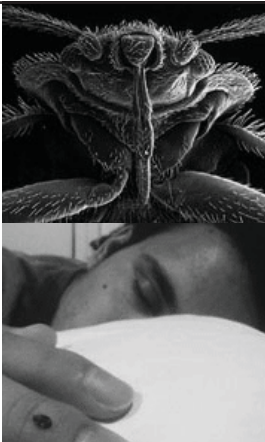


Bed Bugs

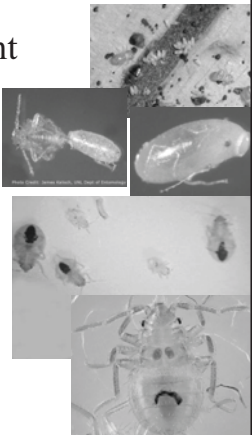
Philip G. Koehler, PhD

Florida Pest Management
Association's Endowed Professor
of Urban Entomology
Entomology & Nematology
Department
University of Florida
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pgk@ufl.edu




Bed Bug Development

- Gradual Metamorphosis
- Eggs
 - ~1 mm long, whitish
 - Sticky, attached to surfaces
 - Laid in loose groups, ~200 per female
- Nymphs
 - 5 instars
 - As small as 1 mm long
 - Tan almost transparent in color
 - At least 1 blood meal per instar

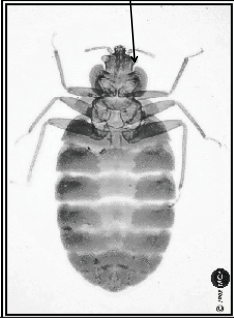


Species of Bugs

Cimex hemipterus, Tropical bed bug
Moderately excavated




Cimex lectularius, Bed bug
Deeply excavated



Adults


- Temperature affects life-span
 - At 37° C, adults live 29-32 days
 - At 10° C, adults live 401-425 days
- can lay 200-500 eggs in their lifetime

(Johnson 1942, Usinger 1966)

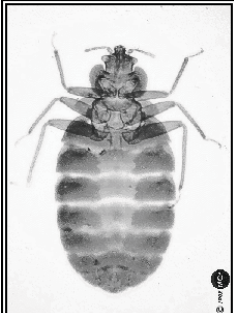


Bed Bug vs Bat Bug

Bat Bug, *Cimex pipistrellae*

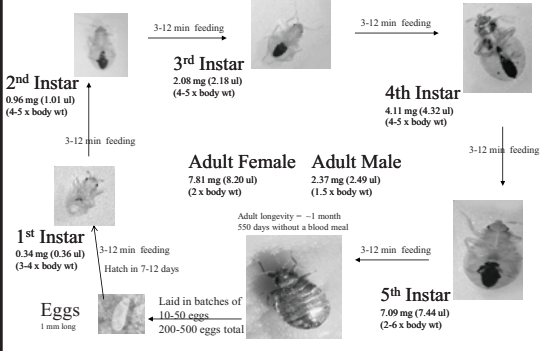


Bed bug, *Cimex lectularius*



Bed Bug Life Cycle?

Total time = 32-48 days



Eggs
1 mm long
Laid in batches of 10-50 eggs
200-500 eggs total

1st Instar
0.34 mg (0.36 ul)
(3-4 x body wt)
Hatch in 7-12 days

2nd Instar
0.96 mg (1.01 ul)
(4-5 x body wt)

3rd Instar
2.08 mg (2.18 ul)
(4-5 x body wt)

