

# Bed Bugs and Human Health: Known Concerns and Emerging Threats



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# Outline

1. History

2. Biology

3. Known Health Effects

4. Emerging Threats?





*Advances in the Biology and Management of Modern Bed Bugs*



Caption: "War on the bed bug". Postcard c. 1916. Clearly humanity's dislike of the bed bug has not changed through the years!

# (not so) Recent Resurgence!

- Disappeared in the 1950s, but re-appeared in the early 2000s
- Found everywhere!



bed bugs news



< All

News

Images

Videos

Shopping

More

Tools

About 8,160 results (0.40 seconds)

BBC

### [Bed bug infestation forces Northampton man to sleep in his car](#)

A pensioner is at his "wits' end" after being driven to sleep in his car due to a bed bug infestation in his flat owned by a retirement...

2 days ago



Las Vegas Review-Journal

### [Bed bugs are a pest to deal with for Las Vegas hotels](#)

Bed bugs are an operational hazard for Las Vegas hotels, as over 50 reports of infestations have been investigated since 2022.

2 days ago



The Mirror

### [Horror bed bug infestation in flat forces man, 83, to set up bedroom and sleep in CAR](#)

Pensioner Michael Kemp decided to set up a makeshift bedroom in his car after a bed bug infestation in his Northampton flat got so bad he...

9 hours ago



USA Today

### [Guests at seven Las Vegas hotels have found bed bugs the past year](#)

Reports of bed bugs at seven hotels on the Las Vegas strip have recently come forward. Caesars Palace, Planet Hollywood, Circus Circus,...

1 month ago



The Independent



## Bed bug infestation forces Northampton man to sleep in his car

2 days ago



Michael Kemp caught nine bugs at the start of the latest infestation



Michael Kemp says the bed bugs have forced him to sleep in his car



Time

## Bed Bugs Aren't Just a Problem In Paris. Here's Why

Bed bugs have an intimate relationship with humankind, and our behaviors have as



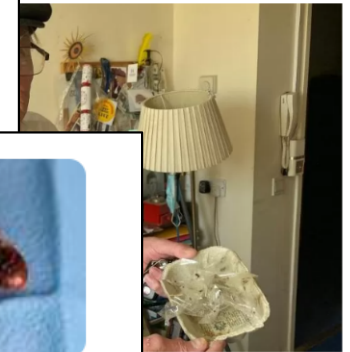
station forces  
n man to sleep in his car



National Geographic

## Bedbugs are everywhere—and they're very good at what they do

Compounding the issue, global travel has grown in the recent decades, making it



CNN

## What you need to know about Europe's bedbug panic

Dermatologist Zeina Nehme says her clinic usually sees a number of cases every summer in which patients have been bitten by bedbugs while...



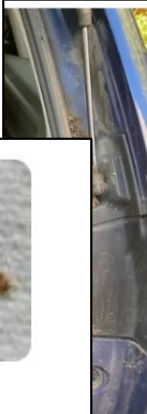
Oct



The New York Times

## The Best Tip of Paris Fashion Week? Avoid Bedbugs.

There's an infestation in the City of Lights, and fashion folks are not immune.



bedroom

Pensioner M  
bug infestati

9 hours ago

Oct



Newsweek

## Bedbugs and Balenciaga: Could Paris's bedbug infestation spread to the US?

Bedbugs and Balenciaga: Could Paris's Bedbug Infestation Spread to the US? ... As Paris finishes hosting Fashion Week, Balenciaga, Dior and Chanel...

Oct 4, 2023



USA Today

Guests at seven  
past year

Reports of bed bugs a  
forward. Caesars Pala

1 month ago



The Independent

# Outline

1. History

**2. Biology**

3. Known Health Effects

4. Emerging Threats?






# Small, but visible



- Adults are  $\frac{1}{4}$ " in length
- Some variability among populations



**Bed Bugs are “True Bugs”  
(Order Hemiptera)**

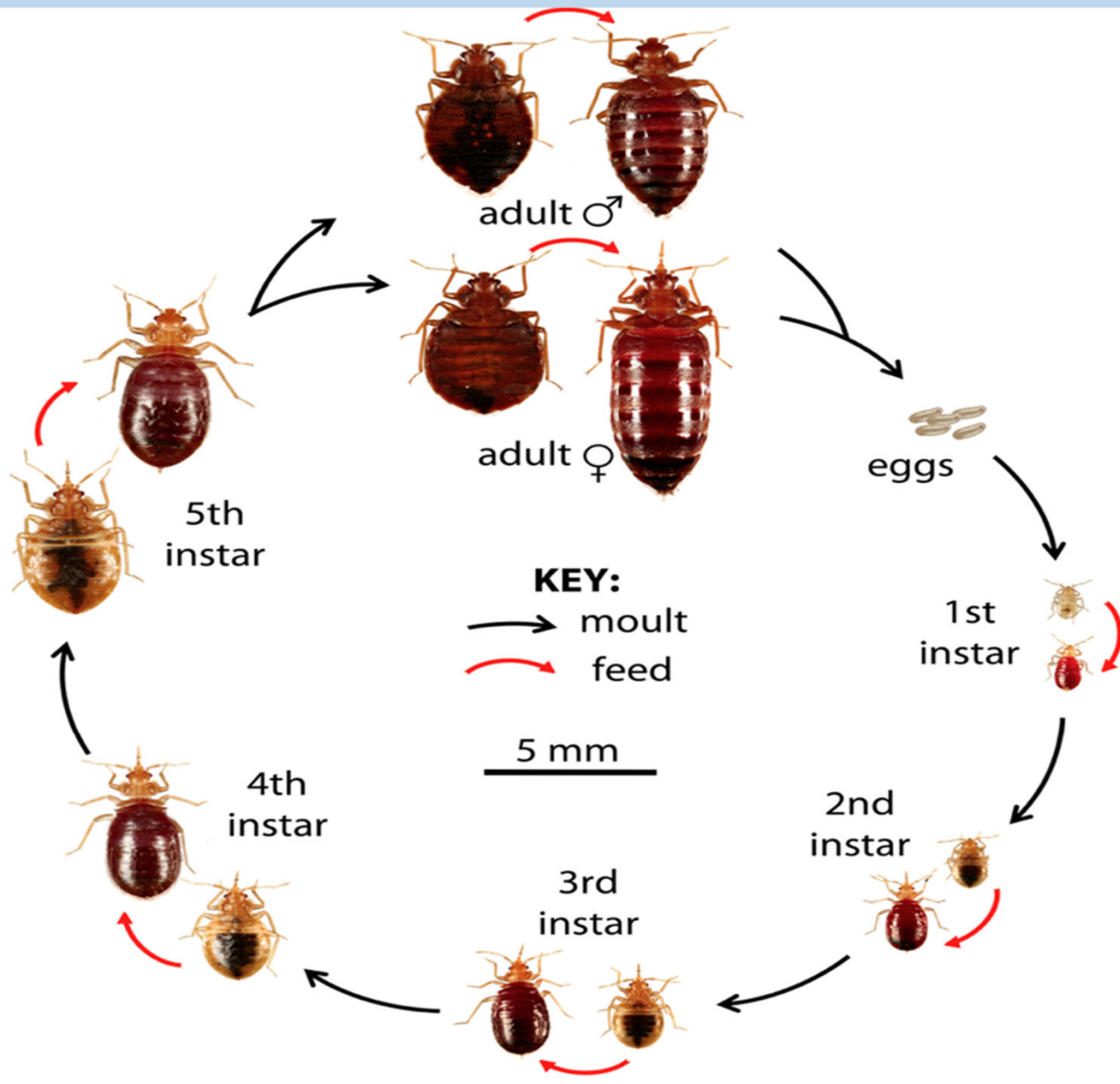
**Feed on blood**





- 2-10 minutes to feed
- Takes ~2x their weight in blood (4x for smaller instars)

# Development



- Require a blood meal to molt
- Egg to adult in about 60 days (72 F)
- 5 nymphal instars (fixed)

# Females and Males



# Traumatic Insemination



- Bypass female reproductive tract when mating

# Eggs



- 2-5 eggs per day
- 200-500 eggs in their lifetime
- Eggs are generally laid in cracks and crevices







# Aggregations



- Aggregation pheromone
- Typically found in and around the bed
- Leave aggregations to feed or mate

# Tough Bugs!

- Can survive extended periods of starvation
- Can survive extreme temperatures
- Don't mind inbreeding

# Outline

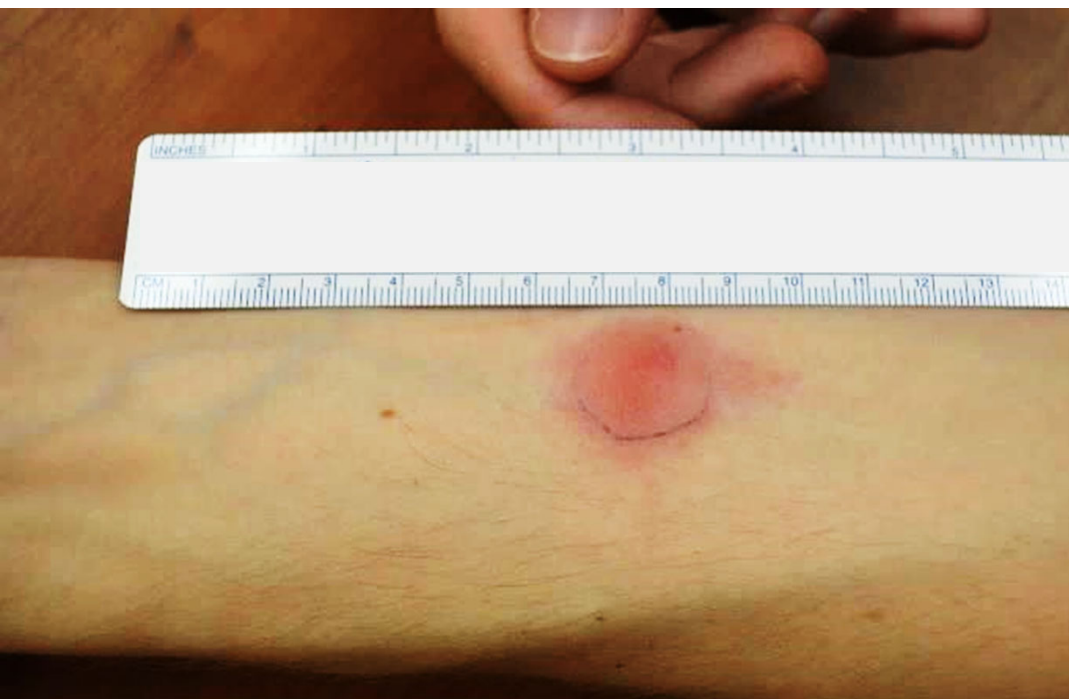
1. History

2. Biology

**3. Known Health Effects**

4. Emerging Threats?





# Known Effects on Human Health



Bites

Disease  
Transmission?



DIY Harm



Psychological

# Bites



**Immediately after bite**





# 24 hours after bite

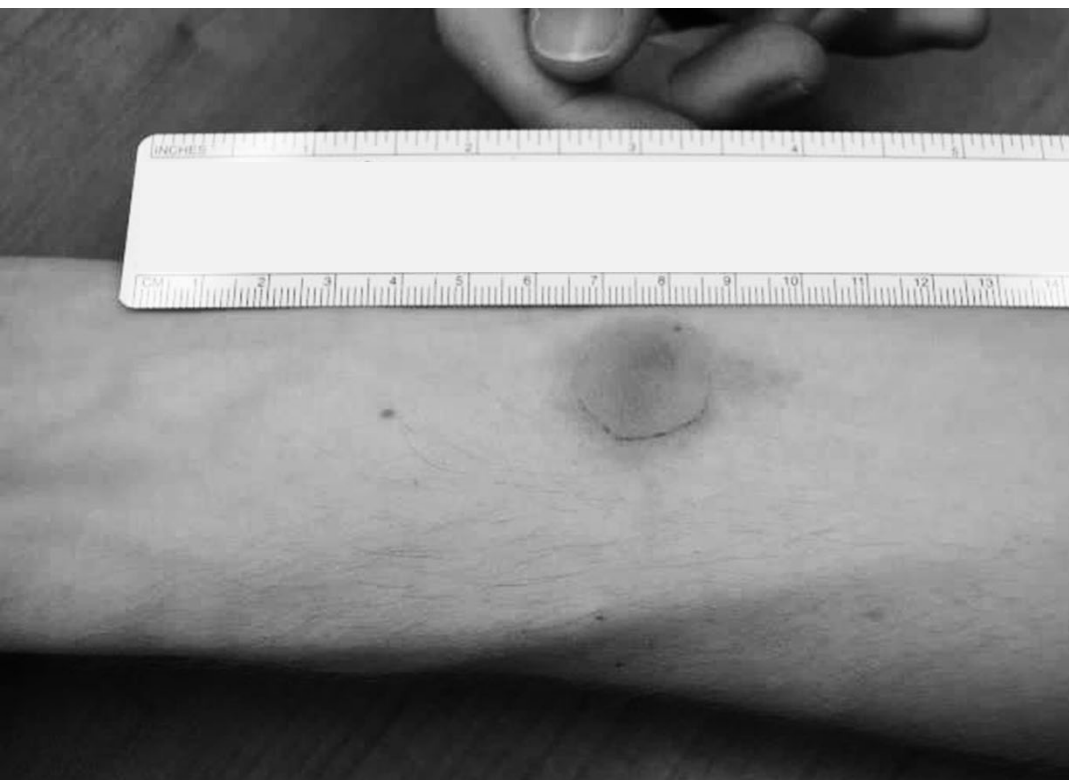
- Severity of reaction changes over time
- Different people have different responses
- No clear or obvious patterns
- Secondary infections are very common
- Rare Cases: anemia and iron deficiency





# What causes our reaction?

- Saliva contains >40 different proteins which play a variety of roles
- Some proteins likely to play a role in our immune response: nitrophorin (vasodilator), Factor X (coagulation inhibitor), apyrase (platelet function inhibitor)



Disease  
Transmission?



