Earlier this year, the National Pest Management Association (NPMA) and the University of Kentucky surveyed U.S. and international member companies about the state of bed bug resurgence. The findings presented here suggest a growing global pandemic that necessitates urgent action by stakeholders.
BED BUGS…

are a hot topic these days throughout the news media and the industry alike. While most industry observers agree that infestations are increasing, the magnitude of the problem and its international implications lack definition. With its enormous customer base, the global pest management community is uniquely equipped to provide such insights. In a sobering report from almost 1,000 companies, this study shows that bed bugs are escalating worldwide, and that society is ill-prepared to deal with the consequences.

SURVEY PARAMETERS

Two online surveys were developed: the first consisting of 43 questions aimed at pest control companies in the United States; the second containing 34 questions for companies operating internationally. Both questionnaires covered topics ranging from frequency of bed bug infestation, to management methods, to business practices. Questions were formatted either as open-ended or closed-ended (fixed) responses. The internet surveys ran from January to April, 2010 with a few reminders sent out during the four-month response period. Letters requesting participation were emailed to approximately 6,000 U.S. and 900 international pest management companies, resulting in 521 and 429 completed surveys, respectively (950 total responses).

Respondents from 43 countries represented firms ranging in size from fewer than 10 individuals to thousands of employees. Worldwide distribution of respondents is shown in Figure 1a, with a regional breakdown for the U.S. shown in Figure 1b. After the U.S. which had 521 respondents, the greatest number of completed surveys came from Latin America [Mexico, Central America, South America and the Caribbean] (208 respondents), Europe (113) and Canada (64), followed by Asia (26) and Africa/Middle East (10). Additional regions (denoted as “Other” on graphs) included Australia (4) and various smaller markets with fewer responses. Respondents from most regions of the world characterized their principal service sector as “urban,” followed usually by “suburban,” then “rural.” Among U.S. firms, the average ratio of work performed was 60% “residential” and 40% “commercial,” elsewhere in the world, however, commercial work exceeded residential.

QUANTIFYING THE RESURGENCE

The first series of questions examined the extent to which bed bugs are increasing throughout the world. An overwhelming 95% of U.S. respondents indicated their company or organization encountered a bed bug infestation in the past year, with similarly high frequencies reported for Canada (98%), Europe (92%) and Africa/Middle East (90%). The majority of respondents also encountered bed bugs during the past year in Mexico/Central America (80%), Asia (73%), and South America (59%). A higher percentage of respondents across regions reported encountering bed bugs at least once in the past year vs. “over five years ago” or “over 10 years ago” (Figure 2). When asked if incidents of bed bugs in their country/region was increasing, decreasing or staying about the same, a higher percentage of respondents from Latin America (including Mexico/Central America and South America) felt infestation levels were staying “about the same,” relative to those dealing with bed bugs elsewhere in the world (Figure 3) (see subsequent section on ‘Controlling Infestations’ for a possible explanation of this).

Many respondents had opinions as to why bed bugs are increasing—most often mentioned were increased travel, more immigration, changing pest control products and methods, and resistance to available insecticides. Another factor noted by many respondents throughout the world was a lack of societal awareness and precautions (e.g. inspecting one’s bed or shunning discarded furniture). Several also mentioned the need for more training within the industry. As expected, many respondents also blamed...
the global resurgence of bed bugs on the loss of once-available more effective insecticides.

Other factors mentioned as contributing to the resurgence included:

- Overcrowding of cities, leading to poor hygiene and sanitation
- Unregulated sale, donation, importation and smuggling of second-hand clothing and mattresses
- More clutter and belongings in which the bugs can hide; conducive building and decorating practices, and transience and turnover of occupants
- Denial/lack of incident reporting by tenants, workers, landlords, hotel or business management, universities, etc.
- Economic expansion in developing countries, enabling more people (living with bed bugs) to travel
- Soldiers returning home from conflicts in Africa, Iraq and Afghanistan
- Global health officials focusing their efforts on disease vectors rather than bed bugs

- Changes in indoor treatment for disease-carrying mosquitoes, including reliance on pyrethroids and short-lived ULV applications that are less effective against bed bugs
- A worldwide decline in preventive inspections/treatments of hotels, apartments, etc. for pests including bed bugs
Changing lifestyles, resulting in greater reliance on communal laundries rather than washing items at home.

A global increase in secondary hosts, including rodents, poultry, dogs and cats.

