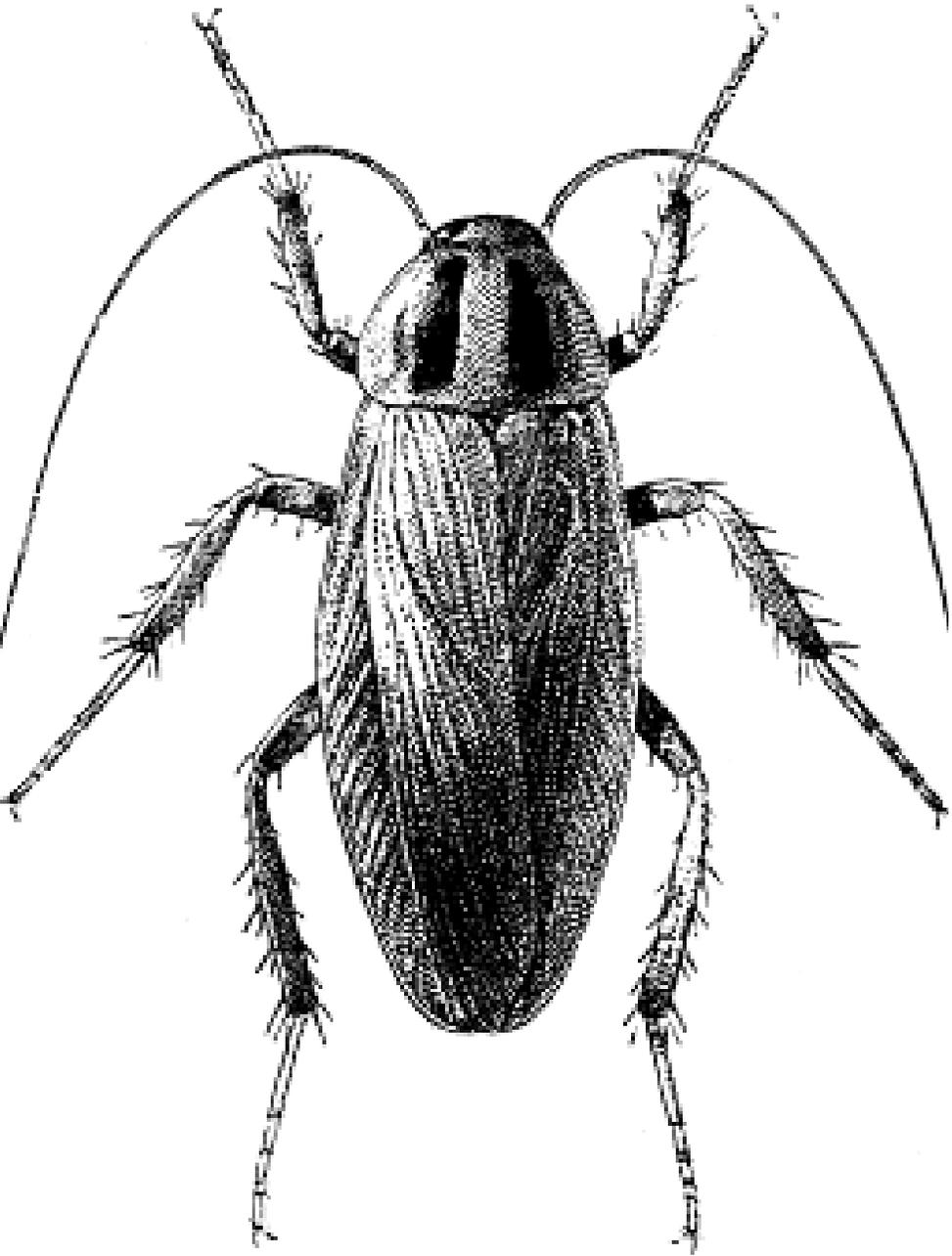
A close-up photograph of two dark brown cockroaches on a piece of light-colored wood. The wood is placed on a dark, textured surface, possibly carpet. The cockroaches are positioned one above the other, with their long antennae and legs visible. The background is dark and out of focus.

# Cockroach IPM in schools

Janet Hurley, ACE

Senior Extension Program Specialist – IPM

Texas A&M AgriLife Extension



# What are cockroaches?

---

- Insects in the Order Blattodea
  - gradual metamorphosis
  - flattened bodies
  - long antennae
  - shield-like pronotum covers head
  - spiny legs
- Over 3500 species worldwide
- 5 to 8 commensal pest species

# Medical Importance of Cockroaches

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- Vectors of disease pathogens
  - Food poisoning
  - Wound infection
  - Respiratory infection
  - Dysentery
- Allergens
  - a leading asthma trigger among inner city youth



# Health issues

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- Carriers of disease pathogens
  - *Mycobacteria*, *Staphylococcus*, *Enterobacter*, *Klebsiella*, *Citrobacter*, *Providencia*, *Pseudomonas*, *Acinetobacter*, *Flavobacter*
- Key focus of health inspectors looking for potential contaminants and filth in food handling areas



# Cockroaches are Everywhere

- No school is immune
  - Shipments
  - Visitors
  - Students





# Cockroach allergies



- 37% of inner-city children allergic to cockroaches (National Cooperative Inner-City Asthma Study)
- Increased incidence of asthma, missed school, hospitalization
- perennial allergic rhinitis

Not all cockroaches are  
created equal

---

# Four major species of cockroaches

- German cockroach
- American cockroach
- Oriental cockroach
- Smoky brown cockroach
- Others
  - Turkestan cockroach
  - brown-banded cockroach
  - woods cockroach

Initial  Scheduled  No Charge  Special  
Follow Up Service Date \_\_\_\_\_

### Findings

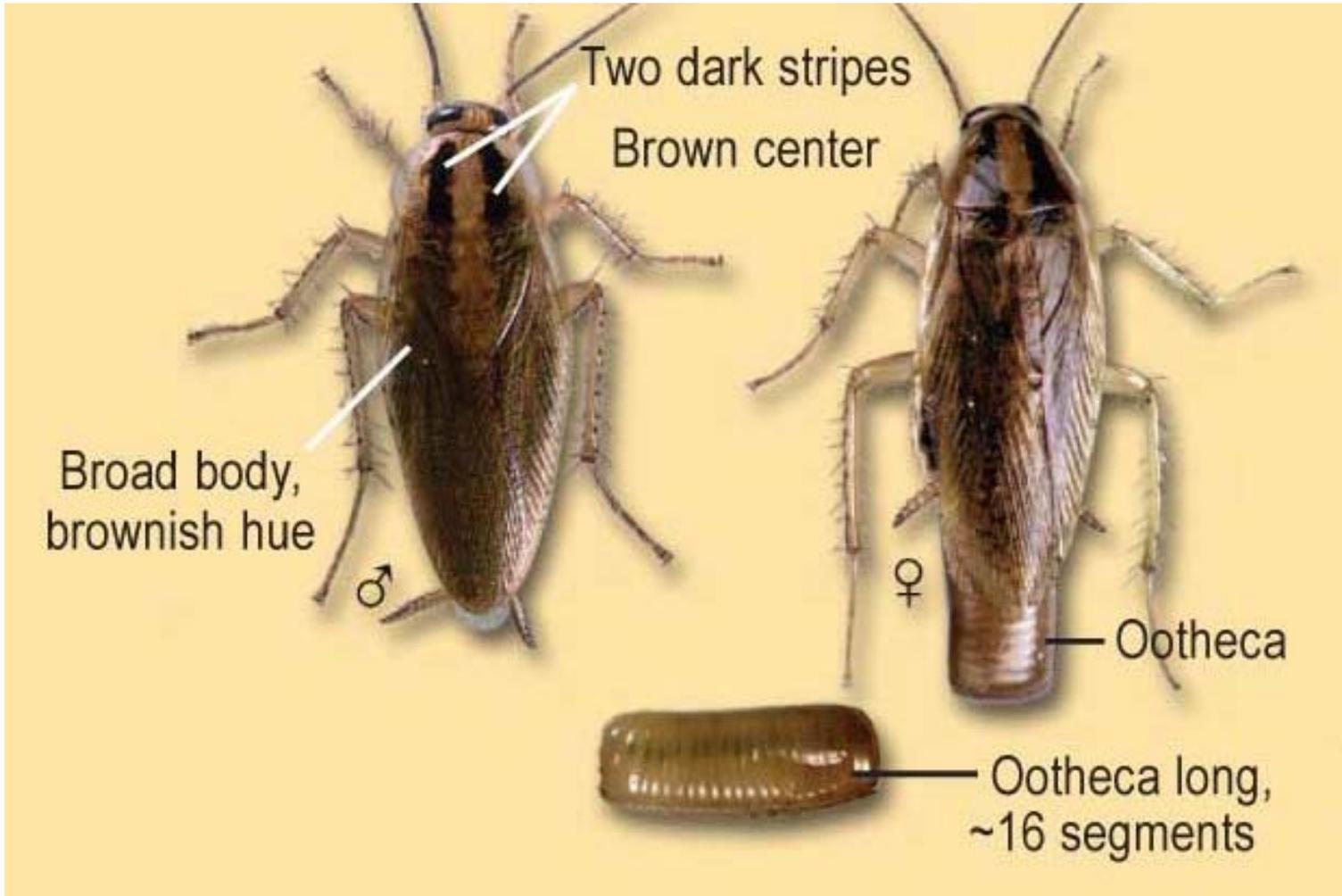
No activity detected. Performed preventive treatment for target pest(s).