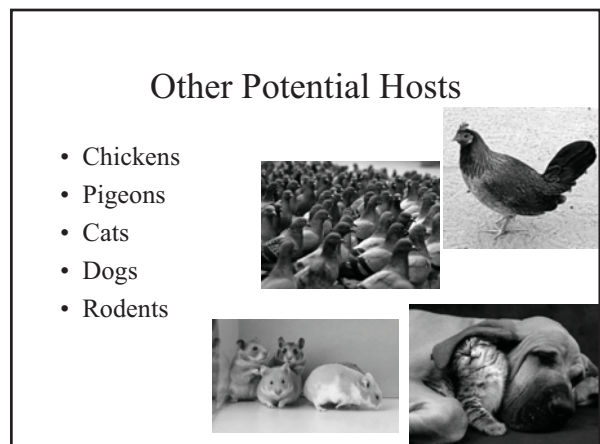
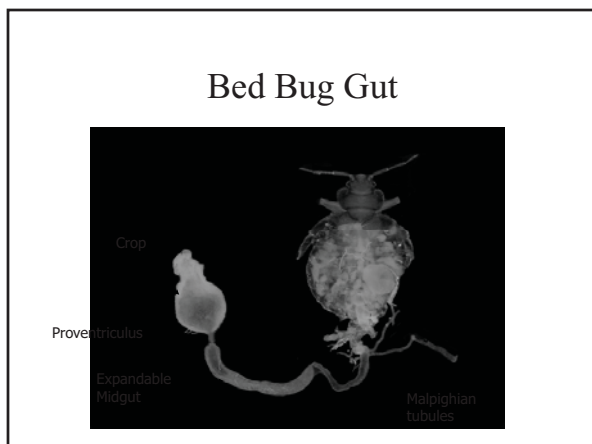
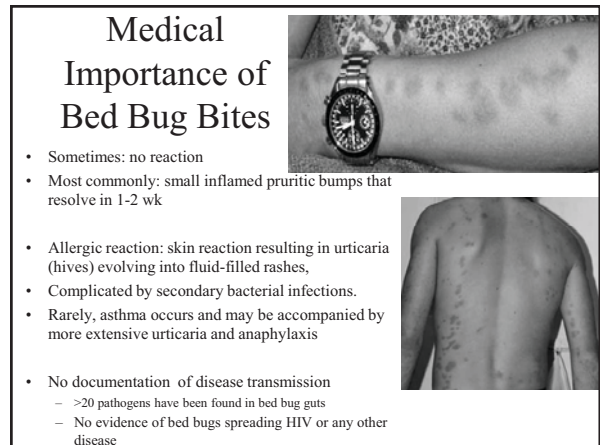
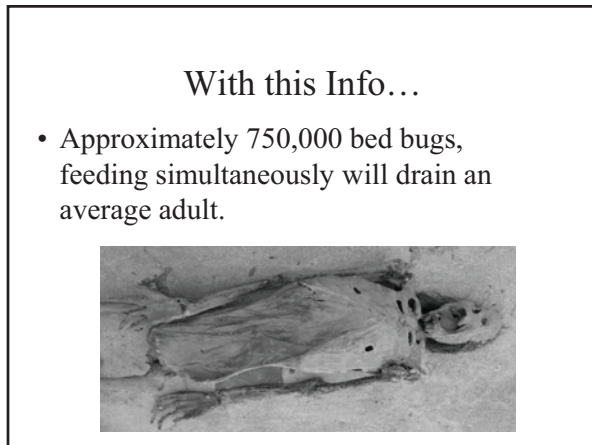
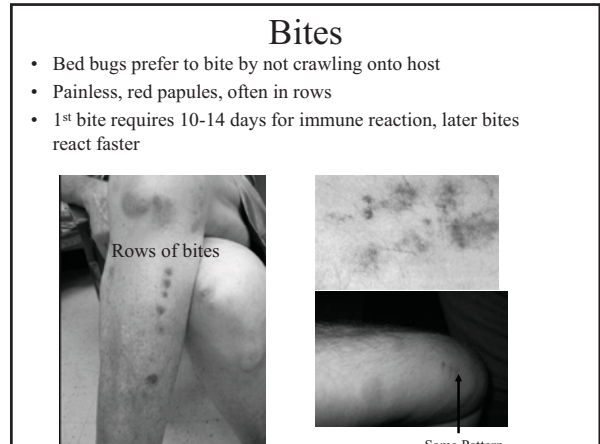
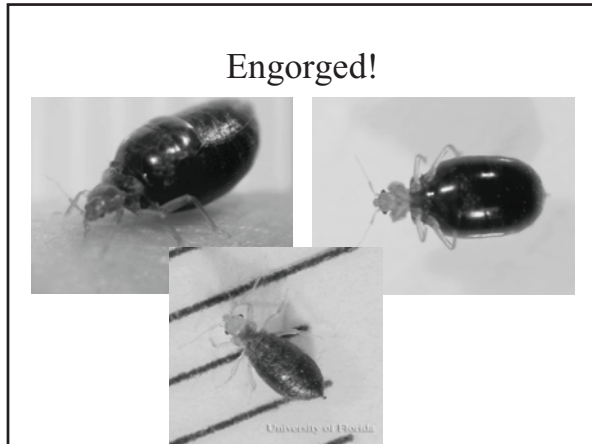
4th Instar
4.11 mg (4.32 ul)
(4-5 x body wt)

5th Instar
7.09 mg (7.44 ul)
(2-6 x body wt)

Adult Female
7.81 mg (8.20 ul)
(2 x body wt)

Adult Male
2.37 mg (2.49 ul)
(1.5 x body wt)

Adult longevity = ~1 month
50 days without a blood meal



½ of the blood ingested is lost by defecation within 5 hours.

