Pest Notes

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How the Mighty Have Fallen

The once-resilient German cockroaches find that change in their conditions stifle dominance.

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Up until recently, the German cockroach was they very foundation of pest management. The so-called "super roach" was able to withstand any modern insecticide and nuclear holocaust, yet when faced with modern technology--it blinked.

However, there is little time to mourn the decline of *Blatella germanica*. Coming quickly behind it are other species ready to fill those vacated harborages. In the last few years, several species of ants, house flies and a variety of stored food pests have increased in importance. They have probably benefited from the absence of baseboard spraying for cockroach management. Now, precise application to cracks and crevices and the use of baits have decreased the presence of insecticides indoors. Regardless, this new group of pests are fast becoming common and economically important.

Before research is directed to other household pests, it may be instructive to consider what happened to the German cockroach and what might be expected to come next. There is a sequence of practices and products that led to the gradual decline of *B. germanica*. While the scenario may be specific to the German cockroach, a similar road may be followed by one of the carpet beetles or stored food pests in the future. Let's look at the "black box" for the German cockroach, and try to establish what happened.

Two-Step Approach

The short answer is, crack and crevice application and

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The Significance of Commensal Rodents

Dr. Robert Corrigan
PCT-Online

No doubt, commensal rodents are among the most significant of all pests on earth. In our cities and towns, rats and mice take advantage of our food and shelters, multiply into populations of millions, and attempt to co-exist with us in our homes, offices and food preparation and storage facilities. Rodents are also especially well designed for carrying and transmitting diseases, and they frequently damage and destroy our buildings, utility systems and electronic communications systems through their gnawing and burrowing activities.

The cost of controlling rodents on a global scale is estimated to be in the billions of dollars. Paradoxically, however, rodents are also among the most beneficial of all mammals to humans, as they are invaluable in health and pharmaceutical research. In non-urban environments, they are an integral component for maintaining balance within most ecosystems.

Rodents impact our food, our shelter, our health and our comfort. Commensal rodents are among the top five most important pests in urban and industrial communities. In some parts of the world, rats and mice are the most important pests insects included. The purpose of this article is to present an overview of the significance of rodents as pests in the urban environment. By understanding how rats and mice impact people and other animals in everyday life, the importance of professional rodent control programs quickly becomes apparent. It is not an exaggeration to say that the earth and its inhabitants would be

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baits happened. These two combined to knock German cockroach populations over a theoretical "tipping point" for infestations. This point may be thought of as a crucial percentage of the population, the number of individuals necessary to successfully recover from an insecticide application. Once this number of individuals was removed, there was little chance for the infestation to recover. However, there is more to this part of the story.

Also contributing to the decline of *B. germanica* was the change in application methods for indoor pests. It went from extensive baseboard treatments to precise crack and crevice application. Gradual improvements in construction and eliminating the chain of "reservoirs" that maintained commercial and residential infestations, were the other factors that contributed to the decline.

The logic behind delivering liquid and dust insecticides directly to infested harborages now seems perfectly obvious. It wasn't always that way, though. Sometime in the mid-1970s, crack and crevice application methods were introduced. By the 1980s, it was an accepted practice. If you didn't change, you were dubbed a "baseboard jockey" and forever shunned!

This precise method of delivering insecticides to the household environment fell in line with the overall concept of integrated pest management (IPM), and has come to be one of the characteristics of IPM indoors. In addition, it helped to reduce public concern for exposure to pesticide use indoors.

Pyrethroids teamed with crack and crevice application to create the next major step in the sequence of German cockroach decline. When first used, this insecticide class was very effective against the cockroach. Pyrethroids are odorless and provide flushing action and, usually, quick knockdown of severe infestations. They become the preferred treatment for cockroaches because their characteristics satisfied both the client and the pest management professional (PMP).

Resistance developed to pyrethroids, just as it does for any modern insecticide, yet not before the value of crack and crevice application of these insecticides was realized. The level of success, the residual activity and the low odor made an impression. After pyrethroids, there was no turning back.

The Construction Climate

One benefit of the sprawl of suburban communities has been a gradual improvement in building construction. What does this have to do with German cockroach programs-or the future of other cockroach programs? A lot! Adults and nymphs of *B. germanica* can and do move between rooms in adjacent apartments, between apartments in buildings and between adjacent buildings. This type of movement can provide for continued re-infestation from untreated areas, and can lead to the development of insecticide resistance in some populations.

Modern construction has gradually improved techniques for soundproofing between rooms and sealing around pipes in commercial and residential buildings. Better construction practices further added to the benefits of crack and crevice application and effective insecticides. Limiting movement resulted in keeping cockroaches in treated areas-and, once eliminated, keeping those areas cockroach-free.

The "Big Bait" Theory

There is nothing especially magical about cockroach baits. They are effective, but the key to the effectiveness of baits is delivery. Baits can quickly knock down and (almost certainly) "knock out" German cockroach infestations when placed in or near infested harborages. Service technicians accustomed to crack and crevice application in the 1970s and 1980s easily adapted to bait guns in the 1990s, delivering small amounts to infested sites.

Delivering baits directly to infested harborages put toxic food material within reach of small nymphs. That alone may have made the difference in success. Small nymphs in search of food

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typically do not move far, if at all, from harborages, and they are usually not managed by traditional spray applications. Because of this, they often provide for the infestation to recover and persist. However, small nymphs readily eat baits placed within the protection of a harborage.

In addition, baits in harborages are available to females carrying egg cases, and this further increases their success. Females with egg cases do not leave the harborage very often in search of food. They eat and drink very little during the time they are carrying the egg case. Bait in the harborage is within their foraging range.

Lastly, German cockroaches typically infest food handling and storage facilities and living areas with poor sanitation. From these sites of large population reservoirs, they are easily moved to start or reinforce existing infestations. The final step in the decline of German cockroach infestations was the elimination of these reservoir populations. Once elimination is achieved in an apartment, office or food facility, it will likely remain cockroach-free with monitoring and prevention strategies.

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20 Questions, Answered

Stoy Hedges/PCT-Online

A significant amount of the commercial pest control services offered in the United States is directed at controlling the German cockroach in food facilities. Despite successes by many pest management professionals, a good many more often fail to provide consistent results in eliminating current infestations for their customers. Why does this occur?

Too often, this author has heard the excuse that the "chemical didn't work" or the "cockroaches must be resistant." Having had to help solve innumerable cockroach situations over the past 18 years, the author has found that the reason for failure in eliminating German cockroaches lies with not applying the

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dramatically affected for the worse without rodent control.

RODENTS IN CITIES. Much is said and speculated about the numbers of rats and mice in our cities and towns. Statements such as "there is one rat for every person in New York City" and "there are more rats in the world than people" are still prevalent among urbanites. Often pest professionals are asked, "How many rats live in my area?" or, "How many mice do you think we have in our warehouse?"

Interesting questions. But even rodentologists cannot provide accurate answers to these questions. In general, not many cities in the world contain rodent populations that equal the human population although there are some where the rodents outnumber the people.

For most developed areas of the world, however, the rodent populations are "clumped," with large populations occurring in some areas and smaller numbers in others. The rodent populations are usually distributed according to the specific environmental conditions of an area. For example, rodent populations are typically larger in urban areas where general sanitation is poor (i.e., abundant garbage and rodent harborage) and rodent control programs are lacking. In those parts of the city where sanitation and control programs are in place, however, only small populations of rats will be able to eke out a living.

It is safe to say that the total population of commensal rats and mice in the larger cities of the world is in the millions. We also know, from body counts of rodent "cleanouts" of badly infested buildings, that thousands of rodents can exist in one building. Documented cases also exist of occasional mouse "plagues" where hundreds of thousands of mice are observed overrunning towns and farms. One Australian farmer recorded 28,000 dead mice on his porch after one night's poisoning. Another 70,000 were killed in his crop field ion one afternoon. But such plagues are

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uncommon, and are cyclic population explosions that result from various coinciding environmental conditions. They are not likely to ever occur in urban areas.

So, we cannot say with any accuracy that "15 million" rats live in New York City or Cleveland or Chicago. For the pest management professional, the more realistic concern relative to estimating rodent population sizes regards a specific population inhabiting a particular building and its immediate environs. When designing control programs, the mistake of underestimating the size of a serious rodent infestation in a building can become costly, due to repetitive callbacks from dissatisfied clients.

DAMAGE TO FOOD. On a global scale, it is difficult to measure the total amount of food consumed or contaminated by rodents, but it is significant. Other books and papers address this subject in detail and provide various statistics regarding the impact of rodents on agricultural production. In 1982, for example, it was reported by the Food and Agricultural Organization of the United Nations that rats destroyed more than 42 million tons of food at a cost of $30 billion.

It has been repeatedly estimated that between one-fifth to one-third of the world's food supply never reaches the table due to losses from rodents. In some parts of the world, the entire crop grown for human consumption has been lost due to rodent outbreaks. In general, the monetary resources lost to combating rodents could be used to feed, clothe and shelter all the impoverished peoples of the world. Surely, humans truly compete with rats and mice for the earth's food and space.

For most urban and industrial areas, the concern about rodents and out food is really more of rodent contamination, spoilage and damage to food rather than consumption. With the exception of food storage facilities, rodents are often mere scavengers of garbage scraps or discarded food residues left lying about from improper cleaning. Rodents living in zoos, parks and livestock and farm facilities often feed on the food that is spilled or discarded by other animals or people.