<input type="checkbox"/> Ants	<input checked="" type="checkbox"/> American Roaches
<input type="checkbox"/> Carpenter Ants	<input type="checkbox"/> Brown Banded Roaches
<input type="checkbox"/> Fire Ants	<input type="checkbox"/> German Roaches
<input type="checkbox"/> Pharoah Ants	<input type="checkbox"/> Oriental Roaches
<input type="checkbox"/> Mice	<input type="checkbox"/> Smokey Brown Roaches
<input type="checkbox"/> Rats	<input type="checkbox"/> Crickets
<input type="checkbox"/> Flies	<input type="checkbox"/> Spiders
<input type="checkbox"/> Fleas	<input type="checkbox"/> Stored Product Pests
<input type="checkbox"/> Other _____	

Activity detected. Treatment applied for the following:

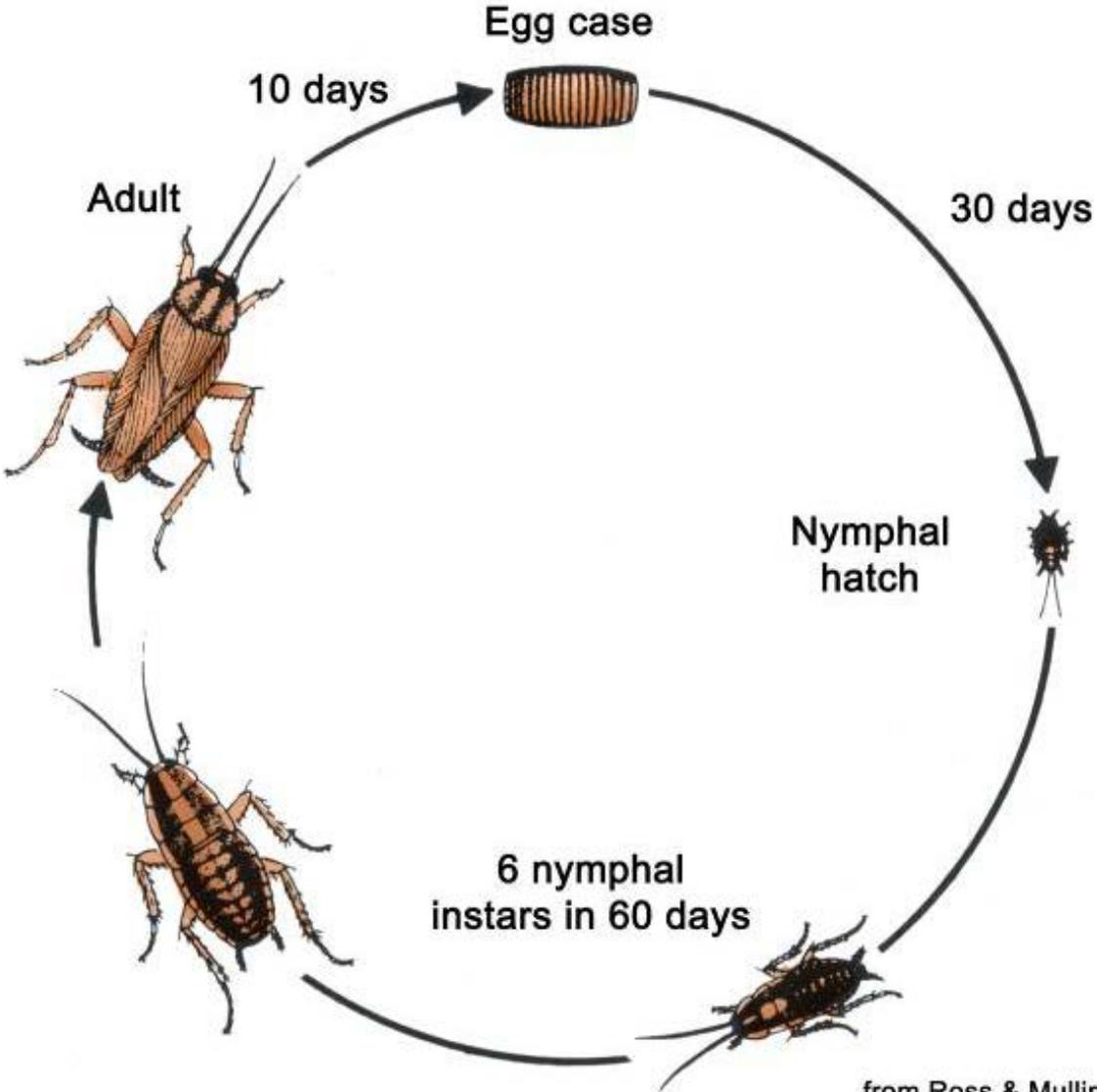
<input type="checkbox"/> Ants	<input type="checkbox"/> American Roaches
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<input type="checkbox"/> Mice	<input type="checkbox"/> Smokey Brown Roaches
<input type="checkbox"/> Rats	<input type="checkbox"/> Crickets
<input type="checkbox"/> Flies	<input type="checkbox"/> Spiders
<input type="checkbox"/> Fleas	<input type="checkbox"/> Stored Product Pests
<input type="checkbox"/> Other _____	

Our satisfaction is guaranteed. If needed, we will return \_\_\_\_\_ additional charge.



German  
cockroach,  
*Blatella  
germanica*

German  
cockroach  
life cycle



from Ross & Mullins 1995

# German cockroach



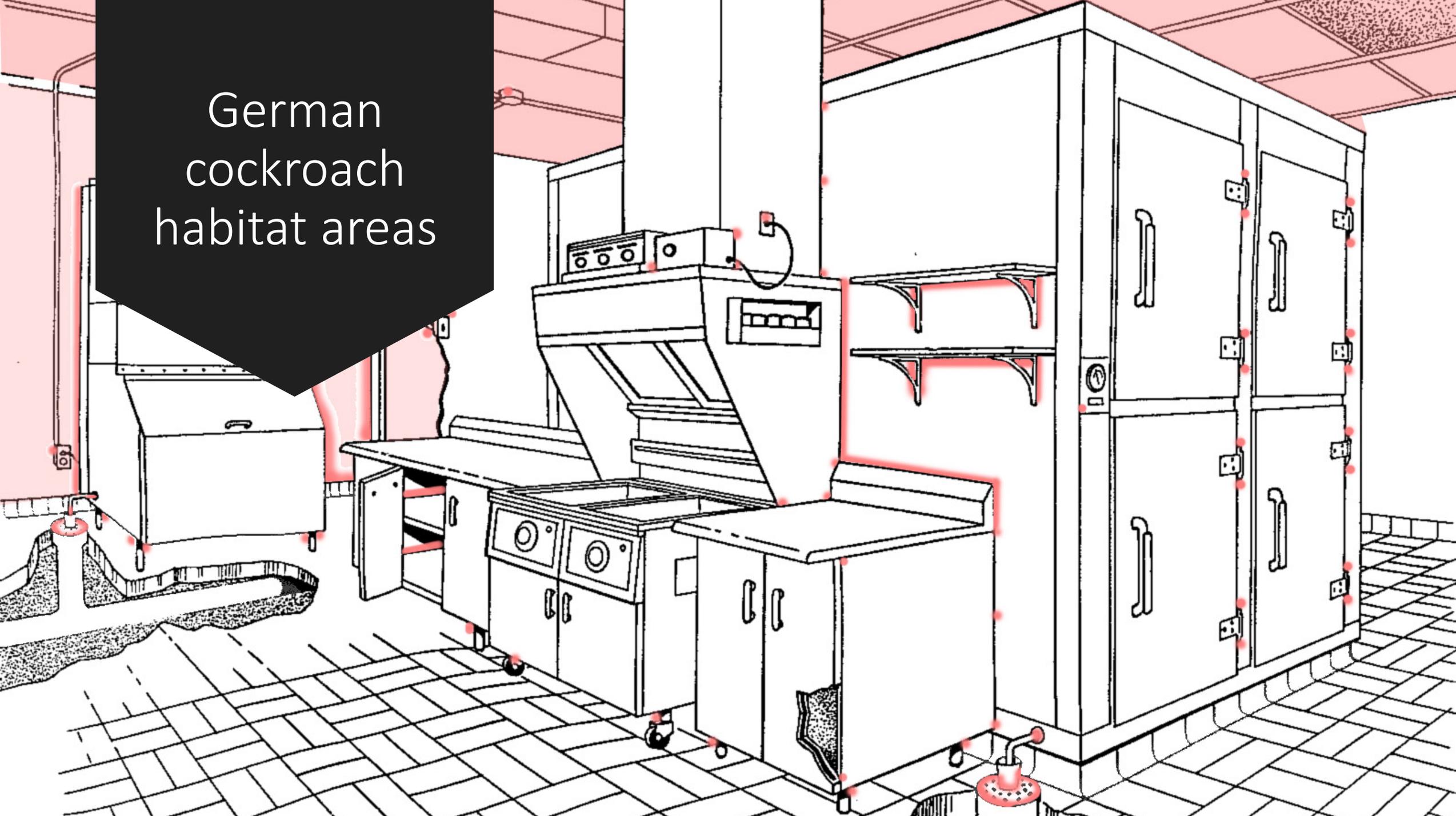
- ½ to 5/8” long (13-16 mm)
- High reproductive rate
  - 30-40 eggs/ootheca
  - 2 months from egg to adult
- Do not fly
- Found indoors in warm, moist areas in kitchens and bathrooms

# German cockroach nymphs



- 5-6 molts to reach adulthood
- early instars remain close to crevices
- feed on feces of older cockroaches (coprophagy)

German  
cockroach  
habitat areas



# German vs Asian cockroach



German



Asian

- Similar in appearance to the German cockroach, microscopic differences.
- Only 2 months from egg to adult
- Adult's fly
- Found outdoors in leaf litter and attracted to lights at night

# Brown-banded cockroach, *Supella longipalpa*



- 1/2" long (11-14 mm)
- Moderate reproductive rate
  - 3-9 months from egg to adult
  - 14-18 eggs per ootheca
- Female glues egg capsule to ceilings, beneath furniture
- Adults do not fly
- Found indoors throughout house, esp. warmer sites

