National Park Service
U.S. Department of the Interior

Northeast Region
Boston, Massachusetts

Integrated Pest Management Plan
Fire Island National Seashore

Natural Resources Report NPS/NER/NRR–2006/012



Developed by:
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International Pest
Management Institute
November 2006

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ON THE COVER
Fire Island Lighthouse
Photograph by: Jean A. Currie, President, International Pest Management Institute

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INTEGRATED PEST MANAGEMENT PLAN
FOR
FIRE ISLAND NATIONAL SEASHORE

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FIRE ISLAND NATIONAL SEASHORE
INTEGRATED PEST MANAGEMENT ACTION PLAN

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EXECUTIVE SUMMARY

INTEGRATED PEST MANAGEMENT PLAN FOR FIRE ISLAND NATIONAL SEASHORE

This Integrated Pest Management (IPM) Plan for Fire Island National Seashore (FIIS) provides basic pest management guidelines to help preserve the stored cultural museum resources and park structures, conserve the park grounds, and protect the health and safety of FIIS staff and visitors. As new information and IPM methods will develop over time, this plan should be reviewed and updated periodically.

The Superintendent is responsible for pest management at the park and designates a park IPM Coordinator (Natural Resource Manager) to implement the IPM plan. The IPM Coordinator works with the Facilities Manager, Curator, and others in the implementation of the plan as outlined in NPS-77 (Natural Resources Management Guidelines).

Use of pesticides at FIIS are required to be in accordance with Servicewide policies as found in NPS-77. All pesticides used within the park must be applied by or under the direct supervision of a State of New York certified pesticide applicator. All pesticides used in the park by residents, contractors, special use permittees, agricultural issues, or non-NPS personnel must conform to NPS policies and guidelines, and be approved before use. It is the goal of FIIS in compliance with NPS policy to use low-risk pesticides, if necessary, that will accomplish desired objectives. At the end of each year, the FIIS IPM Coordinator compiles a list of the pesticides applied in the park (on NPS IPM software PUPS) and forwards a copy of that report to the Northeast Regional Support Office.

Descriptions and low-risk pest management methods of museum and other pests potentially present in FIIS structures, displays and landscapes are described. Museum pests, carpet beetles, mice, wasps, silverfish, carpenter ants, mold, rust, and exotic invasive plants are identified by park staff as high concerns. Preventive methods such as exclusion, sanitation, and habitat modification are described, as well as direct actions such as trapping and the use of directed pesticide applications. Inspections and monitoring of pest populations and environmental conditions will determine the extent of pest presence and direct pest management actions.

Information on mosquitoes and their management is included in this plan. However, a long-term Mosquito Management Plan is being jointly developed by Suffolk County, New York and FIIS and will be implemented when the joint plan is finalized. Until then, the FIIS staff will utilize the park's mosquito surveillance and management protocols currently in existence.

The park is concurrently implementing a collaborative research effort, testing the efficacy of immuno-contraception in managing deer populations. Although FIIS recognizes the detrimental effects the deer may be having on the park's natural resources, along with the Lyme disease threat that they help support, specific management methods are still research-pending.

While invasive plants represent a major issue for the park, the scope of this plan does not allow for a thorough examination of these pests. Management recommendations for known invasive species have been included, but it is recommended that a separate invasive plant management plan be developed for the park to include species distribution, density, and prioritization for management.

Private communities within and adjacent to the Park may plant or harbor exotic invasive plants or animals that adversely affect the Park. Communication and education provided by FIIS may help alleviate the movement of these pest plants and animals into the Park.

INTRODUCTION

Fire Island National Seashore (FIIS), south of Long Island, New York, was authorized by Congress in 1964 in order to conserve and preserve for the use of future generations, relatively unspoiled and undeveloped beaches, dunes, and other natural features in close proximity to large concentrations of urban populations (Public Law 88-587). Lands, waters, and other properties extend from Moriches Inlet in the east to the lighthouse site in the west, along with associated islands and portions of the Great South Bay and Moriches Bay. In 1965, Congress authorized the Secretary of the Interior to accept the donation of the property in Suffolk County, New York known as the William Floyd Estate for addition to the park (Public Law 89-244). The land was not appropriated, however, until 1976 (Public Law 94-578).

Fire Island National Seashore is a complex park with a number of historic and modern structures, landscapes, and natural areas, including wilderness and dynamic coastal dunes with accompanying vegetation. Beyond the usual assortment of urban and rural pest issues, extensive populations of exotic invasive plants present an additional challenge. Communication and education efforts should be developed to reduce movement of exotic invasive plants and animals into the Park.

This low-risk, integrated pest management (IPM) plan provides insight into the continued protection and preservation of park resources and human health. Risk is the result of toxicity (hazard) multiplied by exposure. This low-risk pest management plan reduces pest presence, reducing the hazard to the park and humans. It also encourages low-toxicity pesticides or other non-toxic methods for managing pests, resulting in the low-risk pest management approach. Managing pests that may affect historic structures and/or related landscapes (turf, gardens, orchards, forests) must be accomplished, through a team effort, in a manner that does NOT compromise the resource, landscape or character-defining features. Integrated pest management is a process that utilizes knowledge of the biology and behavior of the pest(s) in managing pest presence through exclusion, sanitation, habitat modification and, if needed, the minimal use of low-risk pesticides. It should be noted that the findings are only related to structures, including privately-managed concession buildings, and land in fee title ownership by the National Park Service. No surveys or inspections were done on private property in any of the communities present on Fire Island.

Any actions taken by the park to remove an invasive plant or animal, for the most part, can only occur on federal lands. Through information and education, the park needs to work with the communities and visitors on any invasive plants and animals that might be impacting park resources.

All photographs included in this IPM plan were either taken by the author or from public domain websites and are not subject to copyright infringement.

LEGAL AUTHORITIES AND REQUIREMENTS

The National Park Service uses integrated pest management (IPM) methods as the preferred means for managing pests based on federal laws, regulations, executive orders, presidential memorandum, NPS policies and guidelines, and state regulations on pesticide use.

FEDERAL LAWS AND REGULATIONS

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947; amended by P.L. 92 516 (82 Stat. 973) and P.L. 94-140 (89 Stat. 751)
Federal Environmental Pesticide Control Act of 1972 (7 U.S.C. 135 et. seq.)
President Carter's 1979 Executive Order requiring all Federal Agencies to use integrated pest management technology for pest control and to reduce use of toxic pesticides
President Clinton's April 26, 1994, Memorandum concerning economically beneficial practices on Federal landscaped grounds
Secretary Babbitt's July 12, 1994, Memorandum concerning the Department of Interior and the Federal Insecticide, Fungicide, and Rodenticide Act
Executive Order 11870 concerning Animal Damage Control
Executive Order 11987 concerning Exotic Organisms
Executive Order 12088 concerning Pollution Control
Resource Conservation and Recovery Act (40 CFR 165) dealing with pesticide disposal
Migratory Bird Treaty Act of 1918 implemented the 1916 Convention between the United States and Great Britain (for Canada) for the protection of migratory birds
Endangered Species Act of 1973 which provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered in the United States or elsewhere
Occupational Health and Safety (OSHA) Hazard Communication Standard (29 CFR 1910.1200) and Respiratory Program Standard (29 CFR 1910.134)

NPS POLICIES AND GUIDELINES

Guide for Pesticide Use in the National Park Service, WASO, and Director's Order 77-7:

NPS Management Policies 2001

> *The decision to incorporate a chemical, biological or bio-engineered pesticide into a management strategy will be based on a determination by a designated IPM specialist that it is necessary, and that all other available options are either not acceptable or not feasible.*

NPS Natural Resources Management Guidelines (NPS-77), Chapters 2, 4 and 5

Additional guidelines relating to the park's IPM program appear in other chapters of NPS-77:

Chapter 2: Vegetation Management; Native Animal Management; Freshwater Resources Management; Endangered, Threatened, and Rare Species Management; Exotic Species Management; Hazardous Waste Management; and Public Health and Safety.

Chapter 3: Agricultural Use, Right-of-Way and Easements, and Backcountry Recreation Management.
Chapter 4: Environmental Compliance
Chapter 5: Special Use Permits and Collections.

The NPS Museum Handbook, Parts I and III, Museum Collections, affords guidance on instituting a museum IPM program, identification of museum pests, and proper actions to take if pests are discovered in a museum.

PARK MANAGEMENT STRATEGIES

LOW-RISK PEST MANAGEMENT ACTION PLAN OBJECTIVES

Plan Objectives: A low-risk integrated pest management (IPM) action plan is designed to provide guidance to staff in the care and protection of the park from pest presence and subsequent damage.

This plan describes:

- observed evidence of pest activity (and damage),
- potential pest species that may interfere with the park's objectives,
- potential public health issues, and
- most importantly the procedures and actions necessary to prevent pest access and methods for their elimination.

This plan will help meet goals to preserve FIIS resources: Cultural resources and natural areas at FIIS are protected, restored and/or maintained in good condition and managed within their cultural or natural context. Staff and visitor concerns are addressed by managing pests that may affect their health and/or safety; and utilizing preventive approaches such as exclusion, sanitation, and habitat modification as the low-risk methods preventing pest presence. Low-risk pesticides are employed only as a last resort.

Many facilities deal with pests in a reactive sense, treating for the pest after the infestation has occurred or with routine monthly sprays. Pests in a museum, library or archive environment can cause serious damage to highly valuable, and many times, irreplaceable materials or artifacts. IPM is proactive – work must be done to prevent pest activity rather than react to pest damage. Damaged artifacts may NOT be replaceable, and the extent of damage may preclude effective restoration. Prevention is equally as important as response and may preclude having to respond! Materials such as paper, glues, leather, sinew, fur, hair, wood, cotton, wool, hemp, linen, silk, casein, grass, reed, pine needles, or fabrics contaminated with sweat, blood, urine, feces and so on, are organic materials susceptible to the ravages of insects and other arthropods, rodents, mold, and bacterial pest organisms.

The benefits of an effective IPM plan, fully implemented, provide a system of protection for the structure, collections, and staff from close encounters with pest species. The absence of pest species reduces potential damage to museum and other objects and, therefore, reduces park resources needed to repair or replace objects. Benefits of implementing a low-risk IPM approach include excluding pests from entering the structure, eliminating pests that may already be present, implementing management procedures prior to pest population buildup, and the elimination (or minimizing) of placing pesticides in the environment. Additionally, it provides an opportunity to provide a flexible and varied approach to managing the site and curatorial environment so the pest does not want to be there. The IPM approach provides an efficient and environmentally conscious preservation or conservation of historic collections, landscapes, and natural areas.

In addition to the potential for actual damage to materials in the displays and collections, some pests pose potential health risks to staff and visitors. Rodents (rats and mice) are known vectors of many disease organisms to humans, including the deadly Hantavirus. The cast skins of dermestid beetle larvae also contain fine barbed hairs that can be very irritating. Ants, bees, wasps, spiders, dust mites, and other insect pests and molds, both inside and outside, may cause some health risks to the general public. Deer ticks (and other species) can transmit Lyme disease and other maladies to staff and visitors. Managing all these potential pest issues where the public has access, as well as staff-accessed areas, is an important consideration in a low-risk integrated pest management plan.

Curatorial staff has a key role in protecting the historic fabric present in displays and storage areas, and will use this low-risk pest management plan to accomplish this objective. Maintenance and custodial staff have already made important contributions toward reducing pest populations. Additional directed efforts by the maintenance and custodial staff will further reduce the potential adverse pest impact upon the protection of the site contents and visitor enjoyment.

IPM is defined as follows:

Integrated Pest Management (IPM) is the coordinated use of pest and environmental information with available pest management methods to prevent unacceptable levels of pest damage by the most economical means, and with the least possible hazard to people and the environment. The goal of the IPM approach is to manage pests and the environment so as to balance costs, benefits, human health, and environmental quality. IPM systems utilize a high quantity and quality of technical information on the pest and its interaction with the environment (site). Because IPM programs apply a holistic approach to pest management decision-making, they take advantage of all low-risk pest management options, emphasizing natural biological methods and the appropriate use of selective pesticides. IPM strategies incorporate environmental considerations by emphasizing pest management measures that minimize intrusion on natural bio-diversity ecosystems. Thus, IPM is:

- A system utilizing multiple methods
- A decision-making process
- A risk reduction system
- Information intensive
- Biologically based
- Cost effective, and
- Site specific

A short definition is:

IPM is risk reduction: reduction of the risks from the presence of the pest, as well as the risks from the means used to manage the pests.

Low-risk IPM considers the acute and chronic toxicity of the pesticide that may be employed as well as the potential exposure from the treatment to staff and visitors (especially more vulnerable children).

NATIONAL PARK SERVICE LOW-RISK INTEGRATED PEST MANAGEMENT PROCESS

The National Park Service has developed an effective and advanced process for developing and implementing an IPM strategy for pests on park sites. An 11-step process has evolved since 1979 to its current form. A brief discussion of these 11 steps as they relate to Fire Island National Seashore follows.

Step 1 Set Site Pest Management Objectives and Priorities

The mission of Fire Island National Seashore is to preserve, conserve, protect, and maintain those resources within its charge for the enjoyment of this and future generations.

Priorities: The natural communities and features of the barrier island, including dunes, Sunken Forest and Otis Pike High Dune Wilderness; lighthouse facilities; William Floyd Estate; Sailors Haven; Talisman/Barrett Beach; Watch Hill/Dune Station; maintenance buildings; curatorial storage building and its contents, rugs and tapestries, permanent and temporary exhibit areas, collections storage areas and workspaces.

- Protect historic resources from pests and other hazards
- Protect structural integrity to maintain historic ambiance and form
- Provide an educational, safe and pleasing experience for visitors
- Maintain an aesthetic (and historic) landscape on the park grounds
- Protect the cultural landscape from damaging pests
- Work closely with the Exotic Plant Management Team to develop strategies for management of exotic invasive plants at Fire Island National Seashore

Step 2 Build Consensus

Establish communication links between interested or concerned parties (occupants, pest managers, decision makers) and agree on mutual pest management approaches, methods and priorities.

- Occupants: public, visitors, community, Park staff
- Pest managers: IPM Coordinator, custodians, curatorial staff, maintenance staff, Exotic Plant Management Team
- Decision makers: Superintendent, Facilities Manager, Natural Resource Manager/IPM Coordinator, Curator

(1) Provide signage and other interpretive information on pest management issues and procedures through interpretive staff, news releases, seminars or conferences.
(2) IPM Coordinator to hold periodic monthly meetings (short) to discuss findings by staff, track progress toward goals and provide praise for jobs well done.
(3) IPM Coordinator to provide briefing for the superintendent two times per year on critical issues, progress and successes.

Step 3 Document Decisions and Maintain Records

This pest management plan will help with pest management decision making and will become part of the park's IPM records.

- Installation of environmental (temperature/humidity) sensors in artifact displays and storage areas are required to gain environmental information of a specific room.
- Collect monitoring data from all pheromone or sticky traps and record findings (pest ID and numbers).
- Placement of traps can be indicators of access routes into the sites by pests.
- Provide pest sighting logs for critical sites, natural areas, wilderness, coastal dunes, curatorial storage, displays, break rooms, etc.
- Record all data collected, information on remedial actions taken to eliminate pest access, and any pesticide treatment actions.

Step 4 Know The Resource

The FIIS maintenance, curatorial and custodial staffs and the IPM Coordinator have intimate knowledge of the site and its contained historic and exhibited materials, natural areas, and coastal dunes.

- The resource consists of historic artifacts, structure(s), storage areas, offices, public areas, landscaping, public grounds, forest and dynamic coastal dunes.
- This rural park has a moderate to heavy human occupancy (public) and staff and pest pressure from the surroundings.

Step 5 Know The Pests

This pest management plan provides detailed information on the pests, their biology and behavior, and low-risk pest management measures.

Potential and known pests:

- Museum pests – carpet beetles, clothes moths, silverfish, mold
- Structural pests – eastern subterranean termites, carpenter ants, carpenter bees, wood borers, mold, rodents, ants, birds, raccoons, opossums
- Public health pests – cockroaches, flies, fleas, spiders, wasps, ticks, Lyme disease, mosquitoes, West Nile virus, geese, poison ivy
- Landscape and forest pests – longhorned beetles, weeds, gypsy moth, invasive exotic plants.

Step 6 Monitor Pests and Environmental Conditions

Monitoring for pest presence will be done through several methods: observation or sighting logs, sticky trap captures, observation of damage, tracks, droppings, etc. Indoor environmental conditions (presence of adequate food, water, shelter and temperature) are

monitored with temperature/humidity recorders and housekeeping sanitation measures. Line transects and grids can be set up to monitor pest presence in landscaped and forested areas.

- Set up monitoring regimens to inspect regularly and record and report findings.
- Set critical environments for photo records taken periodically to provide permanent visual information on the conditions of the wilderness and coastal dunes over time.
- Rangers can provide observations of pest presence in wilderness and coastal dunes.

Step 7 Establish Action Thresholds

For example, in a museum or curatorial storage setting, "Action Thresholds" are set very low to prevent pest activity from damaging artifacts. In a landscaped area, non-invasive weeds in turf may not require any action other than routine mowing and appropriate fertilization. Invasive weeds (exotic) may need remedial action.

- The presence of a single pest in a critical area (artifacts) calls for an immediate remedial action (physical removal, cleaning, trapping, etc.).
- Prevention is a key component: one larval dermestidae in historic artifacts needs immediate action (exclusion, sanitation, habitat modification).
- Changes in the forest, wilderness or coastal dunes may occur over extended periods or after storms and may also require remedial action (Sheila – see steps 8 & 9).

Step 8 Review Available Tools and Best Management Practices

Exclusion, sanitation and habitat modification are effective tools to manage museum, structural and public health pests. Some low-risk pesticides and traps may be necessary in some instances. The Exotic Invasive Plant Management Team may assist with developing a plan for managing invasive exotic plants. Additional resources for invasive plant management are:

- www.nps.gov/plants/alien
- www.invasive.org
- www.nature.nps.gov/biology/invasivespecies

Step 9 Select Effective, Low-Risk IPM Strategies within Laws, Regulations and Policies

This IPM Plan addresses IPM strategies taking into account Federal and State laws, and National Park Service regulations and policy.

Step 10 Obtain Approval, Define Responsibilities, and Implement Strategies

Responsibilities of the IPM Coordinator, curatorial staff, and custodial staff are included in this IPM plan. Action threshold levels determine management strategies to be

implemented, and responsibilities of different divisions determine the staff involved. Information provided to the public through signs and interpretive staff can also make visitors aware of how their actions can help in preventing pest presence. When pesticide applications are deemed necessary, proposed use plans will be submitted by the FIIS IPM Coordinator to the NER IPM Coordinator for approval prior to the performance of any application.

Step 11 Evaluate Results, Follow-up and Adjust Strategy if Needed

Observation, monitoring, exclusion, sanitation and habitat modification utilized in appropriate strengths make this plan easily adjustable to manage most pests likely to be encountered. Following pest management actions, the affected resource will be monitored for continuing presence of the pest. The conditions found will be evaluated to determine the success of management actions. In the event a pest remains above an action threshold level, additional or alternate strategies may be selected and implemented following the appropriate approval and use procedures. Pesticides or other pest lethal force may be necessary.

INTERPRETATION AND IPM

The park interpretive staff has a great responsibility in providing the visiting public with information on the natural resources and historic events that occurred at FIIS. In addition, it is useful to inform the public about how the park preserves and protects the structures, artifacts, landscapes and forests from pests and their potential damage. The public can use IPM information in their homes and become aware of how their actions can help prevent the presence of pests in the park.

The interpretive staff can provide information on some of the specific pests that have been encountered at the park, pest's basic needs (air, water, food, shelter, adequate temperature), and how the IPM approach manages pests through exclusion, sanitation, and habitat modification. A discussion of the influence of pests on the cultural and natural resources, how pests interfere with natural processes, and how exotic invasive plant species may displace native species should be included. A display can be developed to identify pest species and exotic invasive plant species, including how people have a role in providing or preventing pests.

INTEGRATED PEST MANAGEMENT METHODS

Pest exclusion, sanitation and habitat modification are the most effective treatment practices.

EXCLUSION

Exclusion is the first line of defense in any good IPM program. Exclusion means making the structures physically unavailable to pests so that they cannot enter the structure to take up residence or detrimental activity inside. Some pests, especially in the larval stages, are very small and may be able to penetrate our tightest defenses. Exclusion procedures include keeping the external structure intact by repairing all cracks, holes, or other entry points into the structure that could allow insects, mites, spiders, or rodents inside. Roosting, nesting, or loafing sites for

bats or birds must be modified to prevent these pests (spikes and glues don't work for long). Ledges and other level sites must be refitted with 45º to 60 º smooth angled surfaces to prevent bird roosting, loafing, or nesting. Bird netting is effective to exclude birds from alcoves, porches, and attics. This can be accomplished on historic structures without ugly, distracting devices (spikes or glues). Exterior doors can be fitted with "brass kick plates" and tight-fitting door sweeps to close the gaps between the door and the threshold to exclude crawling insects and rodents. Unused chimneys, air vents, and other entry points into a structure should also be screened with 16 mesh or finer to prevent pest intrusion.

Exclusion is finding and eliminating all possible entryways (points of access) pests use to enter a structure or room. Those entryways may be as small as a hairline crack in a wall or as large as a gap under a door, openings around pipe and wire traces, or the absence of screens on windows. Exclusion is more important and effective for the management of most pests than even increased sanitation (elimination of food and moisture). Pests simply cannot be present in a building or display case if they do not have an entryway. All possible routes of pest entry or attraction must be found and eliminated. Periodic inspection and monitoring will guarantee the prompt discovery and correction of any newly appearing entry points.

Correcting exclusion deficiencies is site-specific but is usually done by sealing them (i.e., caulking, carpentry repairs, installing door sweeps, netting, installing filters on air vents and hot air registers, etc.). Identify and seal all holes that could potentially allow insects (small cracks) or rodents (holes or cracks .63 cm (1/4 in) in diameter or larger) to enter the structure or room. In storage areas, sequester sensitive items in metal, glass, or durable plastic containers and periodically monitor them.

Assure that pests are not inadvertently imported into the building in or along with infested products or supplies (i.e., museum items or displays, firewood, outdoor furniture, employee clothing, lumber, books that have been on loan, etc.). This should occur in the receiving quarantine area.

Note: Screening active chimneys and stove pipes may cause soot to build up on the screen. Periodic scrubbing of screening with a nylon brush will clear the screen and restore fireplace or wood stove performance. Various commercial chimney caps are available which exclude rodents, bats, larger mammals, and birds.

Moisture in contact with untreated wood is an opportunity for wood decay fungi to become established and destroy the structural strength of the wood. Wood kept dry will never decay. Wood in contact with soil, cement, or masonry is more susceptible to moisture and, thus, very susceptible to wood decay fungi. The local weather (snow, rain, humidity) also exposes the exterior wood to moisture. Any leaks may also expose interior wood to moisture.

Exclusion of pests from outside landscaped areas may be much more difficult. Voles or other rodents that may damage orchard trees by gnawing the bark can be excluded from individual trees by installing ¼ inch hardware cloth around the trunk (10.16 cm [4 in] out from the trunk) and at least 10.16 cm (4 in) deep below soil level. Weeds or turf can be excluded from around fence lines by installing mowing strips 15.24 cm (6 in) out from center on each side of wire or wooden fences or from walls. Rodent repellents such as coyote or cougar urine can be used to keep rodents away from attractive plantings. Weeds can be discouraged from entering some

areas by modifying soil to encourage healthy turf (aeration and nutrient mix) or by shading out broadleaf weeds by covering with black plastic. Physical removal of larger weeds can be done with a weed wrench or chain saw. Insects are much more mobile but can be excluded with reflective foil around the base of ornamental plants, or repelled temporarily (1 – 2 days without wind) with Garlic Barrier sprayed around a small area (1 – 3 acres) for a special event. The introduction of pest-specific predators or parasites can also reduce or eliminate landscape and ornamental plantings pests.

The IPM Coordinator should perform periodic inspections to identify specific areas to close and direct maintenance efforts to accomplish this. Routine maintenance to repair roofs, siding, windows, doors or other portions of the structure should be accomplished with pest exclusion in mind. The IPM Coordinator should also consider innovative approaches for excluding pests from landscaped areas.

SANITATION

The second line of defense is sanitation; eliminating pest access to food, moisture and shelter. Food and moisture are basic biological needs for any living organism, and life cannot be sustained without them. Eliminating food and moisture from access by pests will cause them to either leave or die. Reducing the access to food and moisture will reduce the carrying capacity of the site for living organisms. Reducing the carrying capacity of a site to zero may not be realistically accomplished with today's technology. However, reducing resources for pests will limit population size and growth. Reducing or eliminating clutter may be a more realistic goal. The combined efforts of Curatorial, Maintenance, and Custodial staff can make great strides toward eliminating clutter in critical portions of the structures.

Identify and remove all potential food sources (rotten wood, food, fabrics, organic artifacts, mold, mildew, fungus, lichens, plants, etc.) and all possible harborage sites (openings, cracks, crevices, stacked firewood, clutter, etc.) available to pests. Verify that employees (or visitors) are not accidentally or willfully feeding animals (birds, squirrels, etc.) around the building(s). Verify that any animal wastes are regularly removed from around the exterior of the building.

Eliminating <u>most</u> food sources available to pests is a responsibility of park staff who work in or otherwise occupy the buildings. Food can be eaten elsewhere out of the buildings, or any (all) food residues cleaned up immediately when noticed. Food stored in the structures must be in metal or glass containers with tight-fitting lids (rodents and some chewing insects can easily cut through plastic containers). Elimination of all food sources that are accessible to insects or rodents is required. Moisture sources (leaks, condensation) can be identified and requested to be remediated by the Maintenance staff. Drink spills must be cleaned up immediately by the responsible staff member.

Many pests can go for great lengths of time without feeding or are able to survive on lint, fabric fibers, mold, and other uncommon food sources. Verify that museum and curatorial storage areas are thoroughly vacuumed (floors, cabinets, windows, and walls; in, under, and around equipment and furniture; and all cracks and crevices) at least twice a month, and more frequently if possible, to remove accumulated lint and dirt. Cleaning denies pests food and harborage and reduces insect survival rates.

Be sure visitors or employees are not providing food and water sources to animals, and that the grounds around buildings are free from debris or stacks of stored items.

Museum Collection Storage

Preventive placement of sticky traps at the floor/wall junction on both sides of the entry doors will reduce access by crawling insects. The inside bottom surface of the enclosed cabinets (below the bottom drawer) can be dusted with diatomaceous earth as a deterrent for dermestid beetle larvae and adults. DO NOT overtreat – a very light layer of diatomaceous earth dust is sufficient. The installation of museum pest-specific pheromone traps in upper corners of the rooms for flying adult moths and beetles can provide monitoring information and is a management method. Periodic vacuuming within the rooms will eliminate dust and other organic materials that can support pests.

Administrative Offices

Trash and other organic refuse must be removed at close of business each day. Thorough cleaning of each office and the break room must be conducted at least once a week. A periodic (unannounced) “white glove” inspection by the IPM Coordinator is helpful to point out clutter and sanitation deficiencies. Occupants (staff) can be made aware of how their own actions (and care) are important to prevent conditions conducive to pests being present (while staff are gone or in the office).

Housing

Employees should be provided information on the role they have in managing pests by eliminating clutter, sanitation, and assuring food or other organic material is not available to rodent or arthropod pests. Keeping their quarters clean, neat and orderly is their own responsibility. Staff or employee education concerning their individual roles in the low-risk integrated pest management plan is the responsibility of the park IPM Coordinator.

HABITAT MODIFICATION

The third line of defense is habitat modification, which may include changing the behavior and activities of the humans that work and visit all park sites. Habitat modification is a term used to describe changes made to a site in order to reduce the number of pests the site can support. Living organisms need to have air, water or moisture, food or nutrients, adequate temperature, secure hiding or resting areas, and light for plant growth. These things make up the habitat of a site. By manipulating the access or availability of these necessities, the "habitat" can be modified to such an extent that the site is no longer attractive to the pest, or the site no longer supports the pest's life. Habitat modification can take many forms and is usually directed toward the "life style" of a specific pest to be managed.

If possible (to keep insects from being attracted to lights near entryways), mount outside lights on poles located at least 9.14 m (30 ft) from the building and shine the light back onto the building. High pressure sodium vapor lamps that attract fewer insects and are more energy efficient can be used for exterior lighting.

Controlling temperature and humidity in structures can be very important in reducing insect populations. Humidity and temperature in museums and curatorial areas should be kept as cool and

dry (below 45% humidity) as practical. The closer temperatures approach 10ºC (50ºF) and below, the slower insect activity becomes, which lessens feeding and reproduction. Reducing humidity lessens survival of humidity-dependent pests like silverfish or psocids.

Exclusion and sanitation measures cited previously are important parts of habitat modification. An additional measure to make habitat modification effective is the elimination of clutter. Clutter provides shelter and hiding places for insect and rodent pests. The elimination of clutter creates open areas where pests prefer to avoid. Material (boxes, boards, etc.) stacked against walls or on the floor create hiding areas and pathways where insects and rodents can live undisturbed and unseen. Every person visiting or occupying the site is responsible for eliminating clutter. The introduction of predators or parasites into an area can also modify the habitat so that insects, rodents or other pests cannot easily propagate or survive.

Verify that all plants overhanging or touching the building are trimmed back at least .91 m (3 ft) from the building so pests can not use them to move onto the building. If possible, establish a .91 m (3 ft) wide vegetation-free zone around buildings. Use 1.91 – 2.54 cm (3/4 – 1 in) rock gravel mulch (at least 2.54 cm [4 in] deep) next to the structure. If a vegetation-free zone is not possible, keep grass, bushes, and trees next to buildings cut short and pruned away at least .91 m (3 ft).

Verify that all sources of moisture around the building are corrected. Eliminate any low spots in the ground that accumulate water run-off and all other water-holding sources (i.e., old tires, cans, refuse, and hollow trees).

BoraCare, a borate product with glycol to enhance penetration, is mixed with water to be applied to wood to protect from termites, wood boring beetles and all wood decay fungi, and is a fire retardant. Apply BoraCare as a spray to clean exterior wood. Apply a second treatment (the next day) to push the first moisture gradient totally throughout the wood beam. This makes all of the wood cells toxic to insects, fungi and molds. A moisture barrier can then be applied to further protect from moisture presence. WOODguard can be applied when wood moisture is 18% or below so it will penetrate to provide a transparent moisture barrier. Reapplication of the moisture barrier may be required every two or four years.

MAINTENANCE

Good maintenance practices should include habitat modification. Maintaining the structural integrity of a building is excluding pests from entering the building. The maintenance activities that repair leaks and other moisture management activities are modifying pest habitats that are reliant upon water. Temperature control can slow or increase the growth of insects, fungi and molds. A good example is interior humidity control. The lower the humidity, the fewer pests can live in a site. Good cleaning or sanitation practices will also reduce the carrying capacity of a site for pests.

Exclusion is another habitat modification that will reduce the capacity of a site for pests. Keeping food stored in pest proof containers such as glass or metal containers with tight fitting lids prevents pest access to food. Tight door sweeps keep crawling insects and rodents from entering. Similarly, repair of masonry and holes in walls and floors prevents potential pest access. The most effective way to manage rodents inside a structure is to keep them from entering the structure in the first place.

Changing the behavior of personnel who occupy the site is another means of habitat modification. Getting people to use trash receptacles, and removing trash at the close of business is necessary. Inspect trash cans to verify that the cans are 15.24 m (50 ft) or more from the building, raised on platforms off the ground, trash is being promptly removed, can interiors are being cleaned (use can liners), lids fit tightly, and can exteriors are clean. Removing or rearranging clutter can improve the habitat to make it less desirable for pests. Convincing occupants to clean up after themselves has great benefits. Habitat modification may also include behavior such as better cleaning practices, more frequent inspections and monitoring, and removing infested or contaminated materials from the structures.

Modification of the landscape can also prevent or reduce pest presence. Keeping turf properly mowed to 10.16 cm (4 in) reduces habitat for broadleaf weeds and ticks. Planting pest resistant varieties of turf and ornamental trees and plants also reduces pest presence and makes pest management easier. Proper watering regimens, fertilizing, and aeration of turf prevent insect, disease, and weed pests on the site. Decorative rock mulch next to the building reduces suitable habitat for rodents, insects and other pests, and also helps manage moisture around the building.

Biological changes of the habitat can include interplanting to repel pests, encouraging the presence of bats or purple martins, introduction of lady bugs, lace wings, preying mantis, predator mites, parasites, other predators, diseases, and entomophagus fungi.

Physical controls can be instituted to manage pest populations, such as: installing screens, air doors, light traps, fencing, proper pruning of foliage, netting or tension wires to exclude birds, sticky traps, lethal snap traps, chimney screens, metal flashing, weather stripping, caulking cracks and crevices, and mosquito nets. Other habitat modifications include moving stored firewood outside away from the building and moving lights away from doors or the building.

Identify and schedule the removal of stinging insect (honey bees, paper wasps, yellow jackets, etc.) and bird nests (English sparrows, swallows, etc.) from the structure as early in the spring as possible. Remove all organic debris (i.e., feathers, dead insects, excrement, etc.) from building ledges, gutters, and openings. Remove any spike or sticky glues used to deter birds and replace with a 45º smooth ledge barrier to eliminate nesting and roosting.

Identify and remove the mammals from all burrows leading under the building foundation. Verify that crawlspace access doors and crawlspace ventilation ports are tight and screened to exclude mammals and arthropods. Verify that holes, cracks, or gaps do not occur (or are sealed) in the foundation.

If animals are using burrows, trap out the animals and securely close the burrow entrances. DO NOT USE TOXIC BAITS. If animal nests are inside or under buildings and can be reached, it may be necessary to treat the nests for fleas, mites, and other parasites.

Rodent Traps

When managing rodents inside buildings, be sure to place a sufficient number of snap traps along all rodent travel routes and in all probable harborage areas. Place two traps 30.48 cm (12 in) apart at each trapping station and locate stations every 3.05 – 6.10 m (10 – 20 ft) along walls in

suspected rodent harborage areas. Place traps with the triggers pointing toward the wall. Fewer traps can be used when larger rodents are present but there should be no less than two traps at each trapping station and at least one trapping station per room. Vary the baits used on traps by using food materials on some and cotton on others. Cotton balls are used by females to line the nest.

Snap traps: Because of Hantavirus and other disease concerns, the Center for Disease Control recommends only using snap traps (not live-capture type traps) for rodents because:

- snap traps prevent the possible spread of Hantavirus into unaffected rodent populations.
- snap traps limit the spread of rodent urine, saliva, and feces around trap sites.
- snap traps prevent human contact with disease organisms which may occur from bites or other physical contact with rodents.
- snap traps prevent human contact with disease-contaminated aerosols during trap handling.
- snap traps must be checked daily.

Glue Boards: Glue board traps are flat boards or trays coated with glue. Rodents become stuck to them and cannot escape. Glue board traps are not humane and must NOT be used.

Insect Traps: Low-Line, Mister Sticky and other crawling insect capturing traps can be placed at the floor/wall junction to remove (and monitor) insects from inside the buildings. Place them inside cabinets, shelving, under sinks and other dark areas where insect pests may seek food, moisture or shelter. Pheromone traps to capture adult (flying) moths and beetles that may attack historic fabrics, furs and other organic materials, can be placed near the ceilings or in corners away from critical or susceptible materials. Check blunder or pheromone traps at least weekly to monitor for the presence of pest insects that may have invaded the site.

Replace sticky traps or pheromone traps when they start getting full. Pheromone traps are most used in a museum setting to attract and capture carpet beetles, cigarette beetles, dermestid beetles, drug store beetles, Indian meal moths, clothing moths, and warehouse beetles (but other pheromones are being developed). Contact Insects Limited, Inc. for newly available pheromone traps.

There are many means to modify the habitat to make the site less attractive to pests, and to deny them the necessities for life.

PESTICIDES

Specific low-risk pesticides may be suggested to preserve and restore certain elements of the structures and historic contents from further damage by pests. Proposed pesticide use must be reviewed and approved by the IPM Coordinators at the regional and perhaps national level before application. Any suggested and approved pesticide applications must be conducted very carefully so as to not contact non-target surfaces. Any pesticides used should first be used on a like "test" surface to avoid any potential "mishap" to "historic fabric" such as wood, tile or plaster. Approved pesticide applications must be documented and kept in the park IPM Coordinator's file.

COMMUNICATION AND EDUCATION

Within the Park boundaries and close outside the Park are private communities and in-holdings that may have impacts upon the Park environment. Some potential adverse effects relate to pest species that can or already have crossed the Park boundaries and invaded Park environments. Invasive exotic plants are of considerable concern. Although the Park may NOT have direct jurisdiction over the management or removal or such invasive exotic pests, through communication and education, these issues may be alleviated.

Communication and education efforts in working with the communities can be active or passive, and both can be effective. Active efforts could include presentations at community events or homeowner meetings to discuss animal or plant pests that invade the Park. Non-invasive alternatives should be recommended by Park experts or by local landscaping professionals. Other methods such as bagging seed heads, physical barriers, or plant trade-in days for removed plants for destruction, like a “Clean-up Day,” for the island. Passive education and communication efforts could include permanent signs within the Park describing effects of invasive animal or plant pests and beneficial alternatives. Informative brochures could also be handed out at entry points, in meetings, or at visitor sites in the Park. The brochures could also be provided for use by commercial nurseries or landscapers in the area.

ROLES AND RESPONSIBILITIES

It is essential for all park operations to support staff and visitor health and safety, as well as preservation and protection of park resources. The integrated pest management (IPM) program has similar responsibilities and should closely interact with all site personnel. Most FIIS staff will be involved in pest management activities at one time or another. To make the IPM program most effective, the entire staff (and several non-NPS persons) should participate as members of the pest problem-solving team. FIIS staff, concessionaires, and contractors should report pest sightings and conditions conducive for pests (food, water, shelter) to the IPM Coordinator.

SUPERINTENDENT

- Has overall responsibility for park functions, including the IPM program.
- Delegates the IPM program implementation to the IPM Coordinator and other site divisions.
- Makes reasonable attempts to provide adequate staffing and funding to implement and sustain the IPM program and provide for monitoring, exclusion and pest management needs.
- Must understand the principles and practices of IPM and realize how the broad scope of IPM tactics relates to park resources and activities.
- Designates and trains the curator to oversee historic artifacts and their preservation,
- Informs employees, through memos, of the need for vigilance and to practice IPM functions.
- Annually reviews with the IPM Coordinator the low-risk IPM plan for necessary changes or additions.
- Provides for proper and necessary training for the IPM Coordinator and other staff.
- Ensures that all pesticide applications are done by certified pesticide applicators who meet both state and federal requirements.

DEPUTY SUPERINTENDENT

- Is responsible for assuring that concessions comply with all NPS rules and regulations, including the low-risk IPM policy adopted by the National Park Service in 1979.

CHIEF, RESOURCES MANAGEMENT DIVISION

- Has a responsibility for management of the park's natural resources and oversight, review and support of the pest management program, including this IPM plan.
- Must also understand the principles and practices of IPM and annually review the IPM plan for any necessary changes or additions.
- Is directly involved in the collaborative process of making key pest management decisions that could potentially affect the park's natural resources.

CULTURAL RESOURCE SPECIALIST

- Has a responsibility for management of the park's cultural resources and oversight, review and support of the pest management program, including this IPM plan.
- Must also understand the principles and practices of IPM and annually review the IPM plan for any necessary changes or additions.

CURATOR

- Has a pest management role that is important to the preservation of historic artifacts and displays. This role includes monitoring for pests within the collections and overseeing an effective museum cleaning program.
- Has the responsibility to inspect, at least semiannually in early spring and late summer (preferably monthly) museum areas, storage and curatorial areas, collections, and the interior and exterior of all buildings containing collections or stored museum artifacts. Inspections should record pest presence and conditions conducive to supporting pests. Needed repairs or maintenance that is identified can be scheduled with the Chief of Maintenance and reported to the IPM Coordinator.
- Is directly involved in making pest management decisions with the IPM Coordinator.

INTERPRETATION

The Chief Ranger and Interpretation staff have a great responsibility in providing the visiting public with information on the natural and cultural resources at FIIS. It is useful to inform the public about how the park preserves and protects the structures, artifacts, natural landscapes and forests from pests and their potential damage with the IPM program. The public can use IPM information in their homes, and become aware of how their actions can help prevent the presence of pests in the park.

The interpretive staff should provide information on:

- Some of the specific pests that have been encountered at the site.
- The pest's basic needs (air, water, food, shelter, adequate temperature).
- How the IPM approach manages pests through exclusion, sanitation and habitat modification.
- Potential human health issues associated with some pests.

Interpretive staff should provide:

- Discussion of the influence of pests on the cultural and natural resources and public health.
- How pests interfere with natural processes.
- How exotic invasive plant species may displace native species. A display can be developed to identify pest species and exotic invasive plant species, including how people have a role in providing or preventing pests.
- Cooperation with the IPM Coordinator in developing IPM-related interpretive materials or displays.

CHIEF OF MAINTENANCE

The maintenance staff have very important roles in FIIS pest management as they provide all the repairs to buildings to ensure there are NO entryways for pests to have access to the inside spaces. Total exclusion of pests from entry into structures is the first line of defense in this pest management plan. The maintenance staff:

- Maintain screens on windows and chimneys, keep tight door sweeps, close cracks and crevices, repair leaks, clean offices and other spaces, and generally keep structures in good repair.
- Report observations of pests or their activity to the IPM Coordinator for action. This is important as facility management staff may work in areas not frequented by the IPM Coordinator or other pest management personnel.
- The Chief of Maintenance trains maintenance staff to be alert to conditions conducive for pests, signs of pests and pest damage, and report findings to the IPM Coordinator.
- The Chief assures good sanitation procedures (the second line of defense in this pest management plan) are carried out to eliminate food, water and shelter conditions that encourage pests.
- The Chief promptly schedules repairs to structures, utilities or vegetation removal that support pest infestations.

IPM COORDINATOR

The responsibilities of the site IPM Coordinator are described in NPS-77 Natural Resource Guidelines and in the March 10, 1997 IPM re-engineering Memorandum. The FIIS IPM Coordinator

- Serves as the focal point of all activities that directly (or indirectly) relate to pest management, including maintenance, resource management, interpretation, planning and design, and other park responsibilities.
- Is responsible for compiling IPM related information and continuing education on IPM techniques, methods and pesticide safety to site staff and residents.
- Is responsible for performing IPM activities in this plan, assisting staff with solving pest problems, reviewing pest monitoring reports, and training employees with pest management duties.
- Prepares monitoring forms and conduct inspections, and document needed repairs and structural deficiencies for action by facilities management staff.
- Annually reviews with the Superintendent and other program managers, the IPM plan for necessary changes or additions.
- Maintains a license by the State of New York as a licensed pesticide applicator
- Ensures other personnel applying restricted-use pesticides work under the direct supervision of a licensed applicator.
- Ensures that all reports, requests, Pesticide Use Proposals (PUPS), and pesticide use logs are accurate, complete and submitted in a timely manner.
- Maintains the locked pesticide cabinet, pesticide labels and material safety data sheets (MSDS) on all approved pesticides.

- Informs the Superintendent on all pest management issues and pesticide use.
- Inspects semiannually (early spring and late summer) the exterior and interior of all buildings in the park and records inspection findings
- Increases monitoring actions if inspections show evidence of pest activity, and if action thresholds for the site are met, initiates further pest management actions and assures park staff is provided the latest information concerning health and safety matters on pests and pesticides.
- Manages a database/recordkeeping system that documents pest sightings, signs of infestations, and pest management actions.

DOCUMENTATION

INSPECTIONS

The initial inspection of a site and a written report may be the first official record of a pest problem. The inspection report (with photos if possible) should identify conditions conducive to supporting pest presence, as well as ID of pests that are present. The inspection report should document the findings, and include the key location and potential distribution of the pest or pests, the resources (water, food, shelter) available to the pest(s), and the remedial actions necessary to manage the situation,

MONITORING

Monitoring provides information on pest activity over a specified period of time. Crawling insect activity can be monitored by placing sticky traps and bait in a strategic location and checking them for captures after a specified time period. If the crawling insect population is suspected to be large, sticky traps should be checked each day to document species identification and relative numbers. If the population is small, traps can be checked weekly or at least monthly. A series of sticky traps may be placed near all possible sources of water, food, entry access or shelter to delineate and document population size, extent of location and whether the population is growing or declining. Monitoring for flying insect pests may require special sticky traps with an appropriate pheromone that is attractive to the male, female (or both) of the flying insect pest(s) of concern (Insects Limited, Inc. is a source). The flying insect pest pheromone traps can be placed in a grid pattern to pinpoint the area of the pest harborage or food source, and thus limit the area and amount of treatment necessary to manage the pest. Monitoring devices should be placed during the inspection in areas where evidence of pest activity is observed. Document all data obtained from monitoring efforts, including temperature and relative humidity.

Talc or diatomaceous earth patches placed in rodent runways can be used to determine rodent population size and if the runways are active. Rodents tend to dribble urine as they run along, which can be detected by using a UV light showing urine as a bluish-green fluorescence. Rodents also run next to vertical surfaces and leave a mark of body oils and dirt where they rub. You can determine if the rub marks are fresh (soft) or old (brittle). Food material, usually a block, can be monitored periodically to determine the amount of food taken by weighing it or by measuring the actual remaining dimensions. Knowing the amount of food the target rodent species takes in a day (or other time frame) can give you an idea of the size of the population.

Monitoring for plants that are undesirable in the site can be conducted by observation, line transects, meter grids and other means. Identification of the species and its location can be placed on a map of the site. Observations over a period of time or seasons can determine the plant's rate of spread or population increase. If an action threshold has been determined, the monitoring record can show when the action threshold has been reached, and remedial action for removal can be taken. Some exotic invasive species may require the presence of even a single plant to be removed. Hazard trees may require pruning or removal as well.

Good records documenting all monitoring results are important for a successful IPM program. Comparing monitoring data from before treatment actions and after can provide evaluations of the relative success or lack thereof for the treatment. If treatment action (exclusion, sanitation, habitat modification, physical trapping or pesticide application) are effective or only partially effective in managing the pest, re-evaluation of the approach may be necessary. Recording the results of monitoring data should include the following:

- Location or site
- Purpose for monitoring
- Target pest population being monitored
- Frequency of monitoring (daily, weekly, monthly)
- Number and description of monitoring locations
- Monitoring procedures (counting, weighing, identification, etc.)
- Record of findings and subsequent management decisions
- Treatment efficacy on target pest (and nontargets)

PESTICIDE USE PROPOSALS (PUPS)

Pesticide use under this low-risk IPM plan must go through an approval process by the Regional IPM Coordinator or the Washington Office IPM Coordinator, depending upon the desired product, pest and site. The PUPS NPS IPM software must be used. The proposed pesticide use approval must be obtained before the pesticide application can be made. The park IPM Coordinator has a password to enter the PUPS intranet database. The Director's Order 77-7 (DO 77-7) provides information on the allowed use of pesticides, approval process and restrictions. The Regional IPM Coordinator can approve most PUPS. Aerial applications, water applications, restricted use pesticides, and areas with threatened and endangered species must be approved by the Washington Office IPM Coordinator.

PESTICIDE USE LOGS

The park will keep records on all pesticides; amount used during the year, and will submit pesticide use reports (PUPS) on NPS pesticide management software to the regional IPM Coordinator at the end of the year. The State of New York may also review the pesticide use logs.

LABELS AND MATERIAL SAFETY DATA SHEETS

Copies of all pesticide labels and MSDS of pesticide products used or stored in the park will be kept in the FIIS IPM Coordinator's office. Copies of pesticide use records and pesticide labels will also be kept in the pesticide applicator's notebook or file.

PEST MANAGEMENT ACTIONS TAKEN

The National Park Service has instituted a nationwide IPM software program to facilitate recordkeeping and tracking pest management actions. Pesticide applications are entered into the software at the end of each year.

PURCHASING, DI-1s

Staff and visitors should NOT purchase pesticides for use in the park. The IPM Coordinator, after approval from the Regional or Washington office IPM Coordinators, can request the purchasing officer to obtain pesticides or contracts. Any product that has a U.S. EPA registration number must go through the approval process. This includes insect repellants as well, even when sold by concessions within the park.

IPM POLICY

The site should establish a procedure and incorporate the pest management approach into any agreement (written or oral) with any outside party who wishes to conduct any activity within the jurisdiction of the site. It should be made clear that NO pesticides are to be used while on park premises. The participant must take appropriate action to avoid providing water, food or shelter for any pest. These factors must be included in any agreement, special use permit, concession contract, right-of-way instrument, lease, contract or other document where the specified activities may attract pests or affect the IPM program. It must also indicate the user's responsibility to exclude pests, eliminate water, food and shelter from pest access, and to immediately remediate any such adverse conditions that may occur.

COOPERATIVE AGREEMENTS

The site, through the IPM Coordinator, may elect to develop a cooperative agreement or contract to engage the assistance of a local expert in the management of pests that may be problematic for some portion of the site. Candidates could be experts from the cooperative extension office or university, an independent consultant, agricultural crop advisor, landscaper, tree service, orchardist, archivist, curator, structural pest management company, or others. The agreement or contract must state that no pesticides will be utilized without the full approval process being completed. Selection criteria should encourage the ability to think outside the pesticide box; and use exclusion, sanitation and habitat modification as the focus.

ANNUAL WORK PLAN

January

- Monitor Curatorial Storage Rooms for insect or other pest activity. Treat cracks and crevices with Diatomaceous Earth (DE) or Disodium Octaborate Tetrahydrate (DOT) if necessary.
- Prepare and submit PUPS anticipated (known) pesticides projected to be used on the site properties to the Regional IPM Coordinator for approval.
- Set and monitor rodent snap traps daily.
- Conduct maintenance and cleaning daily.
- Establish greenhouse planting for desired native plants.
- Establish .91 m (3 ft) wide by 15.24 cm (6 in) deep gravel, vegetation-free zone around all structures.

February

- Monitor Curatorial Storage for insect or other pest activity. Treat cracks and crevices with DE or DOT if necessary.
- Set and monitor rodent snap traps daily.
- Conduct maintenance and cleaning daily.
- Train interpretive staff for inclusion of IPM methods into presentations.
- Identify and repair all moisture leaks in structures.
- Start VIP recruiting campaign.

March

- Monitor Curatorial Storage for insect or other pest activity. Treat cracks and crevices with DE or DOT if necessary.
- Set and monitor rodent snap traps daily.
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Construct and install bat houses for beneficial bats near previous roosts.
- Provide training for VIPs.

April

- Vacuum hibernating insects (beetles, flies, moths, dermestid larvae) and bat droppings from attics, cracks and crevices, roof joists, corners and beams in all structures.
- Set and monitor rodent snap traps daily.
- Monitor Curatorial Storage for pest insect activity. Treat cracks and crevices with DE or DOT if necessary.
- Inspect all wood in each structure for bees, wood borers, mold, algae, and lichens or other wood-destroying organisms and wasp nests; and spot-treat wood with borates if necessary (spring and fall).
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Develop signs that inform the public about IPM methods used in the park.
- Provide training for VIPs.

May

- Monitor Curatorial Storage for pest insect activity. Treat cracks and crevices with DE or DOT if necessary.
- Conduct thorough inspections of all structures for insect, spider and rodent activity.
- Conduct exclusion actions to prevent rodent (mice, squirrel, rat) and insect entry into all structures.
- Set and monitor rodent snap traps daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Conduct maintenance and cleaning daily.
- Interpretive staff include IPM methods in presentations.
- Provide incentives for VIPs: patches, pins, hats, t-shirts, free access, banquets, etc.
- Establish VIP teams for specific areas of the park.

June

- Monitor all structures for pest insect and rodent activity. Treat cracks and crevices with DE or DOT if necessary.
- Search for emergence of carpenter bees, wood beetles, etc. and treat infested wood beams with borates.
- Monitor Curatorial Storage areas, etc. for pest activity.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Conduct maintenance and cleaning daily.
- Monitor and reset rodent snap traps daily.
- VIP teams work in assigned areas.

July

- Monitor Curatorial Storage areas, etc. for pest insect activity. Treat cracks and crevices with DE or DOT if necessary.
- Monitor and reset rodent snap traps daily.
- Conduct a thorough structure inspection and maintenance of structural integrity, repairing holes providing insect or rodent access.
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- VIP teams work in assigned areas.

August

- Monitor Curatorial Storage areas, etc. for pest insect activity. Treat cracks and crevices with DE or DOT if necessary.
- Monitor and reset rodent snap traps daily.
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- VIP teams work in assigned areas.

September

- When bats migrate south, seal exit holes in attics of structures.
- Thoroughly clean inside structures, especially upstairs, to remove hibernating insects (beetles, flies, moths).

- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Inspect the wood in all structures for wood borers, mold, algae, lichens or other wood-destroying organisms, and spot-treat if necessary.
- Conduct maintenance and cleaning daily.
- Monitor Curatorial Storage areas, etc. for pest activity. Treat cracks and crevices with DE or DOT if necessary.
- VIP teams work in assigned areas.

October

- Monitor Curatorial Storage areas, etc. for pest activity. Treat cracks and crevices with DE or DOT if necessary.
- Monitor and reset rodent traps daily.
- Ensure door sweeps are sealed to prevent pest entry into structures.
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings
- Review effectiveness of IPM program and make adjustments.
- Celebrate VIP season with award banquet.

November

- Monitor for insect pests in Artifact Curatorial Storage areas. Treat cracks and crevices with DE or DOT if necessary.
- Conduct maintenance and cleaning daily.
- Maintain .91 m (3 ft) vegetation-free zone around buildings.
- Perform bat-proofing for all structures that housed bats.

December

- Prepare and submit the past year pesticide use amounts and other data to the NPS Regional IPM Coordinator via PUPS.
- Monitor for pest activity in Curatorial Storage areas. Treat cracks and crevices with DE or DOT if necessary.
- Conduct maintenance and cleaning daily.
- Check set rodent (mice, rats, etc.) snap traps each morning, remove captures and reset.

Daily Activities

- Check set rodent (mice, rats) snap traps each morning, remove captures and reset.
- Thorough cleaning of floors, restrooms, break rooms and entryways, etc.
- Remove all trash and organic material from the structures at the close of business.
- Interpretive staff includes IPM information in presentations.
- Eliminate clutter.
- Empty all outside trash containers at close of business.
- Survey and remove exotic invasive plants; replant with desired species.

Weekly Activities

- Check all insect sticky traps and pheromone traps and record findings. Replace those traps that contain numerous captures.

- Clean all trash containers (and dumpsters) as needed (weekly).
- Inspect for insect or rodent damage (holes, gnawing, rub marks, nests) and clean or repair as necessary.
- Inspect structures for pest access, food, moisture and harborage, and modify habitat.
- Recruit VIPs for exotic plant removal.

Monthly Activities

- Download data loggers for all museum and artifact storage sites, and analyze data for anomalies (high temperature or humidity). Adjust air conditioning equipment as necessary.
- Remove dust from all exposed displays.
- Inspect and clean all natural hides and organic material (cloth, etc.) in displays.
- Mow turf to 10.16 cm (4 in) as necessary.
- Prune shrubbery near structures back to .91 m (3 ft) from buildings.

Seasonal Activities (when time and labor are available)

- Train staff in important roles in implementing IPM practices.
- Prepare for insect and/or rodent invasion of structures.
- Seal and/or repair the holes in all structures.
- Seal all openings, cracks and crevices in the upper floors and attics of all structures to exclude bats. This should be accomplished in the winter when bats have migrated south.
- Clean floor/wall junctions and corners of wax, dirt and grime in all structures.
- Inspect and clean all storage cabinets.
- Inspect and unfold/unroll all organic material in displays and clean, brush or vacuum to remove contaminants, eggs, larvae or insects (preferably spring and fall).
- Establish 15.24 cm (6 in) deep and .91 m (3 ft) wide gravel vegetation-free zone around all buildings.
- Obtain and release beneficial insects for ornamental plant pests.
- Obtain and plant desirable native plants to replace removed exotics.
- Establish greenhouse to propagate desired native plants to replace exotics.
- Work with VIPs to help with exotic plant monitoring and removal; replant with desired species.

TIME AND BUDGET REQUIREMENTS

Estimated additional responsibilities for implementing the Integrated Pest Management Action Plan for Fire Island National Seashore reside in all divisions of the park unit. Some tasks are pest management specific, while others are part of building repairs, routine maintenance, public health and safety, and hazardous material handling activities. As such, estimating the added financial support necessary for full implementation of this plan has some inaccuracies. A conservative estimate based on the additional response to pest management within the site (Table 1) is 6240 staff hours of effort among all units. Although this amounts to 3.0 FTE, it is distributed among several units.

Table 1. Estimated additional annual work hours and FTE equivalents of Fire Island National Seashore staff for performing Integrated Pest Management related tasks:

Resource management	
Museum collection management (William Floyd Estate)	
Monitoring; daily, monthly, seasonal	480 hrs
Artifact cleaning, inspection and storage	1040 hrs
Historic site pest management (William Floyd Estate)	
Seasonal and ad hoc inspections	240 hrs
Resource management and interpretation	
Public health and other pest management	
Insect management activities	240 hrs
Rodent trap monitoring	160 hrs
Rodent and insect exclusion	1040 hrs
Interpretive, goods handling	
Daily/weekly cleaning and inspections	480 hrs
Facilities management	
Routine activities	
Refuse handling	480 hrs
Custodial services in buildings	1040 hrs
Seasonal activities	
Buildings maintenance and repair	1040 hrs
Total	6240 hrs

1.53 FTE	Resource management	
		IPM program oversight and monitoring
		Museum collection IPM management
0.23 FTE	Interpretation	
		Museum collection and interpretive goods
		Historic orchard and garden pest management
1.24 FTE	Facilities maintenance	
		Routine cleaning and refuse management
		Buildings and grounds maintenance and repair

FUNDING

Current routine Integrated Pest Management activities are supported under base funding for the site. Unusual or periodic treatments, such as wood preservative treatment or painting of building exteriors, must be supported by additional funding. This may be solicited as cyclical maintenance funds through the PMIS system, as based on needs identified in FMSS and related NPS service-wide fiscal management systems.

Full implementation of this IPM Action Plan and additional needs related to protecting structural integrity and landscape quality may require additional base funds to support additional staffing. Although it is likely to need the addition of a full and partial position, it would provide additional funding for the divisions already performing related actions in order to better address pest management needs.

The above figures do not include other miscellaneous tasks (other duties as assigned).

INSPECTION FINDINGS AND RECOMMENDATIONS

For quick reference to inspection findings and recommendations, see Appendix I: Inspection Findings and Recommendations Summary Chart.

It is obvious that there has been a lot of good work done for FIIS in the way of reports, inventories, pest ID's and determining major and minor pests. However, additional effort is necessary to accomplish the implementation of a low-risk integrated pest management program. Inspection findings and recommendations in this IPM plan were developed from two separate visits to the park, and are independent of the excellent and detailed "Review of Museum Integrated Pest Management Action Plan, William Floyd Estate," by Barbara Cumberland, Assistant Curator, Harpers Ferry Center, in September 2004. Although two different professionals observed pest conditions at the William Floyd Estate at two different times (two years apart), the findings and recommendations are very similar. It is of concern that the excellent observations and recommendations made by Barbara Cumberland apparently have not been acted upon and implemented.

There are three basic concepts for managing pests in historic structures that can also be applied to portions of the landscape. The first concept is exclusion – the first line of defense. Keeping pests of all kinds out of a structure can be accomplished if you think "small" and attend to details. Many quality historic structures were designed and built to be tight and leak-proof. Over the years, structures may loosen up or have openings made in them by modernizing, or by pests themselves. Eliminating pest access to the structure can be accomplished with historic materials and modern technology.

The second concept and second line of defense is good sanitation. Pests' basic needs are air, water, food, shelter and adequate temperature. However, elimination of water, food and shelter from access by pests can be done. Sanitation measurers include general cleaning, moisture management, elimination of clutter or harborage for pests. Landscape areas need leaf removal in the fall, incineration or removal of infected materials, and disinfection or sanitation of pruning tools. Inspection and monitoring procedures will tell you how well you are accomplishing this concept.

The third concept and third line of defense is habitat modification – making the environment uncomfortable for the pest(s) so they don't want to be there. This is in addition to the 1st and 2nd concepts. It could be as simple as moving things around in the site, reducing humidity, reducing or raising the temperature, applying a low-risk pesticide into pest harborage, introducing parasites or predators, or raising the mowing height.

There is a tremendous amount of talent residing in the FIIS staff that can be used to protect and preserve the historic structures and landscape and their ambience for the benefit and enjoyment of this and future generations.

This report is based upon observations from two inspections to the site: October 24-28, 2005 and May 29 – June 16, 2006. The following narrative and photographs are based upon observations at those two inspections. Inspections were conducted during two seasons to

observe pest issues that may be influenced by changes in weather or other factors. The findings from both inspections are compiled here by site and structure.

WILLIAM FLOYD ESTATE



Wood Rot around Window

Main House, Floyd Residence

Outside – East Side: Signs of wood rot by the window frame. Remove damaged wood and replace with BoraCare or TimBor-Pro treated wood and paint to match with quality oil-based paint. Water diversion flashing is holding leaves and dirt. This needs to be cleaned out to allow water flow. The metal flashing should extend at least 2.54 cm (1 in) more over the edge. The wood holds 30 – 40% moisture here. Leaf litter should be raked from underneath structures to reduce moisture, insect and rodent harborage. There are gaps under the coal shed that should be repaired. There is an abundance of multiflora rose *(Rosa multiflora* Thunb.) which is an extremely prolific, exotic invasive plant. Unless there is evidence (photos) of it being purposely planted as part of the landscape, all of it should be removed. It reproduces by canes contacting the ground and forming new plants, and by bird dispersal of seed after eating the fruit. Cut the stem(s) at ground level and paint with Triclopyr or Glyphosate to kill the roots.



Plants too Close

There are many plants too close to the building, holding moisture there and providing harborage for pests. Move all foliage .91 m (3 ft) or more from the side of the building. Additionally, install a vegetation-free area, .91 m (3 ft) wide and 15.24 cm (6 in) deep next to the building, filled with 1.27 – 2.54 cm (1/2 – 1 in) gravel. Plants with significant historical value can be moved and trained on a trellis to keep vegetation away from the structure.

Outside – North Side: The screen has been torn off of the north screened porch allowing flying insects to enter.

Outside – West Side: There is a hole under the house near the Bilco door. The hole can provide entry or harborage for vertebrate animals such as opossums, raccoons, rats or other pests. Monitor for activity by stuffing the hole with wadded newspaper and checking daily to see if it is removed. If not, fill the hole. If the hole is reopened, then determine the species of the animal in residence and whether there are young present. All animals must be removed before exclusion measures can be completed. Install .64 cm (1/4 in) hardware cloth to close the hole and extend it below the soil level sufficient to discourage animals digging beneath.

The boxwood needs a trellis to hold it .91 m (3 ft) away from the structure. If raccoons continue to enter the building through duct work, trace all ducts and find entry points. Close the openings with .64 cm (1/4 in) hardware cloth using metal screws and washers to hold it on the ducts.

Animal access under the porch must also be repaired (closed) after making sure all animals have been removed.

Inside – Attic (A3-1): This room needs periodic general cleaning. The attic is not tight to exclude insects, mice and squirrels. Beams in this portion of the attic recorded 11% moisture content. Mud dauber nests have been constructed on the hanging bridle and tack, beams and structural members. The sticky trap below the bridle has spiders and webs. Many spider webs are present. Remove webs with a Webster brush. The 1720 roof had been reworked, nailed boards removed and some beams shored up. Portions of the roof and eaves that are open to insects need to be repaired to make the attic insect proof and reduce moisture. Treat all wood beams and other wood with TimBor Pro or BoraCare to protect from wood-boring insects and decay organisms. Apply a second treatment to force the borates throughout the wood beam.



Mud Dauber Nest on Tack

There is a hole chewed in the wall at the end of the crawlspace which may provide access to squirrels or mice. Repair the hole with .64 cm (1/4 in) hardware cloth. In the 1740-1760 part of the attic by the bulkhead, a hole with a grease mark indicates frequent access by rodents (could be a squirrel). The floor has holes that have hair caught – possible old access by rodents (squirrel). A cache of nuts is behind the window box shelf. There are squirrel droppings and nesting material here also. There are substantial amounts of detritus present in corners on both sides of this attic. Clean thoroughly to remove pest evidence. Use .64 cm (1/4 in) hardware cloth to close holes. Monitor every week to determine if rodent (squirrel) activity continues. If so, set fine-tuned Victor rat traps baited with chunky-style peanut butter. Check traps daily.



Debris and Nesting Material

Inside – Attic (A3-2): This area needs periodic general cleaning. The beams recorded 13% moisture and may be susceptible to wood-boring beetle damage. Treat all wood beams and other wood portions with BoraCare or TimBor Pro. When dry to the touch (next day), retreat to force the borates throughout the wood. Broken pieces of wood were observed along with rodent droppings. A nest was also observed under the roof, possibly from a squirrel. A hole .91 m (3 ft) from the nest through the floor to the subfloor below had been chewed and was clean and fresh. Fill the hole with Stuf-fit and close it with .64 cm (1/4 in) hardware cloth. Inspect to determine all possible entry points for rodents or insects and securely close them.

Inside – Attic (A3-3): This area needs periodic general cleaning. Treat all wood beams and other wood materials with TimBor Pro or BoraCare to protect wood from wood-boring insects

and decay organisms. A sticky trap in this area had two spiders captured. Check this area periodically for evidence of insect and rodent activity. The closet here is quite dusty.

Inside – Second Floor - Master Bedroom – Rose Room (M2-1): This room needs periodic general cleaning. There is moisture damage on the ceiling above the window and drapes. Damaged paint on window sills is probably caused by moisture. Determine the source of moisture and repair to reduce opportunity for wood-destroying organisms (WDOs). There is a hole in the corner of the fireplace that should be filled with Stuf-fit, covered with .64 cm (1/4 in) hardware cloth and repaired with historic mortar. Leaves in the bottom of the fireplace indicate that a chimney cap should be installed to prevent pests from entering. Remove the leaves. Sticky traps here contained spiders.

Inside – Bedroom (M2-2): This room has "old" water damage on the wall. Determine the source of moisture and provide repairs to reduce the opportunity for WDOs. Carpenter ants, adult varied carpet beetle and an adult anobiid beetle were captured in a sticky trap. Carpenter ants need moisture content over 13% in wood. Anobiid beetle larvae need 13 – 30% wood moisture to develop. They feed only in sapwood older than ten years old. The varied carpet beetle was probably feeding on organic (wool, cotton, silk, etc.) material in the bedroom. Check and clean (HEPA vacuum) all fabrics in the bedroom, including mattresses, bed linens and blankets, pillows and covers, drapes, rugs, clothing, etc. Look for larval and adult varied carpet beetle, cast skins and frass. Check for grazing marks (thin spots) or holes in fabric where larvae have been feeding. Thoroughly clean the room (HEPA vacuum) to remove lint, hair and other organic material that dermestid beetle larvae can feed upon.

Inside – Bedroom (M2-3): This room needs periodic general cleaning. There was no evidence of rodent or insect pests present.

Inside – Bedroom (M2-4): This bedroom needs periodic general cleaning. There was no evidence of rodent or insect pests present.

Inside – Upstairs Hall (M2-6): This room needs frequent thorough cleaning. There are dermestid larvae cast skins on a blanket and larval feeding damage. Check and clean (HEPA vacuum) all fabrics in the room, including couches, pillows, blankets, drapes, rugs, etc. to remove larvae, beetles and any organic material (dust, lint, etc.) that dermestid beetle larvae can feed on. There were no captures in the sticky trap placed in the closet.

Inside – Parlor Bedroom (M2-8): The bedroom needs periodic thorough cleaning. There are old dermestid beetle larvae feeding damage on a hat. Check and clean (HEPA vacuum) all fabric in the bedroom, including mattresses, pillows, linens, blankets, rugs, clothing, drapes, etc. to remove larvae, beetles and any organic material (dust, lint, etc.) that beetle larvae can feed on.

Inside – Bedroom (M2-9): The room needs frequent thorough cleaning. There were dermestid larvae, carpenter ants and a spider captured in sticky traps. Check and clean (HEPA vacuum) all fabric in the bedroom, including mattresses, pillows and covers, linens, blankets, rugs, clothing, drapes, and cracks and crevices to remove larvae, beetles and any organic material (dust, lint, etc.) that beetle larvae and ants can feed on.

Inside – The Garden Room (M2-10): This room needs periodic general cleaning. There was no evidence of rodent or insect pests present.

Inside – Sleeping Porch (NW2-1): Needs periodic general cleaning. There is substantial wood damage from moisture intrusion in the roof and down the wall. Determine the source of the water leak(s) and perform the appropriate repairs. Some of the wood may need to be replaced. Treat all exposed wood with BoraCare or TimBor Pro. Retreat the next day to obtain full penetration throughout the wood. The closet has water damage, beetle damage and wasps. Wood moisture reading was 17%. The leak on the wood floor shows 40% moisture.

Inside – Bedroom (NW2-2): Needs periodic general cleaning. There were six spiders in a sticky trap by the dresser. Install a pest-proof chimney cap to prevent squirrels, birds and other animals from access. If necessary, seal the fireplace flue with .64 cm (1/4 in) hardware cloth.

Inside – Bath (NW2-3): Needs periodic general cleaning. There is evidence of water damage. Check to determine the source of moisture and make appropriate repairs. There were spiders captured in a sticky trap.

Inside – Bath (NW2-5): Needs periodic general cleaning. There was no evidence of rodent or insect presence.

Inside – Mizzen Bedroom (E2-1): Needs frequent thorough cleaning. The floor is spongy from the effects of the squirrel nest between the floors. Carefully remove floor boards and replace if necessary. Remove any remaining nest material. Treat all wood surfaces, beams, flooring, etc. with BoraCare or TimBor Pro to manage WDOs. A second treatment should be applied the next day. Reinforce weak beams or flooring if necessary. If moisture damage is evident, determine the moisture source and repair. There is pest access under the window, although there is a storm window outside. Check and clean (HEPA vacuum) all fabric in the bedroom including mattresses, pillows, linens, blankets, rugs, clothing, drapes, etc. There were two spiders and a dermestid beetle larvae captured in a sticky trap.

Inside – Fo'c'sle Bedroom (E2-2): Needs frequent thorough cleaning. Check and clean (HEPA vacuum) all fabrics, including linens, blankets, clothing, rugs, drapes, etc. Check for moisture sources and make appropriate repairs. Check for dead animals, insects, furs, etc. that are attractive to dermestid beetles. An anobiid beetle, a spider beetle and spiders were captured in a sticky trap.

Inside – Storeroom (NE2-1): Needs frequent thorough cleaning. There is substantial moisture damage here. Determine the moisture source and provide appropriate repairs. Repair the hole in the ceiling. There were rodent droppings and food material on the air duct. Exclude rodents with .64 cm (1/4 in) hardware cloth and make necessary repairs. There were also spider webs and eggs present, which can be removed with a Webster or vacuum cleaner. There were two adult carpet beetles in a sticky trap. Also, there were six crickets (moisture?) and dermestid larvae in an old sticky trap from 2005.

Inside – Storeroom (NE2-2): Needs periodic general cleaning. The 1.27 cm (1/2 in) hardware cloth should be overlaid with .64 cm (1/4 in) hardware cloth to prevent rodent access. Repair the

hole in the bathroom ceiling into the attic. The window sill appears to have been chewed on. The stuffed birds are in poor condition and should be refurbished by a taxidermist. They may need to be cleaned and treated to prevent dermestid larvae damage.

Inside – Bath (E2-5): Needs thorough cleaning. There is moisture damage around the window. Determine the moisture source and make appropriate repair. Repair the hole around the pipe race (use Stuf-fit as filler). There were dermestid larvae and a beetle in a sticky trap.

Inside – First Floor – Dining Room (M1-1): Needs periodic general cleaning. Monitor the ceiling beams (1724 vintage) for evidence of anobiid beetles and their damage (.3 cm [1.8 in], round holes with fine frass). Treat with BoraCare or TimBor Pro to protect from beetle or fungal damage. A second treatment (next day) pushes the first treatment through the entire beam. There was mold observed in the medicine case which is an indication of moisture or high humidity. Reduce the humidity. Spider webs beneath can be removed with a Webster. The liquor case had been treated at Harpers Ferry several years ago. The powder horn in the cabinet had an active hide beetle larvae infestation in the past. Monitor the powder horn for larval presence and physically remove any found. Several stuffed birds apparently had been treated with arsenic in the past. Although the birds were not in great shape, no evidence of live dermestid larvae was observed. Wooden stands show evidence of old powderpost beetle damage. Books in the bookcase show old silverfish or psocid damage on bindings. Reduce humidity. Place Dekko Silverfish Paks behind books to attract and kill silverfish that may be present.

Inside – Pantry (M1-2): Needs periodic general cleaning. Evidence of wood borers in the tea cart was observed. A sow bug, predacious ground beetle and a spider were captured in a sticky trap. Insect frass was also present.

Inside – Gun Room (M1-3): Needs periodic general cleaning. Wood borer damage is extensive here in the original portion of the mansion. Structural repair needs to be done in the gun room chimney closet where the ceiling and the door frame are collapsing. There is a hole in this closet beside the fireplace that shows evidence of rodent chewing. Monitor for evidence of squirrel or other rodent entry. If fresh evidence occurs, set snap traps and monitor for captures daily. Toys have had powderpost beetle damage. Place on white paper to monitor for new frass and treat with heat at 60 – 71ºC (140 – 160ºF) for at least one hour to kill larvae.

Inside – Main Hall (M1-4): Needs periodic cleaning. The master chimney appears to be deteriorating which may lead to collapse and needs repair. Install .64 cm (1/4 in) hardware cloth in the chimney flue to prevent rodent access. Install a chimney cap on top to prevent birds and rodent entry from the roof level. Evidence of clothes moth was observed. Check and clean (HEPA vacuum) all fabrics in this room including rugs, drapes, linens, etc.

Inside – Parlor (M1-5): Needs periodic general cleaning. Install .64 cm (1/4 in) hardware cloth in the fireplace flue to prevent access by pests. Install a chimney cap to prevent bird and rodent access from the roof. There was no evidence of rodent or insect pests present. Continue to monitor with sticky traps.

Inside – Office (M1-6): Needs periodic general cleaning. Monitor for silverfish and/or psocids in books in bookcases. Reduce humidity. Place Dekko Silverfish Paks behind books to manage insects that may damage books. There was insect damage observed on some books. There was also a winged (reproductive) carpenter ant captured on a sticky trap. Weather-stripping has been placed on the outside doors of the emergency exits. Continue to monitor for carpenter ant activity.

Inside – New Kitchen (NW1-1): Needs periodic general cleaning. There is evidence of moisture leaks in the roof and siding. Determine the source of the moisture and make necessary repairs. Treat all exposed wood with BoraCare or TimBor Pro to manage WDOs. There was a clerid beetle and a predacious ground beetle captured in a sticky trap. The hole under the sink needs to be repaired to prevent pest entry. Eastern subterranean termites were captured on a sticky trap beside the stove. Termites are known to swarm in this kitchen. Carpenter ants have also been seen here in the past. Enter the crawl space under the kitchen and inspect for mud tubes made by eastern subterranean termites. Break the mud tube and check for its repair the next day to verify an active colony. Check also for wood/soil contact which allows termite access directly to the structure. Take appropriate measures to dry out the soil beneath the building. Treat all wood under the building with BoraCare. When dry to the touch (next day) treat the entire underside of the building with BoraCare (or TimBor Pro) again to force the borate to totally penetrate the wood. "Termi-mesh," a fine woven stainless steel mesh, can be installed between wood and the foundation to block termite access. The presence of an active eastern subterranean colony in the historic structure may call for a commercial professional pest control company.

Inside – New Dining Room (NW1-3): Needs periodic general cleaning. Continue to monitor for crawling insects and inspect for signs and conditions conducive for pests. There was no evidence of rodent or insect pests present here.

Inside – Bath (NW1-5): Needs periodic general cleaning. Continue monitoring for crawling insects and inspecting for conditions conducive for pests. There was no evidence of rodent or insect pests present here.

Inside – East Entry (E1-1): Has mold on photos and the wall which is a sign of moisture presence. Moisture can be caused by water intrusion as a result of a leak, or from high humidity within the house. Reduce the humidity within the house and determine the location of potential leaks. Occupy the house during rainstorms to learn where water intrusion and leaks may occur. Repair sites of leaks.

Inside – Reception Room (E1-2): This room needs frequent thorough cleaning. Use a HEPA vacuum to remove dust and lint from all cracks, crevices, ledges, display cases, rugs, drapes and any other source of organic material that is food for dermestid beetle larvae. The gap under the outside door (open or closed) must be closed. Install a door sweep or build up the threshold to meet the door so that insects, rodents or other pests are excluded from the building.



Gap under Reception Room Door

Be sure windows are sealed to exclude insects. A spider web behind the Declaration of Independence painting should be removed. The sticky trap at the floor/wall junction by the entrance door had captured gnats, spiders, ants, a mite, several pill bugs (roly-poly's) and several small parasitic wasps. A live dermestid larva was captured in a sticky trap by the fireplace. Check the fireplace and chimney for the presence of dead birds or animals. Install a chimney cap to prevent birds or rodents from entering from the roof. The fireplace flue should have .64 cm (1/4 in) hardware cloth inserted to prevent rodent entry.

Inside – Milk Room (E1-6): This room had a squirrel nest in the corner and moisture leaks around the ceiling area. There were also holes large enough for squirrels to enter. A sticky trap at the floor/wall junction had a spider and a cricket captured. The second inspection found evidence of a well-established squirrel nest in the ceiling void area. There was a varied carpet beetle (*Anthrenus verbasci* [L.]) and dermestid pupal cases in sticky traps. Remove nest material. Clean thoroughly with a HEPA vacuum. Treat the old nest area with diatomaceous earth or TimBor Pro to kill mites or other parasites. Repair holes with period material backed with .64 cm (1/4 in) hardware cloth.

Inside – Old 1850s Kitchen (NE1-1): This room had insect frass on the flour barrel indicating an active powderpost beetle larvae infestation. Treat the barrel with TimBor Pro or BoraCare. When the surface feels dry (next day), apply a second treatment to push the first through the wood to protect the wood from beetle larvae, mold and fungus attack. A spider was caught in a sticky trap at the floor/wall junction (evidence of insects as food for spiders). Thoroughly clean the area, especially cracks and crevices, with a HEPA vacuum to remove insect food (dust, lint, etc.). The second inspection indicated possible access by pests (insects and rodents) and moisture damage in this pantry area. Find and seal all possible insect or rodent entry points. Use .64 cm (1/4 in) hardware cloth for holes larger than 2.54 cm (1 in) diameter, or use Stuf-fit (a copper mesh) to fill smaller holes to exclude pests. Caulk or use period material to cover exclusion repairs. Interior and exterior doors should be fitted with door sweeps (period material would include leather).

Inside – Storeroom (NE1-2): The slave laundry had a squirrel nest that runs the length of the hall, a portion of which previously collapsed. A portion of the nest was removed and the ceiling was replaced. A remaining portion of the nest may still be in the ceiling area. The odors from the old nest portion will be attractive to the squirrel (or others) and invite reoccupancy. Dermestid beetles and other scavengers will also be attracted to the area. Remove the remaining portions of the nest, vacuum the void thoroughly (use a HEPA vacuum) and treat the area with food-grade diatomaceous earth or Borid to kill any remaining mites or other parasites and dermestid beetle larvae. Any exposed beams in the ceiling can also be treated with BoraCare (twice) to help protect the wood from WDOs. The second inspection revealed evidence of squirrels in the ceiling, nuts, urine and fecal droppings on the floor. Moisture damage is in the ceiling, possibly from raccoon urine. Clean the room thoroughly. Set fine-tuned rat traps with shelled nuts or chunky-style peanut butter for bait near old evidence. Check traps daily early in the morning to remove dead squirrels and reset traps.

Inside – (NE1-3): This room needs frequent thorough cleaning. There were holes in the floor to the outside. The holes need to be repaired to prevent rodents and insects from entering. Use



period materials and methods. There is also a large hole behind chairs that needs to be repaired. There were two dermestid larvae and a spider beetle captured in a sticky trap. Dermestid and spider beetle larvae feed on organic material such as fabrics, dead animals and insects, bone, meat, leather, seed, feed, dried gain, flour, etc. Inspect and monitor the room(s) for food sources and remove them. Use a HEPA vacuum to remove dust, lint and any other organic material from cracks, crevices, ledges and other surfaces.

Inside – Slave Meal Room (NE1-?): This room needs frequent thorough cleaning (HEPA vacuum). The ceiling was caving in and evidence of old raccoon and squirrel droppings, urine and nesting material were present. Apparently squirrels are present here in the winter. Inspect and find where squirrels or raccoons find access to the ceiling area and make appropriate repairs. Remove and clean any debris present in the ceiling area. Diatomaceous earth or other insecticide may be necessary to kill mites or other pests. There is a rock and brick foundation under this building, so access beneath this room may be difficult.

Inside – Back Shed (NE1-4): Needs frequent thorough cleaning (HEPA vacuum). There is a gap through the back door which must be closed to prevent pest entry. There was raccoon scat present along with carpenter ant frass. Treat all exposed wood with BoraCare or TimBor Pro to prevent WDOs. Carpenter ant galleries can be drilled and dusted with diatomaceous earth or TimBor Pro dust. The hole in the wall can be closed with period material to prevent pest access. The hardware cloth in the ceiling can be removed and the ceiling void cleaned to remove nut shells and other debris. The ceiling can then be repaired with period material. There were three spider beetles captured in the sticky trap by the entrance door. Inspect for organic material (dead animals or insects, fabric, grain, nuts or other food) available to larvae. Remove potential food sources and continue monitoring.

Ranger Station: The ranger station has been converted from the caretaker's workshop to provide office space for Park rangers. Inspection showed some clutter that may provide harborage for pests. Ants were present in the food eating area. Trash must be removed and emptied at close of business daily to prevent pests from feeding overnight. Exposed wood should be treated with BoraCare or TimBor Pro to protect the (1898) structure from wood-boring insects and other WDOs. A second treatment (next day) should be applied to push the first borates through the wood. Sticky traps can be placed on both sides of entry doors at the floor-wall junction to monitor crawling insects. Mouse snap traps can be set in the food eating area to capture mice that may invade. Check snap traps daily to remove captures and reset.

Outside the organic material needs to be raked out from under the structure and discarded. Organic material (leaves, etc.) holds moisture and encourages insects and rodents to occupy the area. A 15.24 cm (6 in) deep by .91 m (3 ft) wide barrier filled with 1.91 – 2.54 cm (3/4 – 1 in) gravel will reduce insect and rodent activity around and under the structure. Remove all vegetation contacting the structure.