9 ON YOUR SIDE AT NOON  
FD: FIRE STARTED WHEN TEEN TRIED TO BURN BEDBUGS  
HAWAIIAN TERRACE IN MOUNT AIRY

9  
abc  
12:01 5



- Have been found to be naturally infected with >50 human pathogens
- Only a few papers show laboratory potential to vector pathogens



## Bed Bugs (*Cimex lectularius*) as Vectors of *Trypanosoma cruzi*

Renzo Salazar, Ricardo Castillo-Neyra, Aaron W. Tustin, Katty Borrini-Mayorí, César Náquira, and Michael Z. Levy\*  
*Chagas Disease Field Laboratory, Universidad Peruana Cayetano Heredia, Arequipa, Peru; Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland; Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania*



- Bed bugs possess the ability to vector *T. cruzi* (causative agent of Chagas disease)

RESEARCH ARTICLE

## Competence of *Cimex lectularius* Bed Bugs for the Transmission of *Bartonella quintana*, the Agent of Trench Fever

Hamza Leulmi<sup>1,2</sup>, Idir Bitam<sup>2,3,4</sup>, Jean Michel Berenger<sup>1</sup>, Hubert Lepidi<sup>1</sup>, Jean Marc Rolain<sup>1</sup>, Lionel Almeras<sup>1</sup>, Didier Raoult<sup>1</sup>, Philippe Parola<sup>1\*</sup>



- Bed bugs possess the ability to vector *Bartonella quintana* (causative agent of Trench Fever)



## Testing the Competence of *Cimex lectularius* Bed Bugs for the Transmission of *Borrelia recurrentis*, the Agent of Relapsing Fever

Basma El Hamzaoui,<sup>1,2</sup> Maureen Laroche,<sup>1,2</sup> Yassina Bechah,<sup>1,2</sup> Jean Michel Bérenger,<sup>1,2</sup> and Philippe Parola<sup>1,2\*</sup>

<sup>1</sup>Aix Marseille Univ, IRD, AP-HM, SSA, VITROME, Marseille, France; <sup>2</sup>Institut Hospitalo-Universitaire Méditerranée Infection, Marseille, France



- Bed bugs possess the ability to vector *Borrelia recurrentis* (causative agent of Relapsing Fever)

# Experimental Acquisition, Maintenance, and Transmission of Methicillin-Resistant *Staphylococcus aureus* by the Common Bed Bug, *Cimex lectularius*

Andrea L. Herrera, Michael S. Chaussee, and Jose E. Pietri<sup>1</sup>

Division of Basic Biomedical Sciences, Sanford School of Medicine, University of South Dakota, Vermillion



- Bed bugs possess the ability to acquire, maintain, and transmit methicillin-resistant *Staphylococcus aureus* (MRSA)

All of these show potential, but do not link bed bugs to field transmission



Hard to show bed bugs are the sole cause in the places we find bed bugs, and few people really looking.

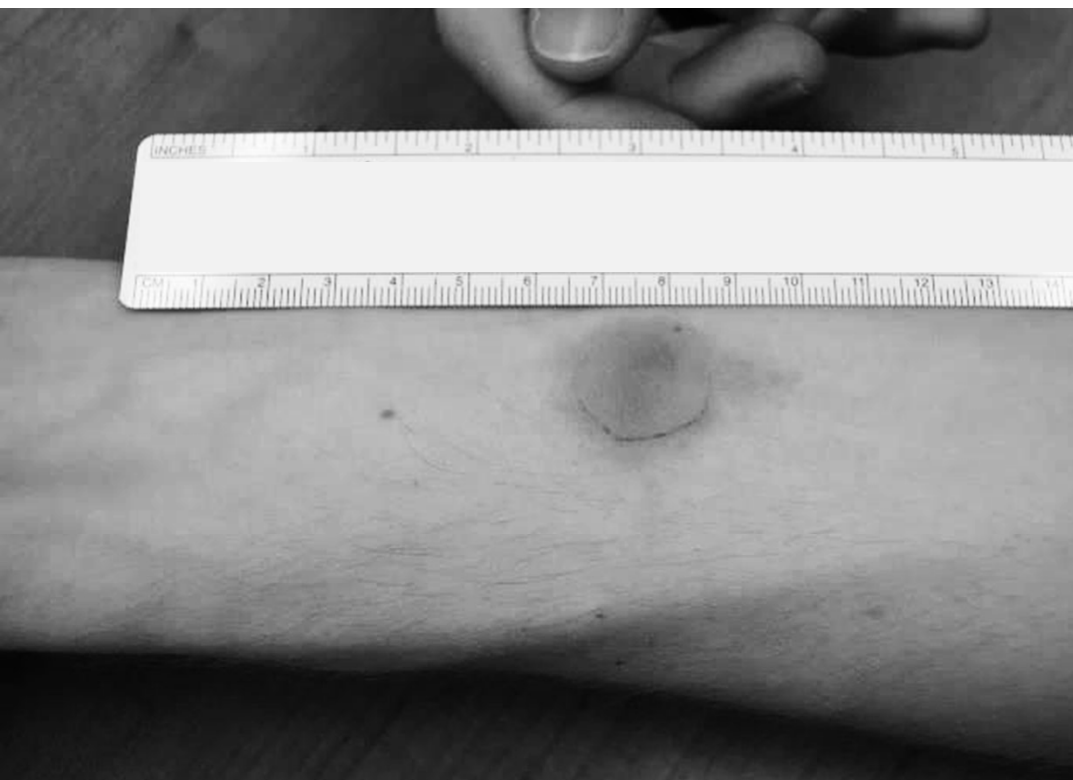
Work out of Ohio State showed bed bugs tended to defecate in close proximity to bite sites



**Major Limitation to Pathogen  
Transmission: Limited number of hosts**



**Locations of Concern:** areas where bed bugs and the causative disease agents are found, and there is frequent turnover of people



Psychological

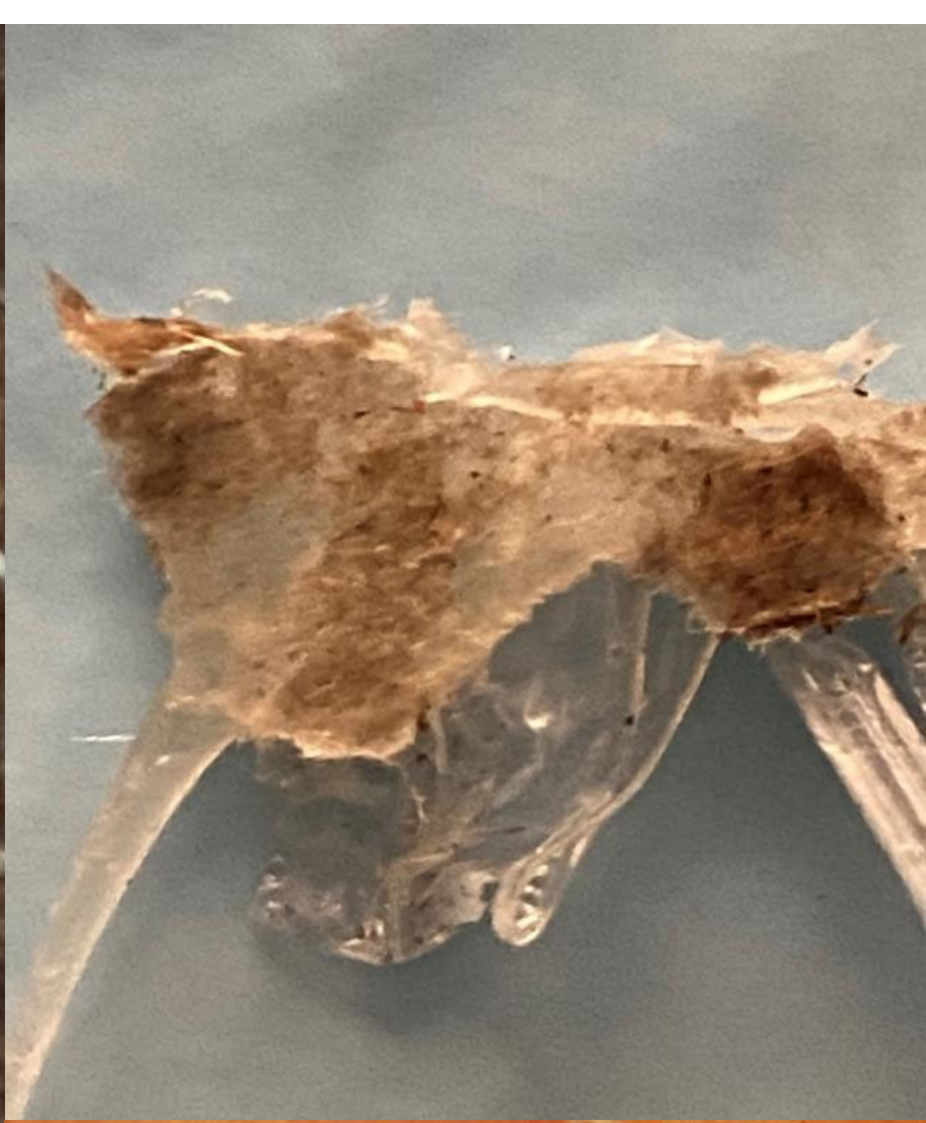
# Psychological Effects



- Poorly understood, but has major effects on humans (Ex. depression, anxiety, sleep disturbance, PTSD)
- Often more difficult to mitigate than the bugs
- ***Delusional Parasitosis***





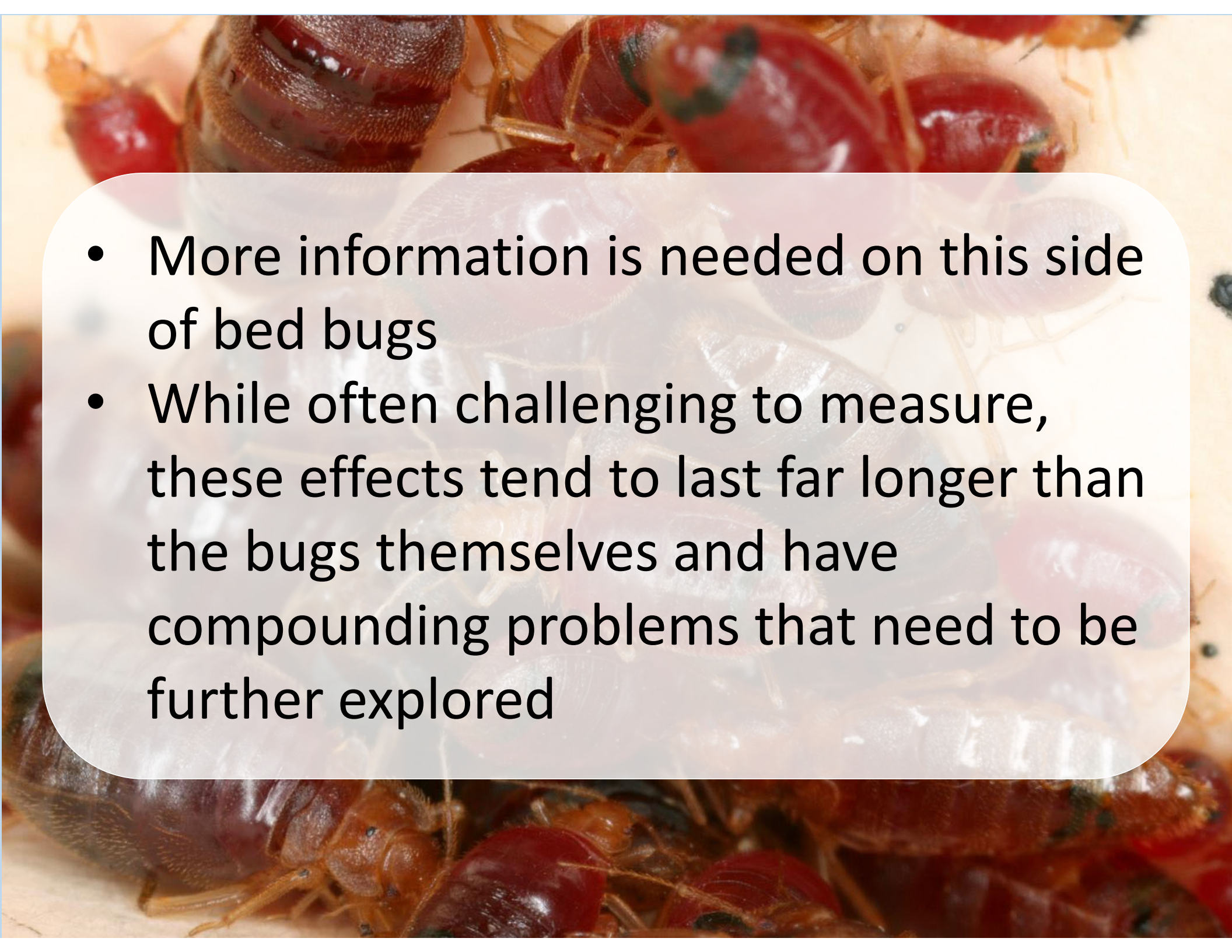


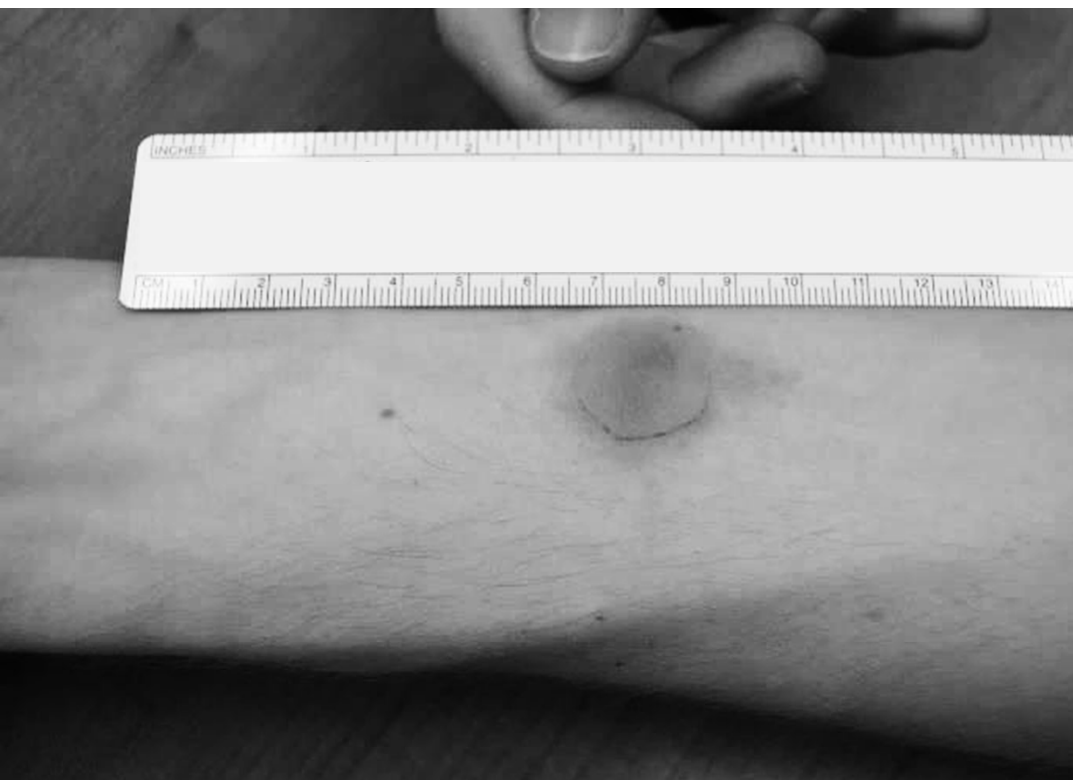


# Mental health effects from urban bed bug infestation (*Cimex lectularius* L.): a cross-sectional study

Stephanie Rebecca Susser,<sup>1,2</sup> Stéphane Perron,<sup>1,2,3</sup> Michel Fournier,<sup>2</sup>  
Louis Jacques,<sup>1,2</sup> Geoffroy Denis,<sup>2</sup> François Tessier,<sup>2</sup> Pasquale Roberge<sup>4</sup>

- Bed bug infestations were strongly associated with anxiety and sleep disturbance
- One of the only papers to take an epidemiological approach to the impact bed bugs have on mental health (most are case studies or anecdotes)

- 
- More information is needed on this side of bed bugs
  - While often challenging to measure, these effects tend to last far longer than the bugs themselves and have compounding problems that need to be further explored