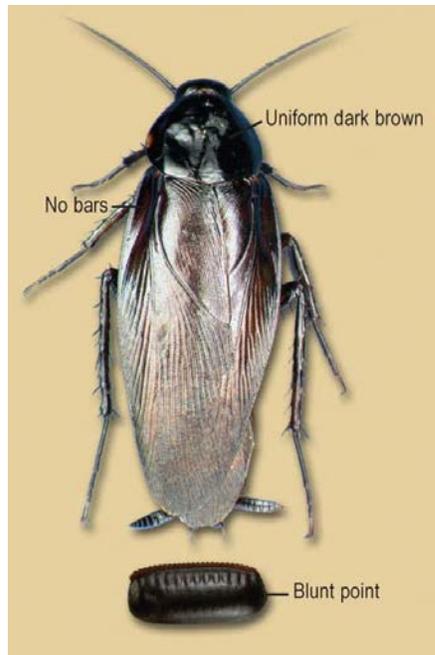
# Cockroach family Blattidae

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- *Blatta orientalis* -- Oriental cockroach
- *Shelfordella (=Blatta) lateralis* – Turkestan cockroach
- *Periplaneta americana* -- American cockroach
- *Periplaneta australasiae* -- Australian cockroach
- *Periplaneta brunnea* -- Brown cockroach
- *Periplaneta fuliginosa* -- Smokybrown cockroach

# Smokybrown Cockroach



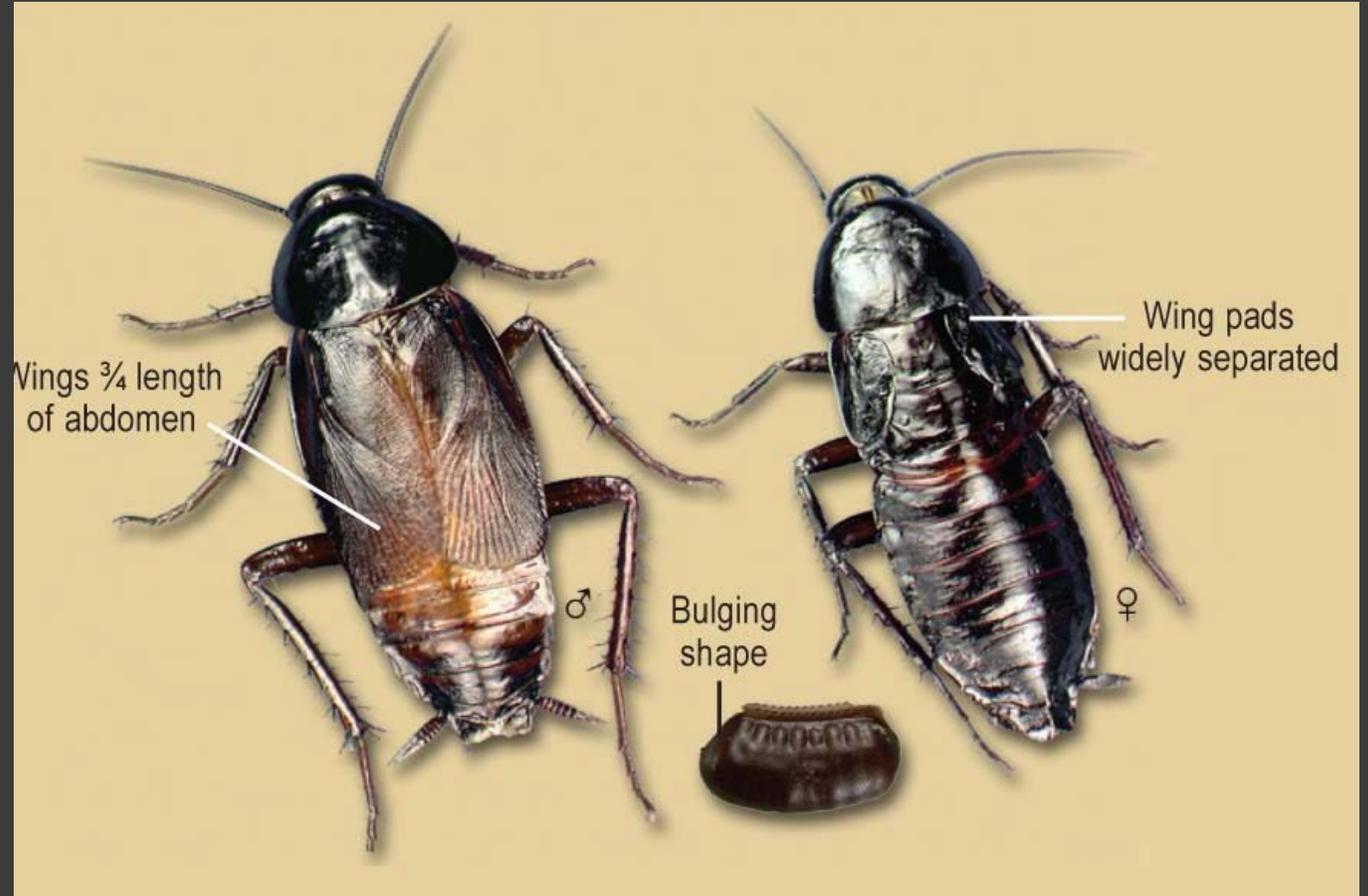


# Smoky-brown cockroach, *Periplaneta fuliginosa*

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- 1  $\frac{3}{4}$ " long, uniform dark brown (white banding in 1<sup>st</sup> instar nymph)
- Slow reproduction
  - 20-28 eggs/ootheca
  - 12 months from egg to adult
- Principally outdoor habitats
  - woodpiles, trees, attics and soffits

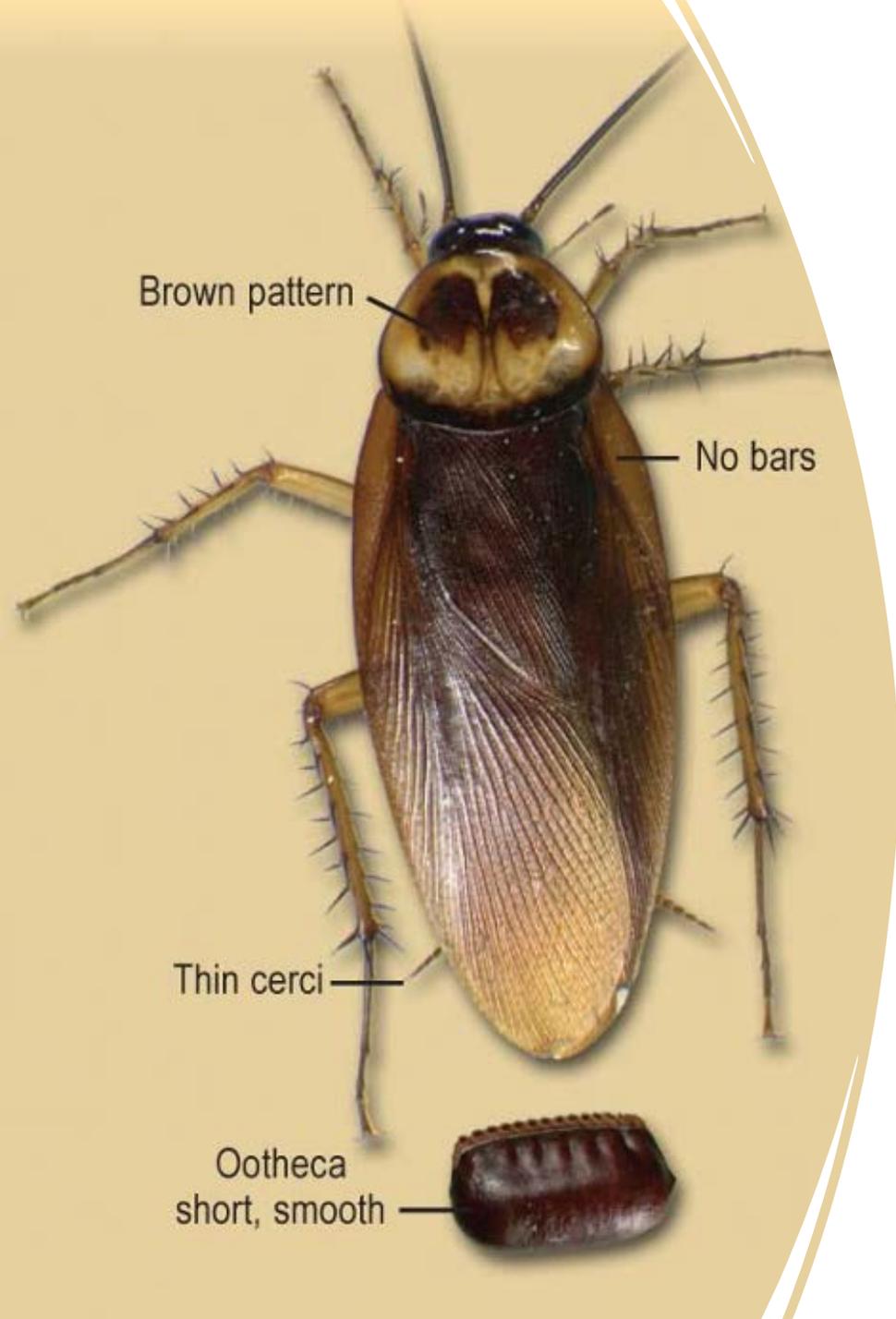
# Oriental Cockroach





# Oriental cockroach, *Blatta orientalis*

- 1 ¼" long
- Dark red brown to black, short wings
- Slower reproduction
  - 16 eggs/ootheca
  - 1-2 years from egg to adult
- Cooler sites close to ground
  - Water meter boxes
  - Sewers
  - Crawl spaces



# American cockroach

## *Periplaneta americana*

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## American Cockroach

- 1  $\frac{3}{4}$ " long, reddish brown with pale edge on pronotum
  - Slower reproduction
    - 14 eggs/ootheca
    - 9-24 months from egg to adult
- Sewers, basements, furnace rooms, attics.
  - Strong flier