Staff Housing Unit #1 (left unit of duplex building): This unit has substantial clutter throughout and sufficient harborage for numerous insects and mice. The stove is quite greasy. Ants were observed in the kitchen. Sticky traps should be placed in each room on both sides of entry doors, and in the kitchen inside lower cabinets and food storage areas.



Staff Housing at WFE

Staff Housing Unit #2 (right unit of duplex building): A gap under the front door needs to have a door sweep installed. This unit was neater and cleaner than Unit #1, although there was some clutter in the middle, front bedroom. Some spider webs were noticed that can be removed with a Webster. Dead *Harmonia* lady beetles and spider webs were observed in the back bedroom. Place sticky traps at the floor-wall junction near entry doors to monitor for crawling insects.

Outside Staff Housing Units #1 and #2: The Sentricon system has been installed around the perimeter of the duplex to monitor and manage subterranean termites. It may be questionable as to the frequency the bait stations are monitored. The system is quite effective if properly monitored and baits maintained. There are carpenter bee nest holes in the wood trim. Wood rot is observed in the white uprights. A bird nest is above the corner security light.

An ant trail was observed on cinderblock, up under the siding by the kitchen of Unit #2. Drax liquidator ant bait stations can be installed to manage the ant colony. A paper wasp nest is under the eave at the peak. These wasps are beneficial in capturing insects to feed to their larvae. If they become a problem (usually in the fall), Victor Wasp Freeze or Victor Poison-Free Wasp & Hornet Killer are effective. Wait until after the hard freeze (winter) to remove the nest. Clean the area to remove the pheromones with soapy water. In the spring when new colonies are initiated, remove the nest started by a new fertile female wasp when small by scraping it off with a knife or spatula. Clean the area with soapy water to remove the pheromone. This becomes more difficult later when the sterile females are guarding the colony, as they sting.

The organic material under the decks needs to be raked out and discarded to prevent moisture and harborage for insects and rodents to build up. The wood decks can be treated with BoraCare or TimBor Pro to prevent wood-boring insects and mold.

The concrete basement has clutter that may harbor rodents and insects. The many spider webs may help in keeping insect populations down. Spider webs can be removed with a Webster. The basement needs periodic general cleaning. The clutter should be better organized to reduce pest harborage.

The laundry room needs periodic thorough cleaning. No evidence of rodent or insect pests was observed. Place sticky traps near both sides of the door at the floor-wall junction to monitor for crawling insects.

The Carriage Barn: This structure is divided into three sections with the center room having a dirt floor. The outside has some wood rot and a top board at the roofline is broken.

Wood-boring beetle damage was noticed in several areas. The entire wood structure can be treated with BoraCare or TimBor Pro to prevent further wood damage.



The Carriage Barn

The left room has a wood plank floor and contains old furniture and leather horse tack. The leather tack does not show teeth marks, but is worn through and is drying out. The leather needs to be cleaned and oiled to help preserve it. The furniture is not well preserved. An oil painting has a hole in the middle of it. There are mouse droppings present and three bird nests on the crossbeams. Wood rot was observed in portions of walls. Many spider webs are present, indicating an abundance of flying insects.

The center room has two active rodent holes with tracks and tail drag marks. The holes go under the raised floors to both left and right rooms. An old sticky trap (dated 4/15/05) has two dead spiders and dust. Two carriages on wooden blocks are very dirty and the upholstery is in poor condition. A thorough examination was NOT conducted due to concerns of further damage. These artifacts should be cleaned and restored to their former usable condition.

The right room has old furniture and a rolled rug. Spider webs are numerous. There are pieces of nuts on the floor from rodent feeding and droppings. Powderpost beetle damage to beams and other wood in the structure is evident. The sawdust (frass) from beetle damage has fallen on the furniture from beams above.

Repairs to the carriage barn need to be made using historic measures, or seal all gaps, holes and rodent access with Stuf-Fit backed with .64 cm (1/4 in) hardware cloth to prevent rodent access. The furniture, rugs and horse tack should be restored or signs placed describing the reason (causes) for the poor condition to create a learning opportunity. Branches from nearby trees should be pruned back to reduce pathways by insects and rodents to the structure.

Inspection and Monitoring: Thorough cleaning of the Carriage Barn and its contents should be accomplished. The cleaned site will then be much easier to monitor for insect and rodent activity. All beams and wood components of the building, including the roof shingles, should be treated with BoraCare or TimBor Pro twice to manage WDOs before the structure is no longer salvageable.

Wood Shed: The wood shed is totally open and has a dirt floor. There were powderpost beetle holes in the wood beams and other portions of the wood structure. There is some firewood stored inside. Carpenter ants were also observed. Substantial animal gnawing on some upright supports inside was observed. The entire wood structure (except firewood) should be treated



The Wood Shed

(twice) with BoraCare or TimBor Pro to protect from WDOs. The circular cones in the soft dirt floor are the home for the larval ant-lion, which feeds on ants and other crawling insects that blunder or fall in. The adults are neuropteran, *Myrmeleon* sp. and also beneficial predators.



Ice House: The wooden roof structure covers a 4.57 m (15 ft) deep round hole in the ground lined with brick. The floor appears to be sand. It is reported that animals occasionally fall into the hole and cannot escape. Making repairs to the roof structure to exclude animals (rodents) and insects would be beneficial. Moisture inside may cause mold or wood rot organisms to damage the wooden structure. Treat the entire wood and roof structure with BoraCare or TimBor Pro to protect it from mold, wood rot, wood borers and other WDOs. Prune back shrubs and tree branches from the ice house at least .91 m (3 ft) to prevent ladders for insects and other animals.







Storage Crib: This storage building was converted from a corn crib. The stored items are very dirty, and there are many spider webs which indicate numerous insect prey. Mouse droppings were noticed inside by the door. There are gaps large enough for mice to enter. Provide appropriate repairs to prevent insects and rodents from entering. There was powderpost beetle and Bostrichid beetle damage in the wood. Treat the entire structure with BoraCare or TimBor Pro twice to protect the wood from beetle larvae attack. There were also carpenter ants observed although the colony site was not seen. Rodent-chewed nuts were also found (probably squirrels). The leaves and other organic debris should be raked out from under the building to reduce moisture retention and reduce moisture, food and harborage for pests.



Old Shop: This wooden structure has lots of powderpost beetle larvae damage and fine frass was observed. There are spider webs and black widow spiders present. Black widow spiders can bite and inject a neurotoxin into the wound. If bitten, capture the spider to take with you for the physician to identify and provide the proper care. Mouse droppings were observed. Provide appropriate exclusion repairs with .64 cm (1/4 in) hardware cloth over holes, gaps and other entry points. Install door sweeps or raise the thresholds to eliminate pest rodents and insect entry under the doors. Close all holes in the Old Shop. Use period materials such as oakum, caulk or other material to fill cracks and



other gaps. Dead *Harmonia* lady beetles were observed, which enter to overwinter. They provide a food source for dermestid beetle larvae. The building needs periodic thorough cleaning. Treat the entire structural wood members with BoraCare or TimBor Pro to protect the wood from further damage by WDOs. A second treatment (next day) will push the borate further through the wood members. Prune tree branches at least .91 m (3 ft) away from the Old Shop. Place fine-tuned mouse traps at the floor-wall junction, baited with chunky-style peanut butter. Monitor traps daily to remove dead mice and reset. Sticky traps can be placed to monitor for crawling insects, including wood borers.



Corn Crib: This wooden structure of vertical slats with open gaps for air-drying corn on the cob cannot exclude rodent or insect pests. There is substantial wood borer damage and sawdust (frass) on the floor. There are also numerous nuts (eaten) dropped by squirrels or other rodents. Squirrels can enter between the slats in the walls and through the floor. Installing rodent exclusion material (.64 cm [1/4 in] hardware cloth) would greatly modify the historic appearance. Treat all wood members twice with BoraCare or TimBor Pro to protect the wood from wood borers. Remove the vegetation growing in and around the corn crib. Remove the organic debris from under the structure to reduce moisture, food and harborage for critters.

Barn: This wooden structure is open in front and has a dirt floor. Old farm machinery are displayed. There is evidence of Bostrichid and powderpost beetle damage in the beams and other wood members. Exclusion of rodents and insects is not practical. Treat all wood beams and wood members twice with BoraCare or TimBor Pro to reduce future damage by WDOs. A swallow nest and an old mud dauber nest were present. These should be removed as they provide food for dermestid beetle larvae. Mites and other parasites may also be present. A small wasp nest on the back side should be removed after the hard freeze in winter. Ant-lions were present in the dirt floor.



New Barn: This wood building had been partially dismantled and portions replaced with new beams and other wood portions. There was an old well or spring covered over or dry nearby. There was wood rot in some of the older beams in the enclosed area. Old subterranean termite damage was observed. A bird nest should be removed, and the mud dauber nest removed to eliminate possible mite and dermestid larvae presence. Raccoon tracks were observed near the hole into the room under the slab. Earwigs were



also observed here, indicating substantial moisture and organic debris. The new and old wood beams and wood siding should be treated twice with BoraCare or TimBor Pro.



Gazebo: This open wood structure made of log poles with a wood-shingled roof shows evidence of cribbing damage by an animal chewing on it. There were also carpenter ants present and holes from beetle larvae feeding. A mud dauber nest should be removed. Treat the entire structure, including the wood roof shingles, twice with BoraCare or TimBor Pro to reduce further WDO damage.



Tractor Shed: This wood building has a ramp to allow a small tractor to be driven inside. There was wood rot observed on the fascia on the east side. There is a large hole in the front which allows rodent access. A nut, partially eaten, was observed in the southeast corner. Clean the tractor shed to remove rodent activity evidence. Repair the hole in the front or close the hole with Stuf-Fit backed by .64 cm (1/4 in) hardware cloth. Remove the portion of fascia with wood rot and replace with BoraCare or TimBor Pro treated wood and paint. The shed can be treated with BoraCare or TimBor Pro from the inside where the wood is not painted. A second treatment (next day) will assure penetration of the borates through the wood.

Workshop: This is a clean workshop. No rodent droppings were observed. There is a gap under doors on the south side that should be sealed with a rubber or neoprene door sweep. There were spider webs under cabinets with insects captured. Webs can be removed with a Webster. Outside there are shingles missing, and several knot holes are open to the inside and should be filled or repaired. There is moss on siding on the north side, which can be removed with bleach. All vegetation should be moved at least .91 m (3 ft) from the building. A 15.24 cm (6 in) deep by .91 m (3 ft) wide 1.91 – 2.54 cm (3/4 – 1 in) gravel barrier around the workshop will help prevent rodents and insects from entering. Treat all unpainted wood twice with BoraCare or TimBor Pro.



Ladder Storage Shed: A carpenter ant and an inchworm were observed. Treat the beams and siding from the inside twice with BoraCare or TimBor Pro to protect from WDOs.





Fuel Storage and Fire Cache Buildings: These buildings were locked and were not accessible for inspection.

Collection Storage Building: This structure was built in 1991 to house curatorial objects, plant and insect collections, and a herbarium with Russian and autumn olive specimens. It was reported that there previously had been a problem with cockroaches, however, none were observed and door sweeps have been installed. Oriental cockroaches were observed in the garbage. Spiders, sow bugs, crickets, rove beetle and carpenter ants were captured in sticky traps at the floor-wall junction. There are spiders in between cabinets. Sow bugs/pill bugs were observed crawling on the floor. The door sweep on the back door is damaged and needs to be replaced. Dermestid beetles (black carpet beetle and varied carpet beetle) and dermestid beetle larvae were observed. An unidentified cocooned insect was also seen as was a clothes moth adult. Psocids are also present in the collection storage area. A predacious ground beetle was also present.





Isolation Room: In the curatorial storage building housed the freezer used for freeze, thaw, freeze cycle of killing insect pests in historic curatorial objects or materials. There were also crickets, isopods, spiders and spider webs, and varied carpet beetle adults observed here, mostly in sticky traps. Sticky traps should be monitored daily for captures and exchanged for fresh traps at least once a month.



Outside of the collection storage building the barn swallow nest over the light should be removed (after the nestlings have flown), and the area treated for bird mites and dermestid larvae. The mud dauber nest at the corner of the roll-up door should be removed. Carpenter ants were observed on the east side of the building by the back door. There is structural wood rot at the ground level there. The loose board on the west side should be refastened. The water in the old, rusted boat should be drained (boat turned upside down) or treated with a mosquito dunk or olive oil on the surface to help manage mosquitoes. Leaves should be raked away from the building.

A .91 m (3 ft) wide, 15.24 cm (6 in) deep barrier of 1.91 – 2.54 cm (3/4 – 1 in) gravel, no vegetation zone, should be installed around the entire outside perimeter of the collection storage building to reduce moisture and access by insects and rodents. Lights should be mounted on poles away from the building to illuminate the outside, NOT mounted on the building to provide bird nesting sites and attract insects to the structure.

Sanitation is very important in a curatorial storage facility. Thorough cleaning should be scheduled each day so that the entire site is cleaned each week. Divide the building into five sections that are somewhat equal to be cleaned each working day. Tops of shelving, cabinets, and tables cleaned. Under shelving units, between cabinets, below bottom drawers, window sills, floors and thoroughly vacuum (HEPA) all cracks ad crevices. Make a thorough inspection

each day to check for dust, lint, crawling insects, flies and other signs of the presence of organic material as food for pests. All cracks, crevices and other gaps or voids should be caulked to prevent pest harborage. Cardboard boxes, packing material and excess clutter must be removed from this building and securely stored elsewhere (if it is to be used for packing or shipping). Staff desks and/or workspace are each person's responsibility to maintain in a clean and orderly condition (pest free). All food must be kept in metal containers with tight-fitting lids (no plastic or Tupperware). The Curator should conduct a "white glove" inspection every Friday afternoon and at random periodically to assess the conditions at the facility. A full-time curatorial technician should be on staff, as well as two half-time curatorial assistants.

Sticky trap monitoring stations should be placed at the floor-wall junction on both sides of all entry doors, several sites throughout the collection that stores critical or pest-sensitive artifacts, and on window sills. Pheromone traps (see Insects Limited in Vendor Section) for clothes moths, dermestid beetles and other potential flying museum pests, should be placed in the upper corners of each room. Monitoring traps should be checked daily and replaced monthly. Victor mouse snap traps should be placed at the floor-wall junction on both sides of every door (inside) and monitored daily for captures, removal or dead rodents and reset. Check daily to verify that all doors have fully functional door sweeps installed. It is recommended that the Curator, curatorial technician and assistants read the William Floyd Estate Museum IPM Action Plan written by Barbara Cumberland in September 2004.

Although the attic access door was not entered (needed a long ladder), the attic should be checked in both spring and fall for pest entry through other access points. Use a bright flashlight. The receiving door (overhead opening garage-type door) should have tight rubber seals installed around the edges, bottom and top to prevent insect and rodent entry.

Artifact storage shelving is raised about 12.7 – 15.24 cm (5 – 6 in) off the floor for easy inspection and cleaning. Enclosed cabinets should also be raised 12.7 – 15.24 cm (5 – 6 in) off the floor for easy inspection and cleaning. Otherwise, the bottom drawer on cabinets will need to be removed for inspection under the cabinet and cleaned to remove dust, lint or insect debris.

The Curator should schedule with the IPM Coordinator for semi-annual (early spring and fall) joint thorough inspections of the William Floyd Estate and outbuildings, the curatorial storage building, and other portions of the site. Any necessary modifications to this plan can be coordinated and implemented. Coordination with the Chief of Maintenance to accomplish necessary structural modifications using historic methods and materials is important to maintain adequate pest exclusion and eliminate conditions conducive to supporting pest presence.

Findings from inspections, data on species and location from sticky trap captures, and data from data loggers recording temperatures and relative humidify in the various structures or rooms, must be recorded for analysis. Trends should be noted to anticipate pest population increases (or decreases) from season to season or year to year.

Exotic, invasive plants that were observed and identified by the William Floyd Estate IPM Coordinator were garlic mustard, Japanese honeysuckle, multiflora rose, Japanese knotweed, Japanese barberry, Norway maple, black locust, wisteria, bamboo, ground ivy, oriental

bittersweet, phragmites, autumn olive, lespedeza, Tree of Heaven, and Russian olive. Observed GPS coordinates were provided to the park IPM Coordinator.

FIRE ISLAND NATIONAL SEASHORE HEADQUARTERS



First Inspection, October 2005. There were numerous openings for mice under radiators where pipes penetrate the floor. Several had evidence of rodent (probably house mouse) chewing the edges of the holes to enlarge them. Fill holes around pipes with Stuf-Fit. Other holes can also be filled with Stuf-Fit, then caulked. Several desks had mouse droppings on top and mouse droppings were also observed in window sills. Floor registers had mouse droppings in the ducts. Remove the floor grates and clean out the ducts (HEPA vacuum). Openings were also found behind some doors which need to be filled. There was an abundance of food on desks (granola bars, cookies, etc.) and in desk drawers. Keep food in metal containers with tight-fitting metal lids. An excess of clutter in offices was apparent which provides harborage for mice and insects. Cleaning in offices should be upgraded with more attention to detail under furniture, desk and cabinet tops, floor corners and edges.

The kitchen had access and evidence of mouse activity. There were holes under the sink, behind the stove, by radiator pipes, above the window, a hole in the lower cabinet beside the refrigerator and drawer, and the dining area door has holes at the bottom on each end. There were mouse droppings observed underneath the broiler, on the floor behind and beside the refrigerator, behind the microwave, and droppings and other detritus on the top cabinet shelf. In cabinet drawers, mice had been chewing on candles and packets of dressing, catsup, sugar and sweetener substitutes. Set Victor mouse snap traps (fine tuned) at the floor-wall junction, on counter space and on top of cabinets. Check traps daily to remove dead mice and reset. Cleaning in the kitchen is the responsibility (for the most part) of those who use it. Custodial staff should be cleaning floors and countertops after work hours, along with emptying and disposing of all trash each evening.



Second Inspection, June 2006: All floor registers should have grates removed and ducts thoroughly cleaned as they are very dirty and contain numerous mouse droppings.

Superintendent's Office: Has a couple of ceiling tiles raised which could provide possible access for insects or rodents. Replace tiles. No evidence of rodent or insect pests present here.

The Superintendent's secretary's office has no evidence of rodent or insect pests present.

The receptionist's office has a hole into the wall at the lower right corner of the front window which should be sealed. There is organic debris and mouse droppings in the floor register between the desk and typing table.

First floor bath has a Webster stored in the shower. There was no evidence of rodent or insect presence.

Utility Room has a hole in the ceiling that should be repaired. The room needs a general cleaning and better organization (or removal) of the clutter. A 10.16 cm (4 in) pipe leading away underground is open and needs a grate or cap. The copper tubing at the third block up from the floor has light showing through from the outside which should be sealed. The abandoned material stored underneath should be surplused or removed and discarded.

The open work area was a bit cluttered, but there was no evidence of insect or rodent pests present. The coat closet under the stairs has AV equipment and clutter. The area should be organized to protect and provide personal access to the AV equipment. The clutter should be organized or discarded.

The Administrative Officer's office had no evidence of rodent or insect pests present.

The Deputy Superintendent's office had no evidence of rodent or insect pests present.

The Facilities Officer's office needs thorough vacuuming, especially the closet floor. No other evidence of rodent or insect pests was found.

Michelle's office had no evidence of rodent or insects present.

The kitchen holes around the pipes under the sink have all been caulked. Great!! The ant trap beside the electrical outlet is empty. The area under the sink has many old mouse droppings that must be cleaned up. There were still old mouse droppings in the drawer with silverware. The stove is dirty and needs to be cleaned, although no mouse droppings were observed. There were mouse droppings under the bottom drawer of the stove. There are mouse droppings in the drawer by the refrigerator and some chewed-on candles. There is a hot pad dropped behind the stove.

The 2nd floor coat closet had no evidence of rodent or insect pests present.

The Chief Ranger's office had some old mouse droppings, but no evidence of recent rodent or insect pests was observed.

Danielle's office (need office title) had a wire hole in the corner by the inner door which should be filled and caulked.

Chief of Resource Management's office had no evidence of rodent of insect pests present.

Chief of Interpretation's office had a substantial amount of clutter which should be better managed. DO NOT allow clutter to block emergency exits. The wood on the outside door is beginning to rot. Treat with BoraCare or TimBor Pro or replace wood and install a metal plate.

The 2nd floor bath has a faucet leaking into the tub which should be repaired. There were no other conducive conditions or evidence of rodent or insect pests present.



Outside of Headquarters' Building: There is substantial opportunity for moisture accumulation next to the building. Install a .91 m (3 ft) wide, 15.24 cm (6 in) deep barrier of 1.91 – 2.54 cm (3/4 – 1 in) gravel around the building to reduce moisture and discourage pests. The decorative lath grid under the building should be backed with .64 cm (1/4 in) hardware cloth to prevent rodent access. Portions of the decorative grid can be repaired. Tree branches should be pruned back at least 1.83 m (6 ft) from the building to discourage rodent (squirrel) access to the roof or other portion of the structure. Leaves should be raked out periodically from under the steps and deck. Prune or move shrubs back .91 m (3 ft) or more from the structure. Shingles need to be replaced under the outside fire escape stairs. Wood rot on the arch over the river side door to the Superintendent's secretary's office should be removed, and the wood replaced and treated with BoraCare or TimBor Pro to prevent recurrence of the wood rot.

Headquarters' Annex: Outside: The tree branches should be pruned back about 1.83 m (6 ft) to prevent easy access to the roof by rodents (squirrels). There is access into the building on the west side by the gas meter behind the downspout. Install a .91 m (3 ft) wide, 15.24 cm (6 in) deep barrier around the building filled with 1.91 – 2.54 cm (3/4 – 1 in) gravel This type of barrier discourages rodents and insects from entering the building and reduces moisture next to the structure. The Sentricon system has been installed around the perimeter for monitoring subterranean termite activity.



Inside: The west side furnace room has a lot of wood shavings and other detritus; however, no rodent droppings were observed. The entire building needs a good general cleaning. There were some old mouse droppings observed by the south door. There is a hole in the west wall of the main section into the furnace room. There is access to down below the structure by the right corner of the south door at the floor-wall junction.



PATCHOGUE MAINTENANCE FACILITIES

Chief of Maintenance office had no evidence of rodent or insect pests present.

Next office (Burch) needs general cleaning although there was no evidence of rodent or insect pests present.

Conference room had spider webs under the grey cabinet which may indicate insect presence. There was no evidence of rodent presence.

Open administrative area had no evidence of rodent of insect pests present.

Irene's office has a substantial amount of clutter. There was no evidence of rodent or insect pests present; however, there was plenty of harborage.



Office south of Barrera's office: There was a lot of clutter present, unable to conduct a thorough inspection. The left-hand corner between the wall and the file cabinet has spider webs with many insect carcasses. Eliminate the clutter and conduct a thorough cleaning.

Daniel Barrera's office: There was no evidence of rodent or insect pests present.

IPM Coordinator's office: There was no evidence of rodent or insect pests present.

Office outside of IPM Coordinator: There was no evidence of rodent of insect pests present.

Bath: There was an old Raid Kill Ant Bait at the back edge of the shower. There was no other evidence of rodent or insect pests present.

Kitchen: There were spider webs behind the refrigerator. A Raid Kill Ant Bait was found behind the toaster oven; the active ingredient is 0.04% indoxacarb. The Raid Kill Ant Bait should be removed.

West side office by exit: There was no evidence of rodent or insect pests present.

The back door has a gap on the hinge side. Install a felt strip or door sweep if necessary to close the gap.

Outside: The Sentricon system has been set in place around the perimeter of the building to monitor for eastern subterranean termite presence. 1.27 cm (1/2 in) hardware cloth was used to cover attic vents. The attic vents should have been screened with .64 cm (1/4 in) hardware cloth. On the north side, a vent was covered with 1.27 cm (1/2 in) hardware cloth. The 1.27 cm (1/2 in) material has space (1.27 cm [1/2 in]) that is large enough for a rat to enter. Use .64 cm (1/4 in) hardware cloth to exclude animals. The alcove around the concrete buttress next to the power lines is open at the bottom.



Goose droppings on the boardwalk at the marina are unsightly and pose a health hazard. Avian flu is carried by migratory waterfowl and can be transmitted to other birds and humans by contact with infected droppings. The goose droppings should be power-washed off the boardwalk early each morning.

PMF-B: It was reported that pigeons fly into the warehouse to roost; however, none were observed during the inspections. Keep the doors closed except when loading or unloading material. There were no other openings for pigeons observed.



Outside of Warehouse: North side needs to have water from the downspout directed away from the building. Holes between block at ground level should be filled with Stuf-Fit, then grouted with cement. The horizontal board at the roofline has some small gaps that should be sealed to prevent pest entry. There is wood rot on the bottom edge of several vertical siding boards. Those that are badly damaged should be replaced. Treat the boards with BoraCare or TimBor Pro to prevent wood rot.



The east side had no evidence of rodent, insect pests or wood rot organisms observed.

The south side had a hole at the top of the block that goes in 15.24 – 20.32 cm (6 – 8 in). A smaller hole goes in farther. Fill these holes with Stuf-Fit and then grout with cement.

On the west side by the southwest door there are holes that go all the way through the wall. Fill the holes with Stuf-Fit and grout with cement.

Inside: The kitchen is new and clean. The stove is clean. There was no evidence of rodent or insect pest activity observed.

Bath: There was no evidence of rodent or insect pest activity observed.

Fire Control Panel room had three tripped mouse traps (no mice caught) with one trap broken. Replace the broken trap and reset all three. A few mouse droppings were observed.

Furnace room had a few old mouse droppings observed. Set three to four Victor mouse traps (chunky-style peanut butter is good bait) at the floor-wall junction. Check traps daily for dead mice and reset.

Electrical room: There was no evidence of rodent or insect pest activity observed; however, the room is cluttered and should be straightened up.

Workshop needs a thorough cleaning. There were old rat droppings observed. Set three to four Victor rat traps (chunky-style peanut butter as bait) at the floor-wall junction. Check traps daily for dead rats and reset.

Mosquito Lab was quite clean. There was no evidence of rodent or insect pest activity observed.

The Paint Room had spiders and webs observed. Use a Webster to remove webs. Needs general cleaning. Rodent droppings were observed under the blue cabinet. Set Victor snap traps and check daily for dead rodents and reset.

File Storage Room had no evidence of rodent or insect pest activity observed.

Hall Closet had no evidence of rodent or insect pest activity observed.

The Office in the middle by the closet is neat, clean and well kept. There was no evidence of rodent or insect pest activity observed.

Storage Room is cluttered and should be straightened up. There was a tripped snap trap, but no droppings observed. No other evidence of rodent or insect pest activity was observed.

The First Office on the east side next to the front door is cluttered; however, no evidence of rodent or insect pest activity was observed.

Library and storage across the hall had one (empty) tripped snap trap but no evidence of rodent or insect pest activity observed.

Second Office on the east side had no evidence of rodent of insect pest activity.

Law Enforcement Ranger's Office had spider webs that can be removed with a Webster. There was a set mousetrap with no bait. No other evidence of rodent or insect pest activity was observed.

The Landscape Architect's office reportedly has a hole in the southeast corner. This could not be observed because of furniture in place. There was no evidence of rodent or insect pest activity observed.

Holly Hauser's Office had no evidence of rodent or insect pest activity observed.

Storage Closet by Holly's office had one tripped and one set mousetrap. The dirt and spider webs could be cleaned up. There was no other evidence of rodent or insect pest activity observed.

The doors to the warehouse seal well and don't allow rodent or insect access.

Warehouse: Several rooms and closets were locked and access for inspection was not available. The warehouse was dusty with substantial clutter. There were some old rodent droppings and spider webs, but not much evidence of recent rodent activity was observed. Access for trucks loading and unloading is through the back pull-up doors which are often left open during working hours. Pigeons may sometimes enter and attempt to roost above the bays; however, the staff deters them.



Old rat droppings were observed inside an enclosed pipe area in the weight room.

Stuf-Fit, .64 cm (1/4 in) hardware cloth and expanding foam is being used to exclude insect and rodent pests. This is an excellent start; however, more is needed.

The upper levels have storage with much clutter and pest harborage.

There are holes through the middle bay wall into the north bay, and one has been chewed upon. Holes need to be filled with Stuf-Fit and backed (each side) with .64 cm (1/4 in) hardware cloth.

The north shop has .64 cm (1/4 in) hardware cloth over the windows with gaps in some areas. These gaps need to be fastened down.

River Room is a conference and training room for staff and others.



Outside: There is evidence of wood rot on the frame alongside the air conditioning unit and on the south window frame. Replace damaged frames and treat with BoraCare or TimBor Pro before painting.

Inside: Spider webs and old rodent droppings were observed in the utility closet. The gas pipe that penetrates the wall has a surrounding opening that would allow access by critters. Fill the opening with Stuf-Fit and caulk or seal the opening. The microwave needs to be thoroughly cleaned. The restroom has dirt in the corners of the room that needs to be thoroughly cleaned. There are also spider webs under the sink that can be removed with a Webster.

Mechanic's Shop: There are carpenter bees working under the NPS arrowhead over the door. If bees are burrowing holes for galleries to provision for larvae, the holes can be dusted with diatomaceous earth or TimBor Pro to kill developing larvae or the adult female carpenter bee drilling the hole. There is a gap under the doors where water comes into the shop. Install quality door sweeps with rubber or neoprene blades. Some areas were inaccessible for inspection due to equipment along walls.



There was a vine growing in a storage closet. The closet needs thorough cleaning and removal of the vine. There was a substantial amount of clutter present. The upstairs area has lots of equipment piled up and is cluttered. Inspection of this area was not possible. There were no doors on the south side which was completely open and had wood stored there. Rat and mouse snap traps should be fine-tuned and set (chunky-style peanut butter used as bait) and monitored daily for captures. There were 14 metal trash cans stored on the south side, upside down, and filled with rainwater. These should be emptied after each rain event to prevent mosquito breeding.



OTIS PIKE HIGH DUNE WILDERNESS AREA



Visitor Center

Outside: There is mold/mildew present on planks. Wood material can be treated with BoraCare or TimBor Pro to prevent WDOs. There is animal access under the rusted roll-up door as evidenced by numerous tracks. The door threshold may need to be replaced or built up to prevent raccoon entry. The .64 cm (1/4 in) hardware cloth on the northeast side may need to be replaced or refastened. The area on the north side behind the white detour sign needs exclusion material installed. The northwest corner also needs some exclusion work done. The south side of the Visitor Center also needs .64 cm (1/4 in) hardware cloth applied to cover gaps.



Basement: There are several rat traps present that have been tripped but no captures are present. Fine tune the rat trap triggers, bait with chunky-style peanut butter and reset with the bait toward (and against) the wall. A Ketch-All trap has also been tripped and has had a dead animal inside. Due to the potential Hantavirus exposure, multiple live capture traps are discouraged. The Ketch-All trap should be disposed of. All rodent traps must be monitored daily to remove dead rodents captured and then reset. There is a substantial amount of raccoon scat present in this basement area. There is a water leak under the hot water heater toward the north side that should be repaired. There were two very young raccoon kits hiding next to the hot water heater down in a corner. There are multiple holes in the basement to below that should be filled or repaired.





Inside: The main level office had spider webs and dirt under desks and cabinets. Spider webs should be removed with a Webster. General thorough cleaning is needed under and behind furniture and cabinets. Several items appeared to have been chewed on, but no droppings were observed. The closet was locked so was not inspected. There was no evidence of rodent or insect activity present in the restrooms; however, they need general cleaning (there was sand in the corners on the floor).

The upper level had spider webs and dead flies observed. Water leaks occur and crickets have been seen.

Wilderness East: The following list of invasive plants were observed and identified by the William Floyd Estate IPM Coordinator: multiflora rose, oriental bittersweet, and autumn olive, English house sparrows have taken up residence in the tree swallow nest boxes. The boxes should be moved farther away from the Visitor Center and human occupied or visited places.



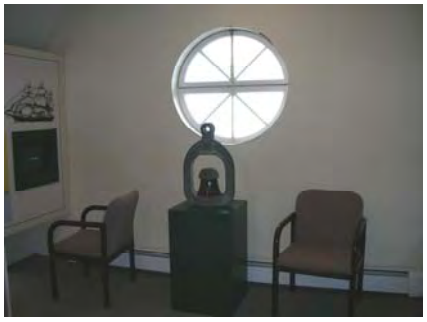
Multiflora Rose

Old Inlet has a substantial, healthy population of phragmites.

THE LIGHTHOUSE

The lighthouse was built in 1858. Overall, the lighthouse structure is in very good repair. An issue of pigeons nesting in the portholes had been communicated from the FIIS IPM Coordinator. The use of .64 cm (1/4 in) hardware cloth cut larger than the porthole and forced in from the inside-out toward the edge to exclude pigeons was discussed. The portholes should be cleaned with all the nesting material removed before installing the .64 cm (1/4 in) hardware cloth.

Second Floor



Lifesaving Room – there was no evidence of rodent or insect pests present.

Shipwreck Room - there was no evidence of rodent or insect pests present.

Main Hallway – needs thorough vacuuming; however, there was no evidence of rodent or insect pests present.

Main Office – clutter present with detritus under and behind cabinets, etc. Needs a thorough vacuuming.

Closets - there was no evidence of rodent or insect pests present.

Center Office – clutter present, possible harborage for rodents and insects; however, there was no evidence of rodent or insect pests present.

Conference Room and Closet - there was no evidence of rodent or insect pests present.



Kitchen – a hole next to the entry into the kitchen has evidence of rodent entry and needs to be filled with Stuf-Fit and sealed with .64 cm (1/4 in) hardware cloth. Dead flies were observed. There were mouse droppings under the register and a “Tin Cat” trap was observed. The area under the stove range top is dirty and needs to be cleaned.

Bath - there was no evidence of rodent or insect pests present. Mold was observed in the shower.

First Floor

Gift Shop and Closet need vacuuming behind shelves and displays, etc. There was no evidence of rodent or insect pest activity observed.

Restrooms - there was no evidence of rodent or insect pests present.

Janitor's Closet - there was no evidence of rodent or insect pests present.

Main Hallway - there was no evidence of rodent or insect pests present.



There is a leak over the archway to the entrance to the lighthouse tower that should be repaired. There is evidence of wood rot in window frames in the hallway to the lighthouse tower. The window frames can be repaired with new frames (or parts) treated with BoraCare or TimBor Pro before being painted.

Northeast Room – this room has very nice, well-designed displays. There is some trash under registers. Spider webs are on each side of the TV monitor and on the fireplace side, which can be removed with a Webster. There was no other evidence of rodent or insect pest activity observed.

Radio Room – there was a lot of clutter present. Holes in the ceiling should be repaired.

Basement: There was an over-the-counter pesticide on a shelf in the basement. Dead crickets and other insects were observed at the floor-wall junction.

The Storage Area has boxes of papers and supplies with high humidity levels. There was no evidence of rodent or insect pests present.

The Southwest Room has moisture problems. They have added a dehumidifier. There was no evidence of rodent or insect pest activity observed.

The Gift Shop Storage Room has lots of cardboard boxes; however, there was no evidence of rodent or insect pest activity observed. There was some moisture around the Bilco door, and mold present on the refrigerator gaskets. Pipe holes going out and up to the level above need to be filled to prevent pest access. There was no rodent or insect pest activity observed.

Maintenance Workshop (Southeast Room): There are some pipe holes through the wall that should be filled to prevent pest access. There was no evidence of rodent or insect pest activity observed.

The Generator Room: The hole by the pipes should be filled with Stuf-Fit and mortar. There are air and moisture coming through the Bilco door on the north side. Seal the gap to stop air and moisture entry. There was no evidence of rodent or insect pest activity observed.

THE LIGHTHOUSE ANNEX



This is an old Coast Guard building which was built in 1944. There was a "Have-A-Heart" trap on the back porch.

Quarters 1: Was vacant and needed cleaning. There was sand and dirt in the corners.

Quarters 2: Was vacant and needed thorough cleaning. The previous occupant had not cleaned before leaving. There were spider webs and debris under registers.

Quarters 3: Was occupied and needed cleaning. There was sand on the floor, a beetle in a corner covered with dust and fuzz, and debris under registers. The front closet needs general cleaning. There was also moisture damage and peeling paint in the ceiling.

Quarters 4: Was occupied and quite clean, although there were dust bunnies under the bed. In the bath there were spider webs under the sink. The linen closet had no evidence of rodent or insect pest activity observed. The back door had spider webs at the corners and under the heat register in the hall.

Laundry Room had a hole through the wall which hooks up with the hall heater. There was trash behind the washer. A mouse trap had been set incorrectly, so the rangers were shown how to fine-tune and set mouse traps to ensure mouse captures.

Rear Restroom had spider webs and insect parts under the toilet.

Kitchen/Lounge has a gap around the drain pipe under the sink which needs to be filled with Stuf-Fit and sealed with spackle or caulk. The stove needs to be cleaned under the range top and under the bottom (broiler) drawer. There were no screens on the back windows (screens are available; however, haven't been installed).

Feral cats are present on this end of the island which are supposed to help keep down the mouse population.

Large Upstairs Apartment is occupied by a family with a baby and two cats. The apartment was very clean with no evidence of rodent or insect pest activity observed. Cat food was observed under the stove. There was also rust observed on the bathroom ceiling. The office room has some clutter, and the baby's room had no evidence of rodent or insect activity observed.

Small Upstairs Apartment: Ants were reported in the kitchen and bedroom where there are cracks. Perhaps the ants are attracted to the dog food. Wipe the ant trail with soapy water to remove the pheromone trail. Remove dog food or other attractive food for ants. Follow the ant trail back to the entry point and seal the ant entrance. There was mold observed in the refrigerator door gaskets. There is a hole around the pipe under the sink. Close the hole with Stuf-Fit and caulk. The kitchen stove needs cleaning, especially under the range top and under the bottom drawer. Spider webs can be removed with a Webster. There is a small gap around

the incoming gas pipe by the washer. Seal the gap with Stuf-Fit and caulk. The ceiling tiles have been cut too small and fall out of the grid. There is no insulation in the ceiling. Closets are open to the attic. There is mold around the bath tub and rust around the ceiling. Kitty litter was observed under the bed and dresser. The apartment was generally clean.

First Floor – Radio Transmitter Room: This area is filled with old Coast Guard equipment from prior to 1950. Nothing can be done with this equipment except storage only. There is substantial dirt and clutter observed. The hole at the bottom of the double doors appears to have been chewed. There is a hole in the wall and spider webs and dirt were observed.

Middle Ranger's Office had holes in the wall under the heat register that need to be filled. If a rodent problem were to exist, there is a lot of rodent access here. No rodents have been observed by the staff. There were no droppings observed, although there was plenty of clutter present.

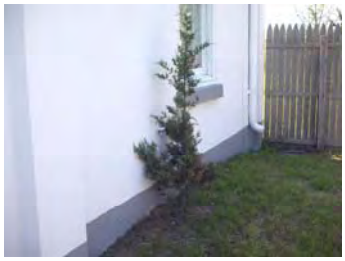


Front Ranger's Office had some clutter. There was a hole observed under the corner of the outside door and access under the inside door. There was mold observed in the refrigerator/ freezer. The refrigerator was very dirty and needs cleaning. A possibly unauthorized pesticide was found in the bathroom (Hot Shot). The active ingredient of this pesticide is a pyrethroid. There were dermestid beetle larvae and frass observed in the stuffed owl. The restroom had a screen missing on the window. The restroom was clean and there was no evidence of rodent or insect pest activity observed here.



Outside: The north side has a moisture leak on the 2nd air conditioning unit on the second floor. The screen is off the window. There is a hole around the electrical wiring box with gnawed wires. There is a rodent hole under the back porch. The downspout end should be reattached.







On the west side in back, a tree is too close to the building and should be pruned back at least .91 m (3 ft) from the building. A smaller tree is growing right next to the structure and should be removed. On the south side there is a sparrow nest that can only be removed after young have flown. Most of the rain gutters are clogged with pine needles. Trees are too close to the building and should be pruned back at least .91 m (3 ft) from the structure, moved farther away, or removed entirely.

Maintenance Shed: There were numerous barn swallows flying around and nests inside were observed. After young birds have flown, exclude the swallows and remove the nests. Repair the

swallow hole in the door and install door sweeps on the bottom. Keeping the roll-up doors closed when not moving equipment will also help. The nests may need to be treated with an insecticide such as diatomaceous earth to kill mites and other parasites that are living in the nests. Mouse droppings were observed on the north side. Access is likely under the west side door. Install a door sweep. Set Victor mouse traps at the floor-wall junction with the baited trigger toward the wall. Chunky-style peanut butter works well as a bait. Check traps daily (every morning) to remove dead mice and reset traps.



The South Room had locked storage that was inaccessible to inspection. There were old mouse droppings observed. The west side storage was clean. The pipe holes to the outside should be sealed.

Exotic plants observed on the lighthouse grounds were autumn olive, oriental bittersweet, bunch grass, little blue stem, phragmites and mugwort.

SAILORS HAVEN

There was construction occurring on the marina, piers and in the Garbage House.

Restaurant/Gift Shop (SH-106)
Outside: The deck posts were checked for moisture content and 22% was found in crossbeams under the deck (toward the bay), 20% in the deck, and 19% in beams facing away from the bay. The wood appeared to have been treated with a preservative. The deck is in good shape overall. There was trash and debris under the deck that needs to be removed. There was evidence of rodent activity underneath the building. The northeast and southeast sides had loose shingles under the eave.





Carpenter bee holes were observed under the eaves on all sides. Inject TimBor Pro dust into the carpenter bee galleries to kill developing larvae. There was no screen on the exhaust fan on the back wall of the kitchen. Replace the screen to prevent insect access. There was clutter (harborage) by the back door out from the office. The roof appeared to be OK. There were bird droppings under the deck roof on beams; however, no bird nests were observed. Moisture readings on vertical beams on the bay side were 28%; those away from the bay and those in full sun had 19% moisture.

Inside: The Gift Shop was very clean with no clutter. The office had sawdust on the floor that should be cleaned up. The kitchen storage room (janitorial closet) and the restroom were clean

with no clutter. The drains appear clean. The kitchen has debris under the grill and shelves (on the bay side) that needs to be cleaned up.

Visitor Center (SH-104)
Outside: There is evidence of wood rot at the area of wood/soil contact. Wood may need to be replaced and/or treated with BoraCare or TimBor Pro to prevent further damage. The dead stretcher storage area has a bird nest in a protected front section where a tank is. A hose from the above deck is dripping water onto the wood walkway below. Repair the leaky faucet. The wood appears to be in good shape; 25% moisture on deck joists as measured from below. There were animal tracks in the sand; possibly fox, raccoon or opossum. The outdoor shower was filled with leaves and needs to be cleaned out. There were plastic bags wrapped around pipes where they entered the building. These are not a deterrent to rodents or insects. Replace the plastic bags with Stuf-Fit jammed in tightly and caulked.

The Towel Storage Room (cement room in the basement) has a musty smell and needs to be thoroughly cleaned. There are several holes penetrating to the outside (in the cement room) that need to be repaired or filled with Stuf-Fit and cemented.



The window frame on the east side needs to be repaired to prevent easy access to the inside by rodent and insect pests.

There is a lot of general debris on the back side underneath that needs to be removed. There is a large hole next to the chimney on the northeast corner that needs to be repaired. The fascia board also needs to be replaced. The chimney and the building are separating from each other near the top. This may be caused by a structural defect that needs major repair. The gap may provide access by pests into the structure and may cause more damage. There are also trees very close to the building that must be pruned back at least .91 m (3 ft) from the structure, moved or removed. On the west side there are some missing shingles that need to be replaced.



Inside: The general cleanliness needs to be upgraded everywhere – the back offices and out in front. Although there was little evidence of rodent or insect pests observed, the Visitor Center needs general housekeeping. There was a leak observed by the hot water heater. The wood has high moisture levels and will eventually rot unless repaired.



Bath House: The ladies' side had some unflushed toilets which may be stopped up or not operating properly and need to be cleaned. There are many dead insects in the light fixtures. The insects can be cleaned out periodically. There are water leaks in the outside showers that should be repaired to reduce water damage. There was wood rot by the shower entrances. Carpenter bee holes and bee galleries are present in the overhead shower beams.

The men's side also had some unflushed toilets which need to be cleaned. There were no screens on the inside window openings. There was also wood rot on several of the showers. The bath house was clean underneath.



The Storage Shed east of the bath house has a mouse nest in the rescue baskets (obviously undisturbed for some time). There was also a mouse nest in coiled ropes inside another basket. There are many holes providing rodent access into the storage shed. Repair the holes to exclude rodents. Do not allow food in this storage shed (rescue equipment only). Provide periodic trapping with Victor mouse traps (fine-tuned) with chunky-style peanut butter (or raisins) as bait. Check mouse traps daily (every morning) to remove dead mice and reset.

Staff Housing Motel (SH-101)



The kitchen has sawdust under the sink and the stove needs to be cleaned under the range top, the oven and under the broiler. The resident staff needs to pay more attention to sanitation and cleaning.



The steel wool used to fill holes by the fireplace has rusted. It is best to use Stuf-Fit (copper mesh) or stainless steel wool. There is moisture damage on the floor in the laundry room. There is tile missing and a hole in the floor under the sink in the half bath, and mold on the walls and in the cabinet. Paint is peeling on bedroom shelves and a hole in the wall in the bedroom closest to the entrance door. There is also a hole in the floor behind the kitchen table. There is wood rot on the deck which should be treated with either BoraCare or TimBor Pro to manage wood rot. The fascia board on the north side is gone, leaving a space wide open to the inside. Underneath the deck on the north side, there was a metal fitting into a plastic tube that has a pinhole water leak, causing a water mist to spray to the side under the laundry room. Replace the metal fitting. There was standing water in a trash can on the front porch which contained mosquito larvae.



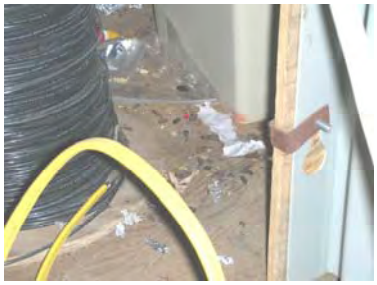
Staff Housing (SH-102)



There are holes in the floor in the laundry room. The holes need to be filled (or repaired). There are many spider and lots of dead insects below. There is assorted debris on the bedroom floor. The large holes in the corner of the small bedroom show rodent chewing. These holes need to be repaired or filled with Stuf-Fit backed with .64 cm (1/4 in) hardware cloth. There was also a set mouse trap without bait and mouse droppings around it.

Demonstrate to staff occupants how to fine-tune, bait and set mouse traps to ensure captures. Staff occupants should perform the necessary sanitation to eliminate food and clutter which supports rodent and insect pests.

Maintenance Shop (SH-109)



There is a 10.16 x 10.16 cm (4 x 4 in) hole in the east wall to the outside, and there are several holes through the floor (down to the sand). There were several mouse droppings in the circuit breaker closet.



Place several fine-tuned Victor mouse traps here with chunky-style peanut better bait. Check traps daily (in the morning) to remove dead captures and reset. There is rodent access under all outside doors in the shop. Install quality door sweeps to close the gaps. There were Norway rat droppings on a lower shelf by the door. Set fine-tuned Victor rat traps baited with chunky-style peanut butter on both sides of doors and where rat droppings are seen. Check traps each morning to remove dead rats and reset.

Staff Housing SH-103 (Old Horse Barn)

There were lots of spider webs which can be removed with a Webster. Mouse droppings were present in the water heater closet. Find access points and perform exclusion repairs. Set fine-tuned Victor mouse snap traps and bait with chunky-style peanut butter. The separate laundry building has holes (for pipes) that penetrate the floor and should be filled to prevent insect and rodent pest access. The old paddock east of the house has some Jimson weed growing. This is a toxic weed, dangerous to horses, and should be removed. It may have come in with hay bales.



The Garbage House

There was construction underway, so the building was over water. There will be a sand fill installed to dry out the excess water. There is wood rot present and wood moisture recorded over 40% (should be below 12%). Holes in the building should be filled with Stuf-Fit, backed by .64 cm (1/4 in) hardware cloth, or other permanent repairs in order to prevent rodent access. The doors need to be tight. The metal doors have a 2.54 cm (1 in) gap at each end of the bottom edge. Install a metal threshold to close the gap. Install .64 cm (1/4 in) hardware cloth over the existing metal mesh in the ceiling to prevent rat and mouse access.



Sailors Haven Dunes may be habitat for Pitch Pine, a state rare species coded as S-1.
There was mosquito larvae habitat (standing water) in a boarded-over cesspool along the path to the Sunken Forest. Within the Sunken Forest, Japanese honeysuckle, oriental bittersweet and phragmites have been found growing here. Greenbrier (or cat briar) is a native which acts like an invasive plant. Spotted knapweed has been seen on FIIS.

TALISMAN/BARRETT BEACH



Concession Building has wood rot at ground level under the south sliding window and a hole on the north side which goes to the inside. The north side also has holes at ground level. At the doorway on the west side, the cover board is open to outside. The storage room on the northwest side is wide open and has mouse droppings on the concrete floor.

Restrooms were locked; no access was available to conduct inspections. There was a pipe hole at the northeast corner of the 1st storage room. There was evidence of moisture in the inner pipe race room along with a few old mouse droppings. There was a water leak at the faucet on the east side. There is mold at the floor-wall junction on both outside showers. The middle south window in the men's restroom is open to the outside and has no screen.

VIP House (TA-155)
There were old mouse droppings in the broiler and behind the refrigerator. There was a rodent-chewed hole under the bathroom sink. A ceiling tile was missing over the door into the northeast bathroom.

Outside: The southeast corner has holes at the roof. Vegetation needs to be removed at least .91 m (3 ft) from the house. Install a .91 m (3 ft) wide, 15.24 cm (6 in) deep gravel barrier all around the house to reduce insect, rodent and vegetation damage to the structure. Use 1.91 – 2.54 cm (3/4 – 1 in) gravel for this barrier. There was wood rot on the northeast window frame and substantial moisture under the house. There was eastern subterranean termite damage and mud tubes on a piling under the house. The covered washer/dryer cabinet on the porch has holes underneath to the outside.



Superintendent's House (TA-154)



This house has substantial evidence of a mouse population. There were mouse droppings in the cabinet by napkins, beside the stove, in the cabinet beside the stove, and a chewed soup carton in a bowl. There were also mouse droppings and chewed paper under the stove top. Under the sink there were seeds, nuts and mouse droppings. There were also mouse droppings on the mattress pad on the bed in the northeast bedroom. Remove all

mouse droppings and disinfect all areas where the droppings are found. Find all entry points for mice (.64 cm [1/4 in] holes) and seal with Stuf-Fit and caulk. Set Victor mouse traps (fine tuned), baited with chunky-style peanut butter. Check traps every morning to remove dead mice and reset traps. There was also mold observed in the refrigerator gaskets.



Outside: There were leaks in the faucets by the washer and dryer. Shingles are missing off the roof, and there was no rain gutter or downspout on the south side.

Motel (TA-153)

This structure has been condemned and will be demolished at some time in the future. The structure is wide open and provides excellent habitat for rats and mice. There are numerous swallow nests and swallows flying in and around the structure. Do not destroy the structure until the nestlings have flown. Monitor the motel site with diatomaceous earth track patches (30.48 cm [12 in]) square placed near possible harborage or runways to get an idea of the rodent and other mammal population that may inhabit the immediate area. Several diatomaceous earth track patches can be monitored each day to identify the species by footprints and determine relative numbers. Night monitoring can be done using a night vision scope from a blind. Place feeding stations near the night blind or diatomaceous earth track patches.



Trap out the rodent population to avoid forcing rats and mice out to invade other park structures. Place numerous fine-tuned Victor rat and mouse traps baited with chunky-style peanut butter. DO NOT use poison baits for rodents because of the potential secondary poisoning of nontarget animals such as fox, raccoon or opossum. These nontarget mammals can also be injured by rat snap traps.

Utility Building

This structure near the motel was not inspected inside as it was locked and no key was available. There was a substantial water leak on the east side from a pipe coming from inside the structure.

Maintenance Shed (TA-156)



The lab portion of the building was boarded up and the interior could not be inspected. There were several holes at ground level to the inside of both the lab and the maintenance shed. There were mouse droppings inside, mold in the ceiling and water damage. There was a window missing on the south side with openings. The west room was open at the eaves on both sides and was also open at the vent on the floor. Pest access into the Maintenance Shed was obviously present. A rodent hole in the north wall had gnawing to enlarge it and grease smears from rodent activity going in and out. Windows on the south side were boarded up. Close all holes available for entry by rodents, use Stuf-Fit in the holes backed up with .64 cm (1/4 in) hardware cloth fastened over openings. Set Victor snap traps (fine-tuned) baited with

chunky-style peanut butter. Check traps daily, preferably early in the morning to remove dead rodents and reset traps.

INVASIVE PLANTS AT SAILORS HAVEN AND TALISMAN/BARRET BEACH

Talisman/Barrett Beach: Phragmites was noted all along by the bay. Several areas of garlic mustard were noted near the VIP house (TA-155), west, northwest and north of the lab building and south of the restroom. Tree of Heaven *(Ailanthus)* was present between the bathrooms and the bay. Garlic mustard was also found south of the picnic area, in a low area south of the picnic area and on the other side of the walk. Garlic mustard can be hand-pulled when young. Phragmites was also seen in a bog on the south side of the trail and in a fresh-water pocket. Giant mullein is an exotic but is not a problem so is not being GPS-plotted. Japanese black pine was imported about 50 years ago and planted to hold dunes. When young, the Japanese black pine does well. However, when they mature, they decline and start to die; thus becoming attractive to bark beetles.



WATCH HILL AND THE DUNE STATION

Dune Station: Has wood rot on the walls and inside of doors. The fabric screens on the louvers have deteriorated, allowing flying insects inside. There were dermestid larvae and their frass found on the stuffed Gannett. The damage may not be able to be repaired. Treat the Gannett with an application of TimBor Pro as a dust and food-grade diatomaceous earth. Paint is peeling from the walls. A dead carpenter bee was observed on the floor; however, there were not any holes drilled into wood portions visible. The old mud dauber nests seen at the ceiling may harbor dermestid larvae and should be removed.





EMS Building: There was a black widow spider web and egg cases present over the door. There were many dead flies under the nest. The spider webs can be removed with a Webster. The building needs a thorough cleaning. Screens on the louvers in the lifeguard changing room have deteriorated allowing flying insects to enter. Screens need to be replaced.

Men's Bath: The screens on the louvers have deteriorated allowing flying insects to enter. Mud dauber nests should be removed. Replace screens.

Women's Bath: The screens on the louvers have deteriorated allowing flying insects to enter. Replace screens. Paint is peeling from the walls. A shower stall fixture was leaking (reported to Maintenance).

There is a large area of phragmites on the walk from the Dune Station to Watch Hill.

Storage Buildings under Dune Station Walkway

Building #29: Has three live *Peromyscus* sp. mice and nests seen in the pump and pressure tank frame. There is easy access under the door. Install a quality door sweep or install a threshold to close the gap. Place four fine-tuned Victor mouse traps baited with chunky peanut butter. Set traps at the floor-wall junction on each side of the door and against two walls. Check traps daily to remove dead mice and reset traps.





Building South of Building 29: Has a dead fox in the building. It probably entered through the broken window. There were dermestid larvae present. The building needs a thorough cleaning.

There is a large water leak under the walkway beneath the water fountain.

Maintenance Shop/Office Complex (WH-20)

The entire structure needs thorough cleaning. There is no access under the Maintenance area door when it is closed. There is a round hole in the wall behind the workbench on the north side. There is a black widow spider and web in the northeast corner at the ceiling. A Webster can be used to remove the web.





Resource Management Office: Had mouse droppings observed on the floor by the north wall. There was a piece of a nut by the droppings. There is plenty of harborage in this office.

Locker Room: There was no access into lockers; however, there was no evidence of rodents or insect pest activity observed.

Front Ranger Offices: Had no evidence of rodent or insect pest activity observed.

Restrooms: Neither bath had evidence of rodent or insect pest activity observed.

Kitchen: A set mousetrap by the trash can to the right of the sink had mouse droppings around it. There is a hole in the wall by the wood panel, left of the sink behind the recycle can. There is no screen on the left hand window. A tripped mouse trap was reset; there were mouse droppings here also. Cabinets are clean inside. There were mouse droppings between the refrigerator and

the wall. Clean up the mouse droppings. Set fine-tuned Victor mouse traps baited with chunky-style peanut butter. Check traps daily to remove dead mice and reset.

Garage building looks to be in good condition. A new façade was placed over the old structure. There was debris under the building that needs to be removed. A long rake will work. There are a substantial number of mature poison ivy plants present. Perhaps the VIPs could help with the removal of the poison ivy and debris under structures. The bales of hay or straw under the building are decomposing, creating a potential fire hazard if they get wet and hot.

Inside the small closet off the garage has several holes in the wall by pipes, and insulation scattered on the floor (may indicate mouse presence). The storage room needs cleaning. There are mouse droppings in the southwest corner of the garage. There is access for mice through floorboards and under the overhead door. Repair the holes in the floorboards and install a threshold to close the gap under the overhead door. Set fine-tuned Victor mouse traps in the southwest corner at the floor-wall junction. Bait the mouse traps with chunky-style peanut butter. Check traps each morning to remove dead mice and reset traps.



Maintenance Yard: The tree under the steps should be removed. There is a substantial amount of poison ivy present. Hand-pull (wear protective clothing and eye protection) or apply a low-risk herbicide such as Matran2.

Flammable Storage Building has a broken window; however, there were no wasps or yellow jackets observed. There were animal tracks inside.

Horse Barn (WH-26): There were several fly strips hanging that are a great help with fly management. However, those present had numerous flies captured and the glue had dried out. The fly strips need to be replaced by a fresh supply. There were a lot of rat droppings on the east side in the first open stall by the white bin and Suzuki. There were also rat droppings in the tack area, but none in the wooden cabinet. There is rodent activity in the insulation behind the covered saddles in the southeast room. There was mouse activity behind the refrigerator and desk in the office. Rodents may be feeding on beetles and other insects as insect pests were observed.







Barns are usually quite open with lots of holes, gaps and cracks that allow rat and mouse entry and harborage. Additionally, there is an abundance of attractive food sources, grain, hay, etc.



Horse and livestock feed should be stored in metal containers with tight-fitting lids to reduce rodent access to this feed. Frequent cleaning of stalls can also reduce attractive food and harborage sources. Fine-tuned Victor rat or mouse snap traps can be placed in places where horses are not likely to contact them. Check traps daily (early morning) to remove dead rodents and reset traps. Using .64 cm (1/4 in) hardware cloth to close gaps and holes in the structure may limit some of the access and harborage.

Pier Fire Storage Building has no evidence of rodent or insect pest activity observed.



Visitor Center needs a thorough cleaning. There is moisture damage by the windows. Determine where the moisture intrusion occurs and seal it.

Snack Bar (WH-18): The concessionaire is to start an entire renovation by the end of this 2006 season. The snack bar kitchen needs general thorough sanitation - EVERYWHERE!! Especially cracks and crevices. Mice have access under the door. Install a quality door sweep with a stiff rubber or neoprene blade. Raise the threshold to help close the gap. The ice machine leaks condensation or melted ice water across the floor all the way over to the ice cream machine. There is substantial dirt behind and under all equipment. There is also a water leak across the floor from by the cash register.



The office is dirty behind the freezer (this is the least offensive room).

The bath is generally dirty, especially under the sink.

Gift Shop: Needs general cleaning. There was no evidence of rodent or insect activity observed.

Restrooms: Have several spider webs with insects. Need general sanitation.

EMS Station: Needs general periodic cleaning.

Dockmaster's Station: Needs general cleaning and removal or at least organizing of the clutter.

Concessionaire's Office: Needs periodic general cleaning. Rodent and insect access is available through double doors. Install quality door sweeps. There was wood rot in the northwest corner and peeling paint on the walls.

WH Staff Laundry Building: This structure has three areas. The laundry room needs periodic general cleaning. A few spider webs were also present. The door for the portion south of the laundry is open at the bottom for rodent and insect access. Install a quality door sweep or raise the threshold to fill the gap. The tank room with pipe storage (had nails spilled) has spider webs with dead insects. There were also mouse droppings present.



After completing the exclusion, mouse traps can be set at the floor-wall junction to capture mice. Check snap traps daily to remove dead mice and reset traps.

Staff Housing (WH-1): Is clean and occupied! There was a power problem being worked on. There was a leaky faucet in the kitchen. The stove was clean. No clutter was observed. Outside there is a hole around the stove pipe which needs to be recaulked with heat-resistant caulk. Carpenter bees were observed flying around eaves, although no nest holes were observed.



Staff Housing (WH-2): This is a newly renovated two-story home occupied presently by two staff. There is substantial clutter in the bedrooms. The kitchen needs periodic general sanitation. Outside there was wood rot observed on upper deck planks. Wood can be treated with BoraCare or TimBor Pro (twice), then painted with water-proofing polyurethane.





Fire Storage Building by WH-2: This structure is wide open on the west side. The siding needs to be nailed shut and the holes need to be filled.

Staff Housing WH-3: This unit is occupied by a Law Enforcement Ranger. There were a few ants observed in the kitchen. The stove needs to be cleaned on top and under the stove top. The bath has a leaky faucet that should be repaired. There were dust bunnies beside the bathroom sink. There were dead insects behind the dresser in the master bedroom. The air vent in the hall is open to the outside. The laundry room has water damage on the ceiling tiles. There were mouse and rat droppings observed in the attic. The back deck has extensive wood rot and some moss. Some portions of the back deck may need to be replaced. Treat wood with BoraCare or TimBor Pro to prevent wood rot damage. The beam under the back deck has substantial wood rot and may not be structurally sound. It may need to be replaced. There is also wood rot in the bench on the front deck seat.



The house needs periodic thorough cleaning. It is suggested that a search for rodent access be made and appropriate exclusion measures be taken.



Outside: There were two holes by the front through the wood siding. There was insect harborage under plywood on the east side of the house which needs to be caulked. There are old mud dauber nests on the north side under the eaves. Dermestids feed on the cast skins left behind. There is a gap

under the roof on the north side which may be open to inside. There is wood rot on the north side at the bottom of the shed wall. The west side is open. There was standing water in shells in the backyard with mosquito larvae present. There were mouse droppings in the outer shed on the back deck, and the beginnings of nest building. There were also mouse droppings in sheds attached to the house facing north under the stove pipe. Conduct a thorough search for rodent access points and provide exclusion. Set and monitor Victor snap traps (fine-tuned) to capture resident rodents. Eliminate rodent access to food and harborage (clutter).



Staff Housing (WH-4): This unit is unoccupied. There was water damage on the front wall and at the bottom of the door. There was mold beside the stove and dead insects behind the stove. There was food under the stove range top that should be cleaned. There were dust bunnies under beds and behind dressers. This unit needs periodic general cleaning.

Outside: There is a bird nest above the middle window on the east side which should be removed after young have flown. There is wood rot in the beam above a piling on the northeast corner of the house. There is also old evidence of eastern subterranean termites on the piling at the northwest corner of the front deck below the house. There is also borer damage in the pilings. There was sawdust on the deck from a carpenter bee nest above. There was no walkway hand-railing on the front walk up to the house (a safety issue).



Staff Housing (WH-5): Has a leaky faucet in the kitchen, which leaked 3 ½ quarts in an hour (timed and measured). This is 210 gallons in 24 hours; 6,300 gallons per month and 31,800 gallons in a five month period; an expensive water bill. There was mold in the refrigerator gaskets. The hole at the outside of the metal frame of the front door needs to be filled. The inside front door framing needs to be installed so there are no openings to the outside. Ceiling tiles in the kitchen over the sink need to be repaired. The roof leaks in the living room by the ceiling fan and in the bathroom above the towel rack. The window by the shower needs a screen, and the gaps to the outside need to be closed. The screen on the window over the commode needs repair (has been taped but it is not holding). The west window in the front bedroom needs a screen installed. The window on the east side by the front door also needs a screen.

Outside: There are leaks in the connection pipes going to the kitchen faucet. There are branches and broken wood stored in contact with soil which could encourage termites and other wood-destroying organisms. There are barn swallow nests under the building. There is a substantial leak in the faucet of the outside shower. There is a gap over the back screen door to the outside.



Staff Housing (WH-6): This unit needs periodic general cleaning. The stove needs cleaning on top and under the range top. There was mold in the top gaskets of the refrigerator in the

kitchen, and in the freezer by the stove. There were lots of spider webs which can be removed with a Webster. The hot water closet is open to the attic. There was also mold in both showers. There was a lot of clutter in the south bedroom.



Outside: Carpenter bees were observed flying near the house. The pine tree limbs should be cut back at least .91 m (3 ft) from the house to discourage rodent access. There was an old subterranean termite tunnel (tube) along the beam under the north side of the house.

Staff Housing (WH-7): This unit has evidence of water damage. There was no water heater;; there was a hole in the closet which was open to the ground. Holes in the chimney may lead to the outside and should be repaired (filled). Repair to the heater needs to be redone. The floor is warped upward from the moisture. The stove heating elements are rusted. The foil is torn (chewed) and mouse droppings are present around the burners. Mouse droppings were observed under the kitchen sink. Stuf-Fit has been used around pipes where they penetrate the wall. The gap in the wall under the sink is large enough for mouse entry and needs to be repaired. The mold in the freezer needs to be cleaned (removed). There were mouse droppings in the shower by the kitchen. There was mold on the shower curtain and the shower in the bathroom by the bedrooms. There were old mouse droppings in the bath. There were also mouse droppings on the heating element in the southeast bedroom, in the closet and on shelves.





Outside: The low areas in the front yard on both sides of the walk held substantial water and possible mosquito larvae habitat. Low spots can be filled with soil and seeded to eliminate standing water. There was an old mud dauber nest under the eave to the right of the front door which can be removed. The northeast corner of the house has gaps under the overhang, which may be possible pest access to inside. There was a "Tin Cat" mouse trap on the front porch with the remains of two mice and one toad inside. Paneling on the east side has warped away from the structure and needs to be nailed down. On the north side, the mud dauber nests appear to be open, which can be a dermestid beetle source. There is a swallow nest on a light fixture under the house. There is loose plywood sheeting on the south side that should be fastened down.





Staff Housing (WH-8): This is a two-story house with central heat. It is occupied all year. There was dust behind the washer and dryer. There was no evidence of rodent or insect activity observed. This unit appears to be brand new.

Outside: Carpenter bees were observed; however, there were no nest holes.

Fire Storage Building by WH-8: This structure has carpenter bees flying and nest holes observed on the building. Nests bored into the wood can be treated with diatomaceous earth or TimBor Pro dust to kill the carpenter bees developing within the nest.

Staff Housing (WH-9): Is not occupied. It needs thorough cleaning and sanitation. There was water damage in the living room ceiling. There was frass like sawdust on the floor by a wall which is possible wood-borer damage. There was mold in the refrigerator gaskets – both refrigerators were left on over the winter. The stove needs to be thoroughly cleaned. There is a hole to the outside by the back door. A mouse trap in the back bedroom appears to have captured a mouse; however, not much is left except a few dead insects.



Outside: There is a swallow nest above a light underneath toward the center. Carpenter bees were flying around the front of the house; however, no holes were observed. There was plywood and insulation stored under the house. There were no apparent leaks. A vine has grown between a corner plank and the structure on the northeast corner which may increase the possibility of pest access. The front door frame has more than .64 cm (1/4 in) gap on the south side, which is a potential mouse entry point. The front window frames are present, two storm windows are missing on the east side. The screen on the back door is held in place with duct tape which has come loose. There are gaps around pipes that enter the underside of the floor that could allow mice to enter. Fill the gaps with Stuf-Fit and seal with caulk.

Staff Housing (WH-10): This unit has lots of spider webs which can be removed with a Webster. The screen in the living room window is held by duct tape which has come loose. There are a lot of flies on the floor by the window. Holes around pipes in the water heater closet need to be filled with Stuf-Fit and caulked. There was a large gnawed hole beside the cabinet.



There was mold in the refrigerator, on the outside gaskets, and in the freezer which needs to be cleaned. The area under the sink is wet. There were ants seen on the island counter in the kitchen. Light was coming in above the refrigerator at the south end of the building. The fascia is not flush with the soffits. The southwest bedroom has a large gap under the door. The sink drain in the bathroom needs Stuf-Fit applied to the gap where the pipe penetrates the wall. There is a large gap between the windows which needs repair in the southeast bedroom. Water damage is apparent on the east wall at the floor.

Outside: The lower door has a 1.27 cm (1/2 in) gap underneath which needs a quality door sweep installed. There is no screen on the upper outside door. There is wood rot on the lower 7.62 cm (3 in) of the fascia on the south side. The northeast corner of the fascia is open at the end. There is wood rot on the vertical corner board on the southeast corner. The screen on the

east side toward the north is loose on the bottom and should be fastened. There is wood rot at the base of angled 2 x 6 support beams at the west end of the deck under the house. There is moss on the deck. There are several swallow nests and one straw nest with substantial droppings on a ledge under the house and on beams. There is a bull thistle in the front (an invasive plant).





Staff Housing (WH-11): Has a large hole in the southwest bedroom on the west wall at the floor which needs to be repaired. The southeast bedroom was locked and inaccessible. A ceiling panel was open in the middle bedroom on the west side. There is no screen on the window that opens, and there is water damage and mold in the northwest corner. There is no screen on the window in the middle bedroom on the east side. The ceiling tiles are warped and open in the bath. Mouse droppings and sawdust were seen in the bottom of shelves in the hallway. Open ceiling tile in the bath in the north end of the house need to be replaced. The north bedroom has a missing ceiling tile on the east side; clutter and wood rot on the outside wall at the floor-wall junction. There are gaps around pipes under the kitchen sink (but tight through the floor). Fill gaps with Stuf-Fit and caulk. There is no screen on the kitchen window. The stove is dirty under the range top and should be cleaned. There is no damper in the fireplace; it is open to the outside which means possible rodent access.



Outside: The house is occupied by the concessionaires who have a dog. The fascia board is rotted out on the south side. There are no screens on either south-side windows. There were carpenter bees flying and eight active holes along the south side fascia. There are greenbrier vines growing up from under the house beneath the siding. There was exclusion done with Stuf-Fit and .64 cm (1/4 in) hardware cloth under the house on the north side. There is a huge hole above the window on the west side toward the north end. The back door screen is out on the upper level. There are swallow nests under the upper level by the chimney. The chimney is separating from the building on the northeast side. Caulk is needed to close the gap on the window on the north side at the west end. There are active carpenter bee holes on the north and south sides of the house also, and activity at the northeast corner on beams under the upper level of the house. There is wood rot in a piling at ground level on the northwest corner. A garbage can lid under the house is filled with water and presents possible mosquito larvae habitat. There is a water leak at a valve on a 1.27 cm (1/2 in) copper pipe under the house next to a large down pipe. The center window on the east side has no screen. There is a trail of ants going up into the house just north of the southeast corner. There is a straw bird nest under the





house on the east side toward the south corner. There is a lot of very healthy poison ivy growing around this house.

Staff Housing (WH-12): This structure has many dead flies on the floor. There is mold in the south refrigerator. There is water damage on the east wall at the floor-wall junction. Pipes penetrating the east wall need the gaps filled with Stuf-Fit and caulk. The screen in the south window by the kitchen is broken and should be repaired. The top of the range has mouse droppings that should be cleaned up. There were mouse droppings in the northeast bedroom closet. There is rodent access under the bottom of the boarded-up south door. The water heater closet has holes to the outside that should be filled with Stuf-Fit and backed by .64 cm (1/4 in) hardware cloth. There is a mouse nest behind the water heater which must be removed and the site sanitized (disinfected). The bath on the east side has a pipe access gap at the bottom of the north wall, and a hole open to the underneath of the structure. These gaps and holes should be repaired or filled with Stuf-Fit backed by .64 cm (1/4 in) hardware cloth, then caulked. The southeast and southwest bedrooms did not have evidence of rodent or insect pests observed. The west bath has lots of dead flies and mouse droppings behind the toilet and under the sink. The west middle bedroom had mouse droppings behind the dresser on the north wall. The storage shed was locked and inaccessible.



Outside: There is a lot of standing water around and under this house. The low areas need to be filled with soil to eliminate the standing water. There is a hole in the front door where the lock used to be. There is a gap to the left of the front door where you can see inside that needs to be repaired. There are greenbrier vines growing up under the house. There are 12 or more swallow nests on beams under the house. Several 2 x 6 beams under the deck are damaged by wood rot. There is also a healthy population of phragmites here that should be managed. The north window on the west side lower level is missing a sill and may be open to the interior wall. The south and north windows on the east side lower level are missing sills and have gaps underneath. The south-side door is boarded up. The east window on the south side is missing a sill and is open to the interior wall. The missing sills must be repaired or replaced to prevent critters from entering the structure.



EXOTIC INVASIVE PLANT MANAGEMENT METHODS

Unfortunately, management of unwanted plant material after it has become established is usually staff-intensive, especially if the plants are fully interspersed with desired native plants.

Identifying and locating unwanted plants requires a team of persons who can recognize the plant(s) in all of their growth stages, cover large areas of wilderness or other landscapes, and provide the appropriate management approach when the exotic plant is found.

Physical measures include:

- Hand-pulling or rogueing plants when young and roots are shallow.
- Leveraging larger plants out of the ground with a Talon Claw or weed wrench.
- Digging up unwanted plants with a shovel or hoe.
- Pruning plants with pruning shears or hand saws.
- Chainsaw large woody plants.
- Cover plants with a dense tarp or plastic to block sunshine.

Chemical measures include:

- Broadcast spray of broadleaf active herbicide.
- Injection of herbicide into the trunk or stem of a plant.
- Hand paint translocatable herbicide to pruned or cut stump.

Biological measures include:

- Release insect or fungal pathogens which are host specific to the exotic invasive plant.
- Plant native species that out-compete exotic species for light, moisture or nutrients.

Ideally, a combination of these methods will be applied. Replacing the removed plant with a desired native plant that will utilize the same environment will provide more permanent results. See Pest Profiles for more specific information.

INSPECTION AND MONITORING

Successful low-risk integrated pest management (IPM) depends on "inspections and monitoring" more than anything else. These activities provide pest management alternatives because they identify the presence and changes in conditions that support pest populations. There is a reason for a pest infestation. The intent of inspection and monitoring is to determine the kind and extent of infestations, how the pest entered the space, and what factors contribute to its survival.

Inspection is an action taken by a person (usually the IPM Coordinator) looking for (and seeing) evidence of pest activity in a structure, its surrounding environment, turf, landscape or other areas. Anyone can conduct an inspection; however, it will achieve better results if the same person performs the inspection periodically, thereby noticing changes that may occur. Other staff can make observations and report them on a Pest Sighting Log.

There are important tools that support the inspector and assist in gathering information. One of the most important tools for the art of inspection is a powerful flashlight. Outdoors, a pocket mirror (on sunny days) can take the place of the flashlight. The flashlight (and mirror) illuminates a relatively small area and helps the inspector to focus the vision in that small area to see more detail. Use a moisture meter to detect the level of moisture in structural media such as wood members, carpeting, plaster, shelving, cabinets, etc., to help detect conditions supporting wood destroying organisms (WDOs) and mold. Be sure to record moisture readings and the media being tested. A UV light (black light) is useful for detecting rodent urine stains (they fluoresce) in runways, corners and other active sites. A notepad and pen, or working tape recorder and camera are also useful tools. Hand lenses, compressed air bottle, killing jars, plastic Zip Loc bags or envelopes for collecting specimens are also useful.

Consequently, non-chemical methods of pest management become very important. When inspecting and monitoring for pests, information obtained will indicate effective non-chemical means for preventing, reducing, or eliminating pest infestations.

In some cases, "inspecting" and "monitoring" may seem to relate to similar activities; however:

"inspection" refers to the initial discovery of pests or conditions supporting them and is a snapshot in time, and

"monitoring" refers to watching or measuring changing conditions over time to quantify whether pest populations or the conducive conditions supporting pests are static, decreasing and improving, or increasing and worsening. The need for continual monitoring and prompt discovery of pests, especially arthropods and rodents, is urgent because populations are able to rapidly increase in a short period of time and, when numerous, management requires significantly more effort, time, and expense.

Even though inspecting and monitoring may have different purposes, both activities examine similar things in similar ways. This describes a large number of things to look for and document on inspection and monitoring forms.

To be effective, low-risk pest management should never begin by applying a pesticide, but rather with an inspection that shows how the pest(s) entered, identifies the pest, and estimates the extent or seriousness of the infestation. There are always good (and usually apparent) reasons for every infestation and these must be discovered. Inspections (and monitoring) for pests and pest damage should always concentrate on obtaining information on:

- identity of the pest(s) (arthropods, vertebrates, plants) to species
- how pests entered (or could enter)
- the location of harborage, food, and water available to the pest
- the existence, extent, and severity of the pest problem
- reproductive, life history, and behavioral information on the pest
- the safest and most appropriate management strategies, based on site limitations

INSPECTING AND MONITORING FIIS STRUCTURES

Exterior Inspections

Thorough inspections of the exterior portions of FIIS structures should be conducted at least twice a year – in early spring (April) and fall (October) when weather patterns change. Good exterior sanitation, exclusion, elimination of pest harborage and moisture, and management of exterior lighting will do much to keep pests away from and being able to enter the building. Use a bright flashlight (or mirror) to carefully look for pests, evidence of pests, equipment deficiencies, and exterior cultural practices (clutter) that could potentially encourage or support pests. Carefully examine the building exterior from the ground to the roof, watching for locations where pests could enter the building (pest management efforts inside the building will not be effective until all exterior holes are closed). Locations sometimes overlooked include openings in and under equipment and inside electrical equipment and motors, openings in soffits, roof dormers, and in or around pipes and ducts (particularly those on the roof). Inspect cracks and voids by applying a flushing agent such as compressed air that forces insects out of hiding.

Inspect locations of outside lighting for attracted insect pests. If possible (to keep insects from being attracted to porches and entryways), mount outside lights on poles located 9.15 m (30 ft) or more from the building and shine the light back onto the building. High pressure sodium vapor lamps that attract fewer insects and are more energy efficient can also be used for exterior lighting.

Look for, identify and remove all potential food sources (rotten wood, food, fabrics, organic artifacts, mold, mildew, fungus, lichens, plants, etc.) and find all possible harborage sites (openings, cracks, crevices, stacked firewood, clutter, etc.) available to pests. Request that employees (or visitors) are not accidentally or willfully feeding animals (birds, squirrels, etc.) around the building. Verify that animal wastes are regularly removed from around the exterior of the building. Check for animal burrows under structures and determine if they are active (occupied).

Ensure that all plants overhanging or touching the building are trimmed back at least .91 m (3 ft) from the building so pests can not use them to move onto the building. If possible, establish a one meter (3 ft) wide vegetation-free zone around buildings. Use 1.89 cm (3/4 in) to 2.54 cm (1 in) rock gravel mulch (at least 10.16 cm [4 in] deep) next to the structure. If a vegetation-free zone is not possible, keep grass, bushes, and trees next to buildings cut short.

Check that all sources of moisture around the building are corrected. Eliminate any low spots in the ground that accumulate water run-off and remove all other water-holding sources (i.e., old tires, cans, refuse, and hollow trees).

Inspect trash containers to verify that they are 15 m (50 ft) or more from the building, raised on platforms off the ground, trash is being promptly removed, interiors are being cleaned, lids fit tightly, and exteriors are clean.

Identify and schedule the removal of stinging insect (honey bees, paper wasps, yellow jackets, etc.) and bird nests (barn swallow, robin and phoebe) from the structure as early in the spring as possible (Fish and Wildlife permits may be required to remove the nests of migratory birds). Remove all organic debris (i.e., feathers, dead insects, excrement, etc.) from building ledges, gutters, and openings. Remove any spike or sticky glues to deter birds and replace with a 45º smooth ledge barrier to eliminate nesting and roosting.

Identify and remove the vertebrates from all burrows under the building foundation. Verify that crawlspace access doors and crawlspace ventilation ports are tight and screened to exclude vertebrates and arthropods. Ensure that holes, cracks, or gaps do not occur (or are sealed) in the foundation.

Outside Bird and Bat Inspections: Birds and bats enter buildings (usually, attics) for nesting or roosting or when outside conditions become too harsh. Bats are usually noticed by their droppings beneath roosting areas. At dusk, they can be seen exiting the structure. Preventing birds and bats from being attracted to or using buildings can be very difficult but such actions are important for preventing accumulations of bird- or bat-associated debris and feces and to keep their ectoparasites from becoming established in buildings. Although bats are beneficial for reducing night-flying insects such as mosquitoes, they should not be allowed to roost inside structures. Provide a bat house for their benefit. Birds like to build nests under protective eaves. Prevent bird nesting by exclusion or applying a 45 - 60º smooth angle on ledges and nesting areas.

Thoroughly inspect the eaves, roofs, gables, and other structural building elements for the presence of birds, bats, bird nests, and bird and bat roosting sites. Verify that chimneys have bat-proof caps and roof vents are screened with woven hardware cloth (.64 cm [1/4 in] mesh). Look for and close small (.64 cm [1/4 in] diameter) holes around soffits, eaves, and attics to keep birds, bats, or other animals out of attics and the void spaces between walls. Be sure that exterior garbage containers are in good condition, kept clean, lids are tight, and disposal practices are appropriate. Be sure water sources are not available to animals, and grounds around buildings are free from debris or stacks of stored items. Bird netting is an effective measure to exclude birds from alcoves, porches, and attics. Fit all ledges or level areas that are attractive for bird nests with 45º angle surfaces as a preventative.

Note: Screening active chimneys and stove pipes may cause soot to build up on the screen. This could reduce the draft and cause smoke-filled rooms or other safety hazards. Periodic scrubbing of screening with a nylon brush will clear the screen and restore fireplace or wood stove performance. Various commercial chimney caps are also available which exclude rodents, bats, larger mammals, and birds.

Outside Inspection for Large Vertebrates: The presence of larger vertebrate pests (i.e., skunks, raccoons, rabbits, porcupines, foxes, feral dogs and cats, etc.) in a structure can allow for various other common pest problems and possible damage. Inspecting buildings for larger animals is easier than for insects or mice because the holes and trails are larger and the animals create more sign.

Carefully inspect building exteriors and perimeters for burrows leading under foundations, large rocks, or tree bases; see that crawlspace openings are tightly closed. If animals are using burrows, trap the animals and securely close the burrow entrances. If animal nests are inside or under buildings and can be reached, it may be necessary to treat the nests for fleas, mites, and other parasites. Record observations of larger animals and damage to grounds and structures.

Some methods for determining if an animal burrow is active are to: (1) place wadded newspaper in it, (2) sprinkle talc or dust on the ground around the opening, or (3) kick in or collapse the burrow. Look for evidence of activity (newspaper moved, tracks in the dust, or the burrow reopened) on your next visit. Active skunk dens usually have a strong odor associated with them.

Outside Rodent Inspection and Monitoring: The long-term management of rodents in outside areas (i.e., burrowing rodents around structures, rodents that enter parked vehicles, etc.) can only be had through habitat and ecosystem management which determines and, if possible, removes resources attracting pests and/or effectively excludes the animals from the resources. The ability to identify such conditions requires knowledge of the pests, their biology, abilities, and habitats.

