Integrated Pest Management Policy and Treatment Options *for* UNIVERSITY HOUSING

Kevyn Juneau, Jennifer Gillett-Kaufman, Norm Leppla, Kirk Martin and Wayne Walker

USDA NIFA Regional IPM Centers

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ACUHO-I Revision

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INSTITUTIONALIZING IPM

Purpose of this Manual

The purpose of this manual is to train pest management technicians and college/university staff in Integrated Pest Management (IPM). All new technicians should receive IPM training and new and existing employees should be provided with continuing education emphasizing IPM. Moreover, any person who applies pesticides for the college/university should practice IPM and be licensed as a commercial pesticide applicator by the state where the college/university is located. Pesticide applicators must follow state and federal regulations and apply pesticides according to the instructions on the labels. To assist college/university technicians and contract pesticide applicators in instituting IPM, this manual includes the college/university IPM policy, specific IPM objectives, responsibilities of the college/university IPM Technician, a flow chart of IPM actions, and requirements for using pesticides and associated recordkeeping. Pest problems can be prevented by requesting that maintenance be performed, providing education for residents, conducting inspections and monitoring, and establishing appropriate landscaping. Pest-specific IPM options are provided for ants; bed bugs; bees and wasps; birds and bats; booklice, silverfish, and earwigs; cockroaches; flies; rodents; stored product pests; termites; and weeds. Selected references are provided and there are forms for assuring service, pest surveillance, and record keeping.

Integrated Pest Management Policy

It should be the policy of the college/university to practice IPM for the buildings and grounds they manage. IPM is a systematic approach for managing pests based on long-term prevention and suppression by a variety of methods that are cost effective and minimize risks to human health and the environment. Pests can just be a nuisance or cause significant health problems, structural damage to buildings, and economic losses due to food contamination, diminished aesthetics and other impacts. By practicing sustainable IPM, risks associated with pests and pesticides can be minimized.

IPM in college/university facilities involves standardized practices derived from community IPM. Residents should be educated about preventing pest infestations and technicians trained to select the most benign yet effective species-specific pest management methods. A combination of the most effective and economical cultural, physical, biological and chemical controls should be used to manage pest infestations and minimize associated damage. Based on a thorough assessment of the problem, treatment options range from no action to non-chemical methods and, if necessary, the use of an effective, least toxic pesticide. Non-chemical methods include exclusion, sanitation, or perhaps tolerance, and least toxic pesticides are those labeled "CAUTION." If it becomes necessary to use pesticides, they should be applied during appropriate times to maximize their efficacy and minimize the possibility of human exposure. All pesticides should be handled according to state and federal laws.

Integrated Pest Management Objectives

The college/university has the following objectives for preventing or expeditiously managing pest problems:

- Protect residents from pests by preventing or suppressing pests to non-damaging levels.
- Reduce environmental pollution through selection and placement of appropriate least-toxic pesticides.
- Base pest management actions on accurate identification of pests and knowledge of their biology.
- Perform thorough assessments of pest problems and determine the best IPM options.
- Evaluate the effectiveness and reduce the cost of pest management actions.
- Educate residents about preventing pests from entering or moving within college/university properties.
- Maintain college/university properties with minimal exposure of residents to pests and pesticides.

Responsibilities of the IPM Coordinator

The IPM Coordinator is responsible for overseeing implementation, evaluation and improvement of the college/university IPM program; he/she must accomplish the following:

- Maintain records of all pest complaints and sightings reported by residents and college/university staff.
- Maintain detailed, up-to-date records of all pest management actions, especially pesticide use.
- Provide complete records of pest management actions in accordance with college/university policies, if requested.
- Maintain a current and readily accessible set of Material Safety Data Sheets (MSDS) for all pesticides used or stored by college/university staff.
- Approve or deny the use of IPM options by IPM technicians, especially pesticide applications.
- Notify the college/university Maintenance Section when maintenance or sanitation deficiencies exist.
- Assure that signs are posted and residents notified before pesticides are applied.
- Continuously evaluate the effectiveness of the college/university IPM program and make improvements.
- Assure that college/university IPM technicians have current pesticide applicator licenses.
- Maintain a library of pertinent, up-to-date pest control and IPM literature.
- Maintain an active network of pest management professionals for consultation.
- Maintain personal pest management licenses and certifications, including continuing education.

Flow Chart of IPM Actions

IPM actions begin with a pest complaint (pest control request) submitted by a resident or a pest sighting by a college/university IPM technician during routine service (Fig. 1). In either case, the pest should be accurately identified and a thorough assessment made to determine if it has reached a level of abundance or caused damage that triggers an IPM action. Continued monitoring, perhaps with an increased frequency of inspection, is the only requirement if the action level has not been reached. Above the action threshold, IPM options are employed based on their effectiveness, safety and cost. IPM options include cultural, physical, biological, and chemical controls used to mitigate pest

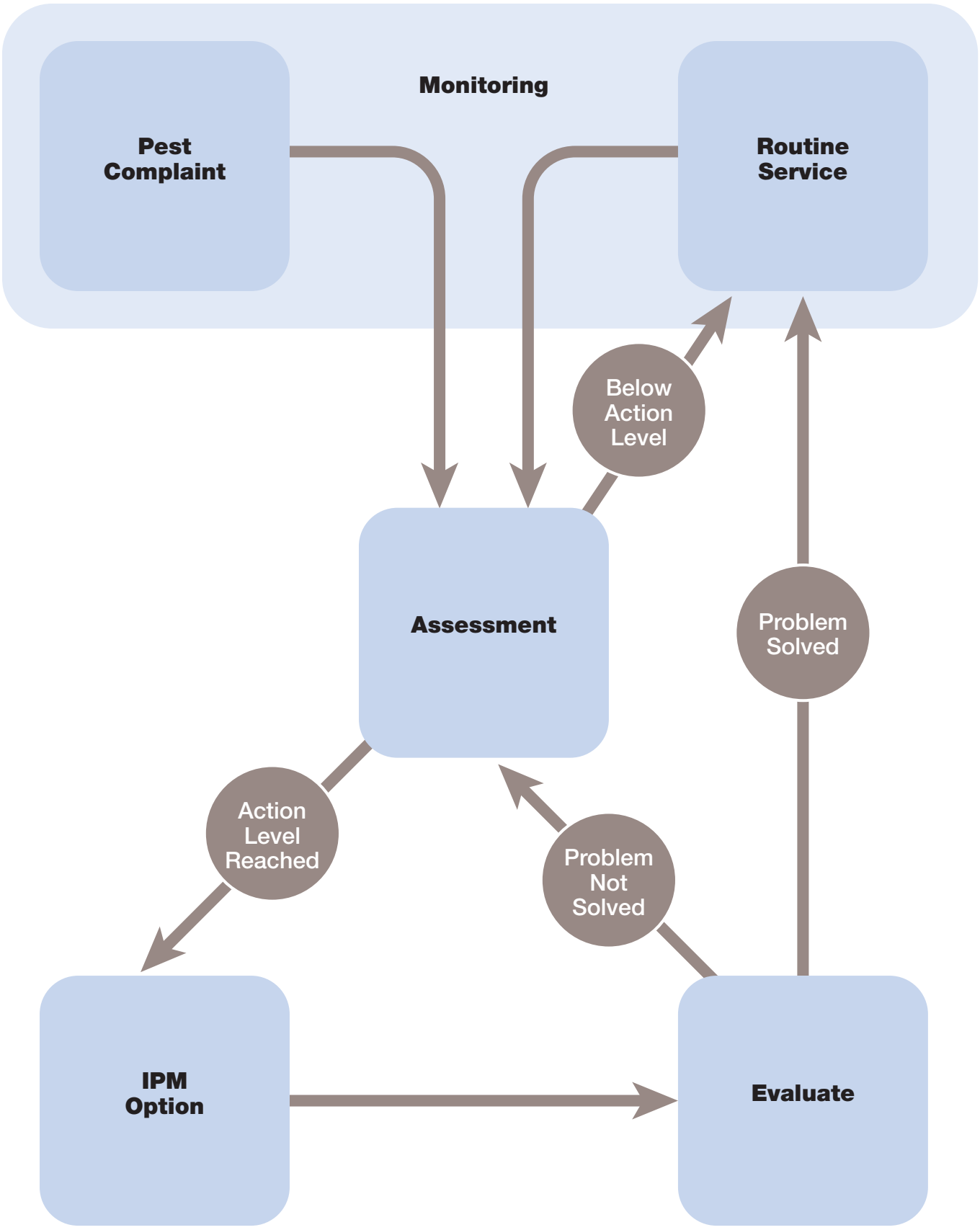


FIGURE 1 • *IPM decision-making flow chart.*

infestations. A subsequent evaluation determines if the pest problem has been solved; if not resolved the IPM actions are reassessed. This decision-making flow chart has two feedback loops: 1. Monitoring-assessment-below action level-continued monitoring and; 2. Assessment-above action level-IPM options-evaluation-problem not solved-reassessment. If the pest is no longer apparent or causing damage, monitoring should be resumed.