In cases of severe rat infestations, however, food consumption and loss can be significant. A rat can consume up to 1.05 ounces (30 grams) of food each evening.

Consider that a realistic population of 50 rats living in a grain storage facility can consume as much as 3 pounds (1.4 kilograms) of grain each week.

Nevertheless, the contamination of food by rodents is a more serious wide-scale problem than the amount of food they consume. One mouse can excrete between 40 and 100 droppings per day, and can deposit hundreds of small droplets of urine during its travels. A rat typically produces between 20 and 50 droppings and excretes 0.5 ounces (14 milliliters) of urine daily.

Obviously, the concern of food industry and health professionals regarding food contamination is justified. In processed foods, minimum amounts of rodent contamination are permitted in the food before the food is considered contaminated and subject to seizure by the U.S. Food and Drug Administration (FDA). This amount is called the Defect Action Level (DAL). The various foods have different action levels, but generally, the levels are very low. Wheat, for example, has a defect action level of 9.0 milligrams of rodent excreta or dropping fragments per kilogram of wheat.

Regardless of the action levels established by the FDA, the reality for pest management professionals is that food and health inspectors will not tolerate the presence of any rodents in areas where they might contaminate food or food product surfaces. In addition, consumers certainly are not tolerant of discovering a rodent dropping in their breakfast cereal.

Even one rodent in a food-handling establishment, therefore, is a big deal, with potentially serious consequences for the food processor who fails to recognize the importance of an effective rodent control program. Pest management professionals must also acknowledge this and implement programs

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designed with long-term control and prevention objectives in mind.

DISEASE TRANSMISSION. Historically, commensal rodents have been responsible for some of the most devastating disease outbreaks of all time. In the past century alone, more than 10 million people have died from rodent-borne diseases. Plague and typhus outbreaks are two well-noted examples that have contributed to this astonishing figure.

Rats and mice have been implicated in about 55 different diseases, representing a diverse range of pathogens from viruses to parasitic worms, as listed below:

Type of Pathogen	#of Rodent-borne Disease
Virus	16
Rickettsial	9
Bacterial	20
Protozoan	3
Cestodes	3
Trematodes	1
Nematodes	3

But from a practical aspect, are the rats and mice living in and around our buildings a serious health threat? This question does not have an easy answer, and perhaps is best answered in terms of potential and actual risks.

In general, rodents, like other wild animals, insects and people are capable of carrying diseases directly into buildings. And they can spread or accelerate the spread of established pathogens from contaminated areas to uncontaminated areas via their droppings, feet, fur, urine, saliva or blood. Thus, the potential for a rat in a house, or a mouse in the local restaurant to transmit salmonella food poisoning, leptospirosis, or some other disease to people is real providing these pathogens already exist in the environment or the structure, or the rodents immigrated or were imported from an infected area. But the mere presence of rodents themselves does not necessarily indicate an imminent disease threat.

In the United States and other developed countries that enjoy organized sanitation programs, modern pharmaceuticals and professional pest management programs, the actual risk of disease transmission from rodents to humans with any degree of frequency is low. This is borne out when you consider the sheer numbers of mice and rats that have co-existed with humans over the past 50 years. In fact, the spread of disease by rodents is no longer the primary reason for rodent control programs in developed nations. IN underdeveloped countries that lack the benefits of modern technology and funding, the risks of zoonoses (diseases that can be transmitted to people by vertebrate animals) of all types are significantly greater.

Nevertheless, when we consider that we are surrounded by and truly co-exist with rodents, and that they are especially "well-designed vehicles" for disease transmission, we must remain vigilant and concerned about the potential for disease transmission. Epidemiologists are keeping a watchful eye on "emerging infections" and readily acknowledge the potential role of rodents in transmitting infections. This cane to light with the 1993 hantavirus/deer mouse outbreak. Thus, despite the low risk associated with rodent-borne diseases, we cannot afford to be complacent in our efforts to control rodents in populated areas.

Some of the more common rodent-borne disease of concern to people in urban environments such are relapsing fever, Lyme disease, plague, food poisoning, leptospirosis, hantavirus and others occur throughout the world. In the United States, plague is endemic (that is, constantly present) in ground squirrels and a few other non-commensal rodents throughout much of the western section of the United States. Rodents can also be health threats in livestock operations and in zoological facilities, where expensive animals are vulnerable to various rodent-transmitted pathogens.

We should not be alarmists about the occasional rodent around the home, yard, or restaurant, but the potential of rodents to transmit serious diseases cannot be easily dismissed. It is this potential threat

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that emphasizes the importance of the pest management professional in protecting public health.

For a more complete discussion of rodent-borne diseases, the reader should refer to any of the excellent references which provide greater details on this subject especially the publications of Norman Gratz.

RODENT BITES. Rodent attacks especially by rats on people is a topic that generates concern (and fear) among the public. Both rats and mice bite people regularly, especially in areas where rodent populations are high and they live in close proximity to people (multi-family housing, homes in older neighborhoods, residential areas abutting commercial areas or industrial sites, etc.). Most rat bites occur in lower socioeconomic areas of urban areas. Unfortunately, it is babies in cribs, the confined elderly, and the indigent homeless that are most vulnerable to foraging rats and mice. Statistics that provide an accurate number of rodent bites per year worldwide are difficult to obtain because most bites go unreported.

It is safe to state that in the large, highly populated cities of the world-especially those without formal rodent control programs-the number of rodent attacks on people is significant. In the United States, it is estimated that as many as 50,000 people are bitten each year by rats, the majority of them children. Neglected children and homeless people in infested areas may suffer serious wound from repeated attacks by one or more rats. In many cases, foraging rodents are attracted to the food residues on the hands, fingers or faces of babies or sleeping adults. The rodent may bite when attempting to consume the food residues completely from the flesh of the person, or the rodent may also consider the flesh itself food. Rodents also bite children when they attempt to pet or pick up the furry animals that has just joined them in bed.

RODENTS AND RABIES. Most people are fearful that rodents transmit rabies when they bite. Although rats and mice can carry the rabies virus, commensal rodents have not been shown to be infected with the rabies virus in wold populations, and thus are not of concern in rabies transmission to people. Consequently, the U.S. Public Health Service does not recommend rabies treatments in the cases of rat or mouse bites.

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Side Bar…..Rodents as Disease Vehicles

Although commensal rodents are not major threats to our everyday health, it is justified to be concerned over the potential for rodents to transmit diseases. By their very nature and design, rodents make excellent "vehicles" for harboring and rapidly transporting diseases. Below is a list of some of the reasons for this.

-Transporters and Elevators for Pathogens and Parasites. Rodents attract and harbor a wide range of ectoparasites such as mites, fleas, lice and ticks. Each of these parasites may itself carry pathogens such as the plague bacteria transmitted by the flea, or the typhus-causing bacteria transmitted by lice and fleas.

Understandably, these arthropods cause alarm when they attack people after rodents have been killed by control programs. Even without ectoparasites, rodents can directly transmit deadly germs because they can serve as reservoirs for many different types of microorganisms which will live inside their bodies and be excreted in their urine and feces.

Rats in city areas often dwell in the most unsanitary areas of the urban environment. Sewers, garbage dumps, abandoned dirty buildings, drainage ditches and back alleyways often serve as rat havens. Such areas may be laden with pathogenic microorganisms. When rats and mice disperse from these areas or emerge from the sewers into homes and buildings, they may virtually be acting as "germ elevators."

-Adaptability and Co-existence with Humans. Rodents are well adapted to living with or in close proximity to

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humans. They and their parasites share our homes, workplaces, restaurants, hospitals, schools, food manufacturing plants and virtually all other buildings. Rodents truly co-exist with us.

In our homes, they nest and sleep in the furniture where we relax, sleep and store our clothing, and they nest in our kitchens and inside appliances with which we prepare our food. Without us even realizing it, rodents can be touching or urinating on the food we eat and the clothes we wear next to our skin. Moreover, they establish nests in the air circulation systems in our buildings and offices, and use them as highways to travel from one part of a building to another.

In this way, their contaminated nesting materials, feces, urine, or hairs can be spread into the air we breathe throughout the structure.

-Planes, Trains, and Automobiles. Rodents fly with us, drive with us, and live on the ships, buses, trains, and trucks that transport us and our food around the globe. Remember, the commensal rodents originated in Asia, and now occupy most parts of the Earth. Their introduction to many parts of the world tool place via trading routes, first on the backs of livestock, then as stowaways in the grains and spices of early tradeships.

-Prolific Breeders. Inside our buildings where food, warmth, and harborage are readily available, and their natural predators do not have access to them, rodents can breed prolifically. If disease organisms are present within these populations, they can be rapidly and widely distributed to uninfected areas, people, and domestic animals.

-Home Ranges and Investigative Behavior. Rodents travel daily in three-dimensional forays from their nests. In buildings, they easily go from room to room and floor to floor depositing urine, feces, hair and other contaminants as they go.

-Body Parts and Excretion. In just one week's time, rats and mice produce hundreds of fecal pellets and deposit urine in thousands of areas. Feces and urine may contain millions of bacteria or viruses which, as a result of rodents' territorial and exploratory behaviors, can be deposited over many areas, contaminating food and general living areas.

