QUALITYPRO PUBLIC HEALTH

CORE EXAM STUDY GUIDE

Version 1.2

This is the study guide for the QualityPro Public Health Core Exam.

QualityPro Public Health is a service certification available exclusively to QualityPro accredited companies. One of the requirements of the QualityPro Public Health service certification is that every employee that performs or sells the certified service has passed the core and a specialty exam. These exams are found at www.npmatraining.org. The service certifications standards are available at www.npmaqualitypro.org.

The core exam covers the general information that every pest management professional (PMP) should know about the pests and topics listed in the following index. For each pest, this includes the public health significance, how to identify it, biology, behavior, basic control strategies, and how to work with the customer. Unless specifically noted, this study guide will fully prepare you for the core exam. Scientific names are included along with common names (if available), but you will not need to know scientific names.

After passing the QualityPro Public Health Core Exam at www.npmatraining.org, you will receive a certificate of completion. This is not an individual certification.

What is in this study guide is a general overview of the knowledge you will put into practice over your career. For more in-depth information, we recommend all PMPs have access to the most current version of the following resources:

- The Mallis Handbook of Pest Control
- Truman's Scientific Guide to Pest Management Operations
- ACE Study Guide
- University of Kentucky Public Health Pest Management Training Guide: http://www.uky.edu/Ag/PAT/Ent_63.pdf
- NPMA Field Guide App / NPMA Field Guide to Structural Pests

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TABLE OF CONTENTS

INTRODUCTION

Pests are a part of public health because they can cause pain and disease in people and pets. In addition, the anxiety that may result when someone is faced with an infestation can impact a person's well-being. As travel has become more convenient and the distribution of pests has changed, the threat of public health pests and vector-borne disease in your service area has most likely risen.

The professional pest management industry is a key part of the first line of defense against public health pests. Knowledgeable professionals educating the public and taking steps to control pests are essential to managing the risks posed by these pests. The National Pest Management Association's mission is your protection. When it comes to public health, this means enabling pest management professionals to utilize science-based solutions to pest threats while also minimizing the risks associated with doing this important work.

The National Pest Management Association identified public health as a focus area for the industry. QualityPro has done its part by creating credentials for QualityPro accredited companies in the pest management industry. The QualityPro Public Health credentials distinguish a company's employees and services that help protect consumers from vectors and pests of public health importance. QualityPro sets the standards of excellence for professional pest management companies and their employees through education, training, and certification, providing consumers protection and confidence when selecting a nationally accredited company.

Companies that have earned the QualityPro Public Health certification have trained professionals performing services that meet industry standards. In addition, these companies first had to earn the QualityPro accreditation which ensures a company's business practices are professional. Customers can look to the QualityPro Public Health certification to find qualified partners in the fight against public health pests. A search of credentialed companies is available at www.qualitypro.org.

GENERAL CONCEPTS FOR VECTOR CONTROL

Pests are a part of the cycle that results in the spread of many different pathogens and diseases. Pest management professionals (PMPs) are the experts on pests, not diseases and medical information. But knowing the vocabulary is helpful for communicating with the public and spreading vetted public health messages.

QualityPro recognizes the U.S. Centers for Disease Control and Prevention (CDC) to be the best source for vector-related information. We encourage all PMPs to visit www.cdc.gov at least once a year to learn more about vector-borne disease and evaluate the risks of disease and vectors in their service areas. In Canada, reference the Public Health Agency of Canada and Health Canada for local information.

In addition to CDC.gov, we recommend the following resources for general information about pest management topics covered in this study guide:

- IPM for the Urban Professional: A Study Guide for the Associate Certified Entomologist
- NPMA Field Guide App & NPMA Field Guide to Structural Pests 2nd Edition
- The Mallis Handbook of Pest Control, 10th Ed
- Truman's Scientific Guide to Pest Management Operations, 7th Ed
- University of Kentucky Public Health Pest Management Training Guide
- Vector Control for Environmental Health Professionals (VCEHP) e-learning modules

Each topic within this study guide includes references specific to the topic.

IMPORTANT TERMS AND DEFINITIONS

Source: Dictionary of Epidemiology - http://irea.ir/files/site1/pages/dictionary.pdf

Antibody – Protein molecule produced in response to exposure to a “foreign” or extraneous substance (e.g., invading microorganisms responsible for infection) or active immunization. May also be present because of passive transfer from mother to infant, via immune globulin, etc. Antibody has the capacity to bind specifically to the foreign substance (antigen) that elicited its production, thus supplying a mechanism for protection against infectious diseases.

Antigen – A substance (protein, polysaccharide, glycolipid, tissue transplant, etc.) that can induce specific immune response. Introduction of antigen may be by the invasion of infectious organisms, immunization, inhalation, ingestion, etc.

Arbovirus – An arthropod-borne virus transmitted between vertebrate host organisms by the bite of a vector.

Carrier – A person or animal harboring a specific infectious agent that may or may not show evidence of disease and which serves as a potential source of the disease infection.

Epidemiology – The study of the occurrence, distribution and causes of health-related events and processes in specified populations. Epidemiology also includes the application of this knowledge to control relevant health problems.

Host – A person or other living animal, including birds and arthropods, that affords subsistence or lodgment to an infectious agent under natural conditions. Some disease-causing organisms pass successive stages in alternate hosts of different species. Hosts in which the parasite attains maturity or passes its sexual stage are primary or definitive hosts; those in which the parasite is in a larval or asexual state are secondary or intermediate hosts. A transport host is a carrier in which the organism remains alive but does not undergo development.

Modes of Transmission of Vector-borne Infection*:*

- **Biological**: Development is required before the arthropod can transmit the infective form of the agent to humans. An incubation period is usually required following infection before the arthropod can transmit the disease. The infectious agent may be passed to succeeding generations by transovarial transmission or transstadial transmission.
- **Mechanical**: Transport of the infectious agent between hosts by arthropod vectors with contaminated mouthparts, antennae, or limbs. There is no multiplication of the infectious agent in the vector.

Mosquito-borne Arbovirus – Viral diseases biologically transmitted by the bite of mosquitoes**.**

Parasite – A foreign organism that lives at the expense of a host.

- **An *ectoparasite*** lives on the surface of its host.
- **An *endoparasite*** lives inside the host.

Pathogen – Any virus, bacteria, fungus, or parasite capable of causing disease.

Transmission of infection - The process, mechanisms, and determinants by which an infectious agent or an infectious disease is spread from a source or reservoir to another person or across communities and countries.

Transovarial transmission – When an infected vector produces infected eggs that hatch into individuals that are also infected and able to transmit disease organisms

Transstadial transmission – Survival of parasites or pathogens through successive developmental stages of the vector.

Vector – An invertebrate animal that is capable of transmitting (through biting, bodily fluids, or waste products) an infectious agent among its hosts.

Vector-borne Diseases - Vector-borne diseases are illnesses caused by parasites, viruses and bacteria that are transmitted by an invertebrate animal.

ROUTES OF TRANSMISSION

Each pathogen escapes its host, gets to a new host, and enters the new host in its own way. This cycle is called a route of transmission. Understanding an infectious agent's route of transmission can help you take preventative steps and help manage the spread. For vector-borne disease, the following are the common routes of transmission.

Bites – Transmission of disease can take place when the pathogen enters the host through the vector's saliva while the vector consumes a blood meal. Examples of vectors that bite (or suck as the case may be) are ticks, mosquitoes, and fleas. The following infectious agents are transmitted through bites:

viruses (chikungunya, yellow fever, dengue fever), bacteria (Lyme disease, plague), and parasites (malaria).

Fecal Contamination – Fecal contamination occurs when a vector's feces containing the infectious agent gets on/in food, water, or wounds. Typhoid fever, cholera, and dysentery can all be spread through fecal contamination.

Inhalation – Disease transmission via inhalation occurs when disease organisms or allergens are inhaled. Cockroaches and rodents are two creatures associated with disease transmission by inhalation. Cockroach fecal deposits, shed exoskeletons, and dead cockroaches may cause allergies and asthma resulting from inhalation of cockroach allergens. Rodents are important since hantavirus infection may occur when inhaling dust and other airborne particles associated with rodent urine, feces, and contaminated rodent nest materials.

Chagas disease is caused by the parasite known *Trypanosoma cruzi*. The route of transmission for Chagas disease is fecal contamination, but it does involve a bite. Here's how it works:

1. A triatomine bug (also known as reduviid bugs, kissing bugs, cone-nosed bugs, and blood suckers) that is a carrier of *T. Cruzi* bites a person to consume a blood meal.
2. As it feeds, the insects also deposit feces on or near the site of their bite. The feces contain *T. cruzi*.
3. In response to the irritation and discomfort created by the bug's bite, the person rubs the contaminated feces into the wound, resulting in the transmission of the Chagas disease organism.

Kissing bug sucking blood from a mouse.
Sturgis McKeever, Georgia Southern University, Bugwood.org

VECTORIAL COMPETENCE & CAPACITY

Vectorial competence and vectorial capacity are used to determine the risk of disease transmission. They are measured through studies in both laboratories and the wild by epidemiologists, medical entomologists and researchers that specialize in vector-borne disease.

Vectorial competence refers to the ability of a vector to acquire, maintain, and transmit an infectious agent. If a vector is not competent, it will not be able to transmit the disease. Not all blood-sucking

arthropods can transmit the disease pathogens they ingest. The pathogen must overcome many obstacles inside the vector before being transmitted to another host.

For example, the insect's gut wall must be bypassed, the pathogen must survive and develop in the insect's body tissue or reproductive system, the pathogen must penetrate the vector's salivary glands and finally it must be injected into a new host as the insect feeds. If any step in this process doesn't happen, the insect will not be a vector of the disease. One of the most well-known examples of this in structural pest management is the bed bug. More than 40 pathogens have been found in bed bugs, yet they are not considered a disease vector.

Vectorial capacity is a measure of the efficiency of vector-borne disease transmission. Vectorial capacity considers the real-world factors that contribute to disease transmission in an area. Vector competence is a part of the equation that measures vectorial capacity. If you want to know the risk of acquiring a disease in an area, look to the vectorial capacity. You do not need to know how to calculate vectorial capacity, but it is useful to understand the factors that are used in the equation:

- Daily survival of vectors
- Density of vectors in relation to density of hosts
- Extrinsic incubation period (the time it takes the pathogen to develop in the vector before transmission can occur)
- Proportion of vectors feeding on a host divided by the length of gonotrophic cycle (the number of days it takes a pregnant female to lay her eggs)
- Vector competence

Other factors that factor into the risk of disease transmission include:

- Host behavior being suitable for a vector to access and infect it.
- The ability of an infected vector to produce infected eggs that hatch into individuals that are also infected and able to transmit disease (transovarial transmission).
- The attractiveness of potential hosts to a vector.
- The infection rate of both the vector and the host.
- The population size of the disease vector and the population size of the susceptible host populations.

Here's an example of this complex equation.
There are reports of at least 40 different mosquito species found naturally infected with West Nile virus (WNV), with some 30 or so in the US. However, merely finding WNV in a mosquito does not mean it is a vector. First, laboratory evidence of the mosquito's ability to pick up and later transmit WNV from one host to another is needed. Since WNV is carried by birds, one would suspect the vectors would prefer to feed on birds. Since birds roost at night and are thus easily accessible for biting at that time, we would guess further that the main WNV vector(s) would be night biters. It turns out that *Culex pipiens* (northern United States), *Culex quinquefasciatus* (southern United States), and *Culex restuans* all meet these conditions and are vectors of WNV.

Knowing these terms and concepts will allow you to both understand information you read about vectors and be able to communicate as a public health professional. The big takeaway is that vector-borne disease is very complex. Many factors must work together for disease transmission to occur. Take this into consideration when making claims about vectors. You should never use fear to motivate your customers. Communicate about real risks in your service area when talking about vectors and disease.

SAFETY

DISCLAIMER

The Occupational Safety and Health Administration (OSHA) Compliance Toolbox at www.qualityprotools.org and this study guide are provided as a benefit from NPMA and QualityPro. The information is derived primarily from OSHA's website (www.OSHA.gov) and corresponding state occupational safety and health plan websites, and is not expressly or impliedly warranted by NPMA or QualityPro to be accurate, complete, or current.

This study guide and www.qualityprotools.org do not provide, and are not intended to provide, legal advice, and are not intended to ensure compliance with OSHA or state regulations. Before relying or acting upon any information, you should seek the advice of an attorney or qualified occupational health and safety consultant.

Detailed and very specific requirements are not completely covered and described within this section—instead the basics of each section are provided. Only what is in the study guide will be on the QualityPro Public Health Core Exam.

GENERAL SAFETY RECOMMENDATIONS

Your daily job is full of risks. Driving, climbing up ladders, encountering public health pests and pesticides are all risky. You must be aware of all the risks encountered in a day and make a conscious effort, in every moment, to be safe. There are many useful safety resources available at www.osha.gov and https://www.cdc.gov/niosh/.

PPE BASICS

The pesticide label will dictate the minimal personal protective equipment (PPE) required. You should follow the safety recommendations on both the pesticide label and the operating manual of any equipment. In addition to what is on the label or in the manual, consider the target pest and the hazards in the environment where you will be working. Find PPE that can protect you from the risks associated with the pesticide, the pest, the equipment, and any other environmental hazards.

Common PPE includes:

Clothing – Your baseline uniform should include coveralls or a long-sleeved shirt and long pants. Select the protective clothing fabric based upon the label instructions. Wash work clothes separate from personal laundry.

Eye Protection – Depending on the job, you may need to wear glasses/goggles, spectacles with side shields, or face shields.

Footwear – Always wear slip-resistant, closed-toed shoes. Do not wear work footwear into a home (your own or a customer's) without shoe covers. Canvas is not recommended unless required by the job.

Gloves – Your hands are the most likely part of the body to be exposed to pesticides. Gloves are an important safety item and should be part of your basic service vehicle setup. When working with water-based insecticide formulations, neoprene, latex, or natural rubber gloves offer protection. When

applying formulations such as emulsifiable concentrates that contain solvents, use nitrile or butyl rubber gloves. Never use leather or cotton gloves since these fabrics can absorb insecticides.

Head Protection – A hard hat or bump cap may be required when working in certain accounts or in a confined space.

Hearing Protection – The two general types of hearing protection are earmuffs and earplugs.

Also consider how prepared you are for an emergency. Have the following:

- A spill control kit
- Access to Safety Data Sheets (SDS) for any product you may use
- Emergency response plans
- Identification that includes your employer's contact information if you lose consciousness and your phone is locked

CONFINED SPACES

OSHA defines a confined space as:

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited entry); and
- Is not designed for continuous employee occupancy.

Once a confined space has been identified as such, you should:

- Identify all potential hazards,
- Put on all PPE prior to entry,
- Make sure all tools and materials needed are gathered prior to entry, and
- Constantly monitor for hazards while working in the confined space.

OSHA defines a permit-required confined space as a space that has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

Regardless of whether the confined space is a true "permit-required confined space," you should use proper preparation, awareness, caution, tools, and equipment in confined spaces to mitigate the many hazards present in these environments. For pest management services, the most common confined spaces are crawl spaces and attics. Other confined spaces may exist and must be evaluated on a case-by-case basis. It is important to identify confined spaces and evaluate hazards prior to entry. If a confined space is a permit-required confined space, do not go in or exit immediately and seek a trained attendant to follow a permit-required program.

NPMA has a sample confined space program available at www.qualityprotools.org. The standards detailed in the sample are derived directly from the Department of Labor Occupational Health and Safety Administration (OSHA), Confined Space regulations for General Industry (29 CFR 1910.146). The structural pest management industry falls within the scope of OSHA's general industry standards.

HEAT EXPOSURE

Many of the pests of public health significance are found outside in the summer. Because of this, you should know about heat exposure—both the signs and the treatment. Exposure to heat can result in occupational illnesses and injuries including heat stroke, heat exhaustion, rhabdomyolysis, fainting/dizziness, heat cramps, and heat rash.

The heat index is a value that takes into account both temperature and humidity. This higher the heat index, the greater the risk. Anything over 91°F should alert you to taking precautions. If you work in the sun, are wearing heavy clothing or PPE, or are performing strenuous work, your risk will be heightened. Drinking plenty of water is a baseline recommendation that you should do every day.

There are ways to acclimatize to heat in preparation for work throughout the hot and humid months. Your employer may have a program in place in addition to training on heat-related illness.

INDUSTRY-SPECIFIC HAZARD ASSESSMENTS

To conduct a thorough inspection and treatment, you must prepare to visit all areas of a customer's property. A complete safety program includes acknowledgement of all workplace risks and how to recognize and mitigate these risks. A company should conduct and document a hazard assessment for all job tasks and environments in which employees will work. The hazard assessment should be reviewed annually and updated accordingly including a review of historical injuries and ensure the cause of all injuries have been included and the company safety program has been updated accordingly. Learn to identify and mitigate all identified hazards. Example hazards include, but are not limited to:

- Animals and/or insects including both wildlife and household pets
- Congested and limited space for movement & work
- Disease transmitted by pests (i.e. rabies, hantavirus, histoplasmosis, lyme, etc).
- Dust and other potential irritants
- Excessive heat or cold
- Heavy objects that obstruct the work area
- HVAC equipment or other rotating machinery/equipment
- Job site clutter that obstructs the work area
- Knob & tube (K&T) wiring
- Low light
- Manual material handling safety
    - Back
    - Shoulder
    - Neck
    - Ergonomics (including ergonomics for office work and driving)
    - Considerations for activities you perform over and over
- Noxious plants such as poison ivy and poison oak
- Potential exposure to energized electrical wiring
- Sharps and sharp objects (including hypodermic needles)

- Standing water
- Uneven and/or slippery working surfaces

LADDER/FALL PROTECTION

Using ladders is one of the riskiest parts of your job. OSHA rules address both fixed and portable ladders, fall arresters and ladder safety systems on fixed ladders over 24 feet. The rules also detail required protections for surfaces that are at least 4 feet above a lower level.

Employers are required to train all employees on fall protection. Qualified instructors who can identify and minimize the threats of fall hazards must provide the training. Specifically, you should

- Be trained on the ladder inspection process
- Understand how to select the proper ladder for a given job
- Understand proper use, e.g. climbing techniques and the proper way to move materials up and down a ladder
- Know proper ladder placement techniques are taught to ensure safe and secure placement of the ladder
- Know proper ladder storage is taught to ensure no damage is sustained while a ladder is not in use

OSHA's fall protection rule requires employers to ensure safe walking surfaces and that proper programs and protections are in place to prevent fall hazards. The rule outlines fall protections in specific situations, fall protection equipment/options, and inspection requirements. A sample ladder safety program that addresses the topics above is available at www.qualityprotools.org.

LIFTING AND MATERIAL HANDLING

Specialized equipment used in public health pest management may require you to lift heavy objects. Lifting heavy items is one of the leading causes of injury in the workplace. Bending, followed by twisting and turning, are the more commonly cited movements that caused back injuries.

The stages of lifting are:

1. Preparation
2. Lifting
3. Carrying
4. Setting Down

There are safety considerations for each of these stages. https://ehs.unc.edu/workplace-safety/ergonomics/lifting/ provides a good summary. The important things to consider from that website are:

- As a rule, bend at the knees, not the hips.
- Get help when needed. Do not lift or carry things you don't feel comfortable with, no matter how light the load.
- Implement rest breaks and job rotation for frequent and/or heavy lifting.
- It is easier and safer to push than to pull.
- Keep loads as close to the body as possible and do not twist while lifting, carrying, or setting down a load. Nose, shoulders, hips, and toes should all be facing the same direction.