Requirements for Recordkeeping and Using Pesticides

Records of pest complaints and sightings, and IPM actions should be kept current and accessible to verify the appropriateness and effectiveness of management decisions (see forms). A detailed database on pesticide use should be maintained, including products, active ingredients and quantities. Residents shall be notified in writing five days before **high-risk pesticides** are used, if this treatment becomes necessary. Notices should be posted on the college/university website and in the main office and common areas of the building to be treated. These notices should remain in place for at least two days after a pesticide is applied. Pesticide purchases should be limited to the approximate amount needed to eliminate each pest outbreak. Pesticides should be placed in safe containers that are labeled appropriately, including the date received, and stored in a secure location not accessible to unauthorized personnel or locked in a utility vehicle. Only the amount of pesticide needed immediately should be prepared. All expired pesticides and those no longer registered by the EPA should be disposed of in accordance with directions on their labels and in compliance with state and federal regulations.

Posting Notices of Pesticide Applications

It should be the responsibility of the IPM Coordinator to insure that proper notices are posted for any pesticide applications that may pose any risk of exposure to residents and staff. At least 24 hours prior to any general liquid or granular insecticide application, the IPM Coordinator or representative should notify electronically the areas where the application is planned. There should be a notice of application posted on the bulletin board in the area where the application is to occur. The notice should remain on the bulletin board for a minimum of 48 hours. If the applications are to occur to the general vegetation outside of the buildings, the area should be segregated utilizing caution tape and notices of the pesticide application. This segregation should remain in effect for a minimum of 48 hours. Exceptions to this policy should be the application of fire ant bait granules by applying directly to the mounds and in the case of stinging insect nests that are a danger to staff or residents. In these two instances, the IPM Coordinator should authorize the treatment without the normal posting of notices of pesticide applications. Containerized bait, crack and crevice, and sealed void applications should also be an exception to the posting rule. These types of applications when performed properly do not pose an exposure risk to the staff or residents.

Drift and Off-Target Applications

The safety of our residents and technicians are of the greatest importance to the college/university IPM program. The IPM Coordinator should insure that all pesticide applications are performed in a manner that is safe and consistent with all of the label requirements. The technicians should at all times wear the appropriate Personal Protection Equipment (PPE) that is required by the label of the product being applied.

Liquid Applications

The college/university IPM program should apply very few, if any liquid pesticides. When the applications of liquid pesticides are deemed by the IPM Coordinator as necessary, the following items should be adhered to:

1. No liquid spray applications that are directed above the waist should be applied when the wind is above 7 MPH.

2. All individuals associated with or that may be associated with the area to be treated should be notified 24 hours in advance. A notice of application should be posted and the area roped off with a barrier tape to prevent entry to the area until it is safe according to label instructions. Notice of application should remain in place for 48 hours.
3. During any liquid application, caution should be taken to insure that only the targeted area should be exposed to pesticide.
4. Label instructions should be strictly adhered to, including PPE and reentry intervals.

Bait Applications

The college/university IPM program should utilize baits of various types in some of its remediation efforts when other efforts have failed to solve the pest problem. The following considerations should be adhered to in the use of commercial bait products:

1. All bait products should be of the type and ingredients that are approved by the IPM Institute of North America. Any new products that are considered for use by the IPM Coordinator should be submitted for approval of the IPM Institute of North America.
2. Baits should only be applied in manners that are consistent with their labels.
3. Baits should be applied in containers that are affixed or placed in inaccessible locations.
4. Gel bait may be applied in a crack or crevice; however, no bait should be visible outside of the crack or crevice. When applying gel bait in areas where no crack or crevice is available, a device named the “Crevice” may be utilized.
5. When granular style baits are deemed necessary, they should only be applied either in a container that is affixed or inaccessible or held in place on a glue board. No granular bait should be scattered under or in any areas inside of any buildings. Outside granular baiting for fire ants may occur on a limited basis without the bait being inside of a container. It is permissible to sprinkle the fire ant bait directly on the mound in limited quantities following the label instructions. When handling granular baits the proper PPE must be worn at all times.

Dust Applications

Dust applications within the college/university IPM program should be limited to a very few instances and must be pre-approved by the IPM Coordinator. Most of the dust insecticide applications should involve stinging insects such as wasps, hornets, and bees. Any other applications would be for void treatments and treatments in inaccessible areas. The following considerations should be adhered to when utilizing insecticide dusts within the college/university IPM program:

1. No dust applications should be made in areas that cannot be sealed so as to prevent contact with the insecticide dusts. After dusting a void or space the area should be sealed.
2. Any over application of dust that is visible should be immediately cleaned up and the cleaning materials disposed of according to label instructions.
3. When making dust applications, the technician(s) should wear appropriate respiratory protection and eye protection.
4. Dusts may be applied to stinging insect nests without it being sealed up. The application should be made, access to the area restricted until insects are dead, and the nest removed and destroyed.

Aerosol Applications

The college/university IPM program only utilizes limited types of aerosol applied products. There are a couple of approved products that are packaged in aerosol containers for application. The following guidelines should apply to the application of any products from aerosol containers:

Pesticide Accidents Contact Numbers and Information

University Police Department

Poison Control Center

800-222-1222

IPM Coordinator Cell

IPM Coordinator Home

IPM Coordinator Radio Number

College/University Maintenance Superintendent (Hazard Waste)

College/University Infirmary

College/University MSDS

College/University Associate Director Building Services

College/University Coordinator for Safety and Security

College/University Environmental Health and Safety

1. The only approved use of aerosol containers is for the application in a crack and crevice with the crack and crevice tube attached to the container.
2. No general release of the aerosol into the air or onto surfaces should be allowed.
3. If during the crack and crevice treatment any of the pesticide is accidentally applied outside of the crack or crevice, it should be immediately cleaned up and the cleaning materials disposed of in accordance with the label instructions.
4. Total release foggers or similar types of aerosol devices should NOT be allowed to be used in any of the college/university buildings. This prohibition applies to the residents, the college/university staff members, and IPM technicians.

IPM Program Accident Protocols

The following guidelines should be to be followed when responding to any of the accident types described below. The college/university IPM Coordinator shall be notified immediately of all pesticide related accidents, including vehicle accidents involving one of the pest control vehicles. The list at left contains the normal duty hours and after hours contacts for all individuals, agencies, and groups that may need to be notified.

1. **Vehicle Accident** • In case of a vehicle accident involving one of the pest control vehicles, first determine if there are any injuries. If there are injuries, immediately call 911. Emergency service providers should dispatch services that are needed such as police, fire, or emergency medical. If there are containers that are leaking or if there is a liquid leaking from the vehicle, contain the spread of the leaking as much as possible. If the liquid appears to be gasoline or fuel, take precautions to stay clear of the location that is leaking. Keep others away from the possible fuel spill. Keep ignition devices away from the area (open flames, lit smoking materials, etc.). If the leaking liquid appears to be pesticides, contain the flow as much as possible and immediately notify the college/university IPM Coordinator. Insure that first responders are made aware of the possible pesticide liquids. The MSDS book should be carried in each of the pest control vehicles and should be normally located behind the driver's seat. The other copies of the MSDS sheets should be located in the main housing office. There are additional copies of the MSDS sheets located in the IPM Coordinator's office and the pesticide warehouse.
2. **Fire** • In case of a fire in one of the pest control vehicles or in the pesticide storage facility, notify the police department at. The IPM Coordinator should be immediately notified.

The MSDS sheets of all materials should be contained in the vehicles, stored in the pesticide warehouse, available in the main housing office and in the IPM Coordinator's office. This information should be available to the fire department. The fire department should also be notified that the fire could involve pesticides when the call is made.

3. **Ingestion/Inhalation of Pesticide** • If it is believed that someone has ingested pesticides, immediately call 911. An effort should be made to determine what pesticide has been ingested. After notifying the emergency services call the IPM Coordinator or the Poison Control Center at 1-800-222-1222. The MSDS sheets should be available in the housing office and in the IPM Coordinator's office.

4. **Eye Contamination** • If the pesticide or any other harmful liquid or dust gets into someone's eye or eyes, the first step is to wash the eye(s) out with clean water. There should be eyewash stations located in the pesticide warehouse, in most college/university work areas and in the maintenance shops. There are bathrooms and water fountains on each floor of the college/university buildings. Immediately notify the IPM Coordinator of the exposure and the individual's supervisor. During work hours, the exposed individual should be transported to the college/university infirmary. If the accident occurs after normal work hours, the individual should be transported to the nearest emergency room. The MSDS sheets for all pesticides should be located in the college/university housing office and in the IPM Coordinator's office. The information on the MSDS sheets should be available for any medical treatment.

5. **Dermal Exposure to Pesticides** • Any dermal exposure to pesticides, in either concentrate form or diluted form, should be immediately washed with plenty of soap and water. The IPM Coordinator should be immediately notified. If the clothes are contaminated with the pesticide, they should be removed and stored in a plastic bag until they can be washed. If the dermal exposure is through soaked clothing, that area needs to be washed immediately with plenty of soap and water. When washing clothing contaminated with pesticides, the clothing should be washed separately from any other clothing. If the dermal exposure involves contamination of an open cut or wound, that area should be washed out with soap and water and then seek medical attention. The MSDS sheets should be available in the college/university housing office and in the IPM Coordinator's office.