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A Lesson in Norway Rat Behavior

Amanda Paskiet/PCT-Online

"The most important thing I've learned in the past 28 years is that rodents have one set of behaviors and PCOs have a set of their own. Rodents won't change their behaviors, so PCOs must change theirs," said Ted Bruesch, Midwest sales manager, Liphatech.

Bruesch used his expertise to discuss the behaviors of Norway rats at LiphaTech's Technical Symposium, held in September. According to the 28-year veteran of the industry, there are four key rat behaviors that PCOs can take control over.

A Good Hiding Place

The first key in Norway rat demeanor is its burrowing behavior. From a control standpoint, this is also a very important one. Bruesch described an incident he encountered where rats had infested a building that stored cottonseed. Rather than burrow in the soft fluffy cottonseed, the rats chose to burrow in the concrete floor underneath. "I've always found at least part of every infestation burrowed in dirt, so that's the first place I look for these critters, " said Bruesch.

Neophobia

Norway rats do not like new or unfamiliar places and objects. Many PCOs place bait stations or traps every 25 feet around the perimeter of a rat-infested area to solve a problem. Bruesch said this method is ineffective if the rats live in a crawlspace under a building. "Rats won't cross open baits to get to a bait station, even if the device is in their path," he said.

A Norway rat's neophobia (fear of new places or objects) also extends to their hatred of foreign

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objects--such as bait blocks or place packs--that are stuffed down its burrow. Bruesch said most of the rats will simply kick these objects out, presenting two problems: First, the rat is still alive and second, non-target animals or children might find the bait.

A Quiet Dinner At Home

Norway rats prefer to eat in their homes and will often take food back to their burrows to eat. Bruesch described an incident in where a friend of his mistakenly treated a rat infestation in a barn like a grain beetle infestation. He cleaned up first, which caused the rats to relocate from the barn to the house. One night, he awoke to see a Norway at trying to drag a sweet potato through a small hole in the drywall. "That potato was the size of a baseball and the rat was still trying to get it inside the tiny hole," said Bruesch. "That's just how much these rats like to eat in their homes!"

Social Classes

The last behavior Bruesch discussed was the Norway rats' system of social hierarchy. In a colony, there are dominant alpha rats, which get the best of everything to assure survival of the fittest. Betas are subordinate to the alphas and receive second best of everything. Last in the colony are the omegas, which receive whatever is left of anything. Hence, a PCO would be wise to eliminate the alpha rat first and work his way down the social ladder, said Bruesch.

If these four behaviors are kept in mind when controlling Norway rats, PCOs are certain to have success, according to Bruesch.

Baiting Rituals

Bruesch explained that because Norway rats prefer to eat inside their homes, he believes the best way to kill them is by directly baiting ground burrows with pellets. "The pellets resemble seeds, and in the wild, wind sometimes blows seeds into a burrow," said Bruesch. He compared a rat's reaction to finding seed-like pellets in their home to himself discovering a bakery truck parked outside his home. "Wind-blown seeds are like donuts on a platter to a Norway rat, and it will be more apt to eat them than to move the seeds out of the burrow," he said.

Using a metal basting spoon modified to fit inside the burrow, Bruesch usually loads the burrow with 4 ounces of pellets--the minimum amount required to treat one burrow. He recommends leaving the burrow open after the pellets are inserted. "I know this step runs counter to what it says on all the books but more often than not, this ends up scattering an infestation," said Bruesch. "The focus of a rat would shift from feeding to reopening its escape route, and in the process, they'll kick out a lot of bait."

Because of the odd shape of a Norway rat burrow, it is often difficult to get the pellets all the way down and out of sight. Bruesch said that if a technician returns to the burrow three days later and can still see pellets, the burrow probably has little or no activity in it. "On the other hand, if you can't see the pellets, it's safe to assume the rat has eaten them and the burrow should be re-treated," said Bruesch. He also suggested closing up all inactive burrows.

Failing Factors

If the baiting treatments fail to kill the Norway rats, there are usually three possible causes, Bruesch said. First, one individual rat may eat more than its share of the bait. Second, rats breed quickly and it may take less than a month for survivors to repopulate the space left by the recently departed. Third, subordinate rats may move in from the periphery and occupy vacated burrows. "For monthly treatments to be successful, re-treatments must occur at least weekly and continue until the entire population is dead," said Bruesch.

Trap-Shy

Norway rats are trap-shy animals, according to Bruesch. "However, the rat doesn't really know a trap is a trap. All it knows is that a combination of wood, plastic, metal and peanut butter bites hard," Bruesch said. "But what it doesn't know is that a trap with a different look, feel and taste also bites."

The best way to attract a Norway rat to a different trap is to get it to think of it as a "dinner table" by pre-baiting it and giving it three or four meals. "The hard part will be convincing the customer to have patience," said Bruesch. "But anyone can catch these rats with pre-baiting and patience."

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5 Basic Keys

Bruesch finished his lecture by explaining what he believes are five important keys to remember in rodent control:

-A PCO should know his rats and they're behavior. They're behavior will never change. A rat will always act like a rat.

-Know the correct rodent control product for the situation.

-A PCO should put whatever product he is using in the correct place. Until the product is in a place the rat is comfortable feeding, it will just be "stuff" sitting there.

-Make sure the correct amount of the rodent control product is used and maintain an interrupted supply of the product.

-Know the risks that can occur with rodent control at all times. Rodent control products are designed to kill, and there is always a level a risk involved.

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Wild Rodents Plus Fleas Equals Risky Business

Dr. Marco Metzger/Pest Control

Plague is a big concern PMPs may have when dealing with feral pests.

Rodents are a group of animals that make pest management interesting, challenging, frustrating and even dangerous. As if peridomestic rodents didn't already create enough problems in and around our homes, pest management professionals (PMPs) should be aware that these pests can also harbor a multitude of ectoparasites, endoparasites and diseases, some of which can threaten human health.

Plague is one such disease. Yes, this is the same disease that killed an estimated 25 million people (roughly a quarter of the European population) over a period of about 15 years during the infamous Black Death of Europe in the late 1340s.

Consider yourself lucky to be living in an age where social hygiene is good and modern medicine cures the majority of our illnesses.

Plague is one of the oldest diseases known to human history, but interestingly, is actually a disease of rodents. It is caused by bacteria that are transmitted through the bite of infected fleas or by contact with infected animal tissues. Unfortunately, these bacteria can also infect a variety of other mammals, including humans.

The disease cycle begins with bacteria circulating in the blood of an infected rodent. As fleas pierce the skin of their hosts to obtain a blood meal, bacteria are ingested and form a colony inside the flea midgut. Infested rodents frequently die from the disease, leaving their fleas without a food source. Starved fleas will attempt to feed on almost any warm-blooded animal. As feeding occurs, bacteria present in the throat area of the infected flea can be inadvertently injected into the body of the animal and lead to an infection.

Plague originated in central Asia and evolved with sylvatic (wild) rodents. Black rats and Norway rats, also of Asian decent and highly susceptible to the disease, spread with humans along land and sea trade routes and became the most important and most widespread carriers of the disease. As they expanded their range, diseased rats and their fleas mingled with and infected native animals. As a result, plague became established in many rodent populations around the world, particularly in the tropics, subtropics and warmer areas of temperate countries.

The port of San Francisco, California, was the first point of introduction of plague into North America, probably by way of clandestine black rats on ships. Within a few years, the disease reached native rodent populations and quickly spread throughout the western United States. Since 1925, all cases of plague reported in North America have been of sylvatic origin, while the black and Norway rats that originally brought the disease to this continent no longer seem to be involved.

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The sylvatic nature of plague in North America is unique and fundamentally different from plague ecology in the rest of the world. Because of this, plague in North America is usually referred to as sylvatic plague. IN the U.S., sylvatic plague infection has been recorded from mammals in 15 western states. The disease is maintained in populations of resistant (reservoir) rodent species that can harbor bacteria in their blood, but do not succumb to the infection. These populations create plague foci, from where epizootics originate. Epizootics are the equivalent of wild animal disease epidemics, and they generally occur in colonial rodent populations, such as ground squirrels and prairie dogs.

The disease spreads rapidly among these rodents, and may kill more than 90 percent of their population. Areas that experience epizootics of plague range from suburbs to grasslands to mountain areas. We still do not completely understand how to predict the onset of an epizootic. However, dense rodent populations increase the probability.

Large numbers of sylvatic rodents may become infected with plague bacteria annually, but only a few a major species are blamed for most plague transmission to humans. To give an indication of how entrenched plague is in the western United States, evidence of infection was fond in 76 species of five mammalian orders (mostly rodents) between 1970 and 1980.

There are approximately 2,500 species of fleas in the world, but most people are only familiar with the ubiquitous cat flea that infests our pet dogs and cats. As a general rule, most flea species are host-specific (they can only survive on one species of animal), and the most common hosts are rodents. Fortunately for us, most flea species are unable to transmit plague bacteria from one animal to the next, and many of those that can live in areas, such as deep in rodent burrows, that are inaccessible to most other animals. However, because plague does not cause death in susceptible rodents, their fleas will begin actively searching for a replacement food source. In the western United States, ground squirrel, chipmunk and prairie dog fleas are often competent vectors of plague bacteria, aggressive biters and plentiful due to the large populations of these rodents.

Plague in Humans

There are three ways in which plague bacteria can invade the human body. Bubonic plague is the most common and mildest form of the disease. It is characterized by swollen lymph glands (buboes) in the neck, armpit or groin.