- Minimize reaching.

Place items to be lifted within the “power zone”. The power zone is close to the body, between the mid-thigh and mid-chest of the person doing the lifting. This is the area where the arms and back can lift the most with the least amount of effort.

Plan for all parts of the lift: lifting, carrying, and setting down.

- Try to utilize proper handholds while lifting. If an item does not have a good handhold, think of ways to remedy this, such as placing the item in a container with good handholds, creating a safe and proper handhold with an appropriate tool, etc.
- Use mechanical means (e.g. hand trucks, pushcarts, etc.) when possible for heavier or awkward loads. Remember to obtain training and authorization before using a forklift.
- Use personal protective equipment where needed, such as gloves with good grip and steel-toed boots where appropriate.

PESTICIDES

You are trained to follow the label when using pesticides to minimize the associated risks. The public is entrusting us with this responsibility to minimize risks associated with both pests and pesticides. The label instructions are not just meant to minimize risks for the environment and your customers, they are also meant to minimize *your* risk of exposure over a career.

RESPIRATORY PROTECTION

OSHA’s Respiratory Protection Standard is very complex and lengthy and is one of OSHA’s most frequently cited standards. Whenever respirator use is required by the product label or environment, a formal respiratory protection program must be implemented. This includes assigning a qualified program administrator to develop and implement a Written Respiratory Protection Program that involves:

- Ensuring cartridges, canisters, or filters are the correct filtration for the job and replaced on a regular schedule.
- Ensuring that a physician or other licensed health care professional medically evaluates employees before using respiratory protection.
- Maintaining training records that prove that employees are retrained not less than once per year.
- Providing at least one annual respirator fit test.
- Selecting NIOSH certified respirators that are properly sized and fitted.

If you will be altering concrete, like drilling for a termite treatment, note that OSHA implemented a respirable silica standard in 2017.

For more information on respiratory protection and respirable silica, visit www.qualityprotools.org.

FOR MORE INFORMATION

- www.cdc.gov/niosh/
- www.osha.gov
- Pest Control Technician Safety Manual 2nd Edition
- www.qualityprotools.org

CUSTOMER COMMUNICATIONS

ENGAGING THE PUBLIC/COMMUNITY

Part of an Integrated Pest Management (IPM) program is involving the people who live, work, or play in and around the structures that are being kept pest-free. Public health pests are well-adapted to live in close association with humans. Managing pests takes constant vigilance as well as your inspections, service, and advice. In this study guide, we use the term “customers,” but anyone can be involved.

Without using scare tactics or exaggerating the risk associated with pest infestations, you can motivate customers to do their part in pest management. When a customer understands the following, they are more empowered to problem-solve and contribute to the success of the IPM program:

- How the infestation started including where the first pest(s) came from/how they got inside.
- How you and customer can work together without duplicating effort.
- The basic life cycle of the pest and any relevant behavior.
- What the pests eat/drink to survive.
- Where infestations are most likely to occur on a property.

Regardless of the service, set customers’ expectations for what your service entails and how the pests should respond. For example, you may use a product that does not kill the pest immediately so that it has the chance to cause secondary kill. Your customer should know that seeing live pests after that treatment is expected and is a good thing. Set their expectations for how long it should be until they see a reduction in pests and what they can do to contribute. In addition, when communicating with customers:

- Acknowledge and applaud anything a customer does to reduce or eliminate pests or pest conducive conditions.
- Ask good questions when interviewing a customer as part of your inspection. Ask questions that cannot be answered with “Yes” or “No,” and instead requires the customer to give you specific information. For example, “Have you seen any live bed bugs?” and “When was the last time you saw a live bed bug?” are similar questions, but the latter gives you more useful information.
- Be as specific as possible when identifying a target pest. For example, instead of calling the target pest a roach, refer to it as a German cockroach and be prepared to communicate details related to the pest’s biology and behavior.
- Let the customer share information with you and ask questions. Helping them understand the target pest can provide relief and you want the customer to come to you any time they have a pest concern.
- Never make a promise or claim of elimination. The following terms are approved for use when describing your service: abatement, reduction, management, and control.
- Never guarantee that your customer or any persons at the service location will not be bitten, stung, or otherwise effected by the target pest.
- When an issue or question is related to the health of people or pets, refer customers to their doctors or veterinarians. If customers have concerns about how pesticides may affect their health, share the product label and SDS sheet of any products you plan to use and have them consult their doctor. Make sure they know that you are trained to follow the label directions and minimize the risk of your application.
- Stress the importance of the customer’s role in pest management. Explain, for the target pest, how their efforts to keep food, water, and shelter away from pests and keep them out through

exclusion and preventing hitchhikers will assist in your management efforts. You can manage almost any infestation with the tools available, but customer cooperation and involvement will make the program more efficient for all.

- Only provide information and suggestions you know is factual. Citing research or training you have received will increase your credibility in the eyes of your customers.
- If you have professional credentials and training, give your customer confidence by telling them. Examples for the pest management industry include:
    - "My company is QualityPro accredited which means they meet national standards for professional practices. An example is that my company maintains and enforces a drug-free workplace policy."
    - "My company offers QualityPro Public Health Certified Service which means that the service I am performing meets national standards and I had to pass an exam proving my knowledge of public health pests."
    - "I am an Associate Certified Entomologist. To earn this certification, I had to pass a rigorous exam about entomology."
    - "I earned and maintain a state license to apply pesticides."
    - I attended our industry's national conference called PestWorld last year to stay on the cutting-edge of pest management. At that conference I learned…"

Never assume a person knows how to contribute to an IPM program. You may need to demonstrate how to use cleaning tools, advise the customer on what materials will be needed for exclusion work, or help put together a cleaning and maintenance schedule that helps the customer stay ahead of the pests. In many communities there are educators and social services that may be able to help. Know the services available and refer customers when appropriate. In addition, your company can work in the community by:

- Getting to know people in local government who work with pests or pest-related issues. Offer to provide training and informational seminars.
- Inviting Extension Agents, local epidemiologists, or a health nurse to help you provide public health related IPM seminars to the community.
- Offering to share your IPM program during a community meeting with neighborhood associations, rural community associations or local municipal groups.
- Readily sharing brochures and other educational information available from University Extension Programs, the NPMA Field Guide, health departments and the Centers for Disease Control and Prevention.
- Referring customers to pestworld.org for science-based information and experts who are trained to talk to the media and encourage people to hire a professional. Your customers are most likely to get their information from the internet, local newspapers, radio, and television.
- When performing Integrated Pest Management in schools, getting to know the school health nurse. They should understand IPM and its importance to public health. These professionals likely have valuable experience dealing with parents, staff, and the public media.

RISK COMMUNICATION

The World Health Organization defines risk communication as

"the exchange of real-time information, advice and opinions between experts and people facing threats to their health, economic or social well-being. The ultimate purpose of risk communication is to enable people at risk to take informed decisions to protect themselves and their loved ones. Risk communication uses many communications techniques ranging from media and social media

communications, mass communications and community engagement. It requires a sound understanding of people's perceptions, concerns and beliefs as well as their knowledge and practices. It also requires the early identification and management of rumors, misinformation, and other challenges"

From https://www.who.int/risk-communication/background/en/

To be effective in risk communication, you must earn the customer's trust as an expert in pest management and use this trust responsibly. "The US CDC examined attributes and behaviors associated with establishing and maintaining trust within the context of partnerships and learned that the following are considered essential components of trust:

- Accessibility
- Dependability
- Good/clear communication
- Mutual benefit
- Openness
- Providing accurate information
- Relationship building
- Responsibility
- Sharing of power/responsibilities
- Supportiveness
- Truthfulness
- Valuing differences"

From https://www.who.int/risk-communication/introduction-to-risk-communication.pdf

You should strive to demonstrate these components your speech and service. Never try to make a customer fearful. Do not exaggerate the risk of disease associated with pests or the impact your service can have on local disease transmission. You should be perceived as a pest management expert who is prepared, honest, relatable, willing to share knowledge, dedicated to managing pests and caring—a protector of public health.

You should communicate risk in order to:

- Dispel rumors and misinformation
- Encourage customers to participate in pest management programs
- Improve cooperation and trust between you and your customers
- Inform customers about the risks associated with pests and pest management techniques and how partnering with you manages those risks
- Raise awareness of public health pests
- Reassure customers

This content in this study guide is mean to both prepare you to pass the QualityPro Public Health Core Exam and have the knowledge needed for proper risk communication about public health pests. Note that only persons who are trained and qualified to speak for your company should speak publicly online or with the media. The National Pest Management Association has trained experts who may be able to help members with public relations. Pest-specific information is contained in the following sections but communicating with customers about the risk of pests and pesticides will be applicable to most services. Some talking points include:

- The risk associated with a pesticide application is a function of toxicity of the product and exposure. Most people just think about the toxicity. You are trained to use products according to the label directions and minimize exposure and risk.
- Just because a pest can transmit a disease, doesn't mean every pest you encounter is a threat. The pathogen needs to be present in the area and the pest must acquire the pathogen to transmit it.
- Pest management service does not eliminate all risk from vector borne illness, but pest management service can reduce pest encounters.
- Our service is designed to manage pests in your immediate area. We do not manage all pests in the entire community. Because of this, we cannot guarantee that you won't encounter pests.
- The instructions on the pesticide label are the law. I must follow the instructions exactly in my service.

WHAT NOT TO SAY

- Avoid using the word "safe." Instead, let your customer know the EPA registers products used in your control program and you always follow the application instructions on the label. The EPA will not register a product unless persuaded by scientific data there is no unreasonable risk of adverse effect when used as directed by the label.
- "Your home is filthy" or some version of that which will leave your customer feeling embarrassed and judged. Remember the components of trust listed above and try to motivate the customer to do his or her part. Focus on the biological and behavioral needs of the pest when communicating with customers about sanitation issues. Make it about the pests, not the people. Rely on your training and expertise to do as much good at possible by managing pests to the best of your ability.
- Don't hype or exaggerate the likelihood of a client getting sick from a vector borne illness simply so you can get the sale. Using fear to make a sale is poor risk communication. Rely on facts that are true for your location.
- Don't provide medical information or advice even if it is a guess and you say so. Refer the customer to a medical professional, whether it be doctor or veterinarian.
- Like diagnosis, don't give customers advice about vaccines and specific disease information when they travel. Instead, refer them to a travel clinic at a local hospital or medical center or their doctor.

BED BUGS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Eastern bat bug (*Cimex adjunctus*)
- Bed bug (*Cimex lectularius*)
- Western bat bug (*Cimex pilosellus*)
- Tropical bed bug (*Cimex hemipterus*)

DISEASES AND CONDITIONS

- Skin reactions to their bite
- Stress & anxiety

OVERVIEW

Bed bugs are wingless, hematophagous (blood loving) red-brown insects that were once rare in the US and Canada. Since a resurgence in the early 2000's, they have become relatively common. They are a challenge for PMPs because they are very good at hiding and only feed on blood. You must be very good at inspection and plan the treatment to contact the insects either in their hiding places or as they travel to find a blood meal or return to hiding. In addition, the pesticide options available for bed bugs are limited by their biology. The fact that they only eat and drink blood means that none of the common pesticide "bait" formulations designed to be eaten by the target pest will work on bed bugs. Another challenge of bed bug work is the location of the infestations. Bed bug infestations usually happens in places where humans frequent like living rooms and bedrooms. You must take care to minimize the risk that a human will encounter the pesticide while maximizing the chance that a bed bug will. Even when faced by all these challenges, PMPs have learned to be very effective at managing bed bugs.

Understanding bed bug feeding helps you understand why the bed bug is problematic. All 5 instar nymphs and the adults feed on blood. When a bed bug locates a host, the insect begins the feeding process by penetrating the host's skin with its tube-like proboscis. The proboscis serves two primary purposes. The first is to penetrate the host's skin and inject saliva that contains a mixture of anticoagulant compounds, which enables blood flow from the host and anesthetic compounds that reduce the irritation and discomfort caused from penetrating the host's skin. As a result of the anesthetic effect from a bed bug's saliva, several hours may pass before a person becomes aware of the bite. The other purpose of the proboscis is to enable the bed bug to suck up the host's blood. After feeding, bed bugs crawl away from the host and digest the blood mean, excreting small reddish-black drops that look like cockroach feces when dry (in size and color). You can tell the two signs apart—cockroach feces are granular like coarse pepper and bed bug spotting is not.

Many other insects that inject saliva, feed on blood, and excrete near the host are disease vectors. Bed bugs have been found to carry pathogens, but not transmit any. They are significant to public health because some people's skin reacts to the bed bug's bite. Reactions differ from person to person and an individual's reaction may even change over time. Despite common belief that their bites occur in a row, there is no telltale bed bug bite. Unless you see the bug feeding, you cannot know for certain a skin reaction was caused by a bed bug bite. If a customer has a skin reaction, refer them to a doctor. Reactions can be severe and, as with any skin wound, infection can result if a person is not cautious.

Another impact bed bugs can have on your customers is stress, irritation, anxiety, irritability, depression, or insomnia. Bed bugs invade our most personal spaces, and this can be very unsettling. In addition, depending on the management plan, bed bug treatments can require both a lot of time and money which are triggers for stress.

Bat bugs (*Cimex adjunctus* and *Cimex pilosellus*)

Bat bugs are much less likely to feed on humans than bed bugs since their primary host is usually bats. However, in the absence of bats, they will feed on people. Bat bug preferred habitat is inside structures where bats are located places such as attics, wall voids or other uninhabited locations within buildings. If bat hosts are not available, bat bugs will move to locations inside living spaces and feed on people. In addition to behavioral differences, bat bugs do look a bit different to the trained eye. They are relatively hairy. Specifically, the hairs on their pronotum are equal to or longer than the width of their eye. Bat bug treatment needs to include wherever the bats were.

Bed bug *(Cimex lectularius)*

In addition to the biology and behavior that was described in the overview above, you should know about the detection and treatment options available for bed bug management.

Like many pests that infest where humans live, bed bugs are most active at night when their potential hosts are least likely to swat them away. Unless the infestation is well established, finding bed bugs with only a visual inspection will be a challenge because they are most often hiding in cracks as thin as the edge of a credit card. Beds and other furniture offer lots of places to hide. Bed bug treatment can be straightforward if the infestation is small (in both number of insects and locations where they are found) so you should perform routine inspections to catch and infestations before they grow and spread.

In addition to a thorough visual inspection with a bright flashlight, you should use monitoring devices that are designed to capture bed bugs when they are active so that you can see there has been activity when she comes to inspect and/or specialized dogs that are trained to find bed bugs. Customers can make inspection easier by covering box springs and mattresses with encasements and keeping living areas as clutter-free as possible. Once live bed bugs have been found, you should use a combination of the treatment options available: heat, cold, pesticides and vacuuming. Some treatment plans ask the customer to prepare the room(s) ahead of time while others do not. With the tools available, customer participation is not necessary, but can make your time more efficient.

Tropical bed bug *(Cimex hemipterus)*

Tropical bed bug infestations are rare in the US and Canada. As the name implies, this insect prefers tropical climates. This species looks very similar to the common bed bug—the shape of the pronotum is the defining characteristic. Consult an entomologist for definitive identification. Because they are not common, little research has been done on what PMPs should do differently to manage tropical bed bugs. For now, the species are treated the same in terms of management.

WORKING WITH YOUR CUSTOMERS

Because bed bugs cause stress and anxiety one of the most impactful things you can do for your customers is help them understand both the insect and how you will help. More than most other pests, with bed bugs the customer is looking to you to not just kill insects, but also to make him feel comfortable living in the space again.

- Ask what the customer knows about bed bugs to correct any misunderstandings. Make sure the customer knows:
    - Bed bugs cannot fly, jump, burrow into the skin or chew through anything.
    - All life stages: egg, 5 nymphal instars, and adults are visible to the naked eye.
    - Bed bugs have not been found to transmit disease.
    - The cleanliness of a home has nothing to do with whether bed bugs can live there—anyone can end up with an infestation.
- Give the customer things he can do to assist in the management, not work against your efforts. For example, if the customer wants to do something, have him vacuum or do laundry on hot cycles. Although these measures are not necessary for the management to be successful, they will give the customer a way to contribute besides applying over-the-counter pesticides.
- Help the customer understand how your treatment will kill bed bugs and how long you expect it will take. If monitors are in place, make sure he knows how they work and how to check them for himself.
- Help the customer develop procedures for bringing items to and from the home so that he can go about his or her normal life and reduce the risk of bringing bed bugs to new locations.
- If possible, discuss how the infestation got introduced and help the customer understand what he can do to prevent it from happening again.
- If the structure may have bats, ask questions that can help you rule out the possibility of bat bugs.
- Do not ask to see or offer to look at a person's suspected bed bug bites. Refer him to a medical professional.
- If you cannot find signs of bed bugs—eggs, live bed bugs, dead bed bugs, shed exoskeletons or fecal spots—offer to install monitoring devices and come back to inspect again. Note: if you suspect someone is suffering from delusional infestations do not offer to monitor or inspect further. See the delusional infestations section of this study guide for further information.
- Don't exaggerate the scale of the infestation—if the infestation is small, don't tell the customer it is larger than it is. Always scale your treatment plan to the scale of the infestation unless the customer understands the situation and still wants a large-scale response like a whole-unit heat treatment. When using pesticides, always follow label instructions. If a customer wants your to do more with pesticides, explain that the label is the law.

FOR MORE INFORMATION

- Advances in the Biology and Management of Modern Bed Bugs
- Bed Bug Handbook: The Complete Guide to Bed Bugs and Their Control
- CDC Bed Bug Frequently Asked Questions: https://www.cdc.gov/parasites/bedbugs/faqs.html
- NPMA Bed Bug BMPs
- NPMA Bed Bug Basics Training at www.npmatraining.org

COCKROACHES

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- American cockroach (*Periplaneta americana*)
- Australian cockroach (*Periplaneta australasiae*)
- Brownbanded cockroach (*Supella longipalpa*)
- German cockroach (*Blattella germanica*)
- Oriental cockroach (*Blatta orientalis*)

DISEASES AND CONDITIONS

- Asthma
- Allergies
- Mechanical transmission of pathogens, especially bacteria and parasites

OVERVIEW

A few species of cockroaches have become well adapted to living with and near humans. They are mostly active at night but can be seen during the day if the infestation is large enough to fill harborages. They prefer moist, warm areas where they can hide in cracks and crevices. The presence of cockroach activity is ideally detected early on in an infestation by using monitoring devices, but more often is detected through their physical presence, musty odor, damage, or fecal matter. Cockroaches enter structures on personal belongings, in corrugated cardboard, grocery packages, animal food and other household goods. They can move from room to room or to adjoining units via wall voids, plumbing and wire runs or in items that are moved to a different area.

Cockroaches have a gradual metamorphosis which has three life stages: egg, nymph, and adult. Nymphs undergo a series of molts in which the insect sheds and leaves its dry, brittle skin (exoskeleton) behind. This shed exoskeleton can easily become airborne particulate matter. Proteins in the exoskeleton can trigger asthma attacks in people who are allergic to them. Both exoskeletons and the excrement produced by cockroaches can cause allergic reactions such as skin rashes, watery eyes, and sneezing. This is notable for protecting public health because the dead cockroaches are just as much of a problem as live cockroaches when it comes to allergies and asthma.

Cockroaches feed and inhabit in unsanitary areas such as sewers and garbage storage areas. They are also commonly found in unclean areas of kitchens and bathrooms harboring in crack and crevices near food sources. This behavior contributes to their potential to contaminate food surfaces, food supplies and other surfaces through mechanical transmission of bacteria and pathogens. They also carry a wide variety of protozoa and other microorganisms inside their bodies which may be involved in the spread of disease to humans.