IPM Training Schedule for New Technician

A. IPM Training

a. ***Week 1:*** IPM Theory and Background, Inspection, Exclusion, Sanitation, Application

i. Day 1: IPM Theory

1. Classes/Trainings: What is IPM and how does it benefit everyone?
2. Course Materials: Truman's Scientific Guide to Pest Management Operations.

ii. Day 2: Inspection and Detection

1. Classes/Trainings: Proper use of inspection tools; mirrors, flashlights, knee pads, screwdrivers, and ladders. Where to look for various insects.
2. Course Materials: Truman's Scientific Guide to Pest Management Operations and The Handbook of Pest Control (Mallis).

iii. Day 3: Exclusion

1. Classes/Trainings: Effective methods of exclusion.
2. Course Materials: Truman's Scientific Guide to Pest Management Operations and The Handbook of Pest Control (Mallis).
3. In-field practice: Accompany supervisor on inspections and service calls.

iv. Day 4: Sanitation

1. In-field practice: Accompany supervisor on inspections and service calls.

v. Day 5: Proper Applications of Products

1. In-field practice: Demonstrations of proper bait placements, dust placements and crack/crevice treatments.

b. ***Week 2:*** In-field Practice with Supervisor

i. Day 1–5: Meet with the Maintenance Staff in Each of the Areas

ii. Day 1: Field Training with Supervisor

1. Inspection, identification, monitoring: use of inspection & monitoring tools: flashlight, screwdriver, magnifier glass, digital camera, sticky traps, etc.

iii. Day 2: Insect Identification
   1. In-field practice: Hands on work with the microscope and insect identification keys.
   2. Course Materials: Truman's Scientific Guide to Pest Management Operations and The Handbook of Pest Control (Mallis).

iv. Day 3: Exterior Perimeter Inspections
   1. In-field practice: Accompanies supervisor on exterior building inspections.

v. Day 4: Exterior Exclusion Procedures
   1. In-field Practice: Observes and practices bat and rodent exclusions.

vi. Day 5: Performs Preventative Inspections
   1. Supervisor observes and allows technician to proceed with minimal supervision. Critiques technician performance at the end of the day.

c. Week 3:

i. Technician works with minimal supervision.
   1. Supervisor reviews each service call and inspection with the technician critiquing as necessary.

d. Week 4:

i. New technician works alone, with the supervisor immediately available.

B. Month 2: Attend monthly training; topics should include new products, tools, and refresher training with tools not utilized during the month.

C. Month 3: Supervisor shadows for day for review, retraining if needed.

D. Month 4–12: Attend monthly training, the topics should include seasonal insects and treatment strategies.

Other topics should include new products and tools. Attend school IPM meetings that may be available or participate in webinars when available.

Continuing Education

The continued education of both the IPM Coordinator and the IPM technician(s) is of great importance. The world of entomology and IPM is a very dynamic and changing arena. The task of staying current on the latest trends in insect management and new IPM strategies is of upmost importance. The college/university should make the commitment to provide the latest information to the IPM Coordinator and the IPM Technician(s).

The college/university should maintain subscriptions to pest management journals, magazines, and newsletters. These periodicals should be made available to the pest control section as they arrive. Through the use of computers at the college/university, online newsletters and electronic media are also available.

The task of each licensed technician and the licensed coordinator to maintain the continuing education units (CEU) for recertification is the responsibility of each license holder. The college/university should make arrangements for the coordinator and technician(s) to attend local conferences and events conducted by the extension services. The college/university should take advantage of numerous opportunities each year for additional interaction with the local entomology department. The college/university encourages the coordinator and technician(s) to actively seek out these opportunities and take advantage of the resources on campus.

The college/university encourages the IPM Coordinator and technician(s) to maintain membership in the IPM working groups. There are numerous opportunities available for participation in IPM in school settings. The college/university should also provide opportunities for travel to pest management conferences, seminars, and other similar type functions that provide additional information on IPM and pest management practices.

Each week the IPM Coordinator and the IPM Technician(s) should review the Univar Pest Web site for the Ask the Expert segment of their site. This section answers questions about control of various insects from all over the United States. It covers many IPM concepts and provides insight into unique solutions to problems.

New Staff Orientation

All newly hired staff members within college/university should be required to attend a Safety and Security class given by the college/university Safety and Security Coordinator's office. During the training session, all new hires should be provided with important information on the college/university IPM program. Staff members should be given information about the general lack of pesticide use in the college/university and the notification procedures that should be used when a pesticide should be used in their area. Staff members should be informed of where to look for physical and electronic postings and how they should be notified of any upcoming pesticide applications. Staff members should be provided with information on how to notify the IPM Coordinator if they should see or encounter any insect issues. Staff members should also be informed about sanitation and how to look for exclusion situations (open windows/doors, missing screens, etc.) and should be instructed to inform the IPM Coordinator via electronic work order.

IPM Program Evaluation

The college/university IPM program is constantly undergoing evaluation from the IPM Coordinator and the Associate Director of Housing for Building Services. Every pest complaint call should be logged into a data base, along with the insect identification, the remediation measures, any products that are utilized, and costs associated with the remediation. This information should be charted and reviewed monthly by the IPM Coordinator and the Associate Director. The charted

information should be available for the previous 5 years and utilized to compare the number of calls per month by area. This data should be evaluated and new procedures developed as the need arises. The IPM Coordinator should develop and utilize a close relationship with the entomology professors and graduate students to evaluate the procedures and products that college/university currently utilize. This close relationship also allows the IPM Coordinator to test and evaluate new IPM procedures and products that are in the testing and developmental stages at the entomology lab. Once each year the college/university IPM Coordinator should meet with the third party evaluators to evaluate the success and direction of the college/university IPM program. Upon certification as a Green Shield Certified program, the college/university IPM program should be evaluated by the IPM Institute of North America on an annual basis to maintain that certification. The evaluation process for the college/university IPM program is a continual process and the college/university IPM Coordinator should annually seek methods and procedures that should enhance the IPM program and safety of our residents.

Qualifications for Pest Management at College/University

All pest management conducted in the college/university buildings should only be conducted by technicians that are licensed under the provisions of the state certification standards. Any state employees conducting pest control at the college/university should hold a minimum of a limited structural pest Control license issued by the state. Any newly hired pest control technicians should have a minimum of two years of experience either as a pest control ID card holder, limited license holder, or a licensed certified operator.

If and when it becomes necessary to contract with pest control companies for services not performed by the in-house technicians, the following minimum requirements should be met by the contracted company:

1. Pest control contractor should have a minimum of 5 years of experience in the area of the contracted services.
2. The contractor should have a current pest control business license for the state.
3. The contractor should be required to provide proof of the necessary insurance levels as required by college/university contracts.
4. The certified operator in charge should not have any disciplinary actions against him in the past 2 years.
5. The contractor should meet with the IPM Coordinator and the college/university IPM program should be explained and the contractor should adhere to the IPM program guidelines. Any deviations from the IPM program should need approval from the IPM Coordinator.

PEST PREVENTION

FIGURE 2 • *An improperly installed escutcheon plate can be repaired by the college/university maintenance section.*

Preventative measures include continuous and emergency maintenance, educating residents about sanitation and pests, routine inspection and monitoring for pests, and landscaping that discourages pests from becoming established.

Maintenance

The college/university maintenance section is an essential partner in the college/university IPM program. If a maintenance problem is discovered (leaking pipes, cracks in walls, etc.) by a resident or IPM technician, a work order should be immediately submitted to the maintenance section. In addition, the maintenance section should conduct an inspection when a resident submits a "Notice of Intent to Vacate" an apartment. General maintenance should be performed at this time, including elimination of openings that might enable pests to enter (Fig. 2). An IPM technician should participate in this inspection and be present when apartments are remodeled to identify potential sources of pest problems. The college/university IPM technician should record work orders submitted to the maintenance section.

Resident Education

Residents should be instructed about sanitation and pests during the orientation required to occupy an apartment. IPM policies and procedures should be communicated orally and reinforced with written documents, e.g., brochures, newsletters and factsheets. Education pertaining to sanitation and pest prevention is a major emphasis of the IPM program. It is expected that the residents should follow sanitation guidelines while living in campus housing.

Information about pests should be provided to establish a tolerance for less harmful species, e.g., lady beetles, and intolerance of more harmful ones, e.g., bed bugs. Residents should be educated about the potential dangers of over-the-counter pesticides and cautioned to use them only if necessary, e.g., stinging insects. They should be educated about low risk pest management methods, such as swatting flies, vacuuming insects, and spraying soap solution. Residents should be encouraged to collect specimens so college/university IPM technicians can identify pests and take appropriate action.

Vacant Unit IPM Inspections

The college/university maintenance services are an essential partner in the IPM program. When village apartments become vacant or when single student residence halls are empty, housing staff complete an inspection of the facility. Housing staff completing the inspection include a member from residence life, maintenance services, building services and an IPM technician. The group looks for a number of pest-proofing items including cleanliness, leaking pipes, cracks in the walls, caulking around windows and doors, weather strips, etc. When maintenance or building services issues are discovered by the inspection team they are documented and should be corrected immediately.