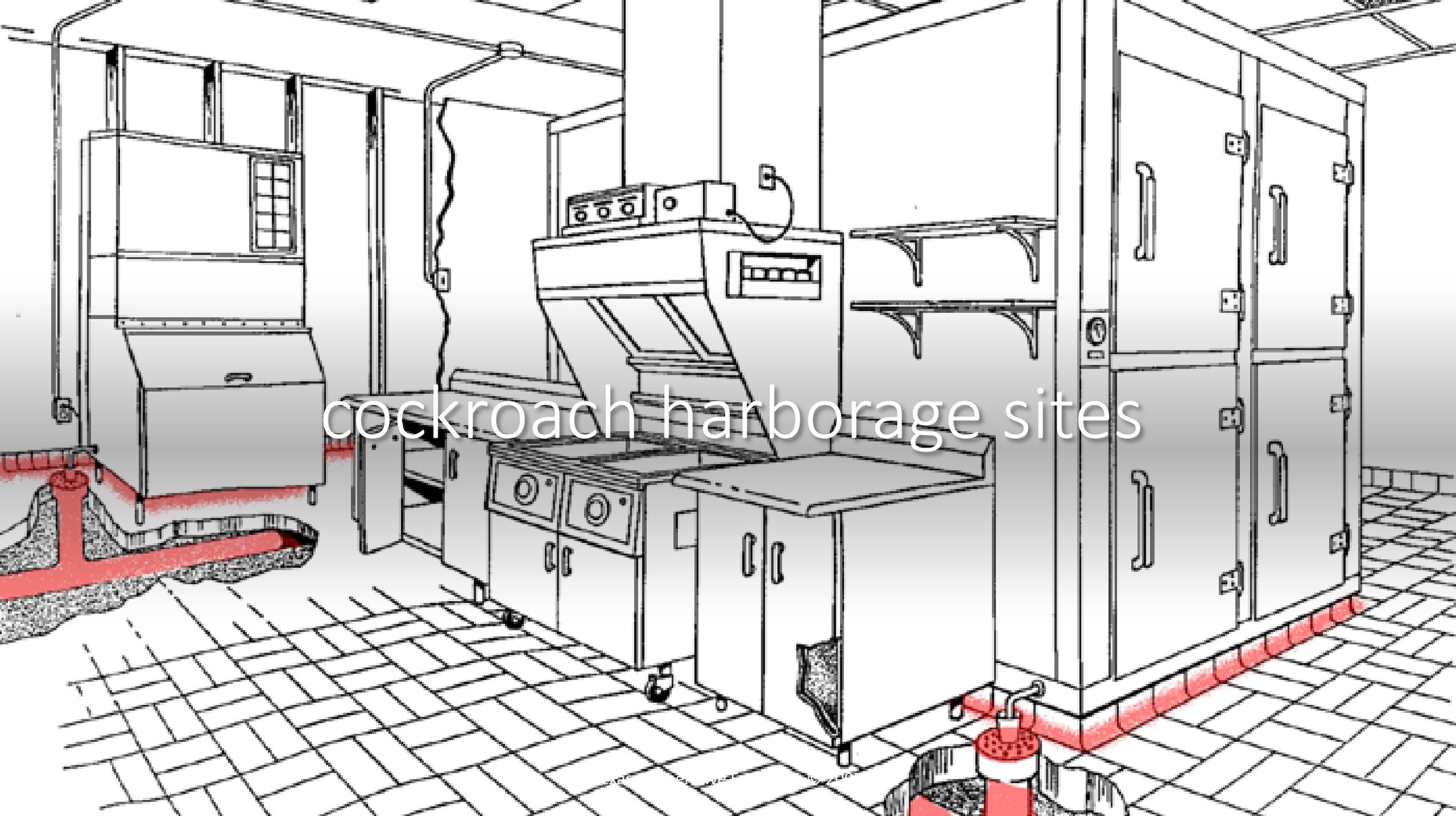
# Turkestan cockroach

- 1.2 inches-long
- Sexually dimorphic
  - Males reddish brown with crème-colored wing bar and incomplete ring around pronotum
  - Females blackish with crème-colored wing bar, vestigial wings
- Emerging pest, mostly SW US, competes with Oriental cockroach



© Stoy A. Hedges





cockroach harborage sites



# Most Common Breeding Sites for Cockroaches

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- German: Kitchen & Bathroom
- Asian: Outdoor leaf litter
- Brown banded: Throughout structure
- Oriental: Basements
- American: Sewers, wall voids, attics, mechanical rooms
- Smoky-brown: Tree holes and palm trees



# Behavioral and Physiological Traits

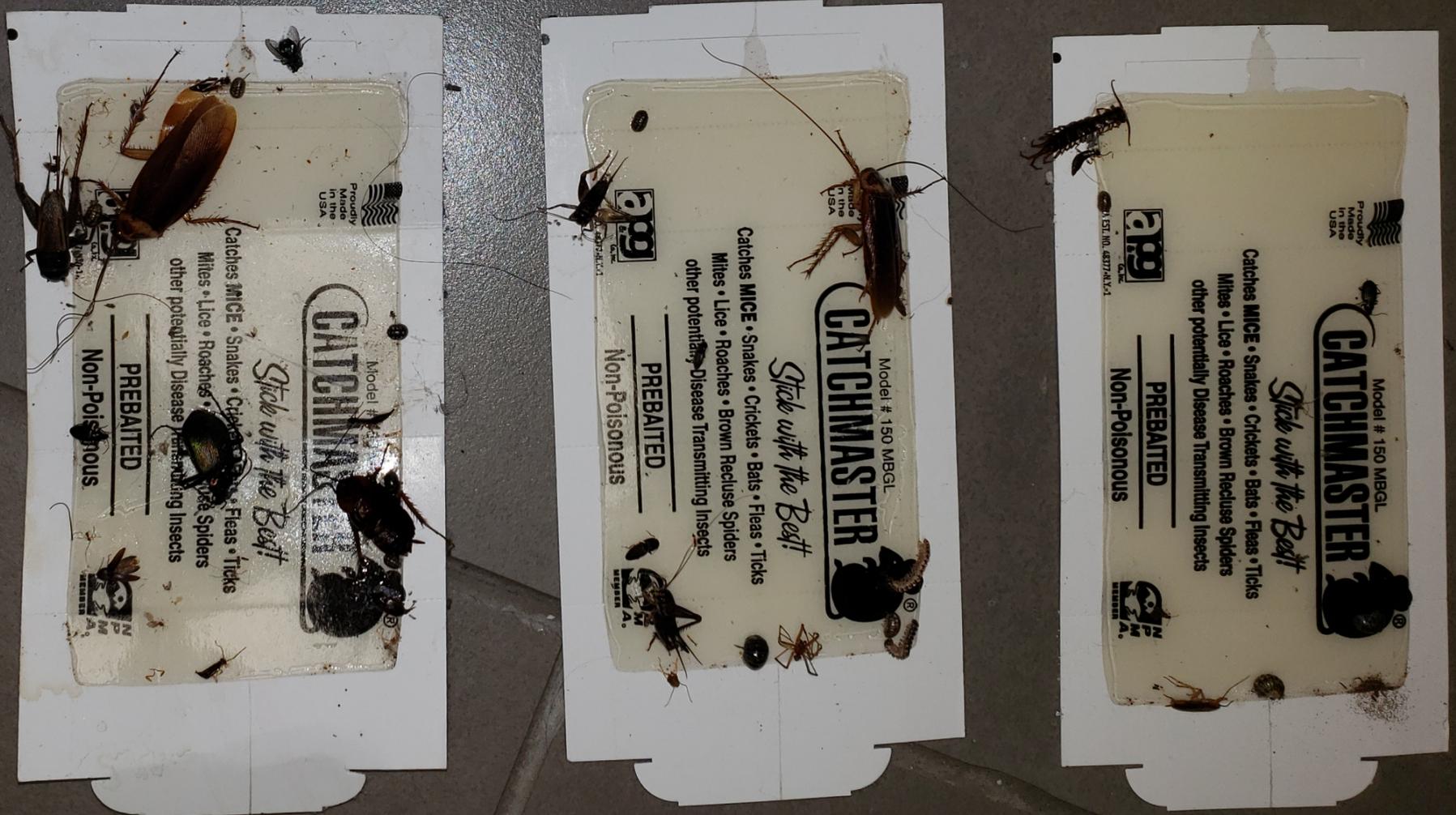
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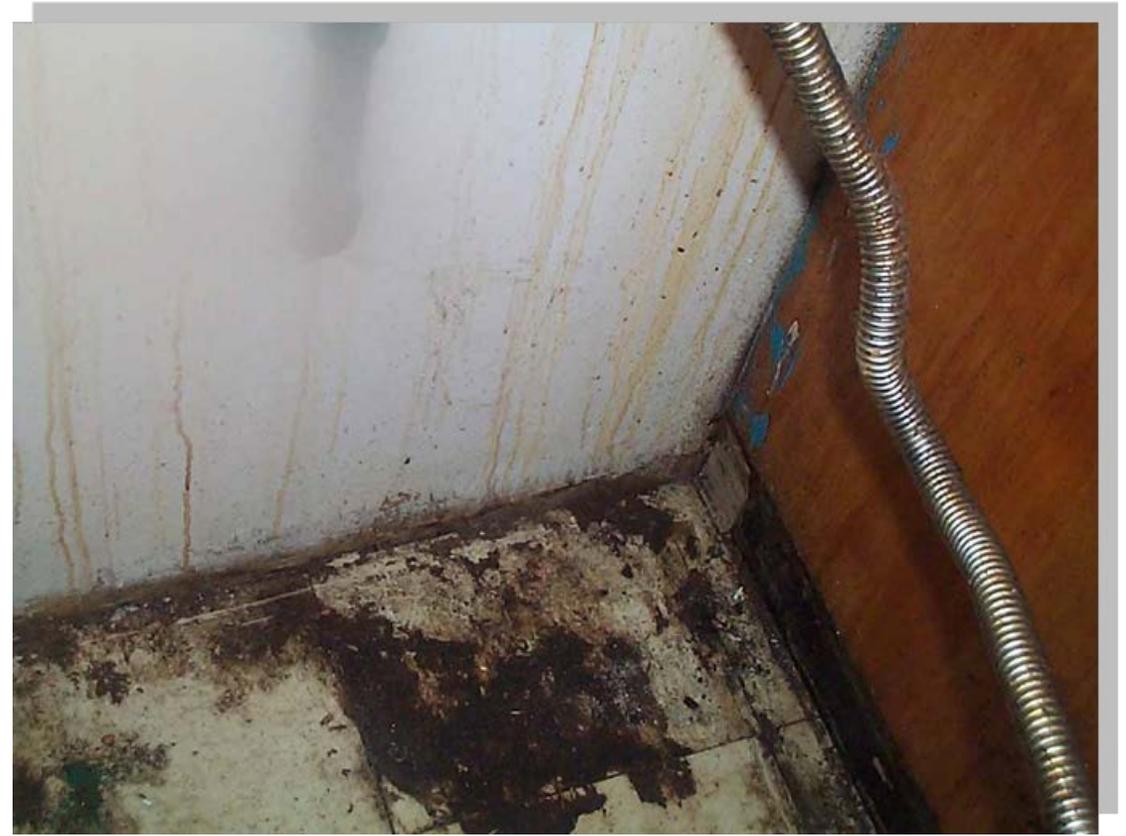
- Avoidance of light and air movement
- Grooming
- Aggregation
- Prefer high humidity
- Cockroaches are “Cryptobiotic”
  - 67% of cockroaches gathered in 4.8 mm space