Leg of Cockroach

- Adapted for running and climbing.
- Claws for traction.
- Pads for climbing smooth surfaces.

Movement

- Quick movers
 - Adults can crawl about 4 ft/minute
 - Nymphs can crawl about 1 ft/minute

2½ minutes for an adult to make it from a TV stand to the pillow

10 minutes for a nymph

Cockroach

Easily climbs smooth surfaces.

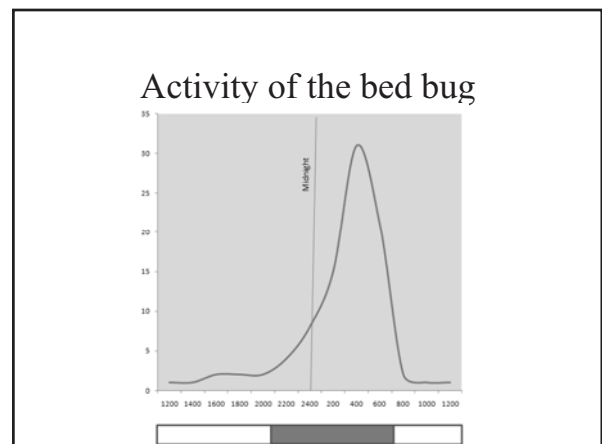
Bed bug

Can't climb smooth surfaces.

Pads vs. No Pads

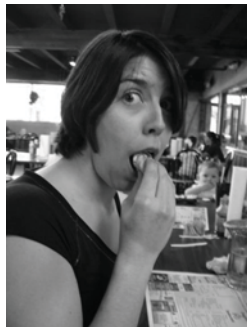
Close up of Bed Bug Leg

- Adapted for crawling.
- Claw used for gripping rough surfaces or for gripping host to insert mouthparts.



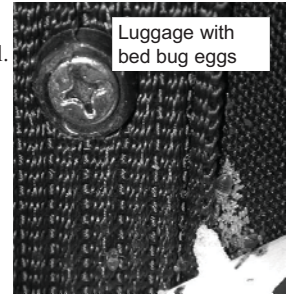
What makes them active?

- Hunger
 - search for host until one is found
 - Most likely follow CO₂ or heat
- Cannot detect a host beyond 5 feet.
- Attractants are being developed



Bed Bug Dispersal

- Disperse on belongings (Uisinger 1966, Pinto et al. 2007)
- If they are dispersing, they are alone, not aggregated
- Why do they disperse from aggregations?



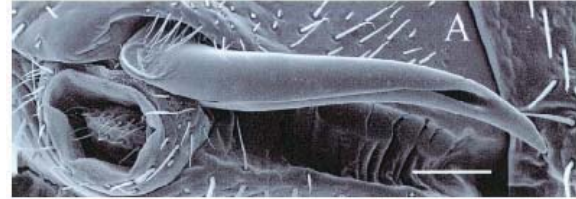
Picture courtesy Rick Cooper, Cooper Pest Solutions

Bed Bug Aggregations



Mating Behavior

- Traumatic insemination- Male's reproductive organ actually pierces the cuticle of the female's abdomen and injects sperm through the wound, outside of the reproductive tract (Uisinger 1966)

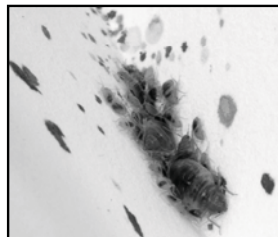


Picture from Stutt and Siva-Jothy 2001

Drywall Screw & Bed Bug Aggregation



15 bed bug nymphs in slots of drywall screw




Problems caused by Bedbugs

- Nuisance
- Sleepless nights
- Inflamed skin lesions
- Stained sheets and mattresses
- Psychological stress from infested environment