DIY Harm



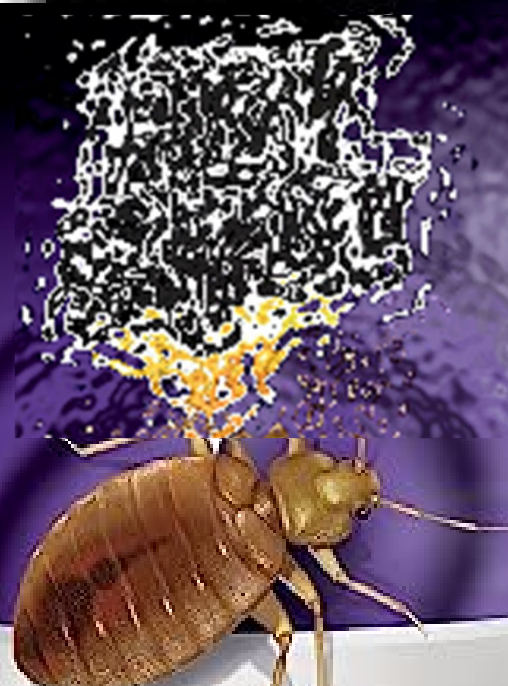


PYRIPROXYFEN GROUP 7C INSECTICIDE

**GUARANTEED!** TO WORK, OR YOUR MONEY BACK!

**CONTAINS NYLAR®**  
PREVENTS FLEAS FROM DEVELOPING  
INTO THE BITING ADULT STAGE

Contiene NyLAR® - Evita que las pulgas  
se conviertan en adultos mordedores



# BEDBUG & FLEA FOGGER

*Nebulizador para chinches de cama y pulgas*

**KILLS BED BUGS, FLEAS, LICE & TICKS**  
Other listed insects

**INHIBITS FLEA REINFESTATION FOR UP TO 7 MONTHS**

*Mata chinches de cama, pulgas, piojos y garrapatas y otros insectos. Evita las futuras nuevas infestaciones de pulgas hasta por 7 meses*



EACH CAN TREATS A ROOM  
up to 16 ft x 16 ft with an 8 ft ceiling or  
2,000 CU FT OF  
UNOBSTRUCTED SPACE

**CONTAINS**  
**3**  
(2 OZ) FOGGERS

**ACTIVE INGREDIENTS:**  
Pyrethrin..... 0.05%  
(S)-cyano(2-phenoxyphenyl)methyl (S)-4-chloro-  
alpha-(3-methylallyl)benzenesulfonate..... 0.10%  
Piperonyl butoxide..... 0.30%  
N-Octyl bicycloheptene dicarbodiimide..... 0.30%  
2-(1-Methyl-2-(4-phenoxyphenyl)ethyl)pyridine..... 0.30%  
**OTHER INGREDIENTS:**..... 89.95%  
..... 100.00%

\* Polyca (TM) (5-propylhexan-3-yl) ether and related compounds  
\*\* MS-9334, Insecticide Synergist  
\*\*\* Nylar®, Insect Growth Regulator

**KEEP OUT OF REACH OF CHILDREN**  
**CAUTION** See side panel for additional  
precautionary statements.

**MANTÉNGASE FUERA DEL ALCANCE DE LOS NIÑOS**  
**PRECAUCIÓN** Consulte dentro de la caja para conocer  
las precauciones preventivas adicionales.

**INSTRUCCIONES EN ESPAÑOL DENTRO DE LA CAJA**

For terms of guarantee, see bottom panel.

**Total Net Wt 6 oz (170 g)**

**STORAGE AND DISPOSAL**  
Do not combine with other foggers.  
Do not use in areas where people or animals are present.  
Do not use in areas where food is prepared or stored.  
Do not use in areas where children play.  
Do not use in areas where pets are present.  
Do not use in areas where people are sleeping.  
Do not use in areas where people are working.  
Do not use in areas where people are exercising.  
Do not use in areas where people are eating or drinking.  
Do not use in areas where people are taking a shower or bath.  
Do not use in areas where people are using a toilet.  
Do not use in areas where people are changing clothes.  
Do not use in areas where people are putting on shoes or socks.  
Do not use in areas where people are putting on hats or coats.  
Do not use in areas where people are putting on jewelry.  
Do not use in areas where people are putting on makeup.  
Do not use in areas where people are putting on perfume or cologne.  
Do not use in areas where people are putting on sunglasses.  
Do not use in areas where people are putting on gloves.  
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**PRECAUTIONARY STATEMENTS**  
**DANGER TO HUMANS AND DOMESTIC ANIMALS:**

**CAUTION:** Irritant to skin. May cause eye, nose, and throat irritation. May cause dizziness or headache. May cause nausea, vomiting, and diarrhea. May cause difficulty breathing. May cause skin rash. May cause allergic reaction. May cause asthma attack. May cause anaphylaxis. May cause severe allergic reaction. May cause severe skin reaction. May cause severe eye irritation. May cause severe eye pain. May cause severe eye redness. May cause severe eye swelling. May cause severe eye tearing. May cause severe eye burning. May cause severe eye stinging. May cause severe eye itching. May cause severe eye soreness. May cause severe eye tenderness. May cause severe eye soreness. May cause severe eye tenderness. May cause severe eye soreness. May cause severe eye tenderness.

**FIRST AID**

**IF SWALLOWED:** Drink water or milk. Do not induce vomiting unless directed by a healthcare professional. If symptoms persist, call a Poison Control Center or doctor for treatment advice.  
**IF INHALED:** Move to fresh air. If symptoms persist, call a Poison Control Center or doctor for treatment advice.  
**IF ON SKIN:** Wash with soap and water. If symptoms persist, call a Poison Control Center or doctor for treatment advice.

For the most current information, visit us at [www.farnam.com](http://www.farnam.com).  
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Contiene NyLAR®. Evita que las pulgas se conviertan en adultos mordedores.  
Evita las futuras nuevas infestaciones de pulgas hasta por 7 meses.  
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Highly Flammable  
Precautionary Statements



**CAUGHT ON CAMERA**

**BUS NEARLY RUNS OVER STRIKERS**

**SEATTLE, WA**



U.S. NEWS

LOCAL

RIENCE. WAITING FOR UPDATE FROM POLICE ON POSSIBLE SUS

5:14

64°





### Man trying to destroy **bedbugs** sets apartment ablaze

Detroit Free Press - Jan 8, 2016

But then, while sitting on the alcohol doused couch, the man lit a cigarette and also tried to s...



### Family **home** burnt in attempt to kill **bed bugs**

Newstalk 106-108 fm - Feb 6, 2015

A family was forced to flee their burning **home** after an attempt to rid a **house** of **bedbugs** went horribly wrong. The **fire** broke out early Wednesday morning at the **house** in Columbus, Ohio after a child accidentally **set** alight a couch while trying ...



### Invasion of the **KILLER bedbugs**

WND.com - Jan 10, 2016

Not everyone plagued with **bedbugs** is as fortunate as this victim. ... her didn't work – all because their **home** was infested with **bedbugs**.

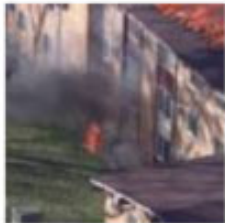
... a m  
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depar



### Torment of **bedbugs** drove woman to **set** apartment **fire**

Detroit Free Press - Nov 5, 2015

Sherry Young says she spent close to a year living in fear of **bedbugs**. So on Monday, sleep deprived and desperate, she turned



### Woman who started blaze trying to kill **bed bugs**: 'I am so ...

Fox 2 Detroit - Nov 4, 2015

DETROIT (WJBK) - The apartment building in De...  
Distraught and ...



### Man **Sets Fire** to 3 Cars While Trying to Get Rid of **Bed B...**

TIME - Apr 16, 2015

A New York man was hospitalized Tuesday after he accidentally **set** three cars on **fire** while attempting to remove **bed bugs** from a rental ...



### New Jersey man **sets house** on fire trying to kill **bedbugs**

New York Daily News - Jun 14, 2013

WOODBURY, N.J. - A New Jersey **house fire** is being blamed on a ... high, sustained heat can kill **bedbugs**, but raising the temperature with the ...

Official: W...  
CBS Loca...



### A woman tried to kill bedbugs with alcohol -- and set a **fire** that left 10 ...

Washington Post - Dec 10, 2017

Three people were hospitalized and several others lost their homes after a woman accidentally started a **fire** inside a multifamily building while trying to kill **bed bugs** with alcohol, authorities said. The **fire** broke out late Friday in Cincinnati's Avondale neighborhood, just north of downtown. Randy Freel ...

90  
FD: FIRE STARTER  
HAWAIIAN TERR


arm

own

W  
R  
E  
50



Bites



Disease  
Transmission?

Clearly, bed bugs can  
have a substantial impact  
on human health



DIY Harm



Psychological



What else do we need  
to worry about?

# Outline

1. History

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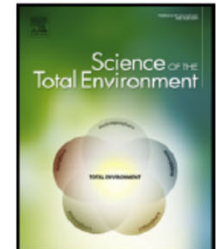




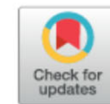
Contents lists available at ScienceDirect

## Science of the Total Environment

journal homepage: [www.elsevier.com/locate/scitotenv](http://www.elsevier.com/locate/scitotenv)



### Bed bugs shape the indoor microbial community composition of infested homes



Madhavi L. Kakumanu <sup>a,\*</sup>, Zachary C. DeVries <sup>a,b</sup>, Alexis M. Barbarin <sup>a,c</sup>, Richard G. Santangelo <sup>a</sup>, Coby Schal <sup>a,\*\*</sup>

<sup>a</sup> Department of Entomology and Plant Pathology and Center for Human Health and the Environment, North Carolina State University, Raleigh, NC, United States

<sup>b</sup> Department of Entomology, University of Kentucky, Lexington, KY, United States

<sup>c</sup> Division of Public Health, Communicable Disease Branch, Raleigh, NC, United States

- The microbial communities differ between infested and uninfested homes







Photo courtesy of Peter Wendorf (Rose Pest Solutions)



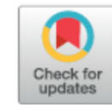
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<sup>b</sup> Department of Entomology, University of Kentucky, Lexington, KY, United States

<sup>c</sup> Division of Public Health, Communicable Disease Branch, Raleigh, NC, United States

- Bed bug eradication can shift the composition back towards that of uninfested homes
- Health risks for the shifted microbiome are unknown but concerning.



# Allergens and Other Contaminants?



Photo courtesy of B. Campbell

**Lessons learned  
from the German  
cockroach!**



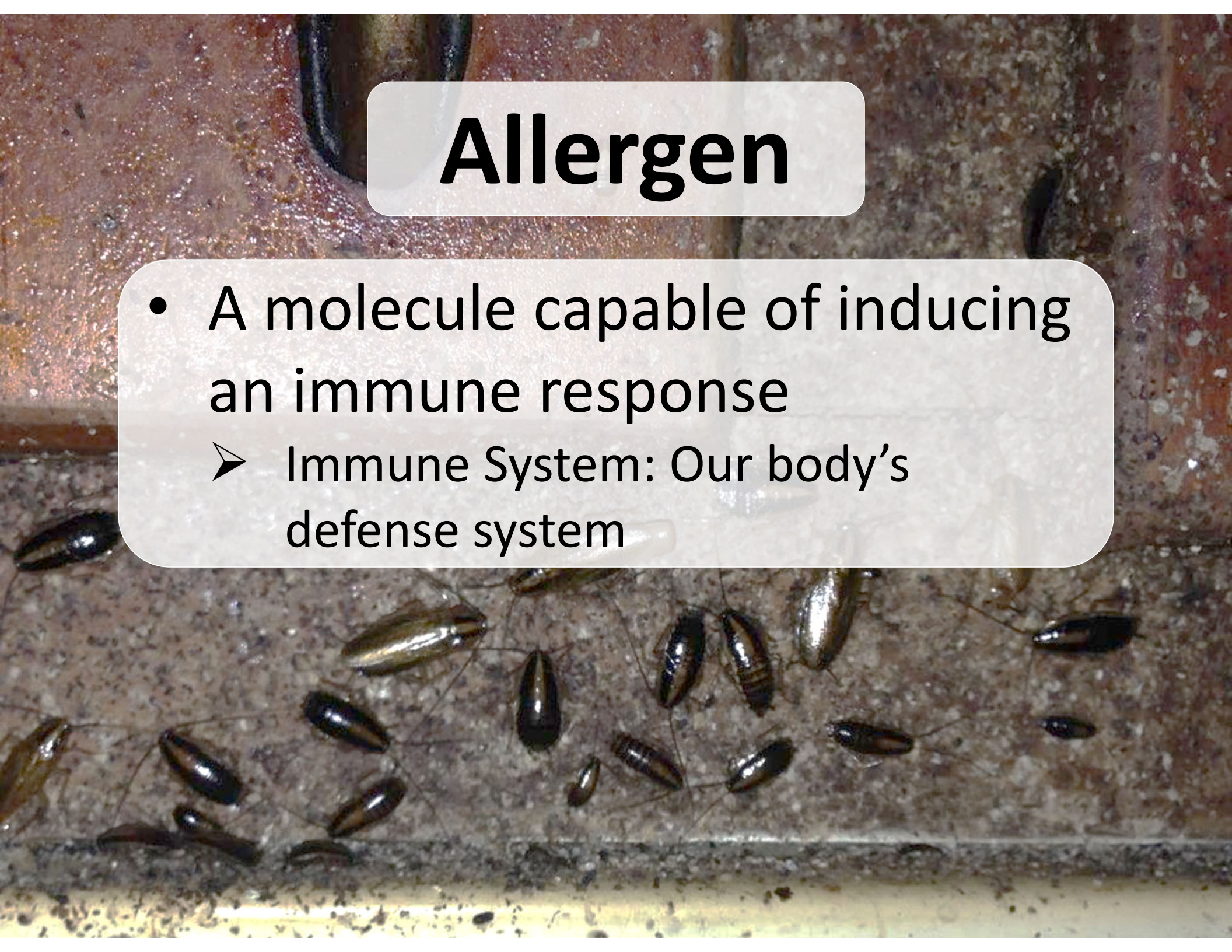
# Cockroach Allergens

- Produce several potent allergens
- Found in feces, muscles, tergal glands, others
- What is an allergen?