Similar to an interior inspection, begin at an identifiable point outside the building and methodically progress around the building to find any evidence of pests or locations where pests could enter the building. Key rodent signs or deficiencies that should be watched for in outdoor inspections are many. Look for fresh burrowing activity, the presence of runways, or damaged plants, etc. Record any structural foundations that are in poor condition or vents, subfloor crawlspace vents and doors, door sweeps, porches, and windows that allow rodents access into buildings. Look for rodent activity around garbage disposal areas. Holes around utility service boxes and pipe or wire chases leading through walls allow rodents access into structures. Be sure structural roofs, chimneys, and roof vents are rodent-proofed with .64 cm (1/4 in) mesh hardware cloth or similar exclusion device. Note any standing water, leaking pipes/hydrants, or poor grade conditions around buildings. Look for "vegetation ladders" that allow rodents to gain access to buildings.

The best methods to monitor population densities of outdoor rodents are through documented visual counts of individuals; counts and locations of active rodent burrows and/or access points into structures; damage to rock or structural walls, foundations, sheds, etc.; and other such observations. Over time, such data will indicate the relative numbers of rodents present in different seasons and in different years. Information obtained from observational study will provide information for effective management approaches.

Monitoring for rodents in outside locations requires:

- regular documented analysis of rodent activity and sign by means of visual observations, trapping and open burrow surveys.

- maintaining weather records (i.e., weather results – not forecasts, water content in winter snowfall, precipitation, etc.) as early-warnings for climatic conditions favoring unusual plant growth that influences the occurrence of larger or smaller rodent populations.
- recording the numbers and kinds of dead rodents found. This information acts as an early warning for possible diseases in wild populations. Where feasible, all discovered freshly-dead rodents should be sent to public health agencies for analysis.
- monitoring the storage, transportation, and disposal of garbage and general area sanitation.
- request assistance from the State Department of Health or NPS Public Health officer for monitoring of possible plague-carrying fleas in rodent burrows.

Interior Inspections

Conduct thorough inspections of the interior of structures at least twice a year – in early spring (April) and fall (October), usually in conjunction with exterior inspections. Inspect critical sites (displays of organic historic fabric, archive storage, etc.) up to twice a month if necessary. Once insects invade a structure, museum or archival storage area, management can be very difficult, expensive, and require considerable time because small, residual populations are able to survive under even the most sanitary of conditions. Given the opportunity, such latent populations can suddenly explode into major problems.

It is important to find pest infestations as early as possible because most pests are highly adaptable to conditions and very prolific. Inspections that discover the early stages of an insect infestation and concentrate corrective measures on good exclusion, increased sanitation, and reducing pest habitat will generally manage most insect problems.

Serious pest problems in one part of a building usually means the entire building will need to have management action because all the rooms usually share an adjoining attic and crawlspace as well as pipes, electrical wiring, and ducts. If pests survive in an untreated room, it is possible for them to quickly spread to all other rooms. Thus, pest inspections should also encompass the entire building containing the historic material or museum.

Use a bright flashlight to examine all portions of the building (all floor, walls, ceilings, and furniture or equipment) for any potential sources of food (crumbs, fabrics, lint, organic artifacts, etc.), water, or harborage (cracks, crevices, clutter, dark corners, etc.) available to pests. Also watch for pests, evidence of pests, and structural deficiencies or cultural practices (sanitation) that could support pests.

Controlling temperature and humidity in structures can be very important in reducing insect populations although it may not affect rodents. Humidity and temperature in museums and curatorial areas should be kept as cool and dry (below 45% humidity) as practical. The closer temperatures approach 10ºC (50ºF), the slower insect activity becomes, which lessens feeding and reproduction. Reducing humidity lessens survival of humidity-dependent pests like silverfish or psocids.

Locations often overlooked include areas inside and under drawers, cabinets, and furniture; attics and store rooms (where rodents or other animals may have food caches), inaccessible wall voids (that may hold dead insect or animal carcasses); and inside electrical equipment and motors (especially computers). Because there are so many different kinds of pests that have different

biology and living requirements, museum inspections must be extremely thorough and the inspector must be familiar with the various species and their preferred habitats.

The signs of a pest infestation can include: shed insect skins, feeding debris (frass) around or below specimens, hair falling from fur or pelts, mats of fibers, silken tubes or cases, live or dead adults, larvae, or pupae, living or dead insects near windows, damage to or exit or feeding holes in organic objects (i.e., wood, fabrics, hide, fur, feathers, horn, silk, etc.), infested or damaged food or food packaging, pests captured in pheromone or sticky traps, pests captured in ceiling light fixtures or pests or pest debris found in vacuum bags. A hand lens may be necessary to examine for small insect parts or to find eggs. Ants infest structures in search of food, moisture and shelter. Ants form trails or randomly search inside. Follow ant trails to the entry point and perform exclusion action.

Carefully examine window sills and ledges, insides of light fixtures and areas behind or under display cases, baseboards and moldings, picture frames, rug edges, furniture, radiators and areas inside air conditioning and heating ducts, etc.

MONITORING

Traps: Even if an inspection has not identified the presence of pests, place light, electrocuter or pheromone traps throughout a building where they will attract and capture flying pests (follow manufacturer's recommendations for placement). Also place sticky insect traps in hidden areas throughout a building, as well as inside specimen cases. Place mouse-sized snap traps near or under furniture and shelving. Check all the insect traps on each visit (at least every two weeks). Check all rodent traps every day. Identify all captured pests. Replace sticky traps and re-set rodent traps, as necessary. Record all information on identity, numbers and location of pest presence found in monitoring traps and their surroundings.

Pheromone traps are an excellent means for the early detection of certain kinds of museum pests since the traps only capture pests that are specifically attracted to the given chemical odors (i.e., pheromone). Pheromone traps are most used in a museum setting to attract and capture carpet beetles, cigarette beetles, dermestid beetles, drug store beetles, Indian meal moths, clothing moths, and warehouse beetles (other pheromones are being developed). Contact manufacturers (Insects Limited, Inc.) for newly available pheromone traps.

Pheromone traps, however, should not be considered as "control traps". Sticky, light, and electrocuter traps are not selective for species caught and are not principally used for control purposes either. These traps are used to verify the presence of insects, give information as to major areas of infestation or entry, obtain specimens for identification, determine if insects are coming in from outside, monitor approximate changes in numbers or types present, and evaluate the effectiveness of management measures.

Sticky traps are used for both inspecting and monitoring and are not selective of the species caught. Record the direction from which pests enter sticky traps and the location on the trap where pests are captured to help indicate possible focal sources of infestations. One innovative method for using insect sticky traps for difficult-to-catch insects is to place the sticky side of the trap down on <1 cm (1/16 in) spacers (such as small coins) to keep the trap just barely suspended over the floor.

Traps set in this manner often are more effective in capturing crawling insects that seek refuge in small cracks.

Insect electrocuter and light traps are useful for detecting flying insects. Some of these traps emit ultraviolet light (black light) that attracts flying insects, particularly flies and moths. The insects attracted to the trap are electrocuted or become stuck on a glue board. These traps, as well as insect sticky traps, must be frequently checked and emptied or replaced or the dead insects can become an attraction for dermestid beetles and other scavengers. Place traps in areas of suspected pest activity, against walls, near doorways, under fixtures and appliances but not directly in air currents, out in the open, or where they will become wet. Pheromone traps, however, sometimes become more effective when placed in air currents (follow the manufacturer's recommendations).

Reposition traps that do not catch pests after a week or two. The number of traps required in a room varies greatly depending on the kinds of pests present, the value of protected materials, and severity and location of infestations. Increase the numbers and locations of traps when suspected infestations can not be found or managed.

Use snap traps to monitor for rodent activity. Check the traps daily for captured animals. Place two snap traps at each trapping location and place the traps against walls (triggers against the wall), in corners, under furniture, and in other areas where rodents may be active. For general building monitoring, place at least two trap stations in each room. Individually number traps and record their locations on a floor plan diagram. Record on the floor plan diagram the numbers, locations, dates, and species of animals and insects caught. Record all findings from inspections, pest reports from residents or employees, track-dusting results, night time surveys with a night-vision scope or red or yellow lights, etc. This information can be used in locating major pest harborage and entrance sites, identifying seasonal risk factors, showing changes in pest numbers over time, providing information on the results of pest management methods, providing information on trap vandalism or unexplained trap losses, noting predation on trapped animals by rodents or other animals, making treatment recommendations, or helping establish new action thresholds.

Exclusion: Exclusion is defined as finding and eliminating all possible entryways (points of access) pests use to enter a structure or room. Those entryways may be as small as a hairline crack in a wall or as large as a gap under a door, openings around pipe and wire traces, or the absence of screens on windows. Exclusion is more important and effective for the management of most pests than even increased sanitation (elimination of food and water). Pests simply can not be present in a building or display case if they do not have an entryway. All possible routes of pest entry or attraction must be found and eliminated. Periodic inspection and monitoring will provide the prompt discovery and correction of any newly appearing entry points.

Correcting exclusion deficiencies is site-specific but is usually done by sealing them (i.e., caulking, carpentry repairs, installing door sweeps, netting, installing filters on air vents and hot air registers, etc.). Identify and seal all holes that could potentially allow insects (small cracks) or rodents (holes or cracks .63 cm [1/4 in] in diameter or larger) to enter the structure or room. In storage areas, sequester sensitive items in metal, glass, or durable plastic containers and periodically monitor them.

Assure that pests are not inadvertently imported into the building in or along with infested products or supplies (i.e., museum items or displays, firewood, outdoor furniture, employee clothing, lumber, books that have been on loan, etc.). This should occur in the receiving quarantine area.

Pest Harborage: Use a bright flashlight to find and examine all pest harborage in the building. As necessary, inspect cracks or voids with a flushing agent, which forces pests out of hiding and shows the focal points of pest activity.

Sources of Moisture Available to Pests: It is very important to find and remove all possible sources of moisture available to pests. Look for any sources of dampness or wet food (especially, slime, lint, and organic matter in open drain receptacles) that could attract fungus-feeding beetles, flies, mites, psocids, silverfish, and other pests. During inspections, watch for spilled or condensate water around water coolers and fountains, dehumidifiers and humidifiers, hot water pipes (condensation), potted plants, and aquaria. Check toilets, kitchens or laboratories (sinks), boiler rooms, mop closets, floors, ceilings, crawlspaces, attics for water leaks.

Use a moisture meter to inspect walls and floors for suspected moisture content or to identify leaking pipes. Watch for mold or fungus on walls. If possible, keep the moisture content of wooden structural elements in buildings below 12% to discourage termite and carpenter ant activity, and reduce the incidence of mold or fungi. Molds and fungi can be detected by a moldy odor or by visual signs of growth or fruiting bodies..

It is best to not have live, potted plants or fresh flowers (adult dermestids and other museum pests feed on pollen and nectar) in offices, museums, or curatorial areas. If plants must remain inside, assure they are not over-watered and carefully inspect the soil, along the edges of pots, and under supporting catch plates for arthropods, particularly fungus gnats.

Insects are often found under rugs close to water coolers and in motors and condenser housings of water coolers. Inspect areas where water bottles are stored; some bottles may leak or are brought into the building in wooden crates that import pests or provide moisture or harborage to insects.

Verify that condensation does not form, run off, or puddle under windows in cold weather. In winter, check for residual moisture or puddles of water near boots and overshoes and for water puddles near entryways and in closets. Cover all open water sources tightly and do not locate them where they will attract insects. Check to see that rest rooms, sinks, drinking fountains, and coffee rooms do not show condensed moisture on cold water lines. Verify that there are no moisture problems in the crawlspace (if so, increase ventilation or install moisture barriers).

Food Available to Pests: Many pests can go for great lengths of time without feeding or are able to survive on lint, fabric fibers, mold, and other uncommon food sources. Verify that museum and curatorial storage areas are thoroughly vacuumed (floors, cabinets, windows, and walls; in, under, and around equipment and furniture; and all cracks and crevices) at least twice a month, and more frequently if possible, to remove accumulated lint and dirt. Cleaning denies pests food and harborage and reduces insect survival rates.

When inspecting buildings containing museum items, be very alert to all possible sources of food available to pests. Check for candy, sugar, fresh fruit, snacks, etc. stored by the staff in office

desks, cabinets, or at visitor contact stations (there should be no human foods at all in curatorial areas and museums); empty aluminum cans or food containers destined for recycling (do not store empty aluminum cans indoors before they are moved to recycling stations); fresh flowers or potted plants in offices; spilled food materials or dirty dishes in break rooms; dead insects or rodents on sticky traps; etc. All food kept in the building in employee lounges should be kept in refrigerators or in tightly sealed glass or metal containers. Verify that birdseed, rodent poison, and other animal food materials are not stored in the building housing the museum or curatorial storage area (if such materials *must* be kept in the building, be sure they are kept in tightly sealed containers). Check to see that lint and all other organic materials are regularly cleaned out of stoves, refrigerator coils, microwave ovens, and other equipment used in the employee break room. Check to see that interior floors are thoroughly vacuumed every day and that custodians notify supervisors, IPM coordinator, and museum curator where moisture, pests or evidence of pests, or food scraps are found. Check to see that fabrics in the museum have been cleaned to remove pest attracting stains (i.e., sweat, food, etc.) and kill insect larvae and eggs. Woolens should be frequently brushed and cleaned (or, dry cleaned) or hung in the sun to remove larvae and destroy eggs.

Importation of Pests: Carefully inspect all boxes, supplies, equipment, wooden pallets, specimens for acquisition, etc. that come into the structure for possible pest infestations. Verify that all incoming goods are carefully checked for possible pests and, if infested, are rejected or quarantined (tightly sealed in a labeled polyethylene bag kept well separated from collections and supplies until it is determined to be pest-free) or sterilized (deep-freeze, heat, fumigated, or by other means). This activity should be conducted in the quarantine area.

Storage Conditions: Verify that all items prone to insect infestation or that could supply harborage to pests (boxes and articles stored on floors) are placed on shelves or platforms (15.24 cm [6 in] or more off the floor; the accepted standard for museum storage). This eliminates harborage beneath the items on the floor, moves items up and away from sites of major insect activity, allows for cleaning and inspection of floors, and allows for placement of monitoring traps.

Infested museum items. Verify that all items in the structure or collections showing signs of active pest infestations are immediately removed from display or storage and are isolated and treated. Following removal of infested items, the area surrounding the infestation should be carefully inspected and treated by appropriate means.

Occasional insect invaders. It is important to note that finding outdoor insect pests inside a building ("accidental pests") clearly demonstrates the inadequacy of exclusion and should initiate a thorough inspection to find and close the entrance holes. Verify that all doors to the outside have tight-fitting door sweeps and that there are no openings around window and door frames.

Interior Rodent Inspection and Monitoring: Begin at an identifiable point in one of the rooms and methodically progress along a wall and through all rooms to completely search out all possible points of rodent entry or elements supporting their presence. A data sheet for recording inspection data can be used to list such inspection findings.

Sign. The presence of rodents produces a variety of signs that can be used for a subjective determination of the size or occurrence of a population. Signs are often found throughout a building in or around such places as fireplaces and mantles, floors and ceilings, edges of electrical

and plumbing traces, attics, hollow walls and structural voids, decorative moldings, wooden and upholstered furniture, inside water heater and furnace cabinets, and in kitchen and bathroom areas. It is always important to consider the physical abilities and behavior of rodents, especially their tendency to seek shelter and warmth behind, under, or in appliances, sink cabinets, drawers, stored goods, wall voids, false ceilings, and other undisturbed areas. Various common signs of rodents to look for during an inspection include:

Food Damage: Food packages that rodents have gnawed into, rodent feces or hair in open food containers, food scattered on the floor, etc.

Sounds: Sounds coming from inside walls or under ceilings of rodents gnawing, scratching, squeaking, or running.

Droppings: The number of rodent fecal pellets found relates to the number and type of rodents present and how long they have frequented a location. Periodically vacuuming rodent debris from an area will allow for information to be developed on relative pest use during an elapsed time interval. Prior to vacuuming, disinfect an area to prevent exposure to Hantavirus.

Urine: Rodent urine stains are visible under ultraviolet light (UV) and fluoresce yellowish, bluish-white, or yellowish-white. Since many other items in a building also fluoresce, it is important to be able to recognize stain patterns when using UV light. Urine patterns appear as lines of fine drops or streaks while chemical and food spills tend to be larger, patchy areas or uniformly spread out. Test kits are available to validate the presence of rodent urine.

Rodent Feeding stations: Many rodents carry food to what they consider to be a safe place to eat it, usually in a protected corner. A greater abundance of rodent feces and urine deposits are seen in those areas. Also, remnants of foods (candy wrappers, nut shells, etc.) the animals have carried there are often seen and suggest what food sources should be inspected for rodent damage. Rodent feeding stations are good places to trap rodents.

Smudge marks: Rodents prefer to run next to vertical surfaces at the floor/wall junction or on pipes, beams and other surfaces. Dirt and oil on a rodent's fur leave smudge marks where the animals rub against pipes, beams, and openings. Once the marks are cleaned off the areas, the next monitoring will show if rodents are still using the trails.

Runs/trails: Rodent trails are often found in sheltered areas where rodents feel secure to travel; these appear as dust-free pathways both within and outside of buildings.

Tracks: Rodent footprints and tail drag marks are sometimes seen in outdoor and indoor mud or dusts. Patches of non-toxic tracking powder (chalk, Diatomaceous Earth [DE] or talc) can be used on floors inside buildings to verify the presence, activity routes, and relative abundance of rodents. Tracking patches have been shown to be up to 150 percent more effective for monitoring rodent activity than are snap traps.

Odor: Musky rodent odors can be detected when infestations are large and well-established, especially when ventilation is poor.

Gnawing: Rodents must constantly gnaw on wood or other firm materials to keep their teeth worn down as rodent teeth constantly grow. Rodent gnawing leaves small piles of chips around doors, baseboards, and windows. Gnaw marks may also be found on stored goods and food containers; electrical wire insulation; and as enlarged areas of pipe and wire traces. Fresh gnawing on wood appears light-colored which darkens as it ages.

Burrows: Holes and enlarged openings in walls and under foundations are often entrances to rodent burrows.

Nests and food caches: Rodent nests and food caches are found in undisturbed locations in structures including storage areas, computer and water cooler cabinets, attics, crawlspaces, and around refrigerator or freezer motors. Nests are also found outside beneath rocks or boards, in pipes, etc.

Pet reactions: Pet cats and dogs may show unusually strong interest in a specific wall or floor area when rodents are present; this is especially true when rodent invasion is recent.

Traps: When monitoring or controlling rodents inside buildings, be sure to place a sufficient number of snap traps along all rodent travel routes and in all probable harborage areas. Place two traps at each trapping station and locate stations every ten to twenty lineal feet along walls in suspected rodent harborage areas. Place traps adjacent to one another with the triggers pointing toward the wall. Fewer traps can be used when larger rodents are present but there should be no less than two traps at each trapping station and at least one trapping station per room. Vary the baits used on traps by using food materials on some and cotton on others. Cotton balls are used by rodent females to line the nest. Snap traps must be monitored for captures daily.

Snap traps:
Because of Hantavirus and other disease concerns, the Center for Disease Control recommends only using snap traps (not live-capture type traps) for rodents because:

- snap-traps prevent the possible spread of Hantavirus into unaffected rodent populations
- snap-traps limit the spread of rodent urine, saliva, and feces around trap sites
- snap-traps prevent human contact with disease organisms which may occur from bites or other physical contact with rodents.
- snap-traps prevent human contact with disease-contaminated aerosols during trap handling or animal release.

Multiple capture traps: Multiple capture traps are available for both mice (one-way-entry and wind-up models) and larger rodents and may catch rodents that can not be caught in snap traps. Rodents, seeking shelter or food, enter traps but are unable to leave. Multiple capture traps are best used in runways where rodent activity is high or in locations difficult to monitor with snap traps. Multiple capture traps must be monitored daily.

Sticky traps: Sticky traps are flat boards or trays coated with glue. Rodents become stuck to them and cannot escape. Sticky traps are inhumane and are NOT to be used at NPS sites.

Exclusion Study: The most effective way to manage rodents inside a structure is to keep them from entering the structure in the first place. Rodent inspections and monitoring must find and close the points of entry. A Center for Disease Control (CDC) study (Glass, et al) found rodents in

rural cabins and mobile homes commonly move from outside habitats into the structure then back outside again. Interior rodent infestations were reduced by more than 90% by simply increasing the standards of construction methods and maintenance. Rodent management will only be effective where inspections uncover and correct structural deficiencies that support rodent infestations, such as: open points of access for movement into the building or between rooms, careless sanitation and garbage management practices, and inappropriate storage conditions which create harborage.

Pre-management inspection and monitoring data can be used as a base-line against which post-treatment results are compared to record the effectiveness of management efforts.

INSPECTION AND MONITORING IN LANDSCAPED AREAS

Inspections of landscaped areas usually rely upon visual and close examination of foliage, stems, flowers and fruit of plants. Healthy plants tend not to have pest problems if provided proper watering and necessary nutrients. Stressed plants are much more susceptible (and attractive) to pest insects and mites. Inspections should be looking for the healthy appearance of the landscape. Plant stress can be caused by too much or too little available moisture, too much sun or shade, inadequate aeration of soil, soil compaction or other physical factors. Other physical characteristics of plants can manifest the presence of pest insects. Look for notched leaves, scars on branches and trunks, honeydew on leaves, mottled or spotted foliage, dead leaves, curled leaves, and other abnormalities. Noticing changes over time between inspections can provide indications of pest insect activity. The presence of predators such as lady beetles, green lacewing larvae and others indicate the presence of pest insects or plants.

Turf can also have insect damage by white grubs feeding underground, foliar damage by chinch bugs, bill bugs and sod webworms; and damage by fungal pathogens. Weeds in turf can also crowd out grass or detract from its aesthetic beauty. Some turf cultivars are being marketed with endophytic properties that are resistant to some pests. Entomopathogenic nematodes such as *Steinernema carpocapsae* may be used for managing some turf insect larvae. Thick vigorous turf may be resistant to weed invasion. Mowing practices also have an effect on turf health.

INTRODUCTION TO MUSEUM PESTS

CHARACTERISTICS AND RECOGNITION

Major museum pests include two species of clothes moths and an array of different, although similar-appearing, small, variously colored beetles, which are grouped under the generic name of carpet beetles. These carpet beetles include black and varied carpet beetles, hide beetles, spider beetles, larder beetles, etc. Cigarette and drugstore beetles are also found to attack and damage organic museum artifacts. Carpet beetles are among the most difficult of all insects to manage. Pesticides are rarely effective for very long. Regardless of the treatment used, the best management for museum pests is thorough and very careful inspections, exclusion, good sanitation, and habitat modification. Other important museum pests included in this IPM plan are psocids, booklice, silverfish, firebrats, Asian lady beetle and crickets.

Textiles infested and damaged by pests are usually wool-based items such as clothing, carpets, and tapestries. However, both carpet beetles and clothes moths feed on a broader diet than just wool, including items containing cotton, silk, hair, mohair, bristles, fur, feathers, and leather, as well as dead insects, pollen, grains, seeds, and many stored foods. Inside, infestations frequently occur when museum pests develop on dead animal carcasses (birds and rodents) or nests located in or adjacent to buildings, on dead insects (wasps, bees, cluster flies, Asian lady beetle, etc.) and molted insect skins, or in spilled foods. Clothing that has food, sweat, or urine stains is especially attractive to clothes moths.

Female moths and carpet beetles lay soft white eggs on materials that will later serve as a larval food source (including lint and organic debris in concealed cracks). Larvae hatch and feed until mature, at which time they may move away from the food source into secluded spots where they pupate. Upon emerging as adults they mate and fly around; the females looking for egg-laying locations. Since larvae and adults often avoid light, finding a random cast skin, larva, pupae, or adult museum pest in a structure may be the only signal of an impending infestation.

Proper identification of pests is a critical part in this IPM program because it provides information on possible effective management alternatives. However, identification of museum pests is an entire field unto itself. This plan does not attempt to provide enough information for complete or scientific identification of museum pests, which would take volumes of information. Refer to pest profiles for a number of the major pests which might be expected in museums along with very brief sketches of their life histories. Museum curators and IPM Coordinators should refer to taxonomic tests and other sources (universities, reputable researchers, etc.) for pest identification.

INSPECTION AND MONITORING

Refer to the Inspection and Monitoring section for general inspection and monitoring information. For museum pests also inspect the following:

Stored woolen clothing and bedding, down pillows and comforters
Silk, fur, mohair objects, leather, horn, wool or silk carpets, rugs and blankets
Stuffed dolls and furniture padding
Upholstered furniture, animal hides and trophies, stuffed animals, light fixtures, dried flower arrangements, picture frames
Floor cracks, baseboards and vents for lint, debris, and hair accumulations
Old books where insects are attracted to the glue in bindings

To inspect carpets, pull back the edges from the tack strip and look under edges. Use sticky traps around walls and make careful visual observations. Insects do not infest the entire rug, only those parts not exposed to light and traffic. Closely examine compressed fibers under rugs and under furniture legs. Also inspect carpet edges under the quarter round.

Critical Site Pest Sighting Logs: From the pest sighting log, request that the occupants mark on a floor plan of the site where pests have been seen, and then carefully examine those areas.

MANAGEMENT

Major Mistakes in Museum Pest Management Programs: The following are some of the major mistakes made in museum pest management programs:

- Allowing museum pest infestations from the outside through poor exclusion or importing by infested artifacts, clothing, containers, and contaminated foods
- Failing to periodically monitor for museum pests and allowing infestations to become severe before initiating prevention or management actions to remove infestation sources

The presence of museum pests generally indicates inadequate sanitation practices; management requires that sources of infestation be found and discarded and the storage area be meticulously cleaned. If the source of infestation is not removed, pest management programs will not be effective.

Physical, Mechanical, and Cultural Measures: Regularly and carefully inspect clothing for insects and evidence of damage; do not import insect eggs or larvae on unprotected or uncleaned articles. Inspect new articles for possible infestation and damage (especially antique upholstered furnishings) before mixing them with articles already in the building. This function should be performed in a quarantine receiving area.

Moths normally only damage seldom-used clothing and blankets; frequently rotate woolen fabrics.

Brush or comb fur skins with a fine-toothed comb close to the skin where larvae spin cocoons.

Heat susceptible flour and cereal goods and hold internal temperature at 54ºC (130ºF) for an hour or more to kill most stored-product pests.

Sterilization: Storing fabrics in atmospheres containing more than 50% carbon dioxide or inert gas suffocates insects. Removing the oxygen from a storage area will also kill pests.

Freeze objects 23ºC (-10ºF) for several days to kill larvae and moths, warm them to 4ºC (40ºF) to encourage any eggs that survived to hatch, and then freeze again to kill any newly emerged larvae.

Subject infested objects to a temperature of 54ºC (130ºF) or more in a microwave, in a plastic bag placed in the sun, or for extended period of time in temperatures greater than 34ºC (93ºF). Museum pests have very low resistance to heat. An infested structure can be heated to 71ºC (160ºF) to kill most pests, including drywood termites and mold spores.

HAZARDS OF INFESTATION

Small barbed hairs on larval carpet beetles, when ingested or inhaled, may cause dermatitis and irritations to nasal passages and sinuses. Food containing carpet beetle larvae can be responsible for enteric irritation in infants, or intestinal disturbances or allergenic conditions (urticaria, conjunctivitis, nausea, respiratory tract irritations) in adults. Further, these insect pests feed upon and damage museum objects.

Although fabric pests are not known to transmit diseases, feeding larvae do considerable damage to organic materials. Clothes moth larvae damage clothing and rugs.

INTRODUCTION TO STRUCTURAL PESTS

CHARACTERISTICS AND RECOGNITION

Structural pests are characterized by those organisms that live, eat, bore and/or lay eggs in the wood that makes up the structure; and those that take up shelter or forage in structures. The former group are the wood destroying insects (powderpost beetles, other beetles and carpenter ants) and molds and fungi. The second group includes several species of ants, bats, birds, mice and squirrels. Although bats, birds, and mice do carry and/or transmit disease organisms to humans and could be included with public health pests, they MUST be excluded from structures. Thus, they are included here with other structural pests.

These various pests can be managed through the application of the basic principles of IPM – thorough inspection and monitoring for conditions conducive to pests as well as the pests themselves, exclusion, sanitation and habitat modification. Structural wood can become the food and shelter for several beetles and fungi, which causes the wood to lose its structural strength and its aesthetic appeal. Reconstructed historical structures may require non-historic methods and materials to protect from damage by these pests. Protecting the structure from the presence of water may be the basic concept necessary to manage most structural pests.

Identification of the pests, sometimes by their left-behind signs or behaviors, is very important to management or prevention of damage by the pest(s). Specific identification of all the structural pests may be beyond the scope of this effort, but general information on several major structural pests is provided in the pest profiles. Insect specimens can be identified by your local extension agent.

INSPECTION AND MONITORING

Refer to the Inspection and Monitoring section for general inspection and monitoring information. Look for small round or oval holes in the wood and fine powdery wood frass from wood-boring beetles, or coarse wood shavings with insect parts intermingled from carpenter ants. Use a moisture meter to monitor wood moisture as most wood pests need a wood-moisture content of 12% or higher. Carpenter bees prefer to bore entry holes and galleries in outdoor beams or fascia to lay eggs and provisions for next year’s generation.

HAZARDS OF INFESTATION

Structural pests occupy areas in buildings that also contain people, thereby placing pests and people in close proximity. Although most of the structural pests do not carry diseases, bats, birds and mice do. Wood-destroying beetles, carpenter ants and molds and fungi can adversely affect the structural strength and aesthetic appearance of wood structures. Structural pests must be managed for safety and aesthetic reasons.

INTRODUCTION TO WOOD-DESTROYING INSECTS

INTRODUCTION

There are several hundred species of beetles, ants and wasps that attack the wood in structures; however, most of the damage is minor except those caused by powderpost beetles, carpenter ants and old house borer. For more information on groups not covered here, please refer to Moore's "Wood-Inhabiting Insects in Houses." There are several groups of powderpost beetles. It is critical to know which type of beetle is present in order to determine the necessary management methods, or if management is necessary at all. More than fifteen kinds of carpenter ants are serious structural pests in this country, some being more common in or restricted to certain geographic areas than others. All carpenter ants show good cold tolerance.

INSPECTION FOR WOOD-BORING BEETLES

Careful inspection is the key to determining what species is causing damage and worth treating. It is essential to note the appearance of wood, moisture conditions, location of infestation, type of frass, beetles found, fecal pellet presence and appearance, appearance of galleries, and size and shape of exit holes. It is advisable to collect as many specimens as possible and, if necessary, give them to an expert for identification. This means that the pest manager will have to work not only with a flashlight, but also with sample-collection vials, a knife, forceps and a hand lens.

PREVENTION AND MANAGEMENT MEASURES

Prevention and management require thorough knowledge of beetles, their life cycles and damage potential on which a meaningful inspection can be based. Using kiln-dried lumber or pressure-treated wood is one of the available preventive measures. Another is keeping moisture out by painting the wood and ensuring good ventilation as most wood-infesting beetles do not flourish below a moisture content of 10 – 12%, depending upon species. Another method for prevention and treatment is pre-treating wood members by painting or spraying wood with sodium isoborate products. This reduced-risk compound can be applied to wood either before or after installation, so remedial treatment as well as prevention is possible in existing structures.

If there is reason to suspect that beetles are present in finish or trim wood to be installed in areas which will be difficult to treat or replace later, heat sterilization or treatment with disodium octaborate tetrahydrate (DOT) may be advisable. Required wood temperatures for heat treatment of infested wood are 49ºC (120ºF) for four hours and up to 60ºC (140ºF) for two hours, with wood temperature measured in the center of the wood member. If bostrichid beetles are involved, the higher temperature range should be used.

INTRODUCTION TO ANTS

CHARACTERISTICS AND RECOGNITION

General

Of the 750 different kinds of ants found in almost every North American habitat, only about 30 species cause problems in structures. Because their small size permits ants to enter tiny holes, ant problems may be common. This section will describe methods for managing ants frequently found in kitchens, pantries, and food storage areas. Structure-damaging carpenter ants are covered in Structural Pest Profiles.

Ants are attracted to a wide variety of foods, including other insects, seeds, nectar, meat, grease, sugar, and honeydew (a sweet liquid produced by plant-sucking insects). Some ant species seem to wander randomly while others form trails from the colony to a food source. Most ants bite when disturbed and many species sting.

HAZARDS OF INFESTATION

Regardless of damages, ants are generally considered beneficial. Like spiders, ants kill and eat many insects including flea and fly larvae, and bedbugs. Ants are important in soil aeration and recycling of dead animal and vegetable materials. However, their management in structures is necessary because they contaminate food, damage structures, and some (pharaohs) transmit disease organisms. Several ant species, including pavement ants, are annoying because of their painful stings.

INSPECTION AND MONITORING

The target for exterior inspections is to find and correct breaches (which may be quite small) where ants are entering the structure from outside. The following are offered to assist in interior ant inspections:

- Study ant trails and identify where they are entering the space.
- Inspect behind baseboards, inside heat registers and ducts.
- Carefully inspect foundations and under grass, mulch, rocks, and logs for possible nest sites and trails.

MANAGEMENT

Major mistakes usually made in ant management are:

- Failure to accurately identify the ant so that its biology can be used to manage it.
- Failure to exclude ants through caulking and sealing and removing vegetation "ladders."

- A failure to thoroughly inspect the building, find nests and sterilize or kill the queen or queens.
- Failure to manage contributing conditions such as damp wood, bad sanitation, poor crawl space ventilation.

PREVENTION OF ANT INFESTATIONS

Established ant infestations can be difficult to manage. The best management is good sanitation practices, which eliminates the conditions attracting ants, and exclusion. The following practices are very important to follow:

- Clean up all food particles and frequently sweep, vacuum or mop up all scraps, lint or dead insects.
- Store all food in pest-proof plastic or glass containers.
- Use garbage receptacles with tight-fitting lids and remove the wet garbage every night.
- Trim back (.91 m [3 ft]) vegetation and trees that are next to buildings as these will harbor ants or aphids.
- Eliminate all sources of water for ants.
- Remove all old and decomposing wood debris, shrubs, or tree trunks that could provide nesting possibility for ants; control honey-dew-producing insects with beneficial predator insects.

MANAGEMENT OF ANT INFESTATIONS

Action Thresholds

Because ants readily communicate the location of food and water sources to other members of the colony, it is imperative that ant management begin immediately upon identifying them in the structure. The initial response may be to follow the line of ants and seal the point of entry to the structure. Remove the food attraction. The presence of swarming or winged ants should always suggest the presence of nests indoors. Determine the ant species and possible nest location.

Physical, Mechanical, Cultural Measures

Limiting Entry: The basic Rule of Thumb in ant management is exclusion <u>not</u> eradication. Simply killing worker ants seldom manages a colony and may, indeed, result in colony multiplication. The following exclusions are suggested:

- Caulk all interior and exterior cracks and crevices and install tight fitting door sweeps on exterior doors; ants will stop coming into the structure when the distance from the nest to food becomes too long.
- As an additional precaution, cracks may be treated with an inert dust before caulking.

Physical and Mechanical Measures

- Sponge mop with soapy water or vacuum to remove trailing ants. Soapy water washes away trailing odors and forces ants to find other sources.

Heat Sterilization
If the affected items can tolerate it, equipment, rooms, and furniture infested with ants can be sterilized by steam cleaning or dry heat (54ºC [130ºF] for 30 minutes).

Pesticide Treatments
Pesticides generally provide only temporary relief from pests in buildings. When chemicals dissipate, ants often reinvade structures. Exterior sanitation should be used in combination with interior sanitation. Treatment should be aimed at destroying the nest or sterilizing the ant queen.

Before any pesticide is applied, it is vital to know the kind of ants present, what they are feeding on, and whether their nests are located indoors. Borate based dusts and baits applied into harborage cracks and crevices of ants and other pests are very effective treatments.

Various types of solid, semi-solid, gel and liquid ant-bait stations are commercially available. Many contain low-risk chemicals including borates, abamectin, or hydramethylnon that are readily taken into the nest and to the queen. Ants feed each other so ant baits must be slow acting as several ants may be fed before the bait is passed through to the queen. These baits are attractive to ants, and help to manage ant populations. Place stations along ant trails where ants quickly find them. However, where sanitation is poor, bait performance will also be poor because of the availability of alternative food sources.

INTRODUCTION TO MOLDS AND FUNGI (Worldwide)

CHARACTERISTICS AND RECOGNITION

Molds and fungi are similar kinds of primitive organisms supported when excessive moisture and proper temperature are present. These organisms can physically damage many kinds of organic objects and create/support conditions that attract pests which may feed on them (i.e., wood-destroying beetles, carpenter ants, springtails, silverfish, mites, millipedes, fungus gnats, booklice and sow bugs). Molds, mildew and fungus are often an important cause of various human allergenic diseases (asthma, hay fever, allergic rhinitis, eczema and hives). Optimum conditions for fungal growth occur in temperatures between 10 and 35ºC (50 and 95ºF) when substrata (usually wood or paper) have 12% or greater moisture content (caused by various problems including moisture in the crawl space, improper drainage, etc.). The growth of mold is inhibited by strong light and dry conditions. Various kinds of fungus-caused rot are sometimes mistaken for insect damage. The presence of indicator moisture-loving insects (booklice for one) points out the need to correct conditions supporting or causing moisture.

There are several types of decay fungi. Decay fungi will occur in any (including redwood and cedar) untreated wood in contact with the ground, cement, masonry or other source of moisture. Other water sources can be plumbing leaks, rain leaks, condensation, poor drainage or broken or inadequate rain gutters.

Brown rot fungi feed on the cellulose in wood. As the cellulose is removed, the brown lignin is left behind (thus brown rot). With only lignin left (which holds wood cells together), the wood structure is weakened. When the moisture is removed or "dried out," it is referred to as "dry rot," a misnomer as wood does NOT decay when dry. Wood with brown rot tends to crack across the grain. This characteristic can be tested with a probe during inspections.

White rot breaks down both the cellulose and the lignin holding the cells together, which causes the wood to look whiter than normal. Wood infested with white rot does not usually crack across the grain. However, the wood will shrink and collapse if severely infected, eventually becoming spongy and weak.

The water conducting fungus, *Poria incrassata,* will attack wood that might not be used by brown or white rot fungi. *Poria* can transport water several feet through rhizomorphs, which look like roots. These fungi may start in damp, dirt-filled porches, crawl spaces and basements, conducting moisture from the soil to the wood. The rhizomorphs transporting water may be dirty white (when young) to dark brown to black as they age. The older the rhizomorphs are, the larger they become (.63 cm [1/4 in] up to 2.54 cm [1 in] or more). *Poria* can damage a substantial amount of wood in a short time.

Molds or stains may be found on wood; however, they do not cause structural damage to the wood. The presence of molds may indicate conducive conditions (moisture) for decay fungi. The elimination or remediation of the moisture source is indicated.

Lichens are a symbiosis between a fungus and an alga – a relationship where the two organisms benefit from each other. The fungus delivers water and minerals to the alga; the alga supplies photosynthesis and delivers sugars to the fungus. This enables the lichen to survive extreme conditions, living on many surfaces (wood, rocks) and surviving freezing, wet and dry conditions. These amazing organisms can be a problem when living on a wood substrate as they are flammable under dry conditions.

HAZARDS OF INFESTATION

Molds and fungi are usually associated with wood or wood products (i.e., paper). As these plants do not have chlorophyll, they must obtain their energy from carbohydrate sources such as starches from wood or paper. Wood infesting fungi may cause brown rot, white rot or blue stain in wood which compromises the structural strength of the wood. Other fungi may cause surface stains from molds and mildew. These molds, mildew and fungi become food sources for wood wasps (in living wood), fungus gnats, mold or plaster beetles, springtails and psocids (booklice).

INSPECTION AND MONITORING

To detect the presence of conditions that are conducive to molds, mildew and fungi, a moisture meter is useful. If the area smells moldy, then these fungi are present. Decayed wood will break when probed (90º angle) with an ice pick or awl, whereas sound wood will splinter.

Any wood material containing more than 12% moisture (use a moisture meter) can be damaged by these various fungi. Preventing wood contact with moisture is a necessary preventive measure. Inspect thoroughly to find all possible moisture sources that contact wood. Repairs or remediation (including redirecting the water) to remove the moisture and dry out the wood is necessary to prevent decay fungi damage. Check rain gutters, downspouts, eaves, roof leaks, condensation, roof valleys and other areas where water flows or stands. The presence of fungi indicates the wood material had or has 12% moisture or more.

MANAGEMENT METHODS

To manage molds and fungi, reduce humidity and moisture sources. A 3% sodium hypochlorite solution (bleach) will kill most molds or fungi. Molds and fungi do not do well in bright direct light. Dry heat can also kill these fungi.

Wood that is in contact with moisture must be protected from decay fungi. A few products are available that, when properly applied, will penetrate throughout the wood beam, log, plank, shingle, post, etc., and protect it from decay fungi. The borates are one of these products. BoraCare, TimBor Pro, Permachink and other borate products, when mixed with water and applied to the surface, will move on the moisture gradient and penetrate each cell of the wood. A second application will push the first through to the center of the wood. This will kill any fungus, wood-boring beetle or other wood-infesting organism present. Following the borate treatment with a water repellent such as WOODguard (Copper 8-quinolinolate) will seal in the protection. WOODguard will need to be reapplied every two to four years as it weathers. The borates do not need to be reapplied after proper treatment and a water repellent sealer. Wood in contact with soil, concrete or masonry may need to be injected with Jecta or Impel rods to prevent further damage by moisture and decay fungi before sealing with WOODguard.

INTRODUCTION TO BATS

CHARACTERISTICS AND RECOGNITION

Bats are unique in the animal kingdom in that they are the only true flying mammals. A thin membrane of skin stretches from their long front legs to the back legs and then to the tail. The bones in their "fingers" are elongated and support the wings.

Bats are usually beneficial, since they feed on insects. They can consume up to half of their body weight in insects in one feeding. Occasionally, bats may become a nuisance when they move into buildings and cause a public-health problem. They become a problem when they live in colonies or groups and defecate inside attic areas or in secluded areas of structures.



Bat Droppings

Fire Island bat species may include little brown bats and big brown bats. These species sometimes hibernate or roost inside buildings in attics, wall and ceiling voids and chimneys. Bat droppings and urine can cause a foul odor and stains on walls and ceilings. Their squeaking and scrambling noises can be intolerable to some people.

HABITS

During warm weather, bats feed on flying insects in late afternoon, evening, and early morning. They are not active in bright daylight. If you see a bat at this time, it has either been disturbed from its daytime resting place or is sick. When not in flight, they rest in dark hiding and roosting sites including caves, buildings, and hollow trees. Bats are able to enter these places of refuge through holes as small as .94 cm (3/8 in).

Bats capture flying insects by "echo-location." They emit high-frequency sound, inaudible to human beings, similar to sonar. They also make audible squeaking sounds for communication. In much of the country, bats migrate south or hibernate when the weather turns cold, sometimes in hanging clusters inside buildings. Depending on the species and geographic location, they breed from late spring to midsummer. Young bats grow rapidly and can fly in three to seven weeks.

HAZARDS OF INFESTATION

Bats and Disease

Bats are associated with a few diseases that affect people. Rabies and Histoplasmosis are the most serious. Rabies is a dangerous disease, fatal if not treated in time. However, the bat's role in transmission has been greatly exaggerated. Although bats are confirmed carriers of the disease, only a few human fatalities have been attributed to bat bites. Nevertheless, use care when handling bats. Bat bites should be considered as potential rabies exposure. Because most

bats will try to bite when handled, they should be picked up with heavy gloves, forceps, or a stick. If a bat has bitten someone, it should be captured without crushing its head. Refrigerate it (don't freeze it). Then take it to the local Health Department for rabies testing. The incidence of Histoplasmosis transmission from bat droppings to humans is not thought to be high. However, when working in a bat roosting site with lots of accumulated droppings, wear a respirator and protective clothing, and follow the safety procedures

INSPECTION AND MONITORING

Inspection for Bats

When inspecting a structure for bats, look for two things: entry and exit points of bats, and the location of the roost. The roost area may be marked by the bats' body oils and fecal droppings beneath.

Entry and exit points

A building in poor repair will have seemingly unlimited entry points. Look for loose flashing, poorly screened vents, loose shingles, or gaps around siding that bats can squeeze through. Look for damage and openings under eaves and soffits, at cornices, louvers, and doors, by chimneys and windows, and anywhere pipes or wiring enter the structure. Notice droppings under openings, smudges around holes, and odors associated with bats.

Bats can be observed at twilight as they leave the building to feed. The best time to observe the bats and pinpoint major exit and entry points is usually from just before sundown to an hour after sunset. Station one or more observers at different sides of the building, looking up toward the roof. Listen for squeaking at the exits just prior to the flight. If the night is chilly or rainy, the bats may not come out.

Location of Roost

Locate the roost in the following way:

- Look inside attics and unused rooms during daylight;
- Check inside the chimney and vents;
- Bang on the walls and listen for squeaks and scratches as roosting bats are disturbed;
- Check behind shutters;
- Look for bat droppings. They will be found below roosting bats. Their droppings differ from mouse droppings because bat droppings contain wings, legs, and other body parts of insects. Bat droppings often accumulate to a depth of several inches or more.
- In large roosts, smell for bats. They have a very pungent and penetrating odor, musky and sweet, that comes from rotting droppings and bat urine.

PEST MANAGEMENT METHODS

The best way to eliminate bats roosting in a building is through "bat-proofing."

Exclusion

BAT-PROOFING: Making a building "bat-proof" means sealing or screening all of the openings used by the bats to enter a building. It can be a challenging job because, in many cases,

all upper openings 1/4 in. and larger must be sealed. This is the only permanent method of ridding a building of bats. Bats should not be entombed when the building is sealed. Otherwise, trapped bats can be a problem. Make the necessary building repairs during winter months when bats are not present in the structures.

June and July are the peak months for bat complaints in much of the country. Unfortunately, this is the worst time for management, since bats are rearing young in their colonies, and young bats cannot fly. Bat-proofing during this period would trap the young bats, and they would die, rot, and become an odor problem. Bats may also crawl and flutter into occupied areas.

The best time of year to bat-proof a building is either in late fall, after bats have left for hibernation, or in late winter and early spring before the bats return. If bat-proofing must be done in summer, it should be done after mid-August when young are flying.

Bat-proofing while bats are present should be carried out as follows: seal all but one or two principal openings. Allow three to four days for the bats to adjust to using the remaining openings, and then seal those openings some evening just after the bats have left for their nightly feeding. "Bat valves" can also be used. These are placed over the remaining openings and allow the bats to leave but not to return.

Standard bat-proofing materials include 1/4 in. hardware cloth, screening, sheet metal, caulking, closed cell expanding polyurethane foam, stainless steel wool, copper mesh, Stuf-Fit, and oakum - the same materials used for rodent-proofing. When old deteriorated buildings have many openings, and can't be sealed economically, large plastic bird nets (1/4 in. mesh) can be draped over the roofs to keep bats out.

During the winter, if big brown bats have left and little brown bats have migrated south, is the best time to clean up the bat droppings and repair the entry holes that allow bats inside. On a sunny day, enter the area (without lights) and look for light leaks in the eaves, where the roof meets the walls, and around the chimney/wall junctions. Fill all holes found with oakum, Stuf-Fit or other compressible material and/or caulk. If, in the spring, the bats have been able to return into the attic, then make observations of the bats leaving to forage in the evenings to locate additional entry/exit sites. Mark those sites for installation of bat valves in summer or repair after bats have left in late fall.

BAT REPELLENTS: Bright lights have been used with some success in repelling bats. Floodlights can be aimed at the bats' entry points to keep them from entering. However, the bright lights may attract insects too, which the bats eat. Attics can be illuminated with four or more bulbs. If this method is used, ensure that all corners of the attic are illuminated. Drafts of cool air from fans and air conditioners may keep bats from roosting in a poorly sealed attic. Ultrasonic devices do not repel bats.

A SINGLE BAT: When a single bat finds its way into a building's occupied area, it will usually find its way out again. When it does not find its way out, capture the bat with an insect net, a coffee can, or even with a gloved hand. The bat can then be released or destroyed.

When bats have been excluded from the Park structures, the benefits of their presence may be lost. Providing an appropriate bat house for bats is useful for reducing flying insects in the area. Visit the Bat Conservation International website (www.batcon.org) for information and plans for large bat houses.

INTRODUCTION TO RODENTS

Rodents are occasional structural pests. Some species present in the eastern United States are the house mouse, native deer and white-footed mouse, voles and grey squirrels; and can also be pests in the Park. These rodents can cause structural damage as well as posing health risks to Park staff and visitors.

CHARACTERISTICS AND RECOGNITION

Mice are small rodents that have very wide distribution. House mice are found throughout the world. Deer mice range from Hudson Bay, Canada to Pennsylvania and the southern Appalachian Mountains. White-footed mice range from mid-Maine south to northern South Carolina. The house mouse prefers to live in structures, whereas deer mice and white-footed mice prefer to nest in woodland habitats. The deer mice are known to carry Hantavirus, and will inhabit structures if they are available. These rodents usually have small territories and fast reproduction rates, so populations can build rapidly.

Grey squirrels may be common in areas with woodlands or large trees. Squirrels can be a nuisance pest if they invade structures. Their teeth are quite hard and strong; and their gnawing can damage historic beams and other wood portions of structures. Nests in attics can harbor fleas and other parasites. Exclusion is the most effective management approach.

Voles, sometimes called “meadow mice,” can be major pests in crops and orchards. They prefer heavy grass ground cover. Voles forage on grasses, forbs, snails, insects and roots. They construct extensive tunnels and runways with many burrow openings. Voles are active day and night throughout the year. Two species may be present at Fire Island National Seashore: the meadow vole and the pine vole.

HAZARDS OF INFESTATION

When rodents infest structures, stored food may be consumed and contaminated by urine and fecal droppings, making it unfit for human consumption. Several diseases can be transmitted by rodents or their ectoparasites, such as Salmonellosis, Rickettsial pox, meningitis, Leptospirosis, dermatitis, rat-bite fever, Ray fungus, ringworm and the deadly Hantavirus.

Hantaviruses are a worldwide occurring family of viruses that were first identified as human disease causing agents in the mid-1970's. One of these viruses, recently identified, causes acute and sudden respiratory illness and has been responsible for a number of deaths. Now, additional cases of this Hantavirus strain caused a disease called Hantavirus-Associated Respiratory Distress Syndrome (HARDS), and have been confirmed in over a dozen states. Although there is reason to believe individual human resistance varies, records show this Hantavirus is lethal in about 60 to 70% of the clinically confirmed cases.

Hantavirus, naturally found in many rodents, is believed to be primarily carried by the very adaptable and widely distributed deer mice. Infected rodents do not show apparent effects of illness and may carry the disease during an entire lifetime, continually shedding virus in urine,

saliva and feces. Humans may contract the disease with exposure to infected rodent excreta, especially when the virus is inhaled on contaminated dust particles. However, human transmission may also occur from rodent bites or when dried materials contaminated with rodent excreta are disturbed, directly introduced into broken skin or the eye, or possibly ingested in contaminated food and water.

Before inside rodent elimination work is begun, ventilate closed buildings or areas inside buildings by opening doors and windows for at least 30 minutes. Use an exhaust fan or cross ventilation if possible. Leave the area until the airing-out period is finished. This airing may help remove any aerosolized virus inside the closed-in structure.

INSPECTION AND MONITORING

Rodents may be more active at night and make their presence known by sounds of scrambling, gnawing and squeaks. Such sounds can be more easily pinpointed with the use of an electronic or regular stethoscope. The most easily noticed evidence of rodent activity in structures is fecal droppings. The house mouse will produce about 70 droppings per day and the native mice will produce similar numbers. Rodent droppings become quite hard within a few days; fresh ones will be firm. Droppings will be along runways, in protected areas, near food sources and nests. Rodents dribble urine as they travel along runways and in protected areas. Look for many small drops of urine fluorescence using a black light. Rodents also produce greasy smears where dirt and oil from their fur mark pipes, beams and baseboards. Look for footprints and tail marks on dusty surfaces or in mud. Light-colored gnawing on wood corners, enlarged cracks or holes in woodwork, doors, cabinets and baseboards is evidence of recent rodent activity.

MANAGEMENT

Management and prevention of rodents is a three-part process: exclusion (rodent-proofing), sanitation (elimination of <u>all</u> food sources), and population reduction indoors with snap traps. The first two are useful preventive measures. When a rodent population already exists, lethal management is necessary. Otherwise, the reproductive capability of the rodents, and their remarkable ability to find food in almost any habitat, will keep their populations up or increase.

<u>Sanitation</u>: Good sanitation makes it easier to detect signs of infestation since it also increases the effectiveness of baits and traps, which represent the only food supply. However, even the best sanitation may not eliminate mice, since they require very little space to get into the building and small amounts of food to flourish.

<u>Rodent-Proofing</u>: It is a challenge to completely rodent-proof a building, since mice are able to squeeze through an opening a bit larger than .64 cm (1/4 in). Seal all holes to limit the movement of rodents into and through a building. Plug holes in foundation walls with 64 cm (1/4 in) hardware cloth or copper mesh. Caulk and fit doors and windows tightly. Seal holes around pipes, utility lines, and vents, to make it difficult for rodents to move in and out of wall and ceiling voids. This confines them to a smaller area and will make snap traps more effective.

Trapping - Snap Traps: If used correctly, snap traps are very effective in managing rodents. The territory of mice rarely extends further than 9.14m (30 ft) from the nest, and usually is about 3.05 m (10 ft). Rats have larger territories. If rodents are sighted throughout a building it means that there are numerous locations where you will have to set traps. Place snap traps not only wherever you see obvious signs, but look for good trap locations in a three-dimensional sphere about 3.05 m (10 ft) in diameter around those signs. Place traps every .91 – 1.83 m (3 – 6 ft) in prime mouse habitat, and every 3.05 – 6.10 m (10 – 20 ft) in rat infested areas at the floor/wall junction with the trigger against and perpendicular to the wall. Check traps daily.

Rodents can be living above their main food supply in suspended ceilings, attics, inside vertical pipe runs, and on top of walk-in coolers. Or they can be below, in floor voids or crawlspaces. The best trapping sites are those with large numbers of droppings, since that indicates that rodents are spending a lot of time there. Other good sites are along walls, behind objects, and in dark corners, particularly where runways narrow down, funneling rodents into a limited area.

Good baits increase the effectiveness of traps. Peanut butter, bacon, cereal, and nuts are traditional, but another is a cotton ball, which the female rodents like to use for nest material. It should be tied securely to the trigger. Food baits should be fresh to be effective. Mice are attracted to sweet baits, so a gumdrop tied to the bait pan may be effective. Probably the biggest mistake made in rodent trapping is not using enough traps. Use enough to make the trapping campaign short and productive.

Remove killed rodents from the traps. Wear rubber or plastic gloves while handling dead rodents. Place the carcasses in a plastic bag containing a sufficient amount of a general-purpose household disinfectant to thoroughly wet the carcasses. Seal and properly dispose of the bag. Rebait and reset all sprung traps, or discard with the rodent. Before removing the gloves, wash gloved hands in a general household disinfectant and then in soap and water. A hypochlorite solution prepared by mixing three tablespoons of household bleach in one gallon of water may be used in place of a commercial disinfectant. Thoroughly wash hands with soap and water after removing the gloves.

Rat Zapper 2000: Rat Zapper 2000 is an electronic trap that humanely kills rodents. The trap is a battery-powered plastic tunnel that is attractive to rodents, and provides a bait placement inside. When the rodent enters the tunnel for the bait and steps on a sensor, the rodent is given a lethal shock. A blinking red light then alerts you to the dead rodent in the trap. Empty the trap by turning it upside down, allowing the dead rodent to slide out. Remote sensing is also available for multiple traps.

Glue Boards: Glue boards are effective against mice. However, glue boards are not humane and are NOT suggested for use on NPS sites.

Rodenticides: The use of toxic baits and tracking powders is discouraged in occupied structures, museums or historic sites. Rodents are nibblers and may not get a large enough dose to achieve a kill. This leads to bait shyness. Rodents that are killed usually die in hidden areas that may be inaccessible. Dead rodents will have a bad odor for a while, another disadvantage to toxic baits. Dead rodents that are not removed immediately become attractive to blowflies and dermestid

beetles that feed upon the carcass. These insects then may become the source of insect infestations in other areas of buildings.

CLEAN-UP OF RODENT CONTAMINATED AREAS

Hantaviruses have lipid envelopes that are susceptible to most disinfectants (e.g., dilute hypochlorite solutions, detergents, ethyl alcohol [70%], or most general purpose household disinfectants), or exposure to strong, direct sunlight.

Areas with evidence of rodent activity (e.g., dead rodents, rodent excreta) should be thoroughly cleaned to reduce the likelihood of exposure to Hantavirus infected materials. Clean-up procedures must be performed in a manner that limits the potential for dirt or dust to become airborne from all potentially contaminated surfaces and goods.

A baseline serum sample, preferably drawn at the time these activities are initiated, should be available for all persons conducting the clean-up of buildings with heavy rodent infestation. Persons involved in the clean-up should wear coveralls (disposable if possible), rubber boots or disposable shoe covers, rubber or plastic gloves, protective goggles, and an appropriate respiratory protection device, such as a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters.

Spray dead rodents, rodent nests, droppings, or foods and other items that have been tainted by rodents with a general-purpose household disinfectant. Soak the material thoroughly, and place in a plastic bag. When clean-up is complete (or when the bag is full), seal the bag, then place it into a second plastic bag and seal. Dispose of the bagged material by burning.

After the above items have been removed, mop floors with a solution of water, detergent, and disinfectant. A second mopping or spraying of floors with a general-purpose household disinfectant is optional. To avoid generating potential infectious aerosols, do not vacuum or sweep dry surfaces before mopping. Disinfect countertops, cabinets, drawers and other durable surfaces by washing them with a solution of detergent, water and disinfectant, followed by wiping them down with a general-purpose household disinfectant.

Rugs and upholstered furniture should be steam cleaned or shampooed. If rodents have nested inside furniture and the nests are not accessible for decontamination, the furniture should be removed and destroyed to avoid reuse. Launder potentially contaminated bedding and clothing with hot water and detergent. Use rubber or plastic gloves when handling the dirty laundry; then wash and disinfect gloves as described earlier. Machine-dry laundry on a high setting or hang it to air dry in the sun.

Personal protective gear should be decontaminated upon removal at the end of the day. If the coveralls are not disposable, they should be laundered on site. If no laundry facilities are available, the coveralls should be immersed in liquid disinfectant until they can be washed.

All potentially infective waste material (including respirator filters) from clean-up operations should be double bagged in appropriate plastic bags. The bagged material should then be labeled as infectious (if it is to be transported) and disposed of in accordance with local requirements for infectious waste.

Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of Hantavirus infection. The physician should contact local health authorities promptly if Hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for Hantavirus antibody testing.

INTRODUCTION TO PUBLIC HEALTH PESTS

Refer to the Inspection and Monitoring section for general inspection and monitoring information. Public health pests are those that have an adverse effect upon human health through the transmission of disease organisms, or through the injection of toxic material into the skin of humans. Many public health pests actually pose a health threat to people; however, some are merely nuisance pests such as cluster flies (*Pollenia rudis* [Fabricius]) and "friendly flies" (*Sarcophaga aldrichi* [Parker]). Other public health pests include fleas, wasps and bees, spiders, ticks, mosquitoes and poison ivy.

CHARACTERISTICS AND RECOGNITION

Flies make up one of the largest groups of insect pests and are carriers and/or transmitters of many health-related diseases. Some species of filth flies and biting flies may be present at FIIS.

Fleas are common indoor pests, but are also present in outdoor areas: lawns, transition areas and woodlands. There are several species of fleas that may be present at Fire Island that have wild hosts such as opossum, fox, coyotes, badgers, skunks, deer, ground squirrels, rats, mice and other rodents. Several flea species can transmit plague, murine typhus and other diseases.

There are only about 50 species of stinging wasps and bees that are troublesome to people. These are generally divided into two groups: the social wasps and bees (including hornets, yellow jackets, umbrella wasps and honey bees); and the solitary wasps and bees which include mud dauber wasps and cicada killer wasps. Social wasps and honeybees build nests in and around structures, beneath eaves, on porches, behind blinds, in trees, shrubbery and vines, in stone walls and in the ground. Solitary wasps prey on insects or spiders they paralyze and place, along with eggs, into individual nests. After the eggs hatch, the larvae feed on those paralyzed arthropods until they can emerge from the nest.

Only a few species of spiders live in structures. Since they feed on insects, they are rarely problems in buildings that do not have an insect food source. They are objectionable pests to people fearful of them, even though most are harmless. There are only two spiders considered dangerous to human beings in the United States: the black widow and the brown recluse, which may be present at FIIS. Funnel web spiders or grass spiders are common throughout the United States and form webs with a funnel the spider hides in. The web is usually in bushes or grass, but may be found in corners of dark rooms inside structures.

Ticks feed on the blood of mammals, birds, reptiles and amphibians. There are two types of ticks: soft and hard. Soft ticks feed on hosts that return periodically to a nest, shelter, cave or coop. Hard ticks are found on pets, cattle, wildlife and people.

Mosquitoes are usually incidental pests in and around buildings since their normal breeding habitats are outdoors. Mosquitoes are generally outdoor pests and may invade buildings during the warmer months from March to October. Some mosquitoes that are of concern at FIIS are *Aedes albopictus, Aedes vexans* and *Culex pipiens*.

Poison ivy (*Toxicodendron radicans* or *Rhus toxicodendron*) is a woody vine that is well-known for its ability to produce urushiol, a skin irrntant that causes an itching rash for most people, technically known as urushiol-induced contact dermatitis.

See the Pest Profiles for more information.

INSPECTION AND MONITORING

Public health pests are usually detected by a thorough inspection of buildings and grounds or from complaints from staff or visitors. Flies, fleas, ticks, wasps or bees, spiders and mosquitoes are quite likely to be complained about by visitors. FIIS can inspect and monitor for these pests, and use signs to suggest personal protection from bites. Monitoring for flies can be done by using sticky fly tapes, Lure Sticks or sticky strings. Inspect ceilings and edges of structural members inside for flies resting at night or fly speck droppings during the day. Ticks can be monitored by using a tick drag (white flannel cloth) in the transition zone between lawn (meadow) and wooded area. Self-monitoring by each person should also be conducted daily. A white plastic sheet with a chunk of dry ice in the center will attract ticks in approximately an hour's time. Place this monitoring method where deer or other mammals frequent.

Some social wasps will build nests in porches or sheds. Inspect for the early stages of paper nests in the spring, and physically remove nests found with a spatula or knife; then clean the site with soap and water to remove the queen's pheromone which she uses to find the nest. Solitary wasp nests can also be physically removed from structures in the same way. Funnel web spiders can be removed with routine cleaning or a Webster brush can be used. Outdoors these spiders are beneficial.

Inspect and monitor for larval mosquitoes in standing water pools or ponds. Larval mosquitoes and pupae are confined to the water environment where they develop and are most easily managed. When the mosquito adults emerge, they become much more difficult to monitor and manage. The Mosquito Magnet (www.mosquitomagnet.com) will monitor (and remove) adult mosquitoes. Adult bite counts can be made (volunteers) and posted on a Mosquito Meter to inform visitors to wear protective clothing or repellents.

MANAGEMENT

The most important major management mistake is the tendency to minimize the potential health risks from exposure to the disease organisms transmitted or carried by mice and ticks.

Flies can best be managed by exclusion from buildings with screens on doors and windows. Keeping flies from access to food sources can be done by good sanitation practices for waste food material. Personal protection from flies, mosquitoes and ticks can be the wearing of light-colored clothing and the personal application of insect repellents. Garlic Barrier can be sprayed around an area to reduce flying insects for a short time.

Wasp nests can be removed in the spring when only the queen is present before the first brood emerges. Physical removal of the small paper nest can be done with a spatula or pocket knife. Remove the pheromone with soap and water or a spray disinfectant. Mud dauber nests can also

be removed before the larvae pupate and the adult solitary wasps emerge. Honey bee swarms must be removed by a professional beekeeper.

Mosquitoes are best managed while in the larval or pupal stage, confined to a pool of standing water. Depressions that hold water in rainy season can be filled, leveled and seeded during the dry season to prevent the puddles. Ponds too large to fill can have mosquito fish released into the pond to feed on the larvae. Vegetable oil or biodegradable mineral oil applied to the surface of the water will prevent mosquito larvae from access to oxygen in the water. This may have adverse effects on other living organisms in the pond as well.

Tick populations can be reduced by mowing pathways short to expose ticks and their eggs to the sun to increase desiccation. Mow up to the wood's edge and along walking or hiking trails.

INTRODUCTION TO LANDSCAPE PESTS

CHARACTERISTICS AND RECOGNITION

Managed cultural, natural, and wilderness landscape pests can be represented by vertebrates, insects, invasive exotic plants, and bacterial or fungal diseases, all of which are currently a concern at the park. Throughout the park there are successional and mature forests that have exotic invasive plants that threaten their natural state. At the William Floyd Estate, the orchard has mature and young fruit trees with vertebrate, insect, and disease pests. The maintained turf and mowed fields have insect and weed pests. The Exotic Plant Management Team will be working with FIIS to address these major exotic invasive plant pest issues.

INSPECTION AND MONITORING

Refer to the Inspection and Monitoring for general inspection and monitoring information. Inspection tells you the conditions and pests present at that point in time. Monitoring tells you what has happened over a period of time (overnight, the past week or month) or changes that have occurred over years. Both are essential in managing landscape pests. Inspection and monitoring activities should be an essential part of the implementation plans developed for Fire Island National Seashore. Periodic inspection and monitoring will provide feedback on progress toward meeting projected (or professed) management goals.

Inspection for vertebrate pests in the landscape may be dependent upon signs of their presence. Such signs may be burrows, runways, clipped grass, droppings or damage to trees, fruit or other potential food sources. Actual sighting of vertebrates gives an excellent opportunity to determine species and perhaps their sex. Monitoring can be done by placing a tracking dust (flour, chalk or diatomaceous earth) in the runways to determine the numbers using the trail. Weighted baits (non-toxic) can be placed to induce feeding overnight, and then weighed to determine feeding activity. A more sophisticated (and expensive) approach would be to place a sensor in the runway that counts the animals that pass by the monitor. Monitoring can help with selecting management methods or determining if management is necessary.

Inspection and monitoring for landscape insect pests may be more challenging as they can be very mobile and have very high reproductive capability. Many are very small (microscopic) and many may be cryptic (hide from human presence). It is sometimes easier to look for the results of insect presence or feeding activity in landscaped areas. Many insects feed on turf, either below ground feeding on roots or above-ground feeding on the grass blades or seed. Insect activity in the Orchard may be feeding on leaves, fruit, roots or stems. Eggs may be placed in or near fruit. Some insects may damage twigs or branches by laying eggs inside. Insects also feed on forest trees and shrubs. Inspect fruit, seeds, leaves, twigs and branches for signs of insect feeding or egg sites. Conduct winter inspections for egg masses on twigs by tent caterpillars (remove them to prevent spring defoliations). Monitoring for insect pests can use pheromone sticky traps for specific insect pests. The pheromone lure is attractive to specific insects (usually males) that get caught in the sticky surface. The glue holds the insect until the trap is monitored and the insect can be identified. Pheromone lures have been developed and marketed for fruit

orchard pests, forest and other insect pests. Insects Limited (see Vendors) has developed several. The USDA Forest Service has also developed monitoring lures for some forest pests.

Inspection and monitoring for exotic invasive plants is complicated by needing to know the various growth stages of plants from other countries or regions. Being able to identify an exotic invasive weed in the seedling or rosette stage is important. Inspection requires an extensive botanical knowledge to be able to differentiate the exotic invasive plant from a native plant (that may even be rare or endangered). Many invasive plants develop quickly and are prolific seed producers. Many also reproduce vegetatively by root suckering or other means. Inspection for weeds is important and should be conducted monthly during the growing season (daily temperatures reach 10ºC [50ºF] or more). Monitoring may involve measuring the infested area and density, rate of growth, seed production and other vegetative measures. Weeds tend to grow where there is bare or disturbed soil, along roads, paths and animal trails.

A brief survey of the William Floyd Estate, Otis Pike High Dune Wilderness, Lighthouse grounds, Sailors Haven, Sunken Forest, Talisman/Barrett Beach, Dune Station and Watch Hill for invasive exotic plants was conducted over several days. The exotic plant species were identified and GPS coordinates were recorded. This information was provided to the Park Biologist. An exotic plant delineation survey was not conducted. Exotic plants and other pests were noted in the inspection findings for the natural areas, Sunken Forest, Talisman/Barrett Beach, Lighthouse visitor area, and Watch Hill. Phragmites was noted to have larger areas infested and was present in more locations than other invasive exotic plants.

MANAGEMENT

Vertebrate pest management methods should involve exclusion, sanitation and habitat modification. In landscaped areas, exclusion may be difficult for some situations. To exclude voles from gnawing and girdling orchard trees, building a .64 cm (1/4 in) hardware cloth 46 cm (18 in) cylinder around each tree trunk, 30.48 cm (12 in) high and 15.24 cm (6 in) into the soil can prevent such damage. Predators on rodents such as owls and hawks can be encouraged by placing hawk roosting stands and owl boxes in various parts of the Park where rodent activity is observed. Snap traps placed in trap boxes (to avoid non-targets) can be effective.

If through monitoring it is determined that an insect population has grown to the point where remedial action is necessary, the release of an appropriate predator or parasite will reduce the pest insect population to a low level. Some exotic insect pests have escaped without their natural enemies and can develop large damaging populations. Low-risk insecticides may be necessary. Obtain approval from the Regional IPM Coordinator for the purchase and use of any pesticide in the park.

Exotic invasive plants must be managed by various means such as hand pulling, pulling saplings with a weed wrench or Talon Claw®, pruning or cut stump and the application of Glyphosate or Triclopyr immediately to the stump. Treating the basal portion of a tree (with no skips) from the ground line up to 60 cm (24 in) with an oil formulation of Glyphosate or Triclopyr can also be effective. Check with the Northeastern Exotic Plant Management Team for appropriate species for use of basal treatment. When exotic plants are removed, it may be appropriate to plant an equivalent desired native plant in its place. Some exotic grasses can be shaded out by staking

black plastic over small patches. Areas in full sun can be killed by solarizing the area under two layers of clear plastic. The Exotic Plant Management Team can assist with the management of exotic invasive plants. Two informative websites are http://tncweeds.ucdavis.edu/index.html and http://science.nature.nps.gov/. Managing exotic invasive plants in the federally designated Otis Pike Wilderness area may require a strict compliance protocol and a Minimum Tool Analysis.

HAZARDS OF INFESTATION

Vertebrate pests of landscape areas, forest, orchard and turf can result in degradation of the desired plants through browsing, girdling and feeding on fruit. Populations can expand and reduce the vigor of the desired plants. Some vertebrates also carry diseases hazardous to humans, or harbor arthropods (ticks) that also feed on humans and transmit Lyme disease.

Insects feed and damage landscaped areas and reduce plant vigor, transmit diseases that have adverse effects on turf, orchards and forests. Invasive exotic plants have infested the forest and other areas of the site, changing its native aspects. Pests interfere with the Park objectives, changing the historic scene and increasing the costs of management.

INTRODUCTION TO FOREST PESTS

Forest pests have been introduced to the Park over several years. Insect pests have occurred in cycles of high population for a few years, then through starvation, predators or disease, the populations crash for several years. Eventually pest populations build up again. Inspection and monitoring can help anticipate population buildup so preventive measures can be taken. Various cultural and biological actions can be taken to manage pest species to reduce hazards.

INTRODUCTION TO INVASIVE EXOTIC PLANT PESTS

Invasive exotic plants may be the most troublesome and expensive pest issue in the Park. Exotic plants are numerous, cover large acreage and produce many seeds that are dispersed by birds and other animals. Many exotic plants reproduce vegetatively as well. Some high priority exotic plants need to be removed (and replaced with desired native plants) and herbicides (i.e., Glyphosate or Triclopyr) applied to cut stumps to reduce resprouting. See Pest Profiles.

INTRODUCTION TO INVASIVE AQUATIC ORGANISMS



Lionfish

Of several exotic, invasive aquatic organisms, the two mentioned below are known to have invaded the east coast of the U.S.

Lionfish (also known as scorpion fish) are exotic organisms from Asia that are sold in specialty pet stores or over the internet. These aquatic “pets” are voracious predators that are kept in “home” aquariums and take time and resources to maintain. Lionfish have poisonous spines and the venom is extremely painful, so they must be handled very carefully. Occasionally the owner tires of the maintenance of these “pets” and decides to discard them – usually into a pond, stream or bay nearby. Be aware that these, among others,

may be released into park waters. Their release would likely disrupt the aquatic ecosystem, and staff should be aware of the possibility of these and other exotic organisms occurring in park waters.



Japanese Shore Crab

The Japanese shore crab is an exotic invasive aquatic omnivore which feeds on young clams, scallops, oysters, fish larvae, European green crab, macroalgae, salt marsh grass, and small invertebrates. The Japanese shore crab was first identified in New Jersey in 1988, and has expanded its presence south to North Carolina and north to Portland, Maine. These crabs inhabit the rocky intertidal zone, between high tide and .31 – .61 m (1 – 2 ft) below low tide. They are aggressive feeders and can reproduce several times a year. The crab has three spines along each side of the carapace, and light and dark banding on its legs. They grow to about 6 cm (2 in) across the carapace. The Japanese shore crab is invading Long Island Sound and reducing native species.

Practical management practices for these and other exotic invasive aquatic predators have not yet been developed.

INTRODUCTION TO TURF MANAGEMENT

GENERAL

Introduction: The continuous planting, maintenance, and replacement of plants is essential to maintaining a high-quality landscape. Over time, landscape development should provide a sense of permanence and a historic context. It should also visually reinforce the road network, screen unsightly views or elements, and buffer incompatible land uses.

This unit presents information for effective, economical, and practical landscape and grounds care, and deals with specific landscape problems most frequently encountered. Other sources of information may be obtained from county or state Cooperative Extension Service Agents, Soil Conservation Service staff, university agriculture departments, and city parks department agronomists or horticulturists.

Preventive Maintenance: To control erosion and maintain healthy turf, preventive maintenance can be best conducted by, but is not limited to, the following:

- Analysis of soil conditions through sampling and testing.
- Selection of appropriate grass, seeds, and other plant materials to achieve natural cultural conditions for the region; to reduce infestation of weeds, encroachment of fungus, and invasion of insects.
- Proper turf care, including seeding, fertilizing, mowing, and watering.
- General cleanliness of grounds, timely attention to aeration, raking, top-dressing, weeding, and the proper preparation of bare spots for reseeding.
- Most desirable frequency and mowing height recommended for the particular type of turf and for a given shade and/or sun environment for each season.
- Resistance of grasses to both drought and excess of rainfall or water in a particular area.
- Need for adequate equipment, tools, and their care.
- Controlling foot traffic and other activities resulting in damage to turf.

This is the cool-season region that includes New York where there is abundant rainfall and acid soils. Upright growing grasses (Kentucky bluegrass *[Poa pratensis]*, fine fescue *[Festuca rubra]*, and perennial ryegrass *[Lolium perenne]*) are adapted to this area. These grasses achieve their best growth during the cool weather of spring and fall, when temperatures are below 27ºC (80ºF). Schedule cultural practices to take advantage of these cooler seasons. The most favorable time to establish turf, or to renovate an existing lawn using these grasses, is during late spring. During the fall season, temperatures are moderate, rainfall is plentiful, and there is less weed competition.

FERTILIZATION

Soil Sampling and Testing: Obtain a soil test kit from New York Cooperative Extension. Soil sampling and testing are the foundation of a good fertilization program. To find out the chemical properties present in various types of soils, it is necessary to take soil samples. Soil tests should

be done between once a year and once every three years, in the spring. Ranges for acceptable test results are as follows:

pH range	5.8 to 7.0
Organic matter	1.5 to 3.0%
Magnesium - Mg	35 pounds/acre
Phosphorous - P	100 pounds/acre
Potassium – K	85 pounds/acre

Soluble salts not to exceed 500 ppm

The reliability of soil testing depends on the method used for taking soil samples. Grass gets most of its nourishment from the top 10.16 cm (4 in) of soil. Soil test results should be considered an estimate of nutrient availability and pH balance within the soil. It is the base to which additional nutrients are to be added. Soil-testing services for determining the degree of acidity or alkalinity, also the chemical analysis for Nitrogen (N), Phosphate (P_2O_5) or Phosphorus (P) and Potash or Potassium (K) determination, are available. Soil-testing kits for the chemical analysis of pH, N, P, and K, are available commercially. Chemicals used in soil-testing deteriorate with age and must be replaced every year. When test kits are used with care following the instructions, a reliable indication of plant food elements and soil reaction is obtained.

Lime: Some soils are "sour" (acid) and others are "sweet" (alkaline), so called because of their respective positions below or above 7.0, the neutral point on the pH scale. While grasses will grow in soil pH ranging from 5.0 to 7.5, better turf grasses prefer a range between 6.0 and 6.5, or slightly acid on the pH scale. The soil's acidity or alkalinity (pH) is normally controlled by spreading dolomitic lime. The use of ground limestone, with its characteristic trace elements, is preferred to maintain a soil reaction slightly below the pH neutral point. This tends to keep grasses green longer in the fall, ward off the encroachment of snow mold disease, increase drought resistance, and improve resistance to brown patch and dollar-spot disease.

Nitrogen: Nitrogen, the growth-producing nutrient for plants, should be supplied at a constant and uniform rate to keep grass growing and maintain a healthy plant condition. An adequate supply results in dark green foliage and active vegetative growth. However, an oversupply of nitrogen causes too-rapid plant growth, less firm tissues, and weakening of the plant so that it is less resistant to disease, infection, and injury. Excess nitrogen applied at flowering time causes the plant to retard flower and seed formation and to resume active vegetative growth.

Phosphates: Phosphate compounds are needed by all plants, especially plants that produce flowers, seeds, and grain. These compounds promote germination of seed and contribute to general plant health. Phosphate materials include organic phosphates, super-phosphates, and ammonia phosphates. Common sources of organic phosphates are bone meal, sewage sludge, and vegetable meals.

Potassium: The principal sources of potassium are muriate of potash and sulphate of potash, which are completely soluble in water. Other potash carriers are potassium nitrate, cottonseed hulls, hardwood ashes, and tobacco stems. Muriate of potash is the common source of potassium in mixed fertilizers, although the sulphate form is preferable where chloride is a problem, for

example, in tobacco fertilizers. Potash is an important food element in the formation and transportation of starch, sugar, and other carbohydrates within the plants. An adequate application of potassium to the soil causes plants to produce disease-resistant, stiff, healthy stems, and improves root growth.

Excessive application of nitrogen (N), or phosphorus (P), or both, often accentuates rust infestation.

Minor Elements: Copper, zinc, iron, manganese, and boron are required by plants in small quantities. Use them with extreme caution, since excess applications may be severely toxic. Animal manures and many natural organic fertilizers contain these trace elements. Copper, zinc, iron, and manganese are usually applied as a sulphate. Recently, however, chelated compounds and insoluble "fritted forms" of these elements have become available.

Slow-Acting Fertilizers: Natural organic and synthetic organic-nitrogen fertilizers are not water-soluble. They depend upon certain soil bacteria and fungi to break down the chemical materials for plant growth. They do not "burn" grass because the bacteria make the nutrients available to the plants. Another reason that natural organic fertilizers do not burn is that they have a low nutrient value.

MAINTAINING TURF GRASS

Watering: The need for, and frequency of, watering is dictated by the type of soil, turf, temperature, humidity, and other weather conditions. A water supply of about 76.2 cm (30 in) per year or more is necessary for the establishment of a good turf. This may be from rainfall or a combination of rainfall and irrigation. Artificial watering may be done by fixed or movable sprinklers. Turf should be watered when indicated by their color, lack of resilience to foot printing, or wilting. The need for watering can also be determined by taking a sample core, cut out of turf and soil, 6.35 cm (2 1/2 in) deep, with a 11.43 cm (4 1/2 in) long tapered hollow-tine sampling tool having a 1.27 cm (1/2 in) diameter cutting edge opening.

Mowing: One common reason for turf failure is cutting the grass too close to the ground, which prevents grass from spreading out and developing into a dense turf. The grass' root development is related to its top growth. To remain healthy and resistant to disease and weed invasion, it must produce, through minimum blade height and surface, enough plant foods for vigorous root development. Low clipping starves the roots, causing them to become shallow.

Also, the turf will thin out and be baked during hot summer temperatures, leaving room for the invasion of low-growing weeds. Low mowing permits sunlight to warm the ground, helping crabgrass seedlings to germinate in late May and June. Grass should not be permitted to grow too high and then cut back so that bleached stems are evident. This is a shock to the plant, which could then be injured by the hot sun. It is also necessary to remove the clippings to avoid smothering the grass with them.

A 7.62 – 10.16 cm (3 – 4 in) mowing height is recommended for all turf grasses to ensure a densely tufted sod, tolerance for long periods of drought, and resistance to heavy traffic. This height also retards the germination of weed seeds lying near the soil surface.

Mowing should be done often enough so that the short clippings can be left on the ground to decompose. This is beneficial to the turf, because clippings under an inch long serve as mulch to the roots and return plant food elements to the soil. Longer clippings tend to mat on top of the grass instead of dropping between the blades to the ground, which smothers the plants. When dried out, long cuttings become an unsightly litter, holding an excessive amount of moisture, and thus weakening the grass. When conditions of humidity and temperature are right, fungi can encroach on the weakened turf.

Aeration: Aeration consists of punching holes and removing soil cores to allow for lateral expansion of the compacted soil into these holes. This loosens the soil beneath the grass without disturbing or damaging the turf surface and root structure. Proper aeration of grass reduces maintenance costs resulting from labor and materials, fertilizer, seed, sod, sprigs, and artificial watering, which would be wasted due to runoff on compacted soils. Also, the turf will be denser, stronger, and better able to withstand traffic. Further, it is less susceptible to disease and hardier through periods of drought. In summary, aeration will do the following:

- Make the soil porous through vertical penetration, permitting air, moisture and fertilizer to reach the grass roots.
- Increase turf growth and density, particularly if plant food is spread and the area dragged while soil cavities are still open.
- Help in preparation of a good seed bed while improving existing turf.

Aeration exposes the ground so it can readily absorb surface water, resulting in less runoff and erosion. When done before fertilization, aeration improves the effectiveness of fertilization. After fertilizing, the turf area should be dragged, raked, or brushed to smooth off any unevenness resulting from the aeration process. This moves the fertilizer from the turf into the soil and grass root system.