Inspection and Monitoring

Every apartment should be inspected at least quarterly for pests and compliance with sanitation requirements. Also, cursory inspections should be made when convenient, such as during the performance of repairs. Deficiencies in sanitation should be reported in writing to the resident and residence director of the housing complex. During inspections, sticky-trap monitors placed in locations where insects commonly occur or near potential harborages, should be examined for the presence of pests (Fig. 3). The monitors must not be disturbed by residents or affected by anything that can hinder their performance (Fig. 4). The type and number of pests in the traps should be assessed (Fig. 5) and, if determined to be above the action threshold, IPM options should be selected and employed (see Pest-Specific IPM Options).

Landscaping

During the quarterly outside inspections of each of the college/university buildings, the IPM technicians should look for signs of plants touching the buildings, attached to the buildings, or any other type of plant pathway for the insects to gain entry to the buildings. Any of the plant issues should be addressed with a work order to the grounds maintenance group. Pest management should be considered when housing complexes are landscaped. Plants and mulch near buildings can provide food and shelter for pests (Fig. 6). Moreover, plants can provide pathways from the ground into apartments if they grow near or touch windows, vents or other openings (Fig. 7). Plant pots with standing water are ideal breeding sites for mosquitoes. Planters made of wood can feed and harbor structural pests, including carpenter ants and termites. If possible, dead trees and stumps should be removed to prevent structural pests from developing colonies near buildings.

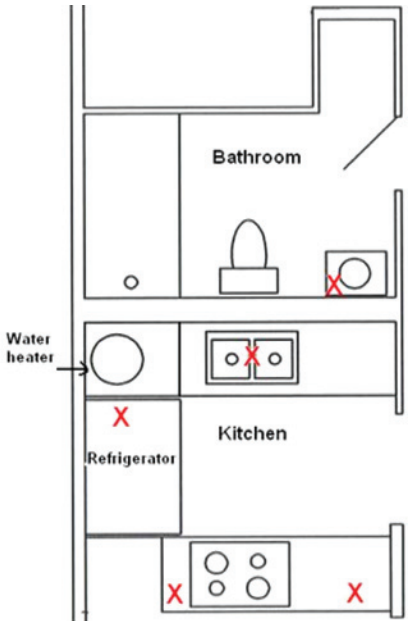


FIGURE 3 • *Areas where monitors can be placed in an apartment are marked with a red "X."*

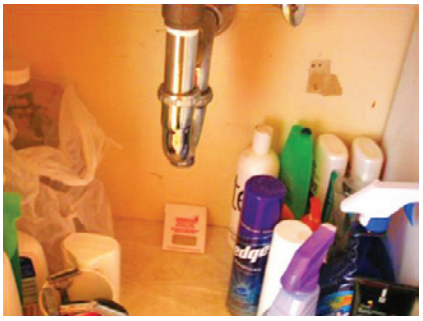


FIGURE 4 • *A sticky-trap monitor placed under a bathroom sink.*

FIGURE 5 • *A sticky-trap monitor with captured German cockroach nymphs, suggesting an infestation.*

FIGURE 6 • *Landscape plants and materials too close to buildings can provide harborages and entry access routes for insects.*

FIGURE 7 • *Vining plants can give insects access into buildings.*

New Construction and Renovations

The college/university maintenance services should be constantly reviewing the residence hall facilities. They design and plan for new construction and renovations of existing facilities. When designing and planning new construction or renovation of an existing residence hall, a team should be formed with staff from various offices within college/university. The college/university IPM Coordinator and staff from other areas involved in the pest management activities should be invited to be part of the design, planning and review team. They look for pest-conducive features and pest-proofing like door sweeps, thresholds, sealing utility openings, check caulking around windows, doors, fascia boards, etc. They also look for adequate sanitation and the location and type of recycling and refuse containers.

PEST-SPECIFIC IPM OPTIONS

Ants

Indoor Infestations

Ant species range in length from 1/16” to 5/8” (2–13 mm). They often enter buildings to search for food, so the primary management strategies for ants are exclusion and sanitation. Chemicals used improperly can cause some species (e.g., Pharaoh ants) to form multiple colonies. With the exception of red imported fire ants and carpenter ants, these insects are generally considered nuisance pests. Educational publications describing fire ants are distributed to all residents during orientation.

Prevention and Non-chemical Options

- **Exclusion** • Determine where the ants are entering the building.Inspect typical locations, e.g., around windows and doors, pipes and vents. If the ants are trailing, it may be possible to follow the trail to the building access point. Place a barrier, e.g., caulking, escutcheon plate or door sweep, where the ants are entering. Ants may also be observed entering a building through cracks in walls, poorly sealed windows and doors, or other areas, during routine inspections around the outside of a building. Maintenance Services should be notified via online work order to repair these problems and help prevent insects from entering the buildings.
- **Sanitation** • Locate the food source to which the ants are attracted and provide the resident with food storage and sanitation suggestions. If general sanitation is an issue, the resident should be provided with a copy of the college/university Sanitation Guidelines and the residence director of the apartment complex should be notified.

Monitoring: Receive a complaint or ants observed during a routine inspection.

Action Threshold Indoors: Observe at least five ants trailing into a room.

Action Threshold Outdoors: Observe fire ant nests in close proximity to a dwelling or common area, e.g., patios, playgrounds, pool area, or other high traffic areas.

ROVER ANT
Brachymyrmex patagonicus

PHARAOH ANT
Monomorium pharaonis

GHOST ANT
Tapinoma melanocephalum

CRAZY ANT
Paratrechina longicornis

BLACK CARPENTER ANT
Camponotus pennsylvanicus

BIG HEADED ANT
Pheidole megacephala

- **Moisture** • Ants can often be found in moist areas near leaking pipes or condensation. If it is determined that sanitation is not the primary cause of the infestation, check for areas of moisture. The maintenance section should be contacted to repair any moisture problems.
- **Food storage** • Ants may be present in food that is not properly sealed in a container. If storage is determined to be an issue, the resident should be provided guidelines on proper food storage and asked to follow the IPM technician's advice. Food that is attractive to ants should be stored in airtight containers. Screw top lids, e.g., those on peanut butter jars, may not always protect food from ant infestations, as tiny ants can crawl around the threads and enter the containers. Food can also be stored in a refrigerator to protect it from becoming infested.
- **Vacuum** • Visible ants and those hiding in cracks can easily be vacuumed by the resident. It is recommended that a tablespoon of cornstarch also be vacuumed to help desiccate the ants while in the vacuum bag or container. Nests found indoors, e.g., in wall voids, can also be vacuumed. The colony should collapse if the queen is located and removed. Care must be taken when removing a colony of stinging or biting ants.
- **Miscellaneous** • A small group of ants can be wiped up with a damp towel or sponge and discarded.

Chemical Options

- **Detergents** • A mixture of liquid dish detergent and water (10% soap) is useful for removing ants. Detergent can be used to control or reduce the number of ants prior to exclusion or sanitation practices. Detergents may also remove scent trails used by ants.
- **Boric acid** • Boric acid can be used by the IPM technician as a least-toxic pesticide. The treatment can be blown under cabinets and into wall voids, cracks, or any other undisturbed and dry place in an apartment. Boric acid also acts as a barrier treatment to pre- vent ants from entering living spaces.
- **Diatomaceous earth and silica aerogel** • These chemicals kill insects through desiccation, so are used in the same fashion as boric acid.
- **Baits and bait stations** • Baits contain an attractant and a pesticide. The pesticide is ingested by an ant and brought back to the nest where it kills more ants in the colony. In the college/university IPM program, baits should only be used to clear a building of an infestation, not as a preventative treatment. Bait

stations placed in an apartment should be removed when the insect population drops below the action threshold. Baits not contained in a bait station should be located where inadvertent human exposure is minimized, e.g., in cracks, behind faceplates and large appliances, and in locked closets accessible only to IPM technicians. Locations where ants enter an apartment can usually be found by inspecting around the outside of the building, so those entrances can be baited and then sealed. Boric acid is a common ingredient in baits used for an IPM program. The bait selection should be rotated between different types in order to avoid bait aversion and resistance. Different ant species forage for different food types (protein, sugar, fat) at different times of the year, so it is important to know the pest ant's biology prior to selecting bait.

- **Botanical products** • Various botanical products (plant oils, "food grade" products) are currently on the market to control insect infestations. These are used in a fashion similar to conventional liquid pesticides but are relatively non-toxic to humans. Many companies that produce "green pesticides" make claims about their products with little or no supporting efficacy data. These products may be exempt from toxicity studies, so they must be used with caution.
- **Broadcast pesticides** • If all other options have been exhausted and an infestation cannot be controlled, broadcast application of a least-toxic insecticide may be warranted. Pesticide labels should be followed and rotation between products is necessary to prevent the ants from developing pesticide resistance.

Outdoor Infestations

The red imported fire ant can be the major outdoor ant pest in many areas of the US. There are few IPM treatment options, and liability dictates that fire ant infestations be prevented. Ants, with few exceptions, e.g., Pharaoh ants, typically establish their colonies outdoors. They become pests when they enter buildings looking for food and water. If ants enter and become a significant problem, and indoor treatments are ineffective, it should be necessary to control outdoor colonies.