Septicemic plague is the invasion of the bloodstream by bacteria leading to septicemia (blood poisoning). In these cases, disease symptoms generally occur two to six days after infection.

By contrast, pneumonic plague is the invasion of the respiratory system. Plague pneumonia is the most dangerous form of the disease for two reasons. First, it is one of the fastest acting human diseases, with almost 100 percent fatality in as little as tow to four days after infection. Second, in this form, fleas are no longer important because the bacteria can be transmitted by air-borne droplets, such as during a cough.

Besides characteristic buboes that may or may not develop, other symptoms of infection are not necessarily diagnostic of plague and may include a high fever (103 to 106 degrees Fahrenheit), headache, nausea, rapid irregular pulse rate and delirium. When diagnosed early, plague can usually be treated with antibiotics such as streptomycin and tetracycline, reducing mortality to less than 15 percent. However, if left untreated, mortality may be as high as 50 percent in bubonic cases and 99 percent in pneumonic cases. Human cases have occurred from sea level to nearly 9,000 feet elevation, but most cases are associated with foothill woodlands, inter-mountain valley grasslands and mountainous regions throughout the western U.S.

Between 1980 and 1997, 247 human plague cases were reported in the U.S. Of these 37 (15 percent) were fatal. Human cases occur with the greatest frequency in two regions--the Southwest (northeastern Arizona, southern Colorado, southern Utah and all of northern and part of southern New Mexico) and the Pacific (California, southern Oregon and western Nevada).

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However, the relatively low number of plague cases in the U.S. over the past 10 years and the sylvatic nature of the disease has allowed it to evade media attention. For the moment, plague has taken a "back seat" when compared to emerging infectious diseases, such as Lyme disease, hantavirus, arenaviruses or West Nile Virus, even though it is widely present in sylvatic rodent populations.

Many recreational areas throughout the western U.S., particularly in and around mountain areas, contain large populations of plague-positive rodents. For example, since 1970, nearly 50 percent of human plague cases have been contracted during recreational pursuits. In an attempt to lessen the chances of plague transmission to humans, management of vector fleas is done in areas of high risk (especially where wild rodents and humans closely intermingle). As a result of routine plague surveillance conducted by public health professionals, campgrounds are sometimes temporarily closed for plague treatment.

To ensure the safety of visitors, hand dusting of rodents burrows with insecticides and insecticide bait stations are the standard procedure for reducing the number of fleas. Bait stations apply a dose of insecticide to animals that come to feed on a non-toxic bait. Bait stations are useful in treating those rodents whose burrows cannot easily be located, such as chipmunks. Campgrounds are re-opened when the number of fleas present on wild rodents is reduced to an "acceptable level," which on average is less than one flea per rodent.

However, similar to recent changes seen in urban pest management, plague risk management is also under pressure to evolve. The growing concern with the impact of broad-spectrum pesticides on the environment has led to an increasingly integrated pest management in high-risk areas. Come of these approaches include habitat management (removing logs, trimming bushes, rodent-proofing trash bins, etc.) and new, flea-specific insecticides. Rapid suburban growth has resulted in ever-increasing numbers of people living in or near areas with active plague foci. Some "hot spots" include the foothills and mountains of the Los Angeles basin, the foothills and mountains of the Sierra Nevada and Cascade Mountains and the eastern slope of the Rocky Mountains.

With this growth, there has been a marked increase in the number of human cases, as well as an increased role of domestic cats as a source of human infection, including the pneumonic form of the disease. This growth also has created artificial habitat and food sources for adaptable rodent species, such as rock squirrels, California ground squirrels and prairie dogs. In turn, these species have increased in density.

By understanding the basic principles of rodent disease and following simple safety precautions, we can help keep all PMPs and their clients in good health.

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The Stray Bat Call

Dr. Robert Corrigan/PCT-Online

Late summer and early fall marks the annual period of stray bat calls to pest management and wildlife professionals in many parts of the United States. Why are these calls so abundant this time of year? How does a professional determine whether or not the bat is merely a stray bat or is part of an infestation needing to be managed? And what is the best strategy for dealing with the stray bat call? Let's examine these questions.

The reason so many bat calls come in late summer and early autumn is due to the life cycle and colony cycles of the "house-infesting" bat species. These include the big brown bats, *Eptesicus fuscus*; little brown bats, *Myotis* spp.; and the Mexican free-tailed bats, *Tadarida brasiliensis*.

Generally, bats give birth during May and June. Most young bats begin flying at three to five weeks of age. But learning to both fly and obtain food is a considerable task for young bats. Consider that the pup not only has to learn how to negotiate many different natural and structural obstacles, but it must also learn to capture and eat its food literally on the fly. And, it's doing all of this in the dark! Moreover, the young bat must learn the various navigational and biological factors enabling it to leave and return to the roost safely.

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Given these challenges, you might expect that any particular "graduating class of flying bats" will have youngsters making mistakes and erroneously flying into various open doors and windows of nearby buildings in the areas they are learning to fly and forage.

Disoriented young bats may also originate, however, from the same buildings in which they are born. This occurs when a nursery colony is established within a building. Young bats, attempting to learn the basics of going and coming, routinely miss exiting correctly. They also attempt to return to their family and roost though the human openings of the building (i.e., doors and windows) instead of through their "designated bat openings" that the rest of the colony is using. In addition to our buildings being in the midst of these "bat flight training grounds," bat sightings and encounters also increase during late August and September as a result of the break up and dispersal of the local summer nursery colonies.

MANAGING THE STRAY BAT CALL. Sightings and encounters of stray bats often cause concern and sometimes even panic among homeowners. This often happens when a parent is awakened by the screams of a young child frightened by the sound and shadows of something fluttering and swooping down around their bed in the darkness of the night. Shortly thereafter, we receive the calls to come and "get rid of the bat." Sometimes this is easy. Sometimes it is not. Let's examine a few ways of managing stray bat calls.

-If the homeowner is distraught or panicked, attempt to calm their fears by explaining that the bat is probably a lost and frightened young bat. The bat will not attack and rabid bats are rare. The bat will not bite anyone provided that no one attempts to handle it. It should be emphasized to the homeowner not to attempt to smash or kill the bat with a broom or a racquet. Doing so only increases the likelihood of a person contacting the bat and being bitten. (Of course, the same holds true for pest management professionals).

-If the bat's location is specifically known, instruct the homeowner to not lose track of the bat (if possible). If it disappears into some other portion of the home, then the homeowner has to live with the "fear" that the bat may reappear during the next several days.

Instruct the homeowner to contain the bat in one room by closing off all the doors and access points to other interior rooms. Then, open up any windows or doors in the bat's room to the outside and allow time for the bat to find its way out.

-If the bat fails to leave, you can either make a service visit and remove the bat and perform a bat infestation inspection, or instruct the homeowner on how to capture and remove the bat themselves.

-When the whereabouts of the stray bat is not specifically known to the client, it is not likely you will find the stray bat should you make a service visit, especially if it was a previous night's bat. In most cases, these bats have already found their way back out. The bat may also be resting, or is close to death from exhaustion and thirst in some obscure nook or cranny within the home. Conducting an exhaustive search (looking inside closets, within air circulation systems, furnaces, underneath appliances and furniture, etc.) of the home in these cases is occasionally productive, but many times the bat is never found. Still, some families will gladly pay to have someone conduct a thorough inspection and confirm that a bat is not hiding under any of the beds.

STRAY BAT OR BAT INFESTATION? Inevitably, stray bat events prompt the question from the homeowner as to whether this was a stray bat or if their home is infested with a colony. To determine this, begin by questioning the homeowner about the history of the home and bat activity. If this is the only experience with a bat inside the home, or if there have been a few sightings, most likely this is a stray bat incident. If the homeowner reports previous and repeated sightings and encounters with bats and/or of hearing scratching and squeaking noises in their walls, the home is a good candidate for containing a nursery colony. Still, this should be confirmed via a thorough inspection from April through September as follows:

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--If the attic is accessible, inspect the floor of the attic for bat droppings. If bats are present, they will usually be hanging and roosting directly above the droppings. Or, they may be hidden within a structural void nearby.

--Outside, if the building is being used as a summer nursery colony, the bats' emergence exits can be easily determined by inspecting along the ground next to the foundation for bat droppings. Many returning bats hang and defecate a time or two just prior to returning to their roost. By looking up above these droppings, the bats' openings or smudge marks reveal the emergence holes. A pair of binoculars will aid in getting a detailed look.

--If the actual bats are not seen during the attic inspection, but droppings and signs are found either inside or along the foundation, a dusk inspection of the roofline can be conducted. Either you or the homeowner can see if any bats leave the roost for their nightly feeding. Most bats leave the roost just before dark and can be easily seen and heard. Allocate about 30 minutes for a dusk inspection.

CAPTURING AND REMOVING STRAY BATS.
Performing a service visit to capture and remove a stray bat can be done easily and safely, providing common sense prevails.

--If the bat is flying around when you arrive, wait until the bat lands.

--Slowly approach the bat with a coffee or similar size can and a piece of cardboard.

--Slowly cover the bat with the can and slip the cardboard underneath the can to trap the bat inside. Some professionals will also bring along an insect collecting net and place the net over the resting bat. Or, to attempt to net a bat while it is flying around the room, the trick is to swing the net from behind the bat to prevent the pest from detecting the oncoming object and swaying to avoid it. This technique also helps avoid hurting the bat by swinging at the bat and hitting and hurting it with the framing of the net. Captured bats should be released outdoors and away from the property. Unless the bat was from a nursery colony from the house it was captured, it isn't likely to return.