Whatever the reason(s), the statistics clearly show that bed bugs are increasing throughout most of the world, which comes as no surprise to professionals in the pest management industry. In a previous survey of U.S. pest control firms (Potter 2008a), 6% of respondents said their companies performed more than 100 services for bed bugs during the previous year. In the more recent survey, conducted two years later, 20% of U.S. respondents reported their company doing more than 100 bed bug jobs last year and 7% reported doing more than 500. Other areas of the world where many respondents reported doing hundreds of bed bug jobs last year included Africa/Middle East (60% of respondents), Canada (37%), Asia (20%), and Europe (13%).

**SHOWING UP EVERYWHERE**

Bed bugs are appearing almost everywhere, from homes to hospitals to high-end clothing stores. In the U.S., the greatest percentage of respondents said they’ve encountered infestations in apartments and condominiums (mentioned by 89%), single family homes (by 88%), and hotels/motels (67%). Several also said they found bed bugs in college dormitories (mentioned by 35%), homeless shelters (31%), nursing homes (24%), office buildings (17%), hospitals (12%), and primary/secondary schools (10%). When U.S. firms were surveyed a few years ago, half as many respondents found them in hospitals and schools, and less than 1% mentioned finding them in office buildings.

Other ‘atypical’ places where U.S. respondents reported finding bed bugs included public transportation (by 9%), laundries (5%) and movie theaters (4%)—as well as in churches, day cares, libraries, summer camps, hostels, furniture and retail stores, restaurants, locker rooms, dressing rooms, prisons, fire and police stations, moving vans, ambulances, funeral homes, doctor’s offices, and dialysis clinics. Another lengthy list of places where bed bugs are being encountered was provided by other respondents around the world (Figure 4).

Bed bugs are reappearing worldwide in every imaginable location.
The resurgence of bed bugs in such varied places should not be too surprising. In the 1930s and ‘40s, infestations were common in hospitals. Entire sections of seating were infested in movie houses. Bed bugs also were common years ago on trains, buses and taxicabs. In Sweden in the 1930s, almost half of all moving vans inspected had bed bugs, and a subsequent survey in Iceland showed that bed bugs were often found inside televisions and radios being serviced by appliance repair shops (Potter 2008b). The remarkable ability of this pest to “hitchhike” from one place to another means they can materialize almost anywhere—from a restaurant booth to a blood pressure cuff.

When asked if they felt there was a correlation in their country between bed bugs and poverty, respondents to our survey were split, with differing opinions by region. In the United States, for example, 55% of respondents said that “problems tend to be worse among the poor” while 45% said “all citizens are equally affected.” A wider discrepancy occurred amongst respondents from Europe, with 77% insisting that bed bugs affected all citizens equally regardless of socio-economic standing. Nowadays, even five star hotels and high-end clothing stores are susceptible to infestation, but historically the poor have suffered the most from bed bugs. This pattern, unfortunately, shows signs of repeating with the resurgence of the pest. Individuals from lower socio-economic groups cannot afford to hire a professional to handle an infestation, nor are they as willing to discard infected items.

PUBLIC ATTITUDES

When U.S. firms were asked to describe the feelings of clients who have had bed bugs, 99% of respondents felt their customers were “upset and concerned,” with 77% saying such customers were “very upset and concerned.” Similar distress over bed bugs was echoed around in the world (Figure 5). Conversely, more than half of respondents in the industry (62%) believed that health and government officials are “not very” or “not at all” concerned about applying insecticides to control their bed bugs. More than half (51%) of U.S. respondents further estimated that 50% or more of their customers tried to treat their problem themselves before calling a professional. Pest control firms reported seeing many ineffective and potentially

bitten by bed bugs is no worse than being bitten by ticks or mosquitoes. This rationale overlooks the fact that in the developed world, ticks and mosquitoes bite and breed mostly outdoors. Bed bugs, however, dwell in one of the most intimate spaces of the home environment; the bed. Dismissing the gravity of bed bug resurgence on the basis that these pests are unproven disease vectors ignores the pain, suffering and emotional toll inflicted on their victims.

Bed bugs are so reviled that people seem willing to do anything necessary to eradicate the pests. Most (93%) of respondents in the U.S. felt their customers were “not very” (31%) or “not at all” (62%) concerned about applying insecticides to control their bed bugs. More than half (51%) of U.S. respondents further estimated that 50% or more of their customers tried to treat their problem themselves before calling a professional. Pest control firms reported seeing many ineffective and potentially
dangerous measures used by do-it-yourselfers, including ammonia, bleach, fire, smoke, kerosene, wasp spray, and bug bombs, as well as professional-use pesticides bought on the internet. As bed bug victims become more desperate, serious injury may result from such applications, especially among those who choose not to hire a professional. These types of behaviors suggest an increasing need for public education on the subject.