WEEDS

General: Webster's dictionary defines a weed as any plant growing in cultivated ground to the detriment of a crop or to the disfigurement of the place. However, weeds may be useful under special conditions or in specific areas, such as for controlling soil erosion. Weed seeds are transported by birds and wind, and most soil contains dormant seeds that germinate when temperature, moisture, and mowing conditions are favorable. They can reduce a healthy stand of turf by competing with and depriving it of the water, light, and the soil nutrients needed to sustain it.

Weeds become a factor after grasses lose aggressiveness and vigor, and in addition, may serve as host for turf-grass diseases. They frequently provide a haven for vermin and for the over-wintering of plant and turf-attacking insects and diseases. One or a combination of the following conditions encourages weed infestation:

Poor soil type and density
Nutrient starvation
Lack of water
Over-fertilization

Over-watering
Inadequate drainage
Soil compaction
Improper mowing
Insect damage (surface and sub-surface types)
Disease damage
Extreme fluctuations in temperature and natural moisture and/or precipitation

These factors retard both root development and top growth, affect turf color, density, and texture, and impede recovery from injury.

A turf-grass management program should include the planting of permanent grasses and their maintenance through good soil sampling, testing, liming, fertilizing, mowing to 7.62 – 10.16 cm (3 – 4 in), and watering practices. Chemical treatment for weeds should be considered only as a last choice.

Characteristics: Various weed seeds remain dormant in the soil for years and germinate when brought to the surface by cultivating, and when other conditions are favorable. Weeds are capable of growing to maturity and setting vast numbers of seed within the short span of 30 – 60 days. When unchecked, their rapid growth enables them to readily overtake and stop turf growth. Certain weeds have extensive root systems and continue to grow new shoots repeatedly, even when the top growth has been destroyed. Clover is a good example of this.

Weeds that are common in turf-grass environments are usually low-growing, prostrate, vine-like forms of undesirable plants. High mowing to shade out weeds should be considered. Low mowing will stress desirable lawn grasses. Weeds may be classed as herbaceous or woody. Most plants regarded as weeds are herbs that are either annuals, biennials, or perennials.

Annuals: Annual herbaceous plants complete their life cycles in one growing season by germinating from seed in the spring or summer, producing seed, and dying in the same year. The seeds of winter annuals germinate in the fall of one growing season. The plants live over winter, produce seed, and die in the spring of the year following germination.

Biennials: Biennials live two years, developing a cluster of leaves fanning out and around the main shoots at ground level during the first year, and a storage root that helps the plant survive the first year's winter. During the second year, leaves, flowers, and seed develop, after which the plant dies. Garlic mustard is an example.

Perennials: Roots and stems of perennials live indefinitely, but their tops die each year and new stems and leaves develop the following year.

Identification and Management: The common names of weeds vary so that a weed may be known by different names in different locations. Conversely, several different weeds may be known by the same common name. Contact your local Cooperative Extension Service for weed I.D. and management methods. Contact the NPS Regional Exotic Plant Management Team.

For those interested in learning to identify and control weeds, the following two books are recommended:
Weeds of the North Central States, Circular No. 718, Agriculture Experiment Station, University of Illinois, Urbana, Illinois 61801, 260 pages.

Weed Identification and Control by Duane Isely, Iowa State University Press, Ames, Iowa 50010, 400 pages.

DISEASES

General: More than 100 different diseases have been found on turf grass. However, only about 10 to 15 of them are known to damage the turf.

Diseases are more likely to occur in turf which have been improperly established or maintained. The following conditions contribute to poor turf, and ultimately to disease attack: improper selection of grass mixtures and species, buried debris, compacted soils, improper watering, improper mowing, insect injury, pesticide injury, fertilizer burn, and hydrated-lime burn. Additional causes are foot traffic, playing on immature and/or wet turf, delivery trucks and automobiles driving over turf or parked on them, and other abuse.

Identification and Management: Some turf diseases can be managed by using chemicals called fungicides, of which many kinds are available. All fungicides are poisonous! On the issue of exposure of workers to pesticides, OSHA defers to the EPA, which enforces pesticide-use laws under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). (OSHA regulations 29 CFR 1910.1200 Scope B.5.A.).

Turf injury from other causes is frequently mistaken for disease symptoms. These include burning with chemical fertilizers, chemical weed killers, drought, dog and insect damage, or fungi damage in combination with other symptoms.

INSECT DAMAGE

General: Turf grass is subject to attack from insects and insect-like pests, which cause it to turn brown and die. These pests can be grouped as follows:

- Soil and root-infesting insects, including Japanese, Oriental, and Asiatic grubs; white-fringed beetles; masked, rose, and European chafers; mole crickets; wireworms; billbugs; and ants.
- Leaf- and stem-damaging insects, including sod webworms, armyworms, cutworms, Lucerne moth, fiery skipper, grasshoppers, and leaf bugs.
- Plant juice-sucking insects, including chinch bugs, aphids, leaf hoppers, mites, scales, and ground pearls.

Inspecting and monitoring the landscaped turf areas should be conducted periodically. Inspections of turf areas can be accomplished during other duties in the turf areas. Healthy turf is generally resistant to pests. Look for good uniform green color, mowing height (10.16 cm [4 in]) and the presence of bare ground patches and weeds. Check the root structure to determine if

it is shallow or deep (15.24 cm [6 in] or more). Inspect for the general health of the turf areas at least three times during the season (spring, mid-summer, fall). Dated photo records may be useful.

Monitoring may consist of using line transects to determine the density of turf, presence and identification of weeds, and presence of damage by rodents or insects. Increase the frequency of monitoring if pest damage has been observed. If damage requires remedial action, monitor after the action has been taken to determine results. Pitfall traps can be used in no or low-traffic areas to capture insects or mites for identification. Keep records of observations while monitoring.

APPENDICES

APPENDIX I

Findings and

Recommendations

Summary Chart

INSPECTION FINDINGS AND RECOMMENDATIONS SUMMARY

Main House, William Floyd Estate

Inspection Findings	Recommended Actions
Outside, East Side	
Signs of wood rot by window frame	Remove damaged wood; replace with BoraCare or TimBor Pro-treated wood; paint to match with quality oil-based paint
Water diversion flashing holding leaves & dirt; wood has 30 – 40% moisture	Clean to allow water flow. Extend flashing 2.54 cm (1 in) over the edge. Install rain gutters & downspouts
Leaf litter under structures holds moisture & provides harborage for insects & rodents	Remove leaf litter & other debris from under structures
Gaps under coal shed allow pest harborage	Repair gaps under coal shed to prevent pest access
Multaflora rose (*Rosa multiflora* Thunb.), an exotic invasive plant	Remove all multiflora rose; cut stems at ground level; paint remaining stems with Glyphosate or Triclopyr
Many plants (vegetation) close to building; hold moisture & provide harborage for pests	Move or prune all vegetation to .91 m (3 ft) from the structure. Create a .91 m (3 ft) vegetation-free zone next to the structure
Outside, North Side	
Screen removed from north screened porch – allows flying insects to enter	Replace screen on porch
Outside, West Side	
Hole under house near Bilco door provides entry or harborage for pests	Monitor for vertebrate or arthropod presence under structure. Remove pests; seal hole with ¼ in. hardware cloth extended below soil surface
Boxwood too close to structure	Install trellis to hold boxwood at least .91 m (3 ft) from structure
Raccoons or squirrels enter ductwork	Remove vertebrate pests. Trace entry into ductwork by pests. Seal ductwork with ¼ in. hardware cloth to exclude vertebrate pests
Animal access under porch	Close access under porch with ¼ in. hardware cloth & historic fabric
Inside, Attic A3-1	
Dust, dirt, debris. Open gaps under eaves. Mud dauber nests & spider webs present	Thorough cleaning. Perform exclusion to fill all gaps. Remove all mud dauber nests. Remove spider webs. Treat all wood beams & other wood material twice with BoraCare or TimBor Pro to protect from WDOs
Hole chewed in wall at end of crawlspace provides access for squirrels or mice	Repair hole with ¼ in. hardware cloth; cover with historic fabric (wood & mortar)
1740-60 portion by the bulkhead; there is a hole with grease mark (rodent access); holes in floor with hair caught; a cache of nuts behind the window box shelf; squirrel droppings & nesting material; substantial detritus in corners	Thoroughly clean attic to remove all evidence of pest activity. Close all holes with ¼ in. hardware cloth to exclude vertebrate pests. Inspect weekly for pest activity. If vertebrate activity resumes, set fine-tuned Victor rat traps baited with chunky-style peanut butter. Check rodent traps daily. Treat all wood material with BoraCare or TimBor Pro.

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, Attic A3-2	
Dust, dirt, debris present	Thoroughly clean this area
Beams recorded 13% moisture; susceptible to WDOs	Treat all wood beams & other wood material twice with BoraCare or TimBor Pro
Broken wood pieces, rodent droppings, nest under the roof; clean fresh hole chewed through the floor (.91 m [3 ft.] from nest) to subfloor below	Thoroughly clean area & remove nest material. Fill hole with Stuf-Fit & seal with ¼ in. hardware cloth. Inspect to find all entry points for arthropods or vertebrates, then securely seal them
Inside, Attic A3-3	
Dust, dirt, debris present	Thoroughly clean this area, especially the closet
Wood beams & other wood material susceptible to WDOs	Treat all wood beams & wood material with BoraCare or TimBor Pro
Spiders captured in sticky trap	Continue to monitor with sticky traps & check periodically (monthly) for pest activity
Inside, Second Floor, Master Bedroom, Rose Room M2-1	
Dust, dirt present	Thoroughly clean this room periodically
Moisture damage on ceiling above window & drapes	Determine source of moisture & repair
Damaged paint on window sills from moisture	Determine source of moisture & repair
Hole present in the corner of the fireplace	Fill hole with Stuf-Fit; seal with ¼ in. hardware cloth & cover with historic mortar
Leaves present in the bottom of the fireplace	Remove the leaves. Install a chimney cap to prevent entry of leaves & arthropod or vertebrate pests
Spiders captured in sticky traps	Continue monitoring with Lo-Line sticky traps. Check traps at least monthly
Inside, Second Floor, Bedroom M2-2	
Old water damage to the wall	Determine moisture source & provide repairs
Carpenter ants, adult varied carpet beetle, adult anobiid beetle in sticky trap	Carpenter ants & anobiid beetle need wood moisture 13% & over to develop. Determine moisture source & provide repairs. Treat all wood twice with BoraCare or TimBor Pro. Check and clean (HEPA vacuum) all fabrics in the bedroom, pillows, covers, drapes, rugs, clothing, etc. Inspect for larvae, cast skins, adult beetles & frass
Inside, Second Floor, Bedroom M2-3	
Dust, dirt present	Thoroughly clean this room. No pest evidence; continue monitoring with Lo-Line sticky traps
Inside, Second Floor, Bedroom M2-4	
Dust, dirt present	Thoroughly clean this room. Continue Lo-Line sticky trap monitoring. No pest evidence
Inside, Upstairs Hall, M2-6	
Dust, dirt present; dermestid larvae cast skins & larvae feeding damage on blanket	Thoroughly clean (HEPA vacuum) all fabrics (couches, pillows, blankets, drapes, rugs, etc.). Check for dermestid beetle larvae & adults, cast skins & feeding damage. Continue monitoring with Lo-Line sticky traps

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, Parlor Bedroom M2-8	
Dust, dirt present; dermestid larvae feeding damage on hat	Inspect & thoroughly clean (HEPA vacuum) all fabric, pillows, linens, blankets, rugs, clothing, drapes, etc. Continue monitoring with Lo-Line sticky traps
Inside, Bedroom M2-9	
Dust, dirt present; dermestid larvae, carpenter ants, spiders observed in sticky traps	Thoroughly clean (HEPA vacuum) all fabrics (mattresses, pillows, covers, linens, blankets, rugs, clothing, drapes), cracks & crevices to remove larvae, beetles & any organic material beetle larvae & ants can feed on. Treat cracks & crevices with DE or Disodium Octaborate Tetrahydrate (DOT) dust. Continue monitoring with Lo-Line sticky traps
Inside, The Garden Room M2-10	
Dust, dirt present. No evidence of pests	Thoroughly clean this area. Continue to monitor with Lo-Line sticky traps
Inside, Sleeping Porch NW2-1	
Dust, dirt present; substantial wood damage from moisture in the roof and wall. Moisture reading 17%. Floor wood moisture reading 40%. Wood-boring beetle damage. Wasps present	Thoroughly clean this area. Determine the moisture source and perform repairs. Replace badly damaged wood. Treat all wood twice with BoraCare or TimBor Pro. Remove wasps with vacuum. Remove nest if present
Inside, Bedroom NW2-2	
Dust, dirt present; spiders in sticky trap by dresser	Thoroughly clean this area. Install a pest-proof chimney cap to exclude squirrels, birds, etc. eal fireplace flue with ¼ in. hardware cloth
Inside, Bath NW2-3	
Dust, dirt present; water damage; spiders in a sticky trap	Thoroughly clean this area. Determine moisture source and perform repairs. Continue monitoring with Lo-Line sticky traps
Inside, Bath NW2-5	
Dust present; no evidence of pest presence	Thoroughly clean this area. Continue monitoring with sticky traps
Inside, Mizzen Bedroom E2-1	
Dust, dirt present; floor spongy from squirrel nest between floors. Moisture damage. Pest access under window. Spiders & dermestid larvae in sticky trap	Thoroughly clean this area. Remove floor boards & replace if necessary. Remove all nest material & droppings. Treat all wood material, beams, flooring, etc. twice with BoraCare or TimBor Pro. Determine moisture source & perform repairs. Reinforce weak beams or flooring, if necessary. Clean (HEPA vacuum) all fabric (bedding, mattresses, pillows, linens, blankets, rugs, clothing, drapes, etc.). Continue monitoring for pests with Lo-Line sticky traps

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, Fo'c'sle Bedroom E2-2	
Dust, dirt present; moisture damage. Anobiid beetle, spider beetle, spiders captured in a sticky trap	Thoroughly clean (HEPA vacuum) all fabrics, linens, blankets, clothing, rugs, drapes, etc. Determine moisture source & make repairs. Search for dead animals, insects, furs, etc. Treat cracks & crevices with DE or DOT dust. Continue monitoring with Lo-Line sticky traps
Inside, Storeroom NE2-1	
Dust, dirt present; moisture damage; hole in the ceiling; rodent droppings & food on air duct; spider webs & eggs; adult & larvae dermestid beetles & crickets in sticky traps	Thoroughly clean this area & remove spider webs with a Webster or HEPA vacuum. Repair the hole in the ceiling. Determine rodent access routes & set snap traps (monitor snap traps daily). Exclude rodents with ¼ in. hardware cloth. Determine moisture source & provide repairs
Inside, Storeroom NE2-2	
Dust, dirt present; hole in the bathroom ceiling into the attic; window sill has chewing damage; stuffed birds in poor condition	Thoroughly clean this area. Overlay ½ in. wire with ¼ in. hardware cloth to prevent rodent access. Repair hole in ceiling. Repair window sill. Taxidermist to clean & check for dermestid evidence or damage on stuffed birds
Inside, Bath E2-5	
Dust, dirt present; moisture damage around window; hole around pipe race; dermestid larvae & adult beetle in sticky trap	Thoroughly clean this area. Determine moisture source & provide repair. Fill hole around pipes with Stuf-Fit & plaster over. Continue to monitor for arthropod pests with Lo-Line sticky traps
Inside, First Floor, Dining Room M1-1	
Dust, dirt present; ceiling beam holes; mold in medicine case; spider webs; old powderpost beetle damage; books with old silverfish damage	Thoroughly clean this room. Reduce humidity. Treat ceiling beams twice with BoraCare or TimBor Pro (by injection). Remove spider webs with a Webster or vacuum. Monitor horn & birds for dermestid beetle larvae. Reduce humidity near artifacts & bookcases. Place Dekko Silverfish Paks behind books to manage (kill) silverfish or psocids. Continue monitoring for crawling arthropods with Lo-Line sticky traps
Inside, Pantry M1-2	
Dust, dirt present; wood borer damage in tea cart; sawbug, spider, predaceous ground beetle & insect frass in sticky traps	Thoroughly clean this area. Inspect tea cart periodically for active wood borer damage. Continue monitoring for crawling arthropods with Lo-Line sticky traps

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, Gun Room M1-3	
Dust, dirt present; wood borer damage; chimney closet, ceiling & door frame are collapsing; rodent hole in closet beside fireplace; wooden toys have powderpost beetle damage	Thoroughly clean this room. Treat all exposed wood with BoraCare or TimBor Pro to prevent further WDO damage. Repair wood beams & door frame, & treat with BoraCare or TimBor Pro. Fill the rodent hole in the closet with Stuf-Fit & seal with ¼ in. hardware cloth. Monitor for squirrel or other rodent activity (set Victor snap traps with chunky peanut butter bait) & check traps for captures daily. Place wood toys on white paper to monitor for fresh frass; then treat with heat at 60 - 71ºC (140 - 160ºF) for at least one hour to kill larvae
Inside, Main Hall M1-4	
Dust, dirt present; clothes moth evidence	Thoroughly clean this area. Check the master chimney for rodent activity. Install chimney cap to prevent bird & rodent entry. Install ¼ in. hardware cloth in the chimney flue to prevent vertebrate entry. Vacuum (HEPA) all fabrics (rugs, drapes, linens, etc.) for clothes moth or dermestid larvae. Continue to monitor for pests with Lo-Line sticky traps
Inside, Parlor M1-5	
Dust, dirt present; no evidence of arthropod or vertebrate pests present	Thoroughly clean this room. Install ¼ in. hardware cloth in the fireplace flue. Install a chimney cap to prevent vertebrate entry. Continue to monitor for crawling insects with Lo-Line sticky traps
Inside, Office M1-6	
Dust, dirt present; insect damage on books; reproductive carpenter ant found on sticky trap; weather-stripping installed on outside doors of emergency exits	Thoroughly clean this area. Reduce humidity. Place Dekko Silverfish Paks behind books to attract & kill silverfish or psocids. Continue to monitor for crawling insects with Lo-Line sticky traps
Inside, New Kitchen NW1-1	
Dust, dirt present; evidence of moisture leaks in the roof & siding; a clerid beetle & a predacious ground beetle were captured in a sticky trap; hole in wall under the sink; eastern subterranean termites were captured on a sticky trap beside the stove; termites known to swarm here & carpenter ants also have been seen in the past	Thoroughly clean this area. Determine the source of moisture & make necessary repairs. Treat all accessible wood with BoraCare or TimBor Pro to manage WDOs. The hole under the sink needs to be repaired with Stuf-Fit and ¼ in. hardware cloth to prevent pest entry. Enter the crawl space under the kitchen & inspect for mud tubes; break mud tubes & reinspect the next day for repaired mud tubes which equals an active termite colony. Also inspect for wood/soil contact which allows termite access to the structure. Dry out the soil beneath the building. Treat all exposed wood under the building twice with BoraCare or TimBor Pro. "Termi-mesh," a fine woven stainless steel mesh can be installed between wood &

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, New Kitchen NW1-1 (cont'd)	
	foundation to block termite access. The continued presence of an active eastern subterranean termite colony may require a commercial pest control company. Continue to monitor for crawling insects with Lo-Line sticky traps
Inside, New Dining Room NW1-3	
Dust, dirt present; no evidence of pest activity here	Thoroughly clean this area. Continue to monitor for crawling insects with Lo-Line sticky traps
Inside, Bath NW1-5	
Dust, dirt present; no evidence of pest activity here	Thoroughly clean this area. Continue to inspect & monitor for pest presence
Inside, East Entry E1-1	
Mold present on photos & the wall which is a sign of moisture intrusion	Determine source of moisture & make appropriate repairs. Reduce humidity. Occupy site during rain event to determine moisture source.
Inside, Reception Room E1-2	
Dust, dirt present; a gap is under the outside door; spider web behind "Declaration of Independence" painting; floor/wall junction sticky trap by the entrance door captured gnats, spiders, ants, a mite, pill bugs & several small parasitic wasps; a live dermestid larva was captured in a sticky trap by the fireplace	Thoroughly clean this area. Install a door sweep or build up the threshold to the door to exclude rodents, insects or other pests. Seal windows to exclude insects. Remove the spider web behind the "Declaration of Independence" painting. Check the fireplace & chimney for dead birds or animals. Install a chimney cap to prevent entry of vertebrates. The fireplace flue can have ¼ in. hardware cloth installed to prevent rodent entry
Inside, Milk Room E1-6	
A squirrel nest was present in the corner; moisture leaks were observed around the ceiling area; there were holes large enough for squirrels to enter; a sticky trap at the floor/wall junction had captured a spider & a cricket; the second inspection found evidence of a well-established squirrel nest in the ceiling void area; a varied carpet beetle *Anthrenus verbasci* [L.]) & dermestid pupal cases were found in sticky traps	Remove nest material. Thoroughly clean this room with a HEPA vacuum. Treat the nest area with diatomaceous earth or TimBor Pro to kill mites or other parasites. Repair holes with period material backed with ¼ in. hardware cloth. Continue monitoring for crawling arthropods with Lo-Line sticky traps
Inside, Old 1850s Kitchen NE1-1	
Insect frass on the flour barrel from powderpost beetle larvae infestation; a spider captured in a sticky trap at the floor/wall junction; a second inspection showed moisture damage & access by insects or rodents	Thoroughly clean area with a HEPA vacuum (cracks & crevices) to remove pest food (dust, lint, etc.). Treat barrel twice with BoraCare or TimBor Pro to protect from beetle larvae, mold or fungus. Determine moisture source & make repairs. Find & seal all pest entry points. Use ¼ in. hardware cloth for holes larger than 2.54 cm (1 in) & Stuf-Fit for smaller holes. Caulk or use period material to cover exclusion repairs. Install door sweeps on interior & exterior doors.

Main House, William Floyd Estate (cont'd)

Inspection Findings	Recommended Actions
Inside, Storeroom NE1-2	
Dust, dirt, detritus present; the slave laundry had a squirrel nest that previously collapsed the ceiling; some of the nest may remain in the ceiling; the second inspection revealed squirrel evidence & moisture damage in the ceiling area	Remove the remaining nest from the ceiling area. Vacuum thoroughly with a HEPA vacuum & treat the void area with DE or DOT dust to kill mites, parasites or beetles. Treat exposed wood with Bora Care or TimBor Pro. Thoroughly clean this area. Set fine-tuned Victor rat traps baited with shelled nuts or chunky-style peanut butter. Monitor traps daily to remove dead rodents & reset traps
Inside, NE1-3	
Dust, dirt, debris present; holes present in floor & behind chairs; dermestid larvae & spider beetle captured on sticky trap	Thoroughly clean this area with HEPA vacuum, especially all fabrics, cracks & crevices. Repair all holes with period material. Remove food sources. Continue monitoring with Lo-Line sticky traps
Inside, Slave Meal Room NE 1-	
Dust, dirt, detritus present; evidence of old raccoon or squirrel droppings & nesting material in damaged ceiling	Thoroughly clean this area with a HEPA vacuum. Determine entry points for raccoons, squirrels & other vertebrate or arthropod pests & make appropriate exclusion repairs. Apply DE or DOT dusts to kill mites, parasites or other arthropods. Continue monitoring with Lo-Line sticky traps
Inside, Back Shed NE1-4	
Dust, dirt, detritus present; gap through back door; raccoon scat & carpenter ant frass present; nut shells & debris present in ceiling void; spider beetles captured in sticky trap by entrance door; hole in the wall	Thoroughly clean (HEPA vacuum) this area. Repair gap in back door. Treat all exposed wood with BoraCare or TimBor Pro. Drill carpenter ant galleries and inject DE or TimBor Pro dust. Repair hole in the wall. HEPA vacuum ceiling void area, then repair ceiling. Remove organic material as food source. Continue monitoring for crawling insects with Lo-Line sticky traps

Outbuildings, William Floyd Estate

Inspection Findings	Recommended Actions
Ranger Station	
Dust, dirt, clutter present; ants observed in food-eating area; organic material under structure	Thoroughly clean (HEPA vacuum) this area. Eliminate clutter. Clean eating area after each meal. Remove trash at close of business daily. Treat all exposed wood twice with BoraCare or TimBor Pro to protect from WDOs. Monitor for crawling insects with Lo-Line sticky traps placed at the floor/wall junction on both sides of entry doors. Set Victor mouse snap traps in food area & check daily, then reset. Rake organic material (leaves, etc.) from under structure. Remove all vegetation to .91 m (3 ft) from structure. Install a .91 m (3 ft) wide gravel barrier around the structure.

Outbuildings, William Floyd Estate

Inspection Findings	Recommended Actions
Inside, Staff Housing Unit 1	
Left unit of duplex has substantial clutter; kitchen stove very greasy & ants observed in kitchen	Thoroughly clean this unit & eliminate clutter (pest harborage). Thoroughly clean kitchen stove after each use. Monitor for crawling insects with Lo-Line sticky traps
Inside, Staff Housing Unit 2	
Right unit of duplex has some clutter in the middle front bedroom; spider webs observed; dead *Harmonia* lady beetles & spider webs observed in back bedroom; & a gap under the front door	Thoroughly clean this unit & reduce clutter. Install door sweep on front door. Remove spider webs & dead lady beetles. Monitor for crawling insects at floor/wall junction on both sides of exit doors with Lo-Line sticky traps
Outside, Staff Housing 1 and 2	
The Sentricon system has been installed around the duplex; carpenter bee nest holes observed in wood trim; wood rot observed in white uprights. A bird nest is on the corner security light; an ant trail was observed going up under the siding by the kitchen of Unit 2. A paper wasp nest was present under the eave; organic matter present under decks; the concrete basement has clutter, spider webs, dust & dirt; the laundry room needs cleaning.	Contractor should monitor Sentricon system monthly. Carpenter bee holes can be treated with DE or TimBor Pro, then sealed with a hardwood dowel. Wood rot can be treated with BoraCare or TimBor Pro. Remove the bird nest. Treat ants outside with Drax Liquidator bait station. Remove wasp nest after hard freeze. Rake out organic material under decks & discard. Wood decks can be treated with BoraCare or TimBor Pro to prevent WDOs. Clean & rearrange basement (remove clutter
The Carriage Barn	
Outside walls have wood rot. Top board at roof line is broken. WDO damage in beams & walls. Leather tack damaged. Mouse droppings present &bird nests on beams. Spider webs present. The carriages are quite dirty & the upholstery is greatly deteriorating. Rodent activity observed. Old furniture damaged. Powderpost beetle damage & frass from beams on stored objects. Open structure provides easy access to vertebrate & arthropod pests.	Repair broken wood portions. Treat entire structure with BoraCare or TimBor Pro to protect wood from WDOs. Clean & oil leather material. This open structure is unable to exclude vertebrate or arthropod pests. Set Victor snap traps for rodents. Remove important historic material & store in pest-free, secure storage facility. Repair structure using sound wood (treated) & historic methods to prevent arthropod & vertebrate pest access into the structure. Prune back overhanging or adjacent vegetation to at least .91 m (3 ft) from structure. Thorough cleaning of the Carriage Barn & its contents is a high priority.
Wood Shed	
Wooden structure has extensive WDO damage from powderpost beetles & carpenter ants. The structure is open & has a dirt floor. Animal gnawing on uprights is present. Ant-lion cones in the dirt floor help reduce ants.	Treat the entire wood structure (except firewood) twice with BoraCare or TimBor Pro to prevent WDOs.

Outbuildings, William Floyd Estate

Inspection Findings	Recommended Actions
Ice House	
Wooden structure has the potential for WDOs & animals falling into the pit. Mold & wood rot are present.	Repair roof of structure to exclude vertebrates with ¼ in. hardware cloth, or close fitting wood roof & side walls. Treat all exposed wood twice with BoraCare or TimBor Pro to prevent mold, wood rot or other WDOs.
Storage Crib	
Wood structure converted from a corn crib. Wood infested with powderpost & Bostrichid beetles. Spider webs & mouse droppings present. Large gaps for vertebrate & insect entry. Rodent-chewed nuts present. Leaves & other organic material under structure. Carpenter ants observed. Stored material dirty.	Thoroughly clean stored material. Repair structure to prevent vertebrate & arthropod access. Treat all exposed wood with BoraCare or TimBor Pro to prevent WDO damage. Remove leaves & other organic material from beneath the Storage Crib.
Old Shop	
Wood structure with substantial powderpost beetle larval damage & fine frass. Mouse droppings, dead *Harmonia* sp. & black widow spiders with webs observed.	Thoroughly clean the structure. Repair all holes, cracks & crevices with historic material or Stuf-Fit and ¼ in. hardware cloth. Install door sweeps. Treat all exposed wood twice with BoraCare or TimBor Pro. Place fine-tuned mouse traps at the floor/wall junction & check daily to remove dead mice & reset. Continue monitoring for crawling insects with Lo-Line sticky traps.
Corn Crib	
Wood structure with open gaps cannot exclude pests. Wood borer damage & frass observed. Eaten nut hulls present.	Thoroughly clean the corn crib. Treat the entire structure twice with BoraCare or TimBor Pro. Remove all vegetation & organic debris under the structure. Install 2.54 cm (1 in) gravel under crib to reduce moisture.
Barn	
Open wood structure with dirt floor. Evidence of beetle damage to beams & wood members. Swallow nest, mud dauber nest & wasp nest observed.	Treat all wood portions of the barn twice with BoraCare or TimBor Pro. Remove bird and wasp nests. Clean all machinery exhibited.
New Barn	
Some beams & wood portions replaced. Wood rot & old subterranean termite damage observed. Bird & wasp nests present. Earwigs present indicate moisture.	Thoroughly clean the New Barn & contents. Treat all wood twice with BoraCare or TimBor Pro. Remove all bird, wasp & mud dauber nests. Remove organic material & reduce moisture (rock gravel).
Gazebo	
Open wood log structure with wood shingles. Wood borers, animal cribbing, mud dauber nest & carpenter ants observed.	Remove nests. Treat entire structure twice with BoraCare or TimBor Pro.

Outbuildings, William Floyd Estate

Inspection Findings	Recommended Actions
Tractor Shed	
Wood rot in fascia. Large hole in front. Evidence of rodents.	Thoroughly clean to remove rodent & insect droppings. Treat entire structure twice with BoraCare or TimBor Pro. Repair holes in structure with ¼ in. hardware cloth or Stuf-Fit. Replace fascia with borate-treated wood & paint with quality oil-based paint.
Workshop	
Gap under doors. Spider webs present. Shingles missing. Knot holes are open. Moss on north side siding. Vegetation too close to building.	Install door sweeps on doors. Replace shingles & repair holes. Remove moss & prune vegetation back at least .91 m (3 ft) from structure. Treat all wood twice with BoraCare or TimBor Pro. Install .91 m (3 ft) by 15.24 cm (6 in) deep gravel barrier around the workshop.
Ladder Storage Shed	
Open wood structure cannot exclude pests. Carpenter ant & inchworm observed.	Treat all wood twice with BoraCare or TimBor Pro.
Fuel Storage & Fire Cache Buildings	
These structures were locked.	Treat all wood twice with BoraCare or TimBor Pro.
Collection Storage Building	
Cockroaches reported; oriental cockroaches observed in garbage. Spiders, sow bugs, crickets, beetles & carpenter ants captured in sticky traps. Live spiders & webs between cabinets. Dermestid beetles & larvae, clothes moth, psocids, predacious ground beetle & an insect cocoon observed. Back door sweep damaged.	Replace back door sweep. Thoroughly clean entire storage building. Place Lo-Line sticky traps at the floor/wall junction & on shelving throughout building. Monitor weekly. Replace traps when mostly filled. Place pheromone traps for clothes moth & dermestid beetle adults high in the inside corners of the building & check for captures weekly. Flying insect captures tell which sector to search for larval activity. Treat all cracks & crevices with DE or DOT, then caulk.
Isolation Room	
Crickets, isopods (sow bugs), spiders & webs, adult varied carpet beetles observed. Most were found in sticky traps.	Thoroughly clean the isolation room daily. Continue to monitor for crawling insects with Lo-Line sticky traps & check them daily. Caulk all cracks & crevices after treating them with DE or DOT.
Outside, Collection Storage Building	
Swallow nest over light. Mud dauber nest near roll-up door. Carpenter ants by back door along with wood rot at ground level. Loose board on west side. Old boat filled with water & mosquitoes.	Remove swallow & mud dauber nests. Treat all wood twice with BoraCare or TimBor Pro. Refasten loose plank. Turn the old boat over to eliminate standing water. Rake leaves away from building. Install .91 m (3 ft) wide, 15.24 cm (6 in) deep gravel for no-vegetation zone around the building. Mount outside lights on poles at least 9.15 m (30 ft) away to attract night-flying insects away from building. Install a bat house to reduce night insects.

Headquarters Facilities - 2005

Inspection Findings	Recommended Actions
General Observations	
Pipe holes through floor with chewing evidence. Mouse droppings on desks, in floor registers & openings behind doors. Excess clutter. Droppings & chewed candles & food packets in kitchen drawers. Holes under the sink, behind stove, by radiator, above windows, in lower cabinet & under dining area door. Mouse droppings under the stove broiler, behind refrigerator, microwave & on top of cabinet shelf.	Thoroughly clean entire office complex, kitchen & restrooms. Fill pipe holes with Stuf-Fit or historic material. Set Victor mouse traps & monitor each morning (daily) to remove captures & reset traps. Each employee using the kitchen is responsible for cleaning up after themselves. Custodial staff are responsible for cleaning floors & emptying trash containers each evening. Floor registers & ducts also need thorough cleaning.

Headquarters Facilities - 2006

Inspection Findings	Recommended Actions
Superintendent's Office	
Ceiling tiles displaced which may provide arthropod or vertebrate access. No evidence of rodent or insect pests observed.	Replace or reseal tiles, reduce clutter, monitor for crawling insect pests.
Superintendent's Secretary's Office	
No evidence of rodent or insect pests observed.	Monitor for crawling insect pests with Lo-Line sticky traps at the floor/wall junction.
Receptionist's Office	
There is a hole into the wall below & to the right of the front window. The floor register & duct between the desk & the typing table has mouse droppings & debris.	Seal the hole with Stuf-Fit & replaster. Set a Victor snap trap in the floor register & check each morning to remove captures & reset. Clean register & duct.
Utility Room	
Observed a hole in the ceiling. Dust, dirt, debris & clutter present. A 10.16 cm (4 in) pipe going underground is open. The copper pipe through the wall has surrounding space for pest entry.	Repair the hole. Thoroughly clean this area & remove or organize the clutter. Cap or grate the pipe. Fill the gap around the copper pipe with Stuf-Fit & caulk. Surplus, remove or discard stashed material.
Administrator's, Deputy Superintendent's, Facilities Officer's, Michelle's Offices	
No evidence of insect or rodent pests present. Some clutter, dust, minor dirt present.	Thoroughly clean, vacuum & organize the small amount of clutter.
Chief Ranger's Office	
Old mouse droppings present.	Thoroughly clean this area. Set Victor mouse traps at the floor/wall junction & monitor daily to empty & reset traps. Monitor for crawling insect activity with Lo-Line sticky traps at the floor/wall junction.
Danielle's Office	
Wire hole in the corner by the door.	Fill & caulk hole.
Chief of Resource Management's Office	
No evidence of arthropod or vertebrate pest presence observed.	Continue monitoring for crawling insects with Lo-Line sticky traps..

Headquarters Facilities - 2006

Inspection Findings	Recommended Actions
Chief of Interpretation's Office	
Substantial clutter present. Outside door has wood rot.	Organize or remove clutter to eliminate pest harborage. Replace rotted wood or treat with BoraCare or TimBor Pro.
Second Floor Bath	
Faucet leaking into the tub. No other evidence of pests present.	Repair the leaking faucet.
Outside, Headquarters Building	
Substantial moisture accumulation around building. The decorative lath grid is damaged & open to vertebrate pests. Tree & ornamental branches contact the structure. Leaves & other organic debris under the steps & deck. Wood rot on the arch over the river-side door.	Install a 15.24 cm (6 in) deep, .91 m (3 ft) wide gravel barrier completely around the building. Repair the lath grid & back it with ¼ in. hardware cloth to prevent access by rodents. Prune tree & shrub branches back to at least .91 m (3 ft) from structure. Rake out organic material from under steps & deck. Replace rotted wood and/or treat with BoraCare or TimBor Pro.
Outside, Headquarters Annex	
Tree branches overhang & touch the roof. A hole behind the downspout by the gas meter provides access to the inside.	Prune branches back at least 1.83 m (6 ft) from the roof. Fill the hole with Stuf-Fit & caulk. Install a 15.24 cm (6 in) deep, .91 m (3 ft) wide gravel no-vegetation zone around the building.
Inside, Headquarters Annex	
The west-side furnace room has wood shavings & detritus. Old mouse droppings are present by the south door. There is a hole in the west wall of the main section into the furnace room. Access to below the structure observed at the floor/wall junction by the right corner of the south door.	Thoroughly clean the entire building. Remove droppings & set Victor mouse traps at the floor/wall junction on both sides of the south door. Fill the hole with Stuf-Fit & seal it with cement.

Patchogue Maintenance Facilities

Inspection Findings	Recommended Actions
Chief of Maintenance's Office	
No evidence of pests present.	Thoroughly clean this area. Continue to monitor for insects with Lo-Line sticky traps.
Next Office (Burch)	
Dust, dirt present. No evidence of rodent or insect pests.	Thoroughly clean this area. Continue to monitor for crawling insects with Lo-Line sticky traps.
Conference Room	
Spider webs present under grey cabinet. No evidence of vertebrate pests present.	Thoroughly clean this area. Use a Webster or vacuum for spider webs. Continue monitoring for arthropods with Lo-Line sticky traps.
Open Administrative Area	
No evidence of arthropod or vertebrate pests present.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.

Patchogue Maintenance Facilities

Inspection Findings	Recommended Actions
Irene's Office	
Dust, dirt & substantial clutter, providing harborage for insects & other pests. There was not evidence of insect or rodent pests present.	Thoroughly clean this area. Organize or remove clutter to eliminate pest harborage & enable inspection. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Office South of Barrera's Office	
Substantial amount of clutter present. Spider webs (with captured insects) between wall & file cabinet.	Organize or remove clutter. Remove spider webs with a Webster or vacuum. Thoroughly clean this area. Continue to monitor with Lo-Line sticky traps.
Daniel Barrera's Office	
There was no evidence of rodent or insect pest presence.	Thoroughly clean this area. Continue to monitor with Lo-Line sticky traps.
IPM Coordinator's Office	
There was no evidence of either rodent or insect pests present.	Thoroughly clean this area. Continue to monitor with Lo-Line sticky traps.
Office Area Outside IPM Coordinator's Office	
There was no evidence of pest presence here.	Thoroughly clean this area. Continue to monitor with Lo-Line sticky traps.
Bath	
Old Raid Kill Ant Bait at the back edge of the shower. No evidence of pest presence.	Remove the old ant bait. Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Kitchen	
Spider webs behind the refrigerator. A Raid Kill Ant Bait found behind the toaster oven. Dust, dirt, crumbs present.	Thoroughly clean this area. Remove & properly discard the Raid Kill Ant Bait. Continue to monitor for crawling insects with Lo-Line sticky traps.
West Side Office by Exit	
There was no evidence of pest presence.	Thoroughly clean this area. Continue monitoring with Lo-Line sticky traps.
Back Exit Door	
The back door has a gap on the hinge side.	Install a felt weather strip and/or door sweep if necessary to close the gap.
Outside Building	
The Sentricon system has been installed to monitor for eastern subterranean termite presence. Attic vents screened with ½ in. hardware cloth. The alcove around the concrete buttress is open at the bottom.	The contractor should monitor the Sentricon system every month. Rescreen the attic vents with ¼ in. hardware cloth. Seal the alcove bottom with ¼ in. hardware cloth to prevent vertebrate entry.
Boardwalk	
Goose droppings on the boardwalk pose a health hazard.	Power wash the boardwalk each morning.

Patchogue Maintenance Facilities

Inspection Findings	Recommended Actions
Outside PMF-B Warehouse	
North side downspout directs water into the warehouse. Holes between cinderblock at ground level. Board at roof line has gaps. Vertical boards damaged by wood rot. The east side had no evidence of either rodent or insect pests, or wood rot organisms. The south side had holes at the top of the block that extend to inside.	Redirect downspout water away from the warehouse. Fill holes with Stuf-Fit and seal with cement. Seal gaps in boards at roof line. Repair or replace damaged siding. Treat all wood in the structure twice with BoraCare or TimBor Pro to prevent wood rot and wood borers (WDOs). Fill all holes in block with Stuf-Fit, then grout with cement.
Inside PMF-B Warehouse	
Pigeons were reported to roost inside the warehouse. None were observed during inspection.	Keep doors closed when not loading or unloading material.
The kitchen is new & clean. The stove is clean. There is no evidence of rodent or insect activity present.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
The bath had no evidence of insect or rodent activity present.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Fire Control Panel Room	
Found three tripped mouse traps. Mouse droppings present.	Thoroughly clean this area. Set fine-tuned Victor snap traps with chunky peanut butter bait. Check traps daily to remove captures & reset.
Electrical Room	
Dust, dirt & clutter. No evidence of rodent or insect activity observed.	Thoroughly clean this area. Remove or organize clutter. Continue to monitor with Lo-Line sticky traps.
Workshop	
Dust, dirt, old rat droppings present.	Thoroughly clean this area. Set fine-tuned Victor rat traps at the floor/wall junction. Monitor traps daily to remove captures & reset. Continue to monitor for crawling insects with Lo-Line sticky traps.
Mosquito Lab	
Very clean. No evidence of pest presence.	Continue thorough cleaning. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Paint Room	
Spiders & webs seen. Rodent droppings under the blue cabinet.	Thoroughly clean this area. Remove spiders & webs with a Webster or vacuum. Set Victor snap traps at the floor/wall junction & monitor daily to remove captures & reset. Continue monitoring with Lo-Line sticky traps.
File Storage Room	
No evidence of rodent or insect activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Hall Closet	
No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Middle Office	
Office neat & clean. No evidence of pest presence.	Continue to thoroughly clean this area & monitor for crawling arthropods with Lo-Line sticky traps.

Patchogue Maintenance Facilities

Inspection Findings	Recommended Actions
East Side PMF-B Front Office	
Substantial clutter. No evidence of pest activity observed.	Remove or organize clutter. Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Library	
Tripped mouse snap trap. No evidence of vertebrate or arthropod pests observed.	Thoroughly clean this area. Fine-tune & reset Victor mouse traps & check daily to remove captures & reset. Continue monitoring for crawling arthropods.
East Side PMF-B Second Office	
No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Law Enforcement Ranger's Office	
Spider webs observed. Unbaited mouse traps.	Remove webs with a Webster or vacuum. Thoroughly clean this area. Fine-tune, bait & set Victor mouse traps at the floor/wall junction & monitor daily to remove captures & reset. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Landscape Architect's Office	
Reportedly a hole in the southeast corner (behind furniture). No evidence of pest activity observed.	Move furniture & repair hole with Stuf-Fit. Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Holly Houser's Office	
No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Storage Closet by Holly's Office	
Tripped mouse trap. Dust, dirt & spider webs present. No other evidence of pest activity observed.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
PMF-B Warehouse	
Doors seal well & prevent pest access. Several rooms were locked. Warehouse was very dusty with substantial clutter. Old rodent droppings & spider webs observed. Old rat droppings in weight room. Upper storage levels have substantial clutter. Holes through the middle bay wall.	Thoroughly clean this area. Set fine-tuned Victor rat or mouse traps on both sides of walk-in & pull-up doors at the floor/wall junction. Remove or organize clutter. Seal all holes with Stuf-Fit & back with ¼ in. hardware cloth.
River Room	
Outside: Wood rot on A/C frame & south window frame. Inside: Spider webs, old rodent droppings in utility closet. Gap around gas pipe. Microwave quite dirty. Bath has dirt in corners & spider webs under sink.	Outside: Replace wood frames, then treat twice with BoraCare or TimBor Pro. Then paint with quality oil-based paint. Inside: Remove spider webs with a Webster or vacuum. Thoroughly clean the area. Clean the microwave. Scrub floor/wall junction & corners in bath.

Patchogue Maintenance Facilities

Inspection Findings	Recommended Actions
Mechanic's Shop	
Carpenter bees working under NPS arrowhead over the door. Gap under doors allows water & pest entry. Vine growing into storage closet. Substantial clutter present. Upstairs area has substantial clutter. Metal trash cans stored outside had rain water exposed; mosquito eggs & larvae observed.	Locate carpenter bee gallery holes & inject DE or TimBor Pro to kill bee larvae. Install door sweeps on doors. Remove vine. Thoroughly clean the entire machine shop. Remove or organize clutter. Set fine-tuned Victor rat & mouse traps at the floor/wall junction & monitor daily to remove captures & reset. Empty water from trash cans to prevent mosquito breeding sites.

Otis Pike High Dune Wilderness

Inspection Findings	Recommended Actions
Visitor Center Outside	
Mold/mildew present on wood planks. Animal access under rusted roll-up door. Hardware cloth on NE side not effective. North side behind detour sign is open to inside. NW corner & south side have gaps.	Treat wood with BoraCare or TimBor Pro to prevent mold, mildew & other WDOs. Deter animal access under roll-up door by installing a close-fitting threshold and/or replace door. Replace or refasten ¼ in. hardware cloth. Use Stuf-Fit secured with ¼ in. hardware cloth to fill gaps.
Visitor Center Basement	
Several rat traps tripped (no captures). Ketch-all trap had dead animals inside. Raccoon scat present. Water leak under hot water heater. Two very young raccoon kits in the corner next to hot water heater. Multiple holes into the basement.	Fine-tune Victor rat traps & bait with chunky peanut butter; reset & monitor daily to remove captures. Thoroughly clean this area. Remove or organize clutter. Repair water leaks. Close holes with Stuf-Fit & seal with ¼ in. hardware cloth. When raccoon female & kits leave basement, seal all entry points.
Visitor Center Inside, Main Level	
Office had spider webs & dirt under desks & cabinets. Chewing marks on several items. No other evidence of pests observed. Restrooms have dirt & sand in corners. Closet locked.	Thoroughly clean this area, especially floor/wall junction, corners & under desks & cabinets. Remove spider webs with a Webster or vacuum. Set Victor mouse traps near chewing evidence. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Visitor Center Inside, Upper Level	
Spider webs & dead flies. Crickets had been seen. Water leaks occur.	Repair leaks. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Wilderness East	
Invasive plants observed and ID'd by Mary Laura Lamont. GPS coordinates taken by the park IPM Coordinator. The following plants listed: multiflora rose, oriental bittersweet, autumn olive. English sparrows in tree swallow nest boxes.	Move swallow nest boxes farther away from human activity near the Visitor Center. Multiflora rose: cut at soil line & treat stumps with Glyphosate or Triclopyr; mow or prune frequently (6 times per growing season for 4 years).

Otis Pike High Dune Wilderness

Inspection Findings	Recommended Actions
Wilderness East (cont'd)	
	Autumn olive: early spring hand pull; cut & treat with Glyphosate or Triclopyr. Oriental bittersweet: hand pull roots before fruiting; cut stem & treat with Glyphosate or Triclopyr.
Old Inlet	
Substantial population of healthy phragmites.	Cut & treat stumps with Glyphosate or Triclopyr. Treat entire area.

Lighthouse

Inspection Findings	Recommended Actions
Pigeons in Portholes	
Reported to FIIS IPM Coordinator that pigeons nesting in portholes are a problem.	Clean portholes to remove nesting & fecal material. Use ¼ in. hardware cloth cut at least 2.54 cm (1 in) larger than the diameter of the porthole. Force hardware cloth into the portholes from the inside-out toward the outer edge.
Second Floor Lifesaving Room	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Shipwreck Room	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Main Hallway	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Main Office	
Substantial clutter present; dust, dirt & detritus under & behind cabinets, under desks, etc. No evidence of pest activity observed.	Thoroughly clean this area. Remove or organize clutter. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Closets	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Center Office	
Substantial clutter present. No evidence of pest activity observed.	Remove or organize clutter. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Conference Room & Closet	
No evidence of pest activity was observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Second Floor Kitchen	
Rodent hole next to entry. Dead flies present. Mouse droppings under the register. Dirt under the range top. A "Tin Cat" was present.	Thoroughly clean this area. Remove the Tin Cat. Repair hole with Stuf-Fit & seal with ¼ in. hardware cloth. Clean the range top.

Lighthouse

Inspection Findings	Recommended Actions
Second Floor Bath	
Mold present in the shower. No other evidence of pests observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps. Clean mold area with a fungicidal cleaner. Increase ventilation to dry out the bath.
First Floor Gift Shop & Closet	
Dust & dirt behind shelves & displays. No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
First Floor Restrooms	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
First Floor Janitorial Closet	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
First Floor Main Hallway	
No evidence of pest activity observed.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
There is a leak over the tower entrance archway. Wood rot is present in window frames.	Repair the leak in the archway. Repair or replace window frames. Treat wood with BoraCare or TimBor Pro; then paint with quality oil-based paint to match.
First Floor Northeast Room	
Well-designed displays. Trash under registers. Spider webs on both sides of TV monitor & on the fireplace. No other evidence of pest activity observed.	Remove webs with a Webster or vacuum. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
First Floor Radio Room	
Substantial clutter present. Several holes in the ceiling. Spider webs observed. No other pest activity observed.	Remove or organize clutter. Repair holes in ceiling with Stuf-Fit & seal with cement. Remove webs with a Webster or vacuum. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Basement	
Dead crickets & other insects at floor-wall junction. An OTC pesticide was found on a shelf. The southwest room has moisture evident. Moisture found around Bilco door. Mold present on refrigerator gaskets. Pipe holes up to the level above have gaps. There was no other evidence of vertebrate or arthropod pests present.	Remove the pesticide container & properly dispose of it. Thoroughly clean this area. Continue to monitor for crawling arthropods. Treat cracks & crevices or voids with Niban-FG, Nibor-D or Perma-Guard Commercial Insecticide for crickets & other arthropods. Repair water leaks. Improve air circulation to reduce humidity. Clean refrigerator gaskets. Fill pipe hole gaps with Stuf-Fit & seal with cement. Remove or organize clutter.
Basement Maintenance Shop Southeast Room	
Pipe holes through wall with gaps. No evidence of pest activity observed.	Fill pipe holes around pipes with Stuf-Fit & seal with mortar. Thoroughly clean this area. Continue monitoring for crawling arthropod pests with Lo-Line sticky traps.

Lighthouse

Inspection Findings	Recommended Actions
Basement Generator Room	
Pipe holes through wall. Air & moisture entering through the Bilco door on north side. No evidence of pest activity observed.	Fill holes around pipes with Stuf-Fit & seal with mortar. Seal Bilco door with weather strips to prevent moisture. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.

Lighthouse Annex

Inspection Findings	Recommended Actions
Quarters 1	
Vacant. Dust, dirt & sand present, especially in corners.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Quarters 2	
Vacant. Dust, dirt, spider webs & debris under registers.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Remove trash from under registers. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Quarters 3	
Occupied. Dust, dirt, sand, insects & debris under registers. Moisture damage & peeling paint on ceiling.	Thoroughly clean this area. Repair moisture leak & repaint with quality oil-based paint. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Quarters 4	
Occupied. Clean. Dust bunnies under bed. Spider webs under sink in bath; webs under heat register & at back door. No other evidence of pests observed.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Laundry Room	
Hole in the wall. Trash behind washer. Incorrectly set mouse traps.	Occupants responsible for thoroughly cleaning this area. Repair hole with Stuf-Fit & seal with mortar. Remove trash. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Rear Restroom	
Spider webs & insect parts under toilet.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Kitchen/Lounge	
Gap around drain pipe under sink. Dirt & grime under range top & under broiler drawer. No screens on the back windows.	Fill gap around pipe with Stuf-Fit & seal with plaster (spackle). Thoroughly clean this area. Clean under range top & below broiler. Install screens on the back windows. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Feral Cats	
Feral cats present. Possible source of cat fleas, distemper & other diseases.	Feral cats feed on mice only if they are not being fed by occupants.

Lighthouse Annex

Inspection Findings	Recommended Actions
Large Upstairs Apartment	
Occupied. Clean. Cat food present under stove. Rust present on bathroom ceiling. Clutter in office. No evidence of pest activity observed..	Thoroughly clean this area. Remove or organize clutter. Continue to monitor for crawling arthropods with Lo-Line sticky traps, placed between appliances & walls (to prevent capturing cats).
Small Upstairs Apartment	
Occupied. Ants report in kitchen & bedroom where cracks occur. Mold in refrigerator door gaskets. Hole around pipe under sink. Dirt & grime under stove range top & under broiler drawer. Spider webs present. Gap around gas pipe by washer. Mold around bathtub.	Follow ant trails to entry point & seal entry with caulk. Clean ant trail with soapy water to remove pheromone. Remove webs with a Webster or vacuum. Fill gas pipe gap with Stuf-Fit & seal with mortar. Remove mold. Thoroughly clean this apartment. Continue monitoring with Lo-Line sticky traps.
First Floor Radio Transmitter Room	
Dirt, clutter & spider webs present. Old radio equipment stored. Hole at the bottom of the double doors. Hole in wall.	Repair hole in wall with Stuf-Fit & seal with mortar. Apply door sweeps to double doors. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Middle Ranger Office	
Holes in wall under heat register. Substantial clutter present. No evidence of pest activity observed.	Repair holes with Stuf-Fit & seal with mortar. Remove or organize clutter. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Front Ranger Office	
Clutter present. Hole under corner of outside door & access under inside door. Mold in refrigerator/freezer. Refrigerator dirty. Dermestid beetle larvae & frass in stuffed owl. Screen missing in bathroom window. An OTC pesticide in bathroom.	Remove or organize clutter. Thoroughly clean this area & refrigerator. Repair hole by door with Stuf-Fit & seal with mortar. Replace window screen. Remove OTC pesticide. Install door sweep if necessary or raise threshold to prevent pest access under door. Place owl in plastic bag & place in freezer for 2 days; allow to thaw 2 days; place in freezer for 2 days; & thaw again to kill dermestid beetle larvae.
Outside Lighthouse Annex	
North side moisture leak from A/C unit (2nd floor). Screen off window. Hole around electrical box with gnawed wires. Rodent hole under back porch. Downspout with outflow device removed. West side has tree too close to structure & a small tree right against building. South side has sparrow nest. Rain gutters full of pine needles.	Repair moisture leak. Replace window screen. Repair electric box hole with Stuf-Fit & mortar. Replace downspout outflow end. Monitor rodent hole for activity; trap & fill hole. Prune all trees back at least .91 m (3 ft) or more or remove trees. Remove tree against building. Remove nest after young have flown. Clean rain gutters & cover with screen.
Maintenance Shed	
Barn swallow nests & swallows inside. Large hole in door for swallows. Large gap under doors. Mouse droppings on north side (access under west door).	After young have flown, exclude birds & remove nests. Treat for mites & swallow bugs with DE as needed. Repair hole in door & install door sweeps. Set fine-tuned Victor snap traps baited with chunky peanut butter & check traps daily. Thoroughly clean this area.

Lighthouse Annex

Inspection Findings	Recommended Actions
Maintenance Shed South Room	
Locked storage. Old mouse droppings. Pipe holes with gaps to outside.	Fill gaps with Stuf-Fit & seal with mortar. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Lighthouse Grounds	
Exotic plants observed: autumn olive, oriental bittersweet, bunch grass, little blue stem, phragmites, & mugwort.	Hand pull when young. Cut at ground level & paint stump with Glyphosate or Triclopyr. Replant with desired native plants.

Sailors Haven

Inspection Findings	Recommended Actions
Restaurant/Gift Shop SH-106	
Outside: Deck posts had 19-22% moisture; had been treated with preservative. Trash & debris under deck. Rodent activity signs observed under building. Loose shingles under eaves. Carpenter bee holes under eaves. Screen missing on kitchen exhaust fan.	Monitor wood posts & beams for wood rot. Remove trash & debris. Monitor for rodent activity to determine burrow or nesting sites. Set fine-tuned Victor snap traps & monitor daily. Repair shingles. Replace screen on exhaust fan. Inject DE or TimBor Pro into bee holes to kill larvae.
Inside: Gift shop clean & without clutter. Office had sawdust on floor. Kitchen storage room & restroom clean with no clutter. Drains clean. Debris under grill & shelves.	Thoroughly clean this area. Remove debris. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Visitor Center SH-104	
Outside: Wood rot at wood/soil interface. Stretcher storage has bird nest near tank. Hose dripping water onto wood walkway. Outdoor shower full of leaves. Plastic bags wrapped around pipes to fill gap into building. Towel storage room has musty odor. Several holes in walls. Window frame on east side has large gap into wall. Debris on back side beneath building. Large hole next to chimney. Fascia board damaged. Chimney separating from building at top. Trees too close to building. Missing shingles.	Wood at soil line may need to be replaced. Treat wood with BoraCare or TimBor Pro to prevent wood rot. Remove bird nest after young fly. Exclude birds. Remove or redirect dripping hose. Fill gaps around pipes with Stuf-Fit & seal with mortar or other material. Thoroughly clean towel room. Repair holes in walls. Repair or replace damaged window frame. Repair the chimney/building interface to prevent pest access. Prune trees back at least .91 m (3 ft) from structure or move or remove the trees. Replace broken shingles.
Inside: Water leak by the hot water heater. Wood has high moisture levels which promote wood rot. Cleanliness of offices & front visitor area is not good. Little evidence of pest activity observed.	Repair leak. May require wood replacement. Treat wood with BoraCare or TimBor Pro. Thoroughly clean these areas. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Bath House	
Ladies' Side: Unflushed toilets. Dead insects in light fixtures. Water leaks from outside showers. Wood rot by shower entrances. Carpenter bee holes & galleries in overhead beams of showers.	Check toilets for operation. Clean out light fixtures. Repair shower leaks. Replace or treat wood with BoraCare or TimBor Pro. Treat bee holes & galleries with DE or TimBor Pro.

Sailors Haven

Inspection Findings	Recommended Actions
Bath House (cont'd)	
Men's Side: Unflushed toilets. No screens on inside window openings. Wood rot in several showers.	Check toilets for operation. Replace window screens. Replace damaged wood and/or treat with BoraCare or TimBor Pro.
Storage Shed	
Mouse nests in rescue baskets & in coiled ropes in another basket. Many holes for rodent access.	Thoroughly clean this area. Repair holes in shed with Stuf-Fit backed by ¼ in. hardware cloth. No food stored in this shed. Set fine-tuned Victor mouse traps at the floor/wall junction. Monitor traps daily to remove captures & reset.
Staff Housing Motel SH-101	
Occupied. Kitchen has sawdust under sink. Stove has dirt & grime under range top, oven & under broiler. Fireplace holes filled with rusted steel wool. Moisture damage on floor of laundry room. Half bath has tile missing, hole in floor under sink, mold on walls & in cabinet. Paint peeling on bedroom shelves & hole in wall, Hole in floor behind kitchen table. Rot in deck wood. Fascia board missing. Pin hole water leak under deck. Water in trash can containing mosquito larvae.	Thoroughly clean this apartment. Clean under range top, oven & under broiler; bathroom walls & cabinet. Repair holes by fireplace with Stuf-Fit & seal with mortar. Repair holes in floor under sink in bedroom wall & kitchen floor. Replace fascia board. Replace deck wood & treat deck with BoraCare or TimBor Pro. Empty water in trash can. Replace metal fitting with pin hole leak.
Staff Housing Motel SH-102	
Holes in laundry room floor. Dead spiders & insects. Debris on bedroom floor. Large chewed holes in corner of small bedroom. Mouse trap (set) with mouse droppings around it.	Staff occupants must conduct cleaning & remove or organize clutter. Fill holes with Stuf-Fit & seal with mortar. Teach occupants how to fine-tune & set mouse snap traps. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Maintenance Shop SH-109	
Large hole in east wall to outside; several holes through the floor. Mouse droppings in circuit breaker closet. Large gaps under all outside doors. Rat droppings near door & on lower shelves.	Thoroughly clean this area. Repair holes in wall and floor. Install quality door sweeps on all outside doors. Set fine-tuned Victor rat traps on both sides of outside doors. Set fine-tuned Victor mouse traps in circuit breaker closet. Check all traps daily for captures & reset. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Staff Housing SH-103 (Old Horse Barn)	
Many spider webs. Mouse droppings in water heater closet. Separate laundry building has holes in floor. Jimson weed in paddock area.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Set fine-tuned Victor mouse traps in water heater closet. Find mouse entry & perform exclusion. Fill holes with Stuf-Fit & seal with mortar. Remove Jimson weed. Monitor for new sprouts & remove.

Sailors Haven

Inspection Findings	Recommended Actions
Garbage House	
Construction ongoing here. Area under building flooded. Sand fill to be installed. Wood rot present. Wood moisture over 40%. Several holes in building. Metal doors hav a 2.54 cm (1 in) gap at each bottom edge. 2.54 cm (1 in) metal mesh in ceiling can't exclude rodents.	Rotted wood should be replaced & all wood treated twice with BoraCare or TimBor Pro. Fill holes in building with Stuf-Fit & back (on both sides of wood) with ¼ in. hardware cloth. Install a metal threshold to fill gap under doors. Install ¼ in. hardware cloth over all of the 2.54 cm (1 in) metal mesh in ceiling to exclude rodents. Doors must close tightly.
Sunken Forest	
Mosquito larvae in boarded cesspool along the path.	Drain the standing water. Apply mosquito dunks. Float oil (olive oil) on surface of water to deter mosquito larvae.
Exotic Invasive Plants: Japanese honeysuckle, oriental bittersweet, phragmites & spotted knapweed have been found here.	Hand pull when young. Cut at ground level & treat stumps with Glyphosate or Triclopyr.

Talisman/Barrett Beach

Inspection Findings	Recommended Actions
Concession Building	
Wood rot at ground level under south sliding window. Holes on north side & at ground level. Doorway on west side has cover board open through to outside. Storage room open & mouse droppings on floor.	Thoroughly clean this area. Replace wood and/or treat with BoraCare or TimBor Pro. Repair holes with Stuf-Fit backed by ¼ in. hardware cloth. Repair cover board. Seal all openings into storage room. Set fine-tuned Victor mouse snap traps at the floor/wall junction in storage room.
Restrooms	
Restrooms were locked – no access. Hole at northwest corner of storeroom. Moisture in inner pipe race with old mouse droppings. Water leak from faucet on east side. Mold at floor/wall junction in both outside showers. Men's restroom, middle south window is open without a screen.	Repair hole with Stuf-Fit backed with ¼ in. hardware cloth. Repair leaks. Remove mold. Treat all wood with BoraCare or TimBor Pro. Replace missing screens.
VIP House TA-155	
Inside: Old mouse droppings in broiler & behind refrigerator. Chewed hole under bathroom sink. Northeast bathroom has missing ceiling tile.	Thoroughly clean this area. Fill hole with Stuf-Fit & back with ¼ in. hardware cloth. Set fine-tuned Victor mouse traps in kitchen at the floor/wall junction & under the broiler. Check traps daily for captures & reset.
Outside: Southeast corner has holes at roof. Vegetation contacting structure. Wood rot on northeast window frame. Substantial moisture under house. Termite mud tubes & damage on piling under structure. Covered washer/dryer cabinet on porch has holes.	Repair holes. Prune vegetation back at least .91 m (3 ft) from structure. Install a 15.24 cm (6 in) deep, .91 m (3 ft) wide gravel, no-vegetation zone completely around the structure. Treat all exposed wood with BoraCare or TimBor Pro to manage WDOs. Drill &

Talisman/Barrett Beach

Inspection Findings	Recommended Actions
VIP House TA-155 (cont'd)	
	inject termite-infested pilings & beams with BoraCare or Jecta.
Superintendent's House TA-154	
Numerous mouse droppings throughout the house & evidence of chewing & other damage. Washer faucets leak. Roof shingles missing. Mold in refrigerator gaskets. Rain gutter & downspouts gone from the south side.	Thoroughly clean the entire structure. Be aware of Hantavirus exposure; disinfect all areas with droppings or urine. Wear protective measures. Search for entry points & install exclusion measures: Stuf-Fit, ¼ in. hardware cloth, metal flashing, etc. Set fine-tuned Victor snap traps & monitor daily to remove captures & reset. Repair faucet leaks. Replace shingles & rain gutters and downspouts.
Motel TA-153	
Structure(s) condemned – slated for demolition. Evidence of substantial rat and mouse population. Numerous swallows inhabiting the ruins.	Trap out rodents with fine-tuned Victor rat and mouse traps. Monitor traps daily to remove captures & reset. Demolition will force any pests present into the surrounding areas or communities.
Utility Building	
Locked – no access. Substantial water leak on east side.	Repair water leak. Monitor for pests.
Maintenance Shed TA-156	
Laboratory locked – no access. Several holes to inside accessible by pests. Mouse droppings inside & water damage & mold in ceiling. Open window. Gnawed rodent hole in north wall.	Replace window. Fill all holes with Stuf-Fit & back up with ¼ in. hardware cloth. Thoroughly clean this area. Set fine-tuned Victor mouse traps & monitor daily to remove captures & reset. Close gaps at eaves & floor vents with ¼ in. hardware cloth.
Invasive Plants	
Phragmites, garlic mustard, tree of heaven & Japanese black pine observed in the area. GPS coordinates provided to the IPM Coordinator.	Garlic mustard can be hand-pulled when young. Phragmites, tree of heaven & Japanese black pine will require cutting at ground level & the stumps treated with Glyphosate or Triclopyr. Replace removed exotic plants with desired native species.

Dune Station

Inspection Findings	Recommended Actions
Visitor Display Area	
Wood rot present on walls & inside doors. Screens on louvers deteriorated. Dermestid larvae attacking displayed Gannett. Paint peeling from walls. Mud dauber nest at ceiling.	Treat all exposed wood twice with BoraCare or TimBor Pro. Remove mud dauber nest(s). Remove old paint & repaint with quality oil-based paint. If salvageable, treat Gannett with DE & TimBor Pro dust to manage dermestid larvae. Replace screens. Monitor for crawling arthropods.

Dune Station

Inspection Findings	Recommended Actions
EMS Building	
Black widow spider with egg case & web over the door. Dead flies below web. Screens on louvers deteriorated. Dust, dirt & debris observed.	Thoroughly clean the area. Remove webs with a Webster or vacuum. Replace screens. Continue monitoring for crawling arthropods.
Men's Bath	
Screens on louvers have deteriorated. Mud dauber nests present.	Replace screens. Remove mud dauber nests. Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Women's Bath	
Screens on louvers deteriorated. Paint peeling from walls. Shower fixture leaking.	Replace screens. Remove paint & repaint with quality oil-based paint. Repair shower fixture leak. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Exotic, Invasive Plants	
Large area of phragmites between Dune Station & Watch Hill.	Pull with a weed wrench or cut at ground level; then treat stumps with Glyphosate or Triclopyr.
Storage Building #29 under Walkway	
Three live *Peromyscus* spp. Mice & nest observed in pump & pressure tank frame. Large gap under the door.	Thoroughly clean this area. Be aware of Hantavirus risk. Wear protective gear. Install a quality door sweep to door or raise threshold to close gap. Set fine-tuned Victor snap traps at the floor/wall junction & monitor daily to remove captures & reset.
Storage Building South of Building #29	
Long dead fox present & dermestid larvae feeding on the carcass. Broken window.	Remove dead fox. Thoroughly clean this area. Repair window. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Large leak under walkway below the drinking fountain.	Repair leaking pipe.

Watch Hill

Inspection Findings	Recommended Actions
Maintenance Shop/Office Complex WH-20	
Dust, dirt & debris present. Hole in wall behind north side workbench. Black widow spider & web in northeast ceiling corner.	Thoroughly clean this area. Repair hole with Stuf-Fit & ¼ in. hardware cloth. Remove spider & web with a Webster or vacuum. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
WH-20 Resource Management Office	
Mouse droppings & nut on floor by north wall. Substantial harborage (clutter).	Thoroughly clean this area. Remove or organize clutter. Set fine-tuned Victor snap traps & monitor daily to remove captures & reset. Find & exclude rodent entry points.
WH-20 Locker Room	
Lockers locked – no access. No evidence of pest activity observed.	Staff responsible for cleanliness of lockers. Continue monitoring for crawling arthropods.

Watch Hill

Inspection Findings	Recommended Actions
WH-20 Front Ranger Offices	
No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
WH-20 Restrooms	
No evidence of pest activity observed in either bath.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
WH-20 Kitchen	
Mouse droppings were abundant, especially around poorly set mouse traps & trash can. Hole in wall by wood panel. No screen on left window. Cabinets clean inside. Mouse droppings between refrigerator & the wall. General sanitation poor. Moisture on floors.	Thoroughly clean this area. Replace window screen. Fill hole in wall with Stuf-Fit & seal with ¼ in. hardware cloth. Remove or organize clutter. Monitor for crawling arthropods with Lo-Line sticky traps. Set several fine-tuned Victor snap traps for mice at the floor/wall junction & monitor daily to remove captures & reset.
WH-20 Garage	
Outside: Building in good condition. Debris under building. Many poison ivy plants present. Bales of hay or straw under the building are decomposing & may pose a fire hazard.	Remove debris under buildings with long-handled rakes. Pull poison ivy or treat with Matran2. Remove bales of hay/straw.
Inside: Small closet has holes around pipes through the wall with scattered insulation. Dust, dirt & debris in store room. Mouse droppings in southwest corner of garage. Mouse access under roll-up door & through floor boards.	Fill gaps around pipes with Stuf-Fit & seal with ¼ in. hardware cloth. Thoroughly clean this area. Set numerous fine-tuned Victor mouse snap traps at the floor/wall junction; monitor daily to remove captures & reset. Repair holes in floor boards. Install threshold to close gap under roll-up door. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Maintenance Yard	
A tree growing under the steps. Poison ivy abundant.	Remove the tree. Hand pull poison ivy (wear gloves and goggles) or treat with Matran2.
Flammable Storage Building	
Broken window. No wasp or yellow jacket nests observed. Animal tracks are present inside.	Repair window. Install Stuf-Fit, ¼ in. hardware cloth, or other exclusion material to exclude vertebrates.
Horse Barn WH-26	
Fly sticky strips captured numerous flies. Rat droppings on east side & in the tack area. Rodent activity in insulation behind saddles. Mouse activity behind refrigerator & desk in office. Insect pests observed. Substantial spilled or scattered grain & hay. Holes, cracks & crevices present.	Replace fly strips as they fill with flies or dry out. Thoroughly clean this area & remove rodent droppings. Fill holes, gaps, cracks & crevices with Stuf-Fit & seal with ¼ in. hardware cloth. Keep grain in tightly closed metal containers. Set fine-tuned Victor mouse traps in office area at floor/wall junction & monitor daily to remove captures & reset. Set fine-tuned Victor rat traps at floor/wall junction where horses can't come in contact. Monitor traps daily to remove captures & reset.

Watch Hill

Inspection Findings	Recommended Actions
Pier Fire Storage Building	
No evidence of pest activity observed.	Thoroughly clean this area. Fill all holes & cracks or crevices with Stuf-Fit & seal with ¼ in. hardware cloth. Continue to monitor for crawling arthropods with Lo-Line sticky traps & rodents with Victor snap traps.
Visitor Center	
Dust, dirt & debris present. Moisture damage by windows.	Thoroughly clean this area. Determine moisture source & seal with caulk. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Snack Bar WH-18	
To be renovated at end of season. Sanitation very poor. Dust, dirt & debris throughout, especially in cracks & crevices. Large gap under the door. Copious mouse droppings. Ice machine leaks water on floor. Multiple water leaks. Trash under equipment.	Thoroughly clean this area. Repair leaks & condensation. Install quality neoprene or rubber door sweeps on doors. Raise thresholds to close gap under doors. Find rodent entry points & repair with Stuf-Fit & ¼ in. hardware cloth. Set fine-tuned Victor mouse snap traps baited with chunky-style peanut butter at floor/wall junction on both sides of doors & every 3.05 m (10 ft) along walls. Monitor daily (early morning) to remove captures & reset.
Office: Dust, dirt & debris present. Dirt behind freezer.	Thoroughly clean this area. Continue to monitor for crawling arthropods with Lo-Line sticky traps.
Bath: Dust, dirt & debris present, especially under the sink.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Gift Shop	
Dust & dirt present. No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Restrooms	
Several spider webs & captured insects. Dust, dirt & grime present. No other evidence of pest activity observed.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Continue monitoring with Lo-Line sticky traps.
EMS Station	
Dust & dirt present. No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Dockmaster’s Station	
Clutter, dust & dirt present. No evidence of pest activity observed.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps. Remove or organize clutter.
Concessionaire’s Office	
Pest access through double doors. Wood rot in northwest corner. Paint peeling on walls. Dust & dirt present.	Thoroughly clean this area. Install quality door sweeps on double doors & weather stripping on inner faces. Treat wood rot area with BoraCare or TimBor Pro or replace wood. Remove peeling paint & repaint with quality oil-based paint.

Watch Hill

Inspection Findings	Recommended Actions
Staff Laundry Building	
Laundry Room: Spider webs. Rodent access under doors. Dust, dirt, Lint & general disarray. Tank Room: Spider webs & captured insects. Mouse droppings observed.	Staff must clean up after themselves when using the laundry. Remove spider webs with a Webster or vacuum. Thoroughly clean this area. Install quality door sweeps on doors & raise the threshold to reduce gaps. Fill holes with Stuf-Fit & seal with ¼ in. hardware cloth. Set fine-tuned Victor mouse snap traps at the floor/wall junction & monitor daily to remove captures & reset.
Staff Housing WH-1	
Occupied. Clean. Leaky faucet in kitchen. Hole around stove pipe outside. Carpenter bees present (no nest holes observed) around eaves.	Repair leaky faucet. Fill gap around stove pipe with Stuf-Fit & seal with heat-resistant caulk.
Staff Housing WH-2	
Occupied. Substantial clutter in bedrooms. Dust, dirt & grime in kitchen. Wood rot observed outside on upper deck.	Remove or organize clutter. Thoroughly clean this area. Treat wood deck wood rot with BoraCare or TimBor Pro (twice), & then paint with waterproofing polyurethane.
Fire Storage Building by WH-2	
Locked – no access. West side plank wide open. Numerous holes.	Repair siding. Fill holes with Stuf-Fit & seal with ¼ in. hardware cloth. Treat wood siding with BoraCare or TimBor Pro.
Staff Housing WH-3	
Occupied. Ants in kitchen. Grime on stove top & under stove top. Leaky faucet in bath. Dead insects behind dresser. Vent open to outside. Moisture damage to ceiling tiles in laundry. Mouse & rat droppings in attic. Moss & extensive wood rot on back deck. Beam under deck has substantial wood rot. Wood rot in bench on front deck seat. Holes in front wood siding. Insect harborage under plywood on east side. Old mud dauber nest under east eaves. Gap under roof. Mouse droppings in sheds. Clutter present.	Thoroughly clean this area. Search & find rodent pest access into structure; fill holes with Stuf-Fit & seal with ¼ in. hardware cloth. Determine moisture leaks & repair. Remove mud dauber nests. Replace damaged wood & beams. Treat all wood twice with BoraCare or TimBor Pro; then paint with polyurethane. Set fine-tuned Victor mouse snap traps at floor/wall junction & monitor daily to remove captures & rreset. Remove or organize clutter.
Staff Housing WH-4	
Unoccupied. Water damage on front wall & at bottom of door. Mold beside stove. Dead insects behind stove. Old food under range top. Dust bunnies under bed. Outside: Bird nest above middle window. Wood rot in beam above northeast piling. Old evidence of eastern subterranean termites on piling. Wood borer damage to pilings. Carpenter bee nest in fascia.	Thoroughly clean this area. Determine source of water leak & repair. Clean stove. Remove bird nest. Treat all exposed wood siding, beams & pilings with BoraCare or TimBor Pro to protect from WDOs. Treat carpenter bee galleries with DE or TimBor Pro. Find rodent access & fill holes with Stuf-Fit. Seal with ¼ in. hardware cloth. Continue monitoring for crawling arthropods with Lo-Line sticky traps.

Watch Hill

Inspection Findings	Recommended Actions
Staff Housing WH-5	
Occupied. Clean. Leaky faucet in kitchen, outside pipes & outdoor shower. Mold in refrigerator gaskets. Door framing missing with gaps to outside. Roof leak in the living room & bathroom. Screen missing in bathroom window. West window in front bedroom & east side window by front door need screens. There is a gap over the back screen door to outside.	Repair all faucets & leaky pipes. Remove mold. Repair roof leaks. Install door frame to inside front door. Replace window screens. Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Staff Housing WH-6	
Occupied. Stove has food residues on top & under range top. Mold in top refrigerator gaskets & freezer. Several spider webs. Mold in both showers./ Substantial clutter in south bedroom./ Outside: Carpenter bees flying. Tree limbs contacting structure. Old termite tube along beam under north side.	Thoroughly clean this area. Remove or organize clutter. Remove webs with a Webster or vacuum. Prune tree limbs at least .91 m (3 ft) from the structure. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Staff Housing WH-7	
Unoccupied. Evidence of water damage. Water heater closet open to the ground. Holes in chimney open to outside. Moisture damage to floor. Mouse droppings on stove & under kitchen sink. Gap under sink open to outside. Mouse droppings in shower. Old mouse droppings in the bath, the southeast bedroom, the closet & on shelves. Outside: Low areas filled with water with mosquito larvae. Old mud dauber nest under eave. Warped paneling & loose sheeting.	Thoroughly clean this area. Find & seal all gaps or openings from the outside to inside. Fill holes with Stuf-Fit & seal with ¼ in. hardware cloth. Fill water-filled low spots with soil & reseed. Remove mud dauber nest. Fasten warped panel & loose sheeting to prevent pest access. Continue monitoring for crawling arthropods with Lo-Line sticky traps.
Staff Housing WH-8	
Occupied Year Around. Clean. Dust behind washer & dryer. No evidence of pest activity observed. Carpenter bees seen flying & nests found.	Thoroughly clean this area. Continue monitoring for crawling arthropods with Lo-Line sticky traps. Treat bee galleries with DE or TimBor Pro dust.
Staff Housing WH-9	
Unoccupied. Water damage to ceiling. Fine frass on floor from WDOs. Mold on refrigerator gaskets. Stove has old food residue on range top. Hole to outside by back door. Mouse trap with captured remains & dead insects present. Outside: Swallow nest above light. Carpenter bees flying (no nests observed). Vine growing between corner planks. Front door frame has gap. Storm windows missing. Gaps around pipes that enter underside of floor.	Thoroughly clean this area. Find water leaks & repair. Remove swallow nest after young fly. Repair front door frame. Remove vine & repair planks. Replace missing storm windows. Fill gaps around pipes with Stuf-Fit & seal with caulk or ¼ in. hardware cloth.

Watch Hill

Inspection Findings	Recommended Actions
Staff Housing WH-10	
Many spider webs. Living room window screen held by duct tape. Flies on floor by window. Water heater pipes have gaps. Large gnawed hole beside closet. Mold in refrigerator, freezer & on outside gaskets. Moisture under sink. Ants on kitchen island counter. Fascia not flush with soffits. Southwest bedroom door has large gap. Bathroom sink has gap around pipe through wall. Large gap between windows in southeast bedroom. Water damage on east wall at floor/wall junction. Outside: Lower door has gap at bottom. Screen missing from upper outside door. Wood rot on lower south fascia. The northeast corner fascia open on the end. Wood rot on southeast vertical corner board. Wood rot at base of support beams at west end of deck under house. Moss on deck. Bull thistle in front lawn.	Thoroughly clean this area. Remove webs with a Webster or vacuum. Replace broken screens. Fill gaps around pipes with Stuf-Fit & seal with caulk or ¼ in. hardware cloth. Repair holes. Repair loose or damaged fascia or other wood members. Find water leaks & repair. Install quality door sweeps to eliminate gaps under doors. Replace rot damaged wood or treat with BoraCare or TimBor Pro. Hand pull the bull thistle before seed forms.
Staff Housing WH-11	
Occupied. Large hole in west wall at floor/wall junction in southwest bedroom. Southeast bedroom locked. Screens missing from windows. Water damage & mold in northwest corner. Mouse droppings on bottom shelves of hallway closet. Wood rot on wall at floor/wall junction. Gaps around pipes under kitchen sink. Kitchen stove has old food residue under range top. Fireplace damper is missing. Outside: South fascia board with wood rot. Carpenter bees & 8 active galleries in south side fascia. Greenbrier vine growing up beneath the siding. Large hole above window on west side. Chimney separating from building. Wood rot in piling at ground level on northwest corner. Water leak at valve under house. Substantial poison ivy growing around the house.	Thoroughly clean this area. Find & fill all holes & gaps around pipes with Stuf-Fit & seal with ¼ in. hardware cloth or caulk. Replace all missing window screens. Find all water leaks or moisture damage & provide repairs. Wood beams, siding or planks with wood rot can be replaced and/or treated with BoraCare or TimBor Pro. Carpenter bee galleries can be treated with DE or TimBor Pro dust. Determine gaps that provide rodent access; fill with Stuf-Fit & seal with ¼ in. hardware cloth. Follow ant trails inside to locate entry points. Clean trails with soapy water to remove pheromones. Seal holes with caulk. An effective ant bait is “Drax Liquidator.”
Staff Housing WH-12	
Dead flies on floor. Mold in south refrigerator. Water damage at floor/wall junction on east wall. Gaps around pipes through east wall. Window screens broken or missing. Stove range top has mouse droppings. Northeast bedroom closet has mouse droppings. Rodent access under bottom of boarded-up south door. Water heater closet holes to outside. Mouse nest behind water heater. East bath has pipe gaps through north wall & a hole open to below. West bath has dead flies & mouse droppings behind toilet & under sink. West middle bedroom has mouse droppings behind dresser.	Thoroughly clean this area. Determine areas of moisture leaks & perform repairs. Replace all damaged or missing window screens. Find all holes or gaps that allow pest entry, fill with Stuf-Fit & seal with ¼ in. hardware cloth or caulk. Set fine-tuned Victor mouse snap traps at floor/wall junction & monitor daily to remove captures & reset. Fill low areas with soil to eliminate standing water. Replace wood rot damaged wood beams, siding or fascia, or treat with BoraCare or TimBor Pro.

Watch Hill

Inspection Findings	Recommended Actions
Staff Housing WH-12 (cont'd)	
Outside: Substantial standing water around & under house. A gap left of front door. Several 2 x 6 beams damaged by wood rot under deck. Windows are missing outside. Sills open to inner wall. Lots of phragmites growing hear the house.	

APPENDIX II

Pest Profiles

MUSEUM PESTS

CLOTHES MOTH (*Tineola bissolliella)*



Webbing Clothes Moth

Webbing clothes moth adults are yellowish or golden colored, 1.27 cm (1/2 in) long or less, with narrow wings of about 1.27 cm (1/2 in) wingspan, and are distinguished by a tuft of fluffy, fine bronze to reddish-gold colored hairs (pompadour) on a bronze head. The wings do not have spots. Adults do not feed, but they fly to find food materials on which they lay 40 to 150 eggs, which hatch in seven to ten days. Clothing moth larvae are about 1.27 cm (1/2 in) long, light cream-colored, with a dark brown head. The larvae do not form a protective case around themselves.