--When performing stray bat removal services and bat inspections, safety considerations are important. Always wear a bump cap when inspecting attics. Leather gloves must be worn to protect your hands from bites. However, it is not necessary to wear large cumbersome or heavy gloves such as those worn by utility repair personnel. In fact, such gloves will not give you the dexterity you'll need to handle a bat without harming or crushing it. But, on the other hand, thin, skintight leather driving gloves do not provide enough protection. Simple calfskin gardening-style gloves or an old pair of winter gloves that fit snugly and give your fingers good and easy movement are best.

--Finally, to prevent further bat incidences, the client should be informed as to the importance of having their home pest proofed. This involves checking chimneys for caps and screening, inspecting fascia boards, repairing any loose flashing, inspecting door thresholds, gaps in window and door frames and other pest proofing repairs. These are all good opportunities to sell the ultimate and best aspect of integrated pest management: prevention.

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insecticide where ALL the cockroaches are harboring. Not enough effort was made in discovering every active harborage. Overlooking one site is enough--the customer will still see cockroaches. It is interesting to hear someone brag about how many hundreds or thousands of cockroaches they killed in that restaurant last night. But which is more important, how many cockroaches you killed, or how many you left active? Suffice to say, customers care more about the latter.

So what are the keys to eliminating a cockroach infestation in a commercial food facility? This article will examine the issue by asking and answering 20 questions that illustrate steps to success.

What is the basic rule to successful elimination of a cockroach infestation?

Investigate all the potential cockroach harborages to find and treat ALL of the active harborages.

Why do cockroach control efforts fail?

If a cockroach infestation occurs, it is because one or more active harborages--or sources--have been missed. For example, the author learned this lesson the hard way when working as a service professional. An institutional kitchen continued to experience cockroaches even after several visits. Each time, the kitchen was well prepared for service, and each time, few cockroaches could be found. On the third visit, the technician had the bright idea to check the items that were being wrapped in plastic bags in preparation for service. Sure enough, inside one meat slicer, more than 400 cockroaches were found. Several other "prepared" items were also infested.

I like to use wettable powders and "band in" the cockroaches. Eventually all the cockroaches will have to cross a treated surface, right?

The cockroaches may cross the treated surface but that doesn't mean they will die. It may take 30 to 60 minutes to many hours of contact with a treated surface in order for the cockroach to absorb a lethal dose. The age of the deposit and the presence of dirt and grease both play a key role in extending the contact time necessary for results.

But why use formulations designed to treat surfaces when cockroaches spend most of their time in cracks and voids? You want to treat where the pest lives rather than where it crawls. For example, a kitchen has 20 active cockroach harborages. You treat all the corners, baseboards, inside cabinets, behind sinks, etc. You see a few cockroaches, maybe even treat them, but how many cockroaches are you sure you have killed when you walk out the door? What if you flushed and inspected and found 19 of those 20 harborages? You vacuum, you bait, you treat voids with dust. When you walk out of the facility, you know that you have made an impact. This can happen, especially in moderate to severe infestations in which cockroaches end up in less-preferred harborages that are often difficult to find. But which would prefer to have--the situation where you might have left most of the infestation alive, or one where you are pretty sure you got them all?

Where do cockroaches go when poor cockroach control services are applied?

A person providing poor cockroach control services will typically treat those areas/harborages that are easy to see and reach. To find cockroaches in a facility being serviced in this manner requires an inspection mirror and attention to hard-to-reach areas. For example, the easy-to-see cracks in the rear of a cabinet will receive treatment.

The inspection mirror directed to the cracks behind the front edges of the cabinet commonly reveal cockroaches. Another example is false ceilings. Cockroaches often move up there--even though the ceiling is a less-preferred harborage--following repeated space treatments or "foggings" (as they are commonly misnamed). We can "train" cockroaches to go where we haven't treated. Look for those hard-to-reach areas to find overlooked sources of cockroaches.

What is the No.1 site in commercial kitchens that is most often overlooked but is the cause of most continued infestations?

Wall voids. Think about it: In a commercial kitchen, the water pipes and electrical wires give

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cockroaches free reign through the walls. Numerous cracks or openings are usually present in these voids. Dark, humid, warm wall voids are in close proximity to food and moisture. Why wouldn't cockroaches want to stay there in droves? If the wall voids behind the stoves, sinks and in the dishwasher are not drilled and treated, an important potential (and usually active) harborage is being missed. The author has been involved in a number of "unsolvable" cockroach infestations in restaurants where treatment of wall voids solved the infestation.

How should wall voids be treated?

In most cases, the voids should be drilled at a level of 4 feet or lower from the floor. Cockroaches will want to be near moisture and food which is generally lower in the wall. In severe infestations, drilling at the ceiling level as well as at the 4 foot or lower level is usually helpful. Each void should be drilled, usually at 16-inch intervals. Be professional and drill holes in out-of-sight areas or in straight, level lines that are evenly spaced. The use of a chalk line can ensure a level line of drill lines.

The use of dust insecticides is usually the best way to treat wall voids, although some professionals use an aerosol machine (e.g., AgrEvo's Actisol) containing the residual Conquer (Paragon Professional Products) and the IGR Gentrol (Zoecon Professional Products). The most important consideration is thorough coverage inside the walls. An electric duster can improve penetration of dusts as will the "aerosol" dust products TriDie and PermaDust (Whitmire Micro-Gen).

What about hallow block walls? Does every void need to be drilled in these too?

No. Since block walls have few holes for cockroaches to ingress and egress, only the voids to either side of plumbing penetrations or other such openings will require treatment.

Other than wall voids, what is the No. 2 area that is overlooked and serves as a source for continued infestation?

Electrical junction boxes and conduits serve as "bus depots" and "highways" for cockroaches around a kitchen and even to other parts of the building. In a recent case, the author spent an evening with a new service professional and visited a fast food restaurant. The manager of the facility pointed out two areas where cockroaches were seen. In the first area, the new professional was asked by the author what stood out in the area as a potential for cockroach activity. He correctly suggested the small refrigerator under the table. The refrigerator was pulled out and, no surprise: it was plugged into a junction box and conduit system. Inside the junction box were more than 100 cockroaches. These were removed by vacuuming and the area was baited with gel bait. If the refrigerator had not been pulled out (it takes effort) and the junction box cover removed (more effort), this source would not have been found and eliminated. This site and the other area pointed out by the manager (cockroaches living in debris under a table) were the only sources of cockroaches found.

Other than baits, how else can junction boxes and conduits be treated?

Dust insecticides are the best long-term choice for junction boxes. Be sure to use a plastic tip on the duster to avoid electric shock, or use one of the “aerosol” dusts. Only a very light amount of dust is needed and the dust should be directed into each conduit feeding into the box. Remove as many cockroaches as possible using a vacuum.

What is the No. 3 area that is overlooked?

The false ceiling in a kitchen is a less preferred harborage for cockroaches, but they will move up into it if the population grows too large or poor cockroach control practices are employed. The ceiling is further from food and water than most German cockroaches want to be from sustenance. When these insects are in the ceiling, they will usually be over an area where food and water is available — typically above the dishwashing area, a stove line, or in the bar area in the front of the restaurant.

How should false ceilings be treated?

False ceilings are tricky to treat because they are open spaces with few available cracks to treat. The first step

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is to inspect the ceiling to see which parts of the ceiling actually have activity. The effort is wasted if cockroaches are not even up there.

The application of an encapsulated insecticide to the wall surfaces above the ceiling in infested areas is the best overall procedure. Cockroaches have to come down into the kitchen to eat and drink, so they will have to crawl down the walls (or columns). They are more likely to sit longer on the wall above the ceiling where it is dark than below the ceiling (where it would be easier to treat). This additional time increases contact with the residual, thus improving results. It is always best, however, to remove as many cockroaches as possible from above the ceiling with a vacuum.

I have treated every potential harborage including wall voids, conduits and the false ceiling. Why does my customer still see cockroaches?

Something is being overlooked. Here are two examples: In one case, a storeroom continued to experience sightings of cockroaches but the service professional (the author) could find no activity on repeated visits. Finally, he decided to check the items being removed from the storeroom in preparation for service. Forty cockroaches were found living inside the ring on a large cardboard drum of powdered dish soap. This was obviously a less-preferred harborage but the cockroaches were there anyway. In a second case, every possible harborage had been treated in the salad prep area of a kitchen but cockroaches continued to be seen. Investigation by the author revealed hundreds of cockroaches living in the rim of the back side of several mirrors lying on a table in the middle of the prep area. No one had bothered to pick up the mirrors and turn them over. This discovery also solved the mystery of why cockroaches would be seen during banquets. The mirrors were used on the serving tables in the banquet rooms for the buffet line. The cockroaches were being carried out there in the mirrors and then carried back in after the function. No wonder the service professional could find no activity in the banquet rooms!

In these two cases, it was assumed that cockroaches would be found in the tables, the walls or other equipment in the area where they were seen. But they weren't. The cockroaches took advantage of being checked. The lesson: Try to look beyond the obvious and look at everything involved in the situation, including those items being carried in and out of the area where the insects are being seen.

What is the most important step in quick elimination of German cockroaches?