**CONTROLLING INFESTATIONS**

The majority of respondents from the U.S., Canada, Europe, Africa and Australia felt that bed bugs are difficult to control—more so than cockroaches, ants and termites (Figure 7). In the U.S., 76% found bed bugs more difficult to control than ants (considered “most difficult” by 13% of respondents), cockroaches (by 9%), and termites (by only 2%). These responses indicate a remarkable shift in thinking among industry professionals, most likely due to availability of effective insecticides for ants, cockroaches and termites. Interestingly, bed bugs were not deemed so difficult to control in Asia, Mexico, and Central/South America. It’s worth noting that in these places, organophosphates and carbamates are still available for use against bed bugs (Figure 8). These products generally perform better against populations resistant to pyrethroids, an increasingly common finding throughout the world (Romero et al. 2007, 2009, Karunaratne et al. 2007, Kilpinen et al. 2008, Lilly et al. 2009, Fang et al. 2010).

The average amount of time spent on an initial bed bug service ranged from less than 30 minutes to more than five hours. In the U.S., 92% of respondents said their company spends more than an hour on the initial service while half (50%) said they spent more than two hours. In most countries/regions, the average number of treatments needed to get an infestation under control was two to three (2.5 in the U.S) although less than two applications were typically needed in Mexico and South/Central America. In a previous U.S. survey (Potter 2008b), four or more treatments were often needed when battling bed bugs in cluttered environments such as apartments—a point worth remembering when pricing bed bug work and educating customers on the need for cooperation.

Most companies throughout the world are currently relying on visual inspections to find bed bugs (Figure 9B). More than a third (36%) of those surveyed also mentioned using glue traps. While glue traps are occasionally effective, their reliability in detecting bed bug infestations is poorer than for such pests as cockroaches.
and spiders. Other inspection methods being employed (especially in the U.S., Canada, Australia and Europe) include canine scent detection dogs, dish-shaped “pitfall” traps placed under bed legs, and traps using heat and/or carbon dioxide. Interestingly, 31% of respondents from Canada and 17% from the U.S. said they have used a bed bug detection dog owned by the company or sub-contracted through a handler. Worldwide, however, there still is great need for effective, efficient and affordable tools for detecting bed bugs. While many such tools are anticipated, it remains to be seen how useful they will be to the industry.

When respondents throughout the world were asked which methods they routinely used to control bed bugs, the greatest number (75% worldwide, 85% in the U.S.) mentioned insecticide sprays; dusts were also a popular response (59% worldwide, 74% in the U.S.). Other commonly used methods included laundering (mentioned by 69% of all respondents), disposal of infested items (by 51%), and encasing of beds with a bed bug-excluding cover (used by 45% worldwide, 66% in Canada and 76% in the U.S.). Vacuuming, steaming and fumigation were also mentioned, and to a lesser extent, heating or freezing infested rooms or belongings. Other miscellaneous measures mentioned by small numbers of respondents included late-night inspections, exclusion/sealing of cracks and crevices, duct tape, brushing or using a knife blade to extract eggs and bugs, exposing mattresses, etc. to the sun, fogging, insecticide-treated paint, ozone, enzymes and ultrasonics.

TREATING BEDS
The majority of respondents around the world (71%) said their company typically treats bed bug-infested beds with insecticides. Of the 81% of respondents in the U.S. that use insecticides for infested beds, 75% treat both the mattress and box springs. The fact that most companies are spraying beds is understandable—but may be problematic, especially given the sensitivity of this area.

In recent decades leading up to the resurgence of bed bugs, most pest managers have been reluctant to treat a bed with insecticides. Due to the bed bug’s habits, pest control professionals have begun treating spaces in the home that were previously left untouched, increasing the likelihood of pesticide exposure. Instances of misuse or perceived misuse may likely increase as greater amounts of pesticide are used to combat infestations.

What PCOs Expect from State Regulatory Agencies
By Liza Fleeson, Virginia Department of Agriculture and Consumer Services, and Tim Drake, Clemson University. On behalf of the Association of Structural Pest Control Regulatory Officials

In the recent NPMA Bed Bug Survey, it was asked if there are any resources or actions that could be provided by state pesticide regulatory agencies to assist with solving the US bed bug problem. A significant percentage of those responding (67%) indicated that they believed regulatory agencies could have some positive impacts if resources were devoted to several different strategies at the state level. These suggestions for state assistance typically fell within one of four broad categories. These categories can be characterized as consumer education and outreach, industry training and education, regulatory changes and/or enforcement, and product registration.