Biology

The life cycle ranges from two to six months, depending upon environmental conditions. Although the adult moths are weak flyers, they are known to move over 91 m (300 ft) in distance. The males fly to find and mate with females, who generally remain in dark and dimly lit areas. Females produce eggs that are glued to potential food materials in closets or other sites where clothes or other natural fiber or animal pelts may be stored. From two to four generations per year are possible in warm, heated areas.

CASEMAKING MOTH (*Tinea pellionella)*

Adults are small; light brown to tan colored moths with a wing span of about 1.27 cm (1/2 in) The front wings have three dark spots and both wings have trailing edges of soft fringe. Larvae are about .94 cm (3/8 in) long and form a slightly smaller protective case (about .79 cm [5/16 in] long) around them which is made from the same material as that which they eat. They carry the case with them while feeding. Casemaking moths are general feeders on dried animal and plant proteins, dead insects and nests, animal carcasses, feathers, hair, etc.

Biology

Although adult moths prefer relatively dry conditions, 75% humidity is the most favorable condition for development of larvae. This moth prefers darkness and seeks out folds of fabric or secluded places to hide when disturbed. Rug lint and hair accumulations behind baseboards or in heating units are favored hiding places. The life cycle is about three to four months with one to two generations per year.



Casemaking Moth

DAMAGE

Clothes moths and casemaking moth adults do not feed but tend to remain close to the materials on which they developed. The adults are very attracted to and lay eggs on soiled materials of vegetable origin. The larvae are general feeders on hair, wool, fur, feathers, upholstered furnishings, piano felts and insect specimens. During feeding, the larvae leave distinctive silken trails on materials and produce round fecal pellets colored like the material being eaten. Any visual evidence of moths usually indicates a major infestation.

INDIAN MEAL MOTH (*Plodia interpuntella* [Hbn.])

The Indian meal moth is a major insect pest in this country. Some of its reputation comes from its increasing resistance to pesticides. The Indian meal moth is a small colorful moth about .84 cm (1/3 in) long with a brown head and thorax. The wing base is gray with the rest copper-colored with dark bands. Larvae are caterpillar-like, about 1.27 cm (1/2 in) long and cream colored with a brown head. Only a few larvae indicate an infestation. As the larvae grow they spin silken strands of webbing contaminated with excrement over the food source. Sticky traps containing attractive odors or pheromones are available to monitor the presence of adults. Indian meal moths can infest cereals and starch-containing products, such as crackers, cake mixes, pasta, dog food, and rodent bait. They are particularly attracted to nut meats, powdered milk, a number of spices, and dried fruits.



Indian Meal Moth



Indian Meal Moth Larvae

Careful inspection of incoming or purchased goods in the quarantine area is crucial for early detection. Management depends on finding and destroying the infested items. Sticky monitoring traps can be used in a grid pattern to determine the location of the infestation. Other techniques include increased sanitation, treatment of cracks, and crevices with pesticides or heat treatment.

SAW-TOOTHED GRAIN BEETLE (*Oryzaephilus surinamensis [L.])*

The saw-toothed grain beetle is another major stored-product pest in the United States. This is a tiny, slender, dark-brown beetle that measures .25 cm (1/10 in) long. It has three ridges on the top and six fine teeth on either side of the thorax. The larvae are about the diameter of a human hair, have three pair of true legs, rest in a C shape, and resemble the larvae of the Indian meal moth.

Biology

Optimum temperature for development is 30 - 35ºC (86 – 95ºF) with fastest development in higher humidity. Saw-toothed grain beetles, however, can survive in cooler temperatures less than 16ºC (60ºF) and withstand cold winters which increase their time of life cycle and time for hatching. The larval period is 12 to 20 days, depending on temperature, nutrition and moisture. The adult's life span ranges up to three years with new generations produced every 30 days. As each female produces around 350 eggs, populations build quickly.



Saw-Toothed Grain Beetle

Damage

Saw-toothed grain beetles are best adapted to infest a wide variety of stored products containing food materials, such as cereal products (dried grain, flour, corn and corn products, hand soap containing corn or oatmeal, spices, herbs, etc.). Adults are imported in infested packages. Saw-toothed grain beetles are scavengers that readily penetrate and feed on the same materials as do Indian meal moths. They can be numerous and destroy a large amount of food or other organic material. Infestations that begin on grains may move throughout a structure to feed on any grain or starch-based material. Pesticides are usually unnecessary when infested materials can be found and discarded and cracks and crevices thoroughly cleaned.

WAREHOUSE BEETLES *Trogoderma variabile*

Adult warehouse beetles are brownish-black, about .30 cm (1/8 in) long and can fly. The larvae range up to .64 cm (1/4 in) long and vary from yellow-white to dark brown in color, depending in age.



Warehouse Beetles & Larvae

Biology

Eggs laid by the female become adults in about a month.

Damage

Warehouse beetles are one of the more voracious feeders and most important pests in museums. These pests infest not only fabrics but also a wide variety of stored products. They feed on seeds of all kinds, dead animals, candy, dog food, dead insects, milk products, starches, stored cereal products, dried grain, insect collections, hides and skins. If food is scarce, some will cannibalize one another or feed on their own cast skins, and can survive for an extended time without any food.

RICE WEEVILS (*Sitophilus oryza [L])* AND GRANARY WEEVILS (*Sitophilus granarius [L])*

Rice weevils and granary weevils are two similar-appearing snout beetles found and transported in whole-grain products throughout the United States.



Rice Weevil



Granary Weevil

Adult beetles have long snouts with jaws at the tip; females use their jaws to drill holes into whole grains, where they deposit eggs. Larvae eat the interior of the seed during growth, pupate, and emerge as adults to renew the cycle. Rice weevils fly, but granary weevils do not. Although these two weevils are more common in granaries and mills than in urban structures, they sometimes infest a wide variety of cereal grains and seeds, including popcorn, puffed wheat, corn and other stored seeds. The presence of adults requires that all stored products be checked and that infested ones be discarded.

CIGARETTE BEETLE (*Lasioderma serricorne [F]*) AND DRUGSTORE BEETLE (*Stegobium paniceum [L]*)

THE CIGARETTE BEETLE is .25 cm (1/10 in) long, reddish-yellow to brownish-red beetle with a stout, oval shape and may be confused with the drugstore beetle. The head of the cigarette beetle is hidden by the thorax in dorsal view and the beetle has a hump-backed appearance when viewed from the side.



Cigarette Beetle

The .51 cm (1/5 in) long cigarette beetle larvae are dirty-white, hairy and have yellow-brown markings on the head capsule.

Biology

The cigarette beetle's life cycle usually takes about 90 days, depending on environmental conditions. Females lay up to 100 eggs. The larvae cannot develop below 18ºC (64ºF), nor survive in less than 35% humidity. Major swarming of adults occurs May and August. The larvae are photophobic and tunnel through materials to create a chamber from bits of food materials in which they pupate. Adults only live from two to six weeks but are strong flyers and are attracted to light.

Damage

Both the larvae and adults attack a wider range of products than other stored-food pests. They are primarily found in tobacco, spices, beans, books, drugs, wood (feeds on both hard and soft woods), paper, cellulose textiles, baskets, herbarium specimens, some upholstered furniture, grain-based rodent bait and cloth materials such as silk.



Drugstore & Cigarette Beetles

THE DRUGSTORE BEETLE is .25 cm (1/10 in) long, uniform light brown beetle that resembles the cigarette beetle. Drugstore beetles are slightly larger, more elongated, have striated wing covers, appear hump-backed, and have three segmented and clubbed antennae. Adults are covered with fine, silky hair. The larvae also resemble the larvae of the Cigarette Beetle and are white with a brown head capsule, but are much less hairy than the Cigarette Beetle larvae.

Biology

The life cycle of the drugstore beetle ranges up to seven months, depending upon environmental conditions. Adults lay eggs on a food source that hatch in two to three weeks, and the larval stage lasts up to five months. Up to four generations per year may be produced. Adults are often not seen in infested materials because they hold their legs and antennae close to their body when at rest.

Damage

The drugstore beetle will eat almost anything ranging from paper, fabrics, books, grain, flour, seeds, baskets, wooden objects, structural building supports, spices, leather, hair, wool, mummies, dry pharmaceuticals, medicinals, poisons, vegetable matter, etc., and will penetrate and damage sheet aluminum foil, tin and lead.

RED (*Tribolium castaneum [Hbst.])* AND CONFUSED (*Tribolium confusum [Duval])* FLOUR BEETLES

These insects are .30 cm (1/8 in) long, reddish-brown in color, and have short, stout antennae. Larvae are only slightly longer than adults, cream-colored, and with few hairs. They infest packaged and milled cereals such as flour, cornmeal, and cake mixes. Bulk flour may remain stored long enough to allow eggs or larvae, that were not killed during milling and packaging, to develop.



Red Flour Beetle

These very similar beetles can be distinguished by their antennae. The red flour beetle has the three end antennal segment abruptly widening. The confused flour beetle has gradually broadening antennal segments at the end.

Biology

The confused flour beetle, in cooler climates, is usually restricted to warmer sites. Adults cannot fly and may live up to three years during which time they produce about 500 eggs.

The red flour beetle adults are strong flyers and infestations may come from grain storage or food manufacturing nearby.



Confused Flour Beetles

Damage

The confused flour beetle is principally a secondary pest of stored cereals, flour, spices, etc., but also infests museum specimens.

The red flour beetle favors flour and processed grain, especially that damaged by weevils and grain borers.

The presence of these pests enhances mold development and imparts disagreeable tastes and odor to flour. They also feed on shelled nuts, dried fruits and milk chocolate. Management requires that the source of infestation be discarded or sanitized and the storage area thoroughly cleaned. This should be done in a quarantine receiving area.

DERMESTID BEETLES (Carpet Beetles)

There are a many different kinds of carpet beetles in the United States, and all have greatly varying life cycles and habits. Therefore, it is best to request pest identification by an insect specialist before considering management. In nature carpet beetles are scavengers that infest bird, mouse, rodent, tent caterpillar, old bee or wasp nests, and spider webs. In general, adult carpet beetles are broadly oval in shape, .15 – .3 cm (1/16 – 1/8 in) long, and calico, brown, or grayish in color. The round shape and mottled color distinguishes fabric beetles from such other stored-product pests as flour and grain beetles. Female carpet beetles lay up to 100 eggs, which hatch in about two weeks. Carpet beetle larvae are brownish or yellowish, about .64 – 1.27 cm (1/4 – 1/2 in) long, with slender bodies that taper towards a tail bearing tufts of hair on the upper surface. The larvae are covered with fine barbed hairs (an effective protection against insect predators). Larvae are generally found on products of animal origin. Adults are attracted to the light at windows. Below are examples of several pests of fabrics, furs and animal origin products.



Black Carpet Beetle
Attagenus megatoma



Dermestid Larvae



Varied Carpet Beetle
Anthrenus verbasci



Varied Carpet Beetle Larvae



Furniture Beetle Larvae



Hide Beetle
Dermestes frischi



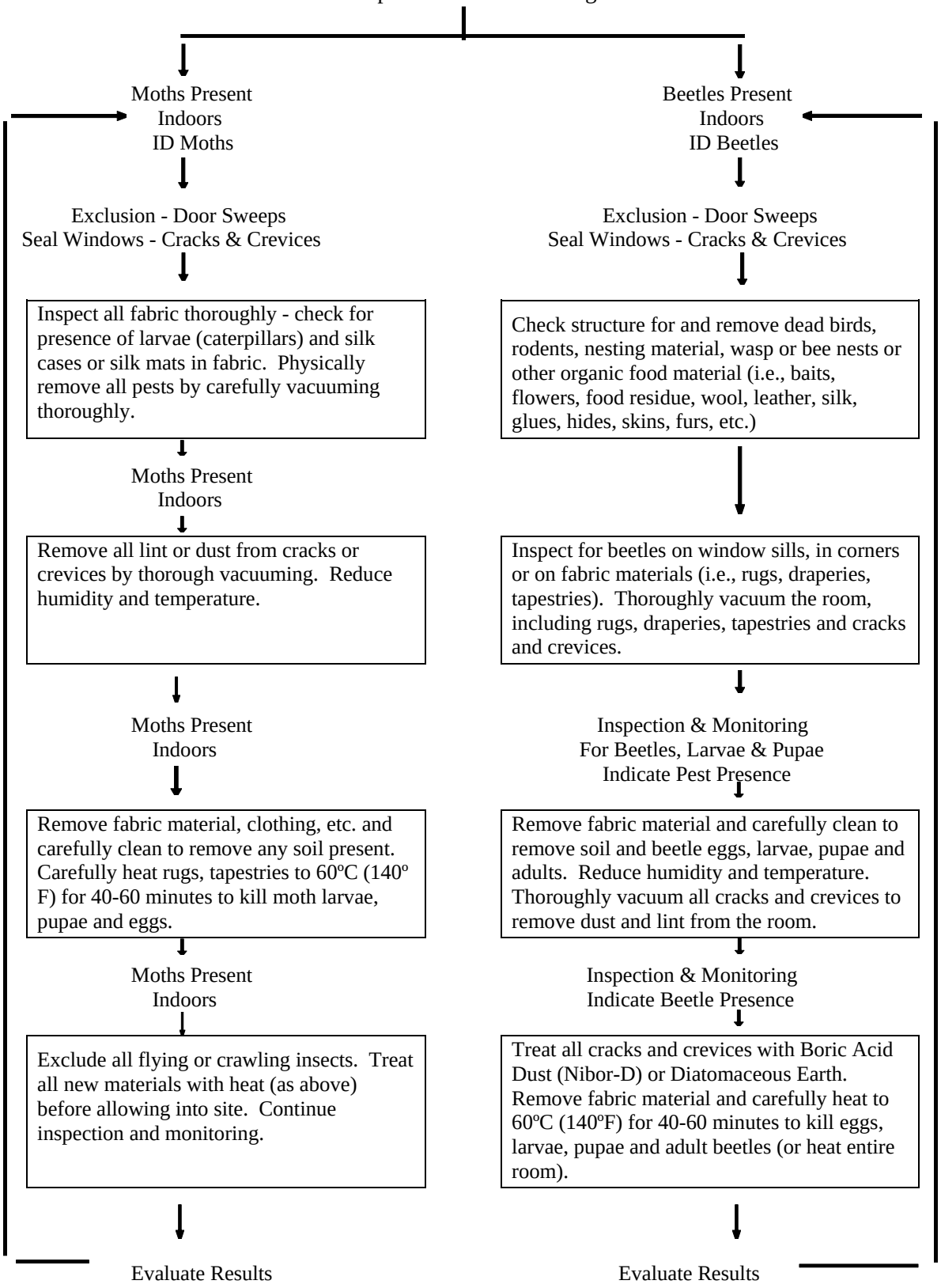
Spider Beetles
Mezium americanum (laporte)



Larder Beetle
Dermestes lardarius L.

MUSEUM PESTS

Inspection and Monitoring



PSOCIDS - BOOKLICE (Worldwide)

Booklice: *(Liposcelis corrodons)* but also many other species. Cosmopolitan distribution.

Description: Psocids or Booklice are small (.1 - .3 cm [1/25 – 1/8 in] long), opaque to white in color, soft-bodied insects with four wings, or only wing buds in adults.



Psocids

Biology: Outdoors, booklice live under tree bark and feed on fungi; they lay eggs during fall and spring. Indoors, booklice feed on mold and mildew and under proper conditions breeding and development can continue indefinitely. Booklice are most commonly found in dark cracks and crevices. Females of at least one species can reproduce parthenogenetically and produce from 120 to 450 eggs per season in clutches that average about 20 to 50 eggs each, depending on temperature conditions. The insects can over winter in the egg stage. After eggs hatch through gradual metamorphosis, booklice attain maturity in around one to two months and can live up to three months. Moist conditions enhance growth and longevity and booklice are most common in structures during spring and summer. Large populations can suddenly appear under high humidity or moisture conditions. Psocids may also be found in bird or mammal nests, moist grain or other starchy plant material.



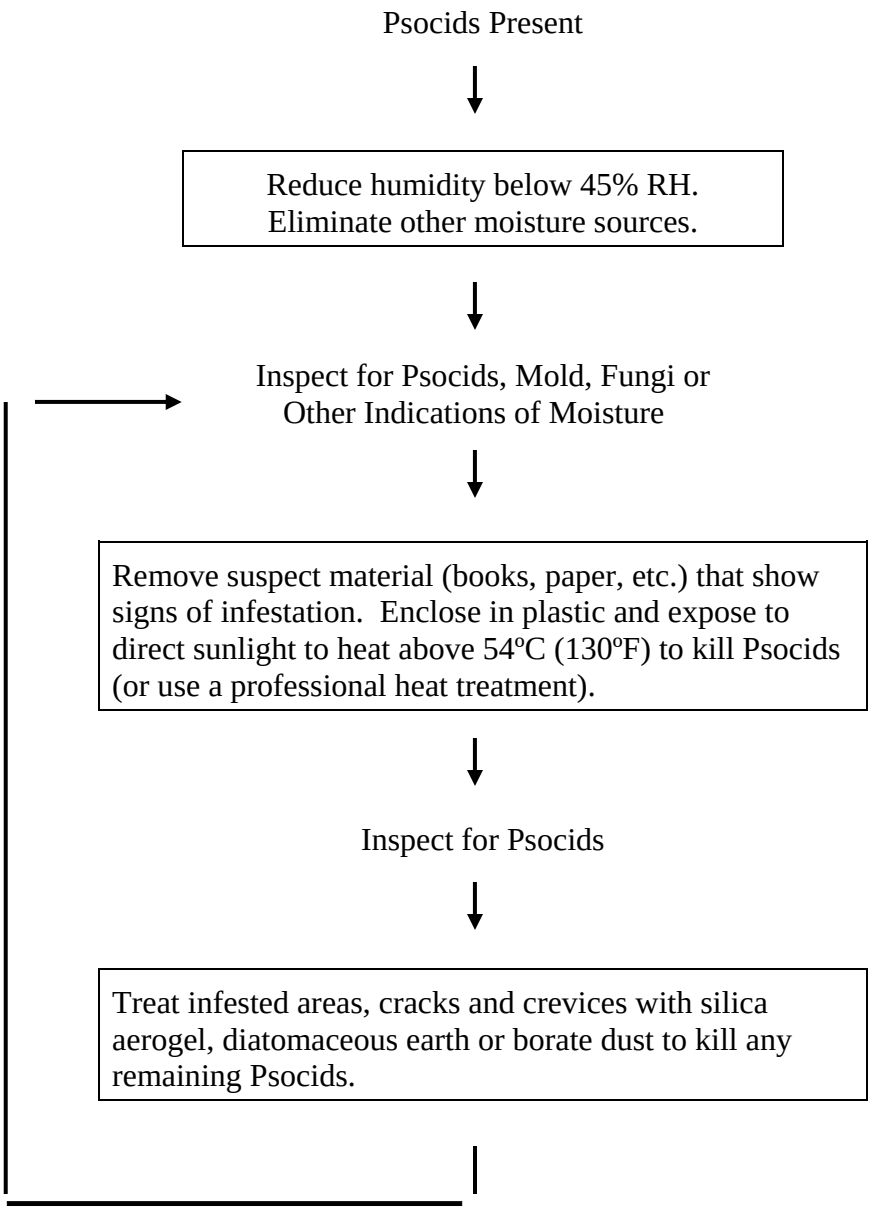
Winged Psocid

Damage: Booklice damage paper products, bindings and eat paste, glue or anything supporting mildew. Psocids generally feed upon microscopic molds. They often infest damp, moldy books, feeding on both the mold and starch in glues. They also will infest dried plants in herbaria, insect collections, and furniture stuffed with flax, hemp, jute or Spanish moss. The presence of booklice is an indicator of moisture problems.

Monitoring: Sticky traps may not be attractive to Psocids except in large populations. Direct observation of susceptible materials may be necessary. The presence of mold, fungi or other indications of high humidity or moisture are clues to conditions favorable to psocids. If mold is present, look for psocids!

Management Action: Psocids are best managed by reducing the humidity below 45%. This may take some time, but eventually all psocids will desiccate and die. Removing other moisture sources will also help. For infested books or other materials, placing them in a clear plastic bag and exposing them to direct sunlight to heat the interior about 54ºC (130ºF) will kill localized infestations. Diatomaceous earth, silica aerogel or borate dusts will manage psocids.

PSOCIDS - BOOKLICE



SILVERFISH AND FIREBRATS (Worldwide)



Silverfish

Silverfish (*Lepisma saccharina L),* are wingless, flat and carrot-shaped insects, about 1.27 cm (1/2 in) long, and covered with a sheen of silvery scales. They have two long antennae and possess three long, slender filaments that project rearward from the abdomen. Silverfish prefer temperatures between 21 - 27ºC (70 – 81 ºF), and high humidity. Adults may live from two to eight years, and can survive as long as a year without food. Silverfish feed on starches like flour, glue, paste, and textile and paper sizing, but they can also digest cellulose.

Silverfish populations build up around materials upon which they feed, such as corrugated cardboard boxes in damp basements, and on insulation, glue, and stored books. Silverfish lay eggs in cracks over an extended period of time, which hatch in about 30 days. Immatures reach maturity in three to four months. Their feeding leaves irregular, yellow-stained holes in textiles and paper, damaged surfaces on corrugated cardboard, and irregular chewed areas on cloth-bound books. Damaged materials often have dark fungus growing on them supported by humidity and insect fecal pellets. Large populations of silverfish spread into other humid areas within the building from basements and wall voids penetrated by pipe ducts and electrical conduits.



Firebrat

Firebrats (*Thermobia domestica [Packard])* are similar insects but not silver-colored, rather mottled dark gray and dull yellow. Their size, shape, and appendages very much resemble silverfish, but firebrats prefer decidedly higher temperatures and surroundings, to 32ºC (90ºF) or above. Firebrats are commonly found in furnace rooms, steam-pipe tunnels, hot bathrooms, and partition walls of water-heater rooms. The firebrat female lays one to three batches of average 50 eggs per batch depositing them in cracks. It takes two to four months from egg to adult under optimum conditions (32 - 38ºC [90 – 100ºF] with 76 – 85% relative humidity). Firebrats feed on carbohydrates and proteins such as bond paper, linen, cotton, silk, dried beef, etc.

HAZARDS OF INFESTATION

Silverfish and firebrats are destructive to books, paper, fabrics, and may contaminate foods. These insects are often found in libraries, book shelves and areas where old books and papers are stored.

INSPECTION AND MONITORING

In a quarantine area, thoroughly inspect incoming goods, furniture, books and other materials for the presence of silverfish or firebrats. Remove or treat any items that are infested.

Conduct a thorough inspection for the presence of pests, moisture, food sources, clutter, cracks, crevices and other openings. Inspect water heater closets, utility rooms and areas of high humidity and temperature. Bookcases and books are especially attractive to these pests.

MANAGEMENT

Exclusion

For pests the size of silverfish or firebrats to be excluded, use caulk, Stuf-Fit, oakum, weather stripping, door sweeps, screens and other repair approaches. Once done, excluding silverfish and firebrats is usually passive and permanent.

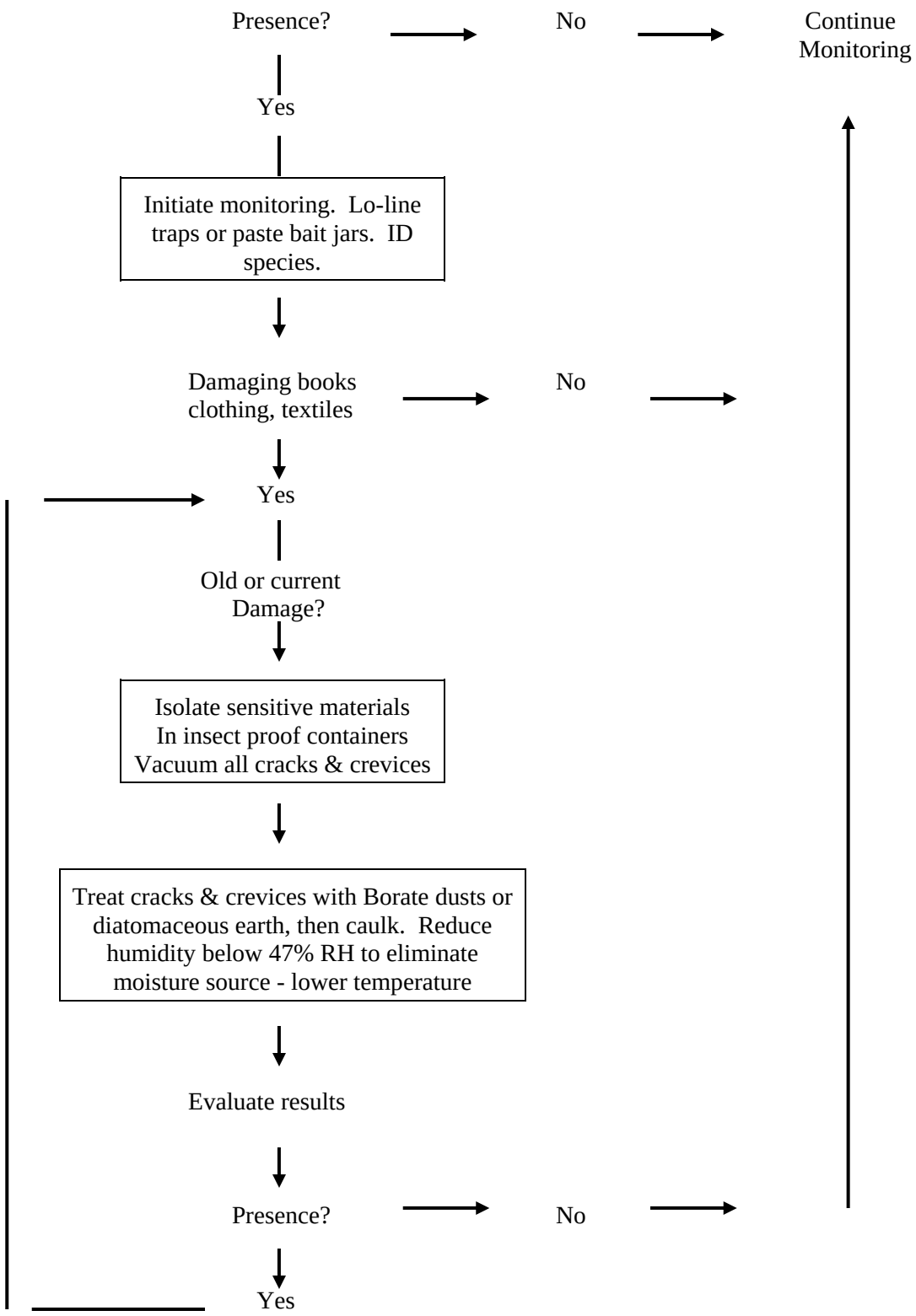
Sanitation

It doesn't take much organic material to feed silverfish or firebrats. Water in any form, condensation, leaks or moisture in potted plants, etc., should be eliminated. Silverfish and firebrats like to be in an area where they feel safe – in between things. Clutter that builds up in corners, on cabinets, shelves or on the floor becomes harborage for firebrats, silverfish that can attack and ruin irreplaceable historic artifacts. Sanitation is active and must be conducted on a daily basis.

Habitat modification

Eliminate food, water and shelter. Other means are raising or lowering temperatures or reducing humidity to levels intolerable by pests, and increasing lighting. Habitat modification is relatively passive and semi-permanent.

SILVERFISH AND FIREBRATS



ASIAN LADY BEETLE *Harmonia axyridis* (Pallas)

The Asian lady beetle, *Harmonia axyridis* (Pallas) was introduced into the United States between 1910 and 1970 unsuccessfully (no survival). After years without a sighting, the beetle was seen in Louisiana in 1988, apparently from an accidental introduction in a freighter from Asia to New Orleans. Since that time, the Asian lady beetle has spread throughout the northeast from Florida to Quebec, and west to Missouri and Texas. It has also been reported in Colorado, Oregon, Washington, and British Columbia, Canada.



Asian Lady Beetles

The Asian lady beetle is a voracious feeder on aphids, scale and other soft-bodied insect pests. Both the adult and larval forms of the beetle are predators on soft-bodied prey. In its native habitat (most of Asia), it tends to overwinter in larger congregations in white cliffs, cracks, crevices and other voids. Here in the United States, the Asian lady beetle tends to aggregate in large numbers in homes, structures and other human-constructed or occupied sites. When they overwinter in a historic structure which contains valuable artifacts, their presence may pose a hazard. Large numbers of beetles in structures over a harsh winter causes a number of the beetles to die. It could be a few or many. The dead beetles can become a food source for dermestid beetle larvae. Dermestid beetle larvae or adults in a historic site may become a major threat for organic material in the collection, including furs, woolens, sinew, cotton, silk or other material on display.



Dead Harmonia & Dermestid Larvae

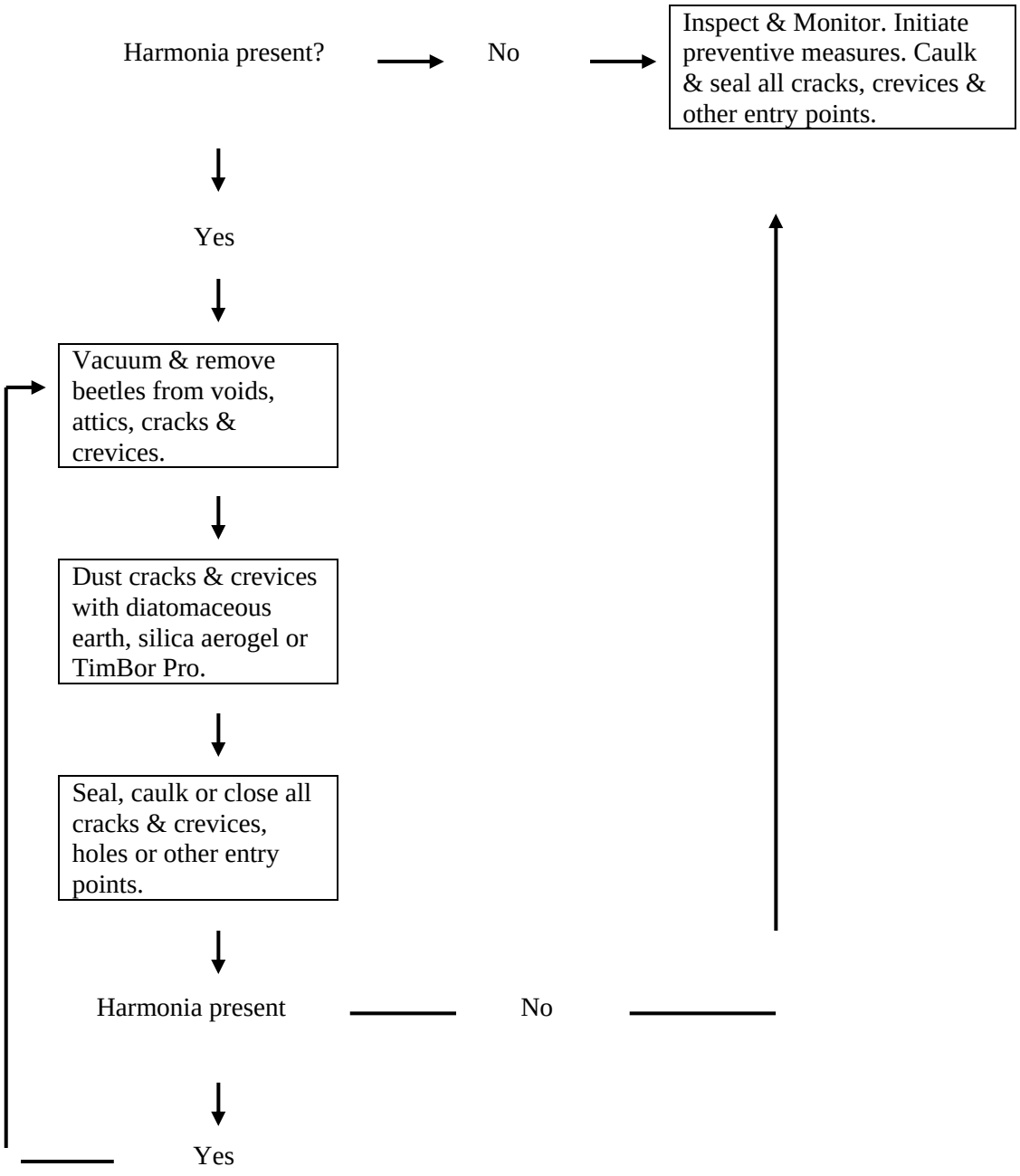
The first line of defense against the beetle is to fill all cracks, crevices, holes or other entry points into the structure. A hole as small as .53 cm (7/32 in) wide can allow beetle access to the inside of the structure.

The second line of defense is sanitation. The beetles like to use clutter in which to overwinter. Elimination of clutter will reduce the areas where the overwintering beetles congregate.

The third means of managing the beetles once they are in the structure is to use a vacuum to remove them in large numbers. Black light (ultraviolet) traps with a sticky glue board to collect the beetles attracted to the light are also useful. The traps should be checked periodically and the glue boards replaced when full.

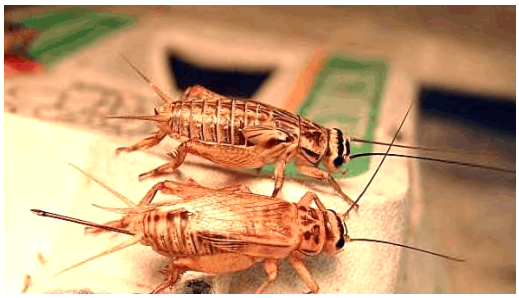
Vacuum the joists, beams and other accessible voids in the attics each spring and late fall.

ASIAN LADY BEETLE CHART



HOUSE CRICKET *(Acheta domesticus [Linnaeus])* (Worldwide)

House cricket adults are 1.91 – 2.54 cm (3/4 – 1 in) long and have a light-colored head marked with three dark cross bands, yellowish-brown to straw-colored body, long and thin antennae, and heavy mandibles. House crickets fly but also have large rear jumping legs like a grasshopper. Crickets are nocturnal insects that enter structures in spring or before winter. They are attracted to shelter, light, moisture, and warmth. House crickets are mainly attracted to warm areas around stoves, fireplaces, and furnaces, but they can also be found throughout the structure.



Nymph & Adult House Crickets

Incessant nocturnal chirping by the male makes this a nuisance pest. Outside, house crickets live in compost piles, debris, and garbage dumps. Usually there is one generation per year. Eggs laid in sandy soil during fall hatch in late spring. Nymphs often enter structures under doors or through cracks and voids and complete their life cycle indoors, where they develop all year and lay eggs in cracks. Nymphs mature in mid- to late-summer.

Outside, house crickets feed on plants and other insects. Inside, their diet is more diverse: they feed in early evening on bread crumbs, fruits, vegetables, liquids, paper (such as soiled news-print), clothing, rubber, silk, wool, linen, rayon, fur, feathers, meat and meat products, dead insects, and leather. House crickets contaminate food by walking over it.

INSPECTION AND MONITORING

Outside: Inspect for the presence of house crickets near the structure. Also check for moisture near the building, and for organic material (mulch, leaves, etc.) that provides harborage and food. Look for cracks, crevices and other openings (drains, pipes, vents) into the structure that provide entry for house crickets.

Inside: Conduct an inspection for the presence of moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where house crickets may occur.

FIELD CRICKETS *(Gryllus spp.)* (North America)



Field Cricket

Field crickets are common pests attracted indoors by light; however, once inside, they die before early winter because they cannot adapt to indoor conditions. Adults are 1.27 – 2.54 cm (1/2 to 1 in) long and look very similar to house crickets, except that field crickets are usually black to dark brown in color, and have brown wings, a shiny head, and antennae much longer than the body. Males have two spear-like appendages at the tip of the abdomen. Females have three similar appendages.

The field cricket also flies and jumps. In northern parts of the United States, eggs deposited in the ground are the overwintering stage for most field crickets. The small remainder pass the winter as half-grown nymphs under leaves, trash, and debris. There is only one generation per year. Females lay 150 to 400 eggs about .64 – 2.54 cm (1/4 – 1 in) deep in the soil in late August to September. Eggs hatch in May to June and nymphs develop in nine to 15 weeks. Adults are only found outside from late July until the first hard freeze. Field crickets migrate into structures during fall, when populations are large, or as vegetation dries up.

Indoors, field crickets are attracted to such warm, dark areas as water-heater closets and large appliances. They are usually found in basements and ground-floor levels where they feed on human food, debris, and clothing. Field crickets do not live long indoors. However, they can cause damage to cotton, wool, linen, silk, synthetics, and leather and fur items.

INSPECTION AND MONITORING

Outside: Inspect for the presence of field crickets near the structure. Also check for moisture near the building and for organic material (mulch, leaves, etc.) that provides harborage and food.

Inside: Conduct a thorough inspection for the presence of crickets, moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where field crickets may occur. Inspect water heater closets, utility rooms and areas of high humidity and temperature.

CAVE OR CAMEL CRICKET *(Ceuthophilus spp.)* (Worldwide)

Cave or camel cricket populations build up indoors during fall, when large numbers of these insects move under doors and through cracks, seeking dark, cool, damp areas in crawlspaces, basements, utility rooms, garages, and outdoor sheds. They are rarely found in occupied spaces. Their natural habitat is outside, where camel crickets live under stones and logs or in animal burrows. Camel crickets have a rounded, hump-backed appearance with a head bent downwards. They are light brown in color with darker brown bands and markings. Camel crickets are easily identified by their long antennae and long and large jumping hind legs. They are wingless, don't chirp, and are not attracted to light. Most importantly, camel crickets serve as a warning or indicator of excessive moisture problems. Camel crickets can feed on cotton, linen or other cloth material.



Cave or Camel Cricket

INSPECTION AND MONITORING

Outside: Inspect for the presence of cave crickets near the structure. Also check for moisture near the building and for organic material (mulch, leaves, etc.) that provides harborage and food. Look for cracks, crevices and other openings (drains, pipes, vents) into the structure that provide entry for pests.

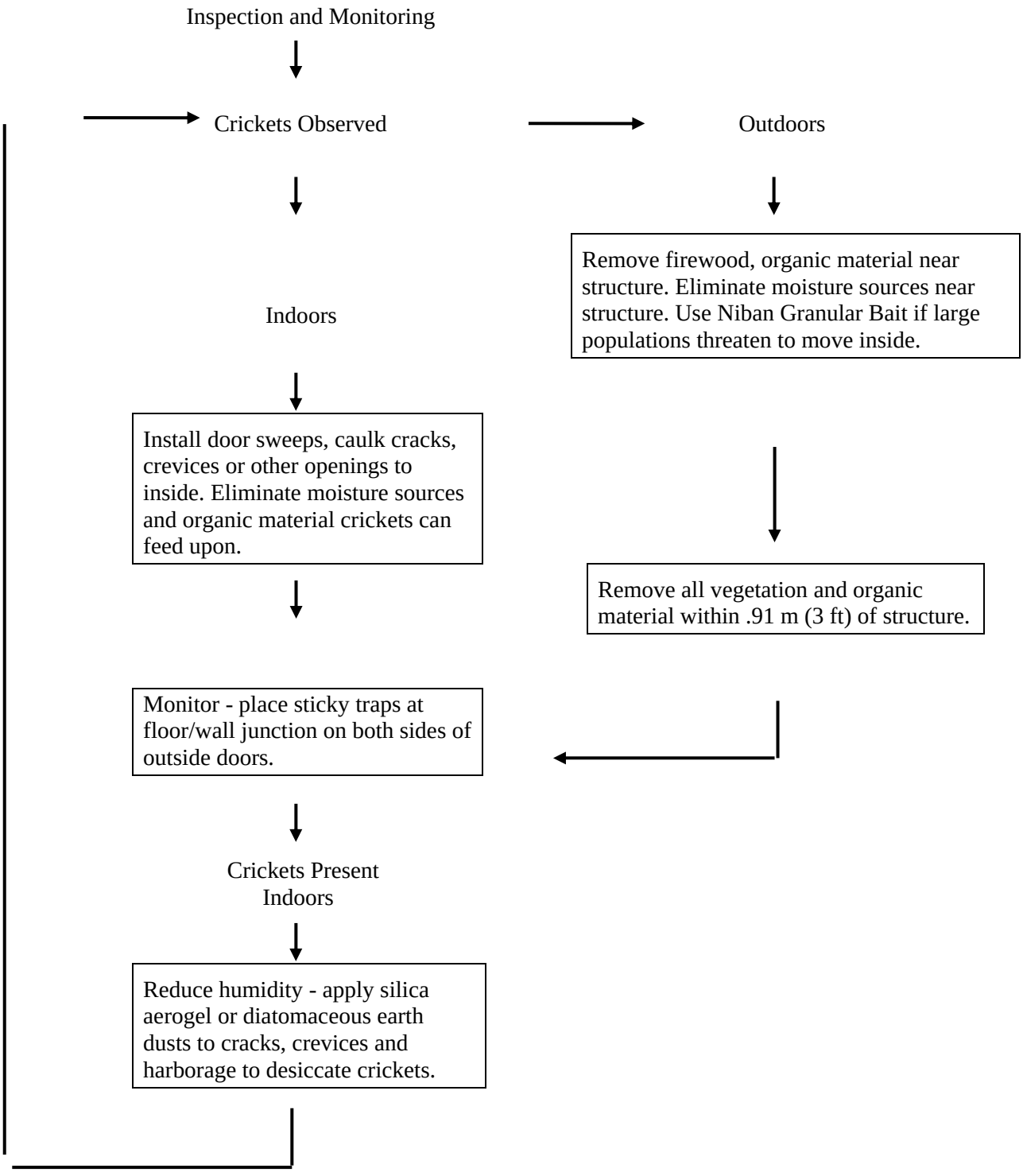
Inside: Conduct a thorough inspection for the presence of crickets, moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where cave crickets may occur. Inspect water heater closets, utility rooms and areas of high humidity.

MANAGEMENT

Outside: Remove all organic material (mulch, leaves, etc.) from within .91 m (3 ft) of the structure (replace with a 1.91 – 2.54 cm [3/4 – 1 in] mulch or gravel) and eliminate moisture and standing water in this area. Install effective door sweeps on all outside doors and eliminate other entry points into the structure.

Inside: Reduce humidity levels and eliminate leaks and other water sources. Keep corridors, offices, exhibits and storage spaces clean (no organic material available to the pest). Eliminate clutter, caulk cracks, crevices and close hiding places. Dust cricket harborage with diatomaceous earth (DE) or borate insecticide.

CRICKETS


Inspection and Monitoring
Crickets Observed
Outdoors
Remove firewood, organic material near structure. Eliminate moisture sources near structure. Use Niban Granular Bait if large populations threaten to move inside.
Indoors
Install door sweeps, caulk cracks, crevices or other openings to inside. Eliminate moisture sources and organic material crickets can feed upon.
Remove all vegetation and organic material within .91 m (3 ft) of structure.
Monitor - place sticky traps at floor/wall junction on both sides of outside doors.
Crickets Present Indoors
Reduce humidity - apply silica aerogel or diatomaceous earth dusts to cracks, crevices and harborage to desiccate crickets.

STRUCTURAL PESTS

TERMITES AND THEIR MANAGEMENT

INTRODUCTION

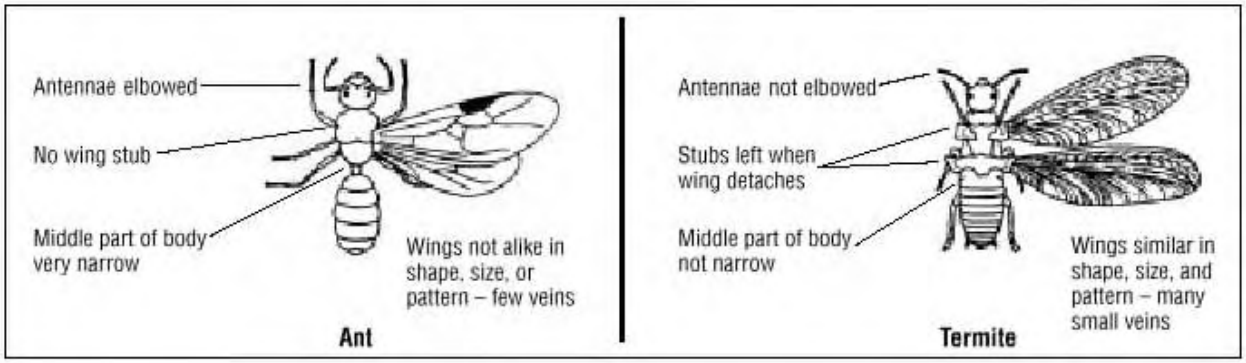
Termites are the most destructive wood-destroying insects in the U.S., costing hundreds of millions of dollars each year in prevention efforts, direct damage to structures and trees, and corrective costs. In older structures, about one of every ten is infested to some degree, while in newer structures; perhaps one in 20 is infested.

Termites are social insects belonging to the order *Isoptera* (meaning equal wings) and, like the cockroaches to which they are closely related, have been around for hundreds of millions of years. As inhabitants of forests, they serve a valuable function in the ecosystem by consuming dead and decaying wood. When people began to build wood structures, these structures became additional food sources and habitat for termites. Termites sometimes endanger the structural integrity of buildings.

Termites are classified according to their primary habitats subterranean, dampwood, and drywood termites. Only eastern subterranean termites are likely to be found at FIIS. By far, the subterranean termites are the most widely distributed. They occur throughout most of the 48 contiguous states, Hawaii, lower Alaska along the pacific coast, and the Caribbean territories. Because of the ever-present threat to housing and other wooden structures, vigilance is necessary to prevent, mitigate, and eliminate termites.

CHARACTERISTICS AND RECOGNITION

Usually, the first experience with termites is when they swarm around structures by the thousands during spring. For the termites, this is a dispersal flight as they begin spreading to new areas. People usually report "flying ants" and immediately call their exterminator. The pest management supervisor identifies these flying insects as termites, and points out the differences between true flying ants, which have two pair of unequal wings, elbowed antennae, and a narrow waist, and termites, which have two pair of nearly equal wings, straight antennae, and a thick-waist.



Typically, the subterranean termites swarm in the early spring on a warm day after a rain. Warmth, sunlight and moisture are the three elements necessary for the survival of this species, and the reproductive termites sense that these conditions will enhance their chance of survival. Close inspection of the building may show piles of detached termite wings, the small (less than .63 cm [1/4 in]) white worker termites in wood below ground, and their galleries in wood structures.

BIOLOGY OF SUBTERRANEAN TERMITES

Subterranean termites, the most widespread and destructive termites in the U.S., have their nests underground and within easy access of wood which is their only food. They are social insects with a complex division of functions including a queen, king, soldiers, supplementary reproductives and workers.



King & Queen



Reproductive



Workers



Soldier

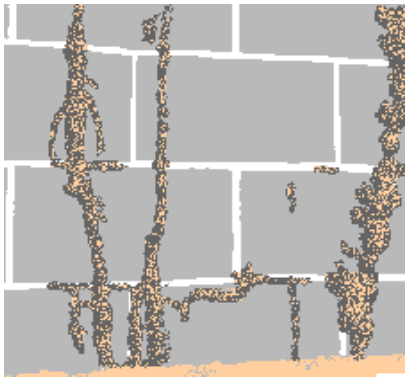
The life of the colony depends on the queen, which is a greatly enlarged, light brown, winged termite about 1.27 cm (1/2 in) long. The queen can lay millions of eggs over her lifetime of over 25 years. Her egg-laying activities are augmented by supplementary wingless reproductives as the queen ages or the colony outgrows its original nest. The king is the same size and color as the queen and also has two pair of wings. It exists only to mate with the queen, and lives, as does the queen, entirely within the subterranean nest once it is established.

The supplementary reproductives are light in color, about .63 cm (1/4 in) long, and have two pair of wing pads. They also stay entirely within the underground nest. The soldiers are white, except for an enlarged brown head capsule, and are about .79 cm (5/16 in) long. They defend entrances to the nest against enemies, particularly ants which are the primary enemies of termites.

The workers, which are actually nymphs, are entirely white, about .46 cm (3/16 in) long, and do all of the foraging and feeding activity of the colony. They may live up to five years, and are the ones that venture above-ground into structures, construct the galleries, bring wood back to the nest, and build the mud tubes that connect the nest to the galleries and the structure. They also feed the young nymphs and other castes which cannot feed themselves.

Since the termites' ability to digest cellulose is totally dependent upon the protozoans living within their midgut, it is imperative that workers exchange anal fluid containing these organisms

so that young termites can digest their food. This is accomplished by grooming among workers, a process that is important in selecting a pest management strategy.



Subterranean Termite Mud Tubes

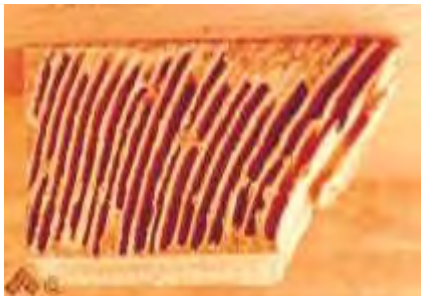
The conditions that termite colonies need to flourish are rather basic, but critical. They include relatively high moisture content in their living and feeding areas, adequate shelter and temperature, and a plentiful food source. The colony will not flourish if any of these is lacking. The high moisture content need is met by the soil in most parts of the country. Even coastal beaches, deep in the sand, provide ample moisture for termite colonies. The soil also provides termites the necessary protection from desiccation, since their cuticle is rather permeable and they can easily die from exposure in air. It has been theorized that the connecting mud tubes from above ground food sources to nests (built from mud, digested wood, and termite secretions and excretions) protect termites against dehydration along the journey from the nest to the food source and back.

These tubes may also provide protection against enemies, primarily ants. The minimum tolerable temperature for termites is -30°C (-22ºF). This does not mean that termites can flourish at this temperature, but rather that they can withdraw deep enough into the ground to survive that outside air temperature for a short period, usually a matter of weeks. If they have to stay too deep for too long, however, they are deprived of their primary food source, decaying wood.

Human habitats are ideal for termites. They provide the cellulose needed for food and the temperatures beside and underneath the building allow year-round activity by the colony. It does not take much wood to attract a mated pair of termites to set up housekeeping; a piece of a discarded 5.08 x 10.16 cm (2 x 4 in) in a foundation void will do it. Of course, once that food source is exhausted, termites will move on through cracks in the foundation to find another food source, usually in the interior of the structure.

Damage

The damage done to wooden structures may take years to reach the point when any evidence is visible. Often the area of damage is inaccessible, such as behind basement walls, in crawl spaces, or where floor joists meet the wall studs. Termites prefer to eat the softer portions (the spring sapwood) of beams, joists, studs, door jambs, window sills, or wood paneling, leaving behind enough of the harder summer sapwood to keep the structure intact.



Termite Damage

Termites will also eat through plastic sheathing, foam insulation, and any other soft obstacles on their path to their foraging sites. If there is moisture in the wood, the

destructive process is accelerated by fungi carried on termites' bodies. Their activities also tend to increase the moisture content in the wood they forage in. Termites deposit their frass (droppings) inside the galleries or use it together with earth and decayed wood to construct mud tubes. The mixture of feces, frass, and decaying wood gives the galleries a dirty appearance.

Over a period of years, the wood may become so thin that literally only paint is holding it together and just touching it can cause the wood to give way. Ultimately, the building may become structurally unsound, and major supporting members may require replacement.

INSPECTION AND MONITORING

Foundations

In order to inspect and monitor for termites, it is important to understand structures and the structural defects that lead to termite infestation.

For subterranean termites, the most common routes of infestation are the basement or ground floors of structures including:

- Poured-concrete slab foundations,
- Raised concrete foundations and footings,
- Vertical void concrete masonry block foundations,
- Brick foundations, and
- Stone and rubble foundations.

Other than solid poured concrete basements, the floor slab is usually supported by footings underneath and at the perimeter, and walls rest on top of the slab.



Subterranean Termite Entry Points

The slab usually has underlying gravel. Caps at the tops of foundations can be solid block caps, poured-concrete caps, top course of hollow blocks filled with concrete, or brick caps.

Sometimes supporting posts or stairs extend through the concrete slab to the soil below. Wherever there is a joint between the wall and floor, or the wall and cap, there is opportunity for cracks to develop which become entry points for termites. Similarly, cracks in the wall, mortar between blocks, bricks, or masonry provide entry points for termites. Faults in the blocks may also provide access for termites to the joists.

Poured concrete wall and pier construction, brick, hollow block, masonry walls, or wooden piers, are all used in buildings constructed on raised foundations. Piers constructed of poured concrete, concrete blocks, bricks or treated wood provide support for the girders and floor joists. Termites gain access through cracks or voids that occur. Access through piers or directly from the crawl space itself are easy portals of

termite entry, since the distance is short and mud tubes may escape notice. Subterranean termites commonly gain access to structures by building shelter tubes from the ground to the wood over concrete piers, foundation walls, and from underneath exterior soil-filled porches and patio slabs.

Slab-on-grade construction has become very common in the last 30 years. The monolithic slab, consisting of a solid, unitized pad and footing, offers protection against termite infestation. The supported slab is another type, which is tied at its ends to the foundation wall. The floating slab is the third type, which is structurally independent from the foundation wall. It "floats" over a gravel layer.

All three types of slabs provide access for termites once cracks develop in the slab or foundation wall. This scenario is most likely to occur at the expansion joint of the floating slab. Once in the building, termites have ready access to the wooden studs, joists, floor sheathing, and finished interior wood.

Site History

The pest manager should be familiar with the history of the site. Sites that were once heavily wooded areas, particularly with softwood trees, often have dense populations of termites. Sources of moisture in structures may also be areas where termites are attracted, and need careful scrutiny. Utility pipes and electrical conduits that run under a structure or up from the ground are natural paths for termites to invade. These termite highways should be checked carefully for mud tubes.

Tools

The tools of inspection are a flashlight, awl or ice pick, small hammer, moisture meter, hacksaw blade, measuring tape, and electronic stethoscope or other sound-listening device. In addition, an inspector needs coveralls, knee pads and bump hat to safely get into tight areas under the structure and graph paper to diagram termite entry points and damage. A stepladder is needed to gain access to the attic and to high areas of the exterior.

THE INSPECTION

Before starting the inspection, always interview the occupants. Often they have some knowledge of previous termite problems, where moisture occurs, and possible hidden joints or voids. Next, size up the exterior of the structure and draw a diagram on graph paper, noting dimensions, grading, drainage, garages, decks, any structural wood in contact with soil, and location of wood piles. The graph also should account for hidden joints, voids in porches, and moisture-laden areas.

Note any exterior wood that shows excessive moisture or decay. Inspect the interior areas adjacent to this decay for further evidence of damage or infestation. Also, observe any possible roof leaks either under the shingles, around chimneys, or toward the structure after exiting downspouts. Blistered paint, insect or woodpecker attack areas, and evidence of insect exit

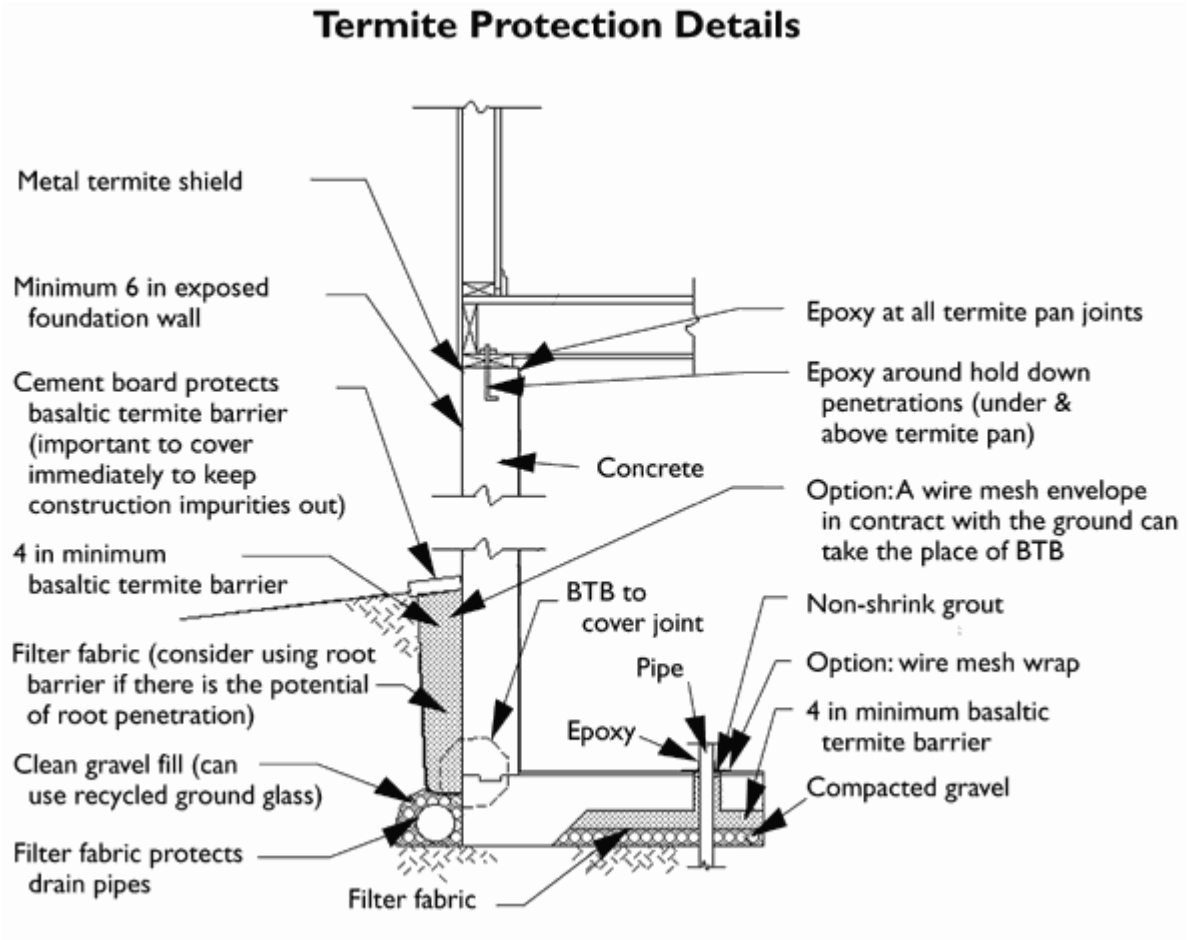
holes, feces, or sawdust are additional points of concern. Outside, in areas where there are planters or earth-filled porches, use a hacksaw blade to insert under window and door sills. The blade should not penetrate beyond the sills or headers. Note any areas where the outside grade is higher than the top of the foundation or slab. This “faulty grade” condition will allow direct access for termites to the wall studs and will contribute to excessive moisture and decay.

In the interior, examine every room systematically. Look for possible signs of decay, damage, and moisture in all wooden structures. For example, if there is a drip or leak under the sink, fill up the sink and examine underneath after it empties to see if water appears at the bottom of the cabinet. If water is leaking from any area, "sound" (tap and listen for a hollow sound) the nearby wood with a hammer, then look for possible mud tubes in adjacent areas. In walking through a structure, notice whether or not floors seem to sag or buckle in places. Sagging members may indicate termite damage . Similarly, water stains, buckling paint, or bulging plaster are indicative of moisture-laden areas which bear further scrutiny. Stained walls may occur where subterranean termites have been depositing mud on inside surfaces of walls. Sound baseboards as well since these are primary areas of attack. Examine cracks occurring around door or window frames since these may be portals of entry.

Inspect bathrooms carefully. Pay particular attention to shower pans and shower or bathtub enclosures as these areas often leak, causing decay and contributing to dry rot and termite infestation. Toilet leaks are common at the point of contact with the floor. Decay or rot is also common at the floor area around the toilet.

In the basement, carefully examine areas around the base of stairs and support posts which may extend through the floor slab. Also, examine the floor joists at the juncture of basement wall for signs of sawdust, feces and spider webs. Probing suspect timbers with an ice pick or sounding, using a small ball peen hammer, may yield a positive finding. Inspect plumbing accesses throughout the structure, as these often will reveal frass, mud tubes, or feces if termites are present. Carefully inspect the underside of stall showers and toilets for leakage, dry rot or termite infestation. Stall showers should be water tested for 15 minutes and inspected for leakage from the basement or substructure if these areas are accessible.

In slab-on-grade construction, look carefully at the expansion joints when these joints are visible for inspection. Occasionally subterranean termite infestations will extend into moist attic areas. Inspect bracing and rafters carefully for evidence of damage or mud tubes. Note any inaccessible areas in the report. Pay particular attention to evidence of leaking water, especially around chimneys, vent pipes, and roof sheathing.



Carefully inspect every part of the crawlspace by using a flashlight, since it is a likely area for hidden termite mud tubes because of the proximity of ground and the first floor wood substructure. Also check the storage sheds and temporary buildings which usually give termites easy access to the structure, if attached or nearby. Pay close attention to areas in which infestation, damage, excessive moisture or faulty grade conditions were noticed from interior or exterior inspection. Signs of infestation or damage may also exist in the substructure. Inspect the areas adjacent to earth-filled porches for evidence of subterranean termites entering from the earth fill. Finally, review carefully any unseen areas and voids, and record such data on the inspection diagram.

Regardless of the type of termite infestation, it is imperative to describe as thoroughly as possible the origin of infestation as well as its extent. In addition to the diagram, a descriptive report must be prepared for future reference, whether or not there is an actual infestation. A list of areas to inspect when performing a termite inspection can be found at the end of this chapter.

PREVENTIVE MEASURES

The implementation of preventive measures discussed in this section can minimize costly repairs of termite damage.

Subterranean Termites

Subterranean termites cannot thrive without ample moisture in the wood of structures, in the adjoining soil, or both. Therefore, repairing defects and correcting patterns that allow water or excess moisture into any part of the structure, will help minimize termite damage. For example, if the ground slopes toward a structure, it should be regraded to redirect the runoff. It is also necessary to ensure that the water from roof, downspouts, porches, driveways, patios, and slabs runs away from the structure, and that leaky drains, baths, toilets, and plumbing are repaired inside the building. If crawl spaces have no ventilation, installation of vents will prevent moisture accumulation. Gutters should be clear of debris so that water does not pour over the top during rainstorms. Roof flashing must not allow water to flow under the membranes and shingles. Flashing around chimneys and vents should be tight and sealed so that water cannot run down into the structure. Tree branches which are moist and close to the structure should be cut back.

It is also necessary to remove wood debris from under the building or near the foundation, firewood that is closer than three feet to the building, and wooden planters next to the building. Modify untreated wooden structural members so that they are more than 45.72 cm (18 in) away from the soil. This may involve regrading if siding or joists are too close to the soil, or installing metal termite shields or a concrete barrier beneath the wood. If decay is evident but slight, treat unpainted wood with a suitable wood preservative such as BoraCare or TimBor. Treat exposed untreated wood. Replace supporting posts, stairs, and fences made of untreated wood with pressure-treated wood. Caulk areas where moisture can enter around windows, door frames, or sills. Remove bark or wood chip mulches next to the structure and replace with decorative rock mulch.

Foam insulation has become a concern in recent years since termites, while not digesting foam, easily tunnel through it to reach wood. Where foam insulation is in close contact with the ground, it might mask termite tunnels and hide structural damage. Therefore, it is essential to ensure that it does not extend closer than 45.72 cm (18 in) from the soil. Even with this precaution, most termite-control companies will not guarantee against termite infestation if a building has foam insulation, because of the high risk of non-detection.

LOW RISK MANAGEMENT METHODS

Termi-Barrier: An innovative, non-toxic treatment, first suggested by Dr. Walter Ebeling in 1957, has been in use by Live Oak Structural, Inc. since 1989 in the San Francisco Bay area to prevent subterranean termites from entering structures. The "Termi-Barrier" is a layer of untreated sand that the termites cannot penetrate because the small particles are too big for the termite to grasp and move with its mandibles, yet the largest particles are not big enough to allow the termites to crawl between. The sand particles, ranging in size from 2.5 to 1.6 mm (.1 to .06 in), form a barrier that prevents termite penetration; however, particles larger or smaller than the narrow size range may allow termites to tunnel through. Sand barriers can be installed before concrete slabs are poured over them, or in crawl spaces around the foundation perimeter and under pier foundations.

The sand is placed 6.62 to 15.24 cm (3 to 6 in) deep next to foundation walls and tapered down to 2.54 cm (1 in) deep over a 25.4 cm (20 in) or more lateral distance from the wall. Occasionally the entire crawl space must be covered if termite activity is intense. Barriers outside the foundation must be capped with concrete or asphalt to prevent movement away from the wall by rain or other means. Periodic inspection of the integrity of the barrier is an integral part of this approach.

Termite Shields: Sheet-metal strips called termite shields have been installed historically during construction, ostensibly to prevent hidden termite entry through masonry walls. In actuality, termite shields are seldom properly installed, and once installed are rarely maintained. They are intended to force termites to build mud tubes over the metal so that they may be observed and treated. However, they are easily damaged and may hide termite activity if frequent observations are not made on the inside, as well as the outside, of the masonry wall. In this situation, termite entry is unimpeded.

Steel Mesh: Efforts are underway to evaluate a stainless steel mesh barrier, developed by Termi-Mesh, Ltd., and to make it commercially available in the U.S.

Diatomaceous Earth: Diatomaceous earth (DE) can be used as a termite barrier by applying it in strategic places. Natural DE is sold under the brand name Perma-Guard, which is available with or without pyrethrins.

THE FUTURE

Termites have been an economic burden to owners of homes and other structures that contain wood, paper or cellulose products for many years. A great deal of research has been, and is being conducted, to develop better and safer means to manage this costly structural pest.

The Sentricon System is now available by DowElanco to selected companies in the commercial pest control industry. Since 1988, Dr. Nan-Yao Su has worked on developing the method, which utilizes a monitoring system for subterranean termites and the biology and behavior of the termite to achieve management. According to Dr. Su, if no termites, keep monitoring. If termites show up in the monitoring device, then a bait tube is provided for the termites in a recruiting chamber. The bait material contains a chitin inhibitor (the juvenile growth hormones hexaflumuron or noviflumeron), which is passed throughout the colony by the termites' normal recruiting and feeding behavior, and eventually leads to the demise of the colony.

Beneficial nematodes have been marketed for subterranean termite control with mixed results. When research with nematodes yields consistently effective results for most sites and soil conditions, it will be considered a "low risk" method.

CHEMICAL PREVENTIVE BARRIERS

When deemed necessary, pesticide applications shall be performed by licensed applicators only. Applications shall be made according to the National Park Service Integrated Pest Management

policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Since few buildings are termite-proof, a preventive chemical-barrier treatment around buildings located in high risk infestation areas is a traditional precaution. Preconstruction treatment of structural wood can be accomplished with a dip-diffusion method, with a 10% disodium octaborate tetrahydrate solution. Such "TimBorized" lumber is available in many areas commercially. Additionally, sodium borate solutions can be applied to exposed structural wood during construction ("dry in" stage) or after construction is completed, which is also suitable for all wood that is not in contact with the ground and not exposed to rain. Applications can be made to wood in attics, walls, around windows, floors and sub floors, joists, and sill plates.

Sodium borate solutions penetrate into the wood, treating more than just the surface, and protect and preserve the wood permanently. Sodium borate functions as a slow-acting stomach poison in insects and decay fungi. Termites accumulate the active ingredients while they feed. These slow-acting poisons allow the termites to move throughout the colony to spread the insecticide by the feeding of nymphs, soldiers, and reproductives. Sodium borate solutions can be brushed or sprayed onto bare wood or drilled and pressure treated into known infestations.

A soil pre-treatment performed during construction usually provides an effective barrier for a specified time. The principle is to provide a pesticide barrier in the soil that will be in contact with the foundation and slab. Apply termiticide according to the label at the recommended rate. Before pouring concrete pads, a moisture barrier of polyethylene sheeting should be in place.

Soil treatment termiticides shall be applied in strict accordance with the recommended rates of the manufacturer which are shown on the container label.

Post-Construction Treatments for Subterranean Termites

If a structure has had termites in the past, or if there are conditions conducive to termites (evidence of infested wood around the foundation along with cracks in the foundation or porch voids), it is reasonable to assume that a chemical barrier is necessary to protect against future infestation. When an infestation occurs, the *entire* barrier requires re-establishment. Treating just the area of infestation often fails to prevent termite entry, and results in costly callbacks.

Unpainted or unsealed termite-infested wood can be remedied by painting (brushing) or spraying sodium borate solution on it. At the same time, eliminate moisture problems that may have led to and sustained the moisture needs of the colony. Wood with known infestations or galleries should be drilled and pressure-injected wherever possible.

Slab construction requires that pesticide not only provide a barrier around the outside, but also underneath the slab so that any possible cracks are protected.

If the infested areas are mainly structural, extensive, and inaccessible, fumigation may be selected. This is an expensive and highly technical procedure that should be undertaken only by

licensed fumigators. It, however, offers no protection against future infestations. The basic procedure is to wrap the entire building in gas-tight tarps made of nylon, rubber, neoprene, or plastic. Seams between sheets of the tarps are rolled together and joined with metal clamps or heat-sealed. The bottoms of the tarps are anchored to the ground with "sand snakes" (sand in bags). It is essential that the entire structure is airtight for fumigation, so careful attention to each detail is necessary. The building is fumigated with sulfuryl fluoride, or other registered fumigant. Fumigation exposure with sulfuryl fluoride is usually a 24-hour process. Additional time will be required for the aeration process.

In some states, the aeration period for Vikane (sulfuryl fluoride) gas is 24 hours. After the aeration period, the structure is reopened and the fumigator measures gas residues with a fumiscope. When the structure contains less than 5 ppm of Vikane, the fumigator can certify the structure for reoccupancy. Warning signs must be posted and maintained from the time the fumigant is introduced until the fumigator clears the building, prohibiting entrance into the building treated. During the fumigation and aeration process, secondary locks remain on the structure to guard against access until the building is safe to occupy.

Infested, stand-alone items such as furniture, construction timbers, or crates can be treated in a fumigation chamber or with heat in similar fashion as buildings.

AREAS TO INSPECT WHEN PERFORMING A TERMITE INSPECTION

Substructure

- Foundations
- Porches
- Sub floor
- Plumbing
- Pier posts, pier pads
- Heating ducts (high humidity)
- Mudsill, floor joists and header joists
- Ventilation
- Shower drains and sub floor adjacent to the shower
- Toilet drains and sub floor adjacent to the toilet
- Inaccessible areas

Exterior

- Foundations
- Porches
- Patios
- Eaves, fascia boards and rafter tails
- Exterior grade level
- Drainage
- Ventilation
- Exterior siding
- Exterior stucco
- Columns and abutments

Attached fences, sheds, wood decks
Visually inspect the roof
Window sills
Porte cochere
Carports

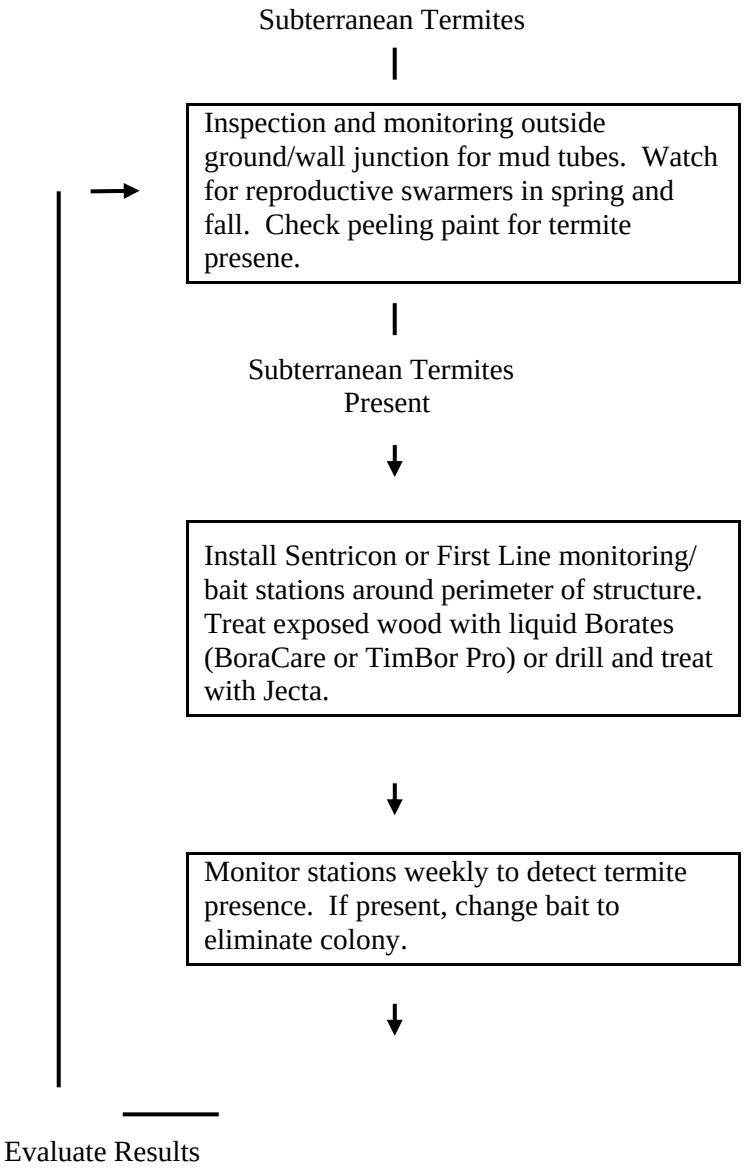
Interior

Baseboards
Window ledges, sills and frames
Floors
Paneling, plaster board and other wall covering
Ceilings
Cabinets
Plumbing fixtures
Shower and bath tub enclosures
Toilet areas
Fireplace
Door jambs
Hollow doors
Door sills, thresholds
Inaccessible areas

Attic

All framing (joists, rafters and sheathing)
Ventilation
Heating and air conditioning system
Roof
Inaccessible areas

TERMITES


Subterranean Termites
Inspection and monitoring outside ground/wall junction for mud tubes. Watch for reproductive swarmers in spring and fall. Check peeling paint for termite presene.
Subterranean Termites Present
Install Sentricon or First Line monitoring/ bait stations around perimeter of structure. Treat exposed wood with liquid Borates (BoraCare or TimBor Pro) or drill and treat with Jecta.
Monitor stations weekly to detect termite presence. If present, change bait to eliminate colony.
Evaluate Results

POWDERPOST BEETLES



Powderpost Beetle



Powderpost Beetle Damage



Powderpost Beetle Larvae

The first group is known as lyctid powderpost beetles. Lyctids are small, reddish-brown to black beetles about .3 – .64 cm (1/8 – 1/4 in) long, whose life cycle requires about a year or less and takes place entirely within wood, except for mating. They only attack the sapwood of hardwoods having large pores, such as oak, hickory, ash, walnut, pecan and many tropical hardwoods. They attack both new and seasoned wood, so they may occur either in structural members or in paneling, furniture and flooring.

Their damage appears when larvae construct numerous galleries, about .15 cm (1/16 in) in diameter, throughout the wood. Exit holes of .08 – .15 cm (1/32 – 1/16 in) in diameter on the wood surface (made as newly-emerged adult beetles escape from the wood), coupled with fine sawdust-like frass, may be the only evidence that lyctid beetles are at work. The frass may collect below the infested wood on spider webs, or it may fall out when slightly tapping the wood. The interior of wood may be so riddled with galleries that the remaining structure is only a veneer of surface wood. Replacement or removal of panels may be the best method if the infestation is not structural. However, if structural members are involved, the treatment depends on the extent of the infestation. If only exposed timbers are involved, a Borate insecticide may be the best treatment. However, if the extent of the infestation is uncertain, one should carefully examine and probe-delineate the infestation for treatment. Heat may then be the treatment of choice.

Anobiid beetles, also known as death-watch or furniture beetles, belong to the powderpost beetle group. The adult beetles are also .3 - .64 cm (1/8 - 1/4 in) in length and reddish-brown to black in color. However, the adult beetles are rarely seen, and it is the fine frass, pellets and exit holes (.15 - .3 cm [1/16 - 1/8 in] in diameter) which indicate their presence. Their damage includes boring in the sapwood of both hardwoods and softwoods, and reinfestation of seasoned wood if conditions are favorable. Attacks often begin in attics or in poorly ventilated crawl spaces and then spread to other parts of the structures.



Death-watch Beetle & Damage

If the frass is yellowed or partially caked on the surface where it lies, the infestation is probably old or already managed. It may take ten years or more for infestations to become significant enough to be noticed. At this point, both large numbers of exit holes and large quantities of whitish frass are observable. Once the infestation is noticed, management, as with lyctids, depends on the extent of the infestation. The options are essentially the same as those listed for management of lyctid beetles.

BOSTRICHID (false) POWDERPOST BEETLES

The size of various species ranges from .64 cm (1/4 in) (most common species) to 5.08 cm (2 in) (uncommon species). All of the species are elongated, cylindrical, compact beetles with a flat-headed appearance in profile. The larvae are whitish, similar to other powderpost beetle larvae. Their life cycle is relatively short (about a year).



Bostrichid Beetles

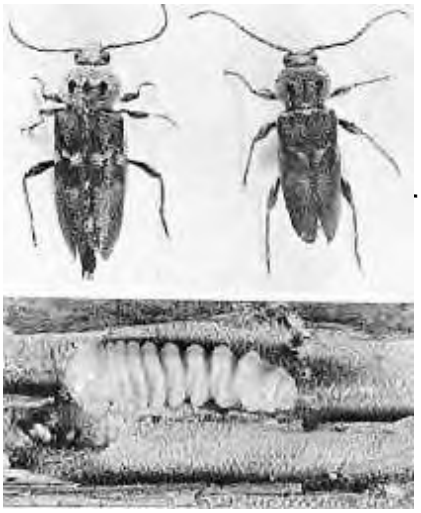
There are several species in this group. Among the well-known species are the bamboo borer, the red-shouldered shot-hole borer, the oriental wood borer, the black polycaon, and the lead cable borer. Some of the species are pests of stored products such as grains.

Although this group reinfests wood, it rarely does severe economic damage. Most damage noticed in construction timbers occurs before curing while moisture content of the wood is high. An exception is bamboo and weakened (from moisture or other damage) structural timber, in which considerable damage may occur. The appearance of frass is similar to that of lyctids, except that it often forms small cakes or clumps. However, unlike the lyctid powderpost beetles, exit holes are free of frass and are .08 – .94 cm (1/32 – 3/8 in) in diameter, depending upon species.

OLD HOUSE BORERS

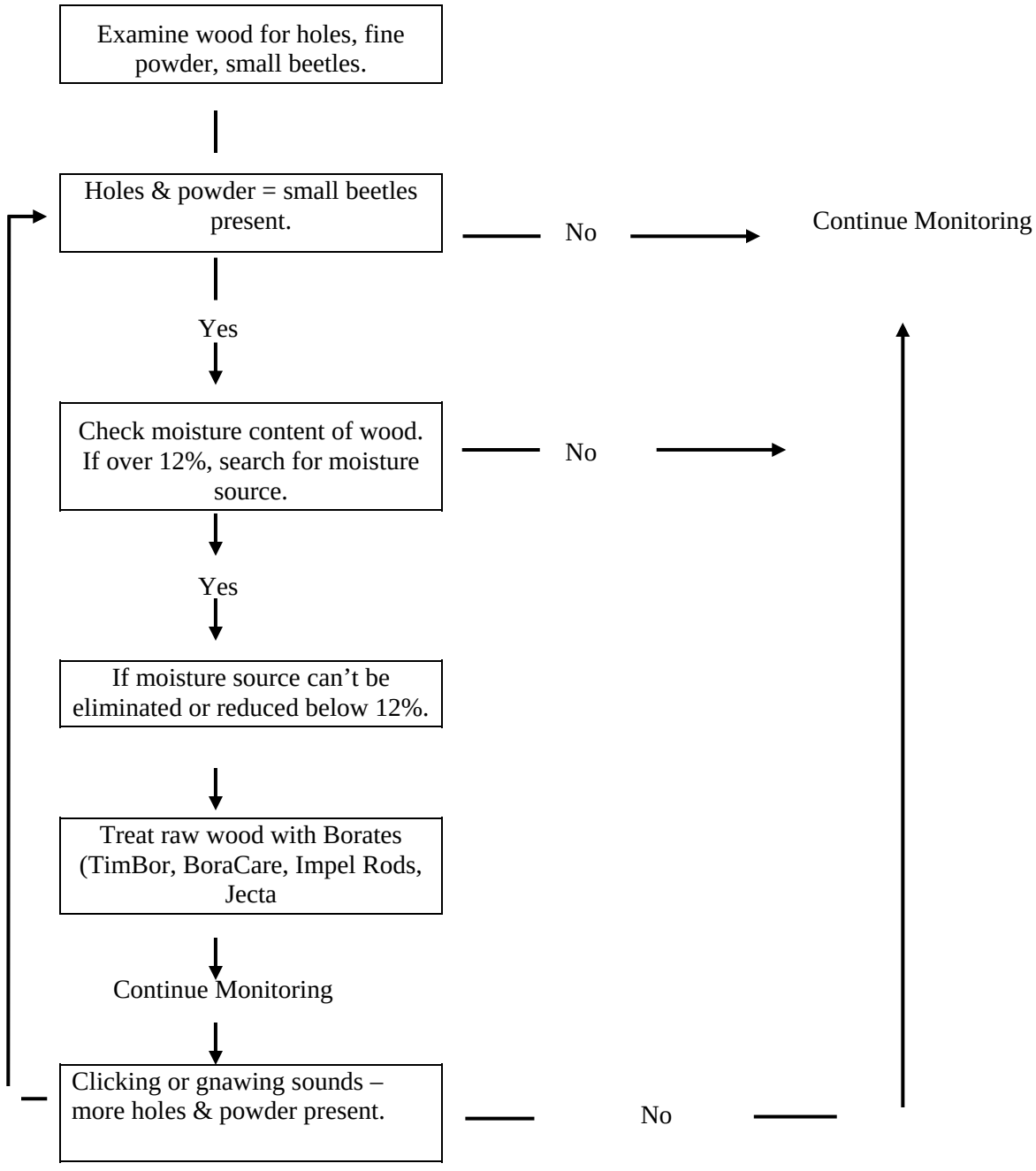
This pest, a native of northern Africa, spread to the U.S. through Europe, and is now ranked second to termites as a pest of seasoned wood in structures. Its distribution is primarily along the east coast, with occasional findings in the other states east of the Mississippi River. The old house borer, *Hylotrupes bajulus,* is a large brownish-black, slightly flattened beetle that ranges from 1.57 – 2.54 cm (5/8 – 1 in) in length. It is a long-horned beetle and has two prominent bumps on the prothorax. The larvae are also large (up to 3.18 cm [1 1/4 in] long) and homeowners may hear them making gnawing sounds (clicking). Unfortunately, evidence of their presence, bulging of the surface wood, only occurs when larvae are near maturity. Eggs are placed in small cracks or in the joints between floor joists and other structures.