Bed Bug Places

- Apartments, condos, houses
- Hotels, motels, restaurants
- Schools, universities, colleges
- Halfway houses
- Homeless shelters
- Correctional facilities
- Hospitals
- Nursing homes
- Subways, busses, taxis
- Discarded mattresses & furniture
- Movie theaters



Training Steps

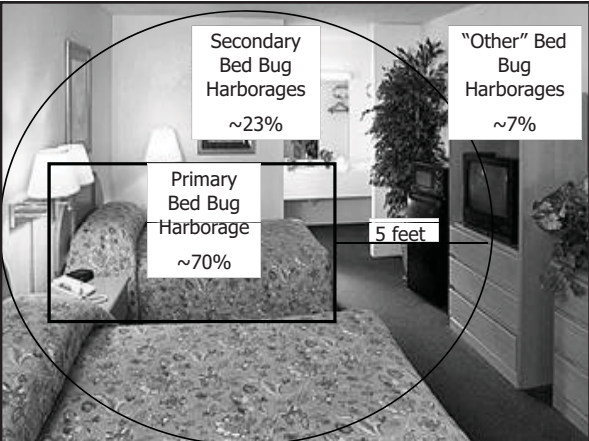


Basic Retrieve

Controlled Retrieve

Buried Hides

Food Reward



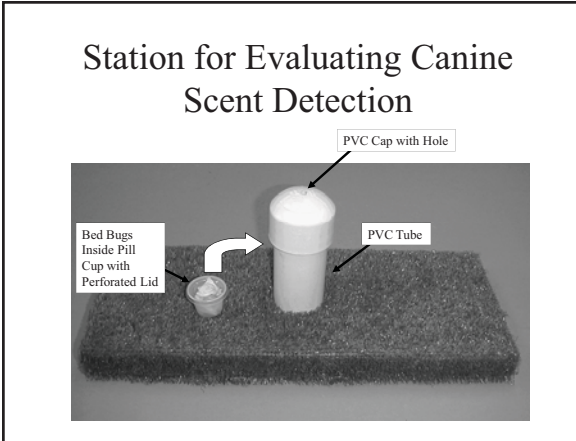
Secondary Bed Bug Harborage ~23%

Primary Bed Bug Harborage ~70%

"Other" Bed Bug Harborage ~7%

5 feet

Station for Evaluating Canine Scent Detection



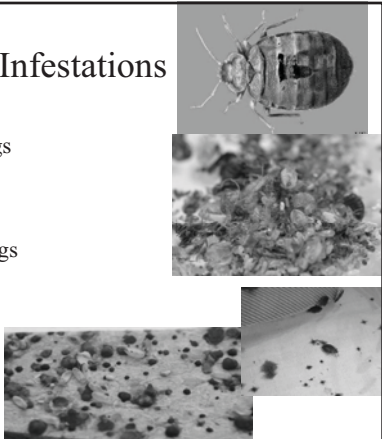
PVC Cap with Hole

Bed Bugs Inside Pill Cup with Perforated Lid

PVC Tube

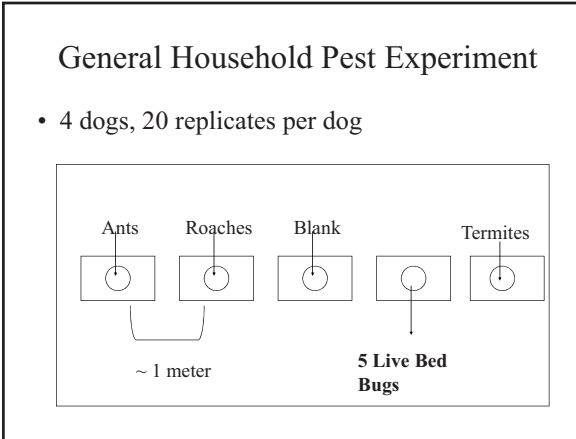
Bed Bug Infestations

- Active
 - Live bed bugs
 - Eggs
- Inactive
 - Dead bed bugs
 - Blood spots
 - Fecal stains
 - Cast skins