- **Biocontrols** • Parasitoids and pathogens that do not affect humans have been discovered and are beginning to be utilized in some areas of the US on a limited basis. Collaboration with your local USDA office or entomology lab may provide access to some of these biocontrols. The close collaboration between the college/university and these groups may yield new methods and may provide additional biocontrol options in the future.

WHITE-FOOTED ANT
Technomyrmex difficilis

ODOROUS ANT
Tapinoma sessile

RED IMPORTED FIRE ANT
Solenopsis invicta

- **Direct bait application to mounds (fire ants)** • A direct application of bait should be applied to new fire ant mounds.
- **Broadcast bait application (fire ants)** • Baits used in IPM typically consist of a chemical that kills the insect after ingestion. Some baits are also formulated with insect growth regulators which are spread throughout the colony by the foraging ants. Weather is a key factor for most bait applications. Ant activity is highest when the temperature is 70–90˚F. In most areas of the US these temperatures occur from the spring through the fall. The baits should not be applied when the ground is wet or when rain is expected. Never apply more than the label requires.
- **Aphid control** • Many sweet feeding ants feed on honeydew produced by aphids or other insects. Control of the honeydew producing insects can control the ants. Aphids can be managed by promoting predators. This may be done through landscaping by choosing plants that amplify predator populations and by releasing natural enemies in the area. Lacewings, lady beetles, and syrphid flies are well known predators of aphids. Another option is to select landscaping plants that aphids do not infest. Aphids can be controlled chemically through the use of least-toxic, systemic pesticides. These pesticides are applied to the soil around the roots and absorbed by the plant. Timing is crucial for this treatment, as it may take up to two months for the entire plant to absorb the pesticide. Knowledge of the aphid's biology and yearly seasonal occurrence should help determine when this treatment is most effective.

Bed Bugs

Adult bed bugs are oval, flat, and about 3/16" (4-5 mm) long (Fig. 8). If not eliminated immediately when discovered, they can become a tremendous problem in apartments. They are small and can hide in cracks smaller than the width of a credit card. Bed bug elimination requires a site-specific treatment plan.

BED BUG
Cimex lectularius

Prevention and Non-chemical Options

- **Education** • Resident education is the key to preventing a bed bug infestation. During orientation, residents should be provided information regarding the acquisition of used furniture. Information is available on how to not transfer bed bugs to an apartment after traveling. Residents should be made aware of what a bed bug is, how to inspect for them, and how to minimize their movement throughout an apartment.
- **Inspection** • When a bed bug is discovered, it is critical that a thorough inspection of the room/apartment be conducted to determine the extent of the infestation. Kickplates, moldings, and faceplates must be removed and inspected. Carpeting must be pulled away from the walls to determine if there are any bed bugs underneath. Furniture, such as couches, beds, dressers, and desks, should be thoroughly inspected. Detection dogs are available through contractors to find bed bugs in a building.
- **Vacuum** • An entire infested room/apartment must be vacuumed, including beds, furniture, and other harborages, to remove any insects and eggs. Cracks in walls, electrical outlets, and spaces behind moldings should be vacuumed as well.
- **Clothing and bedding** • The bedding in an infested apartment must be washed in hot water and dried with hot air. Clothing that may be infested with bed bugs also must be washed. Half loads of clothes washed on the large load setting should kill bed bugs more effectively than full loads.
- **Dry heat and steam** • At 220˚F steam is immediately lethal to bed bugs. Dry heat treatment of 120˚F for 2.5 hours assures bed bug death. The infested furniture, linens, etc., can be heated to this temperature by placing them into the center of a room, building a box of polystyrene sheets around the pile,

FIGURE 8 • *Size comparison of a bed bug with a pencil.*

Monitoring • Receive a complaint or bed bugs observed during a routine inspection.

Action Threshold • Observe at least one live insect in a room.

FIGURE 9 • *Items placed in a pile at the center of a room.*

FIGURE 10 • *A "heat chamber" made of insulated polystyrene sheets built around a pile of furnishings.*

FIGURE 11 • *Items removed from an infested apartment and placed into a mobile fumigation chamber.*

FIGURE 12 • *Fumigation chamber wrapped in polyethylene sheeting.*

and adding two space heaters and two box fans to produce and distribute the heat (Fig. 9). The box is sealed with tape (Fig. 10) and the temperature is measured by a digital thermometer with a long cord, e.g., thermocouple or wireless indoor/outdoor thermometer. The thermometer sensors should be placed in linen piles or under pillows to determine if well insulated areas reach the critical temperature. Residents must not attempt this dry heating procedure.

- **Freezing** • Freezing infested, heat sensitive items at 0˚F for 4–7 days kills bed bugs.
- **Barriers** • Sealing light switch and electrical outlet faceplates, cracks, etc., with caulking traps bed bugs and prevents others from entering. Encasing box springs and mattresses in vinyl covers prevents bed bugs from infesting them or escaping.
- **Disposal of furniture** • Infested furniture must be disinfested or destroyed rather than discarded to prevent someone from salvaging it and spreading the infestation.

Chemical Options

- **Spot treatment** • Silica aerogel containing a least toxic pesticide applied in harborages, such as behind kickplates, moldings, and faceplates should control the bed bugs while minimizing the risk of human exposure.
- **Fumigation** • An extensive bed bug infestation may warrant fumigation by a college/university IPM technician. Remove all furnishings from an apartment and place them into a fumigation chamber (Fig. 11). The chamber is subsequently wrapped in polyethylene and monitored closely (Fig. 12). Select the least toxic fumigant and use it responsibly and according to the label. Exposure time is calculated based on the temperature and volume of the chamber. The area must have proper signage to notify the residents about the use of a fumigant. Fumigants are never used in the apartments.

Bees and Wasps

These insects, known as social Hymenoptera, range in length from 1/2" to over 1" (12 mm-25+ mm). Care should be taken when college/university IPM technicians remove nests because these insects can sting, possibly causing anaphylaxis. A colony should be removed at a time most of the insects are in the nest and when there is little resident traffic. While personal protective equipment is recommended for any social hymenopteran nest removal, it is mandatory for Africanized honeybee hives. A goal in social hymenopteran management is to remove the queen to trigger colony collapse. Since bees and wasps are beneficial insects, they should be removed only when there is a danger to people.

HONEY BEE
Apis mellifera

BALD-FACED HORNET
Dolichovespula maculata

PAPER WASP
Polistes spp.

Prevention and Non-chemical Options

- **Inspection** • Inspection of potential nesting locations around the buildings should be conducted on a regular basis. Electrical boxes, holes in structures and behind walls, shrubs, outdoor furniture, and infrequently used grills are common nest locations. Frequent inspections should detect nest building when nests are small and can be removed easily. Inspect exposed wood for carpenter bees by looking for woodpecker activity, holes that are approximately 15 mm in diameter, bee staining and saw- dust. Carpenter bee infested wood should be thoroughly inspected and, if necessary, replaced.
- **Exclusion** • Repairing cracks and holes in walls and sealing electrical boxes or other potential nesting locations should prevent social Hymenoptera from establishing colonies. Carpenter bees can be deterred by painting or finishing exposed wood. Established holes should be sealed.
- **Education** • Residents should be educated to avoid nests and report their presence to college/university staff immediately. Residents should never attempt to remove a nest or treat one with pesticides. They should be told about the benefits of bees and wasps, and that these insects usually sting only when provoked. Swarming Hymenoptera, or those heavily foraging in a particular area, should be isolated from residents and signs posted to notify them of the insect activity.

Monitoring • Receive a complaint of bees or wasps observed during a routine inspection.

Action Threshold • Observe nest building or high activity near doorways, walkways, or where people are threatened.

BUMBLE BEE
Bombus spp.

YELLOW-JACKET
Vespula maculifrons

- **Sanitation** • These insects are often attracted to sweet food left outside. Beverage cans, bottles and cups with sweet liquids should be collected, rinsed and recycled by the residents. Sweets, such as hard candy, popsicles, ice cream, or juice, that are spilled should be wiped up even when outside. Outdoor garbage receptacles should be covered to prevent these insects from accessing food. Also, removing outdoor clutter eliminates potential nest locations.
- **Vacuum** • An occasional bee or wasp entering an apartment can be carefully vacuumed by the resident. More extensive infestations must be handled by a college/university IPM technician. Nests in wall voids can be vacuumed to remove the wasps and nesting material. A trowel can be used to expose and dislodge a nest. Underground populations can also be vacuumed. Any alternate entrance to the nest must first be adequately covered with soil to eliminate an escape route for the insects. For underground vacuuming, the hose is held a few inches away from the entrance to capture any insects attempting to enter or exit the nest. When no more insects are seen flying, the nest can be dug up and discarded.
- **Nest removal** • Skill and care is required when removing a nest and the use of personal protective equipment is recommended. The ideal time is morning or evening in cool weather when the insects are most likely to be in the nest. Resident traffic should be minimized in the immediate area. Smaller nests can be knocked down and destroyed but larger ones may require a treatment to contain the insects. An aerial nest can be placed into a heavy duty plastic bag and left in the sun for 2-3 hours. This kills any insects prior to disposal. On cool days, it may be necessary to place the bag into a freezer or add a small amount of soap solution. Only an experienced college/university IPM technician should remove a hymenopteran nest.
- **Traps** • These insects also can be trapped using yellow sticky traps and baited cone-type traps. Although trapping entire nesting colonies may be impossible, traps can be used to decrease the number of bees and wasps in an area. Traps also can be used to capture swarming bee colonies, including the queens, so new colonies do not become established.
- **Freezing wasps** • Some products are designed to be sprayed on and into nests to freeze these in- sects. Liquid nitrogen is commonly used to freeze nests, especially those in wall voids or other confined spaces.