The life cycle in the northeastern states may take six to eight years or longer to complete, while in the southeast, the life cycle takes only three to five years. Adults may remain in galleries for up to ten months before emerging. Once emerged, usually in June or July, they live just a matter of weeks before they mate, lay eggs and die.



The old-house borer usually occurs in new, not old wood, as the name implies. However, it usually escapes notice until years after the completion of the structure. Infestation by a second generation of borers occurs rarely in well-ventilated, centrally heated structures. When such reinfestation occurs, there may be overlapping generations of borers in the structure for many years.
Favorite attack sites include attic framing, floor joists and wood studs. The larvae may reduce the sapwood area of these timbers to mere powdery frass. Luckily, the damage is localized. The fecal pellets are rod-like and crumble easily. The most characteristic feature of infestation is the damage, which is striking because of the size (up to .94 cm [3/8 in] in diameter), shape (oval) and rippled appearance in the galleries. Just prior to emergence, larvae may create bulging in the wood. Exit holes are also oval in shape and surrounded by frass and feces.

WOOD DESTROYING BEETLES



NOTE: Holes and powdered frass will not disappear. If holes increase in number and jeopardize structural integrity of building, replace damaged wood with borate-treated wood.

CARPENTER ANTS

Carpenter ants *(Camponotus spp.)* are social insects which live in small to occasionally large nests. Unlike other ants found in structures, they excavate wood and build nests in it, but they do not eat the wood. They occur throughout the contiguous 48 states and Hawaii, especially in the Pacific Northwest and the northeastern states. Carpenter ants are nocturnal forest-dwelling insects that, in nature, live in dead and rotting logs and trees, under stones and in leaf litter at elevations up to 9,000 feet.



Carpenter Ant Queen & Workers

Carpenter ant workers are large (.45 – 1.57 cm [3/16 – 5/8 in] long), usually black (although not invariably so) and can inflict painful stings. The waist between the thorax and abdomen, unlike most structure-infesting ants, has a single node, and the overall profile is continuous. The queen is up to 1.42 cm (9/16 in) in length and, as with the male, may bear wings during the swarming season.

The larvae are white and legless and are fed by the workers. Pupae are also white and often are carried about by workers if the colony is disturbed. The foods of adults are sugar and sometimes proteins found in or around a site. Adult ants often feed on aphid honeydew found on plants infested with large populations of aphids. Winged adults emerge from March to July, depending upon location, and establish a nest in moist wood or a cavity adjacent to wood. The colony grows over a three-to-six year period before it matures. Winged swarmers appear in the nest in the late fall, but do not fly to start new colonies until the following spring.



Eggs, Larvae & Pupae

Swarming begins during the first warm or wet days of the year. New housing built on cleared woodlots that previously supported carpenter ants is generally the most troubled. Nests are found in water-rotted wood under shower stalls, under leaking roof-valley downspouts, in window sills where water accumulates, in poorly ventilated areas, and sometimes under insulation in attics. The larger and more long-lived a carpenter ant colony is, the greater is the structural damage.

Outside, carpenter ant workers forage for such foods as honeydew, insects and ripe fruit juices. Ants are not as active during winter. Carpenter ants often move into structures during fall to forage for sweets after plant aphids disappear. Those that have invaded structures seek out



Carpenter Ant Galleries

sweets, meats, fruit juices and moist kitchen refuse. Since carpenter ants are usually not very active indoors during winter, an occupant's ant complaint during winter is a sure sign of an indoor nest. Carpenter ants usually leave structures for the outside during summer. Carpenter ant nests consist of galleries that normally run with the grain of sapwood and have large interconnections which are free of wood shavings, mud and feces, and appear smooth and sanded.

Wood shavings and frass are thrown out of the nest through slit-like exit holes in the surface. Small piles of sawdust-like material may build up below tunnels. During summer months, ants are active at night when chewing sounds are audible.

The nest location may not necessarily be in the building; it may be a hundred feet or more away in a stump or decaying log.

Access to buildings is through ground connection, utility wires or branches touching the building. Since moisture is required to sustain a colony for any length of time, a carpenter ant nest indoors is normally near a moisture-laden area. Indoor nest locations may be in door and window frames, wall voids, roof/ceiling of flat deck porches and hollow porch columns, or behind fascia boards.

Carpenter ants are multi-queened and usually excavate wood previously decayed or damaged by other agents. They generally forage in humid atmospheres (under debris, in damp crawl spaces or in vegetation on building walls) where they find softened wood. Carpenter ants are not thought to be able to start tunnels in wood dryer than 12% moisture content, and some species even have high humidity requirements for the nest.

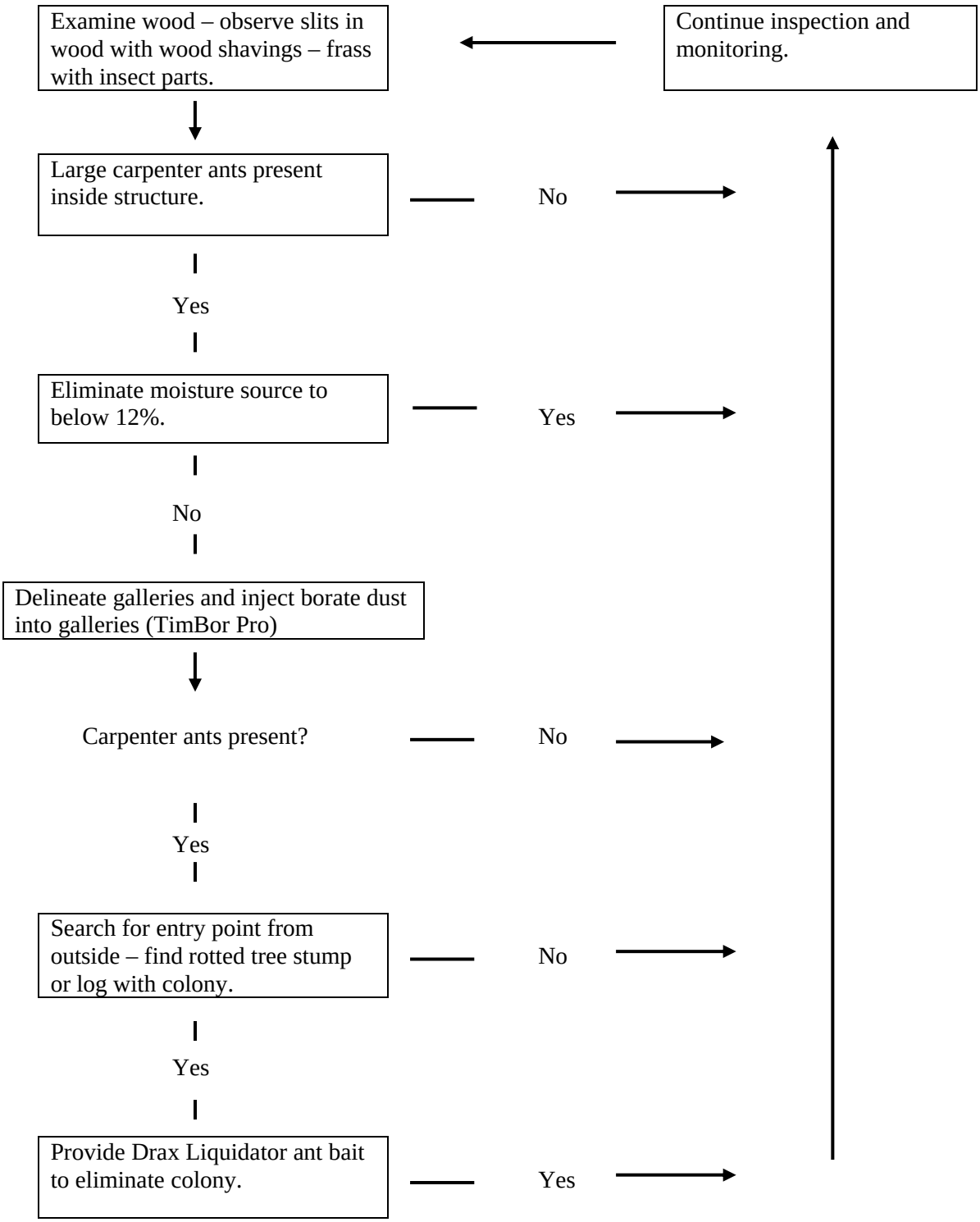
DAMAGE, PREVENTION AND MANAGEMENT

If ignored for many years, structural damage caused by carpenter ants may be extensive and severe. The damage rarely causes structural failure unless the wood is stressed by strong winds or heavy furniture placed on the infested timber.

Prevention methods include eliminating moisture sources in the house, breaking connections to the outside, ensuring good ventilation to crawl spaces, sealing all gaps in wood members, removing wood debris from around the structure, and using borate-treated or pressure-treated lumber in areas subject to moisture.

The most difficult part of treatment is locating the nest, without which the problem cannot be eliminated. If the nest is outside the building, the infested log, stump or other wood item should either be eliminated or removed. Inside the building, the infested areas may be sprayed or dusted with a borate insecticide. In inaccessible areas, wood may require drilling and injection with the pesticide. Chemicals of choice include disodium octaborate tetrahydrate (DOT), silica gel or diatomaceous earth. Some slow-acting baits such as Drax Liquidator may be effective.

CARPENTER ANTS



CARPENTER BEES

Carpenter bees are smooth and shiny solitary bees with a mostly black abdomen. Carpenter bees are similar in appearance to bumble bees, but lack hair on the dorsal side of the abdomen, except on the first segment.



Carpenter Bee

They bore into wood to make a tunnel of cells provisioned with pollen in which they lay eggs and to supply developing young. The tunnel is divided into cells where the individual larvae develop. The tunnels bored by carpenter bees may cause structural damage to buildings where they nest. Typical nesting sites in a structure include fascia, window trim, eave areas, rafters, wood shingles, wood siding, patio furniture and exterior wood trim. Although many different types of wood are selected for nesting sites, softer woods are preferred. Additional damage to the structure can be made by woodpeckers as they bore into the wood to feed on the developing larvae.

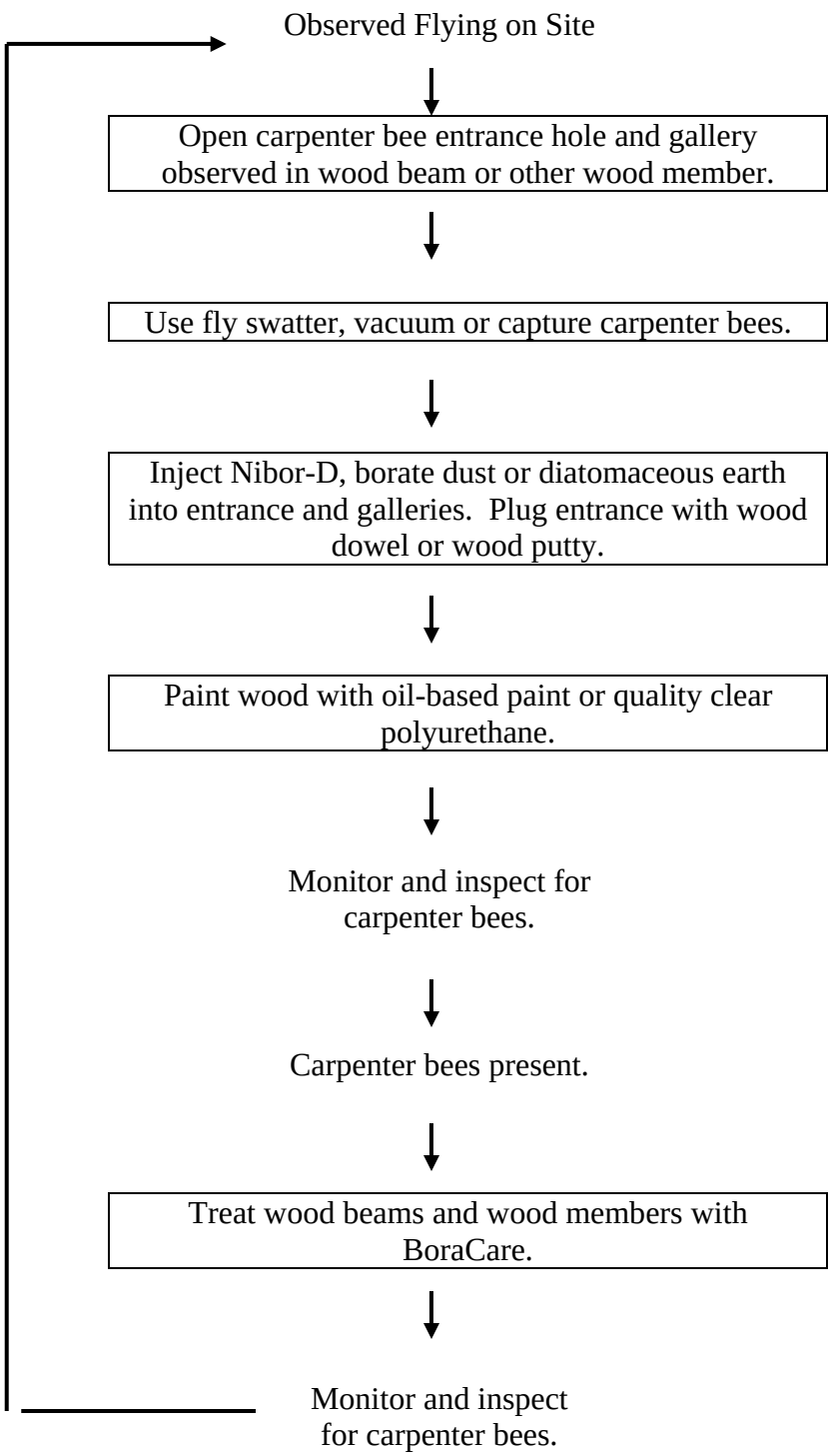
INSPECTION AND MONITORING

Inspect the bottom edges of exterior exposed wood for 1.27 cm (1/2 in) diameter round holes drilled vertically. These are carved by the female carpenter bee forming right angle branches of cells. The male flies aggressively around to protect her while she works. If the hole is sealed, the nest is complete with cells, pollen provisions and eggs or overwintering developing larvae. Adult carpenter bees will emerge in the spring. Only the female carpenter bee can sting. Adult carpenter bees feed on pollen and honey.

MANAGEMENT

Good quality oil-based paint on the wood (especially bottom edges of exposed beams, fascia, etc.) will prevent and exclude the female bee from constructing the nest. If the nest is in the process of being carved into the wood, dusting inside the hole with diatomaceous earth, TimBor Pro or other low-risk dust pesticide will deter further damage and kill the developing eggs or larvae. Woodpeckers will attack live larvae inside the cells by boring through the wood.

CARPENTER BEES



ARGENTINE ANT (*Iridomyrmex humilus [Mayr])*

The Argentine ant, native to South America, now widely ranges throughout the United States and the world. This highly adaptable ant is the most common of the trailing ant species that invade structures in search of foods. Its natural range is only limited by cold temperatures. The Argentine ant has one node on the petiole, a musty odor when crushed, carries no known diseases, and has no public-health importance. It is very aggressive, has no natural enemies, and drives other ants away. Although the Argentine ant bites, it doesn't normally attack human beings.

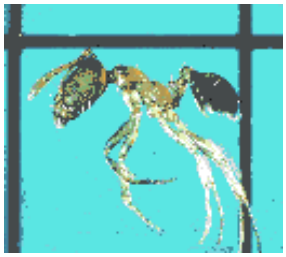


Argentine Ant

Argentine ant nests are usually located in moist areas around refuse piles, under stones or concrete, rotten wood, bird nests, beehives, and in tree holes. In winter, colonies move deep into the soil. Although it seldom nests indoors, nests are sometimes found in buildings near heat sources. This ant is multi-queened, very prolific, and supports large colonies (thousands to tens of thousands) but seldom swarms, because breeding takes place in the nest. The Argentine ant is a major pest in structures, and is commonly seen near baseboards, windows, and water pipes, seeking food or to escape too-wet or too-dry outdoor conditions. It is often found on potted plants because it tends scales, mealy bugs and aphids, from which it obtains honeydew. Indoors they feed on meats, sweets, dairy products, eggs, fats and oils, but prefer sweets. Argentine ants also feed on termites, other ants, fly larvae, and cockroaches. Argentine ant eggs hatch in 28 days, the larval stage lasts 31 days, the pupal stage lasts 15 days, and complete life cycle is 78 days.

PHARAOH ANT (*Monomorium pharaonis L.)*

Originally from the African tropics, the pharaoh ant is a trailing species with two nodes on the petiole, twelve segments in the antennae, and a three-segmented antennal club. Its color is yellow-to-red, and the pharaoh ant is .25 – .15 cm (1/10 – 1/16 in) long. This ant forms extremely large colonies (a million or more workers) and is becoming a dominant indoor pest because of its broad diet and habit of colony budding. Infestations may be established months before being recognized. Pharaohs are one of the few North American ants that are active all year.



Pharaoh Ant

The pharaoh ant prefers to nest at temperatures between 27 - 30ºC (81 – 86ºF). In the North, pharaoh ants do not nest or survive winter outdoors. Indoors, this species is commonly transferred between buildings in furniture, food packages, laundry, and other items. Indoor nests may be found by examining areas adjoining heating systems and searching for ant trails near hot-water pipes.

Although pharaoh ants forage on many foods (they are especially fond of mint-apple jelly), worker ants need protein and carbohydrates from dead insects, meats, bacon, liver, blood, and honey. A constant food source seems important for pharaoh ants. Removing the food source has sometimes caused pharaohs to leave the building. Pharaoh ants penetrate packaged food and may gnaw holes in silk and rubber. Sources of moisture draw foraging ants to kitchen and bathroom faucets, dishwashers, water coolers and water leaks.

This ant is extremely difficult to manage in structures because colonies tend to multiply (or bud) when treated with chemicals. Since most buildings provide abundant habitat, budding occurs as queens leave the colony accompanied by a number of workers who aid in the establishment of a new colony.

Budding often produces more colonies than the original one that provoked the use of pesticides.

The entire life cycle of workers is complete in 38 to 45 days at room temperature, and life span is about 60 to 70 days. There may be twelve or more pharaoh ant colonies in a building; however, only ten percent of the workers forage for food or water at any given time.

Pharaoh ants prey on bedbugs, and pose significant health threats, especially in hospitals. They may carry more than twelve different pathogenic disease organisms picked up from bedpans, toilets, drains, and washbasins. Once the ants are infected, pathogenic organisms quickly spread through the colony from direct contact as well as through food exchange.

PAVEMENT ANT *Teramorium caespitum (L)*

Pavement ants, originally from Europe and Asia, are distributed mostly in urban areas. They are common along the Atlantic seaboard, less common in the southern states and uncommon inland except in large cities such as Cincinnati and St. Louis. Pavement ants are rarely found in California. Although this ant does not compete well with native ants in rural areas, its range seems to be increasing.



Pavement Ant

The pavement ant is a small, .3 cm (1/8 in) long, blackish-brown species with two nodes on the petiole, a twelve-segmented antenna, a shiny abdomen, dull red-brown head and thorax. This is caused by minute, but easily visible parallel grooves. It has pale legs and antennae. The thorax bears two small spines on the top rear. Most complaints about small ants are caused by annoying pavement ants invading structures throughout the year, especially during summer when they get into everything from food to shoe polish.

Pavement ants nest outside under rocks, next to pavement edges, on door stoops and patios, and also establish colonies inside buildings between foundation and sill plates. This species enter through heating ducts, cracks in the slab and other open areas, and nest in wall voids and bathroom plumbing trap areas. Pavement ants may bite and sting causing an allergic reaction or rash.

Pavement ants store debris including sand, seed coats, dead insect parts, and sawdust from building construction in the nest, which the workers clean out when the nest needs to be expanded. This material is often seen in small piles on basement floors where it may be confused with carpenter ant frass. Pavement ants normally swarm in late spring, but large swarms may originate inside heated structures at any time of year.

Pavement ants are omnivorous scavengers with few food preferences, but they seek sweet and greasy materials, dead insects, and seeds. Outside, they tend honeydew-producing insects (root aphids and mealy bugs), and are often pests on eggplants, peanuts, and strawberries. Closely related, trailing species are often introduced via tropical plants into structures, where they flourish in warm, moist environments.

ODOROUS HOUSE ANT (*Tapinoma sessile [Say])*

The odorous house ant is a trailing, non-stinging, native species that occurs in all 48 continental states from sea level to over 10,000 feet in elevation. It has a single node on the petiole, is brownish to black in color, and .3 cm (1/8 in) long. Colonies are multi-queened and seldom swarm. The odorous house ant (and the Argentine ant) is probably the most common found in North American buildings. It is primarily distinguished from the Argentine ant by a darker color and an unpleasant odor when crushed.

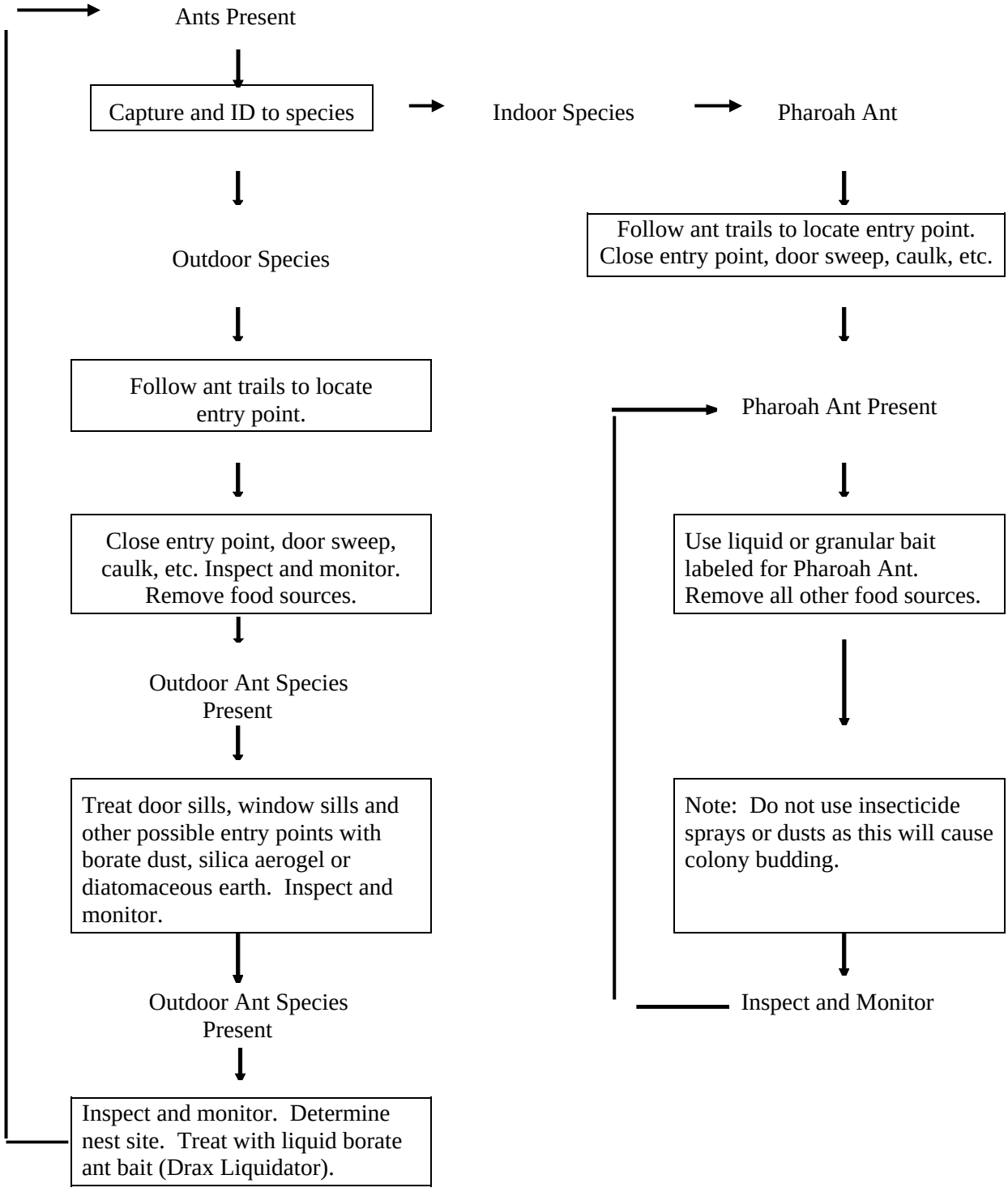


Odorous House Ant

Outside, odorous house ants tend honey-dew-producing insects. Inside, workers prefer sweets but, strangely, sweet baits are seldom effective. Although this ant may invade structures at any time of the year, it becomes an indoor pest at the start of the rainy season, when aphids and honeydew are washed down from plants by rain, and then again late in the year when leaves fall.

Odorous house ants nest outside, are usually shallow and located under boards or stone. Indoors, the nests are found in walls, woodwork, under floors (especially around heat sources), and sometimes in old termite tubes.

ANTS


Ants Present
Capture and ID to species
Indoor Species
Pharoah Ant
Follow ant trails to locate entry point. Close entry point, door sweep, caulk, etc.
Outdoor Species
Follow ant trails to locate entry point.
Pharoah Ant Present
Close entry point, door sweep, caulk, etc. Inspect and monitor. Remove food sources.
Use liquid or granular bait labeled for Pharoah Ant. Remove all other food sources.
Outdoor Ant Species Present
Treat door sills, window sills and other possible entry points with borate dust, silica aerogel or diatomaceous earth. Inspect and monitor.
Note: Do not use insecticide sprays or dusts as this will cause colony budding.
Outdoor Ant Species Present
Inspect and Monitor
Inspect and monitor. Determine nest site. Treat with liquid borate ant bait (Drax Liquidator).

BROWN ROT

Wood rots are a group of microscopic organisms (fungi) that discolor and decay wood. These fungi are unable to produce their own food so they feed upon natural organic substances such as wood and paper, etc. Fungi fruiting bodies release many spores that are moved by wind and rain. When the spores land on wood in the presence of water, they germinate, sending out thread-like hyphae. Enzymes secreted by the hyphae break down organic matter in wood so the fungi can use it for food. For fungi to use wood for food, it must have oxygen, 4 – 38ºC (40 – 100ºF) temperature range, a supply of moisture and a food source – wood.

Brown rot fungi feed on the wood's cellulose, a component of the cell wall. The fungi leave behind the brown lignin, which holds the wood cells together. Infested wood may be greatly weakened and becomes a darker brown than normal. Brown rot causes wood to crack across the grain and shows cubical checking. When brown rot damaged wood is dried, it will turn to powder when crushed. Brown rot that has dried is sometimes called dry rot.



Brown Rot Fungi

Treating wood with borates (BoraCare or TimBor Pro) will prevent brown rot and stop brown rot from further damaging the wood.

WHITE ROT

Wood rots are a group of microscopic fungi that attack and decay wood. These fungi cannot produce their own food so they feed on natural organic substances such as wood and paper, etc. Fungi fruiting bodies release spores that are carried by wind or rain until it reaches a susceptible substrate. When the spores land on wood where there is oxygen and 4 – 38ºC (40 – 100ºF) temperature, they germinate and send out hyphae to break down wood for its nutrients.



White Rot Fungi

When white rot attacks wood, it breaks down both lignin and cellulose causing the wood to lose its color and appear whiter than normal. Wood infested with white rot will shrink and collapse, eventually losing its strength and becoming spongy. Wood with white rot usually does not crack across the grain.

Wood treated with borates (BoraCare, TimBor Pro) will prevent white rot from infesting wood and/or stop further damage to the wood from white rot.

WATER-CONDUCTING FUNGUS, *Poria incrassata*

Poria can attack wood without the initial presence of water. This wood rot fungus can transport water for several feet through large root-like structures called rhizomorphs. When established, it can quickly spread through a building and destroy large portions of the structural wood.

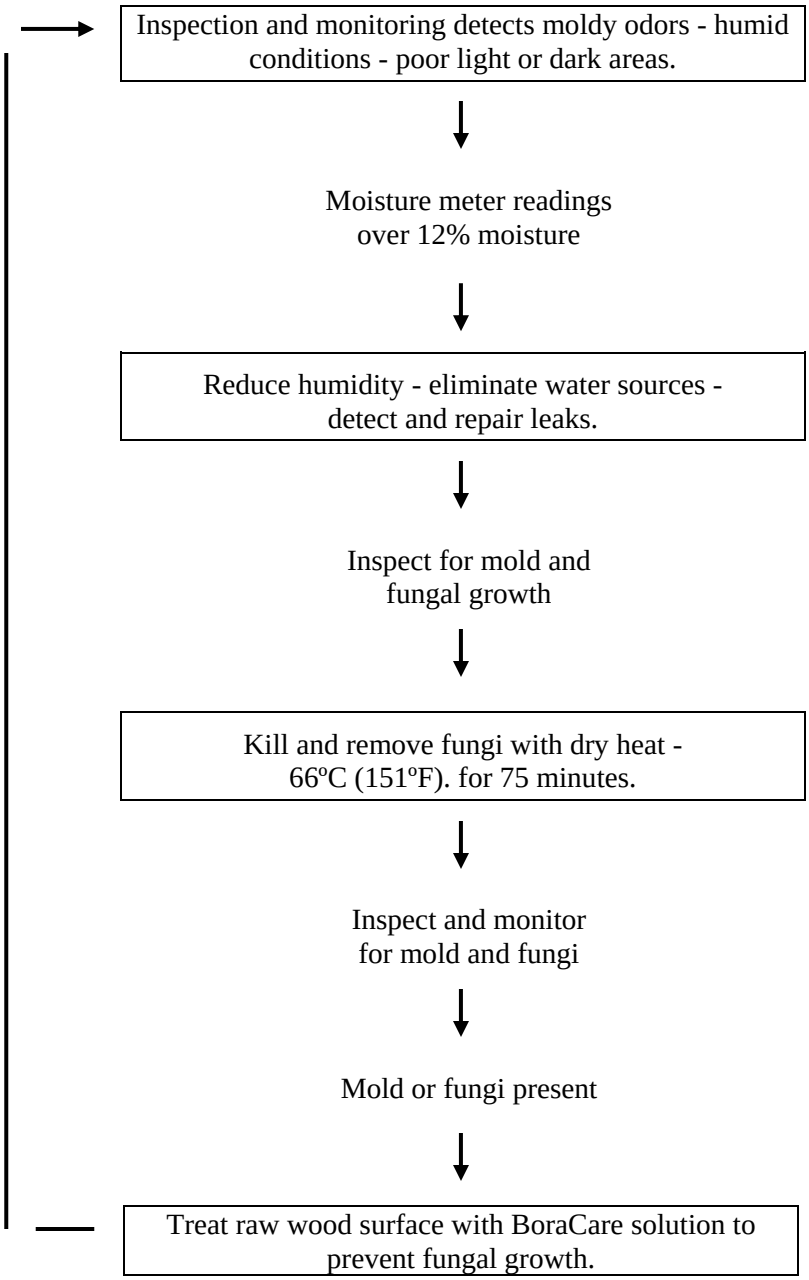


Poria incrassata

Typically, *Poria* infestations start in dirt-filled porches, damp crawlspaces and basements or where wood is in contact with soil. It can also begin in moist concrete or damp bricks. At first, yellowish mycelial fans grow over the surface of wood and other moist areas. The rhizomorphs are small hair-like hyphae that can grow to 2.54 cm (1 in) or more in diameter in older infestations. When *Poria* infested wood dries, it usually shrinks and cracks across the grain.

Wood treated with borates (BoraCare, TimBor Pro) will prevent *Poria* from infesting wood and/or stop further damage to the wood from *Poria.*

MOLDS AND FUNGI



HOUSE MOUSE

INTRODUCTION



House Mouse *Mus musculus*

The house mouse (*Mus musculus*) easily adapts to living with people. It thrives in a wide range of climatic conditions in a great variety of habitats, feeding on most human food, and reproducing at a remarkable rate. House mice subsist throughout the United States, and are found in most areas of human habitation. They are also found living in the wild. They are common inhabitants of grassy fields, and a problem in residences and structures. Not only does the house mouse destroy food and cause damage to structures and personal possessions, it also has the potential to transmit diseases and parasites to people and domestic animals.

CHARACTERISTICS AND RECOGNITION

The house mouse is a delicate, agile little rodent. Adult weights vary by region and usually range from 14 – 28 gr (1/2 – 1 oz). Adult house mice vary in color from light brown to dark gray, but most often are a dusky gray or medium brown over most of their bodies, except the belly, which may be a slightly lighter shade of their general color but never white. The mouse has moderately large ears for its body size. The tail is nearly hairless and about as long as the body and head combined (6.35 – 10.16 cm (2 1/2 – 4 in). The feet are small in proportion to its body, and the eyes are also relatively small.

Under optimum conditions, house mice breed year round. Out-of-doors, house mice may tend toward seasonal breeding, peaking in the spring and fall. Environmental conditions, such as the availability and quality of food, can influence the frequency of pregnancy, litter size, and survival. Females may produce as many as ten litters of five young in each litter in a year. At very high densities, however, reproduction may nearly cease despite the presence of excess food and cover.

Newborn mice are quite undeveloped, weighing between .57 – .85 gr (.02 – .03 oz) and are nearly hairless. Their eyes and ears are closed, but within two weeks the body is covered with hair and the eyes and ears are open. At about three weeks, the young begin short trips away from the nest and begin taking solid food.

While mice primarily are active at night, some day activity occurs. Movements of house mice are largely determined by temperature, food, and hiding places. Home ranges of mice tend to be smallest where living conditions are good. Mice tend to travel over their entire territory daily, investigating each change or new object that may be placed there. They are very aggressive.

They show no fear of new objects. They dart from place to place, covering the same route over and over again. This behavior can be used to advantage in management programs. Disturbing the environment at the beginning of a program by moving boxes, shelves, pallets, and other objects can improve the effectiveness of traps. Mice will investigate the changed territory thoroughly.

Mice have relatively poor vision, and are also color blind. They rely heavily on smell, taste, touch, and hearing. Mice use their keen sense of smell to locate food and to recognize other individuals, especially those of the opposite sex. Taste perception in mice is also good. Mice use their acute hearing to detect and escape danger. An important sensory factor for mice is touch. Mice use long, sensitive whiskers near the nose and guard hairs on the body as tactile sensors to enable them to travel in the dark, pressing against walls and boxes, scurrying through burrows.

It is a challenge to mouse-proof a building or manage mice without understanding their physical capabilities. For their size they are excellent jumpers. They can jump against a wall or flat vertical surface, using it as a spring board to gain additional height. They can run up almost any vertical surface including wood, brick walls, metal girders, pipes, weathered sheet metal, wire mesh, and cables without difficulty if the surface is rough. They can run horizontally along insulated electrical wires, small ropes, and the like, with ease. They can squeeze through openings slightly more than .64 cm (1/4 in). They are quick to explore any physical change in their environment.

House mice prefer cereals over other items, although they feed on a wide variety of foods. Mice satisfy much of their water need with moisture in their food, but they drink if water is readily available. Mice have two main feeding periods, at dusk and just before dawn, and they are nibblers, feeding twenty or more times during evening rounds. In any territory there will be one or two feeding sites, dark and protected, where mice eat more than at other places.

Mice are territorial and seldom travel more than thirty feet from their nest. When food is nearby, mice may restrict their activity to a few feet. Males average slightly larger ranges than do the females. House mice may nest in any dark, sheltered location, in nests approximately 10.16 cm (4 in) in diameter and constructed of fibrous, shredded materials such as paper, cloth, burlap, insulation, or cotton, which generally look like a loosely woven ball. Outdoors, house mice sometimes dig and nest in small burrows.

HAZARDS OF INFESTATION

When mice infest stored food, the greatest loss is not what mice eat, but what is thrown out because of real or suspected contamination. Mice also damage personal property and structures by gnawing, including electrical wiring in buildings. House mice frequently take up residence in electrical appliances and end up chewing into the power supply.

House mice and their parasites are implicated in the transmission of a number of diseases. Salmonellosis can be spread when some foods are contaminated with infected rodent feces.

Mice are probably more responsible than rats for the spread of this disease. *Rickettsia akari* is the causal agent of Rickettsialpox, a disease causing a rash similar to chickenpox. Rickettsialpox is transmitted from mouse to mouse, then to people by the bite of the house-mouse mite. Lymphocytic Choriomeningitis is a virus infection of house mice that may be transmitted to people (mainly to children) through contaminated food or dust. The mouse can also be a major carrier of Leptospirosis (Weil's disease). Rat-bite fever can be transmitted by house mice, as can ray fungus, *Actinomyces muris*. Certain tapeworms are spread in house-mouse droppings, and ringworm, a skin fungus disease, can be carried to human beings by mice or contracted indirectly from mice through cats. Tularemia has also been linked to house mice.

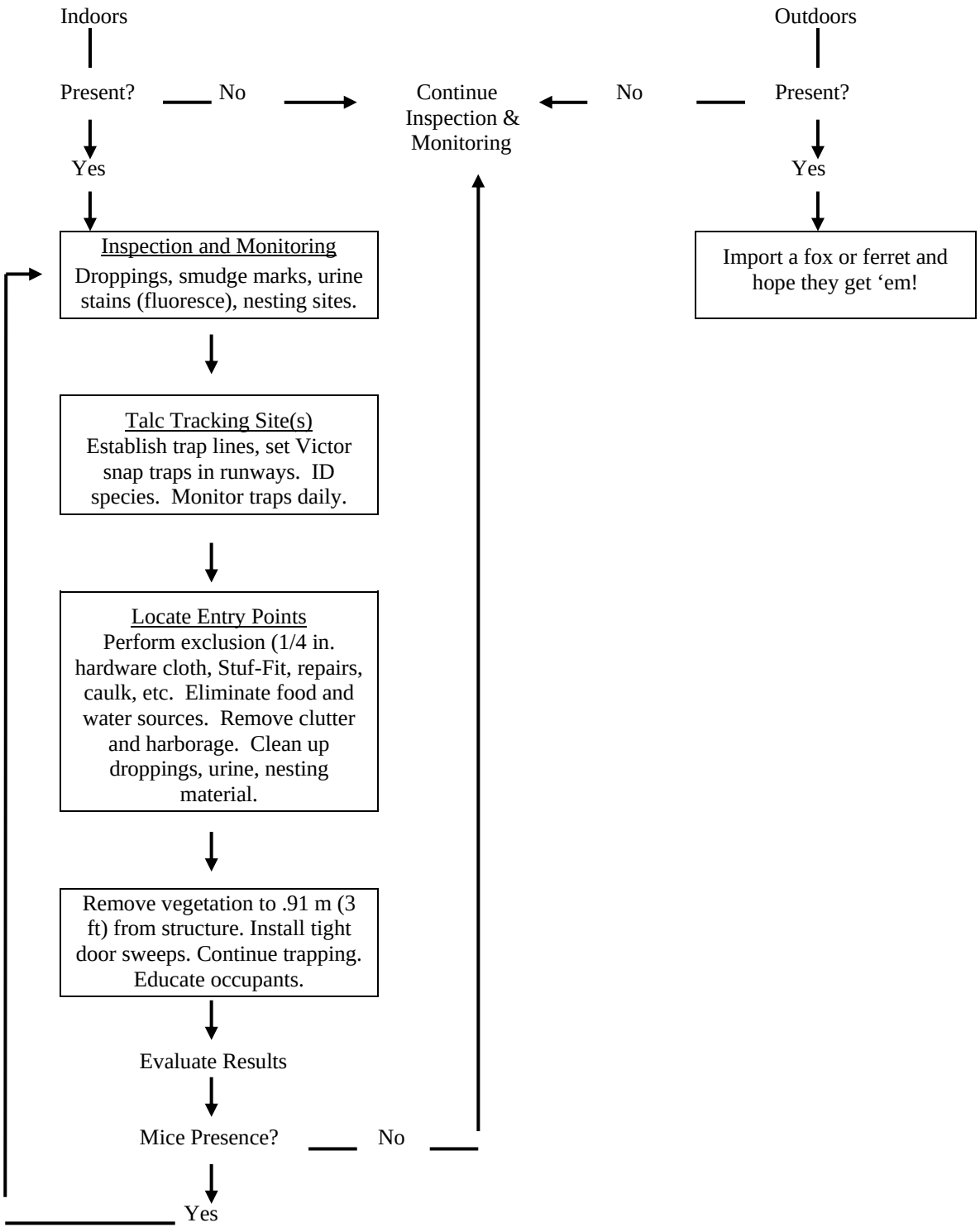
INSPECTION AND MONITORING

Sounds are common at night where large numbers of mice are present. Listen for squeaks, scrambling, and sounds of gnawing. An electronic stethoscope is useful.

Mouse droppings are frequently the first evidence that mice are infesting. Large cockroaches, bats, and other species of mice such as deer mice (*Peromyscus* sp.) and meadow mice (*Microtus* sp.), may produce droppings similar to those of house mice. Look along runways, by food, near shelters, and in other places mice may frequent. House mice occasionally make small mounds known as "urinating pillars." These consist of a combination of grease, urine, and dirt, and may become quite conspicuous. Look for many small drops of urine using a black light, since urine stains will fluoresce under ultraviolet light.

Like rats, mice produce greasy smears where dirt and oil from their fur mark pipes and beams. Recent gnawing damage on wood is light in color and will turn darker with age. Look for enlarged cracks beneath doors and small tooth marks. Such evidence frequently helps to distinguish between mice and rats. Look for wood chips with the consistency of coarse sawdust around baseboards, doors, basement windows and frames, and kitchen cabinets.

HOUSE MICE


Indoors
Present?
No
Continue Inspection & Monitoring
No
Outdoors
Present?
Yes
Yes
Inspection and Monitoring
Droppings, smudge marks, urine stains (fluoresce), nesting sites.
Import a fox or ferret and hope they get 'em!
Talc Tracking Site(s)
Establish trap lines, set Victor snap traps in runways. ID species. Monitor traps daily.
Locate Entry Points
Perform exclusion (1/4 in. hardware cloth, Stuf-Fit, repairs, caulk, etc. Eliminate food and water sources. Remove clutter and harborage. Clean up droppings, urine, nesting material.
Remove vegetation to .91 m (3 ft) from structure. Install tight door sweeps. Continue trapping. Educate occupants.
Evaluate Results
Mice Presence?
No
Yes

DEER MOUSE / WHITE FOOTED MOUSE

The native deer mouse (*Peromyscus maniculatus* [Wagner]) is the rodent in the United States that most commonly carries the Hantavirus, and is implicated in most of the cases of human infection by this strain. The white-footed mouse *(Peromyscus leucopus* [Raphinesque]) also carries Hantavirus. The deer and white-footed mice are also the most likely native rodents to be found in or near buildings. The deer and white-footed mice often invade homes and structures that are closed for the season. If outside populations are large, structures may have numerous *Peronyscus sp.* present, which may result in substantial amounts of saliva, urine and droppings with the Hantavirus aerosolized into the interior air and in dust. The opportunity for human exposure is great when the structure is reopened for use. See Introduction to Mice for Hantavirus remediation.



Deer Mouse *Peromyscus maniculatus*

CHARACTERISTICS AND RECOGNITION

Appearance

The deer mouse is the most widely distributed and the most variable member of the genus. Color ranges from pale grayish buff to deep reddish brown. The tail is always sharply bicolored, dark above and white below. Head and body are 7.11 – 10.16 cm (2 4/5 – 4 in) long and the tail is 5.08 – 12.7 cm (2 – 5 in). The deer mouse weighs only 19 – 35 gr (2/3 – 1 1/4 oz). The eyes and ears are moderate size and prominent and the tail is covered with short fur.

Habitat and Habits

The deer mouse is versatile and occupies nearly every dry land habitat within its range from forests to grassland and a mixture. With the exceptions of Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana, the deer mouse can be found throughout the continental United States (including part of Alaska) and Canada. In the east, deer mice are found from the Hudson Bay south to Pennsylvania and the southern Appalachians. They build a large globular nest in burrows in the ground, in trees and stumps, and buildings. The deer mouse feeds on seeds, nuts, acorns, berries, small fruits, and adult and larval insects, and can carry food in a cheek pouch to be stored in its nest. The home range is one-half to three acres or more. A summer population of 10 to 15 per acre is high, although they may congregate in winter. They rarely live more than two years in the wild. Females may show territorial behavior in the breeding season, which may vary with latitude, normally February to November. There may be two to four litters per year with one to eight naked and blind young



White-footed Mouse
Peromyscus leucopus

(usually three to five) per litter. Gestation period is 21 – 27 days. Deer mice are nocturnal, feeding mostly at dusk and dawn. They are excellent climbers and fast runners.

Appearance

The white-footed mouse is found in the east from Maine south to Georgia. Identifying the various species of *Peromyscus* may require a rodent taxonomist. The white-footed mouse is bicolored with the upper parts grayish to rich reddish-brown, with the belly and feet white. The tail is also bicolored. The head and body length are about 1.4 – 10.5 cm (3 9/16 – 4 1/8 in), tail length is 6.2 – 10.2 cm (2 7/16 – 4 in). Ears are small, 1.3 cm (1/2 in) and weight is about 10.6 – 42.5 g (3/8 – 1 1/2 oz).

Habitat and Habits

White-footed mice are nocturnal. They build nests in concealed locations such as old bird or squirrel nests, burrows, stumps, logs or buildings. They feed on seeds, nuts, fruits, beetles, caterpillars and other insects. Caches of seeds and nuts are stored near the nest. Home range is 1/2 – 1 1/2 acres. They are active year around. Females have two to six young per litter, and two to four litters per year. The gestation period is 21 – 24 days and females can begin breeding at 10 – 11 weeks old. The lifespan is two to three years in the wild.

INSPECTION AND MONITORING

Droppings

Observing droppings indoors where native mice have tunneled, fed and nested are telltale signs of their presence. Outdoors runways in grassy areas may be observed, and droppings may also be present. Fresh mouse droppings are dark and shiny, then turn dull and gray as they age. Large numbers of droppings in a small area indicate a feeding or resting site. Droppings and urine will also be found in the nest.

Runways

Outdoors runways may be distinct as grass is clipped and the trail may show. Inside the runways that are being used will show as dust free areas, usually next to walls or other objects.

Tracks

Outdoors in soft soil or dirt areas look for tracks and tail marks in the dust. Deer and white-footed mice (and others) have large hind feet with five toes and small front feet with four toes. Indoors a non-toxic tracking patch (talc) 15.24 x 25.4 cm (6 x 10 in) and .15 cm (1/16 in) deep can be placed on the floor to determine activity. Place several patches in the area near possible food sources, or other critical areas.

Visual Sightings

If possible, make observations at night as most *Peromyscus* are nocturnal. Use a powerful flashlight or spotlight to check storage spaces or other food or harborage sources. Disturbed mice will rapidly run to shelter.

PEST MANAGEMENT MEASURES

Management of native mice consists of preventive measures such as exclusion, sanitation, habitat modification, and population reduction with snap traps.

Exclusion

If you keep them out, they can't get in! Exclusion may be the most important aspect of native mouse management. All holes, cracks, crevices or other openings larger than .3 cm (1/8 in) must be filled, covered or otherwise blocked to keep mice out.

As the native rodents can gnaw through wood or other soft substances, burrow into soil, and are good climbers, keeping the structure in good repair is important. Use hard material such as metal flashing, concrete and 1/8 in. hardware cloth for exclusion. Doors and windows should also close tightly.

Sanitation

Keep food and water in clean, tightly closed containers that are resistant to rodent attack. Removal of clutter and debris will also deter rodent activity. If rodents are suspected or observed inside the structure, very strict procedures need to be followed.

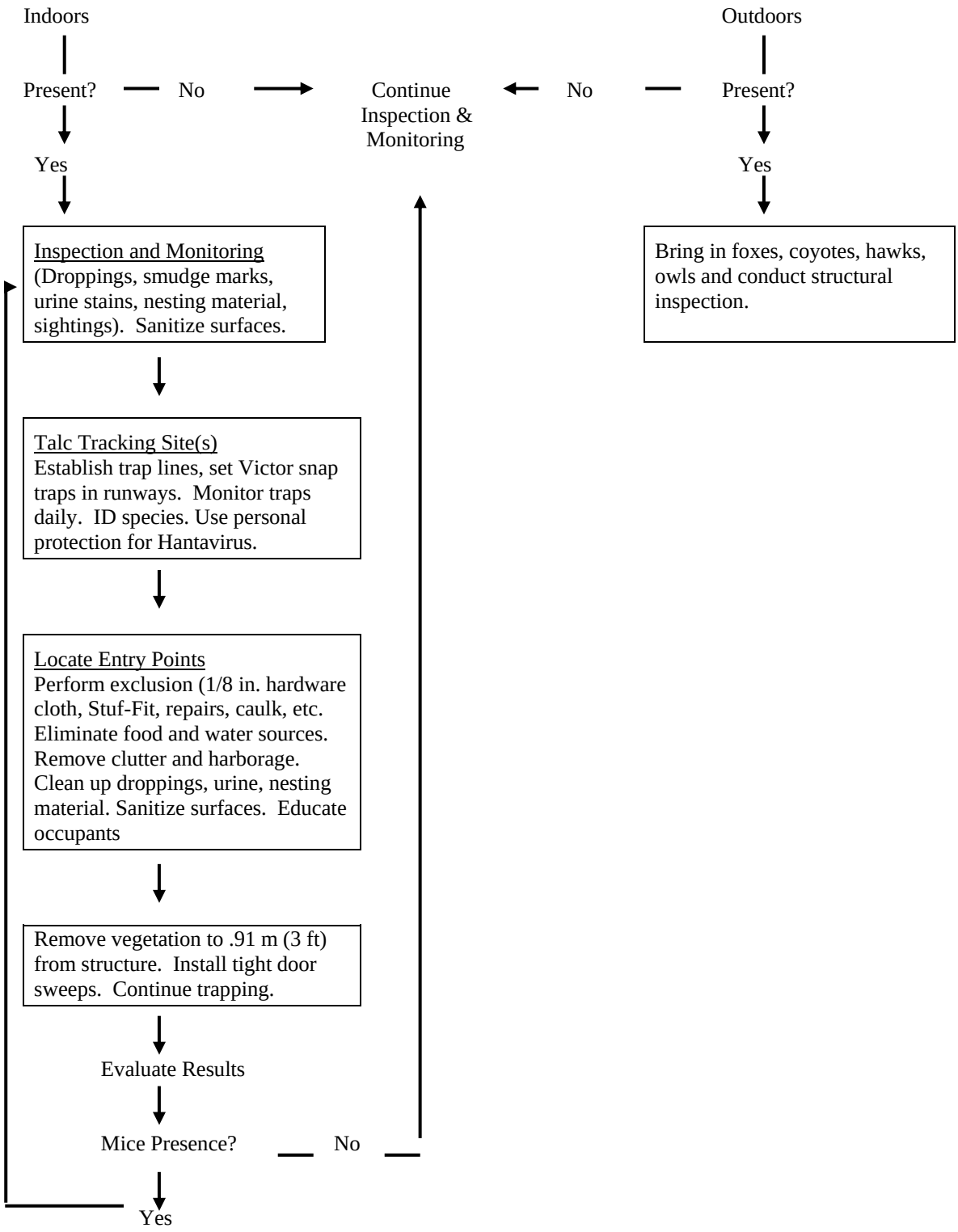
Habitat Modification

Another preventive or remedial measure that can be taken outdoors to reduce the opportunity for rodent/human exposure is to remove brush, weeds and other materials from around structures to reduce protected hiding places for rodents. Modifying protective cover makes native rodents more susceptible to predation by hawks, owls and other natural predators. A gravel barrier 10.16 – 15.24 cm (4 – 6 in) deep and .91 m (3 ft) wide next to the structure reduces rodent intrusion.

Trapping

Because of the risk of exposure to the Hantavirus, if native rodents are dwelling inside structures, lethal force in the form of snap traps is recommended. Do not use live traps. Do not use rodenticides or other toxic means for rodents inside structures. Baits that may be used in the snap traps are seeds such as conifer seed, chunky peanut butter, sunflower seed, oats, or cotton balls (plain or with vanilla flavor). Traps should be placed in observed runways or near resting and feeding sites. Check traps daily. Wear rubber or plastic gloves when handling killed mice. Remove dead mice and treat with a disinfectant to kill Hantavirus.

DEER / WHITE-FOOTED MICE



RATS

INTRODUCTION

A few vertebrates, such as rats and mice, are common pests in urban sites. Others may occasionally become pests when their presence conflicts with human use of a space.

Public concern for animal welfare and the potential risk from vertebrate poisons to people, pets, and other non-targets have made rules governing vertebrate pest management particularly strict. Laws and regulations at state and local levels may be more restrictive than federal regulations. The pest manager should ensure that the applicable regulations are satisfied.

CHARACTERISTICS AND RECOGNITION

Rats have caused more human suffering and economic damage than any other vertebrate pest. It is estimated that rats destroy 20% of the world's food supply every year, by feeding on or contaminating it. Rats have adapted to nearly all human environments. They live in granaries, fields, city sewers, attics, basements, street trees, on roofs, and food storage areas.

Rats can leap 1 m (3 ft) straight up and 1.22 m (4 ft) horizontally. They can scramble up the outside of a pipe 6.62 cm (3 in) in diameter, climb inside pipes of 3.81 – 10.16 cm (1 1/2 – 4 in) in diameter, and walk between buildings on telephone or power lines. Rats can swim through a half mile of open water, tread water for up to three days, swim against a strong current in a sewer line, and dive through a sewer trap to pop up inside a toilet. They can fall more than 15.24 m (50 ft) and survive.

Rats gnaw constantly to wear down their teeth which continue to grow, and their teeth are extremely hard. They commonly chew through building materials such as concrete block, aluminum siding, sun-dried adobe brick, wall board, wooden cabinets, lead sheathing, asphalt paving, and plastic or lead pipes. An adult rat can compress its body and squeeze through a 1.27 cm (1/2 in) opening.

Rats are very wary. Hundreds may be nesting in a city block, in underground burrows, in sewers, on roofs, inside buildings, and few people in the area will realize it. Their populations may be excessive.

Successful long-term rat management is not simple. The key is to manage the environment of rat populations, not individual rats. Rat management requires an integrated approach that includes non-lethal tools such as careful inspection, upgraded sanitation, and rat-proofing structures to exclude rat entry. Lethal methods may also combine the use of low-risk measures such as snap traps or Rat Zappers.

HAZARDS OF INFESTATION

Rats as Disease Carriers

Rats are responsible for the spread of many diseases. Sometimes they transmit the disease directly, by contaminating food with their urine or feces. At other times they transmit disease indirectly; for example, fleas may first bite an infected rat, then a person. Following are some typical diseases associated with rats.

Plague

The "Great Plague" of London killed half of the city's population. The "Black Death" of Europe lasted 50 years in the 14th Century and killed 25 million people. In the first quarter of this century, an estimated 11 million people died in Asia from plague. The disease is transmitted to human beings primarily by the oriental rat flea. The flea bites an infected rat and then, while feeding on people, inoculates them with the bacteria that cause disease.

Although no major urban outbreak of plague has occurred since 1924, this is not a disease of the past. A reservoir of plague exists in some populations of wild rodents in several western states, and human beings contacting these rodents could contract the disease. As suburbia expands into undeveloped areas, wild rodents can transmit the disease to urban rats. There is a concern that an outbreak of urban plague could occur in the United States.

Rat-Bite Fever

Rats bite thousands of people each year; most bites occur in inner cities. In some cases victims, particularly infants and bed-confined elderly, are bitten in the face while sleeping. Those who are bitten may develop rat-bite fever from the bacteria carried on the teeth and gums of rats. Although the disease is similar to flu, it can be fatal. It is of particular risk to infants.

Salmonella Food Poisoning

Rats frequent sewers, rotting garbage, cesspools, and similar sites where salmonella bacteria thrive. Rats can infest stored food or leave bacteria on dishes, silverware, or food-preparation surfaces, and thus transmit Salmonella food poisoning to people.

Leptospirosis or Weil's disease

This disease is seldom fatal to people. The disease organisms are spread from rat urine to water or food, and affect people through mucous membranes, minute cuts, and abrasions of the skin.

KINDS OF RATS

In the United States, the two typical species of rats are the Norway rat (*Rattus norvegicus)* and the roof rat (*Rattus rattus*). The Norway rat is also called the brown rat, house rat, sewer rat, and wharf rat. The Norway rat is considered the most common in the U.S. and is found in every state. The roof rat, also called the black rat, ship rat, and Alexandrine rat, is found primarily in coastal areas including California, Washington, Oregon, the Southeast and Middle Atlantic States, and the Gulf States.

The two species look similar, but there are noticeable differences. In general:



Norway Rat Climbing A Wall



Norway Rat (*Rattus norvegicus)*

A Norway rat looks sturdier than the roof rat; the roof rat is sleeker.

A mature Norway rat is 25% longer than a roof rat, and weighs twice as much.

A Norway rat's tail is shorter than the length of its head and body combined; a roof rat's tail is longer than its head and body.

A Norway rat's ears are small and covered with short hairs; a roof rat's ears are large and nearly hairless.

A Norway rat's snout is blunt; the roof rat's snout is pointed.

HABITS OF RATS

The knowledge of the life history, habitat, food requirements, patterns of behavior, range, and other factors is essential to the management of rat infestations. Since Norway and roof rats have similar habits, these discussions apply to either species.



Roof Rat *(Rattus rattus)*

Life Cycle

A mature female rat can give birth to about twenty young in a year (four to six at a time), if she lives that long. The average life span of a rat in the field is less than one year, although females live longer than males.

The young are born in a nest. They are hairless, and their eyes and ears are closed. Within two weeks their eyes and ears open, they become furry and rat-like, and they begin exploring the nest area. In the third week they begin to eat solid food, and imitate their mother in foraging, escaping, and watching for danger.



Roof Rat *(Rattus rattus)*

If the mother rat has become wary of rodenticides or traps, many of her young will learn to avoid them. This learning experience can make management difficult in sites where long-term rodent-baiting programs have been unsuccessful in the past.

Young are totally weaned at four or five weeks old, when they weigh about 45.52 g (1 1/2 oz), and at the age of three months, the young are independent of their mother. They will mate and continue the cycle in the same location, or will migrate to a new area.

Social Behavior

Rats live in colonies with well-defined territories that they mark with urine and glandular secretions. The colony has a complex social hierarchy with a dominant male leader and a "pecking order" of subordinate males and ranking females. The strongest and most dominant animals occupy the best nest and resting sites, and feed at their leisure. Weaker, subordinate rats are pushed out to less favorable sites, or forced out of the territory completely.

Rats are aggressive, and social conflicts are most common at feeding sites, prime resting areas, and territorial boundaries. Females fiercely defend their nest and young from other rats.

Rat Senses

<u>Vision, Touch, Taste, Balance</u>

Rats have poor vision. They are nearly color blind, and react to shapes and movement rather than identifying objects by sight. 9.14 – 13.72 m (30 – 45 ft) is the limit of their vision, and their eyes are adapted to dim light. Other senses, however, compensate for poor vision. They use their sensitive noses to locate food, follow pathways, tell whether another rat is friend or foe, and identify new objects in their territory. They use long whiskers and guard hairs to "touch" their way through dark burrows, pipe chases, wall voids, and other runways. Their ears detect faint sounds that signal danger. Rats can taste certain chemicals at a parts-per-million concentration.

This explains why rats often reject baits or avoid traps that have been contaminated with insecticides. Rats have an excellent sense of balance which allows them to walk on wires and always land on their feet in a fall.

Fear of New Objects (Neophobia)

Rats are wary of anything new that appears in their territory. A bait station, a trap, or a block of wood will be avoided for a few days until the rats become familiar with the new object. Even then, they approach cautiously. This fear of new objects can make baiting and trapping difficult. Rats will avoid poison bait when it is first placed. Later, they may nibble warily. If the poison bait makes them ill, but doesn't kill them, they will subsequently avoid similar baits or stations.

Food and Water

Rats need about one ounce of food daily. Norway and roof rats prefer different types of food. Norway rats prefer protein-based foods such as meat, fish, insects, pet food, nuts, and grain. Household garbage is ideal food for Norway rats. Roof rats prefer plant materials such as fruits, nuts, seeds, berries, vegetables, and tree bark. They occasionally feed on garbage and meats. Both rat species will feed on non-preferred food if nothing else is available.

Rats may hide or hoard food in hidden areas. This food may or may not be eaten when other food supplies run short. Hoarding food is important for three reasons. First, rats may be moving toxic bait into areas where perhaps the label does not permit its use. Second, rats may be hoarding poison bait while feeding on their regular food. In this case, a baiting program becomes ineffective. Third, hidden food may become a focal point for insect infestations.

Rats need water every day. The amount varies, depending on the moisture content of their food, but is usually around 14.17 – 28.35 g (1/2 – 1 fl oz). Rats prefer to nest where water is available.

Range

Rats usually begin foraging after dark. Most of their food gathering occurs between dusk and midnight, but short bursts of restlessness and activity can occur anytime, day or night. Rats commonly travel 30.48 – 45.72 m (100 – 150 ft) from their nest looking for food and water and patrolling their territory. It is not unusual for a colony that nests outdoors to forage inside a building 30.48 m (100 ft) away.

Nests

Outdoors, Norway rats usually nest in burrows dug into the ground. The burrows are shallow (less than 45.72 cm [18 in]) and usually short (less than 1 m (3 ft), with a central nest. Extra "bolt holes" are used for emergency escapes. They are hidden under grass or boards or lightly plugged with dirt. Burrow openings are 5.08 – 10.16 cm (2 – 4 in) in diameter. Indoors, Norway rats nest inside walls, in the space between floors and ceilings, underneath equipment, between and under pallets, and in crawlspaces, storage rooms, and any cluttered area that is normally unoccupied. Norways prefer to nest in the lower floors of a building.

Roof rats commonly nest above ground, in trees, particularly untrimmed palm trees, and in piles of wood or debris, vine-covered fences, and stacked lumber. Overgrown landscaping is also a prime nesting area. Roof rats will sometimes nest in burrows if above-ground sites are limited and Norway rats are not nesting in the area. Indoors, roof rats prefer to nest in the upper levels of a building in the attic and ceiling voids, near the roof line. But at times, they also nest in the lower levels of a building.

Both species also nest in sewers and storm drains, and highly unusual nest sites and can have several "hotel" nest sites in an area. A rat may spend a week in its home base and then move for a day or two into a secondary "hotel" nest site. Norway rats have been shown, on occasion, to have a home range of up to twenty acres when these secondary nest sites were included in calculations.

INSPECTION AND MONITORING

There are many signs of a rat infestation which can assist the inspector in identifying where rats are feeding and nesting, their patterns of movement, the size of the population, and the extent of infestation. This helps to influence what management measures to use, where and how to use them, and how much effort is needed to manage the population.

Signs of Rats

An inspection using a powerful flashlight after dark is the best way to see live rats. Dead rats are signs of either a current or past infestation. Dried carcasses and skeletons may indicate an old infestation. Fresh carcasses may indicate a recent poison baiting. If rats are seen during the day, the rat population is probably high.

Sounds

Squeaks and fighting noises in a building, clawing, scrambling, or gnawing sounds in walls may indicate the presence of rats. Use a stethoscope or electronic listening device to help pinpoint such noises.

Droppings

A rat may produce 50 droppings daily. Roof-rat droppings are generally smaller (1.27 cm [1/2 in]) than the Norway rat's (1.90 cm [3/4 in]). The highest number of droppings will be found in locations where rats rest or feed. Determine if a rat population is active by removing old droppings, and then reinspect a few days to a week later for new droppings.

Look at the appearance of droppings to determine if rats are present. Fresh rat droppings are black, glisten and look wet, and have the consistency of putty. After a few days the droppings become dry, hard, and appear dull. After a few weeks, droppings become gray, dusty, and crumble easily. Note that sometimes old droppings moistened by rain may look like new droppings; however, if crushed, they will crumble.

Urine

Both wet and dry urine stains will glow blue-white under an ultraviolet light (black light). Use portable ultraviolet light, as used in the food industry, to identify rat urine on food and other items. Other substances besides rat urine also glow, which can be confusing, so proper use of this inspection method, takes practice.

Grease Marks

Oil and dirt rub off of a rat's coat as it runs along walls. Grease marks build up in frequented runways. Look for grease marks along wall and floor junctions, and at pipes, ceiling joists, and sill plates, where rats swing around obstacles. Grease marks are also found at regularly used openings in walls, floors, and ceilings. Fresh grease marks along baseboards are waxy.

Runways

Outdoors, rats constantly travel the same route. Their runways appear as beaten paths on the ground. Look for such paths next to walls, along fences, and under bushes and buildings. Indoor runways of rats may appear as well-polished trails which are free of dust.

Tracks

A rat's footprint is about 1.90 cm (3/4 in) long, and may show four or five toes. Rats may also leave a "tail drag" line in the middle of their tracks. Look in dust or soft moist soil. Place a tracking patch in suspected rat areas to show footprints. A tracking patch is a light dusting of an inert material such as clay, talc (unscented baby powder), or powdered limestone. Don't use flour, which may attract insect pests. A good patch size is 30.48 x 10.16 cm (12 x 4 in). Apply patches in suspected runways and near grease marks. When inspecting tracking patches, shine a flashlight at an angle that causes the tracks to cast a distinct shadow. Note that a tracking patch is not the same as a toxic tracking powder. Tracking powders are diluted rodenticides in dust form. Tracking patches use nontoxic dust. Do not use a toxic tracking powder to make a tracking patch.

Gnawing Damage

A rat's incisor teeth grow at a rate of about 12.70 cm (5 in) per year. Rats keep their teeth worn down by continuously working them against each other and by gnawing on hard surfaces. Look for gnawing damage on floor joists, ceiling joists, door corners, kitchen cabinets, and around pipes in floors and walls as evidence of rat infestation. Gnawed holes may be 5.08 cm (2 in) or more in diameter.

Nest Sites

Roof rats often nest or store food in the attics of buildings. Their nests may also be found in trimmed dense vegetation.

Burrows

Outdoors, rat burrows may be found singly or in groups along foundation walls, under slabs and dumpster pads, in overgrown weedy areas, beneath debris, and in embankments. Look for a burrow opening that is free of dirt, leaves, and debris. The openings may be covered with smooth, hard-packed soil. Look for rub marks at the opening, and soil pushed out in a fan-shaped pattern.

Fill the opening with a small amount of wadded-up newspaper or a few leaves and cover it with loose soil. Or, just kick in the open entrance to close it. If the rats are still using the burrow, they will reopen and clear the hole overnight. This is a good monitoring method to identify active burrows.

Pet Excitement

Cats and dogs may excitedly probe an area of floor or wall where rats are present, especially if the rats have recently invaded.

Odor

Heavy infestations have a distinctive odor which can be identified with practice. The odor of rats can be distinguished from the odor of mice.

Estimating Rat Numbers

It's not easy to tell how many rats are infesting a site. Rat signs, however, may categorize the population as low, medium, or high. In rat-free or low infestation conditions, no signs are seen. In the case of medium infestation, old droppings and gnawing can be observed and one or more rats are seen at night. No rats are seen during the day. When there is a high infestation, fresh droppings, tracks, and gnawings are common. Three or more rats are seen at night, and rats may be seen in the daytime as well.

MANAGEMENT

Most successful rat management programs use a combination of tools and procedures to reduce and eliminate a rat population. The methods combine habitat alteration and population reduction. Some of the tools, such as trapping, are lethal to the rat. Some tools are not. Rat-proofing by making building repairs or increasing the frequency of garbage pickup are examples of non-lethal management methods.

Sanitation

Rats may ignore bait since it can't compete with the rats' regular food. Reducing rats’ normal food supply encourages them to move to some other territory. This can be accomplished by closing or repairing open or damaged dumpsters and garbage containers, cleaning up food spills promptly, and not allowing food to be left out overnight.

Eliminate Hiding Places

Outdoors, remove plant ground covers such as ivy to .91 m (3 ft) from buildings. Remove high grass, weeds, wood piles, and construction debris that permit rats to live and hide adjacent to a building. Indoors, eliminate clutter in buildings and rarely-used rooms, basements, storage rooms, equipment rooms. Organize storage areas to remove clutter.

Rat-Proofing (exclusion)

The most successful long-term form of rat management is to build them out. Rat-proofing is an exclusion technique that makes it impossible for rats to get into a building.

Building Exterior

Seal cracks and holes in building foundations and exterior walls. Block openings around water and sewer pipes, electric lines, air vents, and telephone wires. Install 1/4 in. steel wire screen or hardware cloth on ventilation openings. Caulk and seal doors with door sweeps to ensure a tight fit, especially between door and floor threshold. Fit windows and screens tightly. Caulk and close openings on upper floors and the roof. Inspect under siding and repair damaged soffits. Repair breaks in the foundation below ground level.

Building Interior

Seal spaces inside hollow block voids or behind wallboard. Repair broken blocks and holes around pipes. Repair holes or stuff them with copper Stuf-Fit. Cover floor drains with sturdy metal grates secured firmly in place.

Trapping

Trapping for rodents is a widely used, low-risk method of rodent management. Trapping offers great usefulness and versatility in the form of snap or guillotine traps where toxicants cannot or should not be used. The snap trap is an effective method of killing rats when used correctly, and is advised for use inside structures. It has several advantages: there is less non target risk than from a toxicant bait; the pest manager knows instantly whether or not the trap has been successful; and trapping allows disposal of the carcass to eliminate hidden odor problems. Carcass disposal also eliminates the possibility of secondary infestation by blowflies and dermestid beetles that would feed on it. Traps should be strategically placed in sufficient number, otherwise rats will avoid them. Place bait on the unset trap for a few days until the bait is taken, then bait and set the trap.

Physical Condition of Traps

A trap physically incapable of holding a rodent should never be set out. Staples holding the spring should be firm; the trap jaw should be square and fit inside the trap base. The trigger mechanism should operate smoothly at the slightest touch. Use properly sized traps for the species to be managed: mousetraps for mice; rat traps for roof and Norway rats. The trap base should not be warped or the trap will rock when stepped on. If necessary, working parts should be lightly oiled with mineral or other inorganic oil, not machine oil. Traps should be kept away

from pesticides or other strong odors that might be repellent to the rodents. Don't clean a trap bloodied by a catch, since the odors enhance its acceptance. A shiny new trap increases the possibility of rejection in response to the "new object avoidance" instinct. For some situations, the best traps are those with enlarged bait pans (triggers) set for a light touch.

Enlarged Bait Pans

Some traps may need enlarged bait pans. Commercial traps with expanded bait pans are available, but the old style traps can easily be adapted with wire screen or light metal cut from metal cans or hardware cloth. The enlarged bait pan should be trimmed so that it is .63 cm (1/4 in) smaller than the trap jaw wire and securely fastened to the standard bait pan.

Placement of Traps

Traps with enlarged bait pans, if properly placed in runways, do not need to be baited, but baiting adds to their effectiveness. Smear peanut butter in the center of the bait pan, sprinkle oats lightly across the pan, or tie a nutmeat or dried fruit piece to the center of the pan. Meat, like sausage, bacon, or peanut butter is attractive to Norway rats, while fresh or dried fruit will draw roof rats. Cotton balls also are attractive to females of both rat species. Traps must be placed in the rodents' regular active runways, as indicated by the presence of feces, smears, or tracks.

Place light tracking patches of talc or other odorless, innocuous fine-particled material to find where the rodents are most active and place traps there. All traps should be set perpendicular to and across the runway so that the bait pan is in the runway, and against the wall or other vertical surface. Make narrow runways to force the animals to cross over the trap pan. Put traps in concealed places where rodents are more apt to be found rather than in places the trapper can easily reach. Trap the area heavily, every 3.05 – 3.66 m (10 – 12 ft). Map the locations so traps can be more easily recovered later or by someone else if necessary. Move traps to other areas after two weeks (the first area can be retrapped after a lapse of several weeks).

Adhere to good public relations practices, and pick up trapped animals as soon as possible (at least daily). In areas used frequently by the public, use trap stations to cover trapped animals in snap traps. This also protects them from accidental tripping by maintenance personnel. Don't place traps above food or food handling areas or in areas where pets or children can reach, as rat traps can break their small bones.

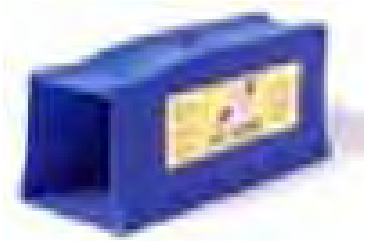
Leaving the traps unset for a few days may increase the catch by reducing the chance that wary rats will trip the traps without capture. Set traps with bait, if food for rats is in short supply and without bait if they have enough. When runways are located on rafters and pipes, set expanded trigger traps directly across them, fastening them securely to pipes with wire or hose clamps, and to rafters with nails. Use enough traps. Set five or ten traps in an active corner of a space. Set three traps in a row so that a rat, leaping over the first, will be caught in the second or third. If unsure about sites of activity, set traps along possible runways spaced ten to twelve feet apart.

Camouflage traps when only a few rats remain and are difficult to capture. Set traps in a shallow pan of meal, sawdust, or grain. In stubborn cases, expose food in shallow pans until the rats readily feed on it. Then add a buried trap. Inspect traps frequently to remove dead rodents and change old bait.



Victor Rat Trap

The Victor Snap Trap is the oldest trap and is still one of the most effective ways to humanely kill rats.


Rat Zapper

Rat Zapper 2000

The Rat Zapper 2000 is an electronic trap that humanely kills rats and mice. The trap is a battery-powered plastic tunnel that is attractive to rodents and provides a bait placement inside. When the rodent enters the tunnel for the bait and steps on a sensor plate, the rodent is given a lethal shock. Empty the trap by turning it upside down, allowing the dead rodent to slide out. A blinking red light alerts you to the dead rodent in the trap. Remote sensing is also available for multiple traps.

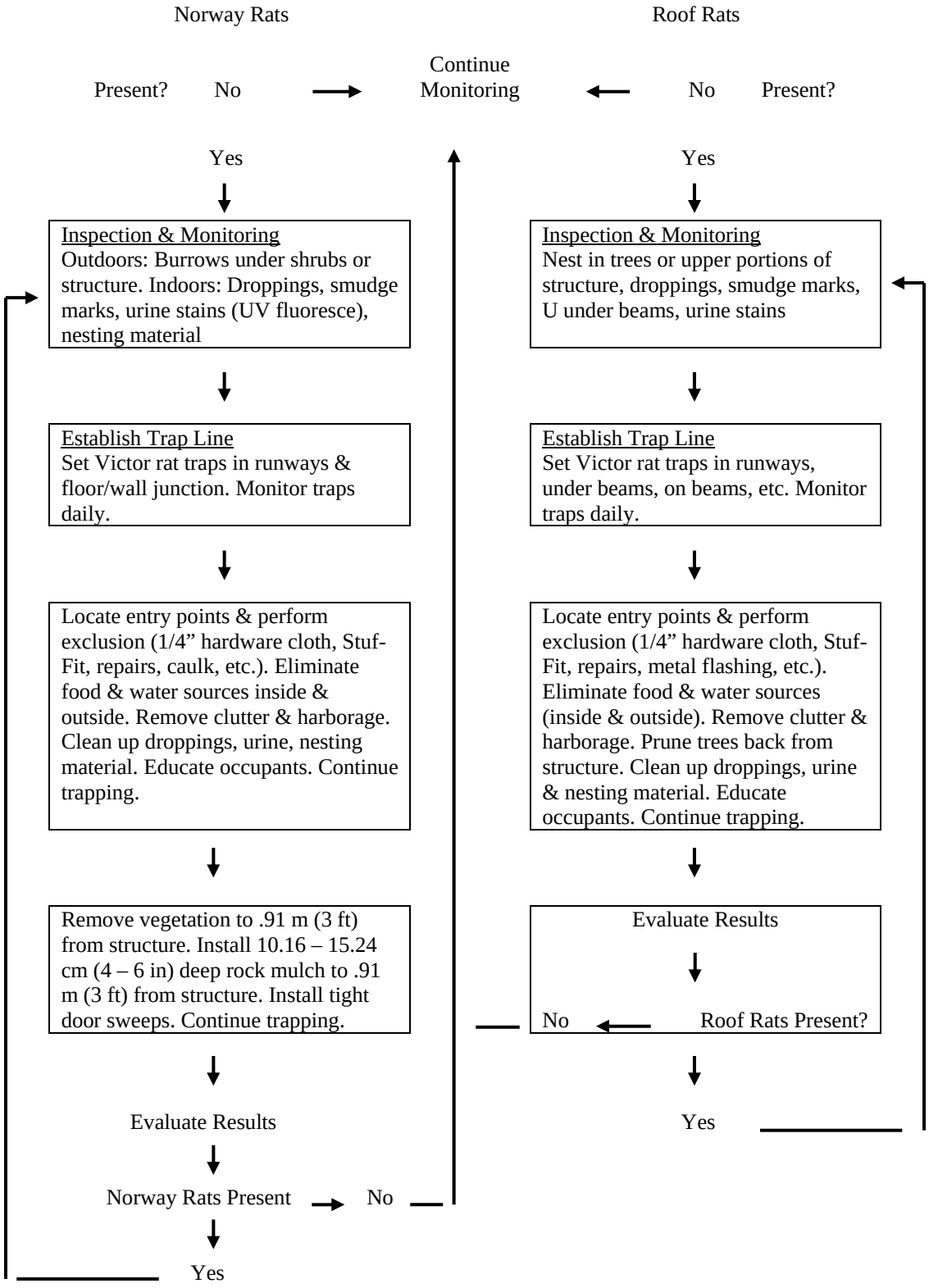
Glue Boards

Glue boards are not humane and must NOT be used on NPS sites.

Rodenticides

A rodenticide is a pesticide designed to kill rodents. Rodenticides are NOT recommended for use in NPS sites or other public areas.

RATS


Norway Rats
Roof Rats
Present?
No
Continue Monitoring
No
Present?
Yes
Yes
Inspection & Monitoring
Outdoors: Burrows under shrubs or structure. Indoors: Droppings, smudge marks, urine stains (UV fluoresce), nesting material
Inspection & Monitoring
Nest in trees or upper portions of structure, droppings, smudge marks, U under beams, urine stains
Establish Trap Line
Set Victor rat traps in runways & floor/wall junction. Monitor traps daily.
Establish Trap Line
Set Victor rat traps in runways, under beams, on beams, etc. Monitor traps daily.
Locate entry points & perform exclusion (1/4" hardware cloth, Stuf-Fit, repairs, caulk, etc.). Eliminate food & water sources inside & outside. Remove clutter & harborage. Clean up droppings, urine, nesting material. Educate occupants. Continue trapping.
Locate entry points & perform exclusion (1/4" hardware cloth, Stuf-Fit, repairs, metal flashing, etc.). Eliminate food & water sources (inside & outside). Remove clutter & harborage. Prune trees back from structure. Clean up droppings, urine & nesting material. Educate occupants. Continue trapping.
Remove vegetation to .91 m (3 ft) from structure. Install 10.16 – 15.24 cm (4 – 6 in) deep rock mulch to .91 m (3 ft) from structure. Install tight door sweeps. Continue trapping.
Evaluate Results
No
Roof Rats Present?
Evaluate Results
Yes
Norway Rats Present
No
Yes

EASTERN GREY SQUIRREL *Sciurus carolinensis*



Grey Squirrel

Eastern grey squirrels commonly occur in two color phases, grey and black, which leads people to think that there are two different species. Its most notable physical feature is its large bushy tail, which has important functions. It acts as a rudder when the animal jumps from high places, as a warm covering during the winter, as a signal to other eastern grey squirrels indicating an individual's mood, and perhaps as a sunshade. The tail can also be used to distract a pursuing predator.

The tracks of eastern grey squirrels are distinctive; forefeet leave a round print about 2.5 cm (1 in) long; the hind prints are more triangular, approximately 6 cm (2 in) long.

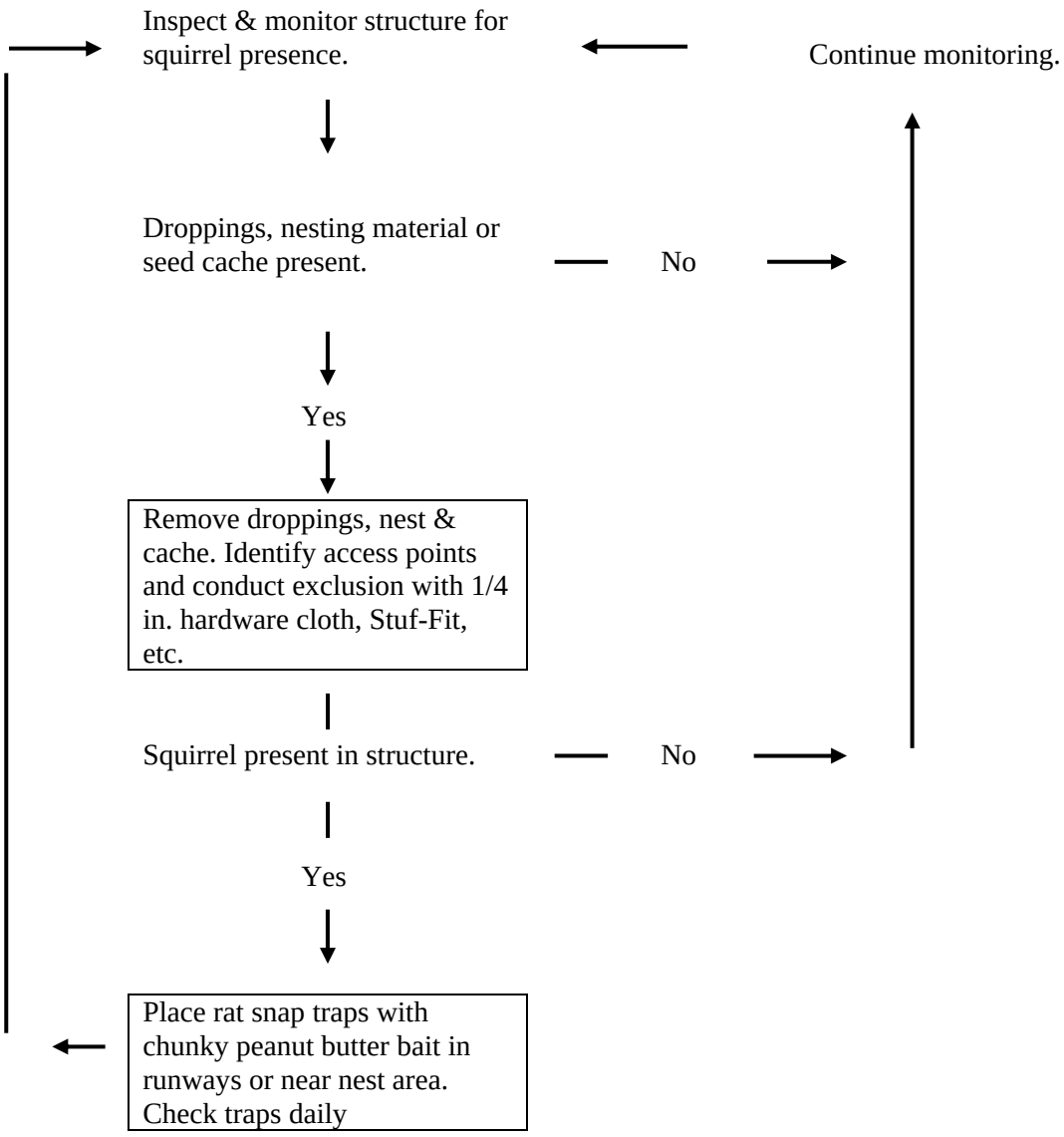
The eastern grey squirrel has two breeding seasons each year, the first in January and February and the second in June and July. Each of the mating periods lasts for about three weeks. Generally, only females over two years of age will breed in both seasons. Gestation takes 40 – 44 days. An average of three young are born, although the litter size may range from one to six.