What signs to look for  
when inspecting for  
roaches

# What can glue boards tell you





Roach staining – extreme conditions

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# Staining on ceiling and light fixture

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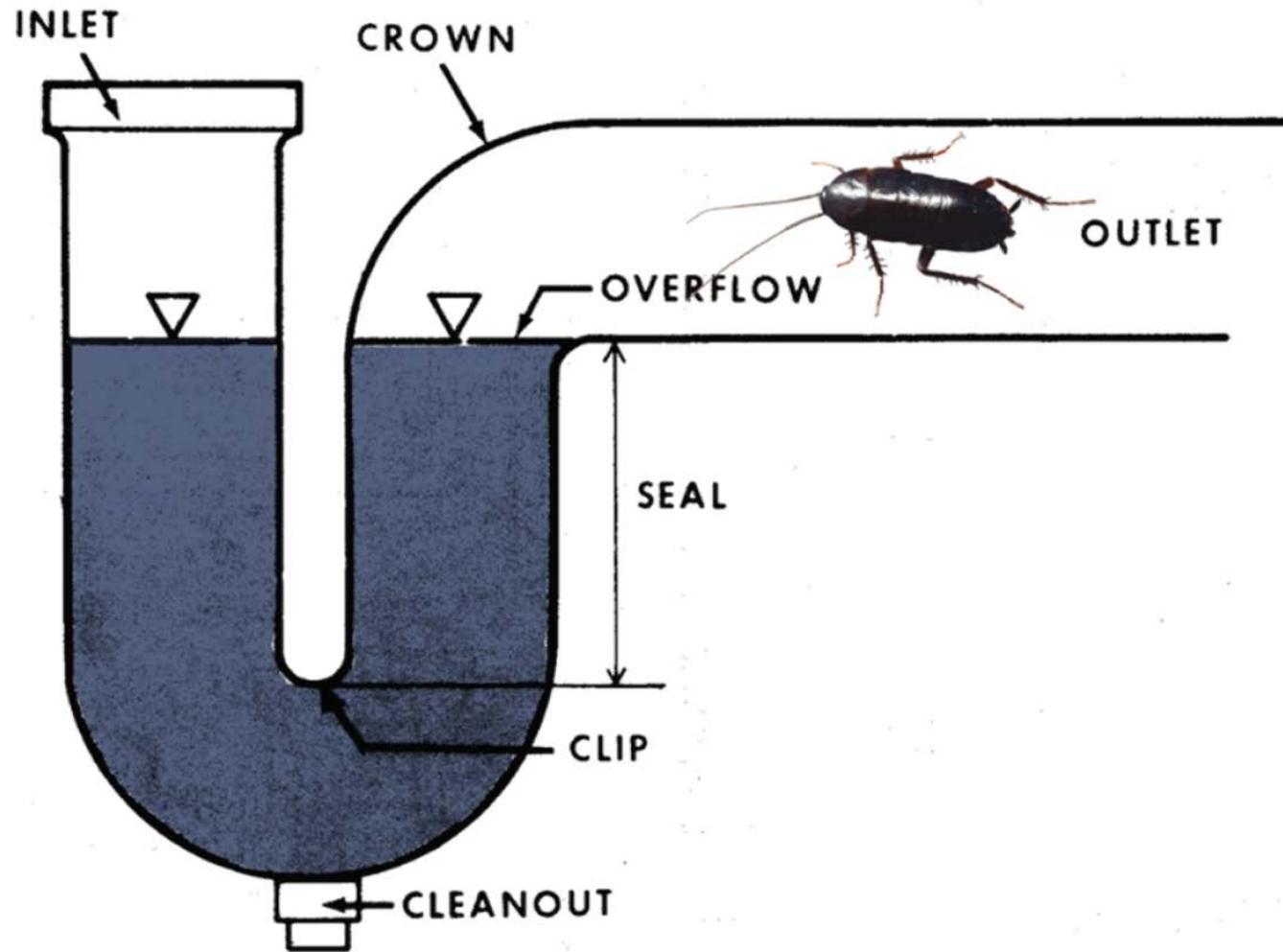