Chemical Options

- **Silica aerogel** • This dust can be blown into ground or wall nests to desiccate the insects. Because of the nest structure, this product may not be effective for large nests.
- **Insecticide sprays** • When using an insecticide spray, it is critical that the college/university IPM technician be as close as possible to the nest to minimize spray drift (Fig. 13). However, the technician needs to maintain a safe distance during spraying to minimize the likelihood of being attacked by the insects. A least-toxic spray should be used to knock down the guard insects and safely remove an aerial nest. For ground or wall nests where removal is not feasible, an insecticide can be applied to the main entrance after all secondary entrances are located and sealed. All insects should be killed by the insecticide, so removal of the nest is not critical. The insecticide label should describe how to apply the insecticide properly.

FIGURE 13 • *Paper wasps on a nest*

ROCK DOVE "PIGEON"
Columba livia

BAT
Order: Chiroptera

Birds and Bats

Animals, such as birds and bats, may occasionally reside in or on buildings. Bats are known vectors of rabies and both bat and bird feces can accumulate and attract other pests or become health hazards. Woodpeckers and other cavity nesting birds may damage property while attempting to find nourishment or make nest holes. When controlling birds, it is important to know what species is present. Not all bird species should accumulate enough to become a problem. All native, non-game, wild bird species are federally protected, so removal of nests that contain eggs, hatchlings, or fledglings is illegal (Migratory Bird Treaty Act of 1918, 16 USC 703 through 712). Common pest species that are not listed as protected by law include the rock dove or pigeon, *Columba livia*; European starling, *Sturnus vulgaris*; and house sparrow, *Passer domesticus*. State and federal laws protect bats.

Prevention and Non-chemical Options

- **Exclusion** • The easiest way to prevent bat and bird infestations is through exclusion. Repairing holes in building exterior walls and roofs discourages these animals from establishing residence. Noise makers are available but are not recommended for use near residential buildings because they are loud. Spike strips can be placed on ledges or the ledges can be angled at 45 degrees to prevent an accumulation of roosting and perching birds. Plastic decoys of predator species are also available. This deterrent may be effective at first but pest birds will become accustomed to a decoy over time. In many states, bats cannot be excluded during the mating season between April 16 and August 14. Bats discovered in occupied living spaces should be reported to the local public health officials since bats are potential vectors of rabies.

Monitoring: Receive a complaint of a bird or bat observed causing deleterious effects during a routine inspection.

Action Threshold: Birds: Observe at least ten per building or areas where feces is one inch deep or greater. Observe any activity above doorways. Bats: Observe at least one on or in a building.

- **Feeding birds** • Many people feed birds with bird feeders. If a large accumulation of seed is spilled on the ground, pest birds may increase in the area. If this occurs, the resident should be asked to temporarily stop feeding birds. Pest birds should never be fed intentionally.
- **Removal** • If the nest of a protected bird is to be removed, the young should be given time to fledge. When it is certain that the birds have left the site, the nest can be removed and the location altered to prevent future nesting. Devices are available to remove bats and birds that reside in cavities. These devices allow movement one way, so when placed on an entrance the animal can exit the cavity but not return (Fig. 14). After all of the animals have vacated, the cavity should be repaired.

FIGURE 14 • *Devices, such as bat netting, can be placed where birds or bats reside to allow one-way movement out of the cavity, thus they can also be used for exclusion.*

Chemical Options

- Chemicals should not be used to control birds or bats.

BOOKLOUSE
Liposcelis spp.

SILVERFISH
Lepisma saccharina

EARWIG
Order: Dermaptera

Booklice, Silverfish and Earwigs

Booklice are 1/32" to 1/4" (1–6 mm) in length, while silverfish and earwigs range from 1/4" to 1" (5–25 mm) in length. These insects are usually associated with moisture. Although they are considered nuisance pests, booklice and silverfish can damage books and documents by feeding on paper and glue. Within apartments, earwigs feed on living and dead plant material and some insects.

Prevention and Non-chemical Options

- **Sanitation** • Drying the areas where these insects are found should eliminate the problem. The bathroom and kitchen, especially around the sinks in both locations, should be kept dry and mold free. The bathroom vent should be in working order and used to reduce the apartment's humidity. Shower curtains used by the residents should be kept unfolded to dry. Leaking pipes should be repaired and all cracks sealed to prevent water from entering under and behind fixtures and walls. Condensation should be eliminated.

Chemical Options

- **Soaps and detergents** • Soaps and detergents can be used to remove insects and clean mold that can be an insect food source.
- **Boric acid** • Boric acid is an effective, least-toxic pesticide that can be blown under cabinets and into wall voids, cracks, or any other undisturbed and dry place in an apartment. Bait products containing boric acid are formulated for managing silverfish.
- **Diatomaceous earth and silica aerogel** • These chemicals kill insects through desiccation and are used in the same fashion as boric acid.
- **Broadcast pesticides** • Broadcast pesticide treatments should not be used to control booklice, silverfish or earwigs in college/university facilities.

Monitoring: Receive a complaint or pests observed during a routine inspection.

Action Threshold: Booklice: Heavy infestation. Silverfish and Earwigs: Observe at least three live in a room.

Cockroaches

The American cockroach, *Periplaneta americana*, attains a maximum of 2 1/8" (53 mm) in length and the German cockroach, *Blattella germanica*, is 1/2" to 5/8" (13–16 mm) in length. Cockroaches tend to avoid light, so they may not be observed during apartment inspections. Look for indirect signs of an infestation, including feces, carcasses, and oothecae (egg cases). These characteristics help identify the species of cockroach and locate the problem areas.

Prevention and Non-chemical Options

- **Exclusion** • Cockroaches can easily move from one residential unit to another. Sealing corridors, e.g., vents and plumbing, between apartments can prevent this transfer of cockroaches. Caulking cracks in walls, sealing windows and doors, and properly installing escutcheon plates prevents cockroaches from entering an apartment from outdoors. Maintenance services should be notified via online work orders to complete these kinds of repairs. Cockroaches also can enter an apartment through sewer vents and drains. Sinks and bathtubs with drain covers that have small holes exclude large cockroaches. The water within sink and bathtub traps can evaporate if they are used infrequently. Dry traps provide cockroaches direct access to an apartment.
- **Sanitation** • Cockroach food sources and harborages must be eliminated (Fig. 15). These pests are especially attracted to grease, so stoves and the surrounding areas must be cleaned frequently. Small appliances, such as toasters and toaster ovens, often are overlooked and can accumulate crumbs. Cockroaches also often feed on and reside in cardboard used for storage. If sanitation in an apartment is unacceptable, a copy of the sanitation guidelines should be provided to the resident and the residence director of the apartment complex should be notified.

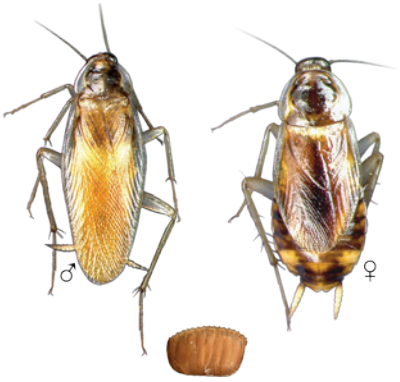
Monitoring: Receive a complaint or live cockroaches observed during a routine inspection. Dead bodies or cockroach fecal pellets can also provide evidence of their presence.

Action Threshold: Observe two live cockroaches in a room or on a monitoring board.

GERMAN COCKROACH WITH ITS OOTHECA
Blattella germanica

AMERICAN COCKROACH
Periplaneta americana

SURINAM COCKROACH
Pycnoscelus surinamensis



BROWNBANDED COCKROACH (male and female with ootheca)
Supella longipalpa

AUSTRALIAN COCKROACH
Periplaneta australasiae

WOOD COCKROACH AND OOTHECA
Eurycotis floridana

- **Moisture** • Cockroaches are attracted to moist areas, e.g., near leaking pipes, condensation, pooled water, or spills. The maintenance section should be contacted to repair pipe leaks or eliminate sources of condensation and the residents should be asked to keep their apartments dry.
- **Food storage** • Cockroaches are attracted to food that is not sealed in a container. If food is not stored properly, the resident should be provided guidelines and asked to follow the IPM technician's advice. It is recommended that food stored in cupboards or on counters be placed in airtight containers. Food can also be stored in the refrigerator to protect it from becoming infested.
- **Vacuum** • Visible living and dead cockroaches, their cast skins, and oothecae, can easily be vacuumed by the resident. This reduces both the number of cockroaches and potential allergens. Vacuum cleaner attachments can be used to access harborage areas, such as cracks in walls or behind large appliances. Vacuum cleaners with HEPA filters provide the best protection from airborne particles, otherwise a dust mask, e.g., N-95, should be worn. Employees must be enrolled in an OSHA mandated respiratory protection program and medically cleared prior to using any respirator.
- **Miscellaneous** • Residents should kill and discard individual cockroaches before they become established in an apartment. Cockroaches can be removed physically, e.g., with a flyswatter or trapped. Immediate removal can prevent cockroaches from developing a reproducing population. If many cockroaches are killed, the carcasses should be discarded to reduce exposure to allergens.