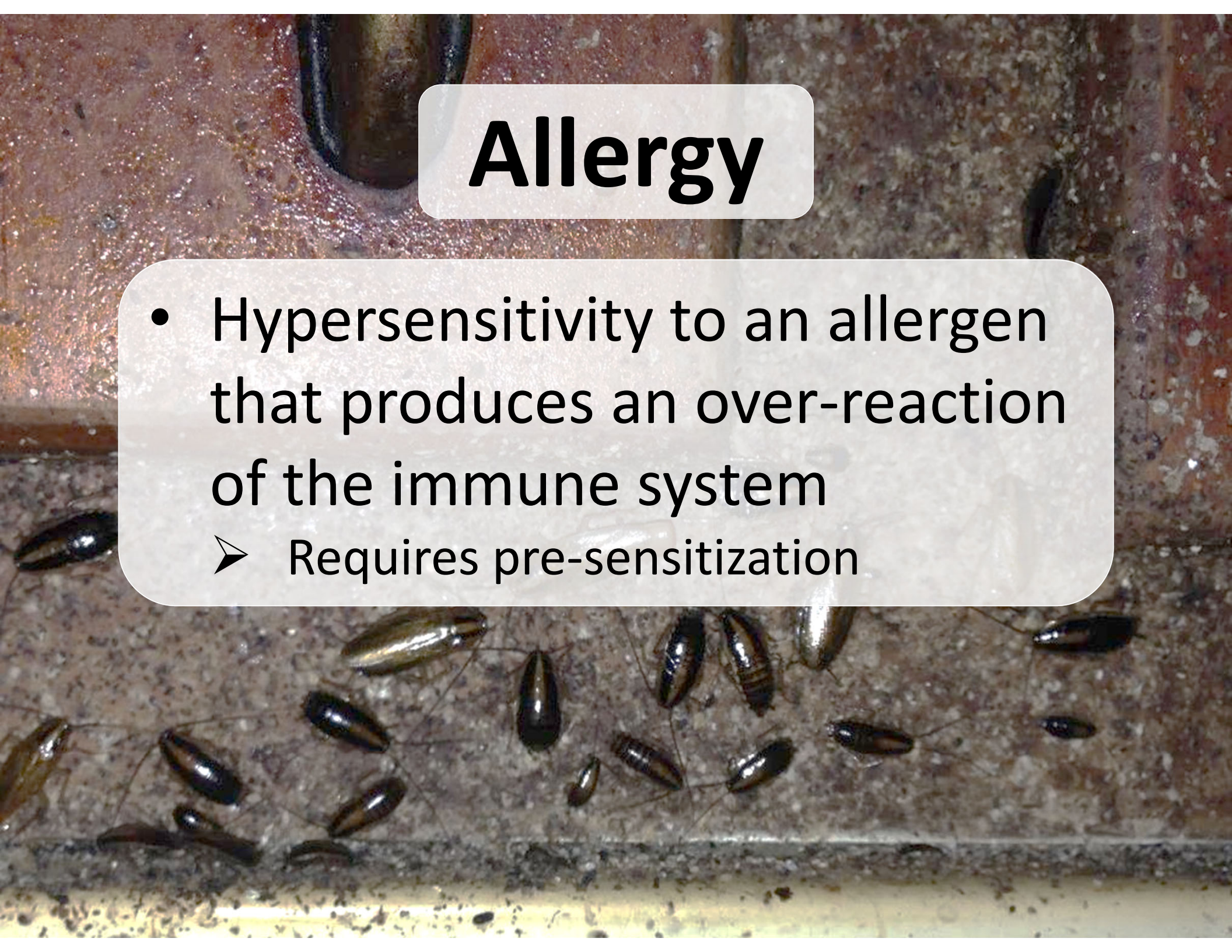
# Allergen

- A molecule capable of inducing an immune response
  - Immune System: Our body's defense system



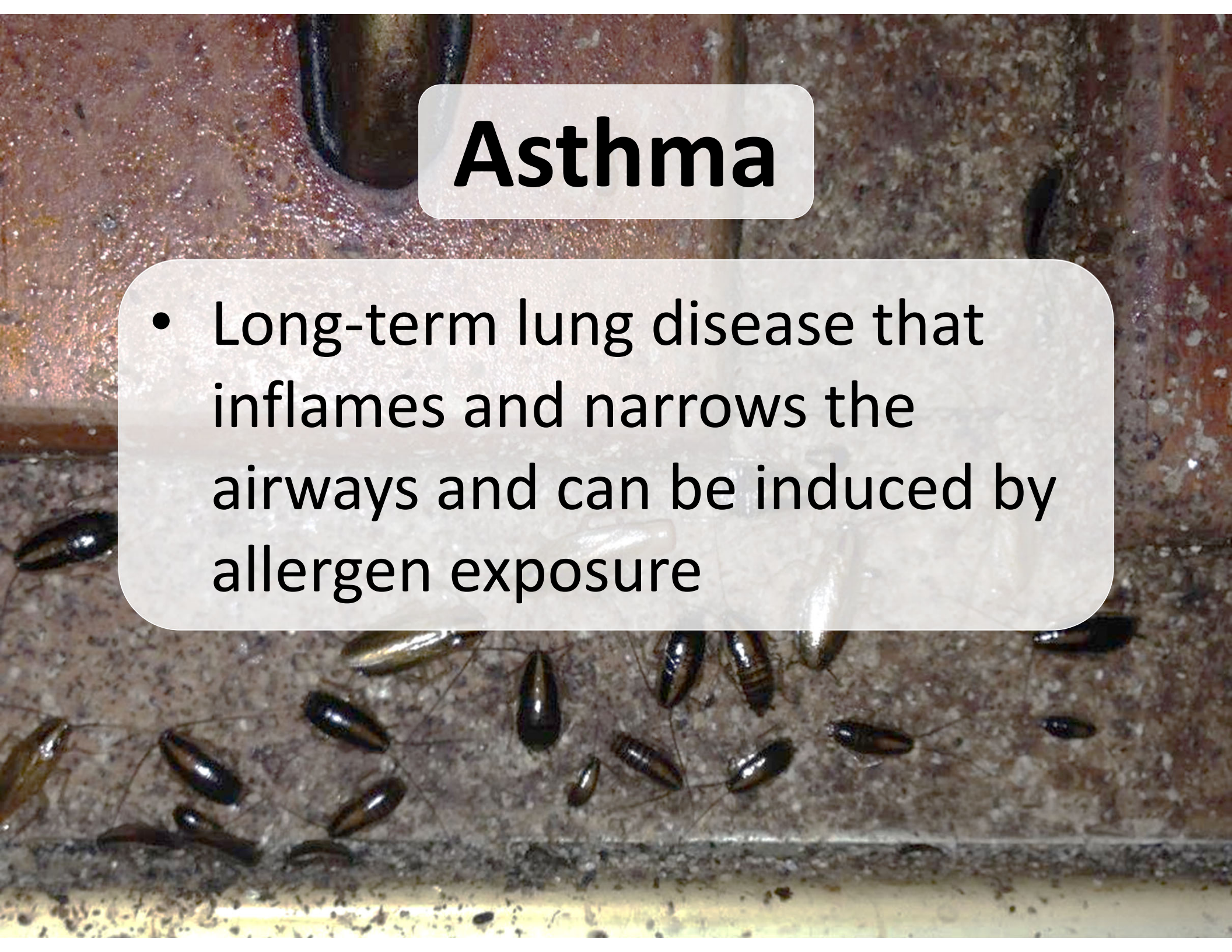
# Allergy

- Hypersensitivity to an allergen that produces an over-reaction of the immune system
  - Requires pre-sensitization



# Asthma

- Long-term lung disease that inflames and narrows the airways and can be induced by allergen exposure



# Importance of Asthma

- Number of people currently affected in the United States  
**>25 million (>7 million children)**
- Estimated cost in the United States  
**\$82 billion annually**
- Percentage of US population allergic to cockroaches  
**>26%** (44-81% for inner-city children with asthma)

# **Asthma Disproportionally Effects Children, Women, Minorities, and those Living in Poverty**

- Children have 2x as many ER visits compared to adults
- Asthma associated deaths are 2x higher in women compared to men
- Asthma hospitalization rate is 3x higher among African Americans compared to Caucasians
- Low-income environments were found to be associated with the development of asthma



## Risks Factors:

- Pollution
- Moisture
- Air circulation
- Allergen levels
- Diet

Asthma

Through cockroach control alone,  
we can reduce or eliminate the  
environmental factor

ment

~~environment~~

~~environment~~

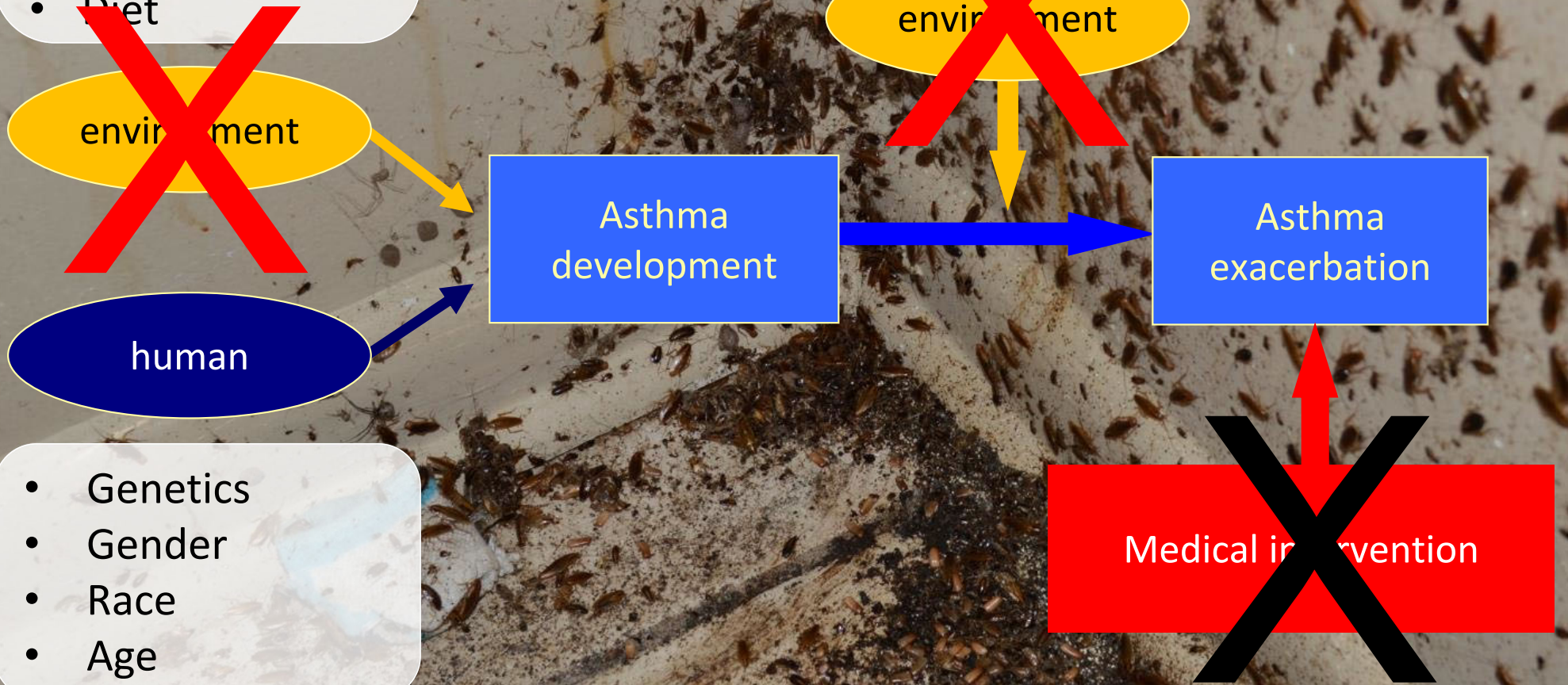
Asthma  
development

Asthma  
exacerbation

human

- Genetics
- Gender
- Race
- Age

~~Medical intervention~~





# Source Reduction

- e.g. cockroach control
  - No roaches = no allergen production
- Critical for cockroach allergen mitigation, but often overlooked by clinicians



# Implications

- Cockroach control alone can mitigate health risks from cockroach allergens
- Do bed bugs pose a similar risk?



Photo courtesy of B. Campbell



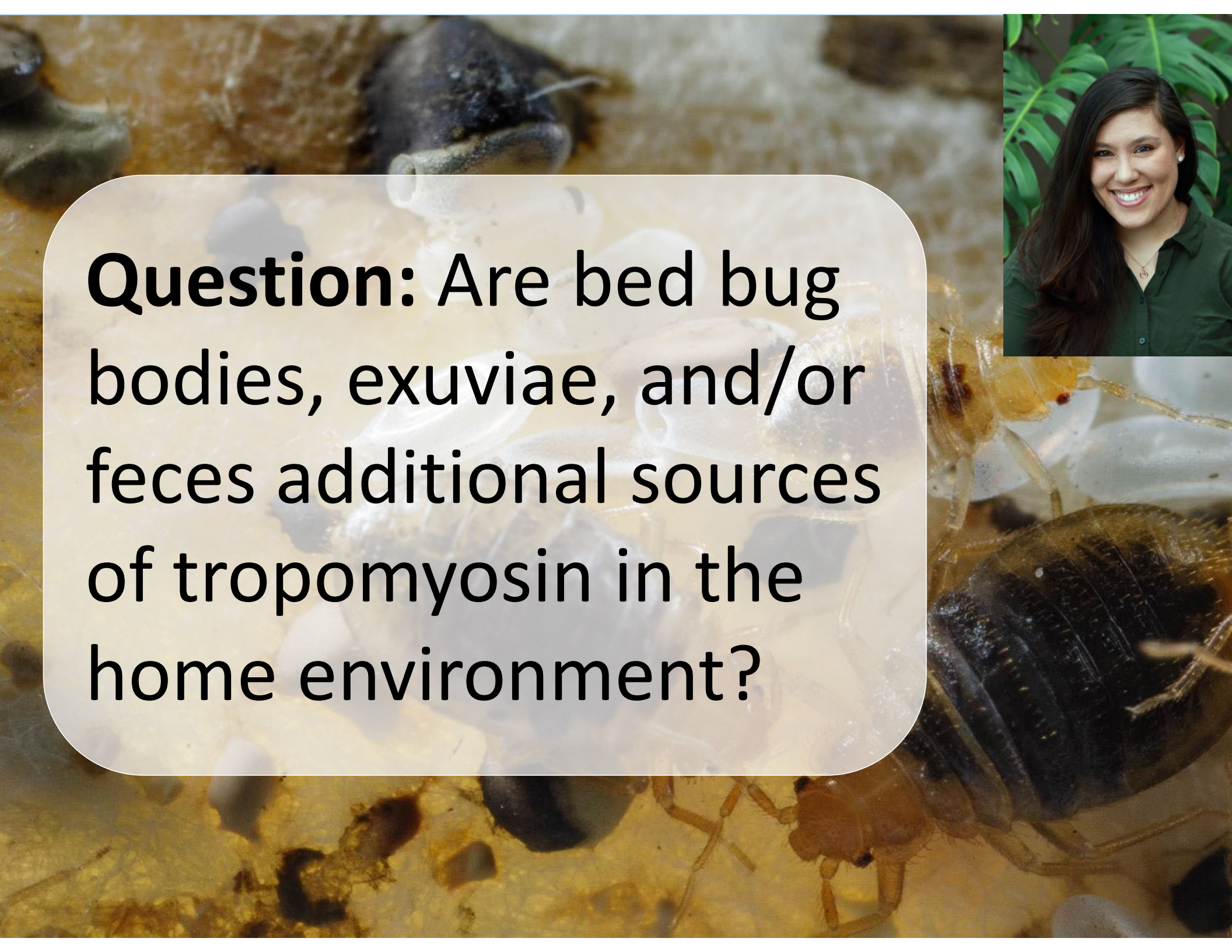
Photo courtesy of Peter Wendorf (Rose Pest Solutions)

# Tropomyosin

- Long fibrous protein found in muscles
- Ubiquitous among all animals, but structures varies by group
- Known Pan Allergen