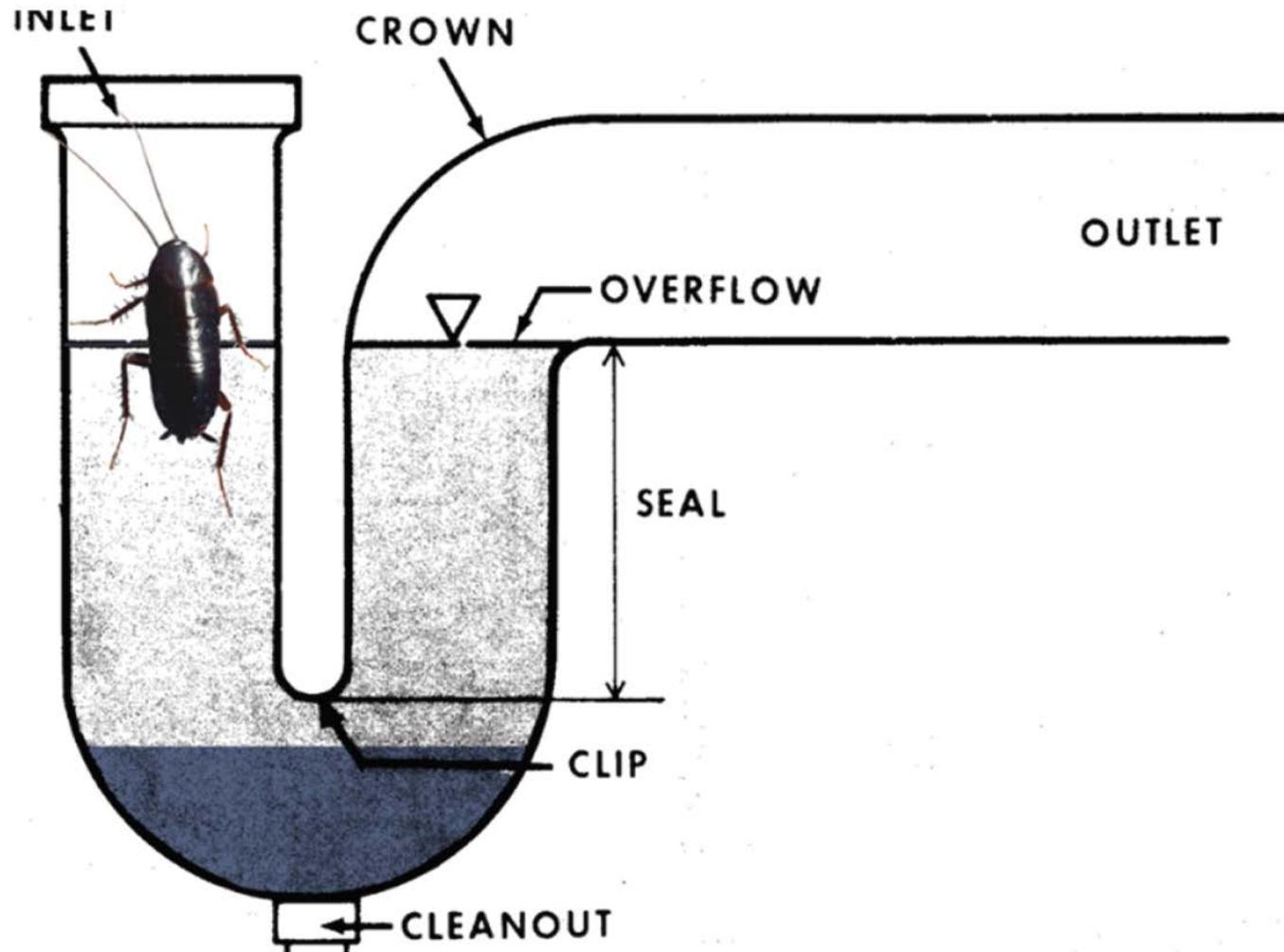




# Non-Chemical Control Measures



Water Sewer  
Lined with  
Water



Sewage Line  
when Dried  
Out Over  
Time

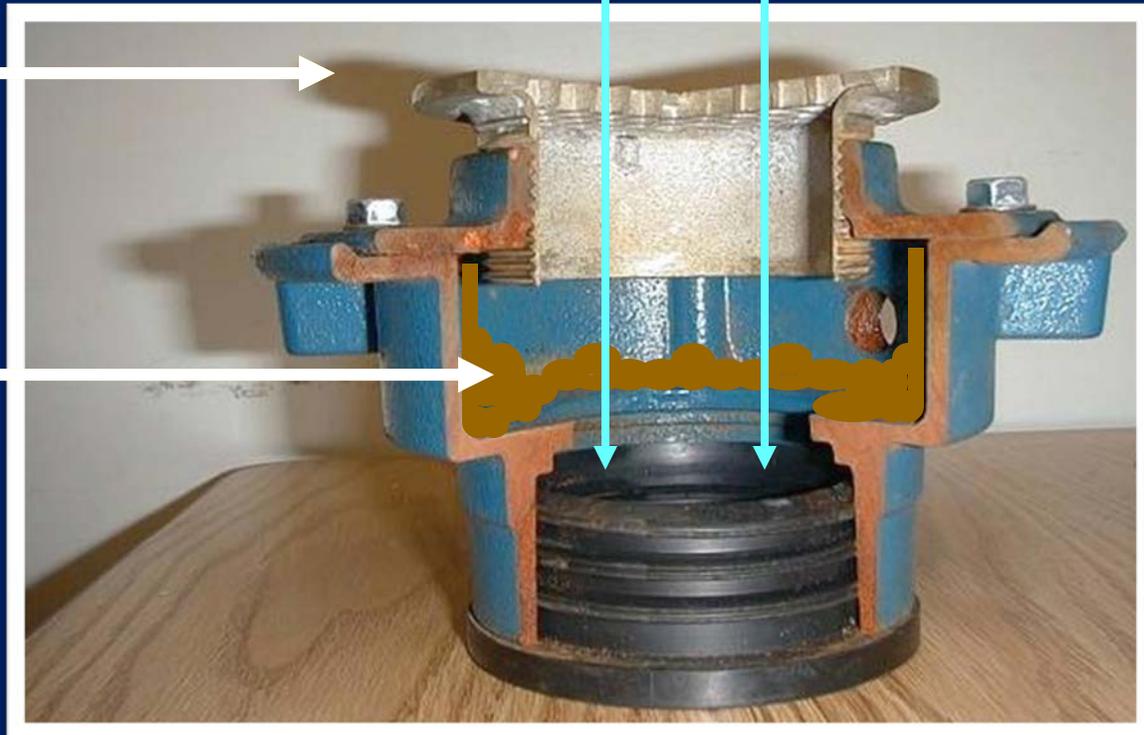
# Anatomy of a Drain

Organic material deposited inside wells

Flow of water

Floor level

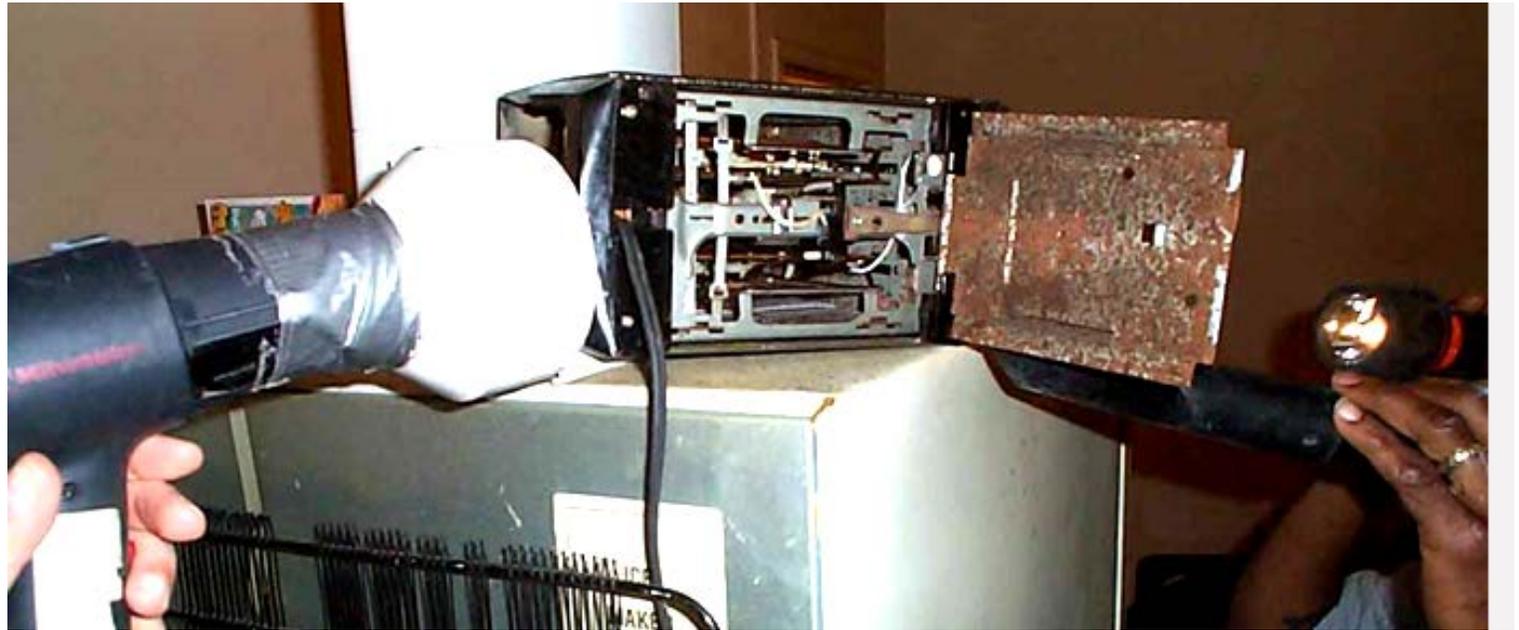
Side well





Simple practices = Large Benefits

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Roaches can be flushed out with a heat source

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# Roaches can be vacuumed up

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# Sanitation matters in IPM

- Survival Triangle
  - Vacuuming, sticky traps, bait, equally effective in controlling German cockroach populations
  - Use of a flushing agent before vacuuming increased population reduction and removal of hard-to-reach gravid females

## HOUSEHOLD AND STRUCTURAL ENTOMOLOGY

### Evaluation of Trapping and Vacuuming Compared with Low-Impact Insecticide Tactics for Managing German Cockroaches in Residences

WALID KAAKEH AND GARY W. BENNETT

Center for Urban and Industrial Pest Management, Department of Entomology,  
Purdue University, West Lafayette, IN 47907-1158

J. Econ. Entomol. 90(4): 976-982 (1997)

**ABSTRACT** In field studies, sticky traps and vacuum cleaners were evaluated to determine their effectiveness in the control of German cockroaches, *Blattella germanica* (L.), infesting multifamily housing. Trapping and vacuuming treatments were compared with insecticide baiting and residual spraying methods. At 4-wk posttreatment in 1995 tests, the percentage of cumulative population reductions caused by Siege gel bait, Victor Roach Pheromone sticky traps, flushing and vacuuming, vacuuming, and Empire spray treatments reached 82.4, 79.3, 80.2, 72.5, and 72.0%, respectively. There were no significant differences in cockroach catch between treatments at all sampling periods after treatment, indicating that the treatments were equally effective in controlling *B. germanica* infestations. At 8 wk after treatment in 1996 tests, the percentage of cumulative population reductions caused by Knockdown Pheromone Boric Acid bait, Victor Roach Pheromone sticky traps, and Suspend spray treatments reached 83.7, 80.1, and 68.5%, respectively. As in 1995 tests, there were no significant differences in cockroach catch between treatments at all sampling periods after treatment. Trapping with sticky traps and the use of the vacuuming technique led to significant reductions in trap catch at all sampling times after treatments. In total, 7,543 cockroaches were caught on Victor Roach Pheromone traps removed from 11 apartments during the 4-wk test period in 1995. In total, 3,554 cockroaches were caught on Victor Roach Pheromone traps removed from 5 apartments during the 8-wk test period in 1996. The use of the flushing agent before vacuuming led to a greater population reduction and removal of hard-to-reach gravid females. Sticky traps and vacuum cleaners also were effective as monitoring devices and provided acceptable control for *B. germanica*.

**KEY WORDS** *Blattella germanica*, vacuum cleaner, sticky traps, baits, flushing, nonchemical control

## Building Features and Employee Practices

- Movement of pests can be done without staff knowing they are part of the problem.
- Education is equally important in an IPM program.