Of those who said that states can make a difference, a significant percentage (31%) responded that consumer education and outreach would be the most effective means to assist with the bed bug issue. Industry training and education were also cited as measures that could be taken by states to assist with the problem, but at a much lower response level (8.5%). The majority of the responses that fell into the regulatory and enforcement category suggested the need for strengthening existing state regulations and the implementation of new control regulations specific to bed bugs.

Approximately ten percent responded that states should provide assistance in registering new pesticides and re-registration of pesticides formerly used against household pests, many of which are unavailable due to cancellation or voluntary withdrawal from the market. There seemed to be a general misunderstanding among those who gave this response regarding a state’s role in the product registration process.

Some states conduct internal label reviews and make decisions regarding which federally registered products will be registered for use within the state. Some states also require registration of 25(b) products which are not required to have federal registrations. States also have some involvement in the issuance of Section 18 Emergency Exemptions and 24(c) Special Local Needs exemptions. However, a state does not make the final decisions with regard to which pesticides are available nationally. These decisions lie within the jurisdiction of the US Environmental Protection Agency which makes all determinations regarding Section 3 product registrations in the United States.
WHICH INSECTICIDES?

When pest managers were asked which of the available insecticides they most frequently use, most mentioned pyrethroids. In the U.S., eight of the 10 most used sprays were pyrethroids—although a non-pyrethroid (Phantom) was the most frequently mentioned product overall by 42% of respondents. The bed bug products reported to be the most utilized in the United States can be seen in Figure 9a.

Pyrethroids were also the predominant insecticides elsewhere in the world, although organophosphates and carbamates were still available for bed bug use in many countries (Figure 8). Specific insecticides mentioned include chlorpyrifos, malathion, dichlorvos, propoxur, bendiocarb and carbaryl. These compounds can be quite effective against pyrethroid-resistant populations—and could be why bed bugs are less difficult to control in Asia, Mexico, and Central/South America where such compounds are still readily available (Figure 7).

When pest managers around the world were asked if they were satisfied with the performance of today’s bed bug insecticides, 21% said they were “very satisfied,” 50% said they were “somewhat satisfied,” and 29% were “not very” or “not at all satisfied.” Respondents from Latin America and Asia were most satisfied with the performance of their pesticides, while Canada, the U.S. and Europe (where organophosphates and carbamates have mostly been removed from the market) were generally least satisfied (Figure 10). Again, the level of satisfaction appears related to the availability of older chemistry.

Respondents were divided about whether they have encountered infestations appearing to be resistant to insecticides (Figure 11). In the U.S. where studies suggest
resistance may be widespread (Fang et al. 2010), one-third (33%) of respondents said they had encountered resistant populations and 20% of them said this occurred often.

Respondents were also split when asked if they received more bed bug calls at certain times of the year. Outside the U.S., 55% saw no seasonal pattern to their bed bug calls while 45% said that they did; among those who did, three fourths (75%) said their company received more calls about bed bugs during the summer. In the U.S., 72% of respondents felt there was no busier time of the year for bed bugs; of those who felt there was a seasonal pattern, however, summer was again mentioned as the busiest season (48%). Several respondents also mentioned they received more bed bug calls after holidays, vacations, and when children return home from school or summer camp.

**BRINGING ‘EM HOME**

Bed bugs are proficient hitchhikers and will crawl onto or into just about anything. Consequently, there is also a risk that technicians could accidentally bring some home or back to the office. More than three fourths (78%) of those surveyed from the U.S. said their employees were concerned about bringing bed bugs home—and 15% noted that someone in their company had already done so. Some companies are already making clothes washers and dryers available to their employees at the end of the work day to prevent the spread of bed bugs. In tests at the University of Kentucky, as little as five to 10 minutes in a clothes dryer on a medium to high temperature setting killed all bed bug life stages (Potter et al. 2007).

Other inspection tips to reduce the likelihood of bringing home bed bugs:

- Avoid brushing up against infested items, which can dislodge bugs or eggs onto clothing—especially when lifting/moving beds and sofas or working in cramped quarters.
- Don't place jackets, hats and gear on beds, sofas and carpeted floors. Instead, place them away from heavily-infested areas and on a hard surface, such as the kitchen table.
- Don’t rely on spraying insect repellent to deter hitchhiking bed bugs, as they have not been proven effective.
- Check shoes (bottom, top, and shoe laces) especially after inspecting badly infested accounts.
- Place uniforms, shoes, etc. in a dryer or washing machine at the end of the work day.