Squirrels build nests near the tops of large pine, hemlock, maple, birch and oak trees where they are lodged in a large crotch or on a limb near the trunk. Mosses, grasses and shredded bark line the nest, occasionally along with cloth, paper, vegetation and bird feathers.

The newborn young weigh about 15 g (1/2 oz), mature quickly and at about 12 weeks, the young will be almost adult size and independent. The males reach sexual maturity at 15-18 months and the females at 11 months. The average lifespan is normally less than six years.

Grey squirrels can become a nuisance when they invade an attic, cause damage around the house, dig up bulbs in gardens or drive birds away from feeders. Prevent squirrels from climbing trees or poles by encircling them with a .61 m (2 ft) wide collar of metal 1.82 m (6 ft) off the ground. Overlap the metal collar to allow for tree growth. Trim trees back from structures to prevent squirrels from jumping onto them. Prevent squirrels from traveling on wires by installing a 1.82 m (2 ft) section of lightweight 6 – 7.62 cm (2 – 3 in) plastic pipe (slit pipe lengthwise to spread it open and place it over the wire). Close all openings into the structure with sheet metal or 1/4 in. hardware cloth to prevent squirrel access. If squirrels have gained access to the interior of a structure, rat traps baited with chunky style peanut butter are effective. Check traps daily to remove captured squirrels and reset traps.

GREY SQUIRREL



BIG BROWN BAT



Big Brown Bat *(Eptesicus fuscus)*

Big brown bat, *Eptesicus fuscus* (Beauvois) is not a pest, and is actually beneficial to the Park, except for roosting in the attics. Adult big brown bats are about 10.16 – 12.70 cm (4 – 5 in) long including the tail, with a wingspread of 30.5 – 36 cm (12 – 14 in), and they weigh 11 – 17 gr (2/5 – 3/5 oz). They are found throughout southern Canada and the United States (except southern Florida). These bats usually give birth to two young during April to July. The big brown bat females form nursery colonies in structures in the spring (the males roost elsewhere). Later in the summer, the two sexes roost together. They commonly roost in attics, behind shutters and loose boards in buildings. They usually feed near the ground on beetles, wasps, ants, planthoppers, leafhoppers, flies, moths, etc. The big brown bat commonly hibernates in structures, caves, mines or rock crevices from December to April.

Winter exclusion efforts are not suggested if big brown bats are hibernating in the Park attics. Summer exclusion can be accomplished when the young are flying after mid-August. Seal all exit/entry points except one or two, and all holes .64 cm (1/4 in) or larger. After a few days to a week when bats are used to only the two exit points, install bat check valves (which allow bats to exit but not return) or seal exits after bats have left for foraging. Providing a proper bat house before the exclusion will allow the bats to remain in the area to feed on flying insects.

LITTLE BROWN BAT

Little brown bat, *Myotis lucifugus* (LeConte), is actually a benefit to the Park except for roosting in attics. Adults are about 7.92 – 9.19 cm (3 1/8 – 3 5/8 in) long, including the tail, with a wingspread of 22 – 27 cm (8 11/16 – 10 5/8 in). They weigh 3.4 – 14 gr (1/8 – 1/2 oz). Little brown bats are found from middle Alaska through southern Canada, and in the United States except Florida, Texas and southern California.

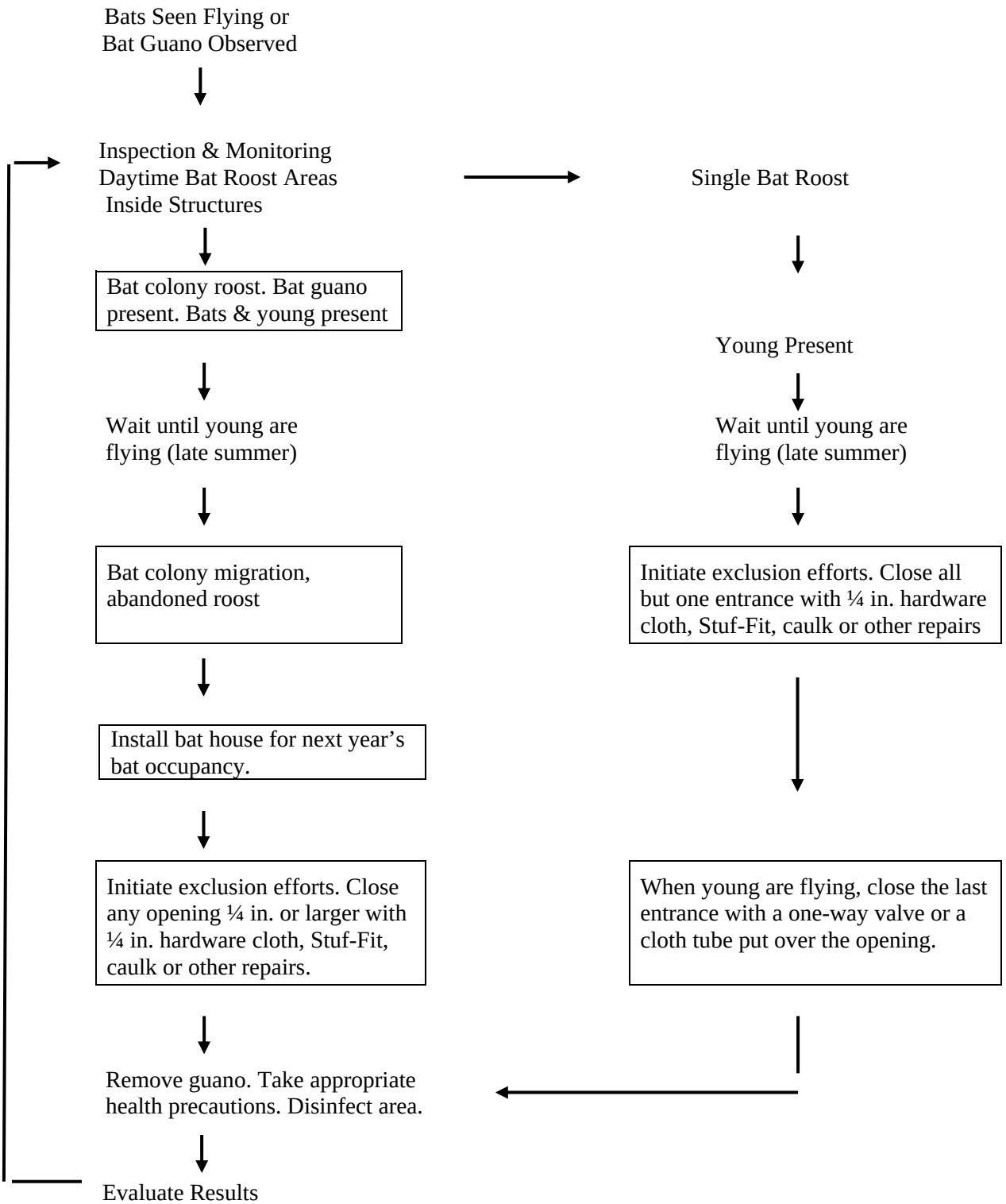


Little Brown Bat *(Myotis lucifugus)*

Little brown bats form nursery colonies in the spring. They feed on flying insects, especially flies and moths. They alternate feeding flights with rest periods to digest the catch. In the north, most little brown bats will migrate south where they hibernate from September/October through March/April in mines and caves in the eastern U.S.

If bats have left the attics of the Park structures in winter (and there are no big brown bats hibernating there), thorough exclusion of the attics at the Park can be accomplished. Otherwise, after mid-August when young are flying, close all exit/entry holes (over .64 cm [1/4 in]) except two exits. When bats have adjusted to those two exits, install bat valves or seal the last two holes after all bats have left for evening foraging. Providing a proper bat house before the exclusion will allow the bats to remain in the area to feed on flying insects.

BATS


Bats Seen Flying or
Bat Guano Observed
Inspection & Monitoring
Daytime Bat Roost Areas
Inside Structures
Single Bat Roost
Bat colony roost. Bat guano present. Bats & young present
Young Present
Wait until young are flying (late summer)
Wait until young are flying (late summer)
Bat colony migration, abandoned roost
Initiate exclusion efforts. Close all but one entrance with ¼ in. hardware cloth, Stuf-Fit, caulk or other repairs
Install bat house for next year's bat occupancy.
Initiate exclusion efforts. Close any opening ¼ in. or larger with ¼ in. hardware cloth, Stuf-Fit, caulk or other repairs.
When young are flying, close the last entrance with a one-way valve or a cloth tube put over the opening.
Remove guano. Take appropriate health precautions. Disinfect area.
Evaluate Results

BIRDS

INTRODUCTION

Birds provide enjoyment and recreation, enhancing the quality of life for those who view, enjoy, study, photograph, or hunt them. Over ten million people enjoy bird-watching as a recreational activity. For this reason, birds are protected by laws, regulations, and public opinion. However, birds can become pests when they create health hazards, roost on buildings, contaminate food, or create a nuisance. Pigeons and other birds, for example, cause human health problems when roosting in large numbers, and their droppings can foul buildings and walkways. Whether birds are seen as beneficial or harmful depends on time, location, and activity.

CHARACTERISTICS AND RECOGNITION

Pigeons (Worldwide)



Pigeon *Columba livia*

The domestic pigeon, *Columba livia*, developed from the rock doves of Europe and Asia where they nested in caves, holes, and under overhanging rocks on cliffs. They have adapted to window ledges, roofs, eaves, steeples, and other portions of structures.

Habits of Pigeons

Primarily seed or grain eaters, in urban areas pigeons feed on garbage, spilled grains, insects, food left by outdoor diners and food provided by bird lovers. Pigeons commonly feed, roost, and loaf together when ever possible. Feeding, roosting, and loafing sites are usually separate areas. Roosting sites are used for nesting, congregating at night, and shelter in bad weather. Loafing sites will be close to the roosting sites used by inactive birds during the day. Feeding sites may be several miles away from the nesting location. When pigeons are not feeding or mating, most of their day is spent cooing, preening, and sun bathing. Sun bathing is most common in the morning of cool days.

Pigeons prefer flat, smooth surfaces on which to feed, roost and nest.

Male pigeons are sexually mature at three to four months old, females at six months. After pairing and mating, a nest is built by the mated pair. Nests are usually located in protected openings in or on buildings.

One or two eggs are laid eight to 12 days after mating and are incubated for 18 days before hatching. Young pigeons are full grown in less than a month, and are fledged at 37 days.

Pigeons mate year around and live from three to 15 years. Fecal material from pigeons is very acidic and may damage structures. Pigeon nests harbor mites, clothes moths, dermestid beetles,

and other insects that feed on the feces, feathers and other organic material. When the nest is abandoned by the birds, these nest inhabitants may find their way into the structure in search of food and habitat.

Starlings

European starlings *(Sturnus vulgaris L.)* were introduced into the United States in 1890 and rapidly expanded throughout North America.



Starling *Sturnus vulgaris L.*

Habits of Starlings

Starlings nest in holes or cavities, and on buildings and other structures. Starlings average two broods per year with four to seven young per brood. Both parents build the nest, incubate the eggs, and feed the young. The young birds leave the nest at about three weeks old.

Starlings form large flocks and migrate to cities as weather cools, forming large roost sites.

Droppings damage buildings and build up to such levels that they become a human health hazard. Starlings have been responsible for outbreaks of a number of diseases.

House Sparrows (Worldwide)



House Sparrow Male & Female, *Passer domesticus (Linnaeus)*

The house sparrow *(Passer domesticus)*, also called the English sparrow, was introduced into the United States in the 1850's, and has spread throughout the continental United States except in heavy forests, mountains and deserts. It prefers human-altered habitats in cities and around farm buildings and houses.

The house sparrow is a brown, chunky bird 12.70 – 15.24 cm (5 – 6 in) long. The male has a distinctive black bib, white cheeks, a chestnut mantle around a gray crown, and chestnut upper wing covers. The female and young birds have a gray breast, buff-colored eye stripe, and a streaked back.

Habits of House Sparrows

House sparrows average three broods per season with four to seven eggs per brood. Breeding can occur in any month, though it is most common from March through August. Eggs are incubated for about two weeks, and the young stay in the nest another two weeks.

Nests are bulky and roofed over, and located in trees and shrubs, on building ledges, in signs, on light fixtures, and under bridges.

Sparrows are aggressive social birds, often out-competing native species. They have no recognized migration patterns, and will stay in an area as long as food and nest sites are available. Young birds, however, move out of an area to establish new territories. Sparrows are tolerant of human activity, and will not hesitate to set up housekeeping in high traffic areas. House sparrows prefer to feed on grain. They will also feed on fruits, seeds, and garbage.

House sparrows can be pests in many situations. Droppings and feathers make unsanitary and smelly wastes. Sparrows can also become a pest when they nest inside a structure. The birds cause damage by pecking at rigid foam insulation in buildings. Sparrows transmit a number of diseases, internal parasites, and ectoparasites. They are thought to be a major reservoir of St. Louis encephalitis.

HAZARDS OF INFESTATION

Large populations of roosting birds may present risks of disease to people nearby. The most serious health risks are from disease organisms growing in accumulations of bird droppings, feathers, and debris under a roost. If conditions are right, particularly if roosts have been active for years, disease organisms can grow in these rich nutrients. Birds may contaminate food. When parasite-infested birds leave roosts or nests, their parasites may invade buildings and can bite, irritate, or infest people.

Histoplasmosis

This systemic fungal disease (mold) is transmitted to humans by airborne spores from soil contaminated by pigeon and starling droppings (as well as from the droppings of other birds and bats). The soil under a roost usually has to have been enriched by droppings for three years or more for the disease organism (*Histoplasma capsulatum*) to increase to significant levels. Although almost always associated with soil, the fungus, in rare instances, has been found in droppings alone, such as in an attic. Infection is by inhalation of the spores carried by wind, particularly after a roost has been disturbed.

Most infections are mild and produce either no symptoms or a minor flu-like illness. The disease can, on occasion, lead to high fever, blood abnormalities, pneumonia, and even death.
The National Eye Institute (NEI) at National Institutes of Health has reported a potentially blinding eye condition, called ocular histoplasmosis syndrome (OHS). OHS results from infection by *Histoplasma capsulatum.* In this condition, the central part of the retina (the macula, used in straight-ahead vision) becomes inflamed and is damaged as blood vessels grow inside the affected area.

Cryptococcosis

Pigeon droppings appear to be the most important source of the disease fungus, *Cryptococcus neoformans*, in the environment. The fungus is typically found in accumulations of droppings in attics, on ledges, and on other roosting and nesting sites on buildings.

The disease is acquired by inhaling the yeast-like vegetative cells (two to three microns) of the organism. There are two forms of Cryptococcosis that may infect humans. Acne-like skin eruptions or ulcers characterize the cutaneous form with nodules just under the skin. The generalized form begins with a lung infection, and spreads to other areas of the body, particularly the central nervous system. It can be fatal. Like Histoplasmosis, outbreaks of this disease often occur after building renovation, roost clean-up, or other actions that disturb the old droppings.

Other diseases carried or transmitted by birds affect people to a lesser degree. Psittacosis, pigeon Ornithosis and Toxoplasmosis are normally mild in human beings, although serious illness or death can occur in rare cases. Pigeons, sparrows and many other species of birds have also been implicated in outbreaks of encephalitis.

Ectoparasites

Pigeons, starlings, and house sparrows harbor ectoparasites that can invade buildings. Some of these parasites can bite and irritate occupants. A long list of mites infest pigeons, but the northern fowl mite and chicken mite are usually the main culprits. These pests generally invade buildings from nesting and roosting sites. Other pigeon ectoparasites that may cause problems inside buildings are the pigeon nest bug (a type of bed bug), various species of biting lice, the pigeon tick, and the pigeon fly.

Droppings, feathers, food, and dead birds under a roosting or loafing area can also breed flies, dermestid beetles and other insects that may become major problems in the immediate area. These pests may fly or walk into windows, ventilators, cracks and crevices, and find other means to enter buildings. Structures that house museum specimens and historic artifacts can be invaded by dermestid beetle larvae that leave nesting and roosting sites.

Defacement and Damage to Structures and Equipment

Bird droppings under window sills, "whitewashing" down a building face, or accumulating on sidewalks and steps are the most obvious problems associated with roosts. Clean-up can be labor-intensive and expensive, particularly on high-rise buildings. Bird droppings are corrosive and will damage automobile finishes, metal trim, electrical equipment, and machinery. Down spouts and vents on buildings also become blocked by droppings, nest materials, and feathers. This accumulation of debris can attract insect pests such as dermestid beetles, spider beetles, and mealworms.

Legal Considerations

With very few exceptions, all birds are protected by one or more federal laws and regulations. Although pigeons, starlings, and house sparrows are considered pest birds and are not directly protected at the federal level, toxicants or repellents should be applied according to the product label and under the restrictions that apply under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

Non-target birds in the treatment area are protected, and any actions that kill or damage protected birds or their habitats would be a violation of various federal and state regulations. State and local regulations may require permits or restrict the actions taken against pest birds.

When in doubt, contact your State Natural Resources Agency or the United States Fish and Wildlife Service District office in your area for further information.

INSPECTION AND MONITORING

The first step in managing birds is to conduct a detailed and accurate bird survey. Surveys should be conducted early in the morning, midday, and again in the evening to correspond to the different activity periods of birds. The survey should not be limited to information about pest birds; non-target bird activity is just as important in order to minimize risk to these birds. The surveyor should investigate:

- What birds are present?
- How many birds are present?
- Are they residents, migrants, adults, juveniles?
- Are they nesting, feeding, roosting, loafing?
- Where do they eat and drink?
- What is attracting them to the various sites?
- Are the birds causing a health risk?
- Are the birds causing physical damage?
- If dispersed, where would they go?
- Is risk involved to non-targets?
- What are the legal considerations?
- Could there be public relations problems?
- Is exclusion or habitat modification practical?

MANAGEMENT

Habitat Modification

Habitat modification for birds means limiting a bird's food, water, or shelter. Attempting to limit the food or water of pigeons, starlings, and house sparrows may be difficult. Elimination of food and water to local bird populations must be accomplished at sensitive sites. These birds will

have a number of feeding and watering sites, often far from roosting and loafing sites. Where people are feeding birds in parks or lunch areas, education can help reduce this source of food. In some cases, people may pay little attention to requests to stop.

The most successful kind of habitat modification is to exclude the birds from their roosting and loafing sites (addressed in the section on exclusion).

Pigeons may be induced to move from an infested site by the persistent destruction of nests and eggs. However, nest destruction is ineffective against sparrows and starlings.

High-pressure streams of water spray are the most cost effective method of nest destruction. It destroys the nest, eliminates ectoparasites, cleans droppings and feathers from the nest site, and harasses the roosting birds. Use high-pressure sprays only where the water will not damage buildings or equipment. Remove all droppings and nest materials from the area.

When spraying is not safe, use a hook fastened to a long pole to the remove nests. When the nests are within 6.1 m (20 ft) of occupied sites, treat the immediate nest area with an insecticide/ acaracide to eliminate ectoparasites.

Destroy nests every two weeks during the spring and summer months until the birds move to other nest sites. Nest destruction by any means is not allowed while young are in the nest.

Exclusion

Some building designs and conditions lend themselves to bird infestation. Flat ledges, openings in water towers and vents, unscreened windows, and other attributes make a building an attractive location for roosting, nesting, and loafing. Modification or repair can exclude birds. Typical solutions include replacing broken windows, adding screens, repairing damaged eaves or ventilation screens, eliminating large crevices, and blocking openings into vents, cooling towers, and roof-top equipment with hardware cloth or similar material.

Exclusion methods also include the use of netting, custom-designed sheet-metal or plastic covers, porcupine wire (Bird Barrier products, for example), electrified wires, and sticky repellents to keep birds from roosting on ledges, roof edges, window sills, building signs, and other surfaces favored by pest birds. Modifying flat ledges by the addition of a 45° angle plastic or metal device eliminates the site for roosting or nesting by birds, and is the most effective approach. Two advantages are that the birds are not killed and the management is comparatively long-lasting.

Netting

Netting is used to block access of birds to large roosting areas in structures. Netting is especially useful in warehouses and around mechanical equipment areas where aesthetics are of minor consideration. It has been used successfully on cooling towers.

Plastic nets are alternatives to metal and fiber nets in bird management. Plastic nets are normally extruded black polypropylene and are made with an ultraviolet inhibitor to reduce UV degradation. Knotted nets are also available. Nets will last from two to five years depending on exposure to sunlight. Use the best quality affordable.

Covers or Ramps

Custom-designed covers for ledges, window air conditioning units, and roof edges are the best technical solution to keep birds from infesting these sites. The cost of this method may deter you from exercising this option on large buildings that have extensive roosting sites. But covers are valid options where limited applications will keep birds off selected sites, and where aesthetics are an important consideration.

The covers usually consist of sheet metal installed at a 45° angle to prevent the birds from landing. Sometimes plastic inserts are custom-fit into the indentations in order to block off ledges.

Plastic or metal 45° angle inserts are now available commercially. These devices become almost invisible when properly installed.

Spikes

Porcupine wire, sharp metal spikes, or any similar "bed of nails" can deter birds from roosting on ledges. Where they can be used, they usually work fairly well. If aesthetics are important, these devices are usually limited to areas where they cannot be easily seen.

If pigeons are likely to drop nest material and other debris on top of the newly installed spikes in an attempt to create a new roosting surface, install metal spikes on potential landing sites above the installation.

Check metal spikes every six months for accumulated debris or nest material. Advise occupants to regularly remove falling leaves and other matter that can cover the spikes and reduce their effectiveness. Prune to ensure that no tree branches hang over protected ledges.

Sticky Repellents

Sticky repellents are tacky gels or liquids. The products are designed to be sticky enough to make a bird uncomfortable, but not so sticky that the birds are trapped. After a few attempts, the birds stop trying to land on treated surfaces. The active ingredient is polybutene or isopolybutene (the same substances used in some adhesive bandages) or petroleum naphthenic oils.

Before applying sticky repellents, clean ledges that are covered by bird droppings, feathers, and nest material with a wire brush, paint scraper, high pressure hoses, or by steam cleaning. Ensure that surfaces are clean and dry.

Seal concrete, unpainted wood, or brownstone with silicone or other sealant, paint, or shellac before applying repellent. Sticky repellents will be absorbed into porous materials.

Use a caulking gun to apply repellent. The depth of the bead necessary to repel different species of pest birds is roughly as follows: crows and sea gulls .95 cm (3/8 in); pigeons .63 cm (1/4 in); starlings .3 cm (1/8 in); sparrows .15 cm (1/16 in). The pattern of application will depend on the site and personal preference. The caulking gun should be held at an angle of 30-45°.

Place breaks in the bead every few feet to avoid trapping rainwater against the building.

Environmental conditions, particularly dust, make a big difference in the effective life of sticky repellents. In an area with no dust, applications should be expected to remain effective for a year or more.

Precautions should be followed when sticky repellents are used. Be sure migratory or other non-target birds are not harmed. Do not place sticky repellant material where it will become unsightly over time.

The disadvantages of sticky bird repellants are so great that they are not recommended for use in school sites or other urban areas.

Spike, glues and other deterrents become ineffective over time and are unsightly.

Remove Nests

Check state and local regulations that may prohibit destroying or disturbing nests containing eggs or young.

Ultrasonic Sound Devices

Tests by university, government, and private independent researchers have failed to demonstrate any efficacy against birds by any of the ultrasonic devices tested. These devices do not work against most birds.

Trapping

In many instances, trapping can be an effective supplemental measure. Trapping is especially effective against pigeons. Where a group of birds are roosting or feeding in a confined and isolated area, trapping could be considered a useful tactic.

The best time to trap pigeons is in the winter when their natural food is at a minimum. There are many pigeon traps to choose from; which type and size is best is a matter of choice. Most pigeon trapping programs use large walk-in traps. These can be 1.22 – 1.83 m (4 – 6 ft) high and designed to be disassembled and moved. Another common type is a low-profile bob-trap that is about 20.32 cm – .61 m (8 in – 2 ft) high. The door or entrance through which pigeons are lured is the principle feature of a trap.

Set traps in inconspicuous places where pigeons commonly roost or feed and where traps are not likely to be vandalized (a major risk in trapping programs). Trap placement is important, and moving an inactive trap just 3.05 – 4.57 m (10 – 15 ft) may significantly improve catches.

Feeding areas are the best trap sites, but are rarely on the same property as the roosting sites.

Rooftops that have water from cooling towers or air conditioning units are often good trapping sites in summer. The most difficult part of trapping is motivating birds to feed in a nonfeeding area so that they will follow the bait into the trap. Whole corn or sorghum are generally the best baits but wheat, milo, oat groats, millet, popcorn, sunflower seeds, peas, greens, bread, or peanuts can be very effective if the birds are feeding on similar food. Once a few birds have been trapped, putting different foods in for the birds can show which bait they prefer.

In the first few weeks of a program, scatter small quantities of bait throughout the area to start the birds feeding and determine the best trap sites. Some specialists leave traps propped open for the first few days to allow the birds to get used to them. When they calmly enter the trap, set it. Put water (a "chick font" is ideal) and bait inside and just a handful or so outside the trap. Leave one or two "decoy" birds in the trap to draw in other birds. Light-colored birds make better decoys than drab ones.

Remove trapped birds regularly (except for decoys), otherwise other pigeons will be frightened by fluttering trapped pigeons in the trap. Since pigeons can fly great distances and find their way home, trap and release is not normally effective. Trapped birds should be humanely destroyed.

Some experts recommend gassing, but many feel it is simpler and more humane to kill the bird by breaking its neck. Local rules may require taking birds to the animal shelter.

Sometimes, indoor roosting sites can be used as a giant trap. Pigeons often use attics, rooftop elevator houses, or empty floors of poorly maintained structures as nest and roost sites. By screening all but one or two entrances these areas can be made into a giant trap. Late in the evening, after a two-week acclimation period, these last entrances can be closed after the pigeons have settled down for the night. The trapped birds can be captured by hand or with butterfly nets.

Sparrow traps come in various sizes and shapes. The sparrow funnel trap is a double funnel that prevents sparrows from escaping after they have traveled through two funnels going for a food bait. Fine cracked corn, millet, wheat, or bread crumbs make good bait. Trap sites should be baited for a few days before you actually begin trapping. Sparrow traps are usually more effective when placed on the ground. Nest box traps attract a sparrow with a potential nest site. Once inside, the bird trips the mechanism, dumping the bird into a collecting bag. This trap also works against starlings, as does the center drop trap. The birds, attracted by food, drop through an opening and cannot escape. However, starlings are not usually good candidates for trapping programs.

<u>Avitrol</u>
AVITROL is a poison bait with flock-alarming properties used to manage different kinds of birds. There are different AVITROL baits for each pest bird species. Within 15 minutes of eating a toxic dose of AVITROL, birds flutter erratically and go into convulsions.

AVITROL should only be used by a professional who specializes in vertebrate animal control measures. Before using Avitrol, the park IPM Coordinator must obtain written approval from the regional IPM Coordinator.

Risks to Non-targets

Most lethal tactics in bird management pose some risk to non-target birds, as well as other animals. All migratory and game birds are considered non-targets, and are protected by various federal, state, and local regulations, as well as by public opinion. Care must be taken to minimize the threat to non-targets or to use tactics that pose the least risk.

First, identify any non-target birds or animals in the area.
Second, use tactics that are least at risk.
Third, modify tactics to minimize risk.
Fourth, monitor operations to be sure that no non-targets are being adversely affected.

Public Relations

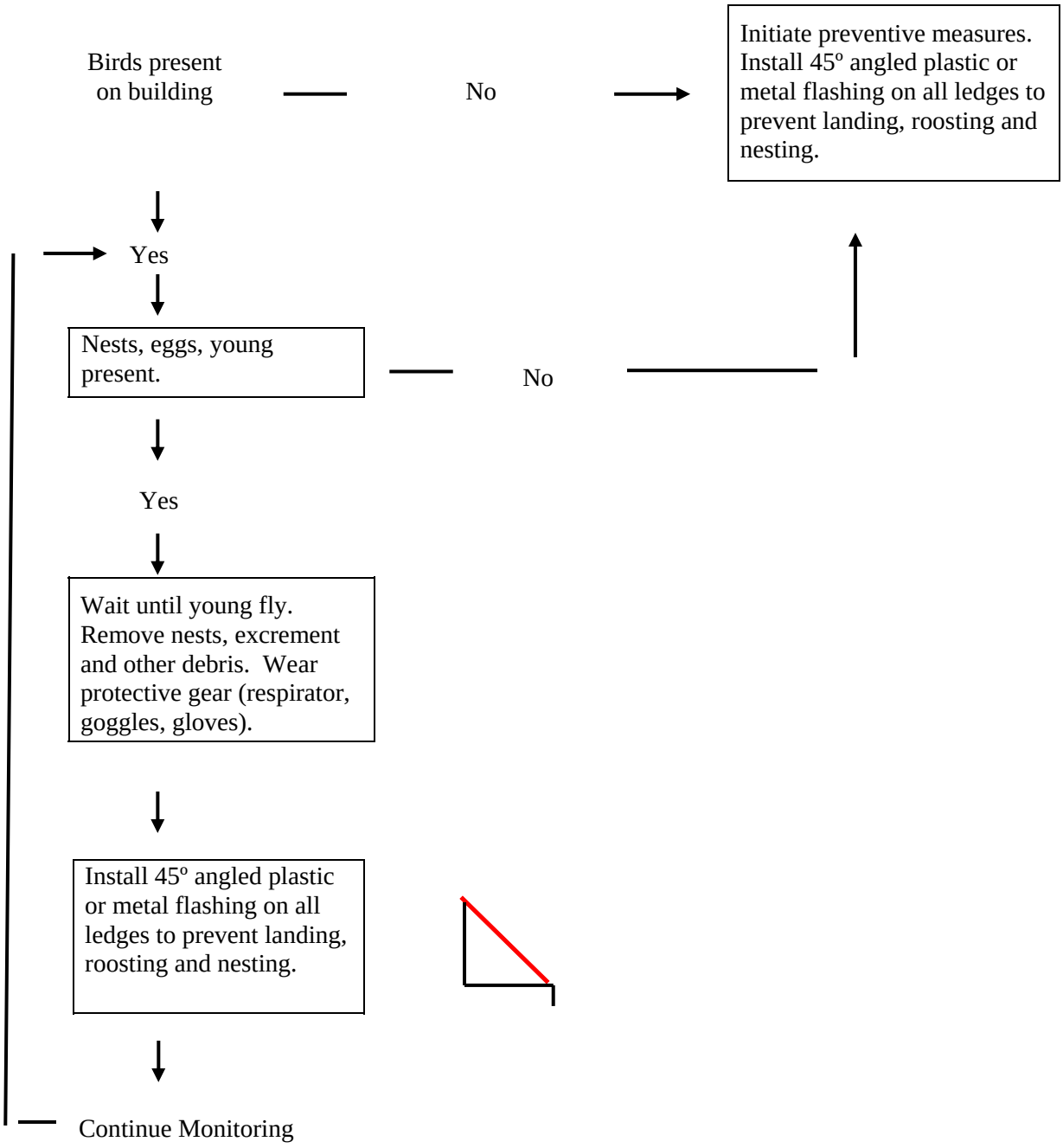
People often react more negatively to one dying bird than to accumulated pigeon droppings on sidewalks or potential risks of parasites and disease from bird roosts. Pigeons and sparrows can be seen as pets rather than pests. The public's perception of bird management operations must be considered. All bird management programs should put some effort into avoiding "people problems," particularly when using AVITROL or other toxic techniques.

BIRD DROPPINGS REMOVAL AND CLEAN-UP

Workers removing large quantities of bird droppings should follow these precautions to minimize risk from disease organisms in the droppings:

- Wear a respirator that is labeled to filter particles down to 0.3 microns.
- Wear disposable protective gloves, hat, coveralls, and boots.
- Wet down the droppings to keep disease spores from becoming airborne, and avoid drying them out.
- Put droppings into sealed plastic garbage bags and wet down the outside of bags.
- Dispose of trash bags. Disposal should be permissible through standard trash pick-up.
- When finished, and while still wearing the respirator, remove the protective clothing and place them in a plastic bag.
- Wash up or shower.

BIRDS


Birds present on building
No
Initiate preventive measures. Install 45º angled plastic or metal flashing on all ledges to prevent landing, roosting and nesting.
Yes
Nests, eggs, young present.
No
Yes
Wait until young fly. Remove nests, excrement and other debris. Wear protective gear (respirator, goggles, gloves).
Install 45º angled plastic or metal flashing on all ledges to prevent landing, roosting and nesting.
Continue Monitoring

RACCOON *Procyon lotor*



Raccoon

Raccoons belong to the Procyonidae (those who came before dogs) family. This mammal is very intelligent and has a rounded head, short nose, small ears, and a sturdy body with thick, grayish-brown fur. Raccoons are easily identified by the narrow black face mask with a white patch above each eye, and white rings around their large, bushy tail. They average .61 – .91 m (2 – 3 ft) long, are 30.48 cm (12 in) tall, weigh 3.63 – 9.98 kg (8 – 22 lbs), and live from 10 to 13 years. Females produce one litter each year from one to six kits.

Raccoons are found in most of the U.S. and southern Canada in many varied habitats, especially near streams, ponds and marshes. For nesting sites it prefers warm, dry, dark, easily protected areas. It dens in tree hollows, hollow logs or caverns. In urban areas, raccoons may nest in crawl spaces, attics, basements or drainpipes. They are usually nocturnal, however, can be occasionally active during the day.

Raccoons will eat whatever their environment provides – from insects, nuts, fish, eggs, snakes and fruits to corn crops, poultry, garden and orchard vegetables, and from garbage cans. They have been seen dunking their food in water before eating it. They have keen senses of smell and hearing, and are excellent climbers.

Inspection and Monitoring: Check for entry points under buildings, into crawl spaces and basements, and plant ladders to attics. Noises at night may be another indicator of raccoon presence. Check for alternate access routes. Be sure there are no young in the nest.

Management: During the mating and nesting seasons, raccoons are attracted to warm, dry and dark areas as temporary homes, such as crawl spaces. Close off all but one access route before taking eviction actions. Be prepared to close off the last entry. Use ammonia-soaked rags placed in the vicinity of the nest. Bright lights may also help with the eviction. The nest area may need to be treated for fleas.

OPOSSUM *Didelphis marsupials*



Opossum

The opossum is the only marsupial found in the United States. It is the only mammal in the U.S. with a prehensile tail which can be used for grasping like a hand. The opossum has four fingers and an opposite thumb for grasping on each of its hind feet. It is a cat-sized mammal averaging .61 – .66 m (24 – 26 in) long and weighs between 2.72 – 5.44 kg (6 – 12 lbs). The opossum is a passive animal, but can be aggressive when threatened.

The opossum has an acute sense of hearing and smell. The life span ranges from two to three years with mortality high in the first year of life. It is mostly a nocturnal animal, but a young animal can be seen during the day searching for food. The ideal habitat is woodland, farmland or neighborhoods with water nearby. The opossum is an adaptable animal and will thrive most anywhere. Females with young tend to use the same den sites for weeks at a time; they often use the abandoned burrows of other animals rather than digging their own. Potential den sites include woodpiles, culverts, barns, thickets, drainpipes; and under porches, buildings and sheds.

The opossum will eat anything it can find or catch, including mice, rats, worms, beetles, frogs, garbage, fruit, corn, etc. They are also immune to snake venom, and will catch, kill and eat snakes, including poisonous ones.

In northern states, opossums produce only one litter a year. The age of maturity for males is eight months; for females six months. The breeding season begins at the end of winter and the female gives birth only 12 – 13 days after mating to an average of 16 – 20 young. The young are the size of a grain of rice and must travel from their birthplace into their mother's pouch. After one week, the babies triple their size; after 60 – 70 days in the pouch, their eyes finally open, and they are the size of a mouse. Youngsters remain with their mother until they are three to four months old.

Opossums do not harbor diseases normally found in dogs and cats such as distemper or feline hepatitis. All warm-blooded mammals can contract rabies, but opossums are rarely found to be rabid.

Management: Do not leave garbage outdoors at night. Eliminate brush piles, access into buildings and holes under concrete slabs. Secure doors at night. Opossums seldom stay in one area for any length of time. They are excellent rodent and insect predators, and are more beneficial as scavengers than harmful for the little damage they may do.

PUBLIC HEALTH

PESTS

COCKROACHES

GENERAL

Cockroach infestations are among the most widespread and persistent of all pest problems. The five most common types of cockroaches in urban areas of the United States are: German, brown-banded, American, oriental, and smoky-brown cockroaches. The smoky-brown cockroach is normally only found in the southern states and will not be addressed here. Six additional cockroach species sometimes found in other than buildings include: brown, Australian, Surinam, woods, Asian and Turkistan cockroaches.

Except for size, most cockroaches are relatively similar in overall shape and appearance. They like tight places where their bodies touch surfaces both above and below them. Once inside a building, cockroaches find harborage in cracks, crevices, and voids, and easily move among floors, rooms, and compartments through hollow walls, electrical and plumbing access holes, on conduits and ducts. In dining halls, cockroaches are commonly found under work benches, tables, and counters where spilled food accumulates, behind and under refrigerators, stoves, and other bulky equipment, in serving-line areas, near raw garbage storage, in wall voids, and in hollow legs of equipment and tables.

The most common pest cockroaches inhabiting buildings are nocturnal and remain in the dark whenever possible, only emerging to search for water and food. Large infestations should be suspected when cockroaches are seen in the open or in the light during the day.

Cockroaches are strongly attracted to food and water. Although they can survive many days without food, they must have frequent access to water. Newly hatched cockroaches die in three days without water, and although adult cockroaches may live 20 to 30 days without it, during that time they are unable to reproduce. Because of the wide range of food available to cockroaches, they cannot be starved out of a building; but, good sanitation and cleanliness may prevent cockroach populations from increasing.

HAZARDS OF INFESTATION

Cockroaches affect more people than any other insect. They vomit partly-digested food materials and continually defecate while eating and pose significant health hazards by transmitting diseases (bacillary dysentery, typhoid fever, cholera, polio, amoebic dysentery, urinary-tract infections, diarrhea, and infectious hepatitis). In some parts of the country, even human allergy is attributed to cockroaches.

Cockroaches are scavengers that live on food waste and are attracted to human foods, particularly bakery products, cereals, meat, and cheese, which they contaminate since they also feed on dead animals and animal feces. Cockroaches also feed on or damage items like leather, wallpaper paste, book bindings, soiled clothing, artwork, books, legal documents, postage stamps, draperies and banknotes. Cockroaches are attracted to electrical switches, outlets, and smoke detectors, where their bodies and body fluids corrode points, activate or deactivate alarm

systems, create pump failures, and cause short circuits in or damage to computers.

Cockroach droppings, body parts, and dead cockroaches may accidentally be incorporated into human meals. Cockroach excrement, scent-gland secretions, and regurgitations spoil the palatability of human food. They strongly attract more cockroaches to established feeding sites, causing additional staining and contamination of food, food packages, and kitchen cabinet cracks and crevices where cockroaches gather.

German Cockroach (*Blattella germanica L.)* – Worldwide

The German cockroach is the most common and most rapidly reproducing of this country's cockroach species. A German cockroach population, given favorable conditions, can increase in number at least 20 times within three months.

The German cockroach is 1.27 cm (1/2 in) long, honey brown in color, and with two dark streaks on the pronotum. Both adult males and females have fully developed wings and can fly short distances, although they seldom fly. Incubation of young lasts about two weeks at 27EC (80ºF). The female protects the eggs by carrying a .63 cm (1/4 in) long egg case, containing from 30 to 40 eggs, until just before hatching, when she deposits it in a protected area.



German Cockroach Male

A female produces from four to eight egg cases in her lifetime, during which time she mostly remains hidden in cracks and therefore less exposed to pesticides. Young (nymphs) German cock-roaches resemble adults but are smaller and lack wings. Nymphs shed their skins (molt) six to seven times before they mature in about 12 weeks. German cockroaches complete a generation in four to six weeks, and the entire life cycle lasts from 14 to 28 weeks. Infestations can be detected by finding shed skins and empty egg cases on shelves, even when cockroaches themselves are not noticed.



German Cockroach Female with Ootheca

The optimum indoor harborage areas for German cockroaches are in areas where protection, food and moisture are available. These areas include the motor area of refrigerators and around stoves, under kitchen and bathroom sinks, undisturbed cabinets, around toilet bowls, leaking sink traps and faucets, condensation, standing water, and wet sponges. Although bathrooms have less food available, cockroaches may live in bathrooms and move through electrical and plumbing pipe chases and floor and wall cracks into adjacent rooms containing food. Small nymphs use cracks, 1 cm (1/64 in) for harborage, but larger adults require crevices about .46 cm (3/16 in) wide.

German cockroaches are usually imported into tightly constructed buildings with bottled-drink containers, in potato, onion, dried pet food, and grocery sacks, and in furniture and corrugated cardboard. When German cockroaches are moved into buildings from outdoors, they may be accompanied by American or Oriental roaches.



Brown-banded Cockroaches

Brown-Banded Cockroach (S*upella supellectilium)* – Worldwide

The brown-banded cockroach is the second most typical U.S. species, but it does not generally constitute a widespread problem as the German cockroach. The brown-banded cockroach is about the same size as the German cockroach (1.27 cm [1/2 in]), but does not have two dark stripes on the pronotum. Wings of both sexes of brown-banded cockroaches show a light, brownish-yellow, horizontal band across the pronotum, and at the base of wings with another partial band about one-third down from the pronotum. Recently hatched young (nymph) brown-banded cockroaches resemble adults, but are smaller and lack wings. Nymphs are dark; the two light bands separated by a dark band behind their pronotum is more obvious than banded markings on adults. Adult males fly readily, but females do not fly.

Brown-banded female cockroaches produce up to fourteen .94 cm (3/8 in) long egg cases (each containing 13 to 18 eggs) during their lifetime. The female carries the new egg case less than two days and then glues it to the underside of furniture, behind kitchen cabinet drawers, and in corners inside cabinets and cabinet frames. Incubation time is about 50 days, similar to that of the American cockroach. Nymphs molt six to eight times before reaching maturity in five to six months. Time required for their complete development varies from three to nine months.

Brown-banded cockroaches occur throughout the United States and become established in warm apartments and office buildings where infestations may quickly build to rival those of German cockroaches. Lesser water requirements allow them to occupy more locations in a building than German cockroaches. Brown-banded cockroaches flourish in rooms with high temperatures and, like German cockroaches, build up the largest populations near food sources. Brown-banded cockroaches more often frequent cabinets near ceiling level, but also find harborage behind picture frames, in areas near stoves, and other warm equipment (refrigerators, electric clocks, light timers, televisions, radios, and computers), as well as in ceiling voids, clothing, drapery, and clutter.

Brown-banded cockroaches gain access to buildings by being imported, along with supplies and containers (particularly corrugated cardboard boxes). Eggs and adults may often be introduced into structures on furniture. After gaining entry, infestations can quickly spread throughout a building.

American Cockroach (*Periplaneta americana*) – Worldwide



American Cockroaches

The American cockroach is very common in the southern U.S., where it is sometimes called “waterbug" or "palmetto bug." This cockroach is about 3.81 cm (1 1/2 in) long, reddish brown with light markings on the thorax, and has fully developed wings. True flight is not common; flying American cockroaches are usually found in the southern states. Adult males, however, can glide extended distances. The pronotum on this cockroach may be ringed by various irregular patterns of light color that darken toward the center; the rear margin is always light colored.

Females can produce a .79 cm (5/16 in) long by .46 cm (3/16 in) wide egg capsule each week during the 12 to 24 weeks of spring and summer, each containing 14 to 16 eggs. She carries an egg case for about a day and then deposits it in a protected spot. A very high population should be suspected when egg cases are found in the open. Incubation lasts from one to two months. Mature American and Oriental cockroach nymphs can be difficult to tell apart. American nymphs normally go through 13 molts before reaching maturity in from seven to 20 months.

Where climate allows, American cockroaches normally live outdoors and enter buildings through holes from crawlspaces or underground ducts, steam tunnels, manholes, and sewer line drains. American cockroaches are found in warm and moist basements, around water heaters, in boiler rooms, floor drains, and water sumps. Large numbers of American cockroaches may move into buildings when triggered by blocked drainage systems, heavy rains, or changes in barometric pressure.

Oriental Cockroach (*Blatta orientalis)* – Worldwide

The Oriental cockroach, sometimes called "water bug" or "black beetle", can be a serious pest. It is dark brown to shiny black in color. Females are 3.17 cm (1 1/4 in) long, about 20% longer than males. Males have fully developed but short, broad wings extending over about 70% of their bodies; females only have short triangular wing pads resembling lobes. Neither males nor females fly. Unlike other cockroaches, Orientals lack specialized pads on their feet and cannot climb smooth surfaces. Each year a female produces about five to ten egg capsules (.75 cm [3/8 in] long by .63 cm [1/4 in] wide) containing 14 to 18 eggs.



Oriental Cockroaches

She carries the egg case for about 24 hours before leaving it in a warm, sheltered spot near available food.

Incubation lasts about two months, and nymphs undergo seven to ten molts before reaching maturity in about 1 1/2 years. Late instar American and Oriental cockroach nymphs may be difficult to tell apart.

Oriental cockroaches are more sensitive to a scarcity of water than other cockroaches, but are able to survive 13 weeks of continuous freezing temperatures outdoors when protected under stones and leaf debris. The Oriental cockroach is normally an outside species and its activity is usually restricted to ground or below-ground level. It favors crawl spaces, gaps between the soil and building foundations, undersides of stoops and sidewalks, landscaping mulches, sewers, storm sewers, trash receptacles, and water meters. Large numbers of Oriental cockroaches enter dwellings to find moisture and optimum temperature, and are often triggered by drought, approach of winter, flooded drains, heavy rain, or changes in barometric pressure. Oriental cockroaches mainly invade structures under doors and through holes, cracks, and pipes joining crawlspaces, underground ducts, manholes, and sewer line drains. The Oriental cockroach prefers harborage on damp, porous surfaces, such as concrete or brick, and is mostly found in dark and damp basements, floor drains, and other moist places having a temperature between 20E and 28EC (68º and 82ºF).

Reducing food is not an effective control for Oriental cockroaches because they feed on a wide assortment of naturally occurring organic matter such as dead insects, slugs, and animals, animal wastes, rotting grass and weeds and human garbage.

INSPECTION AND MONITORING

Inspection

When daytime occupants of a site report seeing cockroaches, a thorough inspection of a structure is necessary to discover the presence and centers of cockroach activities in order to be able to identify them and the available harborage, food, and water sources before management treatments should be initiated. Estimates of the pre-treatment size of cockroach populations compared with post-treatment population estimates provide important data for evaluation of the effectiveness. Placing sticky monitoring traps in suspected harborage area the evening before the inspection will provide valuable information about the pest population.

Refrigerators pose weak links in cockroach management programs because they provide heat, harborage around coils, constant water supply, and hiding places that are difficult to treat. The presence of surface molds and water damage under or around refrigerators will help pinpoint concealed cockroach habitat.

Make inspections, if possible, during evening hours when cockroaches leave harborage. During the day, cockroaches remain deep within cracks. Use a flashlight during inspections (even if the area is not dark) to help concentrate your focus. Inspect for cockroaches every two weeks unless a decrease in roach problems justifies extending the time between inspections to 28 days. When management methods have reduced pest populations to near zero, quarterly thorough inspections may be sufficient if monthly monitoring is continued.

Monitoring

A thorough inspection and the use of sticky traps to determine approximate pest numbers should identify reported infestations. This would provide pre-treatment data for evaluation of the effectiveness of management measures. There are several effective sticky traps, some with attractive food baits such as the ■Lo-Line• that have entered the commercial pest management market.

Numbering traps and analyzing their locations and captures, which should be indicated on room diagram maps, helps to identify cockroach harborage and needs for additional attention to sanitation measures, exclusion, or pesticide treatments.

Monitoring is done by placing sticky traps strategically in rooms and kitchens where harborage, warmth, water, and food are plentiful. The best trap locations are near corners where cockroaches congregate. Place traps against walls, fixtures, and under appliances; do not place them in the open or where they may become wet. Cockroaches tend to stay close to cracks and crevices when foraging for food.

Examine cockroaches found on traps to determine the direction from which they entered the trap. Placing sticky monitoring traps in a standardized approach (always the same way) helps to determine direction of travel. This information will help point out likely harborage sites. Additional follow-up monitoring with sticky traps is necessary four to eight weeks after the first monitoring session to see if young cockroaches are still hatching, and to determine if management methods are effective.

COCKROACH MANAGEMENT

Action Thresholds

When an average of five or more cockroaches per night per sticky trap is caught in a room, daytime sightings are probable. The action threshold should be set at two to three captures, so that corrective action can be taken before the population expands.

Prevention of Cockroach Infestations

Infestations can be prevented by reducing conditions which support cockroaches, including access to structures and harborage, moisture, and food. Otherwise, cockroach populations are very difficult to manage because small, residual populations can survive in even the most sanitary of environments. Further, residual populations can explode into major problems. The use of pesticides, however, cannot be regarded as a substitute for either prevention or good sanitation practices. Pesticidal suppression of cockroach populations without a change in environmental conditions that support them only gives a false and temporary sense of security and may also result in chemical resistance in the pest populations.

Good building maintenance is mandatory if cockroaches are to be denied access to structures. This requires elimination of holes and cracks used by cockroaches to gain entry into buildings.

To eliminate access to structures, install tight-fitting windows, doors, screens, and door sweeps; caulk all exterior and interior cracks and holes in foundations, walls, sills, floors, splash boards, and water, heating, and electrical service chases; screen open sewer lines and drains; and repair leaking plumbing facilities. Remove other sources of moisture.

An effective prevention program should contain the following major elements:

X Careful inspections of areas surrounding the building, noting and correcting conditions which attract or provide harborage for cockroaches such as stacks of firewood, dead tree stumps and branches, vines and other vegetation on or next to the building, piles of bricks, stones, or wood, and leaf litter.

X Careful inspections of building exteriors from foundation to attic; noting and correcting all possible points where cockroaches or other pests could enter the building.

X Careful inspections of building interiors, attics, and crawlspaces from floor to ceiling, noting and sealing all cracks, crevices, holes, and voids which could harbor cockroaches or other pests. Stainless-steel baskets can be used in sink and floor drains to prevent entry of cockroaches from sewers.

X Inspection of structures for accumulations of cardboard or wooden boxes, paper and plastic grocery bags, empty aluminum cans, beverage cartons, furniture, dried pet foods, seasoned firewood, and potted plants, through which cockroaches are often imported into a structure and in which materials cockroach populations flourish. Tactfully advise occupants about needs for improved sanitation.

X Inspection for accumulations of food scraps that are often found under refrigerators and other kitchen equipment and in cupboards. Tactfully advise occupants not to leave dirty dishes or puddles of water on cupboards, clean up all food scraps immediately after eating, store food in pest-proof containers, use tight-fitting lids on garbage containers and take garbage out every day.

Management of Existing Cockroach Infestations

Cockroach problems almost always indicate the presence of excessive moisture and poor sanitation. Effective management measures should include physical, mechanical, and cultural changes. When those methods are not sufficient, pesticide bait measures may also be utilized.

Physical, Mechanical, Cultural Measures

Because of adjoining rooms, attics, crawlspaces, pipes, and other connections, serious cockroach problems in structures usually require an intensive management program for the entire building. One area left untreated will supply cockroaches to other areas of the structure.

Exclusion

The entire building should adequately be sealed and secured against cockroach entry. Carefully check for and seal cracks and crevices in walls, around sinks, and gas, water and electrical lines, cupboards, and baseboards to eliminate all cockroach hiding and breeding habitats. Cockroaches may travel between portions of buildings in and along electrical conduits and enter rooms through open prong holes in electrical outlets; keep outlets covered at all times. Fit self-closing devices to screen doors and check that screens are not broken.

Repair leaking faucets, water and drain pipes, and ventilate or dry out moist areas such as crawl spaces. Remove any other sources of moisture available to insects. Be sure indoor plants are not over watered. Place screens on fish tanks. Cover all air and ventilation vents with fine-mesh wire screens.

Direct runoff away from buildings. Remove rotting leaves from window wells, dense vegetation from around building foundations, and trim trees that touch the building. Place outside lighting away from the structure to prevent attracting cockroaches and other flying insects to the building.

Sanitation

Occupants should be instructed in the following procedures to eliminate all food, moisture, and harborage available to cockroaches:

X Remove unnecessary equipment and stored materials from the building to eliminate harborage areas.

X Store food in insect-proof metal cans, plastic jars, glass jars with tight-fitting lids, or keep in the refrigerator.

X Remove food and grease from stove doors, hinges, burner tops, joints and crevices each day. Thoroughly clean food particles on and under tables and counters as soon as possible after meals. Wash dishes promptly after use. Discourage eating in non-dining areas. Do not use liners on shelves or in drawers, as they provide harborage for cockroaches and other insects under loose edges.

X Place all food, garbage, empty drink and food cans, and other materials providing potential insect food in sealed plastic bags or tightly sealed canisters as soon as possible. Do not store empty aluminum cans or bottles inside the building. Keep garbage cans tightly covered and take garbage out daily. Do not permit garbage to remain exposed overnight.

X Clean cockroach infested "focus" sites by emptying all kitchen or break room cabinets, drawers, and pantries and wash them out with soapy water before replacing items. Empty stored clothing from boxes and bags, and wash and dry them before repacking in sealed plastic bags or in new, clean boxes.

X Egg cases and adult insects are frequently imported into structures on foodstuffs and containers coming from other cockroach-infested areas. A quarantine area should be set up to accept any incoming food or other material into the building. Cockroaches hide and

breed among folds of paper sacks and in voids of corrugated cardboard boxes. Carefully inspect (or sterilize) all incoming containers and shipments for cockroaches and egg cases before putting items on shelves. Seal all paper sacks and cardboard boxes in plastic garbage bags as soon as they are emptied and properly dispose of them.

Provide written information and graphic handouts to familiarize occupants with cockroach management programs and of the needs for sanitation. Occupants should understand and be willing to follow steps to reduce the availability of food and harborage to cockroaches and to take measures to prevent reinfestation.

No amount or frequency of pesticide application is sufficient to control or eliminate cockroach infestations where sanitary conditions are not met.

Direct Controls

Sterilize equipment and furniture that is infested with cockroaches or egg cases by steam cleaning or in dry heat (in excess of 60EC [140ºF]) for 30 minutes. This method is useful when occupants move from an infested area to another location.

Pesticide Treatments

When deemed necessary, pesticide applications shall be performed by licensed applicators only. Applications shall be made according to the procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Pesticides provide only temporary relief from insects in structural units unless moisture, food particles, and grease, found in kitchens or other areas are eliminated. When pesticides dissipate, cockroaches may reinvade structures. Thus, good exterior area sanitation is just as important as inside sanitation and management. To be effective, any short-residual pesticide treatment should attain 95% or greater cockroach kills within the first few days and later follow-up treatments should concentrate on the remaining cockroach reservoirs. Before any pesticide is applied, it is vital to know the kind(s) of cockroaches present and where they are hiding so harborage areas can be effectively treated.

Borate based dusts can be used for effective treatments. This pesticide is applied through a narrow diameter tube into harborage cracks and crevices where cockroaches live and breed. Borate dusts may also be applied under cabinets, drawers and around pipes. When applied in cabinets, be sure to remove utensils and supplies and apply the dust into cracks. Do not treat shelf surfaces. Refined, pesticide grade, 99% borate dust should be used. Borate dusts are harmful (as are most pesticides), therefore, a dust mask, goggles, and gloves should be worn during the treatment process. Various brands and formulations of borates are commercially available, some use aerosol carriers which makes application into small cracks easier.

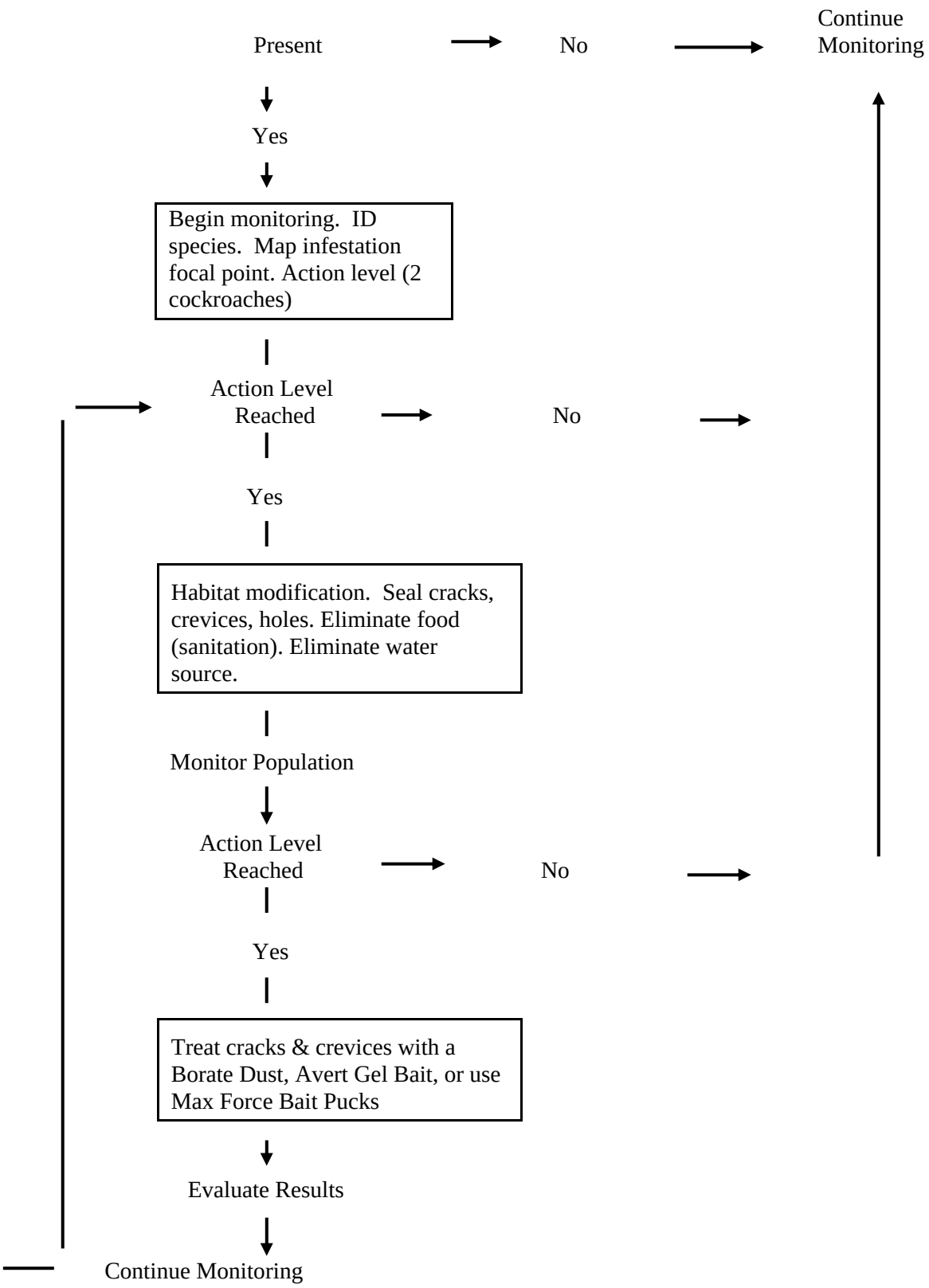
The Borates may take seven to fourteen days to kill cockroaches, whereas other pesticides may kill some cockroaches in a shorter time. Borates remain active for a long time, and do not evaporate away. After over fifty years of use, cockroaches have not become resistant to the Borates. There are also several borate baits available on the market.

After applying pesticide dusts into cracks and crevices, caulk cracks and crevices to eliminate future harborage and to keep out moisture.

Various types of solid, semi-solid, and liquid cockroach bait stations are commercially available. Many contain low-risk chemicals that are attractive to cockroaches and help control cockroach populations. Normally, about 12 or more bait stations are placed in cockroach harborage areas in a normal sized kitchen. Some bait stations (or pucks) contain hydramethylnon which is effective for cockroach management and has reduced risk to occupants. Some bait stations have sticky tape on the back for applying baits to vertical surfaces. However, if sanitation is poor in a site, bait performance will also be poor because of the availability of alternative foods.

Several new toxic paste or gel baits have been developed that are attractive to cockroaches. One of the more effective gel baits for crack and crevice treatment contains abamectin (a low-risk pesticide). Toxicants can be stomach poisons, nerve poisons, chitin inhibitors, or insect growth regulators (IGRs). Also, bait guns have been developed to inject paste or gel baits directly into the cracks and crevices or other places where cockroaches hide.

COCKROACHES



FLIES

CHARACTERISTICS AND RECOGNITION

In terms of both numbers and health concerns, flies make up one of the largest groups of insect pests. Although the major features and management measures given here are for urban pest flies, the principles generally apply to all flies.

The main urban fly pests in the United States are the house fly, fruit fly, hump-backed fly, bottle fly, moth fly, and fungus gnat, each of which has very similar life cycles. Adults seek moist garbage, dead animals, or manure in which females deposit eggs. Eggs develop into grub-like larvae (or maggots) that feed on the food source on which eggs were deposited. After a week or so, larvae leave the food source and spend another week or so in a non-feeding, cocoon-like form (pupa) from which adult flies emerge in a few days. Adult flies quickly mate and may move from the breeding site into human occupied structures through open doors and windows, seeking food.

Food for a fly consists of almost any organic material. House flies (among many others) eat solid food by vomiting digestive enzymes onto the food source and macerating it into a liquid form that can be lapped up with sponging mouth parts. Since flies continually vomit and defecate while feeding, germs are deposited on the food they feed on.

HOUSEFLY (*Musca domestica L.)*



House Fly Life Cycle

Worldwide, the common house fly is one of the most widely distributed insect pests. House flies are soft-bodied, gray-colored, about .63 cm (1/4 in) long, and have only one pair of wings that span about 1.5 cm (5/8 in). Their faces have two soft stripes that are silver above and gold below. The upper surface of its thorax is marked with four dark longitudinal stripes, and the abdomen is yellowish-white at the sides and base. House flies are active year-round outdoors in mild weather and indoors during fall and winter.

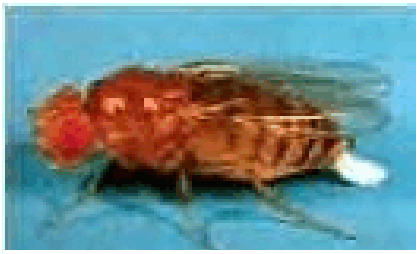
The housefly rarely moves more than a mile to food from its breeding sites. They have an excellent sense of smell, which leads them to food and water. Their range of vision is about eighteen inches. They are attracted to red colors.

Over her lifetime, a female house fly will lay from 350 to 900 eggs in any moist excrement, garbage, decaying fruit, vegetable waste, and soil containing organic matter. After eggs hatch, larvae feed and eventually migrate to cool sites (for instance, soil beneath boards or stones), where they pupate. In three days to four weeks, depending on temperature and humidity, adult flies emerge from pupae. Normal adult life span of the house fly is two to three days if denied food, but flies live up to 54 days when food is present. The time from egg to adult ranges from seven to 45 days, and in warm weather two or more generations can be produced per month.

House fly populations may be greatest in early fall (September and October). Because larval house flies produce a glycerol compound, which keeps their body fluids from freezing, they mostly over-winter as maggots or pupae. Various similarities in appearance and behavior make it important to be sure that suspected "house fly" problems are not really flesh fly problems, which originate with dead animal carcasses.

FRUIT FLY (*Drosophila spp.)*

Fruit flies, also called vinegar gnats and pomace or vinegar flies, are made up of a number of species with worldwide distribution, and are the most common of all small flies. They are .3 to .63 cm (1/8 to 1/4 in) long, dull yellow to dark-brown, and some kinds have distinctive bright red eyes. Fruit flies are small enough to pass through window screens with a mesh size larger than 12 per inch. Fruit flies breed in such decaying matter as juices or other liquids remaining in empty cans, ripe fruits and vegetables, drain slime, wet mops, and dumpsters.



Fruit Fly with Egg

Female fruit flies lay from 400 to 1,000 eggs on the surface of decaying organic materials and in garbage cans; some species prefer briny or vinegary liquids around jar lids. Larvae hatch within 30 hours and begin to feed near the surface of the food source. Mature larvae move into dry areas to pupate, and development is completed in nine to twelve days. Outside, fruit fly numbers quickly build in summer until populations peak during fall harvest. Fruit flies can be present year round, especially indoors where preferred foods and breeding sites are available. Fruit flies are able to quickly reproduce in large numbers and may contaminate food if not managed.

MOTH FLY (*Psychodidae)*

Moth flies - or drain, moth, filter, and sewer flies or sewer gnats - are generally found in drains, especially in kitchens or bathrooms. Adults resemble moths, and are about .3 cm (1/8 in) long. They have light gray, tan, black, or brown bodies, and lighter colored wings that are held roof-like over the back when at rest; both body and wings are covered with long hairs, giving the body a fuzzy look. Moth flies are poor fliers and are most commonly seen just walking or running along walls. Their flight is short and jerky and of short duration (a few feet). Some species are active in winter.



Moth Fly

Moth flies breed in similar material to fruit flies. Females lay masses of eggs, especially between loose floor tiles in wet areas, in drain pipes, dirty garbage containers, water traps, and plumbing fixtures, around built-in sinks, and near decomposing organic matter. Larvae (maggots) develop

in shallow, polluted water and feed on sediments, decaying vegetation, and microscopic plants and animals found in gelatinous drain film. The life cycle is usually two to three weeks but may be as short as one. Adult moth flies emerge from sink, tub, shower, and floor drains. Some species are small enough to pass through window screens. Moth flies are mostly active in the evening, around drains or sinks. Moth flies do not bite and are of little health significance.

HUMP-BACKED FLY (*Phoridae)*



Hump-backed Fly

Hump-backed flies, or phorid or coffin flies, are .15 to .3 cm (1/16 to 1/8 in) long and similar in appearance to fruit flies, except that they are more humpbacked. Most species are brownish-yellow with brown wings, a small head, and a large and humped thorax. Larvae are whitish, legless, and worm-like and feed on sewage, dead animals, insects, rotting plant material, animal feces, and open wounds.

They infest clogged drains and dirty garbage containers, and adults are attracted to light. These flies are active in buildings during winter. Hump-backed flies have strong legs and are reluctant to fly. They are seen running across surfaces in quick and jerky motions. Hump-backed flies can infest building complexes.

Hump-backed fly adults and larvae are common around decaying vegetation (mold and organic matter). They can penetrate several feet into the soil to infest animal carcass or organic waste. Flies emerging in large number inside a structure may indicate plumbing leaks in the crawlspace or beneath floor slabs, and considerable effort may be required to locate the hidden wet breeding areas attracting them.

FUNGUS GNAT (*Sciaridae or Mycetophilidae)*



Fungus Gnat

Adult fungus gnats are .3 cm (1/8 in) long and resemble small mosquitoes, except that they do not bite. Fungus gnats are readily identified by their small size, distinctively long legs, and pointed abdomens. Adults are not strong fliers and are seen running across soil surfaces as potted plants are watered. Adults are also attracted to light, and collect at windows. Larval fungus gnats are worm-like, about .63 cm (1/4 in) long, have a transparent body and dark head, and are
usually found in the top layer of damp potting soil.

Outside, fungus gnats are usually found in gardens, where some larvae live near the soil surface, and others are deeply buried where they feed on plant roots. Fungus gnats reproduce all year long indoors, and the life cycle is 12 to 27 days, depending on temperature.

Over-watering of potted plants supports fungal growth. Larvae thrive in dampness, decaying vegetation, and outdoor compost. These flies do not generally damage plants.

BLOWFLY OR BOTTLEFLY (*Calliphora spp., Phaenicia spp.,)*



Green Bottlefly

A number of blowflies - blue, green, and black blowflies or bottleflies - are common throughout the United States and may enter dwellings where they are attracted to windows. Blowflies are common in populated areas, especially near slaughter houses, meat-processing plants, and garbage dumps. Blowflies are usually the first flies to appear in spring, sometimes emerging from hibernation on warm, sunny winter days. Blowflies mainly invade buildings during cool weather, when they are readily attracted to garbage cans. At night blowflies rest on shrubs or building walls from which they can easily enter buildings when doors and windows are left open. Blowflies are found in trash compactors and chutes, compost piles, on the ground, and in wall voids, attics, and chimneys. Blowfly larvae are sometimes observed on floors or falling from ceiling fixtures.

Adult blowflies are primarily scavengers. They are larger than house flies, make annoying buzzing sounds, and have metallic blue, green, or yellow or brown-colored bodies. Blowflies range in size from .79 to more than 1.27 cm (5/16 – 1/2 in) long and have a single pair of wings. Females usually lay 200 to 700 eggs (one species, up to 3,000 eggs) on meat, dead animals, decaying plant matter (such as lawn clippings), solid animal waste (dog manure is preferred), or at the edge of wounds in living animals. They can produce more than 30,000 flies per week.

Larvae are large and develop fast; they feed for up to ten days on the surface of decaying matter and, when larger, burrow into less decayed areas. When mature (about 1.90 cm [3/4 in] long), larvae wander away from the food source and burrow into the ground to pupate. In one to three weeks they emerge as adults. The time from egg to adult in some species is only nine to 18 days, which allows four to eight generations per year. Some species over-winter in the soil as full-grown larvae, and others hibernate in attics, walls, and ceilings, but not in clusters. The life cycle is from two to four weeks. The presence of either adults or larvae in a structure indicates the presence of dead animals (usually rodents) or rotting organic matter.

CLUSTER FLIES (*Polenia rudis [Fabricus])* (North America)



Cluster Fly

Adult cluster flies are about .9 cm (3/8 in) long, stout, and have a dark grey thorax with short golden hairs. The abdomen has irregular lighter portions. The adult flies often enter structures in the fall as days shorten and the weather cools. They overwinter in attics and wall voids, forming compact clusters of flies. They usually inhabit the side of the structure that gets the most sunlight. The adults overwinter in sheltered places and emerge in spring to mate. Eggs are deposited in soil and hatch after about three days. The hatched larvae search and enter earthworms as parasites. From egg to adult

takes 27-39 days, depending upon temperature; which produces about four generations a year. Cluster fly adults are relatively sluggish in movement.

HAZARDS OF INFESTATION

Flies in General

Flies provide great potential for disease transmission because of their feeding habits. Along with mosquitoes, flies are responsible for spreading serious diseases like malaria, sleeping sickness, leishmaniasis, and filariasis. Other disease-causing organisms that have been collected on flies include germs causing dysentery, tuberculosis, cholera, tularemia, anthrax, poliomyelitis, yellow fever, and typhoid.

Houseflies

Houseflies alone transmit more than 20 human diseases and parasitic worms (including salmonella, typhoid and paratyphoid fever, cholera, summer and infantile diarrhea and dysentery, tuberculosis, and anthrax) which adhere to the fly's sponging mouth parts, sticky foot pads, wings, body surface, or live within the fly's gut.

Blowflies

Blowflies deposit eggs on meat which, when eaten, are responsible for cases of intestinal myiasis (caused when live fly larvae are accidentally ingested, causing nausea and other conditions similar to food poisoning).

Eye Gnats

Eye gnats are suspected transmitters of conjunctivitis.

Cluster Flies

Overwintering cluster flies in attics and wall voids have substantial mortality. The dead flies in their typical clusters become a food source for dermestid beetle larvae. The dermestid beetle larvae can then become a source of infestation of historic organic artifacts in museum collections.

IDENTIFICATION, INSPECTION, AND MONITORING

Identification

If it is difficult to identify flies, request assistance from state health departments or preserve flies in alcohol and send them to university departments of entomology when necessary.

Inspection

Do not stop inspecting after finding the first breeding site, nor concentrate efforts only on those areas where flies were seen. Seek out all possible places which could contain decaying material, garbage, rotting fruits, vegetables, meats, dead animals or grass clippings. When inspecting for fly-breeding sites, first search for wet areas: floor drains, open drums, buckets, cans, bottles, potted plants, dish washers, machinery, and around cracks, roof lines, and loose tiles. Look for moist animal feces, garbage, wet mops, and towels. Housefly maggots on floors or pupae under carpets signal the probability of fly-breeding sites inside the building.

Begin inspections outside by intensively searching for breeding sites, first concentrating on garbage and refuse areas. Look under equipment for maggots in dead animal carcasses (mice, trapped animals, dead rodents), and in garbage and drain sludge. Examine building cracks and crevices, dumpsters and garbage cans, drains and refuse piles. Cat, pigeon, and rodent feces and dead rodents are ideal breeding sources. Develop maps of likely breeding sites and periodically re-check those areas for live fly larvae.

Inside the building, inspect trash container interiors and areas prone to litter (such as break rooms and lounges). Look for empty soda cans, coffee cups, rotting fruit products, misplaced lunch bags, wet towels, and debris in locker and lounge rooms. Inspect all cracks at baseboard level, crevices around loose floor tiles, hollows and voids, and inaccessible areas in machinery that are caked with dirt and organic matter. Inspect potted plants and grease traps.

In kitchens and food processing areas, thoroughly search for decaying food. Inspect floor drains, floors under work counters and equipment, and enclosed counters which permit water or food to accumulate inside or beneath them. Look under ovens, and in both hard-to-reach and under clean machinery at floor level

General Monitoring

Houseflies have certain preferred resting places. During the day and when not feeding, adult flies may be found resting on floors, walls, ceilings, in crack and crevices, and other interior surfaces as well as outdoors on the ground, fences, walls, privies, garbage cans, clothes lines, and vegetation. To monitor for adult flies, place scatter grids out for 30 seconds (or other standard time limit) in locations near preferred resting places and count the numbers of flies landing on grids. Sticky tape, 6.62 x 12.70 cm (3 x 5 in) wide sticky paper, or sticky strings can also be used to monitor adult flies.

When problem flies are attracted to light (for instance, cluster and hump-backed flies), place light traps in dark places or capture flies at windows. Use monitoring information to establish levels of infestation upon which to base management actions.

Monitoring Information on Specific Kinds of Flies

Housefly

Sticky or light-trap monitoring which produces, on the average, 50 to 75 house flies per trap per day indicates a moderately heavy population. More than 150 house flies per trap per day indicate a heavy population.

Drain Flies

To find possible entry points of drain flies:

- Place sticky traps near suspected sites;
- Set clear glass or plastic containers over drains or tape plastic bags over drains to capture emerging drain flies;
- Fit a piece of fine screen over the drain to see if drain flies stop appearing;
- Scrape a pocket-knife blade around the film inside the drain and look for tiny, worm-like drain fly larvae;
- Look for points of drain fly entry through cracks in the slab or expansion joints on the floor to suggest sewage-soaked soil or broken sewer lines;

MANAGEMENT

Mistakes in Fly Management Programs

The following are the most common mistakes made in fly management programs:

- Failure to properly identify flies and to find and correct conditions providing breeding sites.
- Stopping after finding the first breeding site; all possible breeding sites must be discovered and eliminated.
- Trying to manage adult flies without first managing larval breeding sites. Management of adult flies may be helpful to alleviate complaints, but it is not as effective as managing larval breeding sites.
- Attempting to manage flies with only pesticide chemicals. Pesticides alone will not eliminate fly problems and are only effective when good sanitation and exclusion are practiced as primary steps.

Physical, Mechanical, Cultural Measures

Sanitation

General: The first step in any successful fly program is to reduce fly numbers; the key to that is an effective sanitation program for potential breeding sites.

Outside:

- Eliminate conditions responsible for fly-breeding sites around buildings by properly disposing of food materials and garbage (especially under dumpsters), preventing accumulations of moisture, and removing weeds.
- Do not throw waste water from cleaning operations onto the ground; pipe it into covered drains. Keep areas around garbage cans clean. Assure that tight-fitting lids on garbage receptacles are used.
- During warm weather, steam-clean and rinse out garbage cans and dumpsters with disinfectant solutions on a weekly basis.
- Be sure that garbage is picked up twice weekly so larvae will not have time to develop into adults.
- To assure that fewer flies will enter structures, keep garbage cans and dumpsters tightly closed and as far from buildings as possible.
- Keep dumpster bottoms as dry as possible by installing bottom drains and lead water drainage into sewer systems.
- Release fly parasitoids *(Pteromalidae)* near areas where flies may pupate to prevent adult fly emergence.
- Seal cracks and crevices that lead to the inside to prevent adult cluster flies from entering.

Inside:

- Fit garbage cans and dumpsters with tight-fitting lids and always keep receptacles closed.
- Routinely clean cans and dumpsters with disinfectant solutions.
- Seal all wet and dry garbage up in plastic bags before placing it into receptacles; this excludes flies and reduces both odors and the attractiveness of garbage to flies. Be sure to take garbage out every night.
- Keep floors, walls, cooking, and food-preparation surfaces clean and dry.
- Examine plumbing pipes for possible leaks and water condensation.

<u>Notes on Management of Specific Flies</u>

Housefly: Housefly management requires a fully integrated approach based on exclusion and improved sanitation. Reliance on pesticides usually fails in the long-term since house flies have developed resistance to most pesticides.

Fungus Gnats: Allow potted plants to dry out between watering. Remove potted plants if they supply fly food, water, or harborage sites.

Fruit Flies: Management of fruit flies first requires that sources of infestation be removed. This is often difficult because fruit flies feed on a wide array of organic materials, much of which may be well concealed behind plumbing, in janitorial closets, stagnant drain traps, bottoms of garbage cans, and cracks, under appliances or counters, or outside the building. Unless thorough sanitation is practiced to achieve fruit fly management, problems continue to develop.

Drain Flies: Finding and removing breeding sources and good sanitation practices are the only permanent solutions for drain fly problems. Use a brush and industrial cleaner to remove slime and film from drains and flush drains with hot water and commercial caustic drain cleaners or disinfectants. Check carefully under the crawl space for leaks or water backups from possibly

broken garbage disposal or sewer pipes. Inspect such other possible breeding sites as clogged roof gutters, air conditioners and cooling towers, clogged storm drains, septic tanks, loose floor tile, water beneath potted plants, rain barrels, sewage treatment plants, dirty garbage cans, and moist compost piles.

Hump-Backed Fly: The presence of hump-backed flies most often indicates that plumbing is leaking. Hang yellow sticky traps in various places in the room to show where flies are entering, or tape a plastic bag over suspected floor drains. Hump-backed flies are attracted to light, and windows are a good place to collect them. Electric-light traps can also be used in dark areas where there is no other source of light. Once found, eliminate larval food sources (there may be more than one). If broken pipes are found, excavate and discard and replace all gooey soils saturated with organic material. Ventilate and dry out areas so as not to support insects.

Cluster Fly: A vacuum can remove clusters of the adult flies as they are found overwintering. Killing them with a pesticide may leave behind (unless removed) the bodies in an inaccessible void where dermestid larvae can feed upon them. In June or July, when all live adults have left the structure, screen all vents, weepholes and overhangs with at least 16 mesh screen. Caulk all openings, cracks, crevices, cable entrances, windows, doors and other potential entrance points. Cluster flies are attracted to lights.

Exclusion

Exclusion is second only to sanitation in effective fly management programs, because flies are always attracted to the warmth and odors of buildings.

- Assure that all doors, windows, air curtains, and door closing devices are in good repair and maintained to keep flies from entering the structure. Fit windows and doors with 16 mesh-to-the-inch, tight-fitting screens and install self-closing door devices.
- Screen doors should open outward; double sets of screen doors may be required.

Other Management Methods

Heat: Flies die in 30 minutes when exposed to 49°C (120ºF) dry heat.

Vacuum: A vacuum may be used to collect flies in groups (such as cluster flies).

Sticky traps: The best place to put sticky traps is where flies usually rest: in corners, on edges, on thin objects (suspended wires or strings), and on ceilings. Sticky paper and sticky strings are useful to capture house-flies, but flies are also trapped when encouraged to light on cotton balls.
Live-Capture Fly Traps: Outdoor, mechanical, and food-attractant fly traps are useful in some locations to lessen fly numbers, but they require attractive fly bait.

- Home-made fly trap: Place one cup of sugar, one cup of vinegar, and one banana peel in an empty two-liter bottle; fill with water to within 10.16 to 12.70 cm (4 to 5 in) from the top; tie a heavy cord around the neck to hang it from a tree. This trap catches flies all season long.
- Fruit-Fly Trap: For fruit flies, use "fly-in" type traps having specialized saucer-like lids that fit a quart-size mason jar. Bait these traps with a 2.54 cm (1 in) piece of freshly

sliced banana and add one teaspoon of water to keep the banana moist. Replace the banana every two to three days. In areas of high infestation, a trap may become filled with fruit flies in less than 24 hours. In kitchens, place traps out of sight and covered with paper. To kill flies before removing them from the trap, run hot water (66EC [150ºF]) into one of the entry holes. Keep the outside of the jar clean and dry, or fruit flies will feed on the outside and not enter the trap. Since fruit fly eggs hatch in 10 to 15 days, clean the jar every two to three days. Meanwhile, carefully inspect the building to find the source of the flies.

Insect Light Traps

Electric and ultraviolet (UV) insect light traps (ILTs) offer good captures when used according to manufacturers' directions. Correct use of ILTs can help solve many flying pest problems in small facilities. Proper maintenance of ILTs requires annual (or more frequent) lamp replacement, weekly trap cleaning to manage dermestid beetle problems, and a sufficient number of properly located traps. Locate traps three or more meters (12 or more feet) from doorways so flies cannot see them from the outside (to prevent attracting flies into the building), less than 1.52 meters (5 ft) from floor level, and at ceiling level in front of large overhead doors, but not facing outside. Each situation is different and it should be determined in advance how flies enter and move through a building. Clean light-trap trays often, both to monitor efficacy and to prevent scavenger insect problems.

Outside Lighting

If practical, place outside lamps on poles away from buildings but shining onto doors, so as to attract night-flying insects away from the building. High-pressure sodium-vapor lamps help to minimize flies when installed at, but not over, entrance ways.

Temperature

Flies become sluggish or do not fly in lower temperatures. Keep inside temperatures as low as practical.