# Pan Allergen

- An allergenic protein, found across different organisms, that can cause cross-reactivity across distantly-related species
- Cross-reactivity: when the proteins in one organism are similar to the proteins in another – results in similar immune response

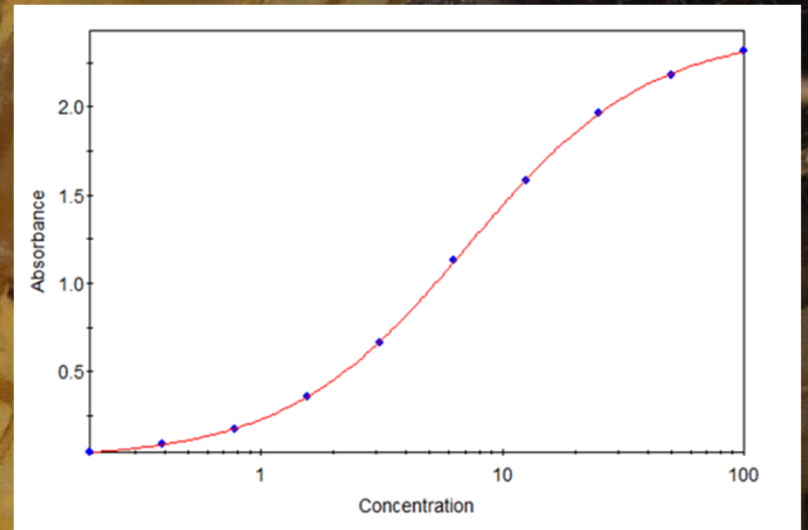
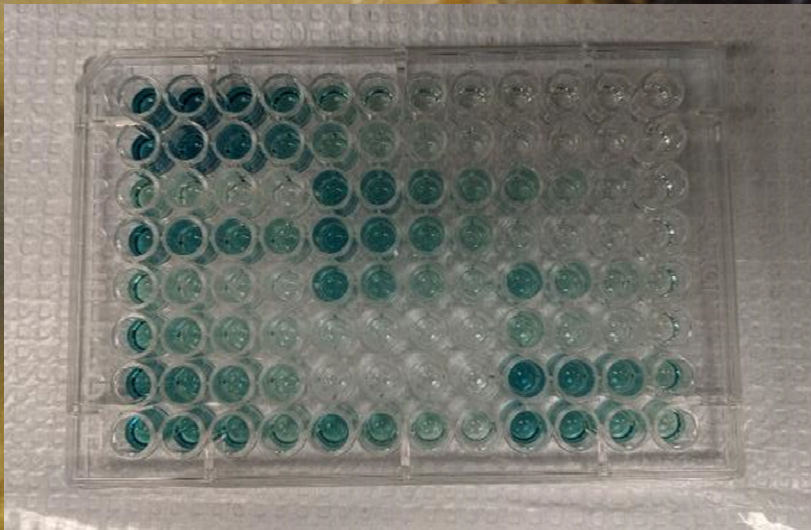


**Question:** Are bed bug bodies, exuviae, and/or feces additional sources of tropomyosin in the home environment?

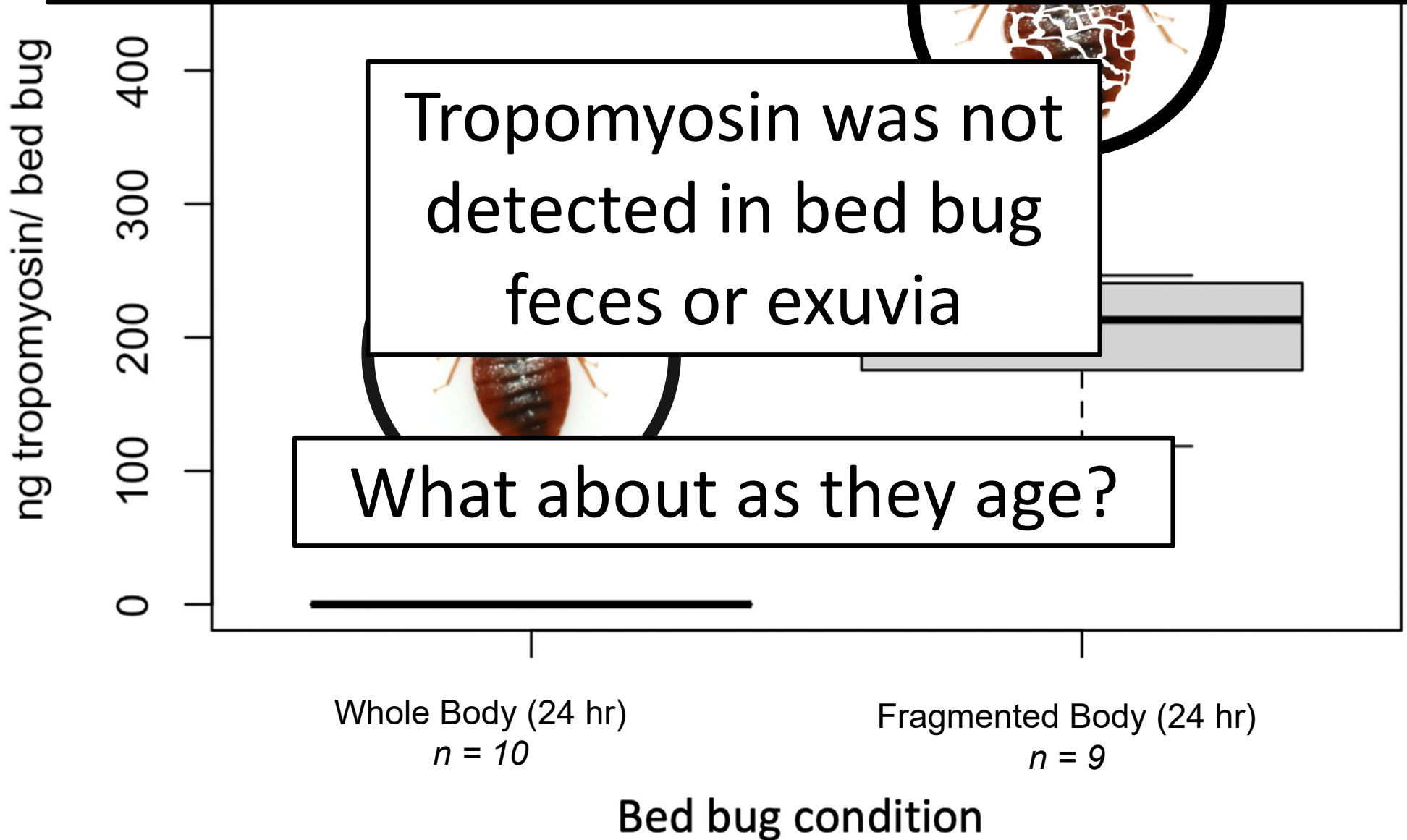




# Tropomyosin Analysis

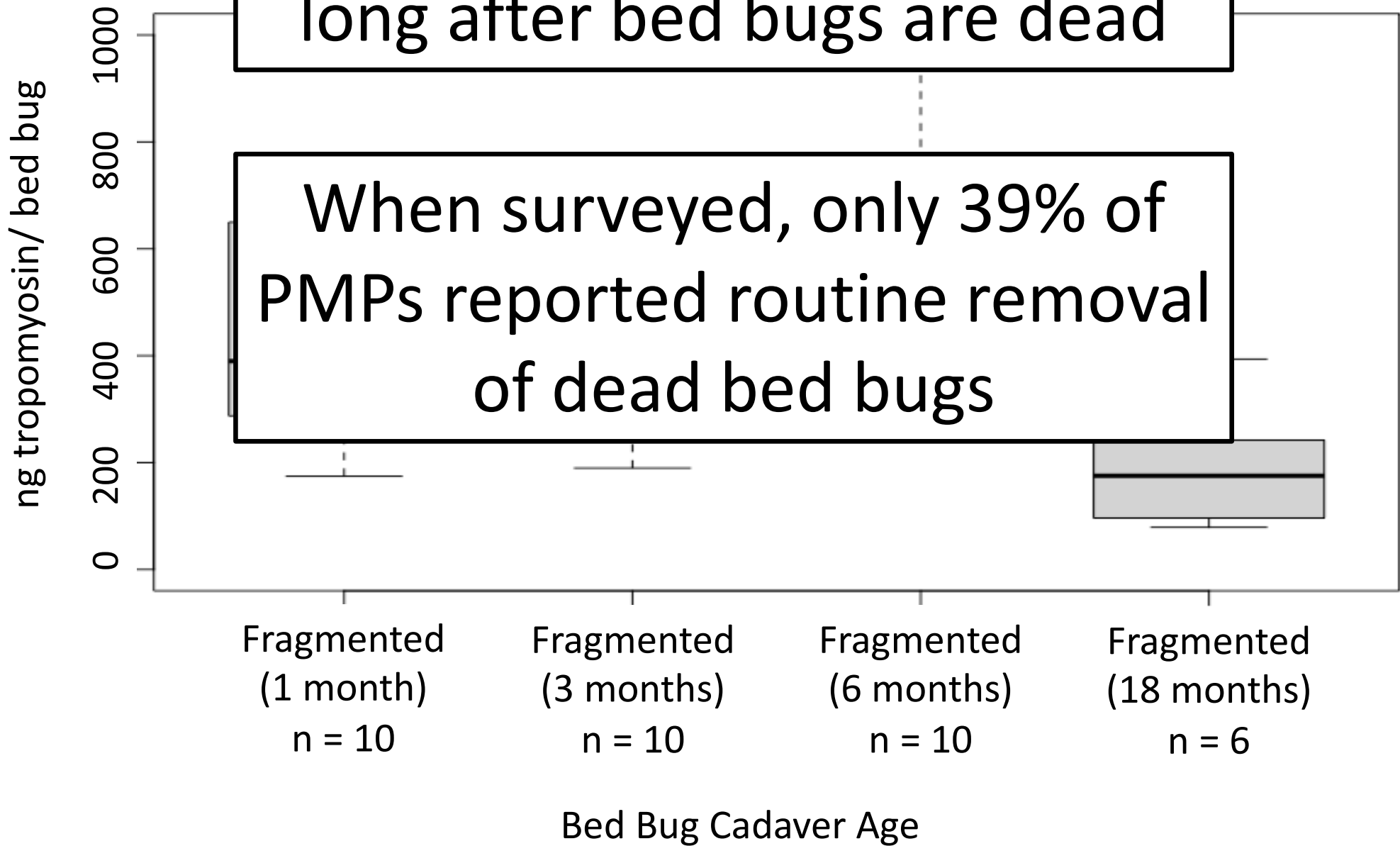


# Bed bug bodies must be ground to release tropomyosin into the environment



Bed bug tropomyosin persists long after bed bugs are dead

When surveyed, only 39% of PMPs reported routine removal of dead bed bugs



# Implications

- Bed bug cadavers may act as ticking “tropomyosin” time bombs
  - Could also be true for other indoor allergens!
- If we don't remove dead insects, we may be trading one problem for another.

# Bed Bug Histamine



**Insect Pheromones**

**Bed Bug Aggregation Pheromone Finally Identified\*\***

*Regine Gries, Robert Britton,\* Michael Holmes, Huimin Zhai, Jason Draper, and Gerhard Gries\**

**Aggregation Pheromone**

1. Dimethyl disulfide
2. Dimethyl trisulfide
3. (E)-2-hexenal
4. (E)-2-octenal
5. 2-hexanone
6. Histamine



**Insect Pheromones**

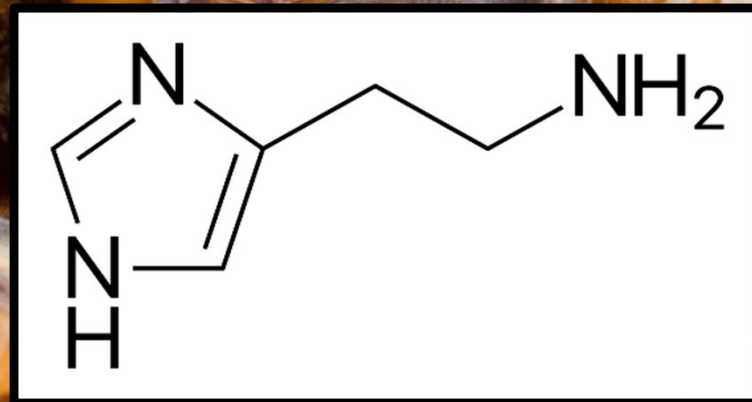


**Bed Bug Aggregation Pheromone Finally Identified\*\***

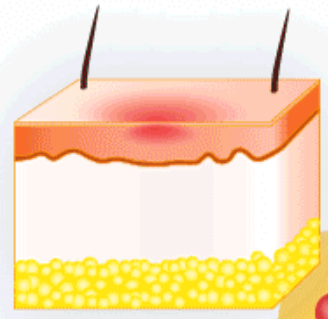
*Regine Gries, Robert Britton,\* Michael Holmes, Huimin Zhai, Jason Draper, and Gerhard Gries\**

**Aggregation Pheromone**

1. Dimethyl disulfide
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3. (E)-2-hexenal
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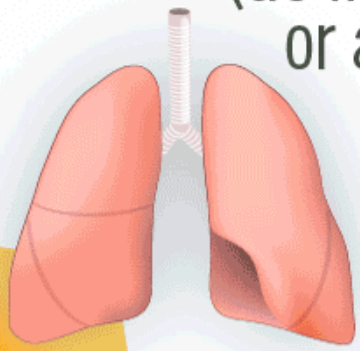
Swelling and Inflammation



Adrenaline Release



Bronchoconstriction (as in asthma or allergies)