To manage cockroaches, you must know the locations and size of the populations and plan control measures accordingly. Monitoring devices help you detect populations before they grow and spread and help inform a thorough inspection based on the number of cockroaches and the life stages present on the trap. For example, if a sticky trap monitor is covered in cockroaches and there are nymphs and females carrying egg cases, there is a harborage within feet that is a main source of the problem. Many tools are available to kill cockroaches including pesticides in dust, granular, gel and liquid formulations.

One of the most powerful tools is the HEPA vacuum which you can use to remove cockroaches, both alive and dead. The high-efficiency filter helps reduce the airborne allergens that are part of what make cockroaches public health threats. In some cases, you or someone else will need to do exclusion work such as sealing around pipes and filling gaps where cockroaches hide to prevent re-infestation. Follow up inspection and monitoring inform you of the success of the control measures and sets the location up for success so that populations do not grow unnoticed.

American cockroach (Periplaneta americana)
Also known as a water bug or palmetto bug.

The American cockroach is a large insect ~35-53 mm in length, reddish-brown in color and has a yellow band around the pronotum. It is the most common species found in sewer systems, steam tunnels and boiler rooms. They enter structures through deliveries, sewer systems via the drains, or they migrate in from other structures. Exclusion work is important in managing this species. They can also be found in commercial buildings such as restaurants, bakeries, grocery stores, food processing plants, and hospitals where they can infest food storage and food preparation areas.

American Cockroach

NPMA

Australian cockroach (*Periplaneta australasiae*)

In the US, the Australian cockroach is most prevalent in Florida and the coastal southeastern states. The adults are ~32-35 mm long, range in color from reddish-brown to dark-brown and have a light-yellow band on the outer edge of their wings. The wings are completely developed and functional, capable of gliding flight.

The Australian cockroach is typically found outdoors under the bark of trees, in firewood piles, and in locations with moisture. Occasionally, it is found indoors in and around water pipes, sinks, toilets, cupboards, and other environments with dark and warm conditions. Because the Australian cockroach primarily lives outdoors, exclusion techniques are recommended.

Australian Cockroach
Pest and Diseases Image Library, Bugwood.org

Brownbanded cockroach (*Supella longipalpa*)

Brownbanded cockroaches are one of the smaller cockroaches, rarely being more than 13 mm in length. They can be distinguished from German cockroaches by the characteristic markings and preferred harborage sites. The adults have two light transverse bands running horizontally across the base of the wings and abdomen. In contrast, the German cockroach's stripes run vertically along its side. They are frequently found in the same structures as German Cockroaches but are seen in different areas. Brownbanded cockroaches are found on ceilings, high on walls, in picture frames and light fixtures. They do not require a close association with moisture sources and are not typically found in kitchens and bathrooms.

Brownbanded Cockroach
NPMA

German cockroach (*Blattella germanica*)

The German cockroach adult is ~13-16 mm long, is light brown in color and has two dark longitudinal stripes on the pronotum (body part behind the head). It is the most common species found in houses, apartments, restaurants, hotels, and other institutions in the United States. They prefer warm, humid conditions in kitchens and bathrooms, but infestations can occur in areas where people eat and drink, such as dens and bedrooms.

Small populations of German cockroaches can quickly turn into infestations due to their biology and behavior. Their egg cases have many embryos (usually more than 30) and the females will carry the capsule until the nymphs are ready to hatch out. This protects the eggs from various hazards and increases their chance for survival. The German cockroach also has the shortest development time from egg to sexual maturity, so populations will build up more quickly than other species. Females with egg cases do not move or eat very much, so control efforts must be targeted to contact them.

German cockroach
NPMA

The German cockroach's proximity to people and our food make them a leading public health threat. German cockroaches have been implicated in the outbreak of illnesses, the transmission of pathogenic organisms, and allergic reactions including asthma in people.

Oriental cockroach (Blatta orientalis)

Adults range from 25-30 mm in length and are usually shiny black in color. The wings of males cover 75% of their body, this distinguishes them from females who have reduced wings (covering only 25% of their body). Neither are capable of flight. Oriental cockroaches feed on decaying organic matter and other types of filth.

In many areas, the Oriental cockroach lives outdoors in wet, shady areas (under rocks, stones, mulch, and leaf litter). They are often around the perimeter of a structure and have been found in wall and porch voids. This species prefers temperatures that are lower than other species of cockroaches and may be found in cool basements and crawlspaces. It may enter a structure in food packages and laundry or from the exterior via sewer pipes, air ducts, ventilators, or other openings. They are usually found on the first floor of a structure but can occasionally reach higher floors by crawling up water pipes or garbage chutes.

Oriental Cockroach
NPMA

WORKING WITH YOUR CUSTOMERS

The best advice to give to customers is to maintain good sanitation and storage practices to keep food away from cockroaches. All areas should be kept clean so that no fragments of food or organic matter remain. Ideally, kitchens are arranged, and equipment is designed to be cleanable and inspectable. Where cockroaches are present outdoors, care should be taken to maintain the building envelope so that cockroaches do not get in. Trash bins should be securely covered and emptied frequently. All incoming deliveries should be inspected for the presence of pest activity. Basements and areas underneath buildings should be kept dry and free of accessible food and water.

You should not assume the customer knows how to clean well enough to remove cockroach food sources. Work with customers so they know exactly where and how to clean areas where cockroaches may feed or hide.

FOR MORE INFORMATION

- American College of Allergy, Asthma & Immunology: https://acaai.org/allergies/types/cockroach-allergy
- PestWorld.org https://www.pestworld.org/search/?search=cockroach

FILTH FLIES

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Blow fly (*Calliphoridae spp.)*
- Drain fly (*Psychodidae spp.)*
- Flesh fly (*Sarcophagidae spp.)*
- Fruit fly (*Drosophila spp*.)
- House fly (*Musca domestica)*
- Phorid fly (*Phoridae spp.)*
- Stable fly (*Stomoxys calcitrans*)

DISEASES AND CONDITIONS

- Foodborne illness
- Bacillary dysentery caused by bacteria
- Amoebic dysentery caused by protozoans
- Cholera, cutaneous diphtheria, polio, and certain skin infections such as yaws and leprosy are not common and can usually be traced back to travelers from areas of the world where these diseases are more common.

OVERVIEW

There are over 50 species of flies in the US that are associated with humans to some extent. Of these species, many are filth flies involved in transmission of pathogens that cause gastrointestinal issues as well as other diseases. Filth flies are not necessarily closely related except that they are flies. The term encompasses many kinds of flies that are grouped because of where they breed—in filth.

Filth flies lay their eggs in animal manure, human excrement, garbage, animal bedding, carcasses and decaying organic matter that is often found in drains and the nooks and crannies of locations where food is handled, processed or served. The eggs hatch into larvae (maggots) that consume the nearby material. Once they are grown, the maggots pupate, and the adult fly emerges out of the pupae. The adult flies usually eat a wider variety of organic matter so they may go from a garbage can to a freshly plated meal.

Because of where they feed and breed and their ability to fly, flies are very capable at mechanical transmission of many pathogens. The pathogens are transported on the wings, mouthparts, feet, legs, and other parts of the fly's body from the contaminated area to food, food preparation surfaces and food utensils in homes, food service businesses and manufacturing plants. Although filth flies aren't implicated in the biological transmission of pathogens, many filth flies regurgitate and poop where they land which is another method of mechanical transmission.
To be successful at filth fly control, you must find and eliminate the material where the maggots are thriving, and adult flies are landing to lay eggs. The search for the source is not always easy. The breeding site may be beneath tiles, in a wet vac filter or deep in a drain. The adult flies are usually what the customer sees and complains about, but these flies may be far from their source. It is up to you to know the species and where it breeds to find the source of the problem. Fly management programs will address the adult flies which can vector pathogens and the maggots to prevent recurring issues.

Infestations are likely to originate from adult flies flying into a building and finding suitable conditions. To prevent this from happening, buildings should use exclusion tools such as screens and air curtains.

Blow fly *(Calliphoridae spp.)*

Blow flies are one of the first insects to lay eggs on a carcass making the maggots helpful to crime scene investigators who are trying to calculate time of death. The adults, also known as bottle flies, are often shiny, metallic, and sometimes colored green or blue. There are many species of blow flies, but all develop in carcasses which is the clue you need for control.

Because blow flies only lay eggs on fresh carcasses (or freshly thawed meat), once the carcass ages, these flies will not be interested. By the time, you are called, the source is likely too old to produce more flies. A common scenario is a customer reports many blow flies in a building and upon further questioning, they remember a dead animal smell nearby indicating that an animal like a mouse may have died in the wall a few weeks prior. The adult flies are the result of the eggs that were laid on the mouse as soon as it died.

Adult flies are of public health importance because they do land and feed on decaying organic matter. You may not be able to address the source but should take steps to remove the adults and ensure flies from the outside cannot enter the building.

Drain fly (Psychodidae spp.)

These small flies are one of the easiest for you to identify. The adults have characteristically round wings and both the body, and the wings appear hairy. Many refer to these as moth flies. Drain flies develop in the gelatinous goo in drains. To determine if drain flies are emerging from an opening, place a cup or folded sticky trap over it as a monitor and see if any adults are captured. To eliminate a drain fly infestation, clean the drain or discovered breeding site. Tools for this include a stiff brush, steam and products designed to break down the organic material.

Flesh fly (Sarcophagidae spp.)

Flesh flies are somewhat unique because their eggs hatch inside the female’s body and what she deposits on the decaying material are tiny maggots. Despite their common name, flesh flies will deposit maggots on more than just flesh, many decaying substances will attract these flies. In fact, flesh flies have been known to deposit maggots around seeping wounds and mucus tissue of live animals. Adults are about the size of a house fly, but more robust. They have three stripes on the thorax and the abdomen of some species has a checkerboard pattern. Some also have what appears to be a red dot at the end of the abdomen. Flesh fly management includes finding and eliminating the breeding site, getting rid of adults so that they cannot transmit disease, and preventing adult flies from entering the building in the future.

Fruit fly (Drosophila spp.)

Fruit flies are very hard to manage because of their size. Adults can enter a building through very small holes and a small amount of decaying or fermenting matter can sustain thousands of fruit fly maggots. The females are not too picky about where they lay their eggs, but sugary or fermenting organic matter is very attractive. Solving a fruit fly problem is rarely as easy as getting rid of the overripe bananas on the counter. Maggots may be present in dirty drain lines, wet mop heads, recycling, drain pans, or unclean garbage containers. You should focus your inspection where there is the most adult fly activity

and eliminate the source through proper cleaning techniques. For outdoor food serving locations that constantly attract fruit flies, consider using air currents to deter fruit flies from landing.

House fly (Musca domestica)

Because of its wide distribution and large reproductive potential, the most important and most common filth fly is the house fly. The house fly can transmit at least 65 diseases to people. In the US, the most common public health link is with foodborne illness. They are strong fliers, so the fly landing on a person's food may have started its life on a farm miles away. House flies lay hundreds of eggs in decaying organic matter and these eggs can develop into adults in as little as 7 days. Adults have 4 longitudinal stripes on the thorax. There are many tools available for house fly control including parasitic wasps, traps, and pesticides. As with other filth flies, finding and eliminating the source is the best way to eliminate this pest.

Phorid fly (Phoridae spp.)

Phorid flies are also known as humpback flies due to their humpback-shaped thorax or scuttle flies due to their behavior of scuttling along a surface rather than taking flight. This behavior can help you identify this small fly. Phorid flies lay their eggs in decaying organic matter and sewage waste. Because of their small size as adults, they can get to very hidden areas to breed. As with drain flies, you may need to place monitors near suspicious areas to pinpoint the source. Many PMPs have horror stories of having to break the news to their customers that the phorid flies are indicating a broken sewage line or pipe beneath a concrete slab that must be fixed to solve the problem. At times, the only way to precisely determine where phorid flies are developing is to request a plumber to pass a camera down the drain or sewer pipes to determine whether a leak or broken pipe exists.

Stable fly (*Stomoxys calcitrans*)

Stable flies look very much like house flies except for their sword-like mouthpart which can be seen sticking out from the front of the head when viewed from above. Unlike the sponging mouthpart of most filth flies, the mouthpart of a stable fly is made to pierce skin and suck blood. They are a common farm pest but will also bite pets and the legs of people. Other common names are dog flies and biting house flies. The develop in decaying organic matter including wet animal bedding, grass clippings, and piles of plant matter that wash up on the shores of lakes and rivers. Interestingly, stable flies have been found to travel long distances on the air currents of storm fronts. People may find themselves being bitten more than usual by stable flies within an hour of a rain storm. Because they can travel long distances as adults, the breeding source may not be at the customer's location. If this is the case, you must focus on managing adults through exclusion or air currents.

LOOK-ALIKES

To the untrained eye, many flies including those listed above, look the same. A few flies that are common in or around structures, but are not considered public health pests are:

- Cluster fly (*Pollenia rudis*) These flies are larger than a house fly and dull gray with a golden sheen. Eggs are laid in soil and emerging larvae find and parasitize earth worms. They are not feeding or breeding in structures. Cluster flies are considered a structural pest because they often enter homes to overwinter. The overwintering adults will not cause damage but can be annoying.
- Fungus gnat (Various spp.) Fungus gnats are small flies that feed on and lay eggs in fungus. In buildings, the fungus is often found in overwatered potted plants. They are not disease vectors.

- Little house fly (*Fannia canicularis*) The little house fly or lesser house fly looks like a small version of the house fly. They don't usually enter structures but may be an annoyance outside. Because they don't usually come inside, they are not considered a significant public health pest for humans.

WORKING WITH YOUR CUSTOMERS

Because source-finding is the key to filth fly management and the breeding sites are usually in hidden areas, interviewing people who live or work in the area can help you focus your inspection.

Some questions related to filth flies might include:

- Can you show me where you are seeing these flies the most?
- Have you noticed any bad odors?
- How do you clean your drains?
- How often are the drain lines cleaned? (Questions about cleaning schedules for drink dispensers, trash cans, etc. can help you advise customers on a cleaning schedule that will contribute to fly management.)
- Is there any rodent bait out or have you set out any rodent traps that could contain a dead rodent somewhere?
- Is this door left open a lot during the day?

Once the filth fly is properly identified and the source is located, you can involve customers in fly management. You should know how to take apart common kitchen and cafeteria equipment to inspect and show customers where routine cleaning needs to occur. Be thorough when explaining the importance of sanitation and debris removal but do so without making the customer think you are being overly critical of their housekeeping and general maintenance of the property. If many homes in a community are is suffering from filth flies, consider informing people about how poorly maintained compost, grass clipping piles, dog waste, and uncovered garbage can contribute to fly problems.

MOSQUITOES

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Aedes
    - Asian tiger mosquito (*Aedes albopictus*)
    - Eastern treehole mosquito (*Aedes triseriatus*)
    - Saltmarsh mosquito (*Aedes sollicitans)*
    - Vexans mosquito (*Aedes vexans*)
    - Yellowfever mosquito (*Aedes aegypti*)
- Anopheles
    - *Anopheles cruciens*
    - Common malaria mosquito (*Anopheles quadrimaculatus*)
    - Western malaria mosquito (*Anopheles freeborni*)
- Cattail mosquito (*Coquillettidia perturbans*)
- Culex
    - *Culex tarsalis*
    - Florida SLE mosquito (*Culex nigripalpus*)
    - Northern house mosquito (*Culex pipiens*)
    - Southern house mosquito (*Culex quinquefasciatus*)
- Psorophora
    - Dark ricefield mosquito or glades mosquito (*Psorophora columbiae*)
    - White-footed woods mosquito (*Psorophora ferox*)

DISEASES AND CONDITIONS

- Chikungunya
- Dengue
- Eastern equine encephalitis
- La Crosse encephalitis
- Malaria
- Saint Louis encephalitis
- West Nile virus
- Yellow fever
- Zika

OVERVIEW

There are over 3,000 different species of mosquitoes, but only about 175 species are recognized in the United States. Mosquitoes are more than just a nuisance pest. Their bites can cause severe skin irritation through an allergic reaction to the mosquito's saliva. Many species are vectors of viruses that can cause severe disease and even death in humans. For most of these viruses there are no vaccines or medicines are available. West Nile virus (WNV) is the most common virus spread by mosquitoes in the continental United States. However, most cases are mild and usually go unreported. There are other dangerous viruses such as Eastern Equine Encephalitis (EEE), Western Equine Encephalitis (WEE), St. Louis Encephalitis (SLE), LaCrosse Encephalitis (LAC) that are transmitted via the bite of a mosquito. Encephalitis attacks the central nervous system. The effects of these viruses vary from mild

in some people to death in others. Many times, those who recover are left with permanent nervous system damage. Certain groups are more vulnerable than others, infants, young children, elderly and people with compromised immune systems. There are also new emerging diseases like Zika, chikungunya and Dengue, most of which have occurred in US territories.

Female mosquitoes of nearly all species require blood from vertebrate animals such as people, pets, and livestock. The consequence is the potential for mosquitoes to transmit diseases via their bites. A female will use her piercing-sucking mouthpart to extract blood after she mates. She needs the nutrients in blood to produce eggs. The males do not suck blood, they feed on nectar. When a female mosquito feeds and picks up a virus, she will transmit it to the next thing she feeds on. Mosquito species have various feeding preferences, some mosquitoes feed on birds while others feed on mammals. There are some species that feed on both birds and mammals which are called “bridge vectors.” Bridge vector species may pick up a virus from a bird and transmit it to humans, horses, and other mammals.

Most mosquito species are actively searching for a blood meal in the evening hours from dusk until dawn. During the daytime, females rest in cooler vegetated areas where the humidity is higher, and they are protected from drying out. However, this is not true for all species, there are some that will readily bite during the daytime hours.

Mosquitoes are in the order Diptera, meaning “two wings.” All insects in this order, including mosquitoes, are flies. Most species of mosquitoes range in size from one-fourth to one-half of an inch in the adult forms. They have scales that cover their bodies and can vary in color depending on the species.

While people sometimes believe they have seen giant mosquitoes, most likely these are similar-looking insects. There are several other types of insects often mistaken for mosquitoes. They include crane flies, mayflies, and midges. Crane flies do not bite and are larger than a mosquito. Mayflies also breed in and near water but do not bite. Midges, including some species of gnats, are most often confused with mosquitoes when people see them in a swarm.

No matter what the mosquito species, water is essential for breeding. The larval and pupal stages are aquatic. Their larvae prefer still (or “standing”) water and can be found in containers, tree holes, roadside ditches, low lying areas, swamps, and tidal salt marshes. Mosquitoes are not found in moving streams and rivers or in areas subjected to heavy wave action. Contrary to popular belief, mosquitoes do not breed in tall grass or thick brush. These areas provide an excellent refuge for adult mosquitoes during the heat of the day but in no way contribute to mosquito breeding.

Mosquitoes undergo a complete metamorphosis that consists of four distinct stages: egg, larva, pupa, and adult. The rate of development varies according to the species and temperature. Under optimal conditions, the entire life cycle usually takes 10 – 16 days. Dumping standing water weekly ensures that the larvae will not make it to a flying, biting adult.

Eggs

Depending on the species, a female mosquito can produce 50-500 eggs in her first brood. She will produce fewer eggs in subsequent broods but may oviposit (lay) 10 times in her life. Mosquito eggs can be characterized by two major types: floodwater and permanent water eggs. The females of floodwater species will lay their eggs on a moist substrate, not on standing water. These eggs need to dry out for a period before they will become viable. They can remain dried out for extended periods of time. Once

they have passed through the drying time, they will hatch if the area is flooded by rain or by high tides. Permanent water mosquito eggs are laid on the surface of the water either singly, or in a raft containing ~50 to 300 eggs. These eggs cannot survive if they dry out and must be laid in a permanent source of water.