The use of a vacuum to remove as many cockroaches as possible helps to achieve zero cockroaches more quickly than any other single step. Still, vacuuming alone will not eliminate an infestation. An integrated approach is critical to success. Wouldn't your customer prefer to see a 50%, 60% or maybe even higher immediate reduction in his/her infestation? Vacuuming accomplishes this goal. Let's examine the rationale for vacuuming versus treatment for some of the situations that might be encountered in a kitchen. You pull out a cabinet drawer and see 100 cockroaches crawling in the open in the corner. Would it be better to spray these insects and potentially scatter them, or remove them all with a vacuum and carry them out of the facility with you? The more cockroaches you take with you, the easier it will be for your other treatment procedures to deal with the rest.

Are baits all that effective in a commercial kitchen environment?

Baits are an extremely effective cockroach control tool when used properly. But in order for a bait to work, the cockroach must find it and eat. To achieve total elimination using baits, every cockroach must eat the bait. Achieving this goal is often difficult at best, which is why baits must be combined with other treatment methods.

How should baits be applied for best results?

The gel and paste baits, such as Maxforce Roach Killer Gel, PT 320 Avert Gel Cockroach Bait, Drax Roach Bait and Blue Diamond MRF 2000 are ideal because they can be placed directly into active harborages where cockroaches will more likely eat the bait. The smaller the placements, the better the results. Large placements are wasteful. Remember, gel baits must be placed into cracks and not on surfaces in commercial food areas.

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Which dust insecticide is best to use?
Drione, boric acid and Tempo 0.1% dust are all effective at controlling cockroaches in food areas. Drione and Tempo provide the quickest knockdown and results, but boric acid products are more economical. Many professionals use boric acid on follow-up services after they have used Drione or Tempo on the initial service. DeltaDust is not yet labeled for food areas, but when it receives such registration from EPA, it will be ideal for use in areas of high moisture, such as wall voids in the dishwasher area.

A big problem in restaurant kitchens is the use of stainless steel sheets on walls. What is the best way to treat cockroaches living behind these?
Usually, the reason stainless steel is on a wall is because the wall has been damaged in some way (usually by excessive moisture), and it is easier to cover it with the steel than to repair the wall. Since moisture has been trapped behind the steel, the site becomes ideal harborage for cockroaches.

In most cases, the edges of the steel are accessible so they can be pried away from the wall and the space behind treated using a dust insecticide or an aerosol machine. In most situations, this process will need to be repeated every month because the moisture and heat will be detrimental to any insecticide used. Any cockroaches chased out need to be removed by vacuuming. It is also important to drill and treat the voids inside these walls. Often, professionals treat one or the other but not both. If the stainless sheets are attached in a way that the edges are not accessible, a hole can be drilled into the steel and a dent puller (obtained at an auto parts store) can be used to pull the sheet away from the wall. Enough space is now created behind the steel to allow dust or aerosol insecticides to be applied, ensuring thorough coverage.

The dishwasher unit is too hot and wet to treat with residuals, yet cockroaches love it. How can this be successfully treated?
Because no residual can stand up to the removed by vacuuming. This process needs to be repeated on every service.

What about sites such as drains, motor housings and inside ice machines? How should these be treated?
Drains will be treated in the same manner as the dishwasher unit — flush and vacuum on every service. The facility should be advised to clean such drains thoroughly and on a regular basis. Infested motor housings should be flushed and vacuumed. If cracks are available, a gel bait can be applied. Otherwise install a Maxforce station in the housing "box."
Ice machines can be treated only by vacuuming and the installation of a bait station in a secure site inside the machine where the station cannot fall into the ice-making machinery. In many cases, the station can be installed outside the vent holes where the cockroaches exit to go foraging for food.

Why should I use an IGR? Don't they take a long time to achieve results?
Yes, it takes many months for the IGR hydroprene (Gentrol) to affect a cockroach population.
The IGR, however, is not to help control the existing infestation. Gentrol is applied for the inevitable future introductions of cockroaches. When new cockroaches arrive, the nymphs and subsequent offspring of the arriving adults will contact the IGR and then mature into functional nonreproductive adults. This process keeps the population at a lower level, where it will be easier to eliminate them using other methods.
Research also suggests that IGRs stimulate feeding by some stages of German cockroaches to feed on baits.

CONCLUSION. The theory behind cockroach elimination is easy — find all the active harborages and treat them directly (using both insecticides and non-chemical techniques). In practice, the difficulty arises in finding all of the active harborages. If you stay in the business long enough, German cockroaches will find new ways to surprise you. Train yourself to look deeper and see all of the aspects affecting the situation, especially the items that are moving in and out of an area where cockroaches are being seen.
Good luck!

SIDEBAR…. Research Update: Finding Clues in Cockroach Droppings

Lisa Josef/PCT-Online

Cockroach droppings aren't very glamorous, says Dini Miller, a doctoral candidate at the University of Florida, Gainesville, but they contain important clues to why cockroaches behave as they do. For the past few years, cockroach fecal material, or at least chemicals within it, has been the focus of a study Miller is completing.

Miller has been working to show that fecal extracts contain an important trail pheromone that provides cockroaches with a "natural odor path" that shows them how to get from the harborage to a food and water source. "Instead of cockroaches wandering all over the house, no doubt they are following a path from hundreds of other cockroaches," Miller explained, "trails that have accumulated from cockroaches using the same route, back and forth, night after night."

Miller has used fecal extracts to document that cockroaches do in fact follow a trail to food and water sites, as opposed to searching randomly for them. In a 4 x 4 foot arena that is shielded from light, Miller has designed a comfortable harborage in a plastic cup. Two paths forming a vertex are painted on sheets of white paper, and then the cup is placed at the vertex.

One leg of the vertex is actually made up of fecal extracts; the other is simply water. "I pull the top of the cup off and the cockroach can choose which way it wants to go," Miller said. "They could go anywhere, but they will run the extract nine times out of ten." Cockroaches are tested individually, Miller explained, and the trick is to make sure the roach is calm before entering the arena. Cockroaches have five minutes to come out of the cup, and must be within one antenna's length of the trail at all times.

With further study, Miller observes, fecal extracts could have several practical uses in the pest control industry. "You could spray a trail of this against the baseboard, and cockroaches would follow that to a monitoring trap," she said. Or the extracts could be painted within or near plastic bait stations. Interestingly, Miller's research indicates that the trail pheromone she is working with may not be the same as the aggregation pheromone which induces cockroaches to rest together in a harborage. "This pheromone is something else," she said, which makes sense. "The aggregation pheromone is a volatile chemical that roaches detect in the air, then come and rest on it," she explained. "This one they have to be in touch with, and they keep moving along on it."

Miller hasn't identified what the trail pheromone might be made up of. For now she is completing her dissertation and plans to graduate in August. Her study, "Trail Following Behavior in the German Cockroach," is expected to be published later this year.

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IN THE NEWS……

Rat Problem Cited At Local McDonald's

Detroit Free Press/24 April 2001

A major rodent problem had forced the closure of an east side Detroit McDonald's Thursday.

City health officials said that an inspection conducted Monday at the McDonald's restaurant at Gratiot Avenue and Townsend Street uncovered evidence of a "heavy rodent infestation inside and outside" of the facility. Rat burrows were discovered around the trash bin and leading to the restaurant, and droppings were found inside the building, Local 4 reported.

The city gave owner and operator Errol Service an option of voluntarily closing the restaurant or being shut down.

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Employees at the building initially told Local 4 that the restaurant was closed while workers completed electrical repairs. Service later confirmed that his restaurant was closed while he addressed the infestation issue.

"We took immediate action and closed our store temporarily," Service said in a statement Thursday. "It is extremely important to us that we maintain cleanliness and food quality in our restaurants." Service said that he will meet the city's Friday deadline to eliminate the problem and expects to reopen.

(Pest Notes: Gives a new meaning to "Happy Meal.")

Neighbors battle rat-ridden house Authorities unable to find owner or get access to home

Phuong cat Le/ Seattle Post-Intelligence 20 April 2001

The first sign of trouble was the 8-inch rat scurrying through his living room.

Then, it was the occasional dead rat he'd find in his basement.

All signs pointed to a potential problem, and T.J. Obey believed the source was the house next door -- a modest Rainier Valley home overgrown with blackberry bushes that appeared to be vacant and filled with garbage.

Obey and another neighbor complained to the property owner and told her they spotted rats "the size of small dogs." They called the health department. They contacted housing inspectors.

That was last year.

Ten months after health inspectors first inspected the home and issued correction notices to the owner, Obey and his neighbor say they are still living in fear of a potential health problem next door.

"This is the one bad apple in the bunch that is going to cause some health problems," Obey said. Obey and neighbor Dori Cahn say they've been fighting an uphill battle to get the city and county to take action.

"How many other places are there around the city that aren't getting attention because there is no aggressive neighbor like me making lots of noise?" asked Cahn, who lives one house down from the vacant house and has complained to numerous city officials in the past year.

Indeed, rats bother more than just Cahn and Obey. Each year, the Seattle-King County Public Health Department receives about 1,200 to 1,500 complaints or inquiries, everything from trash accumulation in a neighbor's yard to rodent problems.

But most of the calls are related to rodents, said Jim Henricksen, Public Health's environmental health services supervisor.

Rodents can cause both economic and health concerns. They gnaw on doors, contaminate food with urine and feces and carry diseases. Incidents of rat-borne diseases are minimal, but the potential for such diseases make it important to control the rodent population, he added.