# Effective control measures

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- Caulk and seal harborages
- Eliminate, reduce, separate water and food resources
- Bait and dust harborage areas identified by sticky traps
- Apply residual sprays to harborages



# How baits work



- Mortality, premature egg case drop, lower hatch rate
- Necrophagy (consumption of dead)
- Coprophagy (consumption of feces)



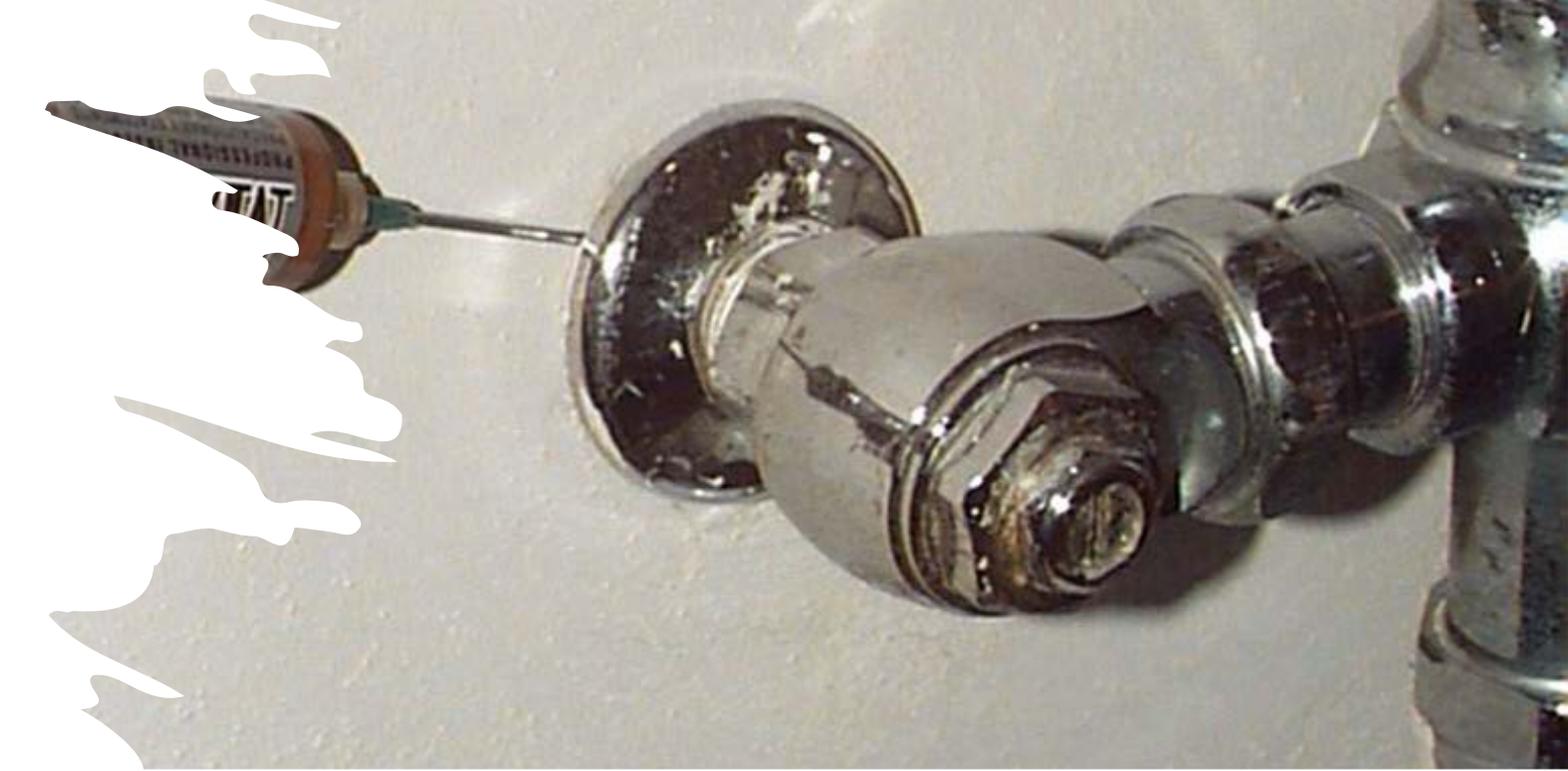
# Key to success with baits is proper placement

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- German cockroaches include under/around sinks and toilets; behind refrigerators, dishwashers, and stoves; near trash containers; and inside cabinets and storage areas
- Ready-to-use plastic bait stations are convenient, gel-type baits applied with a syringe often are more versatile and efficient.
- Syringe makes it possible to inject many small pea-sized dabs of bait into cracks, corners, edges and other places where roaches reside.
- Cockroaches are not drawn to baits from long distances; they come upon them during their foraging activities.
  - More dabs of bait put out, the more likely they are to be found and eaten. More than a dozen placements alone may be necessary to treat corners and edges in cabinets under a kitchen sink

# How to apply baits

- Use in or near all suspected harborages
- Many small placements better than a few large placements
- Consider use of straws, temporary stations to place baits
- Must be out of reach of people, children
- Don't skimp on quantity
- Store properly



# Aerosol sprays

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- “fumigation”
- ULV best for penetration into voids
- Often highly repellent to cockroaches
- Supplement to residual sprays, dusts only





# Liquid residual sprays

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- Three main types
  - Broadcast
  - Spot
  - Crack & crevice
- Baseboard sprays ineffective for German cockroach
- Repellent types less effective
  - Pyrethroids
  - Carbamates (propoxur)

# Dusts

- Technical insecticide sprayed on dust base
- Allows penetration into voids and cracks
- Easily picked up on insect cuticle, transferred to aggregation partners
- Problems?
- Cyfluthrin, deltamethrin, boric acid, silica aerogel



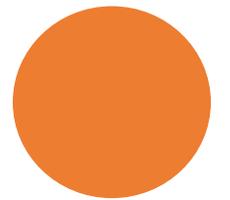


Dusts ingested  
through  
grooming

• CREDIT AYAKO WADA-KATSUMATA

# Insect growth regulators

- Disrupt growth process through mimicking of natural hormones
  - Pyriproxifen (Pivot 10, Nylar<sup>®</sup>, Archer<sup>®</sup>)
  - Hydroprene (Gencor<sup>®</sup>, PointSource<sup>®</sup>)
  - Novaluron and Pyriproxifen (Tekko Pro)





# Cockroach coping strategies

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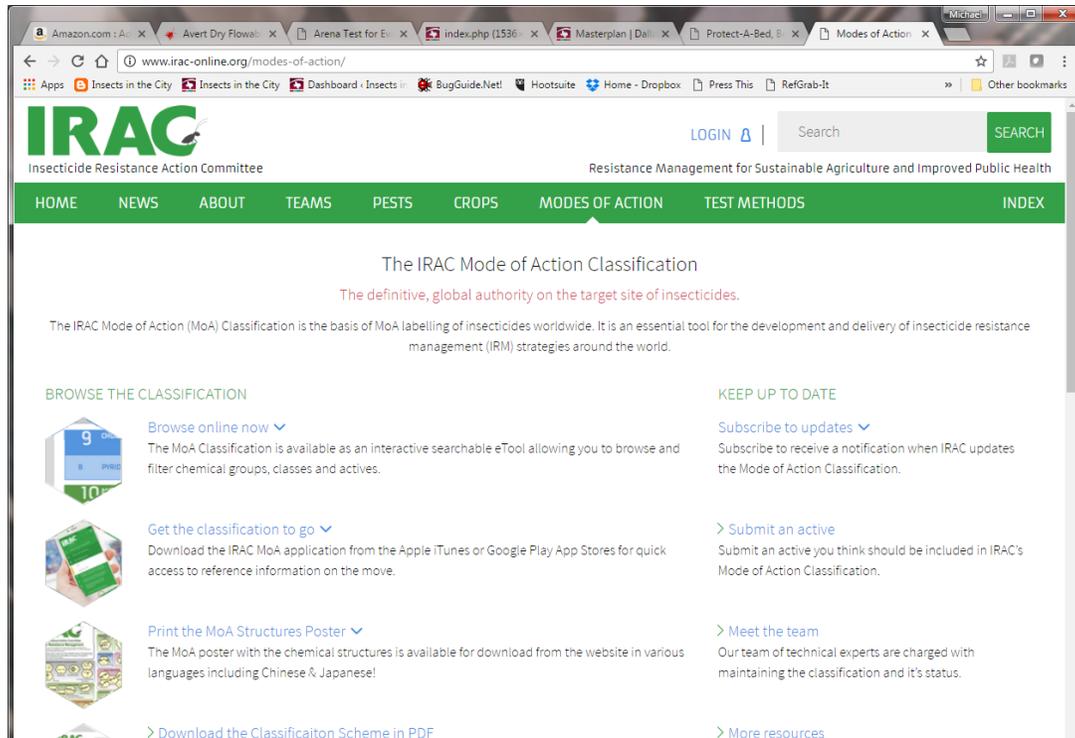
- Avoid spray residues (repellency)
- Physiological resistance
- Behavioral resistance
  - Distaste for bait attractants
  - Bait avoidance



Cockroach  
resistance to  
baits

# How to deal with resistance

- Behavioral resistance: Switch bait attractants
  - Bait station
  - Gel baits
  - powders
- Insecticide resistance: Switch active ingredients



The screenshot shows the IRAC website's 'Modes of Action' page. The header includes the IRAC logo, navigation links (HOME, NEWS, ABOUT, TEAMS, PESTS, CROPS, MODES OF ACTION, TEST METHODS, INDEX), and a search bar. The main content area is titled 'The IRAC Mode of Action Classification' and describes it as the definitive global authority on insecticide target sites. It provides a brief overview of the MoA Classification and offers several options for users to interact with the classification: browse online, download the application, print the poster, and submit new active ingredients. There are also links to keep up to date, meet the team, and download the classification scheme in PDF.