Larvae

Most species of mosquito larvae breathe at the water's surface through a siphon tube at its tail end. Some species lay flat against the water surface, while others pierce the root of submerged plants and breathe through the root system.

All larvae are voracious feeders, needing nourishment to develop to the next stage. Larvae or "wigglers" can be seen resting at the water's surface or wiggling downward as they forage for food or attempt to hide from predators. It is during this stage that larvicide treatments are administered because they are taken into the larva's system while eating or they cover the surface with a film that suffocates them or makes it so they can't attach their siphon tube to the surface. Larvae are filter feeders, consuming algae, plankton, fungi and bacteria and other microorganisms. This stage of development provides nutrition for the non-feeding pupal stage. Larvae molt four times (each of the periods in between the molts is called an instar). Towards the end of the 4th instar, the mosquito larva stops feeding.

Pupae

The pupa is lighter than water and floats at the surface. Pupae are commonly called "tumblers" because they move in a somersault fashion through the water when they are disturbed, then float back to the surface. It takes in oxygen through two breathing tubes called "trumpets". The pupa does not feed. The metamorphosis of the mosquito into an adult is completed within the pupal case and the adult will seem to emerge from the surface of the water.

Because both the larva and pupa stage is very active in the water and will dive to the bottom if disturbed, having a turkey baster to suck water at all levels of the container is a great tool for seeing if there is mosquito activity present. Suck up the water, squirt it into another container, and look for the wigglers and tumblers.

Adults

When the adult is ready to emerge, the pupal skin splits along the top and the adult mosquito slowly works its way out of the pupal case. After emerging, it will float on the surface of the water and rest until its body and wings harden. Once this occurs, the mosquito will fly off. One of the first things newly emerged mosquitoes do is seek out nectar for a sugar meal to provide energy for flying and mating. Some species are very strong fliers and will move miles from the water where they developed.

Mosquito Breeding Habitats

All mosquitoes require some type of water source to complete their lifecycle. Different mosquitoes prefer to breed in specific types of waters. The species Aedes sollicitans breeds in saltmarshes, while Culex pipiens (the primary vector of WNV) prefers stagnant, temporary pools of water that have a high organic content, such as artificial containers and catch basins. Knowing your local species is important because it will allow you to focus on the correct type of standing water breeding sites.

Aedes albopictus adult on water
NPMA

Breeding habitats can be broken down into permanent (or semi-permanent) and temporary water sources. Permanent waters include swamps, bogs, brackish and freshwater ponds and wetlands, marshes, etc. Temporary waters include woodland pools, drainage ditches, tree holes, artificial containers, floodwaters, and catch basins. In most cases, if the water is flowing or a deep pond without shallow areas around the edges it is not likely to produce any mosquitoes.

Control Strategies

Control strategies should always be structured around Integrated Mosquito Management (IMM). IMM, like IPM is a science-based, common-sense approach for managing pests and vectors, such as mosquitoes. IPM programs use a variety of pest management techniques that focus on pest prevention, pest reduction, and the elimination of conditions that lead to pest infestations. They also rely heavily on resident education and pest monitoring.

It is important to identify the species of mosquito you are trying to control for several reasons: (1) to determine if it is a potential disease vector; (2) know potential breeding sites and flight range; and (3) to decide on control measures.

WORKING WITH YOUR CUSTOMERS

Your customers have two main roles in an integrated mosquito management program: get rid of places where mosquitoes will lay their eggs and avoid getting bit. The recommendations you write and conversations you have will can help them accomplish these two goals.

- Use insect repellent with one of the following active ingredients:
    - DEET
    - Picaridin
    - IR3535
    - Oil of lemon eucalyptus (OLE)
    - Para-menthane-diol (PMD)
    - 2-undecanone

- There is a search tool of EPA registered repellents for mosquitoes and ticks available at https://www.epa.gov/insect-repellents/find-repellent-right-you
- Wear long-sleeved shirts and long pants when outside
- Stay indoors when mosquito activity is high
- Use air conditioning, or window and door screens to keep mosquitos outside
- Reduce areas of standing water as much as possible
- Once a week, empty containers that hold standing water
- Maintain pools with salt or chlorine
- Clean gutters regularly
- Mow, prune or remove vegetation that is allowing a lot of shady areas where mosquito adults can rest
- Contrary to popular belief, bats do not have significant impacts on mosquito populations
- Advise against bug zappers

FOR MORE INFORMATION

Books/Manuals/Guidelines

- Best Practices for Integrated Mosquito Management Manual, 2017 (https://www.mosquito.org/page/training)
- Florida Mosquito Control 2018 https://fmel.ifas.ufl.edu/media/fmelifasufledu/7-15-2018-white-paper.pdf
- A Strategy for Integrating Best Practices with New Science to Prevent Disease Transmission by Aedes Mosquito Vectors
- Guidelines for the Emergency Management of Vector-Borne Disease Outbreaks
- Control of Communicable Diseases Manual by the APHA
- Coachella Valley District Mosquito & Vector Control available at "District Invasive Mosquito Species Response Plan"
- AZ Arboviral Handbook for Chikungunya, Dengue, and Zika Viruses
- The owner's manuals and pesticide labels of all equipment and products you will use in your service

Websites

- http://wrbu.si.edu/aors/northcom_Keys.html
- http://vectormap.si.edu/
- https://www.nola.gov/mosquito/
- http://edis.ifas.ufl.edu/topic_family_culicidae
- All CDC pages related to mosquito management, including https://www.cdc.gov/westnile/vectorcontrol/index.html

Training

- New Orleans Mosquito, Termite and Rodent Control Board's Mosquito Academy
- "Zika Virus and Integrated Vector Management" at www.npmatraining.org
- The mosquito portions of CDC's Vector Control for Environmental Health Professionals course: https://www.cdc.gov/nceh/ehs/elearn/vcehp.html
- AMCA's online trainings: https://mosquito.site-ym.com/page/EModules

COMMENSAL RODENTS

COMMENSAL RODENTS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Mice
    - House Mouse (*Mus musculus*)
    - White-Footed and/or Deer Mouse (*Peromyscus spp*.)
- Rats
    - Norway Rat (*Rattus norvegicus*)
    - Roof Rat (*Rattus rattus*)
    - Pack Rat (*Neotoma*)

DISEASES AND CONDITIONS

Rodents are public health threats because they can both directly transmit disease and they serve as disease reservoirs that are fed on by arthropods like fleas and ticks. Some diseases directly transmitted by rodents are:

- Hantavirus Pulmonary Syndrome (HPS)
- Lymphocytic Choriomeningtis (LCM)
- Leptospirosis
- Rat Bite fever
- Salmonellosis
- Tularemia

OVERVIEW

When the public thinks about pest management and public health, rodents are one of the first pests that come to mind. Rats and mice have been plaguing humans throughout history. These formidable foes have evolved to thrive in the environments we create. You must know their biology and behavior very well to manage them effectively.

As with all IPM programs, proper identification is the first step in a rodent management program. You should be familiar with identifying both the rodents and the signs they leave behind. The width of the front two teeth, size, and shape of the feces (a pointed end), and nesting/burrowing habits may be species specific and can help you identify the pest without seeing it. Tools like nontoxic monitoring blocks that they will chew on, powder that they will leave tracks through, and a way for your customer to report sightings or damage will be essential for you to map out and plan your management of these pests.

In general, these rodents you will be called on to manage

- Have bones but are extremely flexible. Rats can fit in a crack or hole ½” or wider. Mice can squeeze through 1/4” or wider.
- Have strong and hard front teeth that allow them to gnaw through many materials (the word rodent comes from a Latin word that means “to gnaw”),
- Will NOT “get thirsty and go outside and die” after consuming rodenticide,
- Will NOT be managed by cats,

- Will NOT be repelled by ultrasonic devices,
- Are most active in the dark,
- Are great at climbing, swimming, and generally getting wherever they want to go,
- Communicate through smell, leaving scent through urine and droppings wherever they go,
- Leave trails of grease or sebum along frequently traveled pathways,
- Have different nutritional needs throughout their life (so bait with what they are eating, nesting with, or might be craving),
- Have urine that glows under a blacklight,
- Travel along lines which may mean along walls, pipes, or landscaping edges, and
- Seek warmth where they nest and burrow.

Rodents covered here are divided into two groups based on how closely they live with and rely on humans. Commensal rodents live in close association with humans. Commensal means to share a table. Examples are the house mouse, Norway rat, and roof rat. Semi-commensal rodents may infest our structures and equipment, but also exist in the wild and are not so dependent on humans. Examples are Peromyscus and Neotoma species.

House mouse (*Mus musculus*)

The common house mouse is a commensal rodent that lives in structures but can live outdoors. It is one of the most successful mammals in the world—second only to humans. Indoors they prefer to nest in corners, under the voids of kitchen floor cabinets, under appliances, above drop ceilings, and in wall voids. Like other rodents, they are attracted to warmth. Finding heat sources can help you focus your inspection on the most likely mouse hiding spots.

House mice have a home range of about 30 feet from their sources of food. When populations become large, territories are formed by dominant males and consist of several reproductive females and some of their young.

House Mouse
Ed Freytag, City of New Orleans, Bugwood.org

House mice are active at night, omnivores, and opportunistic foragers for whatever foods they encounter. They prefer grains, seeds, stored foods, fish, and fruits. Unlike rats, house mice do not need to drink water. They get what they need from the moisture in their food. House mice will often visit 20-30 locations during a nightly search for sources of food. Mice will investigate new items they find in their home range. You should use this behavior when setting out mouse traps or placing stations—install devices where mice signs are seen when inspecting. When conditions are suitable, house mice populations expand rapidly since mice are very prolific and may live from 1-2 years. They produce from 6-10 litters of young and can reproduce after only 6-10 weeks old. Litter size varies from about 5-6 young.

Roof rat (*Rattus rattus*)

Roof rats which are sometimes called black rats are more likely to occur in coastal cities and generally do not populate areas that are more inland. The roof rat is an accomplished climber and generally construct their nests above ground in places such as trees, dense bushes, drop ceilings, and attics within homes. Residential and industrial areas with mature, overgrown landscaping and vegetation in areas along the banks of rivers and streams provide habitat. If above ground locations are not available, roof rats may (rarely) dig burrows. These rats often use wires and tree limbs growing over the roof as ways to get inside an attic. They have an excellent sense of balance and use their long tails to steady themselves while traveling along overhead utility lines. The log tail is a good way to ID—it is longer than the length of the head and body combined. Gaps and holes in soffits also enable roof rats to easily enter attics. Roof rats are more agile and move faster than Norway rats.

Roof Rat
CDC

The roof rat home range is generally up to 300 feet from their nesting site. They are nocturnal and actively search for sources of food such as fruits, vegetables, meats, seeds, and insects. Adult females are ready to breed at about 3 months old and will produce 3-4 litters per year. Pups are born about 21-23 day after conception and number about 5-8 young per liter. The roof rat's lifespan is from 5-18 months, depending upon environmental factors in their habitat.

Neophobia—the fear of new things—is more pronounced in roof rats than Norway rats. Roof rat populations are skittish and will modify their travel routes and feeding locations if frequently disturbed. This behavior makes roof rats more difficult to trap than Norway rats and house mice. You will need to be creative in trap placement and strategy to reach these pests up high.

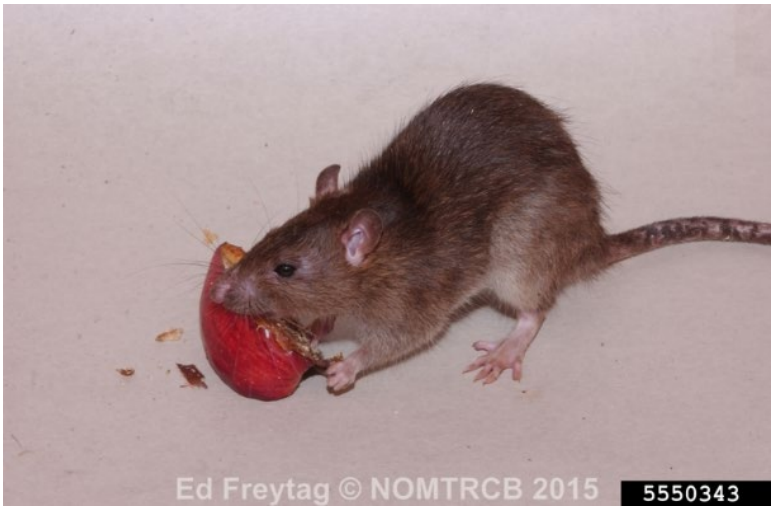
Norway rat (*Rattus norvegicus*)

Norway rats' original habitats are fields, farmlands, and woodlands, but they have become a major pest in and around structures in urban areas. In urban areas, garbage containers, sewers, near food service facilities, basements, and nearly anywhere else that food and shelter can be found provide suitable habitat. Some of their other names—the wharf rat, sewer rat, and subway rat indicate just how successful this animal is at living in habitats that humans create.

These rats are not as adept at climbing as roof rats and inside structures they normally are found in basements or crawl spaces. Norway rats burrow. They construct their nests in the ground or under clutter found in their environment. Dense vegetation is ideal for burrows and an observant PMP will be able to notice subtle runways through the plants and grass to the one or more of the exit holes of the burrow.

The typical home range of Norway rats is from 25-100 feet from their nest site; however, these rats are very likely to search for food as far as needed to locate food and some populations will have a range of 400 feet. Norway rats often choose to live near water and are excellent swimmers, giving them yet another name—water rats.

Norway rats are prolific breeders and females can birth a litter of 8-12 pups. Their gestation period is only 22 days and females can mate at 8-12 weeks old. The lifespan of these rats is generally 5-12 months.



Norway Rat
Ed Freytag, City of New Orleans, Bugwood.org

Food preferences are cereal grains, meats, seeds, fruits, and insects such as cockroaches. However, garbage and food waste food left lying around make up a very important of food consumed by these rats in urban habitats. Norway rats are very competitive with each other and with other rodent species and fights for food, mates and burrowing sites are common.

Rats are competitive and territorial. Norway and roof rats don't get along and will fight to the death. When the two species occupy the same building, Norway rats may dominate the basement and ground floors, while roof rats occupy the attic or second and upper floors.

White-Footed and/or Deer Mouse (*Peromyscus spp.)*

The difference between house mice and deer mice/white-footed mice is the deer and white-footed mice have a hairy, bicolored tail and their body is white on the bottom part and brown on the upper part, while the house mouse's tail is scaly and nearly hairless.

About 15 species of deer mice occur in the US, but information pertaining only to the deer mouse *Peromyscus maniculatus* is provided here. This deer mouse species is found throughout most of the U.S. and prefers a woodlands habitat, but also is frequently located around homes and buildings in rural or suburban areas.

Peromyscus
David Cappaert, Bugwood.org

While deer mice create some of the same problems as house mice, the most important problem created by the presence of deer mice is their role in the transmission of hantavirus pulmonary syndrome, which if untreated can result in death.

Typical habitat for deer mice is outdoors in sheltered areas such as hollow logs or piles of ground debris. However, they will venture inside and build nests in undisturbed structures such as sheds, barns or inside a home attic. One of their more preferred infestation sites are summer homes and unused recreational vehicles where they often nest inside furniture and cupboards. In outbuildings, nests are sometimes built in the upper portions of the structure.

Deer mice construct their nests by using twigs, leaves, grass roots or other similar materials found in their habitat, plus their nests are often lined with mouse fur or shredded materials. Deer mice also build nests in burrows abandoned by other rodents.

Deer mice are generally nocturnal and will range from 1/3-4 acres to locate their favored food sources. They are omnivores and consume seeds, nuts, fruits earthworms, snails, and insects. Deer mice are generally hoarders and will store foods near their nest sites.

Predation pressures often cause their lifespan is to vary greatly – from 2-24 months. Females are ready to breed at 5-8 weeks old and after a gestation period of 3-5 weeks they will give birth to 2-4 litters of 3-11 pups during a typical lifetime. Males will mate with more than one female at a time. Reproduction peaks occurs from spring until fall.

Peromyscus leucopus, the white-footed mouse, is found throughout most of the eastern part of the U.S. and is a very important semi-commensal rodent since ticks that feed on this mouse can transmit Lyme disease. Also, accumulations of feces and urine in nests are known to be the cause of hantavirus pulmonary syndrome. The preferred habitat of white-footed mice is wooded, brushy areas that are close to forested areas. These rodents are not commonly found in built-up areas and structures but may infest buildings located near the brushy areas of forested wood lines.

White-footed mice are active within a home range of about 1/3-4 acres. They are nocturnal and prefer to consume seeds, nuts, berries, and insects. Like the deer mouse, they are hoarders and like to store food caches near their nesting sites. Nest sites are normally found at ground level and include piles of rocks, logs, and ground burrows. These mice are also capable of climbing trees. White-footed mice density is generally lower in grassy areas of coniferous forest environments than in brushy fields and the edge-habitat in deciduous forested areas.

Populations of white-footed mice located in the northern portion of their range have a breeding season generally occurring in the spring through late summer or fall. Females produce only one litter per year, but in southern areas the breeding season is longer, and females may produce more than one generation per year and each litter contains about 3-5 pups. Females are sexually mature at about 4-6 weeks old.

Pack rats / woodrats (*Neotoma spp*)

Eight species of woodrats (Neotoma spp.) are located throughout specific regions of the US. The primary importance of woodrats is their involvement in transmission of plague, Chagas disease and hantavirus. Woodrats are likely to infest homes, cabins, outbuildings, and yards. When nesting inside structures woodrats often continue to feed outside and their foraging activity may create trails to and from the infested structure. They will also consume stored cereals and grains they find inside the home, summer cabin, or other outside structure. Food preferences outside of structures include seeds, nuts, and fruits. Those species living in desert environments consume cactus plants in addition to seeds, nuts, and fruits. The home range of woodrats is from 0.5-1.5 acres from their nest and they are nocturnal except for some juvenile rats that may be active during the day. Woodrats are generally about the same size as Norway rats, but they have a characteristic bushy tail.

Woodrat
CDC

Woodrats are strong climbers and most species build large dens on the ground or in trees using sticks and shredded plant materials. Nests generally contain one individual or perhaps are occupied by a female and her young. Woodrat reproduction usually occurs in the spring and when woodrat females reach an average of about 5-6 months old. Females produce litters of from 1-4 pups and will give birth to only 1-2 litters per year.

Woodrats also are called packrats since they tend to pack away and store small, shiny items that draw their attention. Because of this tendency to move and store thing, be sure to secure baits to your devices so that they are eaten rather than just carried off.

WORKING WITH YOUR CUSTOMERS

- Sanitation is the foundation of an effective rodent IPM program. Your customers will need to keep trash away from rodents and store food in a way that it is inaccessible to them.
- Keep dumpsters maintained and located at least 50 feet away from the building if possible.
- Repair water leaks
- If rodents are infesting a home with a child, do not let any food or drinks (including bottles) in the child's room
- Reduce or eliminate fruit or nut bearing trees and shrubs
- Eliminate dense groundcover
- Choose plants that do not offer hiding spots at their base
- Remove any debris that are not needed piles of almost anything will make attractive rodent harborage

- Don’t leave pet food out at night
- Use screens, cover, sealant, and door sweeps to exclude rodents from entering the building.