Obey said the rats that run through his yard or end up in his basement are so big even his cats are scared.

Public Health spokesman James Apa said the department is actively investigating the matter. Apa said he could not comment on specifics of the case.

But in a letter to Cahn last month, Public Health Director Dr. Alonzo Plough said inspectors have not been able to find the homeowner or get access to the home so it can be inspected.

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Barbara Shaman, who is listed as the property owner, could not be located for comment. Her listed number has been disconnected.

In July, health inspectors noted violations of the city's nuisance and rodent ordinance. They told the owner to correct the problem, but the notices were returned in the mail. Other attempts to call or locate the owner were unsuccessful.

So in February, inspectors obtained a court-issued warrant to enter the house. But the locksmith was unable to break the locks, so they could not enter the home.
Apa declined to say whether a second warrant had been obtained, but said his department is seeking evidence. The department collects evidence before it can refer a case for criminal prosecution. A violation could mean up to 90 days in jail or a $300 fine.

Generally, health officials say, inspectors try to educate the property owners about potential health or safety concerns. But if homeowners don't voluntarily fix the problem, inspectors can issue notices and ultimately refer the case for criminal prosecution.

But that doesn't happen very often. Only a small fraction of complaints end up in court, Hendricksen said.
From 1996 to 2000, for example, the Seattle Attorney's Office received 69 referrals for rodent control violations, Assistant City Attorney Michael Finkle said.

The Seattle City Council voted last year to increase civil penalties from $10 to $75 per day for housing code violations to encourage owners to maintain vacant buildings.

"It's not unlawful to have vacant buildings," said Bob Laird, compliance manager for Department of Construction and Land Use. "We know vacant buildings are going to exist, let's make sure they don't cause harm."

DCLU inspects vacant buildings each year to ensure that they are weather protected and closed to unauthorized entry, required by law. About 75 buildings are currently in a monitoring program, which required quarterly checks by inspectors.

Worried about rodent harboring in her neighbor's vacant house, Cahn first contacted DCLU in September. An inspector did not find violations at that time. Cahn complained again in March. The inspector returned to the house and found that the overgrown vegetation constituted a rodent hazard, Laird said. DCLU issued a warning April 5, giving the homeowner 21 days to fix the problem.

Obey thinks officials should be given the right to enter his neighbor's home, grab evidence and take the issue to court.

As he eyed his neighbors' house -- its mailbox crammed full, a no-trespassing sign on the front door -- he said, "I feel very disappointed that a problem of this nature could go on as long as it has."

The Cause of Mad Cow Disease Was Probably An African Antelope Imported into Britain.

New Scientist/14 April 2001

An African antelope imported into a British safari park in the 1970s was probably the origin of mad cow disease, says a New Zealand epidemiologist.

Roger Morris of Massey University has used computer modeling to analyze dozens of possible explanations for BSE. "The one that comes out on top of the list is the African antelope hypothesis,'" he says.

African antelopes are susceptible to spongiform encephalopathy, says Morris. He thinks a single infected animal used as feed for cattle could have triggered BSE. The BSE epidemic led to the slaughter of millions of cattle and the human form of the disease, vCJD, has killed more than 90 people so far.

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"The area of Britain where BSE started is the area where safari parks started in the 1970s," Morris told AFP. "I've got evidence that every step in the sequence could have occurred."

Spontaneous mutation

But other experts are not convinced. The main alternative suggestions blame scrapie-infected sheep being fed to cattle or a spontaneous genetic mutation in cattle.

The antelope theory "is not the most likely hypothesis, given what happened with the BSE epidemic," says John Wilesmith, head of epidemiology at the UK's Veterinary Laboratory Agency, who has worked with Morris. But he adds: "There are lots of complex theories for BSE and they're all worthy of examination."

Nora Hunter of the Neuropathogenesis Unit at the Institute for Animal Health in Edinburgh agrees the idea is interesting but says: "There are numerous other possibilities and it will be very hard to prove."

Single Strain

A wildlife source of BSE-causing prions would explain why the epidemic in the UK was unique and caused by a single strain of prion, Morris says.

The evidence "strongly favors" the idea that a wild animal of some kind was responsible, he says, and while an infected antelope is the most likely cause other animals, for example lions, can also develop a TSE (transmissible spongiform encephalopathy).

One difficulty with Morris's theory is that a wild antelope suffering from a TSE has never been identified. But this is not surprising, he says, as an afflicted antelope would rapidly fall prey to lions or hyenas.

Counting Sheep

Morris discounts the mutation hypotheses, which was favored by the UK's official inquiry into BSE, published last year. If a spontaneous mutation was to blame, "you would expect BSE to have cropped up sporadically in the past in countries with much larger cattle populations," he told New Scientist in November 2000.

The inquiry report rejected suggestions that changes to the way sheep are rendered allowed scrapie to cross to cattle and Morris agrees. Other countries have scrapie and similar rendering practices to Britain but none has had a native case of BSE, he points out.

However, Wilesmith favors the hypothesis. "The factor that distinguishes Britain from lots of other countries is that we have a large sheep population. Our ration of sheep to cattle is uniquely high. A scrapie-like agent seems the most likely explanation," he says.

Pressure Cooker

One legacy of the BSE epidemic is the difficult task of destroying the infectious prions from BSE-infected carcasses, but a Scottish company believes they have now found a way.

Prions resist standard sterilization but Waste Reduction Europe has adapted a US technique which involves pressure-cooking carcasses with sodium hydroxide to 1,500 degrees centigrade.

This destroys the prions and converts the carcasses into aqueous solution that can be safely disposed of in a sewer, the company says.

Somehow, This Cop's Work Doesn't Bug Him

John Marzulli/New York Daily News

In the film "The Silence of the Lambs," when a moth's cocoon is discovered in the throat of a murder victim, the FBI consults an entomologist at the Smithsonian Institution to identify the moth.

The NYPD has yet to match wits against a Hannibal Lecter-inspired killer who leaves behind insect clues. But should the need arise, they won't have to contact

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the Bronx Zoo or a museum; they can simply reach out for the man they affectionately call "Bugsy."

Detective Henry Mulzac of the crime scene unit is a board certified entomologist and got his nickname because, quite frankly, he knows bugs.

"that was a Death's Head Sphinx Moth," Mulzac said matter-of-factly of the clue in the Anthony Hopkins' film. "On its thorax it has what looks to be a skull."

Inside a file cabinet in his Queens office, Mulzac, 46, has two specimen boxes containing dozens of preserved flesh-eating beetles and flies recovered from corpses. Among them is a 3" long Bessie Beetle-courtesy of a body found in Van Cortlandt Park in the Bronx-that may be best viewed on an empty stomach.

"New York City has real abundant insect life," Mulzac said. "I use these for teaching purposes to help detectives familiarize themselves with what they might see at a crime scene and why they are there," Mulzac said.

Like the advances DNA technology has brought to criminal investigations, forensic entomology-using the study of insects in an investigation-is advancing beyond merely a tool to estimate the time and place of death. Now, it's being used to catch murderers and rapists as well.

And someday, Mulzac predicts, devices using ultrasensitive beetle antennae-which may be more effective and safer than cadaver-sniffing dogs-will be used to detect bodies inside collapsed buildings.

Mulzac's passion for bugs began when he was about 8 years old, after his older sister encouraged him to collect and identify insects for a summer science project.

He ultimately joined the junior entomological society at the American Museum of Natural History and was soon raising honeybees on the roof of his parents' brownstone in Bedford-Stuyvesant, Brooklyn.

As a teen, Mulzac was often called upon by the Parks Department to remove swarms of honeybees from traffic lights and trees.

After a stint with the Peace Corps in Belize teaching Mayan Indians how to raise honeybees, and a brief bee-breeding gig in Louisiana, Mulzac wanted to return to New York.

His father, a firefighter, recommended the benefits of Civil Service. So Mulzac took the police exam and became a cop in 1981.

Merging entomology with police work was not his initial intention, but his background did come in handy.

There was the time when, as a young cop, he was at the scene of a badly decomposed body in a Brooklyn apartment. The cops, except for Mulzac, were horrified by the sight of what looked like the corpse furiously kicking under the blanket.

"It was the mass of migration of maggots," Mulzac said. "when the maggots reach their full development, they leave the remains in a southeasterly direction away from the body and go about 3 yards away to pupate.

"It's never a pleasant thing to look at or smell, but I understand the process," he explains.

Mulzac's superiors knew of his background, and his ability to correctly answer the question "Can you tell how old a maggot is?" landed him in the elite investigative unit that collects and documents evidence of violent crimes.

"There is no way of us excluding our lives from insects," Mulzac said. "Insects are syanthropic, they live in close proximity to us. It's fascinating that they can sometimes help us solve crimes."

In a real-life case reminiscent of "The Silence of the Lambs," Mulzac last year was asked to analyze insects on the burned remains of a woman found
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under the Williamsburg Bridge. She was the apparent victim of a serial killer.

"If the body has been immolated, it will be a long time before flies infest the body. So if a maggot is there, it would show that somebody tried to burn what were already decomposed remains," he concluded.

"I determined the [the insects] were not necrophagous. They were ordinary house flies."

Insects found at a death scene can tell a forensic entomologist like Mulzac how long the body has been where it was found, or whether the body was dumped there. Flies attracted to bright sunlight should not be on a body found in a shady area, he explained, unless the body was moved.