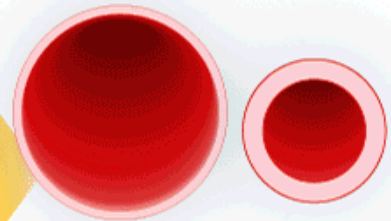


# Activated Histamine

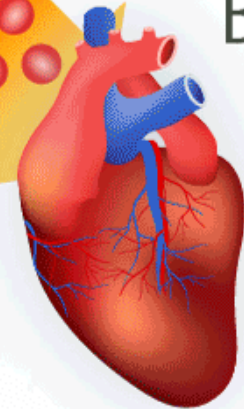
Stimulation of Gastric Acid Secretion



Dilation of Blood Vessels



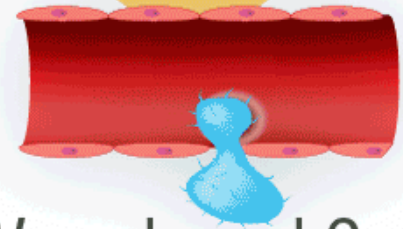
Frequent Heartbeat



Blood Clotting



Vessels and Capillaries Increase In Permeability





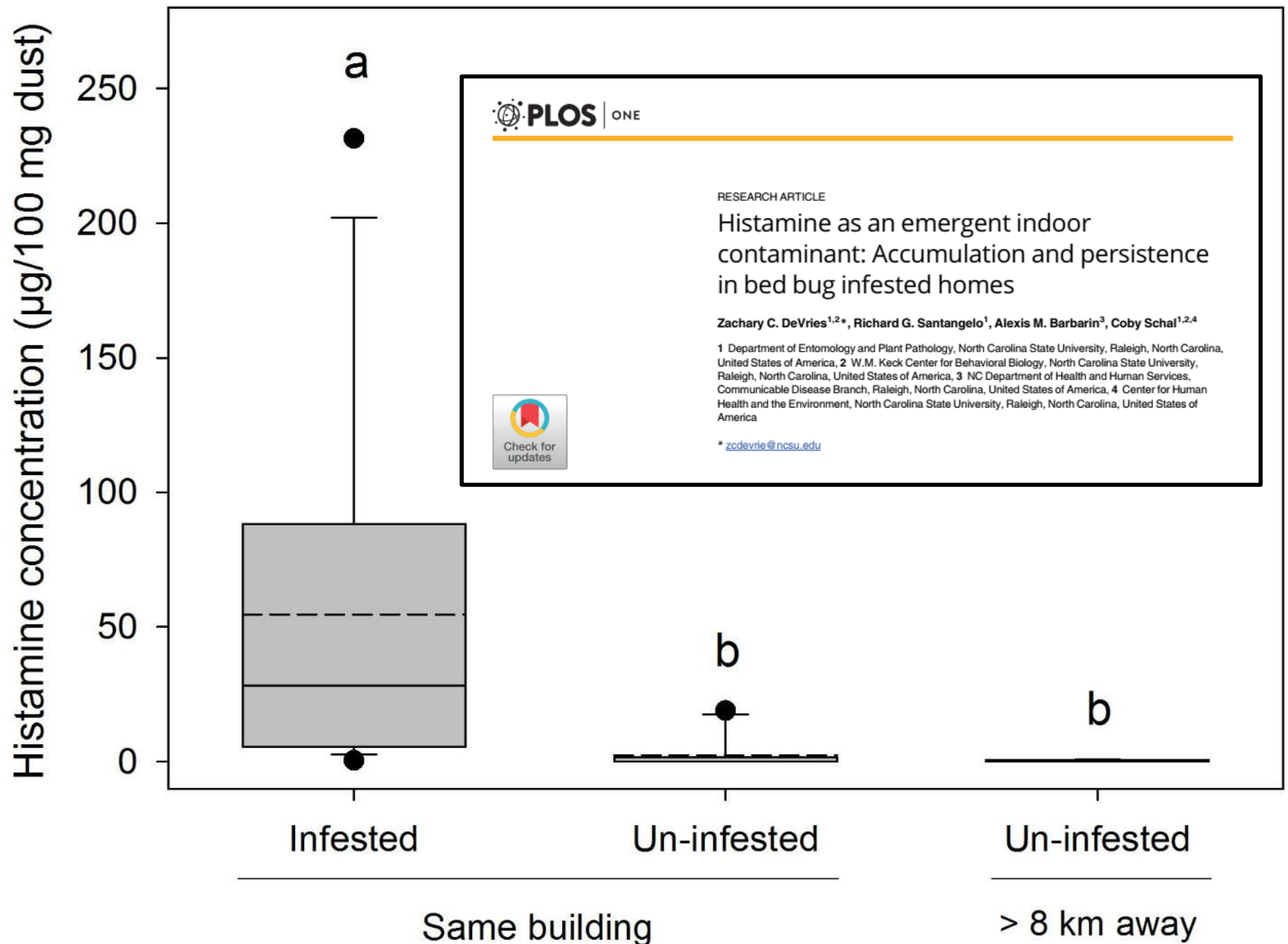
**Does histamine  
accumulate indoors?**



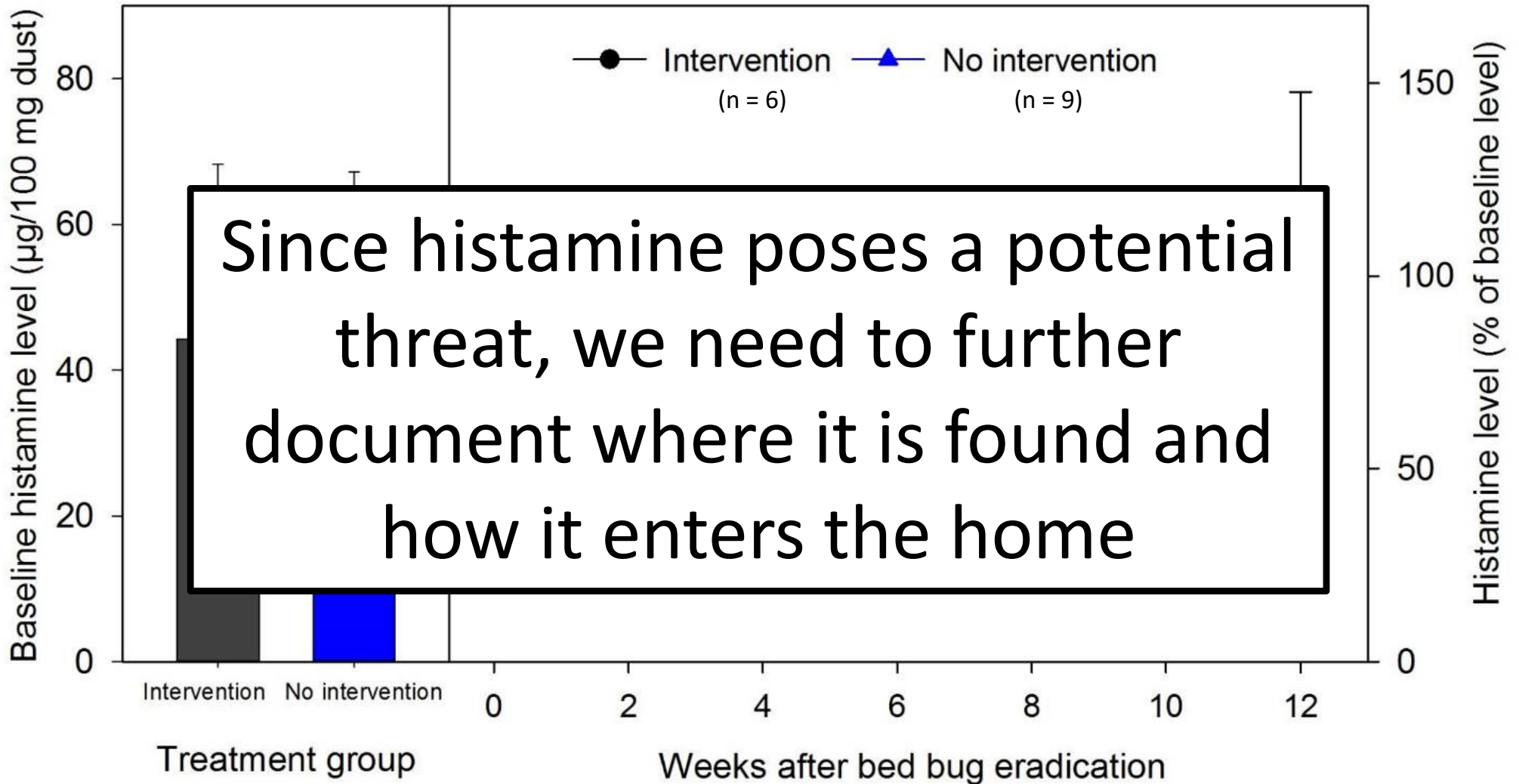




# Histamine is found in bed bug infested homes

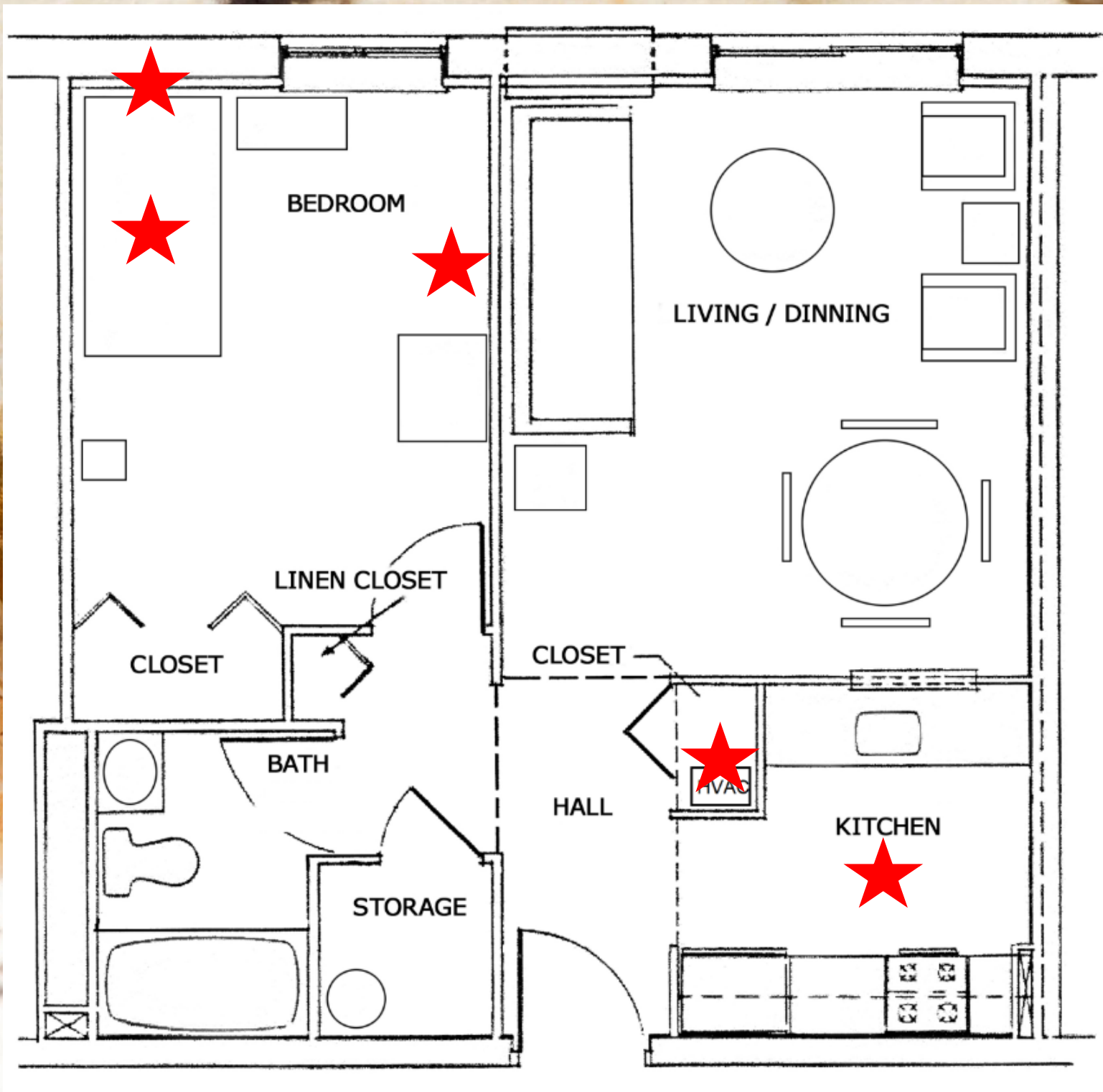


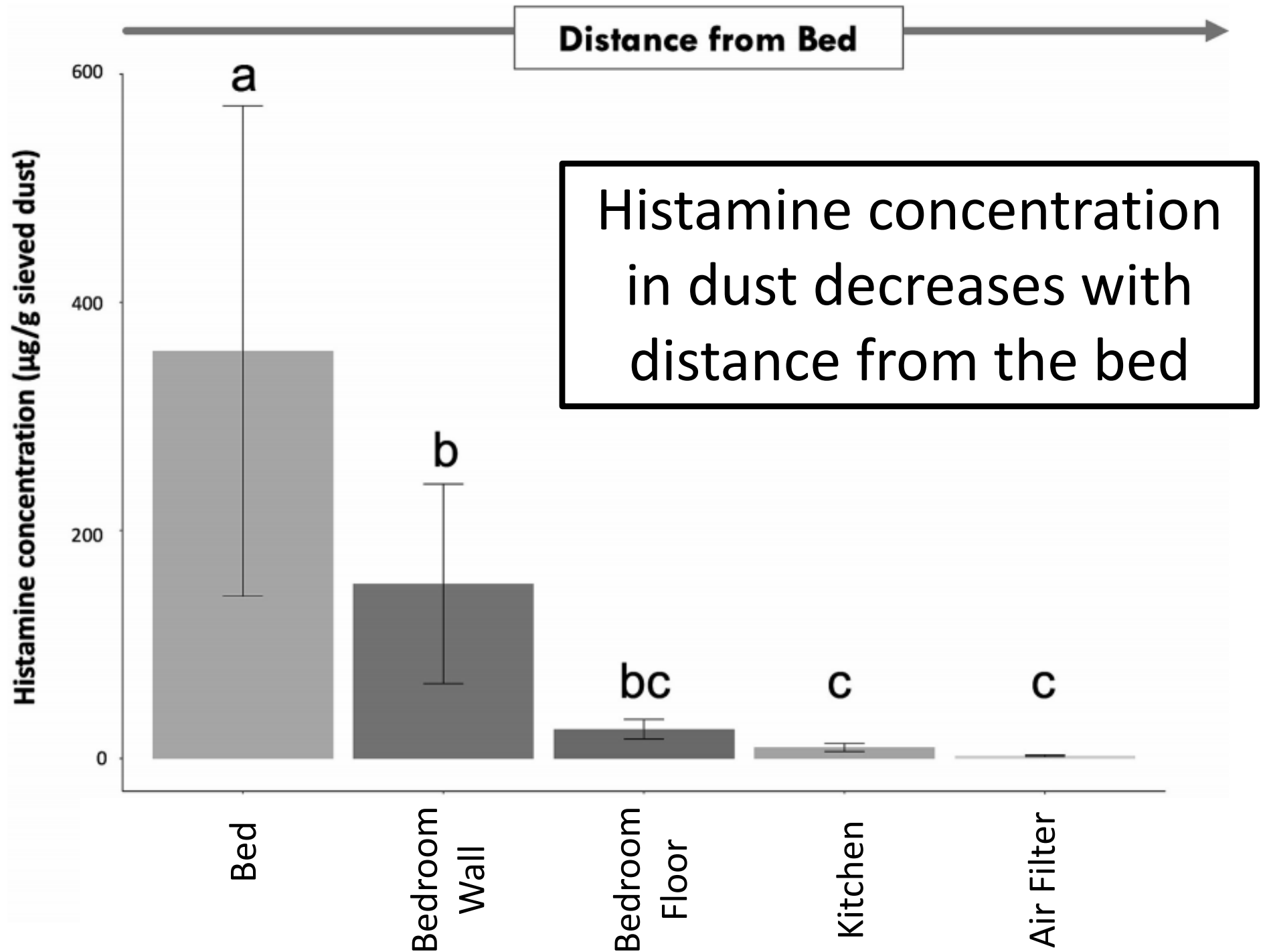
# Histamine persists after bed bug eradication



# Where is histamine found indoors?









# Is histamine unique to bed bugs?



# Histamine Screening

- Standardized collection kit
- Collection from rearing containers
- 3 replicates per species
- Population size and life stage recorded