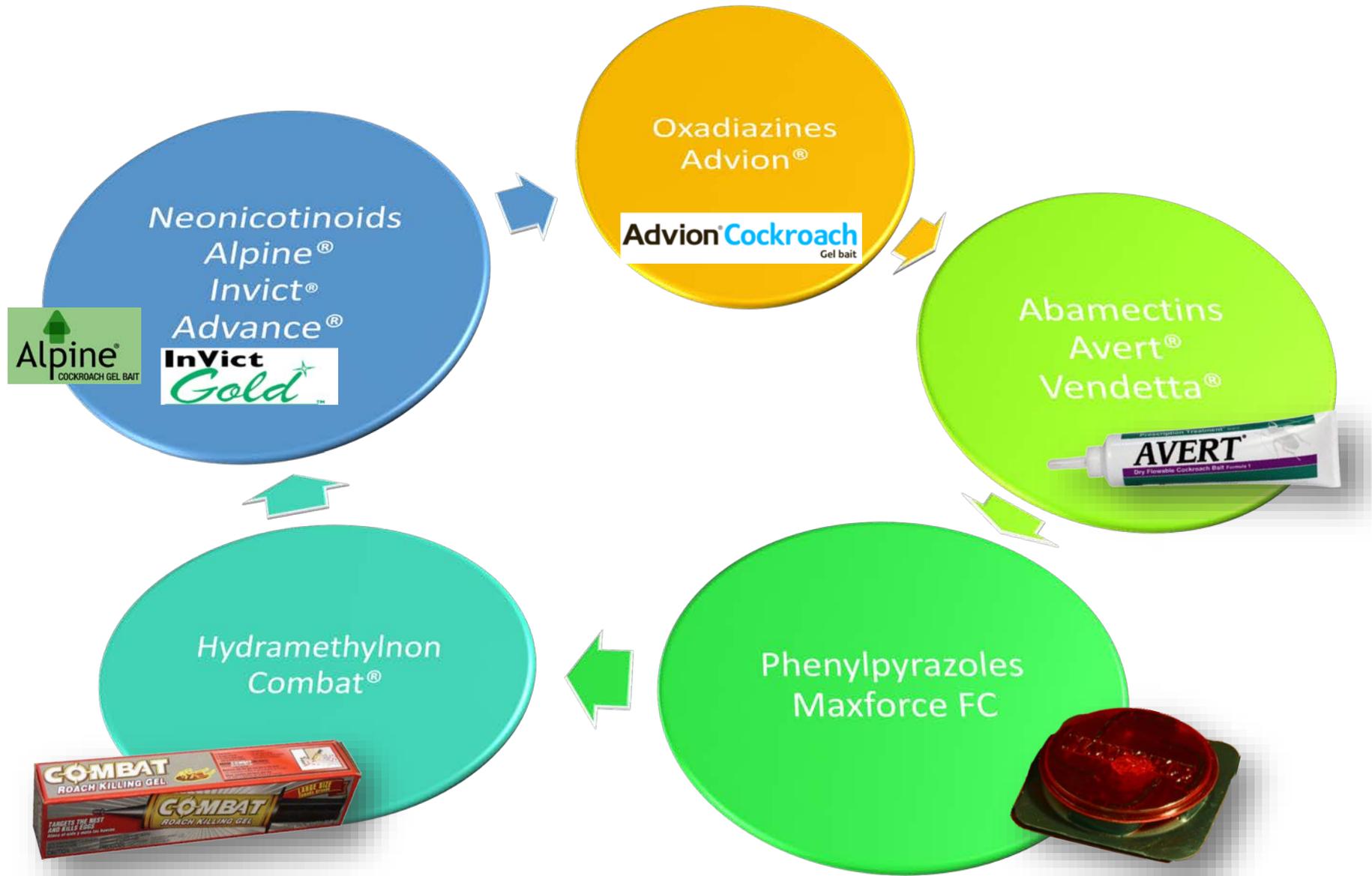
- Rotation must be among different chemical classes
- International Resistance Action Committee provides listing of chemical classes of insecticides  
<http://www.irc-online.org/modes-of-action/>



# Current cockroach baits

Trade name	Active ingredient	Type	Class
Advion Roach Bait Gel	Indoxacarb 0.6%	Gel	22A oxadiazines
Advion Bait Arena	Indoxacarb 0.5%	Station	22A oxadiazines
Avert® Dry Flowable	Abamectin B1 0.05%	Powder	6 avermectins
Avert® Cockroach Gel Bait	Abamectin B1 0.05%	Gel	6 avermectins
Alpine	Dinotefuran	Gel	4A neonicotinoids
Maxforce FC Magnum	Fipronil	Gel	2B phenylpyrazoles
Invict Gold	Imidacloprid 2.15%	Gel	4A neonicotinoids
Vendetta® Plus	Abamectin 0.05% + pyriproxyfen 0.5%	Gel	6 avermectins + 7C pyriproxyfen
Combat®	Hydramethylnon 2%	Station	20A hydramethylnon
Advance®	Dinotefuran	Station	4A neonicotinoids
Advance® Cockroach Gel bait	Dinotefuran 0.5%	Gel	4A neonicotinoids

# Rotate baits every 3-6 months





## Successful IPM strategies for cockroach control

- Sanitation (reduce food and water)
- Harborage reduction
- Multiple control tactics
  - IGRs
  - Residual insecticides
  - Use of multiple bait formulations at adequate density (4-5 stations per 100 ft<sup>2</sup>)
  - dusts
  - Trapping?
- Effective monitoring/identification of harborages

# Tips for insecticide use against cockroaches



- Immature cockroaches tend to stay close to harborage
  - Good inspection will reveal harborage areas
  - Apply near or in harborage areas
- Avoid drips, spray-back, drift
  - Clean up excess
  - Use crack and crevice tips
- Read and follow label directions
- Choose the right formulation for the surface to be treated



No substitute  
for hard work

# Inspections and thresholds

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<b><i>Ave. # cockroaches per zone</i></b>	<b><i>Action</i></b>
<b><i>0</i></b>	None
<b><i>1-2</i></b>	Bait stations; check sanitation
<b><i>3-6</i></b>	Spot treat c&c; add or replace baits; review sanitation
<b><i>7-15</i></b>	Thorough bait and c&c application; revisit in two weeks
<b><i>15+</i></b>	Close facility; conduct thorough c&c inspection and sanitation improvement;



# For more information or to share

## IPM Action Plan for Outdoor Cockroaches

### General Information



Outdoor cockroaches can find their way indoors. An IPM program ensures they don't become established indoors.

Although many species of cockroaches are found in the United States, only a few species are typically problems in schools. Cockroaches are often referred to by other, local common names including water bugs and palmetto bugs.

Outdoor cockroaches prefer warmer climates and moist surroundings and can thrive year round in these conditions. The American cockroach is common in city sewers and basements, particularly around pipes and drains. The smokybrown prefers tree holes, loose bark, and mulch. The Australian cockroach is abundant outdoors and in greenhouses. The Oriental cockroach is common outdoors and lives in warm, damp shady areas near the ground or any area containing natural debris. The Turkestan cockroach is a detritus feeder, is often found in meter and irrigation boxes and exposed compost piles, and the males are attracted to lights. Each species can build large populations if uncontrolled and can spread bacteria by contact. Finding them inside often indicates a need to pest-proof external entryways.

Effective management includes cultural and mechanical practices such as eliminating food and water sources and harborage sites for cockroaches. Examples include removing incoming food products from cardboard shipping containers as soon as they are delivered; cleaning drains regularly; repairing leaking pipes and faucets; sealing exterior cracks and crevices; sealing cracks and crevices in food storage, preparation, and serving areas; and sealing openings around the edges of electrical boxes, bulletin boards, and signage. Due to the development of effective insecticide bait formulations, cockroach problems have become much less prevalent in general. Spray-applied residual insecticides are much less effective than baits in reducing cockroach populations and increase potential for exposure. Enzyme-based cleaners can also be effective in cleaning up cockroach debris.

### Identification

Species	Description	Where to Look	Image
American cockroach, <i>Periplaneta americana</i>	Adults are brown to reddish-brown with a pale brown or yellow border around the outside of the top of the head shield (pronotum). Wings cover the abdomen. They are 1 3/8 to 2 1/8 inches long. Early nymphal stages are grayish-brown. Later stages are reddish-brown. Egg cases (oothecae) are dark reddish-brown to brownish-black and about 3/8 inches. There usually are eight eggs on each side. The droppings of American cockroaches can be confused with mouse droppings, but are shorter with square (rather than pointed) tips.	Indoors, they are found in warm areas with high humidity—bottle rooms, basements, sewers or around drains and pipes. They are more common in large commercial buildings infesting food storage and preparation areas. Outdoors, they are found in moist, shady areas in yards, hollow trees, wood piles and mulch. They are frequent inhabitants of storm drains and sewers.	 <p>American cockroach (<i>Periplaneta americana</i>) Nymphs</p> 

## IPM Action Plan for German Cockroaches



German cockroaches are our most prolific cockroach species producing 3-6 generations per year. Besides its importance as a sign of poor sanitation used by health departments, the German cockroach has been implicated in the transmission of several pathogenic organisms and as a cause of allergic reactions for children and adults. Prompt attention to sanitation and control are necessary to prevent this pest from becoming abundant.

### Identification

Adults are 1/2 to 5/8 inches long, light brown to tan, with two dark stripes on the shield (pronotum) behind the head. Females are often seen carrying a yellowish-brown egg capsule (ootheca) protruding from the end of the abdomen. Nymphs are generally darker with two prominent dark stripes surrounding a lighter tan spot or stripe on body midsection (thorax).

### General Information

German cockroaches are our most prolific cockroach species producing 3-6 generations per year. Besides its importance as a sign of poor sanitation used by health departments, the German cockroach has been implicated in the transmission of several pathogenic organisms and as a cause of allergic reactions for children and adults. Prompt attention to sanitation and control are necessary to prevent this pest from becoming abundant at school facilities. German cockroaches do not enter structures from outdoors; they are spread entirely by humans and live only indoors. German cockroaches spend most of their lives in cracks and protected void areas near sources of food and water.

### Suggested Thresholds

One cockroach justifies baiting and monitoring efforts. More than 5 cockroaches per inspection should trigger a complete review of sanitation and control efforts and possibly a more aggressive treatment strategy.

### Monitoring and Inspection

The number one monitoring tool for cockroaches is an adhesive-coated, cardboard insect monitoring trap, also known as "sticky traps". Some sticky traps have a German cockroach aggregation pheromone and are effective in attracting roaches to the monitor. The pheromone traps are effective with low populations and detecting new infestations. These inexpensive devices should be placed in pest vulnerable areas including food storerooms and preparation areas, and anywhere else cockroaches have been a problem including laundry rooms, custodial closets, electrical closets, storage closets, staff lounges and student stores. Insect monitors are exceptional in detecting cockroaches but also in indicating direction of travel, species present, and whether immatures as well as adults are present.