Chemical Options

- **Detergents** • A mixture of liquid dish detergent and water (10% soap) can be used by residents to kill solitary cockroaches and avoid filing a pest control request.
- **Boric acid** • Boric acid can be used by the IPM technician as a least-toxic pesticide. The treatment can be blown under cabinets and into wall voids, cracks, or any other undisturbed and dry place in an apartment. Boric acid acts as a barrier treatment to prevent cockroaches from entering living spaces.
- **Diatomaceous earth and silica aerogel** • These chemicals kill insects through desiccation, so are used in the same fashion as boric acid.

- **Baits and bait stations** • Baits contain an attractant and a pesticide that is ingested by a cockroach. In the college/university IPM program, baits should only be used to clear an apartment of an infestation, and not as a preventative treatment. Bait stations placed in an apartment should be removed when the insect population decreases below the action threshold. Baits not contained in a bait station should be located where inadvertent exposure is minimized, e.g., in cracks, behind faceplates and large appliances, and in locked closets accessible only to college/university IPM technicians. Locations where cockroaches enter an apartment should be found by inspecting the building perimeter. Insect entry points should be baited and sealed. Boric acid is a common ingredient in baits. Bait selections should be rotated among different active ingredients in order to avoid bait aversion and resistance by cockroaches.
- **Botanical products** • Various botanical products, e.g., oils and "food grade" products, are currently on the market to control insect infestations. These are used in a fashion similar to conventional liquid insecticides but are relatively non-toxic to humans. However, many companies that produce "green pesticides" make claims about their products with little or no supporting efficacy data. These products may be exempt from toxicity studies, so they must be used with caution.
- **Broadcast pesticides** • If all other options have been exhausted and an infestation cannot be con- trolled, a broadcast application of a least-toxic insecticide may be warranted. Pesticide labels should be followed and rotation between products is necessary to prevent pesticide resistance.

FIGURE 15 • *Containers to be recycled can provide food for cockroaches if not rinsed thoroughly.*

DRAIN FLY
Psychoda spp.

HOUSE FLY
Musca domestica

FRUIT FLY
Drosophila melanogaster

Flies

Fruit flies are about 1/8" (3 mm) in length, while other indoor pest flies range from 1/8" to 5/8" (3–16 mm) in length. Indoor flies are primarily considered nuisance pests but they have the ability to mechanically vector human pathogens. Since the larvae of many species develop in soft, rotting organic material, a large population of flies can indicate poor sanitation. Mosquitoes, though often present in an apartment, do not reproduce unless there is standing water. Biting flies, such as horse and deer flies, are outdoor pests seldom encountered in an apartment.

Prevention and Non-chemical Options

- **Exclusion** • Sealing doors and installing window screens that fit prevent flies from entering an apartment. Small seasonal flies can be excluded by keeping windows and doors shut during their peak activity.
- **Sanitation** • A large number of flies in an apartment indicates poor sanitation. If there is garbage containing food, it must be removed from the apartment immediately. Garbage cans should have lids and be cleaned often by the residents. Dumpsters should be located away from the apartments and emptied frequently. Fruit flies breed in fruit left out on counters, so old fruit should be discarded and fresh fruit stored in the refrigerator. Drain flies can infest an apartment if the drains are clogged with hair or standing water is left in sinks. Drains should be cleaned if there is drain fly activity. Removing odors in an apartment makes it less attractive to flies.
- **Miscellaneous** • Flies can be killed by the residents with flyswatters. If flies are abundant in an apartment or building, fly traps and fly paper can be used.

Chemical Options

- Chemical treatments should not be used to control flies in the college/university IPM program.

Monitoring: Receive a complaint or flies observed during a routine inspection.

Action Threshold: Observe at least five live flies in a room.

Rodents

Rodent infestations are indicated by signs of activity, including feces, nests and evidence of chewing. In college/university facilities, pest rodents include mice, rats, and squirrels that may reside in buildings and cause considerable damage.

Prevention and Non-chemical Options

- **Exclusion** • Rodents can fit through holes and cracks much smaller than their apparent body size. Sealing holes and other possible entrances with foam or wood may not deter rodents, so wire mesh should be used. Rodents cannot chew through wire mesh to enter a residence. All drains should be capped, especially storm or overflow drains located near buildings.
- **Landscaping** • Improper landscaping can provide rodents with harborages, food and access into buildings. Avoid planting shrubbery close to buildings, and trim tall grass and weeds at least one foot from exterior walls.
- **Sanitation** • Eliminating food sources and harborages by properly disposing of waste materials makes apartments less attractive to rodents (Fig. 16). Both indoor and outdoor clutter should be eliminated by the residents. Dumpsters should be located away from apartments and emptied frequently. Residents should be instructed to place garbage into the dumpsters, not on the adjacent ground.
- **Food storage** • Food should be stored in metal or glass containers because rodents cannot chew through them to gain access. If the residents feed birds with a feeder, they should prevent access by other animals and remove spilled seeds. Bird seed should be stored in a sealed container.
- **Snap traps** • There are various types of traps that do not involve poisoning rodents. Live traps are preferred because the captured rodents can be relocated by the IPM technician. If snap traps are used, they should be checked often to immediately remove captured rodents. Food should not be used to bait a trap because it can attract pests, such as ants

FIGURE 16 • *Uncovered trash attracts rodents.*

Monitoring: Receive a complaint or a rodent observed during a routine inspection.

Action Threshold: Observe one rodent indoors or outdoors when destroying property. Rodent nesting in wall voids.

FIGURE 17 • *A mouse trap with a square of plastic on the trigger to increase its effectiveness.*

and cockroaches. Cotton can be an acceptable alternative that rodents may attempt to take for nesting material. To improve snap trap efficiency, a stiff square of cardboard or plastic can be placed on the trigger to make it larger (Fig. 17). An enclosed snap trap can be used if the interior of the trap is visible. Traps should be placed in locations where they should be encountered by foraging rodents. This includes sites along walls, obvious pathways, in front of known access points, or situations in which rodents are forced to encounter the trigger. If placed along a wall, the trap should be oriented perpendicular to it with the trigger facing inward. Trapping locations and periods should be varied to discourage trap avoidance.

Chemical Options

- **Baits** • Poison baits should not be used in the college/university IPM program. Baits are often colorful and may be eaten by children and pets. Also, baits kill rodents slowly, enabling them to return to harbor- ages and die where they cannot be removed. This can cause an unpleasant odor as rodents decompose.

Stored Product Pests

Some of the most common stored product pests are the cigarette, drugstore, confused flour, merchant grain, and saw-toothed grain beetles; grain, cowpea, granary, and rice weevils; and Indian-meal and Angoumois grain moths. Dermestid beetles can also be included because they are known to feed on cured meats that are not properly stored. The beetles and weevils range in length from 1/16" to 1/4" (2–5 mm) and moth caterpillars are 1/4" to 1/2" (5–12 mm) in length.

DRUGSTORE BEETLE
Stegobium paniceum

Prevention and Non-chemical Options

- **Education** • These insects are usually brought into apartments in poorly preserved or packaged products. Residents should be provided information on food inspection and storage. Infestations can be prevented by not purchasing contaminated products.
- **Sanitation** • Food packages in an apartment should be discarded when infested with stored product pests. All packages of food should be inspected to determine if they are infested. Cardboard boxes containing food should be placed into air tight plastic, glass or metal containers. Storage cabinets should be cleaned periodically to remove contaminated food and pests.
- **Heat or cold treatment** • Food for consumption or display can be cooked or frozen. Decorative corn, for example, should be either baked at 150°F for 20 minutes or frozen at 0°F for four days before it is displayed.
- **Traps** • Sticky traps can be placed into cabinets to detect stored product pests. Sticky traps supplemented with attractants are available for capturing moths. Light traps can be used to remove certain kinds of stored product pests from pantries.

RICE WEEVIL
Sitophilus oryzae

CONFUSED FLOUR BEETLE
Tribolium confusum

Chemical Options

- **Baits** • Bait stations should be placed into infested cabinets to capture and eliminate pests that are discovered during an inspection. When no stored product pests are detected during follow-up inspections, the bait stations should be removed.

SAWTOOTHED GRAIN BEETLE
Oryzaephilus surinamensis

Monitoring: Receive a complaint or stored product pests observed during a routine inspection.

Action Threshold: Observe at least three live pests in a room.

FORMOSAN TERMITE
Coptotermes formosanus

EASTERN SUBTERRANEAN TERMITE
Reticulitermes flavipes

DRYWOOD TERMITE
Cryptotermes brevis

Termites

Termites are social insects well known for their structure destroying habits, so early detection is critical to minimize the damage and repair costs. Swarming termites range from 1/4" to 1/2" (5–13 mm) in length. Three types are named based on their habitats: subterranean, drywood, and dampwood termites. Identification of the type is necessary to select appropriate control measures. Drywood termites are considered the most difficult to control and fumigation is often required. Many states building codes specify preventative treatments that require approved products and procedures.