Mulzac's partner, Detective Maureen McMahon, said there are other benefits to having an entomologist in the unit.

"People bring in bugs from their homes to see if they're termites or carpenter ants and how to get rid of them," she said.

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Opinions in Pest Management

Forecast: Hot, Wet, Chance of Cataclysm

Mitch Tobin/ Arizona Daily Star-11 April 2001

A warmer and wetter climate in the Southwest during the next century could spawn flooding, tropical diseases and energy shortages, according to a new study from government and UA researchers.

Climate models used in the study predict the region's average temperature will rise 4 to 5 degrees F by 2030, and 7 to 12 degrees F by 2090. Annual precipitation in parts of the Southwest could double, with winter rainfall increasing up to 0.2 of an inch per day by the year 2090.

Although the study's authors believe the Southwest generally will be hotter and wetter because of the global warming phenomenon, they caution that the effects of vegetation, human health and the region economy are clouded by uncertainty.

For example, the region's scant water supply might be boosted by heavier winter rains. But if temperatures are higher, evaporation will also be greater. Determining where the increased precipitation will fall, and whether it will come down as snow or rain, also are tough to predict.

"There's less and less certainty when you get down to a small region, particularly a region with complex weather like the Southwest," said UA geographer Andrew Comrie, on of the 40 contributors to the report.

The study is the first to take a comprehensive look at how global climate change might affect a variety of economic and environmental issues in the Southwest, a region already undergoing rapid and profound changes because of its swelling population.

U.S. Census figures included in the report project that 13.5 million more people will live in the six-state region by 2025, an 82% increase.

Principal investigator William Sprigg said global warming will probably increase the frequency of the El Nino weather pattern, when warmer temperatures in the central Pacific typically cause wetter winters in the Southwest.

At the same time, weather observations from the past century and studies of tree rings from the past millennium have revealed that the Southwest periodically suffers severe draughts lasting many years. Such dry spells will eventually return, the study cautions.

"We've got rock-solid data on those things. It's not a figment of someone's imagination that the drought occurring in this area in the 1950s was pretty serious," said Sprigg, deputy director of UA's Institute for the Study of Planet Earth.

The study says detailed projections of climate change are difficult to make on their own, and their

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impact will only be compounded by policy and population shifts. But it warns that extremes in weather are inevitable and should be part of the region's long-range planning.

Warmer temperatures could allow tropical, mosquito-borne diseases from the south, such as malaria, dengue fever and encephalitis, to migrate north into the Southwestern United States.

Precipitation and temperature changes likely will affect the prevalence of valley fever, an illness common in desert portions of California and Arizona that is caused by a soil fungus. But "the jury is still out" on what conditions make the illness most prevalent, Comrie said.

Hantavirus, a disease endemic to the Southwest that is spread by rodents, may become more common because it tends to ride during the El Nino cycle.

The study's other findings include analyses on these topics:

-Ranching. More rainfall may increase how much livestock a piece of land can sustain, but that may be offset by a more variable climate.

-Mining. Higher rainfall may increase the risk that storage basins overflow, posing a contamination threat.

-Urban areas. Increased flooding may damage roads, sewage systems and other infrastructure. Rising temperatures may intensify the "urban heat-island effect"- in which city centers stay hotter than surrounding areas because of the prevalence of asphalt and buildings.

-Energy. Hotter weather would tax cooling systems and energy supplies. But more rain might increase energy from hydroelectric dams.

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On The Web

Iowa State University Entomology Image Gallery - A pleasingly vast and fully searchable database of insect imagery, which also includes some video files. The pictures are large, and you can browse through the collection with or without thumbnails, which is helpful. Among the sections not to miss is the virtual grasshopper - though you'll need a recent version of QuickTime to see it in all its glorious 360-degree technicolour. The images are arranged in categories like "beetles", "lice" and "butterflies and moths", though there are some big gaps - a lack of any bees, wasps or ants for example. It's OK though, because the image gallery is part of the much larger Entomology department website, which has information (though not necessarily pictures) on just about every insect there is.
http://www.ent.iastate.edu/imagegallery/.

Introduction to forensic entomology - Forensic entomology is the application of the study of insects and other arthropods to legal issues. The stages of the blowfly life cycle can determine time of death of a corpse, for instance. This site covers such subjects as what happens to a corpse after death, how wasps have been used as murder weapons, how blowflies in the genitoanal region are a sign of sexual assault before death. There are 27 case histories showing how insects led to a conviction: how chigger bites convicted a man of murder, how weevil larvae inside cockleburs on a ski mask convicted a rapist. A good bibliography of journal articles is in the process of compilation. A fascinating depiction of a little-known area of scientific interest.
http://www.uio.no/~mostarke/forens_ent/introduction.shtml

University of Florida Book of Insect Records - As its name suggests, this site names insect champions and documents their achievements. Started in 1994, the chapters are contributed by graduate students in Insect Ecology at the University of Florida. Each chapter deals with a different entomological category, for example 'fastest flyer' and the rather intriguing sounding 'most spectacular mating'. So if you wanted to know which insect is the least specific sucker of vertebrate blood or has the shortest sexual life cycle, now's your chance!
http://ufbir.ifas.ufl.edu/

Vector-Borne Disease Of The Month

East African Trypanosomiasis

CDC/NCID

What is African trypanosomiasis?

There are two types of African trypanosomiasis, also called sleeping sickness, named for the areas in Africa in which they are found. East African trypanosomiasis is caused by a parasite named *Trypanosoma brucei rhodesiense* (tri-PAN-o-SO-ma brew-see-eye rho-dee-see-ense). In the United States, twenty-one cases of East African trypanosomiasis in travelers to Africa have been reported since 1967.

How can I get East African trypanosomiasis?

Through the bite of an infected tsetse fly, found only in Africa.

Is East African trypanosomiasis a serious illness?

Yes. If untreated, death will occur within several weeks to months.

What are the symptoms of East African trypanosomiasis?

A bite by the tsetse fly is often painful and can develop into a red sore, also called a chancre (SHAN-ker). Fever, severe headaches, irritability, extreme fatigue, swollen lymph nodes, and aching muscles and joints are common symptoms of sleeping sickness. Some people get a skin rash. Progressive confusion, personality changes, slurred speech, seizures, and difficulty in walking and talking occur when infection has invaded the central nervous system. If left untreated, infection becomes worse and death will occur within several weeks or months.

How soon will I have symptoms of East African trypanosomiasis?

Symptoms occur within 1-4 weeks of infection.

Can I take a medication to prevent East African trypanosomiasis?

No. Neither a vaccine nor recommended drug is available to prevent East African trypanosomiasis.

What should I do if I think I have African trypanosomiasis?

See your health care provider who will order several tests for the parasite. Common tests include blood samples, a spinal tap, and skin biopsies, especially if you have a chancre.

What is the treatment for East African trypanosomiasis?

Treatment should be started as soon as possible and is based on the infected person's symptoms and laboratory results. Medication for the treatment of East African trypanosomiasis is available through the CDC. Hospitalization is necessary for treatment. Periodic follow-up exams, including a spinal tap, are required for 2 years.

Once infected, am I immune to East African trypanosomiasis?

No. You can get reinfected.

Where can you contract East African trypanosomiasis?

East African trypanosomiasis can be contracted in parts of Eastern and Central Africa, including Uganda, Kenya, Tanzania, Malawi, Ethiopia, Zaire, Zimbabwe, and Botswana. Areas where infection is contracted are largely determined by the infected tsetse fly and wild animal population. See the map for areas where East African trypanosomiasis can be found.

Who is at risk for contracting African trypanosomiasis?

East African trypanosomiasis is usually found in woodland and savannah areas away from human habitation. Tourists, hunters, game wardens, and other persons working or visiting game parks in East and Central Africa are at greatest risk for illness.
How can I prevent African trypanosomiasis and prevent other insect bites?

- Wear protective clothing, including long-sleeved shirts and pants. The tsetse fly can bite through thin fabrics, so clothing should be made of thick material.
- Wear khaki or olive colored clothing. The tsetse fly is attracted to both bright and very dark colors.

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- Use insect repellant. Though insect repellants have not proven effective in preventing tsetse fly bites, they are effective in preventing other insects from biting and causing illness.
- When sleeping, use bednets.
- Inspect vehicles for tsetse flies before entering. Don't ride in the back of jeeps, pickup trucks or other open vehicles. The tsetse fly is attracted to the dust that moving vehicles and wild animals create.
- Avoid bushes. The tsetse fly is less active during the hottest period of the day. It rests in bushes but may bite if disturbed.

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STILL AVAILABLE

DSCP-WCSO has produced two informational CDs: Stored Product and Facility Pest Management and Fresh Fruit and Vegetable Pest Management. Each contains a variety of information concerning specific areas of pest management presented in an easily accessible format. If you are interested in receiving one or both CDs please give us a call or send an email.

DSCP-WCSO has produced several pest fact sheets addressing identification and management of several common stored product and facility pests. For more information or a listing of available sheets, please give us a call.

Parting Shots.....

That's all for now. Remember we are here to address your pest management concerns. Give us a call at DSN 686-8122, commercial (510) 337-8122 or drop us a line at paa5245@exmail.dscp.dla.mil.

Pests of the Month

See if you can identify the following pests. Last month's pests: A) *Aedes albopictus*, B) Tsetse Fly, C) House fly.