# Indoor Pests



Mold mite



Borer beetle



Fruit fly



Carpet beetle



Red flour beetle



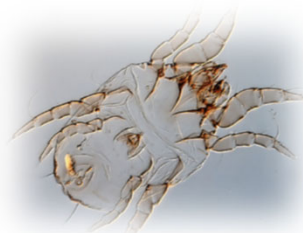
Oriental cockroach



American cockroach



Grocer's itch mite



House dust mite



German cockroach



House fly



Indianmeal moth

# Blood Feeders



Cat flea



Yellow fever mosquito



Lone star tick

# Hemipterans

## Plant feeding Hemipteran



Brown marmorated stink bug

## Blood feeding Hemipterans



Bed bug



Bat bug



Tropical Bed bug



*Triatoma rubida*



*Rhodnius prolixus*

Kissing bugs

Histamine detection	Presence/Absence
<b>Indoor pests</b>	
German cockroach ( <i>Blattella germanica</i> )	
American cockroach ( <i>Periplaneta americana</i> )	
Oriental cockroach ( <i>Blatta orientalis</i> )	
Eastern subterranean termite ( <i>Reticulitermes flavipis</i> )	
House fly ( <i>Musca domestica</i> )	
Fruit fly ( <i>Drosophila melanogaster</i> )	
Indian meal moth ( <i>Plodia interpuctella</i> )	
Varied carpet beetle ( <i>Anthrenus verbasci</i> )	
Borer beetle ( <i>Oligomerus ptilinoides</i> )	
Red flour beetle ( <i>Tribolium castaneum</i> )	
House dust mite ( <i>Dermatophagoides farinae</i> )	
Mold mite ( <i>Glycyphagus domesticus</i> )	
Grocer's mite ( <i>Glycyphagus domesticus</i> )	
<b>Blood-feeding species</b>	
Yellow fever mosquito ( <i>Aedes aegypti</i> )	
Lone star tick ( <i>Amblyomma americanum</i> )	
Cat flea ( <i>Ctenocephalides felis</i> )	
<b>Phytophagous Hemipterans</b>	
Brown marmorated stink bug ( <i>Halyomorpha halys</i> )	
<b>Blood-feeding Hemipterans</b>	
Bed bug ( <i>Cimex lectularius</i> )	
Bat bug ( <i>Cimex adjunctus</i> )	
Tropical bed bug ( <i>Cimex hemipterus</i> )	
Kissing bug ( <i>Rhodnius prolixus</i> )	
Kissing bug ( <i>Triatoma rubida</i> )	

Principato et al.,  
2023, J. Medical.  
Entomology

Histamine detection	Presence/Absence
<b>Indoor pests</b>	
German cockroach ( <i>Blattella germanica</i> )	✗
American cockroach ( <i>Periplaneta americana</i> )	✗
Oriental cockroach ( <i>Blatta orientalis</i> )	✗
Eastern subterranean termite ( <i>Reticulitermes flavipis</i> )	✗
House fly ( <i>Musca domestica</i> )	✗
Fruit fly ( <i>Drosophila melanogaster</i> )	✗
Indian meal moth ( <i>Plodia interpuctella</i> )	✗
Varied carpet beetle ( <i>Anthrenus verbasci</i> )	✗
Borer beetle ( <i>Oligomerus ptilinoides</i> )	✗
Red flour beetle ( <i>Tribolium castaneum</i> )	✗
House dust mite ( <i>Dermatophagoides farinae</i> )	✗
Mold mite ( <i>Glycyphagus domesticus</i> )	✗
Grocer's mite ( <i>Glycyphagus domesticus</i> )	✗
<b>Blood-feeding species</b>	
Yellow fever mosquito ( <i>Aedes aegypti</i> )	
Lone s	
Cat fle	
<b>Phyto</b>	
Brown	
<b>Blood</b>	
Bed b	
Bat b	
Tropical bed bug ( <i>Cimex hemipterus</i> )	
Kissing bug ( <i>Rhodnius prolixus</i> )	
Kissing bug ( <i>Triatoma rubida</i> )	

**Histamine not detected  
in any other common  
indoor arthropods**

Histamine detection	Presence/Absence
<b>Indoor pests</b>	
German cockroach ( <i>Blattella germanica</i> )	✗
American cockroach ( <i>Periplaneta americana</i> )	✗
Oriental cockroach ( <i>Blatta orientalis</i> )	✗
Eastern House f	
Fruit fly	
Indian r	
Varied c	
Borer b	
Red flo	
House dust mite ( <i>Dermatophagoides farinae</i> )	✗
Mold mite ( <i>Glycyphagus domesticus</i> )	✗
Grocer's mite ( <i>Glycyphagus domesticus</i> )	✗
<b>Blood-feeding species</b>	
Yellow fever mosquito ( <i>Aedes aegypti</i> )	✗
Lone star tick ( <i>Amblyomma americanum</i> )	✗
Cat flea ( <i>Ctenocephalides felis</i> )	✗
<b>Phytophagous Hemipterans</b>	
Brown marmorated stink bug ( <i>Halyomorpha halys</i> )	
<b>Blood-feeding Hemipterans</b>	
Bed bug ( <i>Cimex lectularius</i> )	
Bat bug ( <i>Cimex adjunctus</i> )	
Tropical bed bug ( <i>Cimex hemipterus</i> )	
Kissing bug ( <i>Rhodnius prolixus</i> )	
Kissing bug ( <i>Triatoma rubida</i> )	

**Histamine not  
detected in other  
blood feeding species**



Histamine detection	Presence/Absence
<b>Indoor pests</b>	
German cockroach ( <i>Blattella germanica</i> )	✗
American cockroach ( <i>Periplaneta americana</i> )	✗
Oriental cockroach ( <i>Blatta orientalis</i> )	✗
Eastern subterranean termite ( <i>Reticulitermes flavipis</i> )	✗
House fly	
Fruit fly ( <i>Drosophila melanogaster</i> )	
Indian meal moth ( <i>Plodia interpunctella</i> )	
Varied carpet beetle	
Borer beetle	
Red flour beetle	
House dust mite	
Mold mite ( <i>Glycyphagus domesticus</i> )	✗
Grocer's mite ( <i>Glycyphagus domesticus</i> )	✗
<b>Blood-feeding species</b>	
Yellow fever mosquito ( <i>Aedes aegypti</i> )	✗
Lone star tick ( <i>Amblyomma americanum</i> )	✗
Cat flea ( <i>Ctenocephalides felis</i> )	✗
<b>Phytophagous Hemipterans</b>	
Brown marmorated stink bug ( <i>Halyomorpha halys</i> )	✗
<b>Blood-feeding Hemipterans</b>	
Bed bug ( <i>Cimex lectularius</i> )	
Bat bug ( <i>Cimex adjunctus</i> )	
Tropical bed bug ( <i>Cimex hemipterus</i> )	
Kissing bug ( <i>Rhodnius prolixus</i> )	
Kissing bug ( <i>Triatoma rubida</i> )	

Histamine not found  
in a plant-feeding  
hemipteran

Histamine detection	Presence/Absence
<b>Indoor pests</b>	

Histamine appears to be common among blood feeding hemipterans

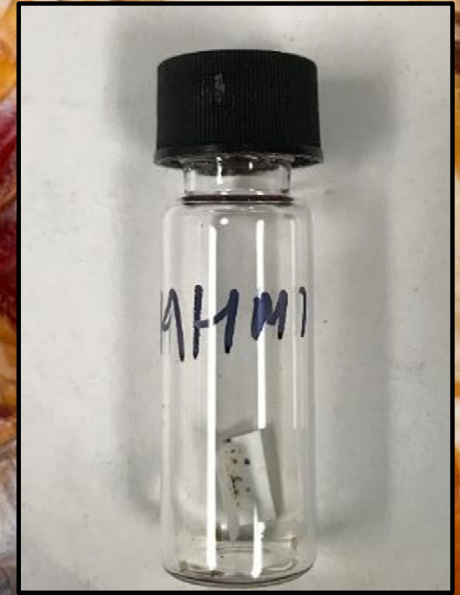
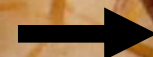
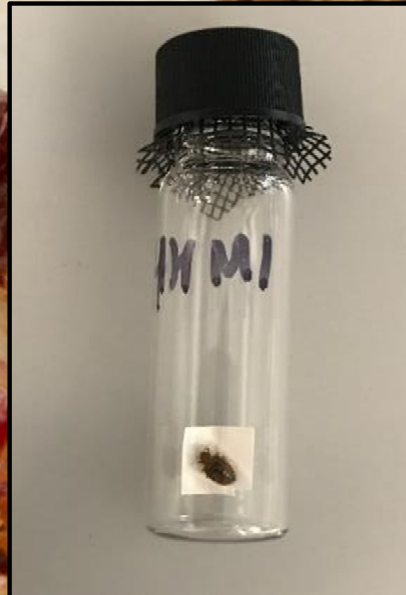
Bed bugs are the most important species to worry about for indoor contamination

Cat flea ( <i>Ctenocephalides felis</i> )	✗
<b>Phytophagous Hemipterans</b>	
Brown marmorated stink bug ( <i>Halyomorpha halys</i> )	✗
<b>Blood-feeding Hemipterans</b>	
Bed bug ( <i>Cimex lectularius</i> )	✓
Bat bug ( <i>Cimex adjunctus</i> )	✓
Tropical bed bug ( <i>Cimex hemipterus</i> )	✓
Kissing bug ( <i>Rhodnius prolixus</i> )	✓
Kissing bug ( <i>Triatoma rubida</i> )	✓

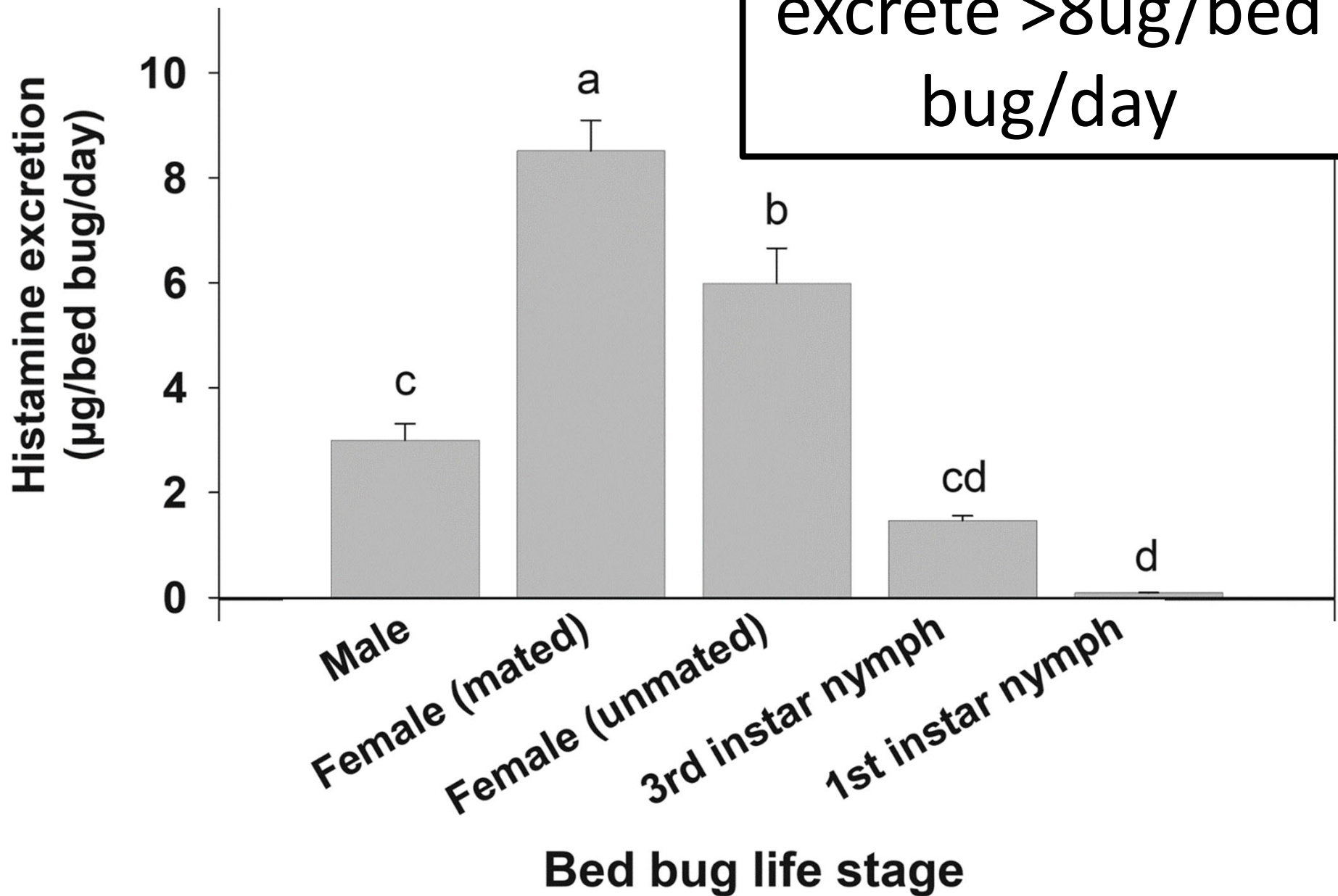
# Histamine excretion dynamics?