Prevention and Non-chemical Options

- **Inspection and detection** • Termites can be difficult to detect, so the most definitive way to confirm an infestation is to observe them swarming in or from a building. Swarming termites are easy to collect and identify to type and perhaps to species. Inspecting cracks for soil and walls for mud tubes can reveal potential infestations, as well. Tapping on the surface and listening for hollow areas or probing with a tool can help locate an infestation in wood. Also, frass is often found near infested wood. Detection dogs can be used to locate termite infestations and help minimize invasive testing and probing.
- **Moisture** • Subterranean and dampwood termites require moisture to survive. Consequently, water must be drained away from buildings to minimize soil moisture in the area. Attics and crawl spaces should be well ventilated to keep humidity and, consequently, wood moisture low. Water from lawn irrigation systems and other sources should not reach buildings. Both indoor and outdoor pipe leaks must be repaired expeditiously.
- **Exclusion** • Trees should be planted away from buildings so termites cannot follow roots to cracks in foundations. Wood structures must not touch the soil and should be kept at least 8–12 inches above the surface. Access into crawl spaces or attics should be screened to provide adequate ventilation and prevent swarming termites from entering. Swarming termites and mud tubes can originate from small cracks that must be

Monitoring: Receive a complaint or termites observed during a routine inspection.

Action Threshold: Observe at least 20 subterranean termites in a monitoring station. A termite tube on or in a building. Termites swarming from a building. Drywood termite frass and live workers.

sealed. All cracks in the buildings should be filled to exclude termites and other pests.

- **Harborages** • Removing tree stumps and wood debris from the grounds can prevent termites from establishing and spreading to a building. Untreated wood should never be buried, which includes fence posts, wood debris, and wood used for landscaping.
- **Maintenance** • A building inspector should evaluate wood heavily damaged by termites and, if necessary, recommend that it be replaced. Wood that is rotting or accessible to termites should be replaced with metal or plastic building materials. If replaced with wood, it must be resistant to termites, e.g., cedar, white oak or cypress.

Chemical Options

- **Wood treatments** • Only wood pressure treated with low risk chemicals should be used in college/university facilities. Although borate-treated wood repels termites and kills those that feed on it, the chemical can leach into the soil. Moreover, borates work well only in areas protected from water. Pressure treated wood containing chromated copper arsenate (CCA) also is resistant to termites but contains chemicals that may pose a risk to humans and the environment. Wood pressure treated with other than borates and CCA should be used when it is in contact with the ground.
- **Baits** • Baits made of sawdust, paper, or wood treated with a pesticide are placed into plastic containers and distributed around structures. Termites are attracted to these slow-acting baits and feed on them. Once exposed, the contaminated termites re-enter the colony to spread the toxicant by feeding it to others. Baiting can take months before a colony is eliminated. Subterranean termites are baited most effectively in late spring and early summer. Baits can also be used for monitoring by checking them periodically for termites.
- **Liquid pesticides** • Termite-infested wood can be injected with a least-toxic pesticide. The size and location of holes drilled into a structure are selected to minimize damage and facilitate sealing after the pesticide is applied. Liquid pesticides used as a preventative barrier are applied during building construction, as required by many state building codes.
- **Fumigants** • Fumigation may be required to eliminate termite infestations. Fumigants should be used by certified technicians as directed by the label and all safety precautions shall be followed. Fumigation of a single apartment is impractical and not an option at college/university facilities.

Weeds

FIGURE 18 • *Poison ivy,* Toxicodendron radicans.

Most weeds are only considered aesthetically undesirable. However, noxious plants, such as poison ivy can cause severe rashes (Fig. 18). Plants with sharp spines or stinging hairs can be hazardous, such as thistles or nettles, respectively. In addition, some weeds are highly toxic, e.g., pokeweed, *Phytolacca americana,* and should be removed from areas near buildings managed by the college/university. Children can be attracted to the poisonous pokeweed berries. Developing a tolerance for weeds that pose no health risks, such as dandelions or crabgrass, is preferred over chemical treatments in the college/university IPM program.

Monitoring: Receive a complaint or noxious weeds observed during a routine inspection.

Action Thresholds: Observe no weeds of public health significance in close proximity to a structure. Nuisance or aesthetic weeds, 25% in 100 ft2 or at IPM technician's discretion.

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FORMS

Work Request Form

Please enter the information in the form below to your best ability. Incorrect or missing information should delay the process.

If this is an emergency, please contact the Department of Housing at **(352) 392-2161**.

Name _____ Email _____

UFID ____ - ____ Phone Number ____ - _____ - _____ Ext. ____ please check number and extension

Please Select Your Room Select One

Emergency Maintenance called? No Emergency Building Services called? No

Please Choose the Request Type:

- ○ **Pest Control Request:** These include problems involving ants, roaches, etc.
- ○ **Building Services:** These include problems involving cleaning or health and safety issues.
- ○ **Maintenance Request:** These include problems with plumbing leaks, tub and shower and toilet stoppages, appliances, doors and locks, windows, furniture, lights and air conditioning.
- ○ **Mold and Mildew:** These include problems like Mold and Mildew.

Enter a thorough description of your request: (Please limit your response to 375 characters—375 remaining)

Confirm Work Request

Housing Inspection Form

Inspector: _____ Inspection Date: _____

Building: _____ Re-Inspection Date: _____

Apartment Number: _____

Housekeeping Issues[1]	Maintenance Issue[2]	Action Taken[3]

[1] Excessive clutter, prohibited animals, unacceptable sanitation, etc.

[2] Leaking pipes/faucets, windows/doors do not seal, holes in walls, etc.

[3] No action taken, verbal notification to resident, formal citation, follow-up inspection required, IPM option, etc.

Pest Monitoring Form

Building: _____ Inspector: _____

Apartment Number: _____

Dates Monitor Checked:								
Trap	Location	Date of Placement	Insect Species	#	Insect Species	#	Insect Species	#
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Comments:								

Integrated Pest Management Form

Request, Monitoring, Inspection Form			Assessment, Prevention and Non-chemical Treatment, Evaluation	Chemical Treatments			Entered in Database
Date	Building	Apt. #	IPM Options	Product	Active Ingredients	Amount	✓

Vacant Apartment Inspection Pest Control

1. Exterior of Building:

- ☐ Inspect porch, windows, and eaves for wasps and other insect activity.
- ☐ Check for ants intruding and fire ant mounds near the apartment.
- ☐ Check upper areas for gaps that would allow bat activity.
- ☐ Check the exterior side of the windows for gaps, cracks and that they are properly sealed.
- ☐ Check wall penetrations for proper sealing around all penetrations.
- ☐ Check condition of walls for gaps, cracks, and moisture issues.
- ☐ Check specifically for proper rodent exclusion.

2. Doors/Windows:

- ☐ Check doors to insure they close without apparent gaps around the door frame.
- ☐ Look for light gap at the threshold.
- ☐ Check window frames for gaps/cracks requiring caulking.
- ☐ Check window penetrating hardware for completeness and insure that it is secure.
- ☐ Check the window screens for tears, gaps and completeness.
- ☐ Check around windows for signs of insect activity (fecal pellets/stains, wings, etc.)

3. Kitchen:

- ☐ Check wall/counter top joints for proper seal.
- ☐ Check for leaks and moisture issues.
- ☐ Check wall penetrations for escutcheons and sealing.
- ☐ Look for evidence of current or past insect/rodent activity.

4. Bathroom:

- ☐ Check wall/counter top joints for proper seal.
- ☐ Check wall penetrations for escutcheons and proper sealing.
- ☐ Check walls and areas near tub/toilet for signs of moisture issues.
- ☐ Check tub for proper seal to floor and walls.
- ☐ Check toilet for proper sealing and secured.

5. Utility Closet (AC/ Hot Water) if accessible:

- ☐ Check wall/ceiling penetrations for proper sealing.
- ☐ Check hot water heater for signs of leaking/weeping.
- ☐ Check area for indications of insect/rodent activity.

6. Bedrooms, closets, dining, and living rooms:

- ☐ Check walls for signs of moisture, insect activity, or rodent activity.
- ☐ Check the carpet/wall junctions for signs of insect activity.
- ☐ Check the areas under the windows for signs insect activity.
- ☐ Check the base boards to insure they are secure and for signs of insect activity.
- ☐ Check wall outlet and light switch covers for indications of insect activity.

Any maintenance deficiencies that are discovered should be noted and brought to the attention of the village maintenance supervisor.

LEARN ABOUT HOUSING IPM METHODS

Housing Integrated Pest Management requires a partnership among building managers, maintenance and pest control personnel, and residents. It is important to identify pests accurately and establish threshold levels before utilizing control methods.

Cultural Control

Remove the food, water and environmental conditions that sustain insects.

Physical Control

Exclude pests by sealing cracks and holes leading into the residence.

Use alternatives to pesticides, such as traps and vacuuming, when managing infestations.

Biological Control

Protect and add natural enemies of pests.

Chemical Control

Use pesticides responsibly and according to the label when they are needed.

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