General Household Pest Experiment

- 4 dogs, 20 replicates per dog



Ants

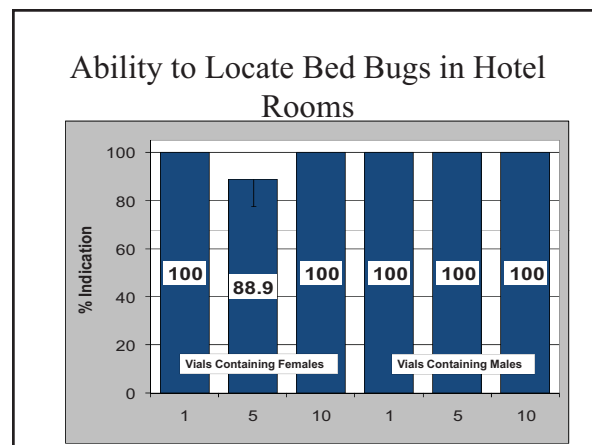
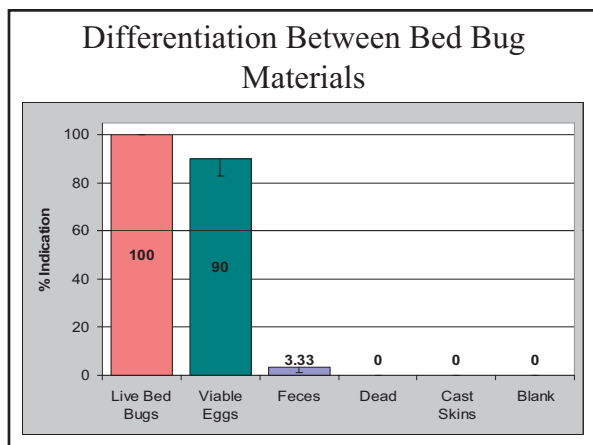
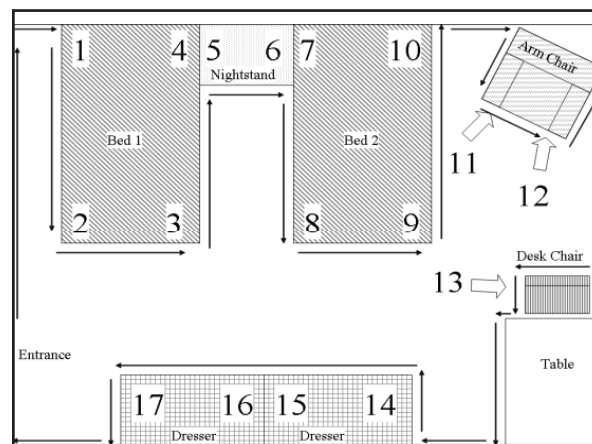
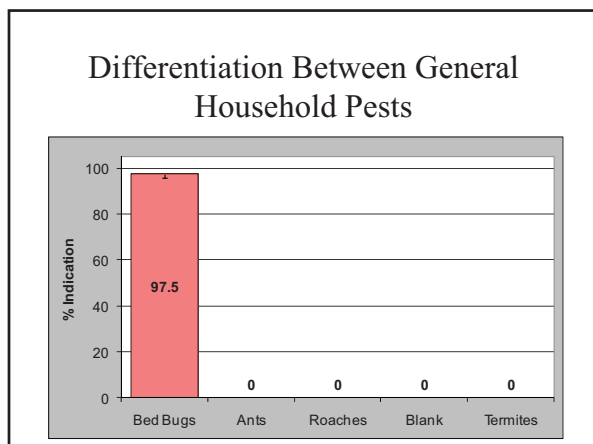
Roaches

Blank

Termites

~ 1 meter

5 Live Bed Bugs



Hotel Field Experiment

- 3 vials male adults only- 1, 5, and 10
- 3 vials female adults only- 1, 5, and 10
- 2 hotel rooms:
 - One with only female vials
 - One with only male vials
- Randomly hidden in 17 possible locations
- 3 dogs, 6 replicates per dog

Conclusions

- Dogs can be trained to detect the scent of bed bugs
- Dogs differentiated
 - Bed bugs from other household pests
 - Active from inactive infestations
- Determined that dogs could locate bed bugs in hotel rooms
- Hotel rooms could be inspected in less than 2 minutes with 98% accuracy
- Reputable dog trainer:
 - Use NESDCA certified dogs
 - J&K Canine Academy (pepedogs.com)