You and your customers alike should review CDC’s clear and helpful guidelines on cleaning up after rodents to minimize risk of disease: https://www.cdc.gov/rodents/cleaning/index.html

FOR MORE INFORMATION

Books/Manuals/Guidelines

- "Rodent Control: A Practical Guide for Pest Management Professionals" by Dr. Robert Corrigan
- Conducting Rodent Surveys: https://www.cdc.gov/nceh/ehs/docs/IPM_Manual.pdf
- Pest Prevention by Design: https://sfenvironment.org/download/pest-prevention-by-design-guidelines
- Ecologically Based Rodent Management: http://aciar.gov.au/publication/mn059
- "Vertebrate Pest Handbook" by Dr. Austin Frishman
- "Veterinarian’s Guide to Accidental Rodenticide Ingestion by Dogs and Cats" from LiphaTech
- "Full Revelations of a Professional Rat-Catcher After 25 Years' Experience" by Ike Matthews
- NPMA's Pest Management Standards for Food Processing & Handling Facilities: https://npmapestworld.org/public-policy/federal-advocacy/public-health/food-safety/

Websites

- https://www.cdc.gov/rodents/
- http://npic.orst.edu/factsheets/rodenticides.html
- https://extension2.missouri.edu/g9446

Training

- The rodent module of CDC's Environmental Health Professional course: https://www.cdc.gov/nceh/ehs/elearn/vcehp.html
- One of the many in-person Rodent Control Academies offered around the country based off the NYC Rodent Control Academy
- NPMA Rodenticide Stewardship Course: www.npmatraining.org
- NPMA 360 Videos with Bobby Corrigan (best if viewed with a cell phone so you can have the 360 experience): https://www.youtube.com/c/NPMA360

ANTS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Fire Ants (Solenopsis)
- Harvester ants (Pogonomyrmex)
- Pharaoh ant (Monomorium pharaonis)

DISEASES AND CONDITIONS

- Anaphylactic shock
- Mechanical transmission of bacteria
- Reactions to bites
- Reactions to stings

OVERVIEW

There are more than 12,000 species of ants in the world, each with a unique way of thriving in its environment. Luckily, only a few are public health pests in the US and Canada. Each type of ant has unique biology and behavior that you must know to plan and implement an effective management program.

General concepts about ant biology and behavior that you should know and use to help their customers understand the pest are:

- Ants are in the order Hymenoptera along with bees and wasps. All have a complete metamorphosis life cycle (egg, larva, pupa, and adult). Many species of Hymenoptera (almost all species of ants) are eusocial, meaning they have a highly organized social system in which members of the colony specialize in performing tasks necessary for the colony's survival including care of the young, retrieving food and reproducing. No one individual does it all. Ant management programs often utilize the ants that are gathering food for the colony (foraging workers) to bring pesticide into the colony. When homeowners simply wipe or vacuum up the workers they are seeing, the colony is not impacted in any significant way.
- Ants communicate through pheromones. They use these chemical signals to attract a mate, lay down trails to a food source or alert the colony that danger is near. When their nest is disturbed, ants release an alert pheromone, signaling other workers to come to its defense. You can put down bait or food, wait for foraging workers to discover it, and then follow the pheromone trail back to the nest where control efforts are needed.
- Eusocial ants feed each other pre-digested food they regurgitate. This behavior is called trophallaxis. Because of trophallaxis, an ant that has ingested pesticide may kill others in her colony.

The colonies of eusocial Hymenopterans are usually made up of the following specialized groups (castes): reproductives (including one or more queens), workers, and soldiers. A management program must eliminate the reproductives to eliminate the colony.

To plan the extent of the inspection and subsequent treatment, for each ant species it is important to know:

- How to identify the ant, including whether the workers are monomorphic (all look the same), dimorphic (two sizes/shapes), or polymorphic (multiple sizes/shapes)
- Whether the colonies begin by swarming, moving, budding or a combination of these
- Whether the colony is monodomous (one nest) or polydomous (satellite nests)
- Whether the colony is monogyne (one queen) or polygyne (multiple queens)

Fire Ants (Solenopsis spp.)

Fire ants are an invasive pest that bite to hold onto their target and then sting. There are four species commonly found in southern areas of the United States: southern fire ants (*Solenopsis xyloni*), tropical fire ants (*Solenopsis geminata*), Red Imported fire ants (*Solenopsis invicta*) and Black imported Fire ants (*Solenopsis richteri*). When present, their nest mounds are characteristically messy, consisting of soil mounded up in grass with the exits at the base of the mound or in the soil nearby rather than out of the top.

They are polymorphic, so size and color can vary. Colonies contain multiple queens, multiple nests, and can start by moving, budding, or swarming. You must conduct a thorough inspection and incorporate the entire colony (and all the nests) into the management plan. This may include neighboring properties which is why a coordinated community response is preferable. Elimination is very hard to achieve, and constant management is usually required. The “two-step method” of fire ant management includes two broadcast bait applications per year along with individual mound treatment.

Red Imported fire ant workers can forage over a radius of 100 yards. These ants can have up to 500,000 individuals in a colony. Fire ants are both predators and scavengers, attacking and killing other insects and small animals, or feeding on dead animals. Occasionally, the red Imported fire ant will nest inside homes or institutional buildings such as hospitals and nursing homes, especially in the winter. They prefer to be near sources of warmth, such as hot water heaters. They often gain access to a building through concrete slab floors.

Fire ants have a rapid response to any nest intrusion and aggressively defend it from invaders. When fire ant mounds or nests are disturbed, worker ants rush to the surface and climb up on any vertical object such as grass blades, sticks or legs of people or animals that are standing on or near to the nest. They sting and inject venom, which causes a burning sensation. Red bumps form at the sting site and within a day or two they become white fluid-filled pustules. Some people can have whole body allergic reactions such as anaphylactic shock and occasionally death.

Individual workers ants can inflict multiple stings and because large numbers of worker ants often occur together, incidents usually involve an abundant number of stings. For instance, when a person steps into a mound, hundreds of ants can rapidly crawl up the legs. Within several seconds, they begin stinging almost simultaneously. High numbers of stings can lead to severe medical reactions even in people with normal immune systems. Infants, neurologically compromised people, the elderly and otherwise immobile or unaware individuals are at a higher risk of multiple stinging incidents and should be supervised carefully in areas where fire ants occur.

The United States Dept. of Agriculture, Animal and Plant Health Inspection Service developed a quarantine program that states no person may move interstate from any quarantined area any regulated article including:

- Baled hay and baled straw stored in direct contact with the ground.
- Imported fire ant queens and reproducing colonies of imported fire ants.
- Plants and sod with roots and soil attached, except plants maintained indoors in a home or office environment and not for sale.
- Soil, separately or with other articles, except potting soil that is shipped in original containers in which the soil was placed after commercial preparation.
- Used soil-moving equipment, unless removed of all noncompacted soil.

Red Imported Fire Ant
NPMA

Harvester ants (*Pogonomyrmex spp.)*

Harvester ants get their common name from their behavior of collecting and harvesting seeds as their primary food source. Because of this behavior, they play a role in seed dispersal that is good for the environment. There are 22 species of harvester ants found in the United States. The most common types are the California harvester ant (*Pogonomyrmex californicus*), Florida harvester ant (*Pogonomyrmex badius*), red harvester ant (*Pogonomyrmex barbatus*), black harvester ant Maricopa harvester ant (*Pogonomyrmex maricopa*) and the Western harvester ant (*Pogonomyrmex occidentalis*). Workers are small (~6-12 mm in length) and can be monomorphic (similar in size and appearance) or polymorphic (occurs in different sizes and colors) depending on the species. Likewise, depending on the species, colonies may be monogyne or polygyne and begin by moving to a new area on foot or by swarming.

Harvester ants do not invade structures but build their nests near structures or in yards, parks, and athletic fields. They can strip the vegetation from large areas. They are a concern in urban settings due to their behavior of aggressively defending their nests by inflicting painful stings. Stings can cause sores and possible allergic reactions in people. Some species have a stinger with reverse barbs, so it breaks off in the wound, like that of a honeybee. Multiple stings will produce excruciating pain and may induce severe reactions. People who are stung and allergic to their venom may experience anaphylactic shock.

Rough harvester ant mound
Whitney Cranshaw, Colorado State University, Bugwood.org

Western harvester ants
Whitney Cranshaw, Colorado State University, Bugwood.org

Pharaoh ant (*Monomorium pharaonis*)

The Pharaoh ant is a tiny (2 mm), yellow to reddish-brown ant. They are monomorhic and have very large colonies (some containing more than 100,000 ants) with multiple queens (polygyne). They nest in voids in floors, walls and ceilings and often infest large buildings. They are so small; they can nest in electrical outlets. The pharaoh ant is extremely similar in appearance to the Thief ant. In fact, there is only one feature that distinguished these ants from each other; their antennae. Pharaoh ants have a three-segmented club, while Thief ants have a two-segmented club.

In hospitals, Pharaoh ants pose a health risk because they can carry infectious bacteria from the warm, moist areas they inhabit to intravenous fluids, blood, and wounds. These ants can transmit over a dozen pathogens such as *Salmonella spp., Staphylococcus spp.,* and *Streptococcus spp.*

Pharaoh ants are very challenging to control due to the size of the colonies and their ability to easily start up new nests by budding. Pharaoh ant colonies do not spread by swarming, but instead by "budding" when the colony breaks apart and establishes sub-colonies in new locations. This process can be triggered when the colony is stressed by the application of repellent liquid or dust pesticides.

Pharaoh Ant
Eli Sarnat, PIA Key: Invasive Ants of the Pacific Islands, USDA APHIS PPQ, Bugwood.org

WORKING WITH YOUR CUSTOMERS

- For pharaoh ants: homeowners and building occupants should be advised to never "self-treat" by using over the counter pesticides. Many of these products are repellants and can trigger budding which causes one colony in a specific area to spread throughout the structure, making control even more difficult.
- If a small property has a fire ant colony, routine inspections (and likely treatment) by a professional the best strategy. If the property is small, a community-wide response is important so that the entire colony can be addressed.
- There are many "home remedies" for treating ant mounds including pouring hot liquid such as water or coffee into the nest, pouring soapy water on mounds, spreading grits in the infested area, and digging out mounds. None of these treatments will solve a fire ant problem. Disturbing the nests is dangerous to the individual performing the treatment and will usually result in the colony budding or moving. Most of the fire ant colony is deep within the soil, so any "treatments" that are only applied to a nest from the surface will not work.

FOR MORE INFORMATION

- Ant Resources from eXtension: https://articles.extension.org/ant_pests and https://articles.extension.org/fire_ants
- Social and Solitary Hymenoptera: Biology, Behavior, and Control at www.npmatraining.org

BITING FLIES

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Biting midges, no-see-ums, punkies *(Ceratopogonidae)*
- Black flies, buffalo gnats or turkey gnats *(Simuliidae)*
- Deer and horse flies *(Tabainidae)*
- Mosquitos → Covered in the Mosquitoes section of this study guide
- Stable fly *(Stomoxys calcitrans)* → Covered in the Filth Flies section of this study guide

DISEASES AND CONDITIONS

- Tularemia (transmitted by the deer fly species *Chrysops discalis)*
- Painful bite
- Skin reactions to the bites

OVERVIEW

Every year, the eggs of large numbers of blood-feeding flies hatch in rivers, lakes, and wetlands throughout the United States. The larvae develop underwater or in the mud that makes up the banks. The adult flies that emerge are strong fliers and the females are aggressive biters. These flies do not breed indoors. There are many species of biting flies. Fortunately, in the US and Canada, it is rare for these insects to transmit disease to humans. Livestock and animals are at greater risk. Nonetheless, their annoying persistence and painful bites are enough to make them public health pests. They locate humans and other animals by sensing certain substances, including the carbon dioxide and moisture in exhaled breath. They are attracted to dark colors, movement, body heat and perspiration.

Biting midges, no-see-ums, punkies *(Ceratopogonidae)*

Adult biting midges are small flies (~1-4 mm in length). They are gray in color and their wings—if you look closely—have dense hairs and pigmentation patterns. These wing patterns are used by entomologists to identify species. They are also known as punkies, no-see-ums or simply gnats. Their tiny size allows them to get through window and door screens. Female biting midges can be serious pests along the shores of oceans, lakes, ponds, and rivers and will bite during the day or at night.

The natural habitats of biting midges vary by species. Salt marshes are major producers of many biting midge species. Additional sources include highly organic soil that is wet but not underwater like manure loads in swine, sheep, and cattle farming operations.

Biting Midge
Whitney Cranshaw, Colorado State University, Bugwood.org

The bites of biting midges inflict a burning sensation and can cause different reactions in humans, ranging from a small reddish welt at the bite site to local allergic reactions that cause significant itching. Although not considered a problem in the US, in other parts of the world biding midges transmit filarial worms in the genus *Mansonella* to humans.

Midges in the family Chironomidae look like biting midges and mosquitoes but lack the piercing-sucking mouthparts and cannot bite.

Black flies, buffalo gnats or turkey gnats (Simuliidae)

Adult black flies are small (~1-5 mm), blood-sucking insects with broad wings, a humpbacked appearance, and piercing-sucking mouthparts. They complete their life cycle in shallow, fast-moving waters in rivers, creeks and streams but can also be found in slow-moving water, such as in irrigation canals and ditches.

Black flies occur in large numbers typically in late spring and early summer. They are active during the day, usually biting in shaded or partially shaded areas. They will travel up to 15 miles in search of a blood meal so pinpointing the source of the problem is very difficult. Black flies are attracted to dark clothing and prefer to attack the head. The bites are extremely painful and cause swelling, numbing and soreness which may persist for days. They do not transmit disease to humans in the US and Canada.

Black Fly
Whitney Cranshaw, Colorado State University, Bugwood.org

Deer and horse flies (Tabanidae)

Horse flies and deer flies are closely related and have similar life cycles. They can be serious pests of cattle, horses, and humans. Horse flies are relatively large, ranging in size from 2-3 cm long. Horse flies usually have clear or solidly colored wings. The most obvious characteristic is their big, brightly colored eyes. Deer flies are smaller with dark bands across the wings. Deer flies also have large brightly colored. Adults are often found near larval habitats: marshes, swamps, and shorelines of lakes and ponds, but females will travel considerable distances for a blood meal.

Both flies are daytime feeders and find their prey using visual cues. They are attracted to shiny surfaces and linear movement, making it hard to design effective traps. Horse flies and deer flies can be serious nuisances when people swim. They may be attracted by the shiny surface of the water and the movement of the swimmers.

The females use large scissor-like mouthparts to cut skin. While feeding, they put an anticoagulant into the wound to increase the blood flow while they lap it up. These wounds can often serve as sites for secondary infections and many people are allergic to their saliva. Although rare, one species of deer fly can transmit Tularemia to people in the United States. Tularemia, also known as rabbit fever, is a bacterial disease that can be acquired from the bites of the deer fly Chrysops discalis.

Deer Fly
Whitney Cranshaw, Colorado State University, Bugwood.org

Horse fly
Jennifer Dacey, CTPCA

WORKING WITH YOUR CUSTOMERS

Unfortunately, because of aquatic places where they lay their eggs and develop through the larval and pupal stages, there is very little you or customer can do to manage biting flies at their source—usually the goal in fly management. The exception is the stable fly which is discussed in the Filth Flies section of this study guide. Advise customers to wear protective clothing, apply repellent according to the instructions on the label and use airflow from a fan to discourage the flies if possible. These recommendations work for livestock as well.

FOR MORE INFORMATION

- Illinois Department of Health: http://www.idph.state.il.us/envhealth/pcbitingflies.htm
- Trolling Deer Fly Trap: http://entomology.ifas.ufl.edu/pestalert/deerfly.htm
- University of Florida
  - http://entnemdept.ufl.edu/creatures/aquatic/biting_midges.htm
  - http://entnemdept.ufl.edu/creatures/livestock/bfly.htm
  - http://entnemdept.ufl.edu/creatures/livestock/deer_fly.htm

FLEAS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Cat flea (*Ctenocephalides felis*)
- Dog flea (*Ctenocephalides canis*)
- Oriental rat flea (*Xenopsylla cheopis*)

DISEASES AND CONDITIONS

- Cat scratch disease (CSD)
- Itchy bites
- Murine typhus
- Plague

OVERVIEW

Of the three flea species that are considered vectors in the US, the cat flea is by far the most common in homes. Despite their common names, cat, dog, and oriental rat fleas are not host-specific. The cat flea especially can thrive on many hosts. You will need a microscope to tell them apart—the differences are on the head and hind legs.

To effectively manage fleas, you must understand the flea's life cycle and target the vulnerable stages of its growth with your treatment plan. Fleas have a complete metamorphosis (egg, larva, pupa, and adult). Eggs may be laid on a host or in the bedding of the host. In the case of dogs and cats, this could include carpets, dirt outside, or pet bedding. If the eggs are laid on the host, they fall out of the fur or feathers when the animal moves or scratches. Larvae hatch out of the eggs and eat organic debris in the environment including shed hair, dander, and the feces of adult fleas. The larvae pupate into a tough cocoon. In the cocoon, the larva will develop into an adult flea which emerges and hops (quite literally) onto a host to live and feed on blood. The egg and cocoon stages are very tough and if there are no vibrations or warmth indicating a host is present, the fleas will stay protected in these stages. Customers will report moving into a home that hasn't been occupied for months and having an "outbreak" of fleas. This is entirely possible—the cocoons were likely lying dormant waiting for the next hosts—your customers—to move in.

Adults are brown in color and have hard, shiny, laterally flattened bodies that allow for easy movement through fur and feathers. Their body shape and size allow them to crawl quickly through hair or feathers and their strong hind legs enable them to jump out of the way. They have adapted to survive a host's attempts to scratch, rub and squash them—they are hard to kill with force! Adults have piercing-sucking mouthparts that penetrate the skin and suck up blood.

To detect fleas, shuffle across the floor in suspected areas with light colored shoes and pants (or just tall white socks) on and look for the adults jumping up onto your legs. Customers can inspect their animals for flea dander (feces that looks like pepper) and adult fleas. Flea bites usually occur on people's legs, but do not speculate with your customer about bite marks—have them consult a doctor.

You should design a management plan that targets the larvae and adults—the most vulnerable stages. If your customer has pets, have them consult a veterinarian. The vet can recommend products that will

kill the adult fleas. The pesticides you apply will target larvae and adult fleas that are off a host. Direct the customer to vacuum with a beater brush (rotating carpet attachment)—the warmth and vibration will encourage the cocoons to hatch, increasing the likelihood that adult fleas get exposed to your treatment.

Fleas are public health pests because of the irritation their bites cause and their role in transmitting pathogens. The oriental rat flea is the main carrier of the plague bacteria (*Yersinia pestis)* and murine typhus bacteria (*Rickettsia typhi).* Both pathogens are carried by rodents and other animals and can be transmitted to humans. The cat flea has also been found to transmit murine typhus. Plague is transmitted when the flea bites its host. Typhus is transmitted with flea feces containing the bacteria encounter wounds.

Cat fleas can also transmit the bacteria that causes cat scratch disease (CSD) (*Bartonella henselae*) to cats. When infected cats scratch humans, they may transmit the bacteria and cause CSD. Flea-to-human transmission of CSD has not been proven.

Cat Flea
Pest and Diseases Image Library, Bugwood.org

WORKING WITH YOUR CUSTOMERS

Customers often have important roles in flea management. They should work with a veterinarian to continuously manage fleas (and ticks) on their pets and inspect their animals regularly for flea dander (feces that looks like pepper) and adult fleas. If an infestation occurs, you may want your customer to vacuum more often to encourage all eggs and cocoons to hatch.