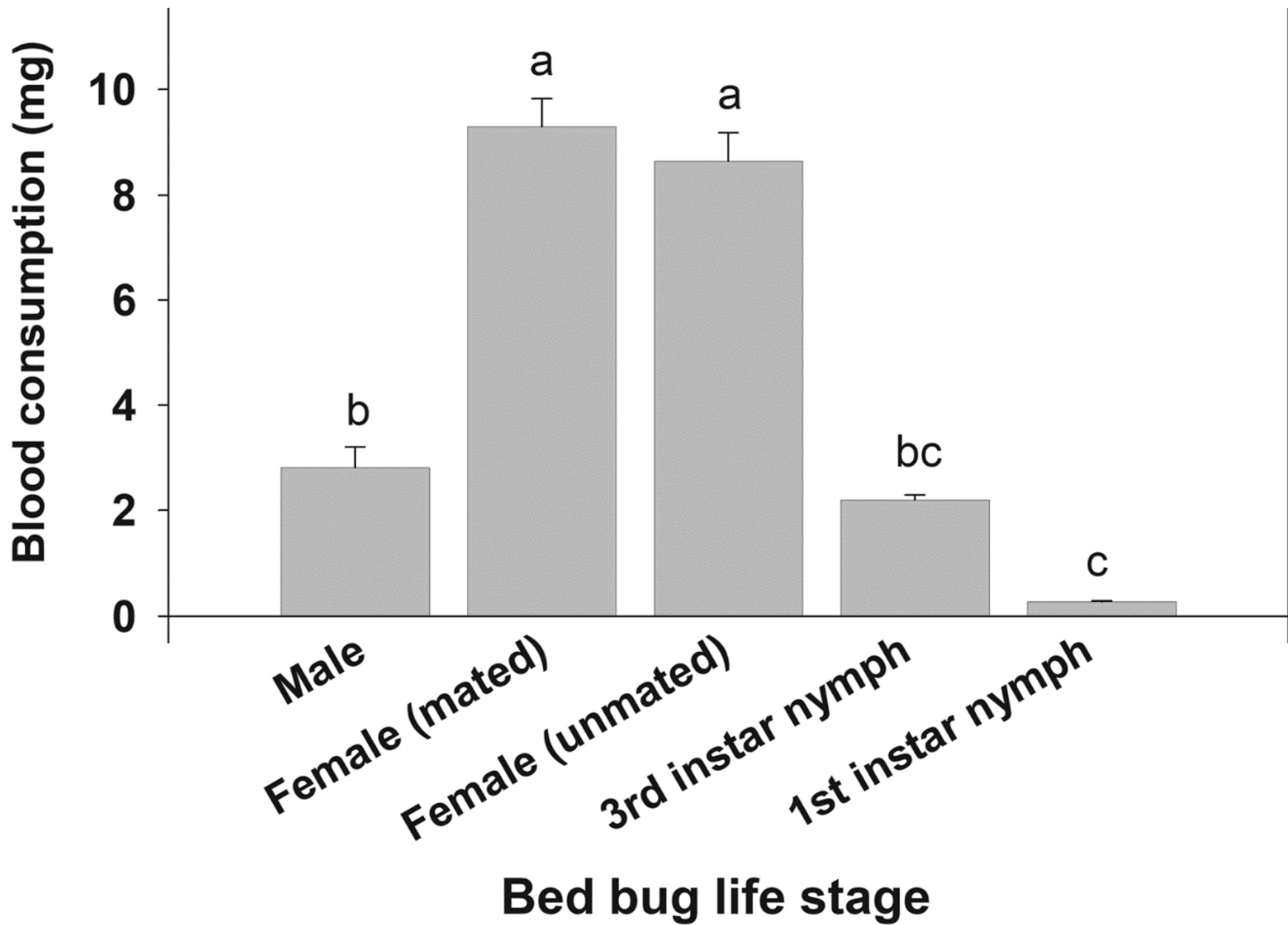


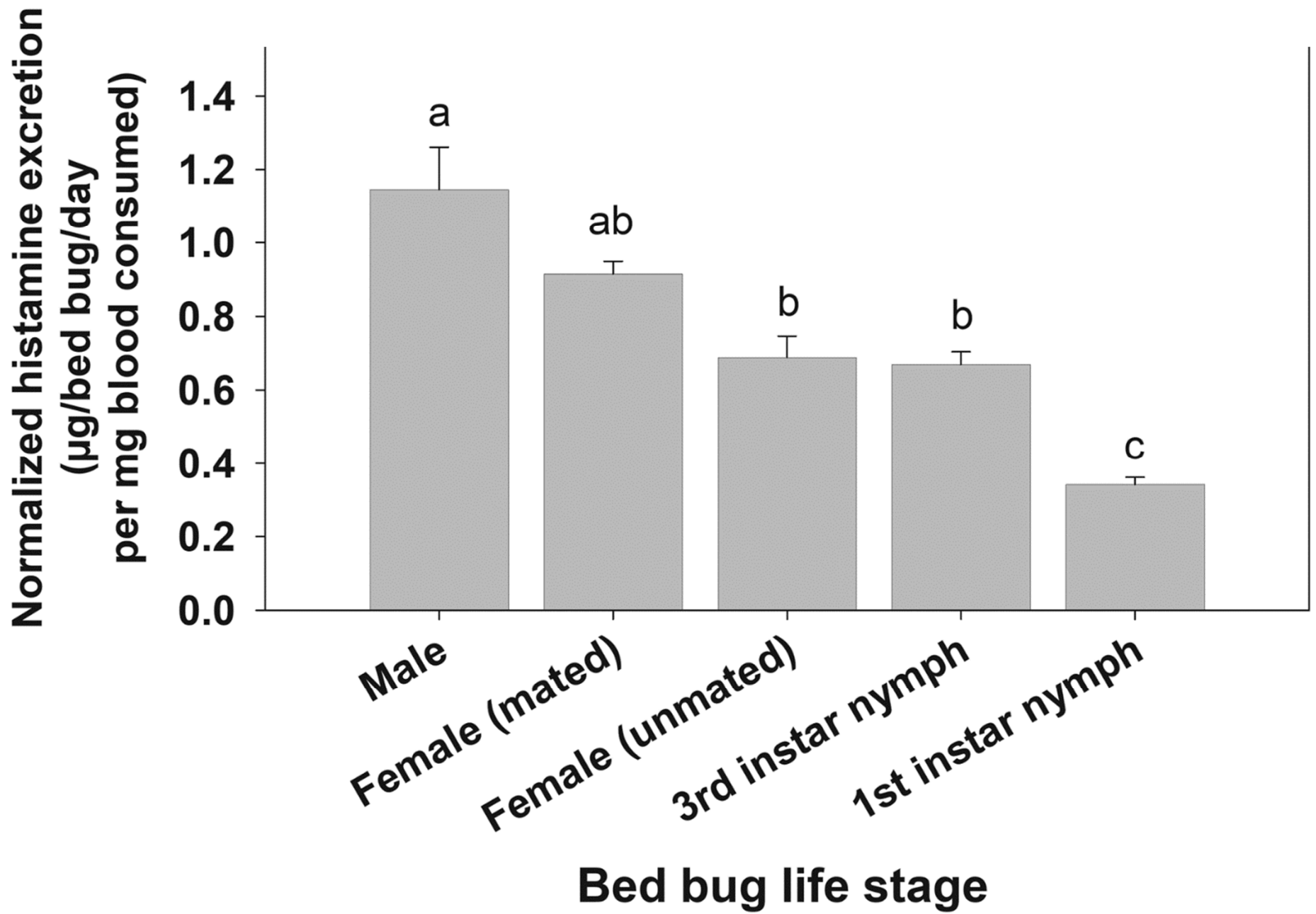
# Bed Bug Fecal Collection/Screening

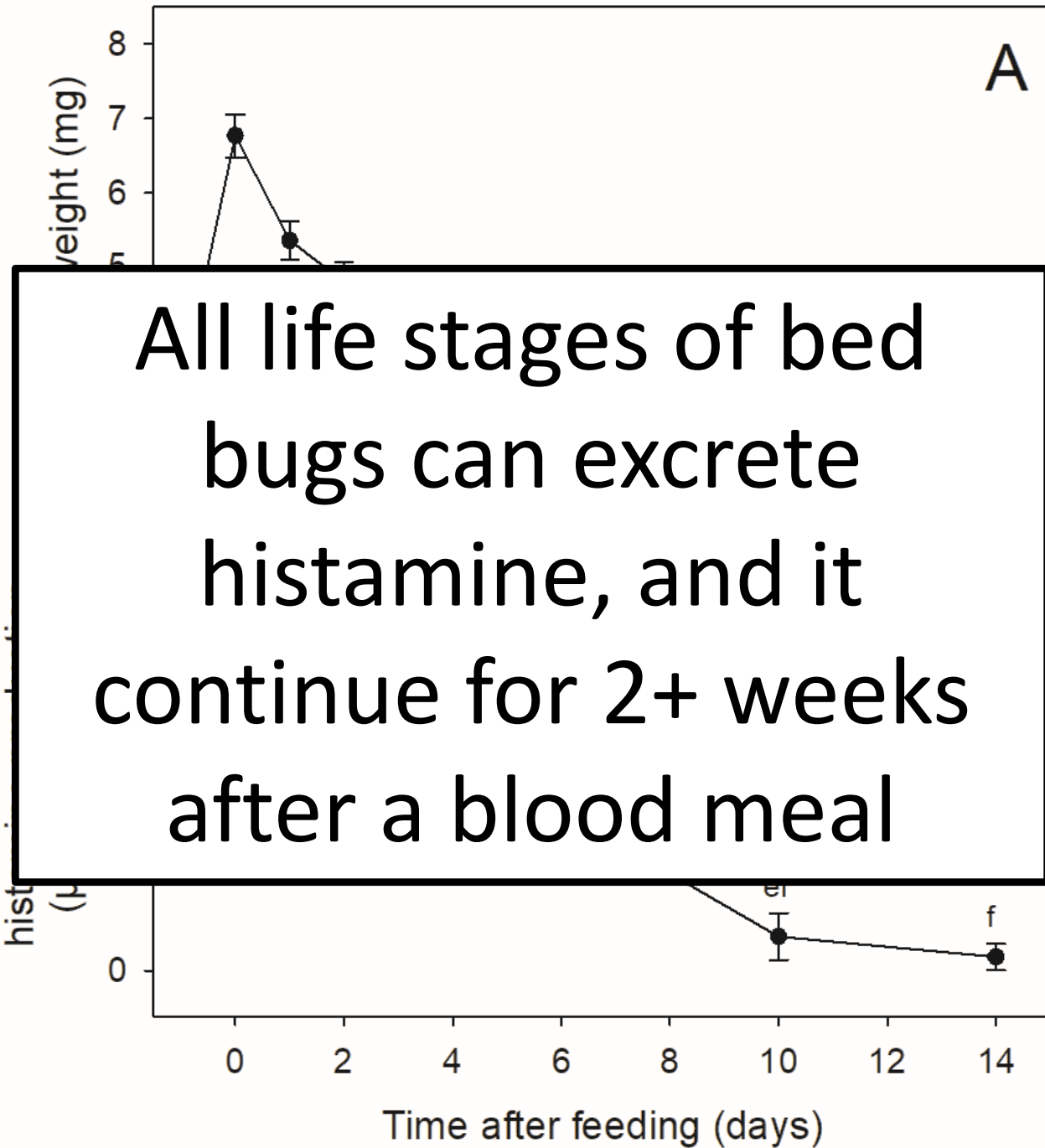


Bed bugs can excrete >8ug/bed bug/day







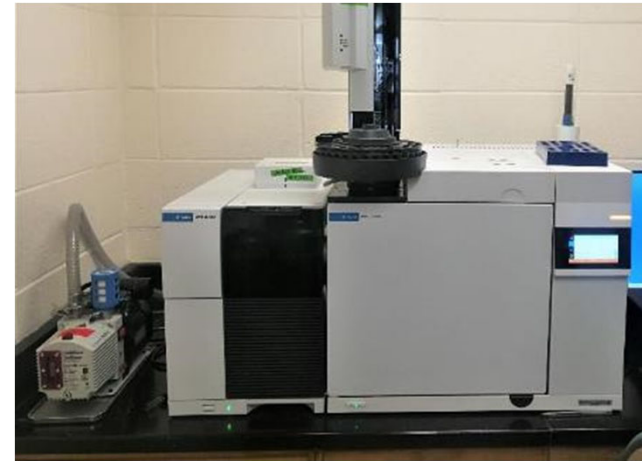




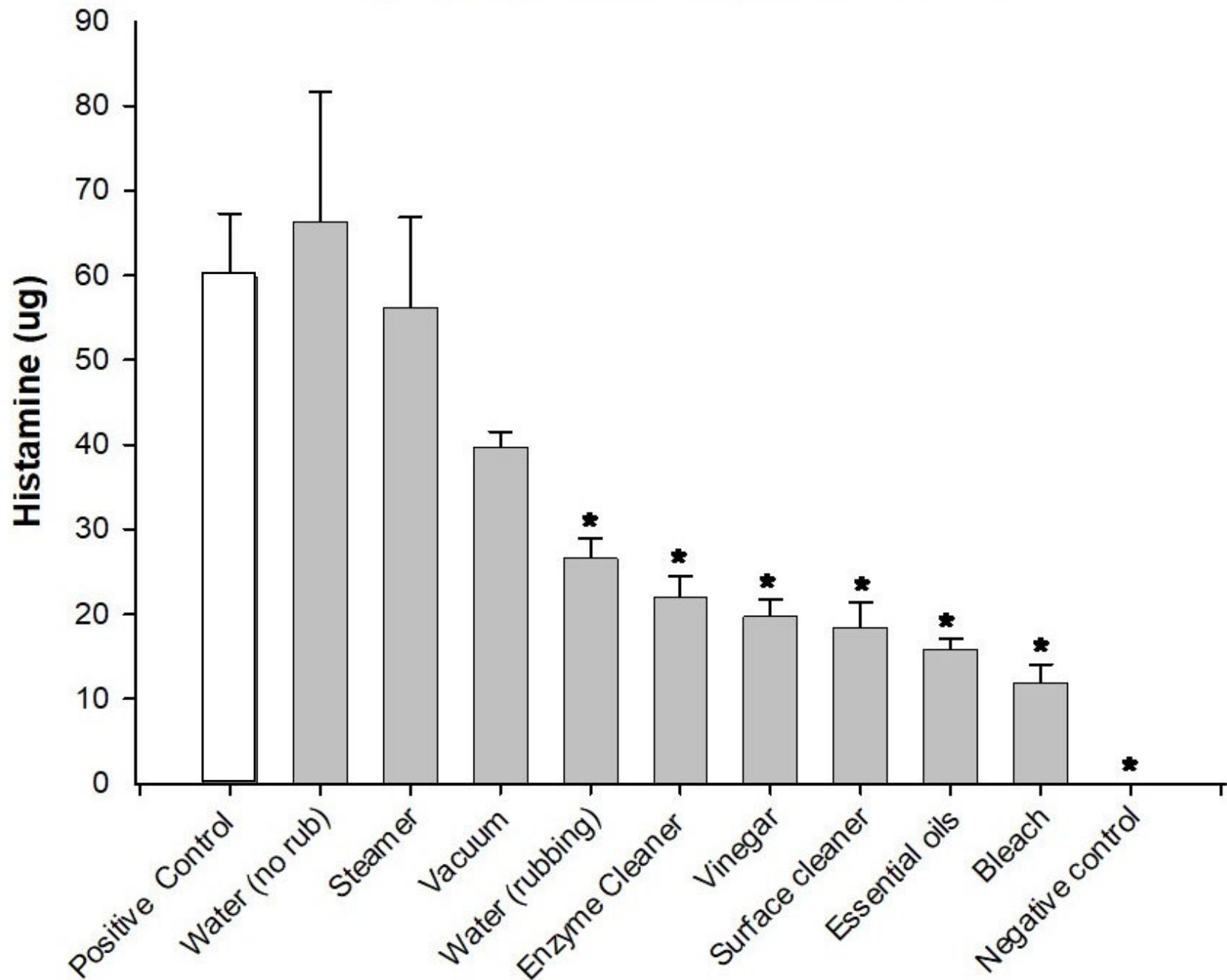
**How do we  
remove histamine  
from homes?**



# Histamine Cleaning/Removal



## Efficacy of soft cleaning methods in reducing histamine from unfinished wood



# Histamine and human health?



# Conclusions:



- Bed bugs can contaminate the indoor environment with both allergens and novel contaminants (histamine)
- Unclear what the long-term health effects are from exposure to exogenous histamine, but we suspect there is an effect

# Importance and Implications



- We don't have all the answers, but bed bug infestations pose a multitude of risks for people
- When we consider where they are predominantly found (low-income environments), this raises questions of environmental justice.

# Importance and Implications



- If we do our jobs and eliminate bed bugs, we can make a real difference; if we don't, we could leave people to deal with any number of negative health consequences
- The work we do matters!



# Thank You!



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EARLY  
INDEPENDENCE  
AWARD



Washington State  
COMMISSION ON  
PESTICIDE REGISTRATION



**Additional Funding Support:** Envu, Syngenta, Bedoukian Bio, CSI, BASF, FMC

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