**BUSINESS CONSIDERATIONS**

Several survey questions addressed the business aspects of bed bug management. When asked “Does your company price bed bug work by the hour or the job?” most respondents (between 75% and 95%) throughout the world said “by the job.” The majority (61%) also said their company did not use a separate bed bug contract but rather used the same contract as for other pests (Figure 12). In the U.S., where bed bug litigation is an important topic, the majority (55%) employ a separate contract when treating for bed bugs. Nearly three-quarters of U.S. respondents felt that bed bug litigation or the risk of negative public-
An overwhelming 95% of U.S. respondents indicated their company or organization encountered a bed bug infestation in the past year, with similarly high frequencies reported for Canada (98%), Europe (92%) and Africa/Middle East (90%).

Despite the resurgence, bed bugs still comprise a small percentage of the pest control industry’s overall revenue. In fact, in the U.S. some respondents mentioned that their companies refuse to provide bed bug service under any circumstance. When asked “About what percent of your annual revenue is from bed bugs?” 45% of companies throughout the world said less than one percent while another 28% of respondents said 2 to 5%. Nevertheless, in some regions in the U.S. a significant percentage of respondents (e.g., 24% in East North Central and 28% in New England) indicated that more than 10% of their annual revenue came from bed bug treatments. As infestations become more common, these numbers will certainly increase. Companies that refuse to treat bed bug infestations can expect to lose new business and risk forfeiting existing accounts to others.

No specific questions were asked about what companies are charging for their bed bug work. Based on discussions in the U.S., some companies are charging as much to de-bug a dwelling as they do for termites. Others providing less intensive inspections and treatments are billing no more than for other household pests. This variance in pricing and approach is causing considerable confusion among consumers.

**ROLE OF REGULATORS**

At the request of ASPCRO (Association of Structural Pest Control Regulatory Officials), U.S. respondents were asked: “Are there any resources or actions that your state pesticide regulatory agency could take that would assist with the bed bug problem (e.g.—consumer education, industry training, enforcement, registration, etc.)?” Two-thirds (67%) of industry respondents felt there were indeed actions state regulators could take to assist with the bed bug problem and most offered specifics. The most common suggestion made was for more education, outreach and training for both the public and the pest control industry (see sidebar on page 15: What PCOs
Expect from State Regulatory Agencies). Increasing societal awareness and informing consumers that bed bugs are best controlled by professionals were also frequent suggestions, as was more training for companies lacking experience treating for bed bugs.

In terms of regulatory action, many respondents wanted state and federal regulators to register more effective bed bug insecticides. Several respondents recommended re-registering chlorpyrifos, diazinon, malathion, propoxur and/or bendiocarb at least until newer materials are available. Some industry professionals also made the suggestion that a new certification category be created specific to bed bugs, as well as a tracking system for the number and location of treatments, similar to current tracking of termites in some states. Other enforcement actions that respondents requested of regulators included banning do-it-yourself pesticides sold on the internet, regulating the sale of recycled beds and furniture, and making property managers responsible for bed bugs in their buildings (not all of these actions fall within the authority of regulators).

Several respondents also hoped regulators would pressure other government agencies to designate bed bugs as a public health threat and allocate more resources for inspections, education and research. One respondent advocated that “the problem is beyond the scope of state agencies; it needs to be handled at the federal level.”

CLOSING THOUGHTS

As the most detailed portrait of bed bug resurgence to date, this study confirms that infestations are increasing worldwide, although in some areas (e.g., Latin America), the upsurge is less evident. Many factors are fueling the growing global pandemic of bed bugs—but it remains a mystery why we’re seeing such an abrupt increase after years of scarce encounters.

Infestations are showing up in all the same places they did years ago—from poor house to penthouse, schools to surgical suites, cubicles to clothing stores. Bed Bugs are a wake up call to the developed world that it is not their birthright to live free of vermin. Perhaps most unsettling about 21st century bed bugs from a societal standpoint is that we are in uncharted waters. There will be new challenges this time around including unprecedented movement of people from across town and around the globe; more clutter and belongings in which bugs can hide; less potent insecticides for both householder and professional use; more restrictions involving fumigation; public apprehensions about pesticides (and an industry increasingly ‘gun-shy’ about using them); and a mindset today that when someone is harmed they should sue.

Interestingly, bed bugs are more manageable in Latin America and Asia, where organophosphates and carbamates are still available to control infesta-
tions. Elsewhere in the world where pyrethroids are the main insecticidal option, bed bugs are proving far more difficult than ants, roaches and termites. Regardless of treatment methods, bed bugs are increasing across the globe and without bias for highly developed or currently developing nations. The crux of bed bug management, however, remains hard work, public education, and constant vigilance to prevent or detect infestations in the early stages.  

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