Help customers understand how your treatment plan will work and when you expect to get the fleas under control. Give them ways they can participate in the management plan without using over-the-counter pesticides. They can help your efforts by laundering pet bedding on hot cycles and vacuuming.

If your customer's skin is reacting, have them consult a doctor.

FOR MORE INFORMATION

Flea Control and Prevention: https://entomology.ca.uky.edu/ef602

MITES

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Chiggers *(Trombiculidae spp.)*
- House dust mites (*Dermatophagoides spp*.)
- Itch mite *(Sarcoptes scabiei)*

DISEASES AND CONDITIONS

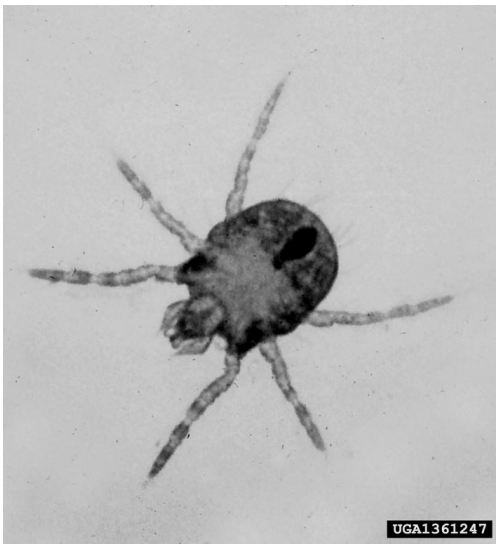
- Allergies
- Asthma
- Itchy bites
- Scabies

OVERVIEW

The mites you may have to deal with are small arachnids (less than 0.04 inches/ 1 mm in size). The adults have four pairs of legs, no antennae, and their head and thorax are fused into a single region called a cephalothorax. Mites develop through incomplete metamorphosis. Some lay eggs and others give live birth. You will likely need a microscope to see any detail on them to make an exact ID so keeping a vial with alcohol for collection is always a good practice. The species can often be narrowed down by the location and conducive conditions like bird or rodent nests. In the US and Canada mites do not transmit pathogens to humans. A few are considered are public health pests because they can cause skin irritation or produce allergens that contribute to asthma. As you will see, there are a few aspects of mite control that you contribute to, but in most cases your role will be advising the person on how they can minimize conducive conditions and directing them to a medical professional for any symptoms they may be experiencing.

Chiggers *(Trombiculidae)*

"Chiggers" are the 6-legged larval stage of some mites in the family *Trombiculidae*. The adult mites—also called harvest mites, harvest bugs, harvest lice, mower's mites, or redbugs—are harmless to people. The adult mites lay eggs soil and when it is warm and humid larvae hatch and crawl up grass and other vegetation, usually about one foot in height. There they wait and will attach themselves to a passing host. Chiggers will feed on several hosts including mammals, poultry, and reptiles. They're usually found during the late spring and summer.



Chigger mite
Hansell F. Cross, Georgia State University, Bugwood.org

People are usually not aware of chiggers until they begin to itch, or notice raised, red spots on their skin. The chiggers sink their tiny mouthparts into a skin pore or hair follicle and inject a digestive enzyme that liquefies skin cells. This substance is what the larvae eat. Chiggers don't cause disease, but the welts can become infected from scratching.

If chiggers are persistent in a customer's lawn, treating for the mites may be warranted. You can monitor for chiggers by putting a black piece of paper vertically in the grass and seeing if the tiny light-colored mites crawl on it. If you are working in chigger habitat, take precautions to avoid getting them on your skin.

In addition to your treatment, recommend your customer keep vegetation trimmed, including cutting the grass. As with ticks, recommend customers wear long pants, socks, closed shoes, and a repellent that is labeled for chiggers.

House dust mites (*Dermatophagoides spp.)*

This section is about two species of dust mites: the American house dust mite (*Dermatophagoides farina*) and the European house dust mite, (*Dermatophagoides pteronyssinus*) both of which occur in homes. House dust mites do not bite or sting humans, but they are public health pests because of the allergic reactions people can have any the links to asthma.

House mites are a wide-spread and commonly occurring group of mites that are associated with the nests of mammals and birds. They are not ectoparasites, but they do feed on flakes of dead skin and dander that falls off humans and animals. It has been shown that dust mites and their feces can become airborne and are one of the most common indoor allergens. That is, most people diagnosed as being allergic to "house dust" are allergic to the dust mites whose bodies and feces are major components of dust. They have also been implicated in triggering asthma attacks. But, unlike rodent mites and chiggers, skin irritation is rarely caused by exposure to dust mites. Although they may "hitchhike" on clothing, dust mites do not live on people. They are commonly found in carpets, upholstered furniture, pillows, and mattresses.

They are tiny (0.008–0.012 in/ 0.2–0.3 mm) mites that thrive in humid (above 70% relative humidity (RH)) conditions where there are flakes of dead skin and dander from humans and animals. It has been shown that dust mites and their feces can become airborne and are one of the most common indoor allergens. Most people diagnosed as being allergic to "house dust" are allergic to the dust mites whose bodies and feces are major components of dust. They can also trigger asthma attacks in sensitive individuals. Skin irritation is rarely caused by exposure to dust mites. They are commonly found in carpets, upholstered furniture, pillows, and mattresses.

Managing dust mites is mostly in the hands of your customers. To manage dust mites:

- Keep the home in the 30-50% RH recommended range
- Vacuum regularly with a HEPA filter
- Minimize the amount of fabric in the home, especially in bedrooms. This includes carpeting, window curtains and stuffed animals.
- Wash bedding weekly
- See a medical professional who may recommend further actions such as encasements and special precautions when cleaning.

Rodent and bird mites

Rodent and bird mites may bite people when their hosts die or abandon their nests. They move into living spaces in houses, climbing on walls, ceilings, and bedding in search of a blood meal. Three types of rodent mites readily bite humans: the house mouse mite, spiny rat mite and tropical rat mite. They are all capable of causing rodent mite dermatitis. The best

The house mouse mite prefers to suck the blood of mice, but also will bite rats and people. They prefer warm places (e.g., around pipes and furnaces) where rodents live. The mite leaves its mouse host after feeding and is frequently found on walls and other areas where it can encounter people. They can carry the causal organism of rickettsial pox, a non-fatal disease of humans.

The spiny rat mite feeds on rats at night and hides by day in cracks and crevices around rat nests and resting places.

The tropical rat mite is a common parasite of the Norway rat. Its bite is painful and causes skin irritation and itching. This mite often becomes a serious problem where rat eradication programs are underway. It will readily feed on humans, even where rats are abundant. In infested buildings, they can be found on basement walls, in kitchens, bathrooms, and hot water pipes. It usually feeds in the dark and then retreats to cracks and crevices, especially where there is a heat source. These areas should be for focus areas for pesticide treatments. Both the nymphs and adults may bite humans. Under ideal conditions, they can complete their life cycle within 2 weeks, but unfed adults may live around 2 months without food.

Bird mites are found where birds (such as pigeons, starlings, sparrows, pet birds, and poultry) and their nests are located and are generally associated with moist or humid conditions. The last nymphal stage and adult mites that normally infest bird nests may also bite people. Humans can be exposed to bird mites when young birds leave their nests and the mite is left without a suitable host to feed from.

The northern fowl mite and chicken mite primarily infest chickens, but also pigeons, starlings, and sparrows. This mite normally lives only on its host but may leave the body of a dead host to feed on humans. The chicken mite hides in cracks and crevices near bird nests during the day and feeds by night.

For all the Rodent and Bird mites, your primary role will be in the elimination of and cleanup after the primary host animal. If the linked mite infestation is bad, a pesticide application may be justified.

In many cases you will solve the entire problem, but if the host is a pet bird or livestock the customer will need to work with a veterinarian.

Reduction in humidity may help.

Itch mite (Sarcoptes scabiei)

You will have no role in the elimination of Itch mites other than answering a person’s mite-related questions and referring them to a doctor for treatment.

Human scabies is caused by an infestation of the skin by the itch mite (Sarcoptes scabiei). The microscopic scabies mite burrows into the upper layer of the skin where it lives and lays its eggs. The most common symptoms of scabies are intense itching and a pimple-like skin rash. The scabies mite usually is spread by direct, prolonged; skin-to-skin contact with a person who has scabies. Animals do not spread human scabies. Pets can become infested with a different kind of scabies mite that does not

survive or reproduce on humans but causes “mange” in animals. If an animal with “mange” has close contact with a person, the animal mite can get under the person’s skin and cause temporary itching and skin irritation. However, the animal mite cannot reproduce on a person and will die on its own in a couple of days.

Scabies can spread rapidly under crowded conditions where close body contact is frequent. Institutions such as nursing homes, extended-care facilities, and prisons are often sites of scabies outbreaks.

Scabies mites do not survive more than 2-3 days away from human skin. Items such as bedding, clothing, and towels used by a person with scabies can be decontaminated by machine-washing in hot water and drying using the hot cycle or by dry-cleaning. Items that cannot be washed or dry-cleaned can be decontaminated by preventing contact with a body for at least 72 hours. A physician should be consulted for treatment on a person with skin afflictions.

People suffering from delusory parasitosis may think that mites are the source of their problems. See the section on delusional infestation for more information.

Have your customer visit a medical professional

FOR MORE INFORMATION

- Illinois Department of Public Health http://www.idph.state.il.us/envhealth/pcmites.htm
- American College of Allergy, Asthma & Immunology: https://acaai.org/allergies/types/dust-allergy

SCORPIONS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

Arizona bark scorpion (Centruroides sculpturatus)

DISEASES AND CONDITIONS

Wide variety of reactions to the toxic venom delivered by the sting

OVERVIEW

Scorpions are arachnids that are characterized by their pedipalps that are modified into pincers and their tail that is tipped by a stinger. They are predators that hold their prey (a variety of arthropods) with their pincers and immobilize it with a sting. Scorpions give live birth to young that look exactly like tiny adults. These young ride on the mother's back for the first week of life, before their first molt. Scorpions take years to reach maturity. Scorpions are most active at night, choosing to hide in dark places whenever possible. There are about 90 species of scorpions in the US, all but 5 occurring west of the Mississippi. Like bees and wasps, scorpion venom varies by species so you should know the kinds that are active in your area and the potential health effects to prepare yourself and your customers. Although all can sting, here we will focus on the most medically significant scorpions, bark scorpions in the family Buthidae and genus *Centruroide*. One trait that can help identify a bark scorpion is that they will coil their tail to one side when at rest instead of straight up. The most dangerous and medically important of these is the Arizona bark scorpion.

Scorpions glow green under a blacklight so inspections in the dark can be made easier for you and your customers by using a UV "blacklight." The best hours to inspect for scorpions are 8-11pm. Look under loose bark, stones, logs, woodpiles, etc., especially where there is moisture in dry climates. You can use this behavior to your advantage by creating a makeshift scorpion monitor by wetting a piece of cardboard and placing a rock or log on top of it. Check back over the next few days for scorpions which will be attracted to the ideal environment you have created.

Management of scorpions should rely primarily on removal of attractive hiding places such as stones, logs, and debris and minimizing the changes that scorpions make their way on or into a home by trimming back vegetation from walls, sealing any penetration, and using screens and door sweeps. The monitor described above can also be used to give you the chance to kill or collect many at a time which will reduce the population. Pesticides may be used if there are many present but should always be used in an integrated approach that includes exclusion and taking away hiding spots.

In the south, the most prevalent species is the striped bark scorpion (*Centruroides vittatus*). As the name indicates, many of these scorpions do have stripes, but color and the presence of stripes may vary.

Striped Bark Scorpion
CDC/ Margaret A. Parsons

In Arizona and into the bordering states, there is a very similar looking species that does not have stripes. This is the Arizona bark scorpion (*Centruroides sculpturatus*) which is the most dangerous scorpion in North America and is the only one considered truly medically significant. Anyone stung by an Arizona bark scorpion should call a medical professional or poison control center. Although mild stings will only cause local pain that resolves without treatment in hours to days, some may experience neuromotor hyperactivity, pulmonary edema, and trouble breathing. Stings from this species are potentially death without immediate treatment. Unlike most scorpions which prefer to be along, Arizona bark scorpions may be found in groups, especially in the winter.

Arizona bark scorpion in a shoe
Dawn Gouge, University of Arizona

Bark Scorpion in blacklight
Dawn Gouge, University of Arizona

WORKING WITH YOUR CUSTOMERS

- If scorpions are active on the property, be aware when putting hands or feet into dark cavities like the inside of shoes or under piles of items.
- Wear shoes while walking outdoors at night
- Avoid storing shoes on the floor
- Keep towels and clothing off the ground
- Place beds and cribs so that they do not touch walls
- Use a black light outside at night to see scorpions
- If scorpions are found inside, interception devices or petroleum jelly can be used on bed legs

FOR MORE INFORMATION

Scorpions in Arizona:
https://cals.arizona.edu/backyards/sites/cals.arizona.edu.backyards/files/b10summer_pp4-6.pdf

SPIDERS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Yellow sac spider (*Cheiracanthium inclusum and Cheiracanthium mildei*)
- Black widow spiders *(Latrodoctus spp.)* *
- Brown recluse spider (*Loxosceles reclusa*) *
- Hobo spider (*Tegenaria agrestis*)

* The CDC's National Institute for Occupational Safety and Health (NIOSH) only lists black widows and brown recluse spiders on their list of venomous spiders.

DISEASES AND CONDITIONS

Venomous bites

OVERVIEW

Spiders do not vector disease and the vast majority cannot harm humans. Most spiders are of little public health significance because they are either too small or have venom that does not affect humans. A spider will usually bite a person only in self-defense. It may be in defensive mode because a human accidentally disturbed it. People want spiders out of their homes because of fear and/or repulsion. The perceived risk of spiders is much greater than the actual risk they pose.

Spider bites can result in uncomfortable pain and swelling. There is a lot of confusion regarding poisonous spiders, even among the medical community. While all spiders use venom to subdue their prey (hence, all spiders are "venomous"), the bites of most spiders are only mildly irritating. The exceptions include people with compromised immune systems or other medical conditions that leave them vulnerable to spider venoms.

All spiders use venom to kill prey and digest it externally. The chemicals in spider venom vary between species. Spiders create egg sacs out of which hatch many tiny spiderlings. These spiderlings have 8 legs and look like spiders in every life stage.

Spider management usually involves removing webs and working with customers to reduce the number of insects available for the spiders to feed on.

Black widow spiders (*Latrodoctus spp*.)

Black widow spiders are found throughout North America but are most common in the southern and western areas of the United States. The adult female is ~4 cm in diameter and is jet black with two red triangular markings on the underside of her abdomen. Males are much smaller and lighter colored, with light streaks on their abdomens. The two species in the US are the southern black widow (*Latrodectus mactans*) and the western black widow (*Latrodectus hesperus*).

They occur in dry, undisturbed areas such as wood piles, old lumber, dry crawl spaces, outbuildings, sheds and garages, pump, and meter enclosures, under stones, in rodent bait boxes, and other areas

where debris has accumulated. In areas where black widows are common, customers should reduce yard debris as much as possible and that precautions to avoid getting bit.

The black widow spider is not aggressive. Most bites occur when one is trapped or unintentionally touched. They build dense webs between objects, and bites can also occur when humans come into direct contact with these webs. The venom is a neurotoxin that produces pain at the bite area and that spreads to the chest, abdomen, or the entire body and can last for several days. Some people do not have a strong reaction. Death rarely occurs.

There are other widow spider species in the US, but these spiders very rarely bite humans. Some have the red hourglass on the female's abdomen and similar egg sacs. Perhaps the most common look-alike is the brown widow (*Latrodectus geometricus)* which is not jet black and creates an egg sac with spines. Black widow egg sacs are smooth.

Black Widow Spider
James Solomon, USDA Forest Service, Bugwood.org

Agrarian, yellow sac, black-footed, yellow house, or long-legged sac spiders (*Cheiracanthium inclusum* and *Cheiracanthium mildei*)

There is no recognized common name for either of these species of spiders. Both species are of similar size (females 5-10 mm; males 4-8 mm) and coloration. *C. inclusum* is a light yellow to cream color, with the jaws, tips of the legs, and palps dark brown. *C. mildei* has a slightly greenish tinge to its abdomen and a pale-yellow cephalothorax. Both spiders have a slightly darker dorsal stripe running lengthwise across the abdomen. They have eight eyes which are all similar in size and arranged in two nearly straight rows.

Yellow sac spiders are active hunters that search for prey at night rather than catching it in a web. During the day they rest in silken retreats. *C. inclusum* is more often encountered outside under objects such as stones, bark, and folded leaves. *C. mildei* is more often encountered within man-made structures and lay eggs almost exclusively indoors. They occur in corners, folds of fabric and dark recesses. In homes with light, neutral-colored walls and ceilings, the retreats may go unnoticed, as they are small and blend in with the background coloration.

C. inclusum bites usually happen outdoors to people gardening or doing yardwork in the summer. *C. mildei* spiders bite when they become trapped between a person's skin and sheets, clothing, shoes, etc.

The yellow sac spiders probably account for more human bites that any other type of spider. The bite of *C. inclusum* is more destructive than the bite of *C. mildei*. Its bite is usually painful. The burning sensation associated with the bite will last for up to an hour, with a rash and blistering occurring during

the next 1-10 hours. Some patients may exhibit systemic reactions with fever, malaise, muscle cramps, and nausea. These symptoms are like black widow bite symptoms but are much less severe. A wound may also occur at the site, but this is less than the similar symptoms that accompany a brown recluse bite.

Yellow Sac Spider
NPMA

Brown recluse spider (Loxosceles reclusa)

The Entomological Society of America recognizes “Brown recluse spider” as the common name for Loxosceles reclusa, but along with big reputation they have received many names: fiddleback spider, brown fiddler and violin spider are common. Recluse is a good name for these spiders because they are shy and not aggressive preferring to hide during the day and often coexisting with humans without a problem.

Adult brown recluse spiders are ~6-12 mm in length. Their color ranges from tan to dark brown and they often have a distinctive fiddle-shaped marking on the cephalothorax. Many spiders are misidentified as brown recluses. A brown recluse will have all 5 of the following characteristics:

- six eyes in pairs
- uniformly colored abdomen with fine hairs
- no spines on the legs
- uniformly colored legs
- body not more than 3/8" in length

Brown recluse spiders are found throughout the south central and some Midwestern states in the US. Recluse spiders are rare outside their native range. In general, these spiders are widely over-reported and less common than perceived. Occasionally, one or a few spiders may be transported to a non-native area in boxes or furnishings, but infestations seldom become established.

In nature, brown recluse spiders live outdoors under rocks, logs, woodpiles, and debris. The spider is also well adapted to living indoors with humans. Indoor infestations can get large and be difficult to control. Effective brown recluse control involves more than pesticides—customers will need to reduce clutter, boxes, and other areas where the spiders are found. Sticky traps can be used to trap brown recluse spiders and are both a monitoring and control tool in this instance.

They do not live on webs. Instead they hunt at night seeking insect prey, either alive or dead. During daylight hours, brown recluse spiders typically retreat to dark, secluded areas. Adult female recluses seldom venture far from their retreat, whereas males and older juveniles are more mobile and tend to travel farther. Consequently, they are more likely to wander into shoes, clothing or bedding at night and bite people when they inadvertently become trapped against the skin.

The brown recluse spider usually bites humans through unintentional contact that traps the spider against the skin. The severity of the bite may vary. A small white blister usually develops at the site of the bite. The venom of a brown recluse can cause a severe lesion by destroying skin tissue (skin necrosis). This skin lesion will require professional medical attention.

Brown Recluse Spider
NPMA

Hobo spider (Tegenaria agrestis)

The Hobo spider is a common type of spider found in the Pacific Northwest. It will build its funnel web in almost any place close to the ground with holes and cracks, such as rock retaining walls, in construction supplies, beneath debris and around building foundations. Sometimes people refer to the hobo spider as the “aggressive house spider” but this name is misleading. The spider does not live indoors and it’s not aggressive towards humans. It is a relatively large spider being ~ 40-50 mm in length. They have with long, hairy legs and chevron-shaped abdominal markings. These characteristics are true of many other spiders. For proper ID of a hobo spider, bring a sample to an entomologist. Knowing what hobo spiders NOT look like is helpful to know too. If a spider has any of these features, it is not a hobo spider:

- spots on the sternum (flat shield on the underside where the legs attach to the body)
- distinct stripes on the cephalothorax (the body part where the legs attach)
- dark rings around the legs
- shiny, dark-orange legs and cephalothorax
- long and pointy palps (boxing glove looking structures at the front of male spiders)

Hobo spider
NPMA / Tom Myers

Hobo spiders build funnel webs that open at both ends with one end expanding outward into a broad, slightly curved sheet like a trampoline. An escape tunnel is built in the back of the web which leads to a deep crack or other protected area. From late June to October, males wander seeking a mate. Roving males may enter the ground level of a structure. Male hobo spiders are responsible for more bites than female hobo spiders because this wandering habit brings them into contact with humans.

The hobo spider will bite in defense. There is debate around the effects of hobo spider bites as these spiders are frequently confused with other species. The prevailing thought is that hobo spider bites causes only mild pain and redness. The U.S. Centers for Disease Control (CDC) has removed it from its list of poisonous spiders.

WORKING WITH YOUR CUSTOMERS

Spiders are usually in a location because other insects are there for them to eat. Help your customers understand this and what they can do to prevent insects from getting in/on their structures. The recommendations will vary by location where spiders are being found in/around the building. Some common recommendations are:

- If exterior lights are used, choose warmer color light and LEDs if possible, to attract fewer insects,
- Minimize the types of locations where spiders build their webs or hide.
- Make sure screens are intact. If you keep interior lights on at night, consider keeping the surrounding windows closed to prevent small flying insects from getting inside.
- Keep basements dry to discourage many household pests that thrive in moist environments.

To avoid spider bites, recommend customers wear gloves while gardening, doing yardwork, or moving items that have not been moved in a while and have spider webs around them.

Spider myths abound. Two that you can help stop are:

- Daddy-longlegs are the most poisonous spider in the world but cannot penetrate human skin. There are two arachnids that are commonly called daddy-legs. One (Opilliones) is an arachnid, but not a spider and has no venom at all. The other (Pholcidae) is a spider, but there are no known cases of it biting a human and no studies have been done on the toxicity of its venom.
- Humans eat spiders in their sleep. This is not likely at all. There is nothing about a gaping human mouth that would attract a spider. In fact, vibrations from snoring would scare a spider away.

FOR MORE INFORMATION

- PCT Field Guide for the Management of Urban Spiders
- Texas A&M University https://citybugs.tamu.edu/factsheets/biting-stinging/others/ent-3003/
- University of California Riverside: https://spiders.ucr.edu/
- University of Kentucky: https://entomology.ca.uky.edu/ef623

TICKS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- American dog tick (*Dermacentor variabilis*)
- Blacklegged tick (*Ixodes scapularis*)
- Brown dog tick (*Rhipicephalus sanguineus*)
- Gulf Coast tick (*Amblyomma maculatum*)
- Lone star tick (*Amblyomma americanum*)
- Rocky Mountain wood tick (*Dermacentor andersoni*)
- Western blacklegged tick (*Ixodes pacificus*)

DISEASES AND CONDITIONS

- Anaplasmosis
- Babesiosis
- Colorado Tick fever
- Human Ehrlichiosis
- Lyme Disease
- Powassan virus
- Red Meat Allergy
- Rickettsia parkeri rickettsiosis
- Rocky Mountain Spotted fever
- Southern Tick-Associated Rash Illness (STARI)
- Tick Borne Relapsing fever (TBRF)
- Tick Paralysis

OVERVIEW

Ticks are considered public health pests because they can transmit diseases that affect humans and animals. Most species of ticks are blood-feeding ectoparasites – parasites that live outside the body of their hosts. Blood feeding ticks may cause skin inflammation at the site of the bite and may also cause a red colored swollen bump on the skin. But the most serious problems created by tick bites involve transmission of infectious diseases during the tick's consumption of a blood meal.

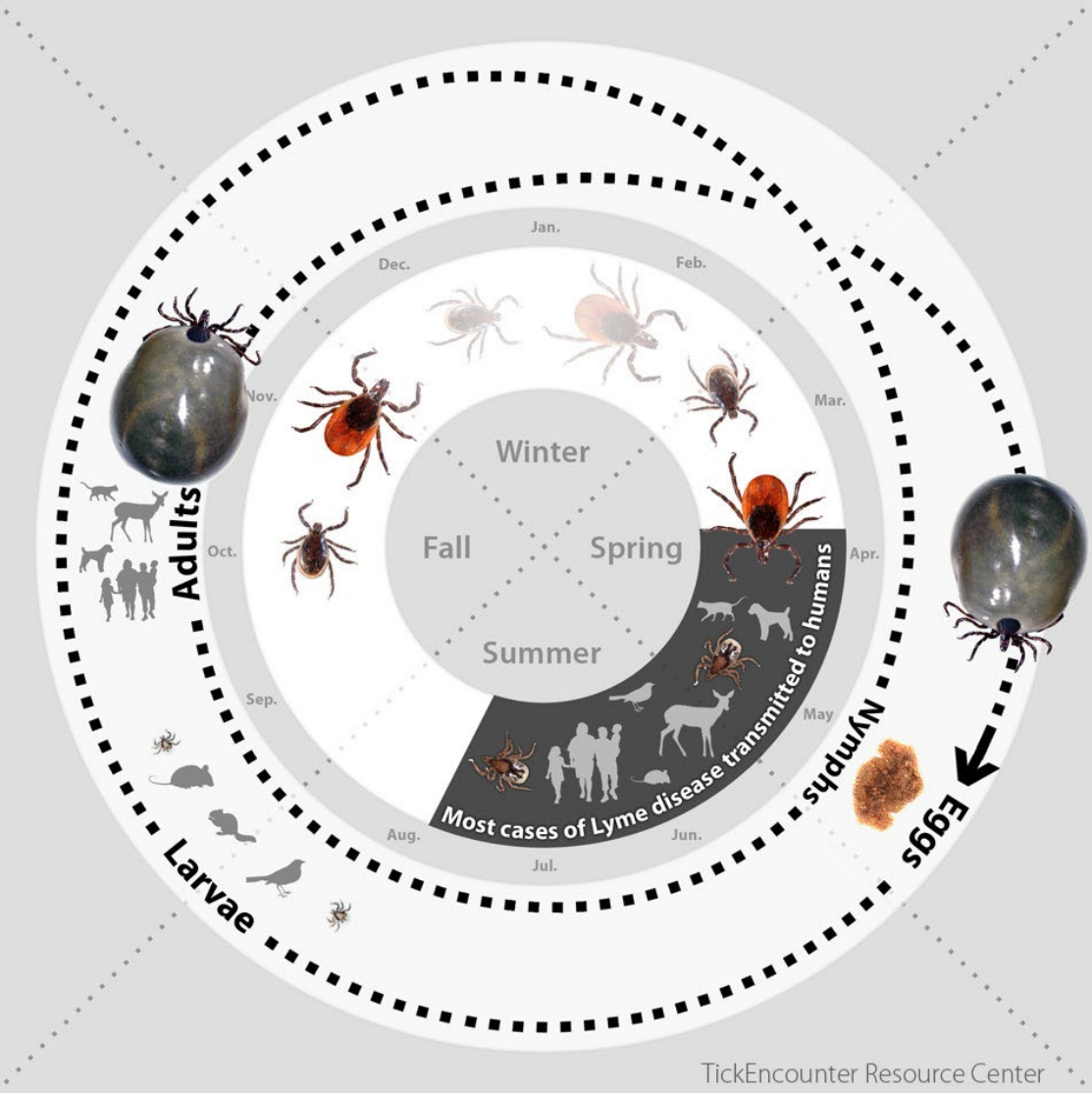
Understanding the tick life cycle can help you understand how they vector disease. Become familiar with the life cycle of the tick species in your area to better educate your customers and time your service.

For example, the blacklegged or deer tick (*Ixodes scapularis*) has a two-year life cycle during which it feeds on different animals including rodents, deer, and humans. In the northeast/mid-Atlantic/upper-mid-western states, each adult female lays more than a thousand egg in the spring. When they hatch during the summer, the larvae do not carry any disease and pose little threat to the first animals they feed on. In the fall, the tiny six-legged larvae will attach to and feed on small mammals and birds. Each larva attaches to its host, feeds until it is engorged (filled with blood), and then drops off, usually back into the leaf litter. If a larva feeds on a rodent that is carrying the bacterium *Borrelia burgdorferi*, it may pick up the pathogen and be able to transmit it to other animals it feeds on throughout its life cycle. The

term larva can be misleading but is correct. Larval ticks, like other life stages have no antennae and two body parts. Unlike nymphs and adults, the nymphs only have six legs.

The fed larvae molt over the winter and emerge in May as poppy-size, eight-legged nymphs. These nymphs carry whatever pathogens the larvae picked up and can transmit them to the next animals they feed on. Throughout the summer and into the fall, the nymphs feed and molt to grow. They feed on larger animals including dogs, deer, and people. Nymph and adult ticks find their next meal by climbing up tall grass or to the tips of branches and waving their first set of legs in a behavior called questing. They cannot jump or fly, but easily catch a ride on any animal that brushes by.

Fed, adult females overwinter in the leaflitter, but can be active if the ground is not frozen. In the spring they lay their eggs and the 2-year life cycle begins again.



Blacklegged Tick Life Cycle
URI TickEncounter Resource Center

Ticks can carry and transmit disease, in-part, because of the way they feed. When the tick finds a feeding spot on a host, it grips the host's skin, cuts into the skin surface, and inserts its feeding-tube-

mouthpart. Feeding tubes have barbs, which help keep the tick in place while it's feeding. Ticks secrete saliva, which contains anesthetic compounds that enables the tick to feed without the animal or human host feeling the tick's bite. A tick will suck blood slowly for several days and if the host animal has a blood-borne infection, the tick will ingest the pathogens along with the blood. Small amounts of saliva from the tick may also enter the host animal during the feeding process. If the tick contains disease pathogens from a previous host, the disease pathogens may be transmitted to the host and create an infected host. After feeding, most ticks will drop off and prepare for the next life stage. At its next feeding, it can then transmit the acquired disease to another host.

Many infectious disease pathogens transmitted by ticks also involve rodent and other carrier (host) species that ticks feed upon. During the period 2004-2016 the number of tick-borne diseases doubled in the U.S. and were 77% of all vector-borne diseases reported to the CDC. While there are many tick-borne diseases reported in the US, Lyme disease is one of the most significant.

Tick-borne diseases of public health importance within the U.S. and their primary tick vectors include:

- Anaplasmosis – a bacterial disease primarily transmitted by the bites of blacklegged ticks (*Ixodes scapularis*) and western blacklegged ticks (*Ixodes pacificus*).
- Babesiosis – a parasitic disease transmitted by the bite of an infected nymphal stage blacklegged tick (*Ixodes scapularis).*
- Colorado Tick fever – a viral disease transmitted by Rocky Mountain wood ticks (*Dermacentor andersoni*), American dog ticks (*Dermancentor variabillis*) and brown dog ticks (*Rhipicephalus sanguineus*)
- Human Ehrlichiosis – a bacterial disease transmitted by the bite of lone star ticks (*Ambylomma americanum*).
- Lyme Disease – a bacterial disease transmitted to humans in the northeastern and mid-western US by infected blacklegged tick (*Ixodes scapularis*) and in the western parts of the U.S. by infected western blacklegged tick (*Ixodes pacificus*).
- Powassan virus – a viral disease transmitted to humans by blacklegged ticks (Ixodes scapularis) and groundhog ticks (*Ixodes cookei*).
- Rickettsia parkeri rickettsiosis – a type of bacterial disease transmitted to humans by the bite of an infected Gulf Coast tick (*Amblyomma maculatum*).
- Rocky Mountain Spotted fever – a type of bacterial disease transmitted to humans by an infected American dog tick (*Dermacentor variabilis*), the Rocky Mountain wood tick (*Dermacentor andersoni*), and the brown dog tick (*Rhipicephalus sanguineus*).
- Tick Borne Relapsing fever (TBRF) – a bacterial disease transmitted to humans by the bite of infected soft ticks in the genus *Ornithodoros*.

Other conditions that ticks can cause include:

Red Meat Allergy – is a rare reaction that develops in people who are bitten by lone star ticks (*Amblyomma americanum*). During the tick's feeding process, it injects saliva that contains compounds that help the tick remain attached and feed successfully. Contained within the tick's saliva is a molecule called alpha-gal, which is a sugar found in red meat and one that humans don't have. The red meat allergy response is created when alpha-gal from a tick is introduced into a human host. Since people don't have alpha-gal in their system, the tick's bite sets up the need for production of antibodies to combat the foreign alpha-gal molecule. This production of antibodies can set up person for an allergic reaction the next time red meat is consumed.

Southern Tick-Associated Rash Illness (STARI) – is a rash like the rash in the early stages of Lyme disease, but not associated with the bacterium Borrelia burgdorferi that causes Lyme disease. Fatigue, fever, headache, muscle, and joint pains may accompany the rash, but the symptoms from Lyme disease such as arthritis, nerve-related disease or other long-lasting Lyme disease symptoms do not occur in those with STARI. The cause of STARI is not yet known.

Tick Paralysis – is a rarely reported, noninfectious nerve condition with symptoms of severe paralysis that progressively climbs upward from the lower extremities and progresses rapidly. Tick paralysis is caused by the adverse reaction of a nerve toxin produced by several species of ticks as they consume a blood meal. Tick paralysis is most likely to be caused by blood feeding wood ticks and American dog ticks. Once the feeding tick causing the condition is located and removed, recovery is quick, and the sufferer is treated using supportive care.

To understand the current distribution of ticks and tickborne illnesses in the US, visit www.cdc.gov/ticks/geographic_distribution.html and view the images, maps and transmission information associated with the following ticks.

- American dog tick (*Dermacentor variabilis*)
- Blacklegged tick (*Ixodes scapularis*)
- Brown dog tick (*Rhipicephalus sanguineus*)
- Gulf Coast tick (*Amblyomma maculatum*)
- Lone star tick (*Amblyomma americanum*)
- Rocky Mountain wood tick (*Dermacentor andersoni*)
- Western blacklegged tick (*Ixodes pacificus*)

WORKING WITH YOUR CUSTOMERS

Part of your role is educating the customer about ways they can help prevent tick bites when they or their pets are enjoying the outdoors. For the yard, recommend having a professional apply pesticides that are labeled for use against ticks. In addition to treatments of the landscape, this may include installing mouse-targeted devices that kill the ticks that are feeding on mice. For pets, recommend the homeowner talk to his or her vet about tick control options and available vaccinations. You can help the customer understand where their pets should and should not go to minimize exposure to ticks.

To minimize the risk of being bit by a tick, people should avoid going into tick habitat if possible, but take precautions if they do. These precautions, from toe-to-head include wearing closed shoes, light colored socks pulled up over the cuffs of long pants, long sleeved shirts, and repellent on clothes and skin according to the label instructions. Your can minimize risk of tick bites by wearing light-colored coveralls when working in tick habitats. Clothing is available pre-treated with repellent or there are products that can be used to make fabric repellent through many washes. If the customer is wary of using a repellent, help them understand why the risk of a tick bite is likely greater than the risk of using a repellent used according to label instructions. There is a search tool of EPA registered repellents for mosquitoes and ticks available at https://www.epa.gov/insect-repellents/find-repellent-right-you

If a tick is attached to a person or an animal, the best way to remove it is to use pointy tweezers to grasp the tick at the head, as close to the skin as possible, and pull straight out. Vaseline, cigarettes, matches, and other remedies are not recommended because they may not work, and they increase the chance that the tick puts more pathogen-containing saliva into the host.

FOR MORE INFORMATION

- Best Management Practices for Brown Dog Tick
- https://pmu.ifas.ufl.edu/sites/ufpmu/files/TickBMPs.pdf
- Tickborne Diseases of the US www.cdc.gov/lyme/resources/TickborneDiseases.pdf
- TickEncounter Resource Center www.TickEncounter.org
- Tick Management Handbook www.ct.gov/caes/lib/caes/documents/special_features/tickhandbook.pdf

TRUE BUGS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Conenose bugs or kissing bugs *(*Reduviidae*)*
- Masked hunter *(Reduvius personatus)*

DISEASES AND CONDITIONS

- Chagas disease
- Painful bite

OVERVIEW

The best-known true bug (order Hemiptera) to most PMPs is the bed bug. Because of their significance in structural pest control, they get their own section in this study guide. Other true bugs that are significant to public health are in the assassin bug family (Reduviidae). These insects are more common in South America, than the US but can be found in the southern half of the US.

- Conenose, kissing, triatoma, assassin or vampire bugs *(*Triatominae*)*
    - Kingdom: Animals (Animalia)
        - Phylum: Invertebrates—insects, spiders, and crustaceans (Arthropoda)
            - Class: Insects (Insecta)
                - Order: True bugs (Hemiptera)
                - Family: Assassin bugs (Reduviidae)
                - Subfamily: Triatominae

There are more than 100 Triatominae species that are significant to public health because they can transmit Chagas disease—hence all the generalized common names—kissing, conenose, vampire, etc. The common name “conenose” for these bugs comes from their cone-shaped head. Adults generally have large eyes, a distinctive neck, and the piercing-sucking mouthpart that all true bugs have. They hatch from eggs and grow through an incomplete metamorphosis life cycle to adults that are ~14-24 mm in length, light brown to black in color, some with paler markings. They have wings and are capable of flight. Adults can fly considerable distances and are attracted to light. It’s not uncommon for adults to fly from animal nesting sites to lighted structures in search of a blood meal during the evening hours when they are most active.

In the US, where thatched roof and adobe wall construction is not common, these bugs rarely infest homes. They usually complete their life cycles in close association with wildlife—near bird nests, animal dens, etc. If a structure has been invaded by conenose bugs and there are animals on the property like dog kennels or chicken coops, you should inspect those areas.

Conenosed bugs are ectoparasites. They feed on the blood of a wide variety of vertebrates including humans and both wild and domestic animals. Both nymphs and adults of both sexes require blood for development and reproduction. They are called kissing bugs due to their behavior of occasionally biting their hosts on the face near the lips. The bite from their piercing-sucking mouthpart is usually not painful, however, severe allergic reactions can occur in sensitive people. Like bed bugs, they are most active at night.

Members of the subfamily Triatomidae include species that are known carriers of the pathogen that causes Changas' disease. This disease is not common in the United States but is significant in Central America and South America. The insect's feces can contain the protozoa which causes the disease. As detailed in the General Concepts for Vector Control section, when the infected feces enter the host, through an open wound (like that created by the bite) or through the eyes or mouth, disease transmission can occur.

Masked hunter (*Reduvius personatus*)

- Conenose, kissing, triatoma, assassin or vampire bugs *(*Triatominae*)*
    - Kingdom: Animals (Animalia)
        - Phylum: Invertebrates—insects, spiders, and crustaceans (Arthropoda)
            - Class: Insects (Insecta)
                - Order: True bugs (Hemiptera)
                - Family: Assassin bugs (Reduviidae)
                - Subfamily: Reduviinae

As you can see from their scientific classification, the masked hunter is closely related to the Triatomid bugs in the above section. They are part of the same family, but different subfamilies. Unlike the Triatomids, the masked hunter does not suck blood or transmit disease. Both adults and nymphs are predators that feed on other insects including flies, carpet beetles, mealworms, and bed bugs. The adult bug is dark brown or black and ~19 mm in length. The nymphs or immatures are covered with microscopic hairs which catch and hold dust, lint, and other small particles of debris. This camouflage helps the nymph to ambush prey, hence the common name, "masked hunter." If threatened, handled roughly, or trapped between clothing and skin, these insects will bite people with their needle-like mouthparts. Their bite is extremely painful and can result in localized swelling. Masked hunters are not known to transmit any diseases and medical attention is rarely needed.

WORKING WITH YOUR CUSTOMERS

Like bed bugs, these insects are unsettling because they usually bite us when we are in a location where we usually feel safe from the perils of the world. Help your customers understand how your management efforts will help reduce the chances of them getting bit and empower them with ways they can help guard their homes against these pests. Specifically, help your customer understand the concept of a building envelope and walk around their home with them (ideally the outside) pointing out areas where exclusion work could be done to help block out bugs. For conenose bugs and masked hunters, intact window screens are key to exclusion because they can fly and are attracted to light.

FOR MORE INFORMATION

- CDC https://www.cdc.gov/parasites/chagas/gen_info/vectors/index.html
- PestWorld https://www.pestworld.org/pest-guide/other-pests/kissing-bugs/

BEES AND WASPS

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

- Bees (Apidae)
- Wasps, hornets, and yellow jackets (Vespidae)

DISEASES AND CONDITIONS

- Stings resulting in local reactions, regional reactions, or systemic anaphylactic responses

OVERVIEW

This group of insects is, for the most part, beneficial. They are the major pollinators of flowering plants and some species control other insect pests. As a general practice, you should minimize the risk of these insects encountering pesticides. Some pesticides contain specific sections on the label about pollinator protection. Pollinator protection is paramount unless these pests build their nests or are very active where humans are likely to encounter them and suffer. They are a health risk to some people who have allergic reactions to their painful stings which is why they are considered public health pests. Understanding their biology and behavior can help you work with customers to minimize the risk of encountering bees and wasps to minimize the number that need to be killed to protect public health.

The first thing to know about a species is whether it is social or solitary. This can tell you both about the behavior of the insect and the scope of your potential problem. Solitary bees and wasps live alone, only encountering others of its own species to mate. Individuals of social species live together in colonies consisting of many workers and one or more queens. The workers specialize in different tasks and cooperate to raise the queen’s offspring.

Solitary bees and wasps are not likely to sting humans. In addition, the venom of solitary bees and wasps such as carpenter bees, cicada killers, mud daubers and spider wasps consist primarily of chemicals that subdue and paralyze other insects and spiders they use as food for their larvae. These chemicals effect the nervous system of the prey and have little effect on humans aside from causing minor, temporary pain.

Social bees and wasps pose a risk greater risk. Nests may be in the ground, in natural or man-made cavities or constructed by the wasps with paper. When the nest is disturbed, workers release an alert pheromone which causes other workers to rapidly attack and sting the intruder. Bees can only sting once. Wasps, hornets, and yellow jackets can sting multiple times.

The venom the workers inject through a stinger to discourage an attacker can cause allergic reactions. The public often mistakenly thinks of individual bees and wasps as inherently aggressive. While it is true that disturbing a nest will result in a defensive attack, individual workers away from the nest tend to focus on foraging for food and typically ignore humans. Stings from these workers are almost always provoked by firm, accidental contact, such as stepping on a worker, taking the insect into the mouth with food or drink, or striking a bee or wasp with the hand.

A small percentage of the U.S. population is prone to developing allergies to the venom of social bee and wasp species. These individuals are at risk of experiencing allergic reactions known as "immediate

hypersensitivity reactions," including life-threatening systemic anaphylaxis. The most common specific cause is respiratory failure due to constriction of airway passages and swelling in the throat area. The next most common cause is cardiovascular collapse due to a rapid drop in blood pressure. A person's reaction to bee and wasp venom is specific to the kind of bee/wasp and may change over time. In fact, there are now immunotherapies that can reduce a person's allergic response. Advise customers to consult a medical professional for all medical concerns including questions about kids and pets.

Avoiding contact with these insects is key to prevent getting stung. When working outdoors, people should be aware of their surroundings and take caution when disturbing vegetation, especially will performing yard work. Homeowners should seal up any tiny openings in structures to prevent entry and nest building activities. Sanitation measures that minimize food and food waste available to worker bees and wasps tend to be more effective in reducing their numbers than other methods. Wasps and hornets may be attracted to protein, fat, or sugar depending on their dietary needs.

Take precautions when managing bees, wasps, and hornets. Wear light-colored heavy coveralls or a bee suit, high sleeved canvas or leather gloves, and a helmet or bonnet with a veil. If you will be treating nests, plan your service for when the customer and pets won't be around. Because the nests may be up high, specialty equipment and ladders are often required.

There are thousands of species of social bees and wasps. Below are descriptions of a few that you may encounter.

Honey bees (Apidae)

Honey bees occur in various shades of yellow, black and brown and are typically 0.4-0.6" / 11-15 mm in length. They are notably hairy which is a distinguishing feature from the smooth and shiny wasps and hornets. This hair and their shape also make the constriction at their waist between their abdomen and thorax less prominent than in the yellowjackets, wasps, and hornets. There are many species of bees which are active pollinators and produce honey to feed their young. They often build their nests (called hives) in tree crevices, but will occasionally build nests in walls, attics, or chimneys. Bees specialize in keeping their hives at a perfect temperature to ensure their waxy walls stay intact. If you are going to remove honey bees, you need to have a plan for how to remove the hive and its honey. Without the bees, the hive will melt or break down and the honey will leak out causing other problems, especially in walls.

It is helpful to partner with a local beekeeper who can assist in removing the honey bee hive and re-home the insects. Knowing beekeepers is especially useful when a customer calls reporting a bee swarm because the beekeeper can come and move the swarm to an appropriate place for you. Just like ants (which are closely related to bees and wasps), honey bees will swarm when a colony gets large to establish a new colony. A swarm consists of a queen and many workers. Because they have no young or hive to defend, they are not aggressive. Swarms can be captured and moved to an appropriate nesting location where they will colonize and build a nest. You should not kill swarming honey bees if possible

The stinger of the worker honey bee is barbed, so when it is forced to defend itself or the colony, the stinger becomes stuck in the skin. When the bee pulls itself away from the stuck stinger, the venom sack has a mechanism that continues to pump venom into the skin. If you are stung by a bee, remove the stinger and venom sac as soon as possible.

Honey Bee
NPMA

Africanized honey bees

The Africanized bee is a hybrid species that has invaded parts of the southern US. They are similar in appearance to western honey bees except they are slightly smaller in size. They can be used in commercial beekeeping, but their behaviors do not make them ideal. Africanized honey bees have been known to chase people for more than a quarter of a mile once they get excited and aggressive. If you are attacked by the Africanized honey bee, run for shelter and protect your head and face because they will focus on this area. Therefore they earned the nickname “killer bee.” The colonies are more defensive, swarm more frequently, are more likely to nest in ground cavities, and are more likely to abandon their nest and all move when stressed.

Yellowjackets (*Vespula* & *Dolichovespula spp.*)

Adult workers of this species are 0.4-0.6” / 10-16 mm in length depending on the species. Their abdomen is usually banded yellow or orange and black and are commonly mistaken for honey bees but they lack the hairy body and are more intensely colored.

They construct their nests of a paper-like material that is made when the wasps chew up wood fibers. The nests are completely enclosed in an envelope except for the entrance hole. These wasps are primarily ground nesters. The subterranean nests may be found in gardens, flower beds, pastures, roadside embankments and elsewhere.

Yellowjacket
NPMA / Tom Myers

Occasionally nests can be found in dark, enclosed areas of a building, such as crawl spaces, attics, or wall voids. Nests in wall voids are particularly difficult. The nest itself may be a ways from the entrance hole, so investigate the size and location before moving forward with treatment.

Yellowjacket foragers can be a menace around parks, camps, and suburban sites where people leave open food and discard garbage. Colonies are readily defended, and they will sting when the nest area is disturbed. Yellow jackets can be serious pests during late summer months. Unless the nests are located close to the entrance to a building, in the ground of a lawn that is mowed, or in any area where the public is likely to encounter them, the nests can be ignored. At the end of the season, only the mated queen survives the winter and will start a new colony the next year. The nest is not reused the following season. This is also true of bald-faced hornets and paper wasps.

Paper wasps “Umbrella wasps” (*Polistes spp*)

Adults are 0.6-0.8”/16-20 mm in length and are brownish in color with yellow markings. A few species have reddish markings. Paper wasps get their name from the paper-like material with which they construct their nests. They are also sometimes referred to as “Umbrella” wasps due to the open-faced, umbrella-shaped nests they construct. Nests are often found hanging from twigs and branches of trees and shrubs, as well as porch ceilings, door frames, eaves, deck floor joints, railings, etc. Although paper wasps are typically not an aggressive type of wasp, they will defend their nest if it is touched or disturbed. Paper wasps are considered beneficial insects because they control many pest insect species.

When you are inspecting the exteriors of structures in the springtime, keep an eye out for the beginnings of paper wasp nests on and around the structure. Control is much easier before the colony is established and if the temperature is still cool, they may be less likely to fly. When you are inspecting for paper wasps, you may find tubes of mud left by the mud dauber wasp. This solidary wasp rarely stings, and the mud tubes simply contain an egg and food for the larva when it hatches. Simply knock down the mud tubes that are built on the structure.

Paper Wasp and Nest
Whitney Cranshaw, Colorado State University, Bugwood.org

Baldfaced hornets (*Dolichovespula maculate*)

Baldfaced hornets greatly resemble their smaller yellowjacket relatives, with black bodies and a predominantly white-patterned face. They also have two slanted lines running from their midsection towards their head and on the latter part of their abdomen. Baldfaced hornets build aerial nests out of paper. The nests are round and usually in exposed locations, often on trees, utility poles, overhangs or

other structures and can be large, growing to 14 inches in diameter and 24 inches in length. If you see a big ball-shaped nest in a tree, it is likely baldfaced hornets.

Baldfaced Hornet
Jennifer Dacey, CTPCA

WORKING WITH YOUR CUSTOMERS

- Cover food and drinks (especially cans of soda) to avoid ingesting a bee
- Plant flowering plants, bushes, and trees away from where people frequently travel
- Seal up any tiny openings in structures to prevent entry and nest building activities
- Minimize food and food waste available to worker bees and wasps by cleaning up spills and bagging or at least covering garbage
- Keep trash cans away from food serving and eating areas
- Use strong fans to discourage flying insects in an area
- Wear light colored clothing
- Don’t wear strong fragrances like perfume

FOR MORE INFORMATION

Controlling Wasps, Hornets, and Yellowjackets: https://entomology.ca.uky.edu/ef620

PESTS OUTSIDE THE RESPONSIBILITY OF THE PMP

CRAB, HEAD AND BODY LICE

ARTHROPODS RELEVANT TO PUBLIC HEALTH IN THE US & CANADA

In the US, there are three types of lice that are human ectoparasites. Each species lays eggs (referred to as nits) which hatch into nymphs. They have an incomplete metamorphosis life cycle in which each stage feeds on human blood. Lice do not survive for much more than 48 hours if they are dislodged from their human host. These lice and scabies mites are the only pests that you can expect to encounter infesting people in the US and Canada.

- Body louse (Pediculus humanus humanus)
  Adults are ~3 mm long and generally lives in the seams of clothing. Can survive a week off the host, but generally less than 10 days.
- Crab louse (Pthirus pubis)
  Adults are ~2 mm long and are usually found in the pubic region and sometimes in coarse hair such as beards, moustaches armpit hair, and eyebrows. The crab louse looks like a crab. Will die within 48 hours off a host.
- Head louse (Pediculus humanus capitis)
  Adults are ~3 mm long and generally live close to the scalp. They lay their eggs within ¼" of the scalp on strands of hair. Will die within 48 hours off a host.

A fully developed adult louse has six legs and is tan to grayish-white in color. Head and body lice are nearly identical, so the location where they are found is key to identification without a microscope.

DISEASES AND CONDITIONS

Although body lice can vector epidemic typhus, trench fever and relapsing fever, none of these are common in the US or Canada. Head and pubic lice are not vectors. Today, body, head and pubic lice are NOT considered important disease vectors in the US or Canada. Unless you are a medical doctor, there is nothing you can do to help manage lice. A medical professional must be involved. Of the three species, head lice are most common, especially on children.

While not a disease in the strict sense of the word, there is distress and discomfort caused when lice are discovered on children and adults. The intense itching and scratching of louse bites can cause sores and secondary bacterial infections of the skin. If untreated, heavily bitten areas of the skin can become thickened and darkened, resulting in a condition called "vagabond's disease."

WORKING WITH YOUR CUSTOMERS

When requested to help control lice, provide information instead of an insecticide application. This information is valuable and can be a major source of relief. Your role in dealing with lice is the address fears that are founded in misconception and direct the sufferer to a medical professional. Let clients know that the insecticides you have available are not what is needed to eliminate the infestation. In addition, you are not allowed by the "law of the label" to apply insecticide treatments to people. You should not make specific recommendations for the use of over the counter products approved for

controlling lice, but you can let them know that a medical professional may simply give them directions for using the lice treatments that are found in stores.

If they feel the need to do something to their home and belongings, weekly vacuuming and laundering items in hot water and drying in a hot dryer may bring some peace and, in the case of body lice, will be part of the management plan. The most comforting thing you can do is to assume the customer that lice must be very close to a person to survive. If an object or piece of fabric has not been in contact with a person for 48 hours, there are no live head or pubic lice adults or nymphs on it. Head lice nits will die within a week. It is rare for lice to be transmitted via inanimate objects like helmets and hairbrushes. Lice nits will not hatch unless they are warm (very close to the skin). For example, head lice nits need to be within ¼" of the scalp to hatch.

Of note, from https://www.cdc.gov/parasites/lice/head/schools.html:

“Students diagnosed with live head lice do not need to be sent home early from school; they can go home at the end of the day, be treated, and return to class after appropriate treatment has begun. Nits may persist after treatment, but successful treatment should kill crawling lice.

Head lice can be a nuisance, but they have not been shown to spread disease. Personal hygiene or cleanliness in the home or school has nothing to do with getting head lice. Both the American Academy of Pediatrics (AAP) and the National Association of School Nurses (NASN) advocate that “no-nit” policies should be discontinued.”

FOR MORE INFORMATION

The Centers for Disease Control and Prevention provides crab, head and body lice information that can be used to prepare information sheets that might be valuable when communicating to your customers or their schools. The website links are:

- Body Lice: https://www.cdc.gov/parasites/lice/body/index.html
- Crab Lice: https://www.cdc.gov/parasites/lice/pubic/index.html
- Head Lice: https://www.cdc.gov/parasites/lice/head/index.html

DELUSIONAL INFESTATION

On occasion you will likely encounter customers that have extreme reactions to pests. When the pest is present, the root of a customer’s reaction may be a fear like arachnophobia (fear of spiders). When there are no pests present, but the customer insists there are, you should look for other signs that the person may be suffering from delusional infestation. This condition is also known as delusory parasitosis or Ekbom’s syndrome. It is characterized by the fixed belief that one (or one’s environment) is infested with insects, parasites, inanimate objects, or small living creatures in the absence of medical evidence.

Delusional infestation is a relatively uncommon disorder. To treat it, psychiatric support is needed. The most difficult part is convincing the patient of the absence of parasites and obtaining his or her agreement to see a psychiatrist. More often, sufferers bounce between dermatologists, general practitioners, and pest control companies, trying to get someone to confirm the presence of the organisms. Delusional infestation is a medical condition and there is nothing you can do to alleviate or

solve the person's problem. Likewise, antihistamines, antibiotics and lice or scabies treatments prescribed by a doctor will have no effect.

Sufferers will be adamant that pests are present and go into great detail about the parasites description, habits and ability to jump or scurry around, most of which make no sense and do not describe the behaviors and habitats of any household pest.

The symptoms of delusional infestation are:

- Excessive cleaning or use of pesticides
- Occasionally dangerous attempts "to get rid of the pests" using pesticides or cleaning products
- Reduced social contacts, avoidance of home and reduced quality of life
- Secondary itching, scratching, and resulting infections
- The person will present "pests" they have collected which are lint, scabs etc. These are often provided in containers such as matchboxes, pill bottles, envelops, plastic or glass containers that they say contain some of the parasites they caught and collected.

Delusional infestation is most common in elderly, and disproportionately among females. It may occur as a symptom of psychiatric illness, medical illness, or drug use (prescribed or illicit). To diagnose, a medical professional will listen for signs of delusion in the person's line of reasoning about their "pests." Antipsychotic medications get rid of the condition, but sufferers rarely agree to treatment.

RECOMMENDED COURSE OF ACTION

These customers as especially troublesome for a pest control company. The person will show their (often damaged) skin, make accusations about other companies they have hired and insist on pesticide treatment. No matter how much time you spend trying to help, the person will continue to insist the organisms are present.

Customer service representatives should be trained to recognize when someone may be suffering from delusional infestation. By recognizing some of the symptoms listed above, the representative can transfer the service request to the office manager or technical services specialist who may be able to deflect the service request.

If an inspection is scheduled, stick to an inspection for household pests. Never let the customer show you signs on the private parts of his or her body – explain that since you're not a doctor it would be unethical to examine the person.

- Bird mites cannot infest humans.
- No insect or mite can live in the environment and switch to infesting a human.
- The only arthropods that commonly infest human bodies in the US and Canada are scabies mites and human lice and these are medical conditions that only a doctor can treat.

If an insect, mite, or spider is not found, there is nothing to treat. DO NOT OFFER TO TREAT THE PREMISES since that would be a violation of label laws. Explain that none of the tools you have, including pesticides, will solve the problem. If you provide a treatment a sufferer of delusional infestation, they will likely demand more and more needless treatments since the source of their problems are not resolved by IPM measures.

Consider developing a good relationship with local medical professionals to whom you can refer these individuals for help. The medical professional may be able to prescribe a neuroleptic drug to help with the distress they are experiencing that will also alleviate the delusional infestation.

WHAT NOT TO SAY OR ASK

- Don't allow a sufferer to show you rash or wound marks on the private parts of their body.
- Don't ask questions about their medical conditions, personal life and lifestyle.
- Don't engage in their line of reasoning about the infestation—either to support or contradict them.
- Don't say,
    - "Let me spray your residence and we'll see what happens."
    - "Those bumps and red places on your body look like some sort of bite or sting to me."
    - "I think you should see a psychiatrist because I think this condition is all in your head."

FOR MORE INFORMATION

- Delusional Infestation https://cmr.asm.org/content/22/4/690.abstract
- Invisible Itches: Insect and Non-insect Causes https://www.life.illinois.edu/entomology/pdfs/Invisible_Itches.pdf
- Is Something Biting Me?: https://extension.psu.edu/is-something-biting-me
- Webinar on Delusional Infestation: http://www.stoppests.org/ipm-training/training-opportunities/stoppests-webinars/di/

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