Other

Fungus gnats: Where fungus gnats are a problem inside, stir soil of potted plants so it will dry out. Allow soil to dry out between watering (just until plants begin to show very first signs of wilting). Discard dead plants, rotting vegetation, and infested soils. Pot new plants and transplants only in sterile potting soil. Store unused soil separately in a covered container where it cannot become infested. Hang yellow sticky cards (used by the greenhouse industry) above the plants; this will also help control white flies and other plant pests.

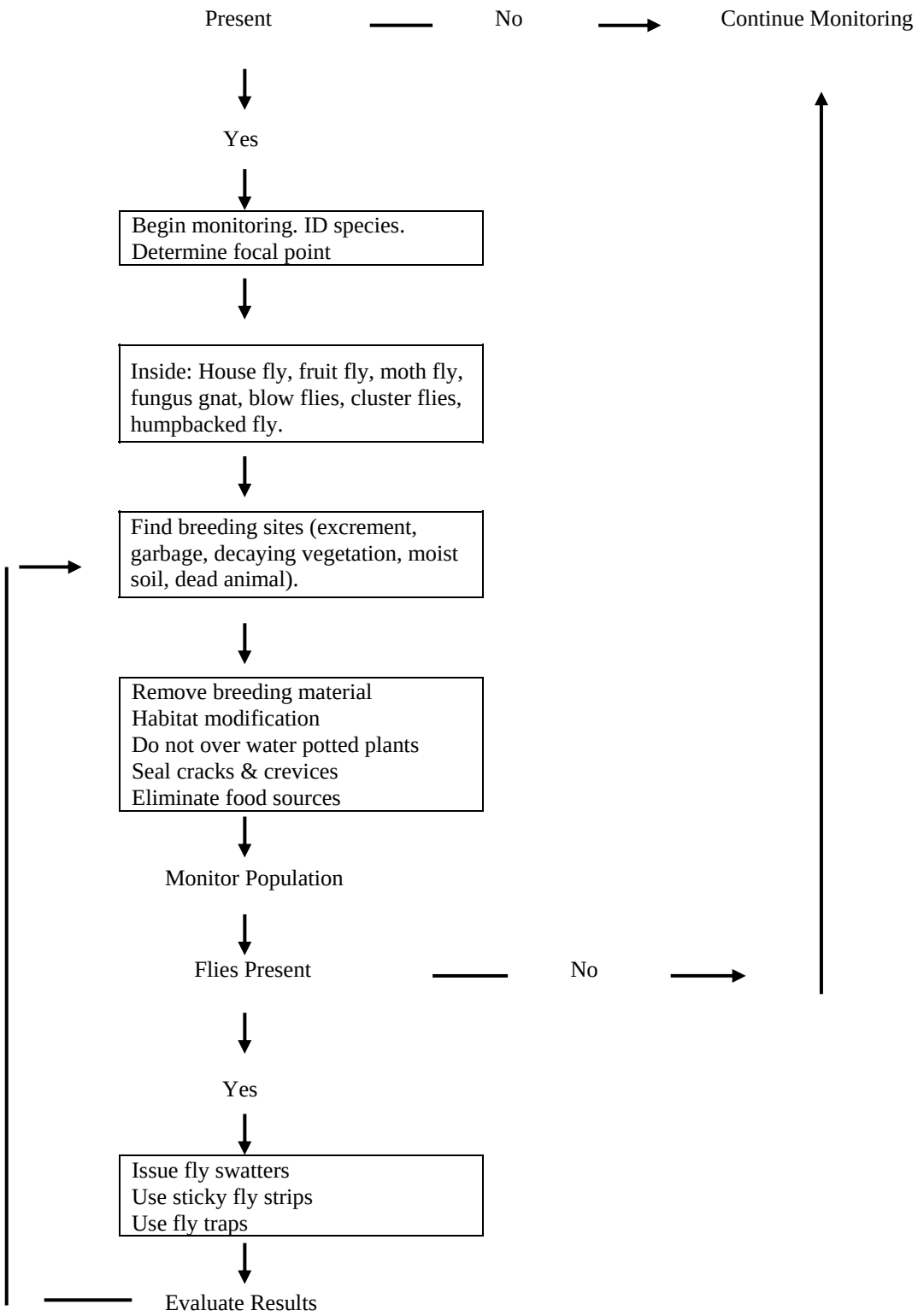
PESTICIDES

When deemed necessary, pesticide applications shall be performed by approved licensed applicators only. Applications shall be made according to National Park Service policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Pesticide applications for flies are generally unnecessary since sanitation, cultural controls and exclusion will reduce or eliminate fly infestations in structures. Do not treat for cluster fly in

attics or wall voids.

FLIES

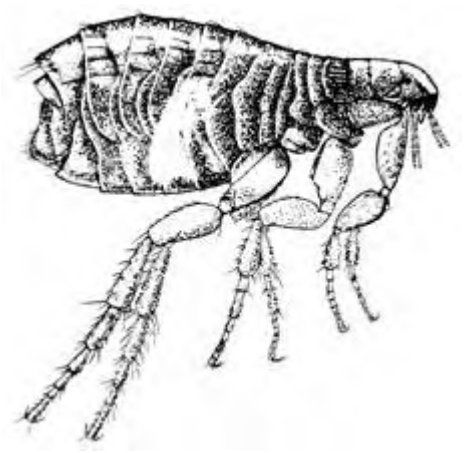

Present
No
Continue Monitoring
Yes
Begin monitoring. ID species.
Determine focal point
Inside: House fly, fruit fly, moth fly, fungus gnat, blow flies, cluster flies, humpbacked fly.
Find breeding sites (excrement, garbage, decaying vegetation, moist soil, dead animal).
Remove breeding material
Habitat modification
Do not over water potted plants
Seal cracks & crevices
Eliminate food sources
Monitor Population
Flies Present
No
Yes
Issue fly swatters
Use sticky fly strips
Use fly traps
Evaluate Results

FLEAS

CHARACTERISTICS AND RECOGNITION

Fleas are common indoor problems throughout the United States, except in very dry areas. The most typical species, and the one used here as a model for flea management, is the cat flea. It feeds on a number of hosts, including cats, dogs, rodents, opossums, etc., and is found in a wide range of environmental conditions. This flea prefers animals but also affects people. Some conditions may encourage large numbers of fleas because:

- Summertime provides optimum temperature and humidity for flea-growth;
- After an absence of a host, large numbers of emerged and emerging adult fleas are ready to feed on <u>any</u> warm-blooded host.



Cat Flea

Adult cat fleas are about .3 cm (1/8 in) long, have sucking mouthparts, and exclusively feed on a host's blood. Flea bodies can withstand substantial pressures. Egg production in females begins two days after her first blood meal and peaks about the fourth day. She produces from 150 to 400 round, light colored eggs, the size of a fine-point pen tip, and lays about 20 of them per day for up to three weeks. Since about half of the fleas on an animal or pet are female, up to 500 flea eggs per day can drop onto turf and other resting areas in a site. Larvae hatch in two to fourteen days and then move to the base of turf or other fibers seeking food.

Larvae of cat fleas are also .3 cm (1/8 in) long, have chewing mouthparts, and feed on adult flea feces (which are partly digested blood), and organic debris. They must have a source of dried-blood or blood-containing materials to be able to complete the three necessary molts of larval development. Cat flea larvae are not very mobile. They are usually either in the animal's resting areas or protected spots. They shun heat, sunlight, and decreased humidity but are attracted to moisture. When molts are completed, larvae spin a sticky silken cocoon within the substrate and pupate. When pupal development is complete, they become adult but may remain within the cocoon until some stimulus triggers their emergence: for instance, being stepped near by an animal, carbon dioxide exhaled by a host, vibrations, or increased temperature and humidity. Most adult fleas emerge from pupal cocoons in ten to fourteen days; adult fleas can remain in the pupal stage cocoon, inactive but ready to emerge, for as long as a year while waiting for the proper host stimulus.

Flea larvae and pupae are mostly found in undisturbed areas which provide optimum humidity and temperature, regularly visited by animals and contain larval food. Fleas may be imported into structures by pets or squirrels entering the house through chimneys or other openings.

HAZARDS OF INFESTATION

Typical flea bites show as a central, small red spot where flea mandibles penetrated the skin, surrounded by a red halo. Some animals may be allergic to flea bites which may be seen as dermatitis, hair loss, excessive scratching, and skin inflammation.

INSPECTION AND MONITORING

Inspection of Buildings

Conduct a close inspection of the living unit to find "hot spot" areas with flea development.

- Look under furniture, in rugs, etc. for granules resembling salt and pepper which indicate flea presence. These salt-and-pepper granules are made up of flea feces, empty egg cases, shed larval skins, and dried blood.

- Collect fleas and have them identified. Fleas can be trapped in a number of ways:

  Collect fleas that land on an inspector's long white socks after a one-minute walk-through of flea-infested areas.

  Collect fleas from pet bedding, or by combing infected animals with a flea comb; place fleas in a plastic bag and kill them by freezing or heating to 49ºC (120ºF).

  Use commercial flea traps available from pet-supply dealers.

- Watch for animals going into yards or under dwellings. Look for bird or mammal nests under the structure and in unscreened chimneys and pipes. Opossums carry large populations of cat fleas, which may subsequently infest areas they travel through.

MANAGEMENT

Major Mistakes in Flea Management Programs

The effectiveness of flea management programs can be diminished by:

Failure to identify fleas and find the source of the problem;
Failure to exclude animals bringing fleas into the site;
Failure to clean indoor areas where fleas find harborage; failing to instruct occupants on cleaning methods;
Failure to gain occupant cooperation or inform them of what to expect after treatment -- because of the flea's life cycle, a few adult fleas will be seen after treatments;

Physical, Mechanical, and Cultural Measures

<u>Sanitation</u>
Thoroughly vacuum in a criss-cross pattern all flea "hot spots" and other areas used by animals (rugs, sofas, drapes) with a strong vacuum cleaner. Vacuuming can remove a large percent of the flea larvae present and flea eggs. Good vacuuming can keep a flea population low. Removal

of flea larvae from carpeting is the most important action in reducing an indoor infestation.

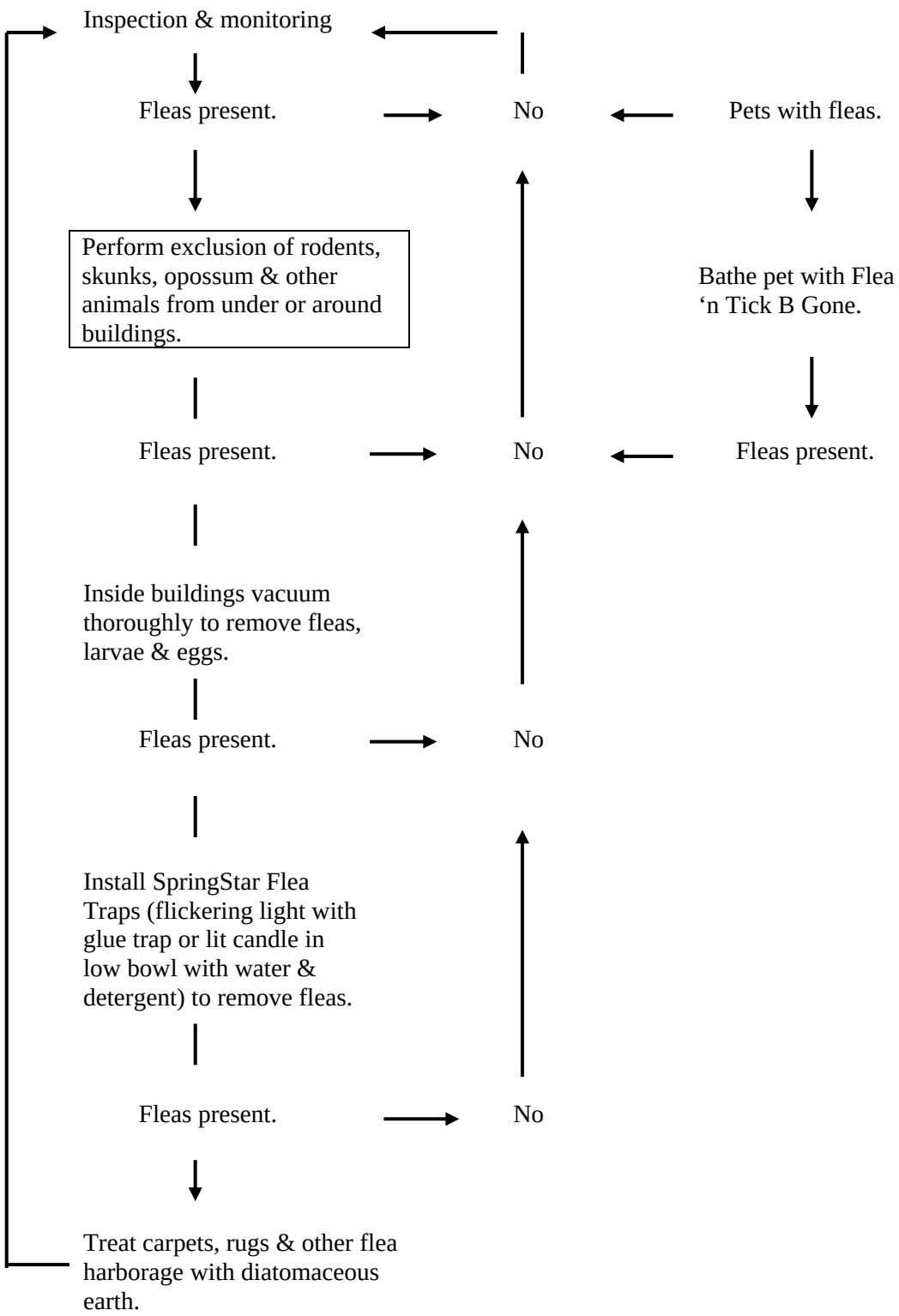
Carefully dispose of sealed vacuum bags containing live fleas.
If possible, lower the relative humidity in the structure to less than 50%.
Remove vegetation near the structure that may provide rodent harborage.

Exclusion
Screen vents, crawl spaces, and chimneys to keep animals out from under structures, outbuildings, or chimneys.
Ultrasonic devices have not been shown to be effective for flea control.
Fleas are killed in dry or moist air temperatures of 43 ºC (110ºF).

Pesticides
Pesticides alone will not eliminate flea problems. The management should be with combined physical and mechanical means. The following are additional items for flea management:

- If low-risk, enzyme products such as Flea and Tick B Gone are used on pets such as dogs; there is no need to wear protective equipment.
- Insect-growth regulators offer best results when used before spring flea activity begins. Follow label directions.
- Commercial, non-pesticidal flea soaps may also be effective against fleas; bathe pets with flea soap according to the label.

FLEAS


Inspection & monitoring
Fleas present.
No
Pets with fleas.
Perform exclusion of rodents, skunks, opossum & other animals from under or around buildings.
Bathe pet with Flea 'n Tick B Gone.
Fleas present.
No
Fleas present.
Inside buildings vacuum thoroughly to remove fleas, larvae & eggs.
Fleas present.
No
Install SpringStar Flea Traps (flickering light with glue trap or lit candle in low bowl with water & detergent) to remove fleas.
Fleas present.
No
Treat carpets, rugs & other flea harborage with diatomaceous earth.

WASPS AND BEES

CHARACTERISTICS AND RECOGNITION

General

There are thousands of different kinds of wasps and bees in North America, most of which are small wasps that are parasitoids of other insects and solitary burrowing bees. However, there are only 50 or so species of stinging wasps and bees that are troublesome to people. These are generally divided into two groups: the social wasps and bees (including hornets, yellow jackets, umbrella wasps, and honey bees); and the solitary wasps and bees which include mud dauber wasps, cicada killer wasps, and carpenter bees.

Social wasps and honeybees build nests in and around structures. Typical nest sites include beneath eaves, on porches, behind blinds, in trees, shrubbery, and vines, in stone walls, and in the ground. Most of the social wasps prey on destructive insects (house flies, blowflies, caterpillars, and moths) that they feed to their young (larvae). From this standpoint, they are considered beneficial. Honey bees gather nectar from flowers and convert it into a thick viscous liquid we call honey, which is fed to both adults and larvae. Solitary wasps prey on insects they paralyze and place, along with eggs, into individual nests. After the eggs hatch, the larvae feed on those insects until they can emerge from the nest.

Social Wasps

Social wasps live in colonies that have a caste system (division of labor) with overlapping generations, and a single fertile reproductive female called the queen produces all offspring. The other two adult forms in social-wasp colonies are the fertile males that mate with queens and the female workers, which are sterile. Their social colonies may persist for many years, unlike other stinging wasps which start anew each year.

All social wasps develop in similar ways. In the autumn, queens and males leave the nest to mate. The males die after mating, but the queens hibernate over winter in some protected area such as a crack, under tree bark, in buildings, attics, and basements, or in a hole in the ground. Next spring, the queens come out of hibernation, find a suitable nest site, construct simple, small, paper-like nests made from masticated wood and plant fibers mixed with water, and lay 25 to 70 eggs. The queen will not lay more eggs until that first brood has matured. Larvae hatch in a few days and glue themselves into the cells. The queen will feed the larvae chewed up bits of insects over the next 12 to 18 days until larvae mature. When mature, larvae spin a silken cap to close the cell and pupate (undergo metamorphosis into an adult). Once the first brood emerges as adults, the queen resumes egg-laying. Subsequent larvae produced by the queen are fed by the first generation of workers who also expand the comb or nest. The queen and workers do not eat the insects they collect for larvae. They subsist entirely on flower nectar and a sweet liquid provided by larvae when fed. With the onset of cold weather, wasps abandon the nest, which disintegrates from actions of weather, birds, or squirrels. The only member of the colony that over-winters is the fertilized queen.
Although yellow jackets and umbrella wasps are closely related and have similar life histories,

their nest-building habits differ.

Umbrella Wasps



Umbrella Wasp & Nest

The nest of the umbrella wasp best demonstrates a basic building pattern. Nests are made of paper-like material produced by the wasps, but appear as a flattened, circular-shaped comb of cells opening downward.

These are initiated by the umbrella wasp queen, which starts the nest with a thick paper-like strand attached to an overhanging structure, then adds a small number of cells.

Umbrella wasps are slender, elongated wasps, about 1.9 to 2.54 cm (3/4 – 1 in) long. They are black, brown or red with a few yellow markings. An umbrella wasp nest usually contains less than 250 individuals.

Hornets and Yellow Jackets

Hornets and yellow jackets build two different kinds of nests.

Aerial Nest Builders: Aerial nest builders include hornets and some yellow jackets, which build large football-shaped nests from paper materials similar to those of the umbrella wasp. These nests do not consist of a single, flat comb like that of the umbrella wasp, but contain from four to six wide circular combs, one hanging below the other, and all enclosed in an exterior multi-layer oval paper envelope which provides insulation. These nests are usually found on branches of trees, in shrubbery, and on gables. Hornet nests may only contain 500 to 600 workers, but yellow-jacket nests can support up to 10,000 individuals.



Yellowjacket & Underground Nest



Bald Faced Hornet Nest

Underground Nest Builders: Underground nest builders include other yellow jackets that place a protected nest in a natural ground depression, rodent or animal burrow, or into building wall voids, attics, hollow trees, and other enclosed spaces instead of in the ground.

Once workers begin to care for the nest, they enlarge the entrance hole and try to expand the nest. Combs are placed in tiers, one above the other. Nests can become very large and contain up to 15,000 individuals.

Hornets and yellowjackets are black with yellow or white markings and are more compact appearing than umbrella wasps.

Hornet and yellowjacket queens measure about 1.9 cm (3/4 in) long. The males and workers are about 1.27 cm (1/2 in) long. These wasps are feared because they sting. Populations are at a peak from late July to late September. Hornets and yellow jackets become more aggressive and easily irritated in the fall as the colony becomes old and there are fewer larvae to provide foraging adults their "sugar hit."

Solitary Wasps and Bees

Solitary wasps and bees do not build large social nests. The female digs a hole in the ground, tunnels into wood, or builds a nest out of mud. She then constructs a cell or group of cells into which she deposits eggs, provides them with a food source (pollen, or paralyzed insects), and abandons the nest, leaving the young to hatch and mature on their own.

Mud Daubers

Mud daubers are slender wasps, about 1.9 – 2.54 cm (3/4 – 1 in) long. They are black and yellow, metallic blue, or shiny black, and do not sting unless provoked. Their nests are long clay cells placed in such protected places as electric-motor housings, stored machinery, sheds, outhouses, attics, on building siding under overhangs, and under porch ceilings. Occasionally, wasps construct their nests on painted surfaces, which may create an added burden of repainting the area after the nest is removed. Mud daubers stock their clay nest tunnels with a paralyzed spider, caterpillar, or other insect. Then, inside a silken cocoon, they deposit a fertilized egg on the prey and close the nest hole. The egg hatches and the larvae feed on the prey.



Mud Dauber

Adults emerge in the spring. In the fall and spring, abandoned nests often house carpet beetle larvae that feed on residual organic debris in the open clay tunnel. Indoor carpet beetle infestations have been traced to abandoned mud-dauber nests.

Cicada Killer Wasps

Cicada killer wasps are very large (2.84 – 4.04 cm [1 1/8 – 1 5/8 in] long) solitary wasps with a black body. The first three abdominal segments are marked with yellow across the thorax, similar to smaller yellow jackets. Legs of the cicada killer wasp are yellowish and wings are brownish. Adult cicada killer wasps feed on nectar. In late summer, the female digs a conspicuous burrow (nest) in the ground (often in lawns or gardens) that has a horseshoe-shaped mound of dirt at the entrance. Burrows may be one inch to 3.81 cm (1 1/2 in) in diameter, .61 – 3.05 cm (2 – 10 in) under the surface of



ller with Cicada



Cicada Killer Wasp

the ground, and up to 45.72 cm (18 in) long. The female constructs three to four cells at the end of the tunnel, which she stocks with a paralyzed cicada or two, and then lays an egg in each cell. After eggs hatch, larvae feed on the cicada. Mature larvae hibernate over winter in the burrow, pupate in the spring, and emerge as adults from late July to August.

Although cicada killer wasps are helpful in reducing cicada populations, they frighten people because of their large size and the number of wasps frequenting attractive egg-laying sites. Male cicada killer wasps guard the burrows. Although they may aggressively fly at an invader, they do not sting. Females rarely sting, usually only if provoked.

Carpenter Bees

Carpenter bees are smooth and shiny solitary bees with a mostly black abdomen. Carpenter bees are similar in appearance to bumble bees, but lack hair on the dorsal side of the abdomen, except on the first segment.



Carpenter Bee

They bore into wood to make a tunnel in which they lay eggs and supply developing young with pollen. The tunnel is divided into cells where the individual larvae develop. The tunnels bored by carpenter bees may cause structural damage to buildings where they nest. Typical nesting sites in a structure include fascia, window trim, eave areas, rafters, wood shingles, wood siding, patio furniture and exterior wood trim. Although many different types of wood are selected for nesting sites, softer woods are preferred. Additional damage to the structure can be made by woodpeckers as they bore into the wood to feed on the developing larvae.

Honey Bees

Honey bees make social colonies of up to 60,000 individuals that live through a number of seasons. Individuals survive the winter by clumping together into a tight group to conserve heat and feed on honey collected and stored during the preceding summer. The number of individuals in a honey-bee colony increase during the spring nectar flow (flower bloom) and the members develop a queen cell. Before the new queen hatches, the old queen and about half of the bees leave (swarm) the colony and establish a new one in a protected hollow tree, rock void, attic, or building void.



Honey Bee

Both the original and new colonies increase in number over summer and swarm again the next spring. Africanized or "Highly Defensive Bee" colonies have the same life cycle as the European honey bee in the United States, except that Africanized honey bees produce less honey during summer and the colonies swarm much more frequently. Wild (colonies not housed in hives) honey-bee combs appear as long, hanging tiers of cells joined together at the top and made from wax that worker bees produce.

HAZARDS OF INFESTATION

Hazards

Yellow jacket problems develop in August or later, when their populations and nest activities are the greatest. Yellow jackets are extremely aggressive wasps and, when stinging, release odors that further enrage the entire colony.

When disturbed, bees and wasps drive a needle-like stinger into a victim's flesh and inject a venomous fluid. The venom causes painful swelling that may last several days. Stings may prove fatal to persons allergic to the venom who do not immediately use an anti-venom or consult a doctor.

Africanized honeybees or "Highly Defensive Bees" are a serious health and safety threat due to their aggressive nature. The Africanized bees will respond to threats to the hive by sending out as many as ten times the number of European bees to protect the hive, resulting in more incidences of bee stings and multiple sting events. Africanized bees have also been known to follow a moving target after stinging has begun.

Africanized bees and European honeybees can live almost anywhere around buildings, making the Africanized bee an even greater threat. Nesting sites include hollow tree wells, chimneys, storage, in trees, in abandoned automobiles, under eaves or overhangs and anywhere they can find shelter from the sun large enough to protect their wax combs. Eliminating access to potential nesting sites when possible is one way to prevent honeybee infestation. This can be accomplished by:

- Removing and discarding stored items around the exterior of buildings and grounds.
- Repairing holes in exterior walls to prevent bees from nesting in the hollow wall areas.
- Install fine meshed (.3 cm [1/8 in] hardware cloth) screens over tops of rain spouts, vents and openings in utility boxes.
- Secure sheds and outbuildings; close void areas if possible.

INSPECTION AND MONITORING

Inspect areas above doorways, holes leading into structures, and hollow trees or rotten tree stumps for stinging-insect nests. Monitor garbage cans for the numbers of wasps or bees feeding there over a set period of time. Take management action when fifteen or more foraging wasps or bees visit an open garbage can in ten minutes. Good records should allow correlation of stings

with numbers of foragers. This monitoring information can be used to predict when action may need to be taken to manage these generally beneficial insects.

Heed the following precautions when working with wasps and bees:

- Listen for buzzing indicating presence of bees nearby.
- Use caution when entering sheds, outbuildings or any storage area that is infrequently accessed.
- Inspect work areas before using outdoor power equipment including lawnmowers and weed cutters.
- Perform exterior inspections of buildings and outbuildings regularly (at least twice per year).
- From spring to fall, check once or twice a week for bees entering or leaving the same area of the building or yard.
- Teach staff to be cautious and respectful around all bees.

Treatment for Wasp and Bee Stings

If stung by a wasp or bee, take the following steps:

- Go quickly to a safe area inside a building and close the door.
- Remove stinger(s) as soon as possible.
- Don't squeeze the stinger; pressure will release more venom.
- Scrape the stinger out with fingernail, knife blade or credit card.
- Wash the sting area with soap and water.
- Apply an ice pack for a few minutes to relieve pain and swelling.
- Seek medical attention if breathing is troubled, if stung numerous times or if allergic to bee stings.

MANAGEMENT

Sanitation

Good sanitation manages the amount of food available to wasps. Denying food forces worker wasps to find less abundant natural prey and limits the amount of nutrition which larvae receive during periods of exponential colony growth. This ultimately restricts the colony size. Following are sanitation measures which will reduce wasp and bee problems:

- Keep garbage cans tightly closed.
- Check cans often for gaps and holes; request frequent garbage pickup.
- Install garbage liners in cans and promptly clean up garbage spills.
- Frequently clean both inside and outside of garbage cans with steam or soap and water.
- Move dumpsters and trash barrels away from doorways or other areas of human traffic.
- Prevent the accumulation of standing liquid waste from garbage or dumpster containers underneath the dumpster or in low-lying areas.

- During summer, yellow jackets are attracted to meat; keep food covered.
- Clean up all food or drink spills that attract bees and wasps. Wipe outdoor food-preparation surfaces and picnic-table tops with appropriate cleaning solutions.

Exclusion

Some methods of exclusion appropriate to a public building site are:

- Assure that all doors and windows close tightly and that screens are in good condition.
- Frequently and carefully inspect structural exteriors and seal all possible wasp or bee entry spots.
- Seal holes in hollow trees and remove rotten stumps.

Physical, Mechanical, and Cultural Measures

Whenever working around wasps and bees, wear protective bee veils and coveralls. Do not allow bystanders and pets to remain nearby. Approach honey bee nests on warm and calm days. Bees are more aggressive on cloudy and windy days when foraging is not possible. Avoid walking through the flight paths of foraging wasps and bees leaving and returning to the colony. At night, avoid shining lights or casting shadows on the nests; use red lights when working on colonies at night. Walk softly near ground-nesting bees and wasps to avoid making vibrations that alert the bees. Carefully and slowly brush off a bee or wasp that lands on a person, or wait until it flies off. Inspect and remove all small wasp nests early in the spring, while nests are still small. Removal at this time of the year is easily done with a broom, vacuum cleaner, garden hose, or other mechanical means. Later, nests will be much larger and better guarded by workers. Watch for honey bee swarms in April and May when they begin to search for new nesting places: including holes leading into structural voids. Swarms can be discouraged from nest establishment in buildings by various mechanical means such as providing a hive box.

Nesting pests in wall voids can be detected by using a stethoscope. Yellow jacket nests in wall voids do not necessarily require removal since they do not contain honey and are not reused in the following year. Abandoned nests, however, may attract fabric pests such as dermestid beetles. Do not seal up active nests before killing the insects. If wasps or yellow jackets are sealed into wall voids without an exit, they will chew through the wall to exit somewhere else, even into the interior of the building. If honey bees are sealed into wall voids, melting honey will spoil, rot, and stain the wall. After destroying and removing nests, close up holes with copper gauze, caulk, duct tape, spackle, putty or screening.

Use outdoor lights that are not attractive to insects. Remove stumps, dead limbs and hollow trees that can be used for nest sites. Remove plants that attract wasps and bees, including those that are vulnerable to scale or aphid attack which produce honeydew food sources for wasps.

Sticky or jar traps may be used to capture wasps, however, traps reduce only a small number of foragers.

Keep a list of local bee keepers who may voluntarily remove honeybee nests. Remove dead honeybee colonies and residue from walls so remaining organic debris and odor does not attract more insects.

Don't go barefoot; don't make unnecessary movements, and don't strike at individual wasps or bees flying nearby. In areas frequented by such insects, avoid wearing perfumes, scents, hair spray, suntan lotion, shaving lotions, talcum powder, cosmetics, and brightly colored or highly patterned clothing, which are attractive to bees and wasps. Examine wet towels before use to see if insects are taking moisture from them. Reduce honey bees on lawns by closely mowing clover and flower heads.

Other Measures

Biological
Biological methods show little promise; parasites, predators, and pathogens are mostly effective only on small, weakened colonies.

Heat
Wet or dry temperatures of 54°C (130ºF) effectively kill wasps and bees. If an infested area is covered with a plastic tarp, the summer sun generates sufficient heat to kill them.

Vacuum
Wasp and bee nests can be removed with an industrial vacuum cleaner. (Wear protective clothing.) Be sure the vacuum nozzle is placed over the only entrance hole before disturbing the nest. When the last of the colony is removed, plug the vacuum bag with cotton and heat it in the sun to kill the insects.

Pesticides

Poison Baits
When deemed necessary, pesticide applications shall be performed by licensed applicators only.

Applications shall be made according to National Park Service policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

A number of commercial pesticides are available which foraging wasps and bees carry into the nest. Choose the appropriate bait material to mix with the insecticide depending on feeding habits, which change with the season. Poison baits should not be accessible to children and nontarget insects and animals.

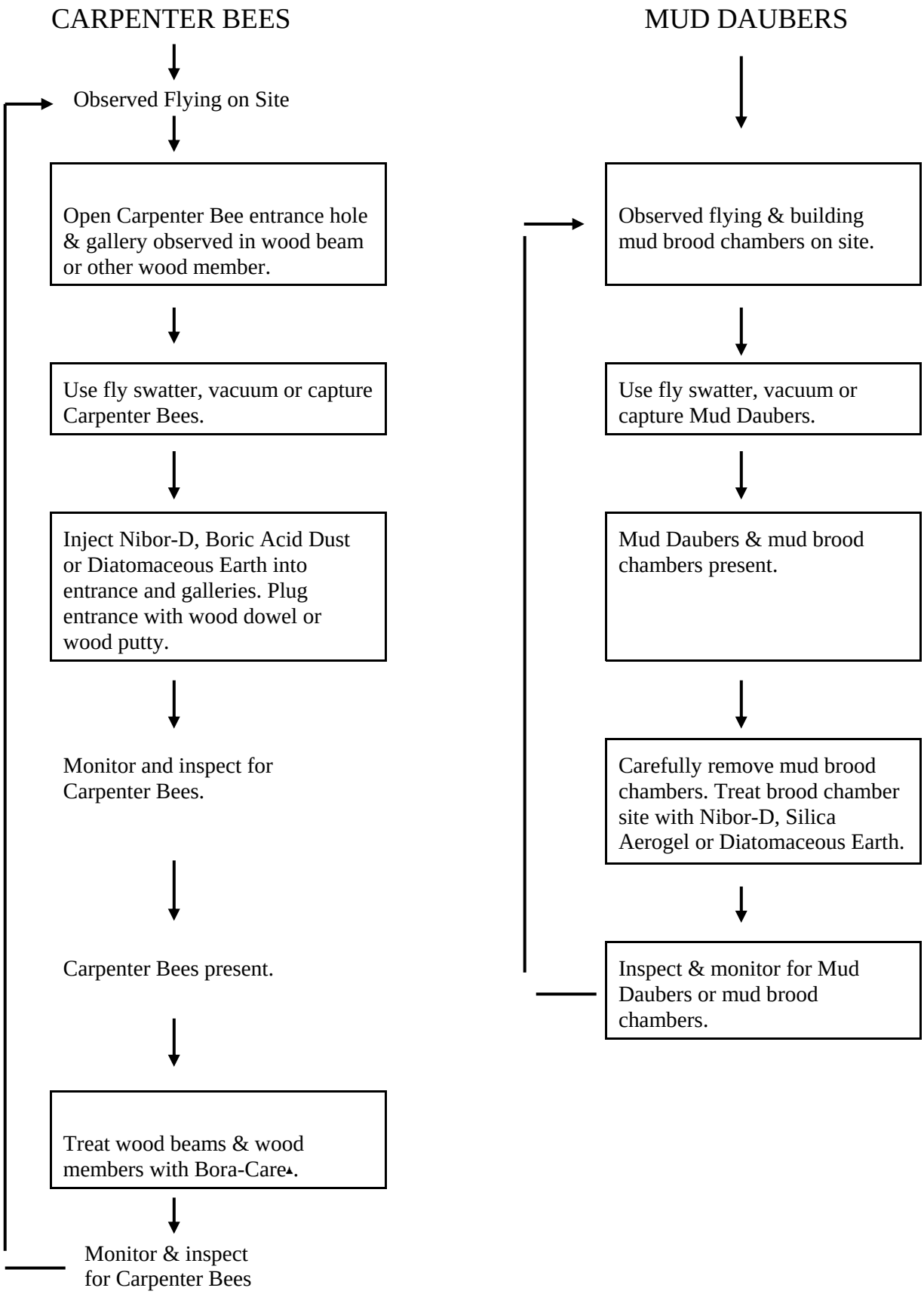
Aerosol Sprays for Aerial Nests
A number of commercial aerosol preparations are available that quickly and safely destroy aerial wasp and bee nests. Follow label directions.

Insecticides for Subterranean Nests
After locating and sealing all entrances but one, properly labeled insecticides can be poured into

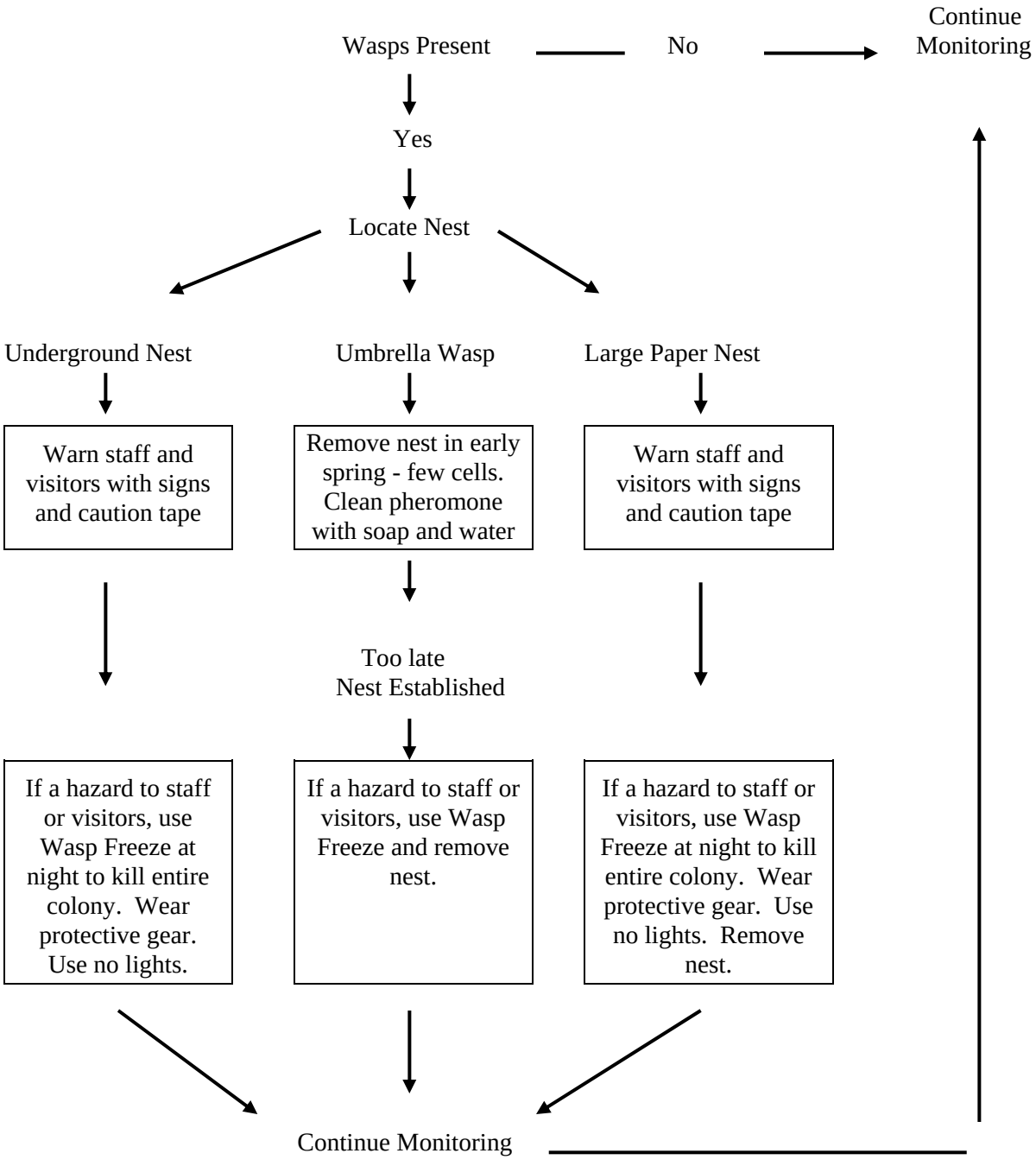
subterranean colonies and the entrance plugged.

Dusts and Aerosols for Wasp and Bee Nests in Wall Voids and Attics

A number of residual pesticide dusts and aerosol formulations are available to treat nests in building walls and attics. Follow label directions. Having found the location of a nest (listening for buzzing behind plasterboard), drill a hole and inject aerosol or dust directly into the colony. Killing honey bees in walls with pesticides causes deterioration of honey and nest combs and attracts other bees and troublesome insects; melting honey and wax may stain walls unless the structure is opened up to remove the debris. Contact your local beekeeper association for assistance, if necessary, to remove honey bees by means other than pesticides. Do not seal all entrances of nests located in building walls without killing the colony since wasps and bees may find an exit into the interior of the building.


CARPENTER BEES
Observed Flying on Site
Open Carpenter Bee entrance hole & gallery observed in wood beam or other wood member.
Use fly swatter, vacuum or capture Carpenter Bees.
Inject Nibor-D, Boric Acid Dust or Diatomaceous Earth into entrance and galleries. Plug entrance with wood dowel or wood putty.
Monitor and inspect for Carpenter Bees.
Carpenter Bees present.
Treat wood beams & wood members with Bora-Care.
Monitor & inspect for Carpenter Bees
MUD DAUBERS
Observed flying & building mud brood chambers on site.
Use fly swatter, vacuum or capture Mud Daubers.
Mud Daubers & mud brood chambers present.
Carefully remove mud brood chambers. Treat brood chamber site with Nibor-D, Silica Aerogel or Diatomaceous Earth.
Inspect & monitor for Mud Daubers or mud brood chambers.

WASPS


Wasps Present
No
Continue Monitoring
Yes
Locate Nest
Underground Nest
Umbrella Wasp
Large Paper Nest
Warn staff and visitors with signs and caution tape
Remove nest in early spring - few cells. Clean pheromone with soap and water
Warn staff and visitors with signs and caution tape
Too late
Nest Established
If a hazard to staff or visitors, use Wasp Freeze at night to kill entire colony. Wear protective gear. Use no lights.
If a hazard to staff or visitors, use Wasp Freeze and remove nest.
If a hazard to staff or visitors, use Wasp Freeze at night to kill entire colony. Wear protective gear. Use no lights. Remove nest.
Continue Monitoring

SPIDERS

CHARACTERISTICS AND RECOGNITION

General

Only a few species of spiders live in structures; most are accidentally carried into buildings on firewood, laundry, or plants. Since they feed on insects, they are rarely problems in buildings that do not have an insect food source. They are objectionable pests to people fearful of them, even though most are harmless. There are only two spiders considered dangerous to human beings in the United States: the black widow and the brown recluse. These generic names, however, represent several different species. The following discussion describes these two spiders, but generally applies to all spiders.

Black Widow Spider

Several kinds of black widow spiders are widely distributed over the eastern, southern, western, and northwestern states of this country. Black widow spiders are normally outdoor species that sometimes move or are accidentally brought indoors. Young spiders may migrate inside on ground-floor levels. Outside, the black widow can be found in crawl spaces and bird nests, on low-growing plants and grape arbors, and under porches, garages, and sheds. They are also found in stacked pots, baskets, boards, firewood piles, rodent burrows, and water meters, and under bricks and stones.



Female Black Widow with Egg Sac



Female Black Widow

The female black widow has poison glands and fangs with which she kills insect prey. These spiders can go for as long as three to four months without eating. Although the female black widow rarely leaves the web, males are more adventurous, especially when seeking a mate. When they first hatch, males are slightly venomous, but the potency of venom is lost as they mature. Male black widow spiders are not dangerous to people.

The adult female black widow spider has a shiny black abdomen that is usually decorated on the underside with red or yellow-red markings resembling an hourglass. This mark is visible when the female hangs upside down in the web. The markings, which may be absent, vary in different individuals from that of a typical hourglass shape to a pattern of two or more triangles; occasionally, some spiders may only possess a long, irregularly colored area. Male black widow spiders are small, white, and streaked with red, white, or yellow. Female black widows are about 1.27 cm (1/2 in) long; males are only about half that size and have longer legs.

The adult female black widow spider is primarily nocturnal. She weaves tangled webs of coarse silk in dark locations, and in late summer she begins to lay batches of eggs in units of 300 to 400 on the web. Four to nine batches of eggs, covered with a silken sac, can be produced during a season. The female guards the egg capsules and moves them as necessary when repairing the web. Females tend to be hungry and aggressive after egg laying, during which time most human-related bites seem to occur. Eggs hatch in eight to 10 days, and the young disperse by riding air currents on short strands of web. Young black widows mature in about four months and only mate once. Although some believe the female kills the male after mating (hence, the name "widow"), others contend that the female rarely does so. The life span of a spider is from eighteen to twenty-four months.

Brown Recluse Spider

Seven varieties of brown recluse spiders make up this group. These are dusky-tan or brown spiders that range over most of the United States, sometimes "hitch-hiking" into dwellings on luggage or household furnishings imported from other places.



Brown Recluse Spider

The brown recluse spider is an outdoor species that hunts at night. It doesn't use a web to capture prey; but rather runs fast to overtake it instead. In the south, the brown recluse lives under loose bark, in woodpiles, under sheds and beneath debris. In the north, it has to live indoors, especially in the sleeves of clothing hung for long periods of time in closets. The brown recluse spider has a high moisture requirement, and is often found near water heaters. It may also be found behind or under furniture and boxes.

The brown recluse is a medium-sized spider (about .79 – 1.27 cm [5/16 – 1/2 in]) and smaller than the black widow. Unlike the black widow, the brown recluse has an oval abdomen that is uniformly tan-to-dark brown and without markings. A dark "violin-shaped" fiddle back mark is obvious on the cephalothorax (combined head and thorax portions) on most species. The broad base of the fiddle begins at the eyes and the narrow part of the fiddle neck ends just above the attachment of the abdomen. The brown recluse has three pairs of eyes (in groups of two) placed in a semi-circular pattern (rather than four pairs for most other spiders). Its legs are long, the second pair longer than the first.

Although the brown recluse makes a fine, irregular web, it wanders around to hunt after maturing. During a lifetime, females produce one to five egg cases of 30 to 50 eggs each. Eggs are placed on the web in a loosely woven sac of wispy sheets of silk. Usually one or two young spiders per brood survive, because adults are cannibalistic (and also feed on black widow spiders). Recluse spiders mature in seven to twelve months, and they generally live one or two years.

HAZARDS OF INFESTATION

Black Widow Spider Bites

Death results in less than four percent of persons bitten by black widow spiders. Strong, healthy adults rarely succumb to a bite, but young children are more vulnerable. Deaths among the elderly are usually the result of complications beyond the spider's bite.

Female black widow spiders are quite timid and usually make no effort to bite, even when provoked. Bites may occur when a spider is accidentally squeezed against a person's body. Spiders make webs in the folds of clothing, shoes, or under objects in dark corners.

The severity of the black widow bite depends on the amount of venom injected, age and condition of both the victim and the spider, part of the body bitten, degree of immunity of the victim, and treatment given. A black widow spider bite is not always felt, and in most cases, only two tiny spots along with redness appear at the bite site. Pain begins to increase around the bite after half an hour or more, along with other symptoms such as headache, dizziness, shortness of breath, and abdominal and back pain. The pain lasts for 12 to 48 hours and is generally worse by the second or third hour. Muscles in the victim's abdomen become rigid, and the person may develop nausea and, in some cases, convulsions.

How to Treat a Black Widow Bite

Anyone bitten by a black widow spider should be treated for shock by being kept quiet, preferably in bed and covered with a blanket. Victims should receive hospital treatment as soon as possible; antivenom is readily available to most physicians. If a doctor is not available, wash the skin around the bite but make sure any venom still remaining on the skin is flushed away from and not into the wound. A recommendation is to continually apply ice to the bite site, since cold delays absorption of the poison and gives the body an opportunity to neutralize the venom. Never administer alcohol since it increases sensitivity to the venom. Give the patient plenty of water and sweet weak tea.

Brown Recluse Spider Bites

Brown recluse spiders generally avoid areas of human activity, and are usually found only in unused rooms. Even though indoor infestations may be large, household residents are seldom bitten. The brown recluse is not aggressive but bites and causes severe wounds when squeezed against a person's skin, as in putting on shoes or clothing (most bites occur on arms and legs). Bites can be expected when previously unused rooms are occupied or when clothing stored for a long time in closets is brought out for use. Brown recluse bites sometimes produce a sharp

sensation at first, which may be mistaken for a bee sting or insect bite. However, it may not be noticed at all. Victims may not realize the full extent of the trouble for eight to 12 hours, when pain becomes intense. A reddened area and accompanying painful swelling develop at the bite, and nausea, vomiting, fever, and a rash may follow. The site of the bite becomes dark and dry and after seven to 14 days, tissue surrounding the bite becomes an open ulcerous wound. Without prompt medical attention and over a period of days, the ulcerous wound becomes a festering sore. Although scabs may form over the wound, they tend to fall off and the wound continually grows deeper and fails to heal for several months (up to a year). There is always the potential for gangrenous infection and skin grafts are sometimes required to close the wound. Death from bites is extremely rare, but bites are very debilitating and traumatic.

How to Treat a Brown Recluse Bite

Apply ice to a bite as soon as possible, elevate the limb, and take the victim and captured spider (if possible) to a physician. The brown recluse is a delicate spider and after a bite it can usually be found near where it was slapped by the victim. The spider should be killed (without destroying it so it can be identified) and taken with the victim to the physician. Identification of the spider is important for proper treatment because a few other biting arthropods produce similar injury.

Other Hazards

Some spider webs may clog vent pipes and trap fumes or odors inside structures.

INSPECTION AND MONITORING

Move cautiously when inspecting or treating any sites where there is potential spider harborage.

Inspecting For Recluse Spiders

Wear long sleeves, long pants, socks, and gloves and use a flashlight during inspections along walls in little-used, cluttered storage areas such as closets and attics. Look for loose irregular webs, cast skins and silky egg cases (about .84 cm [1/3 in] in diameter) but avoid placing hands into dark places. Spiders shed their skins in order to grow. These "cast" skins are fragile but retain a characteristic violin marking. Such skins indicate infestation.

Inspect behind and under furniture, in kitchen and bathroom cabinets, closets, ceiling light fixtures, stacks of firewood, and water heater closets. Other locations for inspection should include mattresses and bedding; walls and floors and stacked boxes, bags, papers in store rooms and sheds; behind picture frames; under stairs; and hanging clothing that has not been used for some time. Concentrate on areas outside daily traffic patterns.

Outdoors, brown recluses are found between the soil and foundations, under door stoops, and in window wells.

Monitoring Brown Recluse Spiders

The presence of brown recluse spiders can be monitored in sticky traps. Tent-top or other sticky traps with covers seem the most effective.

MANAGEMENT

General

Spiders should be conserved whenever possible; they are natural control agents for many pests.

Major Mistakes in Spider Management Procedures

The following are the mistakes made in spider management procedures:

- Spiders are re-introduced into structures by way of firewood, laundry, and flowers.
- Failure to eliminate the insect food source.
- Over-responding in management measures due to spider misidentification.
- Extensive pesticide application when only a few harmless spiders are present, which could be managed by physical or mechanical means.

Physical, Mechanical, and Cultural Measures

Sanitation
Habitat modification, good sanitation, and exclusion are absolutely necessary for long-term spider elimination; inform occupants of the need and the techniques.

Frequently and thoroughly vacuum (with an industrial vacuum) all cracks and crevices, closets, behind furniture, and mop floors to destroy webs, egg sacks, and young spiders. Clean dark corners inside the structure using leather or rubber gloves. Concentrate efforts for brown recluse management in seldom-used rooms. Remove webs off exterior of building so that spiders leave.

Remove lumber, scrap, rubbish, and debris from near and under buildings and frequently clean rain gutters. Stack firewood, brick, and stone piles away from buildings; inspect firewood for spiders and egg sacs. Keep grass mowed and cut very short next to buildings; establish a three foot swathe of gravel cleared of vegetation all around buildings. Keep trees and shrubs trimmed back at least three feet from structural walls. Pick up leaf litter and other debris in yard, especially next to buildings.

Make occupants aware that spiders are often introduced into structures on firewood, lawn furniture, garden implements, and children's toys. Remove the bark from firewood before bringing it inside; don't bring in any more wood than will be burned in an hour or two.

Perform annual spring cleaning: turn mattresses, clean closets; dispose of unused items, rotate seldom-used items in garages, under beds; neatly stack items inside away from walls; remove and wash all bedding; remove and clean drawers from dressers and remove cobwebs. This is

very important for brown recluse management because it interrupts the spider's reclusive habits. Re-inspect spaces disturbed by dusting, vacuuming, and mopping the same evening, and kill any moving spiders.

Inspect winter clothing and other unused closets during spring and summer. Before returning clothing to storage, clean it and pack it in sealed plastic bags.
Repair all water leaks and sources of condensation on pipes.

Reduce the numbers of insects in and around building. To avoid attracting spiders, arrange outside lighting so as not to attract insects. Move lights onto poles and away from structures. Trim weeds and remove debris around foundations, caulk entry holes, install tight-fitting screens and door sweeps. Spiders need a ready supply of insects to survive and invade structures infested with insects.

Regularly clean floors and baseboards and remove debris. Do not leave old clothing, bedding, boxes or piles of paper on floors.

Thoroughly clean attached garages and basements, crawlspaces, and outbuildings.

Dry out crawlspaces or spider problems will recur.

Exclusion
Inspect doors and window casings to be sure screens function properly. Caulk holes large enough to admit spiders including openings around water pipes and electrical lines. Keep tubs, sinks, and drains stopped at night. Install tight-fitting door sweeps to exclude spiders and crawling insects.

Other Measures

Biological
Mud dauber wasps, birds, rodents, and predatory insects prey on spiders.

Heat
Infested rooms can be treated by heating them to over 49°C (120ºF) for one-half hour.

Direct Measures
Step on individual spiders, kill them with a fly swatter, or remove them with a vacuum.

Pesticides

When deemed necessary, pesticide applications can be performed by licensed applicators only. Applications shall be made according to the National Park Service Integrated Pest Management policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Pesticides, when used, should be combined with nonchemical measures. Although spiders are

susceptible to most insecticides, chemicals are seldom used because of difficulties in getting spiders into contact with pesticides: they do not ingest pesticides during grooming and walk on hairs on their feet which prevent surface contact.

Web-building spiders seldom leave their webs.

Pesticide dusts, however, are sometimes applied in attics and crawlspaces. If a good spider reduction is done in the fall, few problems should occur until early to late summer of the next year.

When using pesticides to treat structures for spiders, warn occupants to be cautious in rooms that were treated, because spiders not killed will wander for a few days following treatment.

Carefully analyze the microhabitat occupied by problem spiders and use appropriate nonchemical and management methods.

Indoors

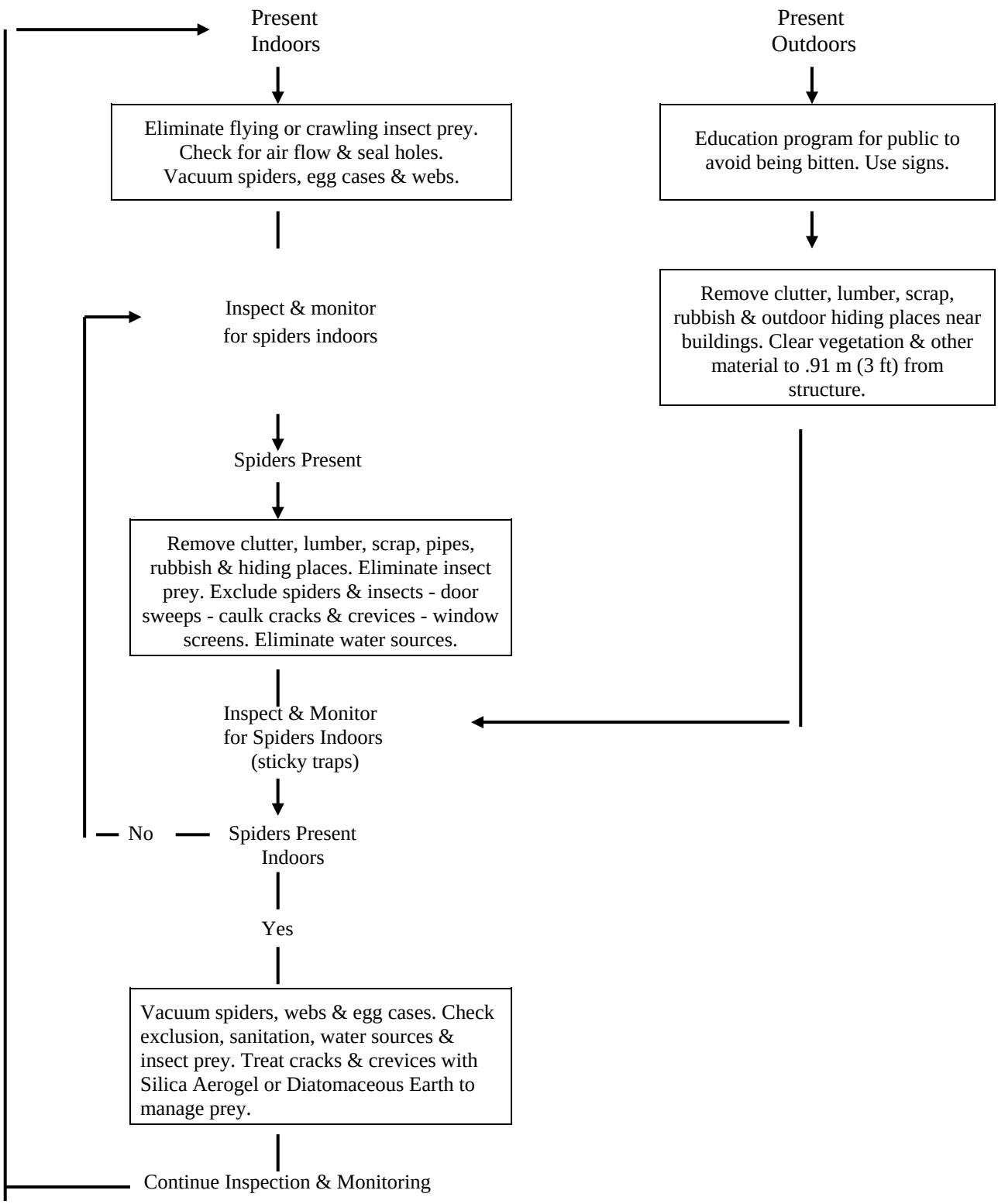
If necessary, use crack-and-crevice application dusts such as diatomaceous earth to treat the structure, including attic and crawlspace, window and door frames and casings, baseboards, cracks and crevices, room corners, beneath and behind furniture, closet bottoms, and garage in order to reduce insects spiders feed on. Since web-building spiders recycle silk (eat and digest old webs); light dust applications on webs may be effective.

If spider populations are not reduced, spot-treat areas of infestation with residual pesticides by directing insecticide into voids, cracks, and crevices.

Outside

Using the above techniques and materials, treat around foundations, windows, doorways, pipe openings, wooden fences, weep holes in brick walls or veneers, and building perimeters. Dustings should be wide-spread to eliminate spiders before they enter the dwelling. There is no need to treat the lawn. Follow label directions.

SPIDERS


Present Indoors
Present Outdoors
Eliminate flying or crawling insect prey. Check for air flow & seal holes. Vacuum spiders, egg cases & webs.
Education program for public to avoid being bitten. Use signs.
Remove clutter, lumber, scrap, rubbish & outdoor hiding places near buildings. Clear vegetation & other material to .91 m (3 ft) from structure.
Inspect & monitor for spiders indoors
Spiders Present
Remove clutter, lumber, scrap, pipes, rubbish & hiding places. Eliminate insect prey. Exclude spiders & insects - door sweeps - caulk cracks & crevices - window screens. Eliminate water sources.
Inspect & Monitor for Spiders Indoors (sticky traps)
No
Spiders Present Indoors
Yes
Vacuum spiders, webs & egg cases. Check exclusion, sanitation, water sources & insect prey. Treat cracks & crevices with Silica Aerogel or Diatomaceous Earth to manage prey.
Continue Inspection & Monitoring

TICKS

GENERAL

Ticks have recurved teeth or ridges on the central mouthparts (called the holdfast organ). They also have, on each of the first pair of legs, a sensory pit which detects stimuli such as heat and carbon dioxide. Ticks also detect light and dark as well as shapes, shadows, and vibrations—all stimuli that help them find their hosts. Soft ticks are not likely to be found at WEFA. Worldwide, there are over 650 species of hard ticks.

Some ticks live their entire lives on one host, while others spend only their larval and nymphal stages on a single host; then drop off as an adult to find another host. Most ticks, however, have three hosts, one for each stage.

Life Cycle

Seed Ticks

Normally, thousands of tiny larvae hatch from a batch of eggs and crawl randomly in the surrounding area; larvae (or seed ticks) have only three pair of legs. Some attach to a small mammal or lizard. They suck blood. Their feeding (or engorgement) time lasts for hours or a day or so since they are small. The host may distribute them while wandering away from the site of the initial encounter. When the engorged seed ticks drop off, they are still usually in or near an animal run.

Nymph

After molting, the nymph climbs grass leaves or a plant stem. Ticks climb progressively higher as they develop, so that different stages reach different layers of vegetation. Because of this, developing ticks find larger hosts than they had during the previous stage. After several days of feeding, the engorged nymph drops off its host and molts. Nymphs and adult ticks have four pair of legs.

Adult

The adult climbs vegetation, stretches its front pair of legs, and waits for vibrations or a shadow announcing a nearby host. Ticks sometimes wait for months or more for a suitable host. If heat or carbon dioxide is detected (for instance, from a passing mouse), the tick will seek it out. As the host passes by, claws located at the tips of the tick's legs grab hold of the host, and the tick moves to a place where it can engorge.

Attachment and Feeding

Adult female hard ticks will feed for several days to more than a week. Ticks usually grasp human hosts from a point close to the ground and crawl upwards until constricted by tight clothing or reach the head. On wild mammals or pets, they move until they reach the highest point on the host, the head or ears.

The tick's ability to creep undetected is matched only by its ability to attach for feeding without the notice of the host; stealth keeps ticks from being scratched off by the host before they can attach. When feeding is complete, the engorged female drops off of the host, lays eggs, then dies.

TICK RECOGNITION

American Dog Tick



American Dog Tick

Larvae and nymphs of the American dog tick, *Dermacentor variabilis,* prefer small rodents especially *Microtus,* the short tailed voles, called meadow mice.

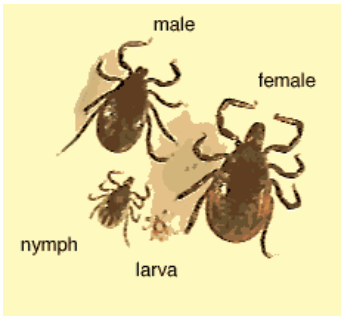
The adults, which are slightly over .3 cm (1/8 in) long, are found on dogs and people. The adult female is brown with a pearly light anterior dorsal shield. Males are brown-backed with pearly streaks. Both sexes have eyes, or unpigmented light-receiving areas, at the edges of the shield.

With a favorable food supply, American dog ticks can complete their life cycle in three months, with the female laying up to 6,500 eggs in late summer. Warm springs promote early adult and larval activity and egg-laying.

Adult ticks usually contact people on the lower extremities and crawl upwards until they are stopped by constricting clothing. Loose clothing allows ticks to proceed as far as the head. Because of possible communication of Rocky Mountain Spotted Fever (RMSF), any tick attachment should be noted and the victim observed for symptoms.

Deer Tick

The deer tick, *Ixodes scapularis* Say, larvae are very small. Nymphs are close in size to the adult, a little less than .15 cm (1/16 in), or the size of the head of a pin. Adult deer ticks are the size of a sesame seed. Deer ticks have a two-year life cycle and utilize three different hosts.



Deer Ticks

<u>Eggs and Larvae</u>
Eggs of the deer tick are laid in the spring by overwintering females. Tiny larvae hatch and feed on deer mice and white-footed mice in the late summer. Larvae can feed on human beings but will not transmit Lyme disease. After overwintering, larvae molt into the nymphal stage the following spring.

Nymphs

Nymphs are ready to feed in May and June. The body of the nymph is tan with black legs and a black shield (scutum) near its front. Nymphs climb vegetation and attach to passing animals such as dogs, cats, horses, cattle, raccoons, opossums, mice, migrating birds, and people.

Nymphs live in woodlands: bushy, low shrub regions and grassy areas where they can infect animals and people. Most human Lyme disease cases are the result of nymphal tick feeding. The remainder is due to adult activity. Nymphs usually molt into the adult stage in late summer, although they sometimes overwinter and molt in the spring.

Adults

The body of the adult female is brick red with black legs; she has a black shield (scutum) in the front. The male is entirely dark and smaller than the female. Adults feed in late fall or spring as well as on warm days in winter.

TICKS AND DISEASES

Several species of hard ticks are responsible for the spread and increase of Lyme disease and the persistence of Rocky Mountain Spotted Fever (RMSF).

Lyme Disease

Lyme disease is caused by a spirochaete (a spiral shaped bacteria). Symptoms vary and may resemble other diseases; many cases go undetected. The first indication of a potential infection may be the discovery of an attached *Ixodes* tick. Disease transmission does not occur until an estimated 10 – 12 hours after feeding begins, if the tick is located and removed within that time, no infection will occur. If infestation occurs, Lyme disease is a very debilitating and painful disease.

Rocky Mountain Spotted Fever (RMSF)

RMSF is caused by a rickettsia, a disease organism related to bacteria. It is an acute infectious disease characterized by pain in muscles and joints, fever, and spotty, red skin eruptions. At least four to six hours elapse after the American dog tick begins feeding before disease transmission begins. If ticks are removed during this noninfective period, infection will not occur.

Tick Paralysis

All species may cause tick paralysis if they feed at the base of the victim's skull for extended periods. Symptoms include paralysis of the arms and legs, followed by a general paralysis which can cause death. The victim can recover completely in a few hours, after the tick is removed.

TICK PEST MANAGEMENT

Where pest-management services are provided to a public site, it is important to know what

kinds of ticks are present, where they are most numerous, and what the disease potential in the

area is, and what the host and reservoir populations are. Pest-management programs are critical for effective management of tick species that transmit Lyme disease or Rocky Mountain spotted fever.

Inspection and Monitoring

Dragging

A commonly-used method of off-host sampling involves dragging a white flannel cloth over the ground or foliage where ticks are questing for passing hosts. Ticks cling to the cloth, and can be removed for counting and identification. Sample sites should represent favored tick habitats, and sampling should be done under conditions favoring tick presence (when vegetation is not wet, and when temperatures are above 10ºC (50ºF). All stages of ticks will attach to the flannel.

Dry Ice Collection

This technique appears to give more reproducible results than the drag technique. This technique involves placing a half-pound block of dry ice in the center of a .61 x .91 m (2 x 3 ft) panel of white polyester cloth on the ground at the chosen sampling site. The sampling sites should be selected in areas favoring ticks. After one hour, ticks on the top side of the panel are collected and can be counted.

Habitat Modification

Outdoor Areas

Dense shrub or tree cover or tall grass provides harborage for animal hosts of ticks, and protects ticks from losing body fluids resulting from drying winds and direct sunlight. Removal of excess brush and shrubbery, and pruning of overstory trees so that approximately 50% of a site is exposed to direct sunlight are recommended. Grass should not be allowed to grow more than six inches high, to allow ventilation and illumination of soil. Most ticks prefer the transition environment next to forested areas. Pesticides are rarely needed for ticks when vegetation management is practiced. Inspection of the site should be performed regularly to determine when pest management techniques should be conducted.

Indoor Areas

Methods of indoor tick management include regular inspection, elimination of animal harborage areas and entry, and animal-proofing of each site. The latter includes sealing of all holes in foundations and walls, and screening with heavy-gauge, 1/4 in. hardware cloth metal screen, along with vents, and other openings through which animals may enter.

Periodic surveys of potential or known habitats can reveal the presence of low-level tick infestations, thus indicating the need for application of management procedures (such as habitat modification) to prevent or retard further population increase.

Pest Management

Inside:

Use crack-and-crevice pesticide dust applications such as food grade diatomaceous earth where ticks hide. Treat under the edge of rugs, under furniture, in cracks around baseboards, windows, door frames, and in dog boxes. Fogging for ticks is useless.

Outside:
Managing the host animals is the most effective means to reduce tick populations. Pesticides are more effective when applied to paths frequented by animals. Treat low vegetation, including low shrubs, thoroughly. Mow around weedy fences that provide cover for rodents moving in from nearby woodland edges. Remove all vegetation at least .91 m (3 ft) from the structure. Broad application of pesticides to mowed grass does not reduce tick populations because the host, white-footed mice, does not infest lawns. Dust rodent runs or burrows in areas where human traffic cannot be controlled and where there is a danger of disease transmission.

Follow up
Continued monitoring and record-keeping is important. Tick counts should be reviewed at least annually to evaluate and adjust the pest-management program. Educational programs and materials for at-risk groups are vital.

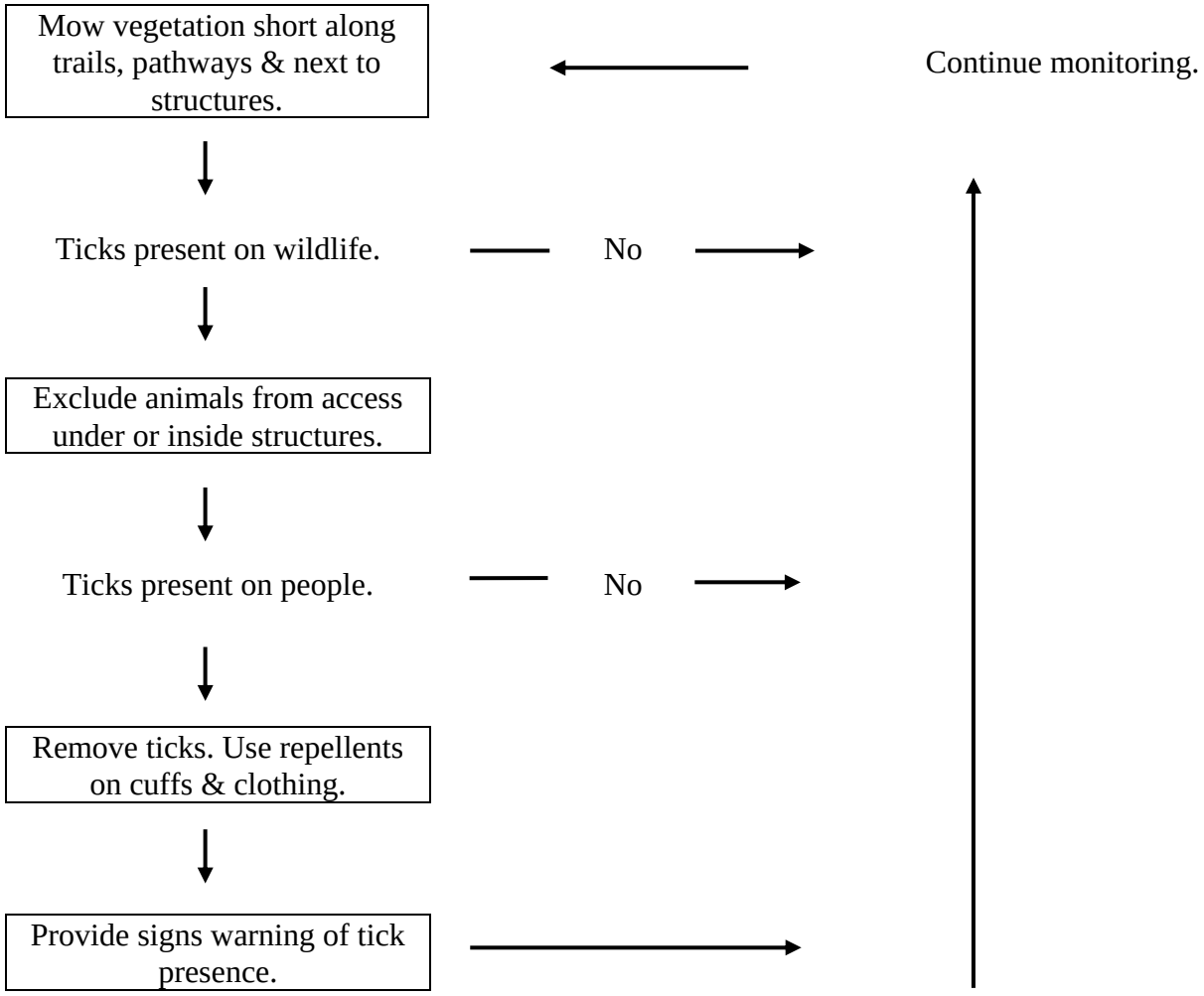
Precautions for At-Risk Group Members
Wear long pants tucked into socks while working or hiking in tick habitat. Use insect repellents on clothes and cuffs. Schedule regular body inspections for ticks at noon and at bedtime: Nymphal deer ticks are small, but they can be seen with close inspection. Larval deer ticks cannot be spotted easily, but they are not disease carriers.

Tick Removal
Regular inspection, location, and early removal of ticks prevent disease transmission. To remove feeding ticks dab them with alcohol. If feeding has just started, and mouthparts are not cemented in, ticks sometimes pull their mouthparts out. If they do not release in a few minutes, take tweezers, grasp the tick at the skin level, and pull steadily until the tick is removed.

Grasping the tick by the back end, or heating it, can force disease organisms into the wound. Place the tick in alcohol or otherwise keep it for identification. If the mouthparts are left in the skin, they will not transmit the disease, but the wound should be treated with an antiseptic to prevent secondary infection. Note the date of removal to calculate the time of symptoms onset.

If the tick is identified as a deer tick, see a physician. If it is a RMSF carrier, look for symptoms within a week after exposure, if they occur notify a physician.

TICKS


Mow vegetation short along trails, pathways & next to structures.
Continue monitoring.
Ticks present on wildlife.
No
Exclude animals from access under or inside structures.
Ticks present on people.
No
Remove ticks. Use repellents on cuffs & clothing.
Provide signs warning of tick presence.

MOSQUITOES

CHARACTERISTICS AND RECOGNITION

General

Mosquitoes usually are incidental pests in and around buildings, since their normal breeding habitats are outdoors. Mosquitoes may invade buildings during the warmer months from March to October.



Mosquito Larvae & Pupae

Adult mosquitoes have one pair of oar-shaped wings that are partially covered with scales. The females have sharp, lancet-like proboscises used for sucking blood, whereas the males do not. Males have large bushy antennae. Eggs are laid singly or in rafts (depending upon species) either on or near the surface of a body of water. Larvae, sometimes called wrigglers, live in water, usually developing through four stages to become pupae. The larvae feed on organic debris on the bottom or suspended in shallow pools. The depth of pools inhabited by mosquitoes is limited by the need for larvae to return regularly to the surface to obtain air through an air tube on their posterior ends. Pupae have a "question-mark" shape and are active swimmers, but do not feed. Adult mosquitoes emerge from pupae at the surface of water, but usually do not feed until the second or third night after emergence. Their entire life cycle can take place in 10 – 14 days, depending upon temperature, with adults living less than two weeks on average.

Biology of Domestic Mosquitoes

Aedes albopictus



***Aedes albopictus* Mosquito**

The Asian tiger mosquito, introduced from Asia in 1985, has spread to the eastern states south of New Jersey and the Midwestern U.S. east of the Mississippi River to the Great Lakes. The adults are black and white in appearance with a silver streak dividing the middle of the thorax.

The biology of this species is that they drink nectar between blood meals and eggs are deposited in artificial water containers. Eggs are placed into water in tree holes in addition to flower pots, vases, cans and old tires. The females are less likely to feed on people than other mosquitoes. The egg stage over-winters in the northern states. Adults die when winter temperatures drop below 4ºC (40ºF).

This species is a known carrier of many arboviruses, including dengue, encephalitides viruses, and other viral diseases not normally indigenous to the United States.

Aedes vexans

Aedes vexans occurs throughout the continental United States and Alaska. The adult has an unmarked thorax and white bands on the legs and abdomen. It is a true floodwater breeder. Its larvae develop in large numbers following spring runoffs, when meadows and woodland pools are flooded. Unlike the other *Aedes*, this species prefers to lay eggs in sewage-contaminated water.



***Aedes vexans* Mosquito**

The egg stage overwinters in the northern states, while in the south larval development may continue year-round. Biting occurs in the early morning, early to late evening, or even daytime hours in shaded areas. Adults readily fly toward lights at night; they also are migratory and may fly 10 miles or more from the larval habitat to seek hosts. This species feeds on domestic animals much more readily than *Aedes albopictus*.

Aedes vexans is a fair potential carrier of encephalitides viruses, WNv, and a moderately efficient carrier of dog heartworm. Moreover, it is such a persistent biter that even small populations are irritating.

Culex pipiens complex

House mosquitoes consist of several species, two of which are major pests in the United States. The northern species, *Culex pipiens* occurs in a band across the northern tier of the U.S. These house mosquito species overlap across the middle tier of states. They are a rather dull light brown with light white bands across the base of each abdominal segment.



***Culex pipiens* Mosquito**

The last abdominal segment is blunt at the end in contrast to the pointed abdomen of the aedine mosquitoes. The house mosquitoes lay egg rafts containing 200 or more eggs each in foul water such as ground pools, tire ruts, catch basins, open cesspools, and street and roof gutters. They may also lay eggs in basements, where larvae may continue to develop even in winter. Eggs hatch in a day or two and may develop through all larval stages in six to 10 days if temperatures are high, or several weeks if temperatures are low.

Although house mosquitoes are capable of transmitting encephalitides viruses, they are unlikely natural carriers because of their low human-blood feeding preference and comparatively short life span. However, they are competent transmitters of West Nile virus (WNv). Adults of *Culex*

pipiens feed principally in the evening on birds and domestic animals, but will feed on people if given the opportunity. Adults hibernate in the northern states, while breeding takes place year-round in the southern tier of states.

INSPECTION

When occupants express concerns about mosquitoes it should be determined which species are present, and where their larvae are. The species can be identified by determining if the abdomen is pointed (generally aedine species) or blunt (generally *Culex* species). The inspection starts on the basis of such identification. The aedine larval mosquitoes may be found in domestic water containers and tree holes, while the *Culex* species larval mosquitoes in foul water areas in and around the building. Identification of adult and larval mosquitoes is work for mosquito taxonomy specialists.

MOSQUITO MANAGEMENT

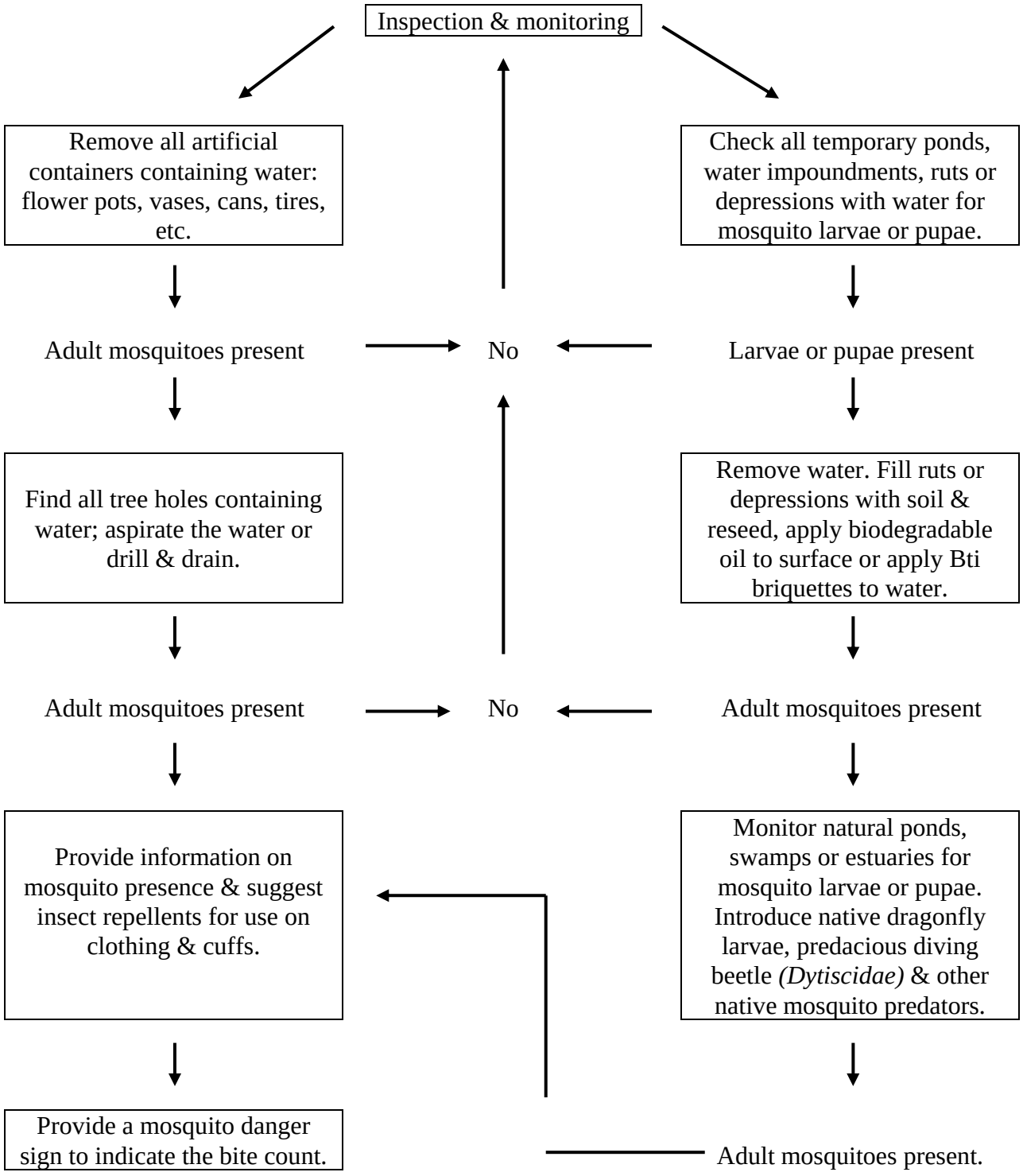
The best approach to managing mosquito populations is eliminating the larvae in their breeding habitat or the breeding habitat itself. A first step is not to keep water in pots, cans, or other containers. Often this just means letting plants dry out thoroughly between waterings. Major corrections may have to be made to reduce runoff from rains, especially in catch basins or in ground pools. Larger impoundments often produce predators such as frogs, fish, or predatory insects, so mosquitoes will not thrive there. Water in tree holes can usually be aspirated. If the water is removed in the spring, there will be no problem for months or perhaps even a year. Spaces having sewage backups or periodic flooding may require a permanent solution for continuous drainage.

If source reduction is not practical, mosquito larvicides may need to be used. This type of solution can become expensive if the larval habitats have to be continually retreated. There are relatively few pesticides registered for larval mosquito control in the U.S. Some of them include *Bacillus thuringiensis* (a bacterial insecticide) impregnated granules or "doughnuts." These formulations can be spread with a manual spreader where the breeding pools are small. Light biodegradable petroleum or vegetable oils spread on the surface of waters also manage larvae.

Adult mosquito management is frequently more challenging than larval control. Exclusion by use of screening is certainly the best means of preventing indoor infestations. Adult mosquito management, by black lights or "bug zappers" is ineffective outdoors and is destructive of the natural insect predators of mosquitoes such as crane flies and syrphid flies. Fogging or ultra low volume (ULV) treatment outdoors is rarely warranted or effective.

West Nile virus (WNv) is an exotic virus recently introduced into the United States that is of major concern as it has adverse effects on birds, horses and other animal species; and the elderly and very young humans. WNv is transmitted by several mosquito species. The most likely “competent” transmitters of WNv are *C. pipiens and Aedes vexans.* Infested water sources may be eliminated (drained or filled with soil) or treated with a larvicide or biodegradable oil. The introduction of mosquito fish can be used under certain circumstances (i.e., totally enclosed ponds so no possible escape, etc.). Adulticiding should be considered as a last resort.

MOSQUITOES


Inspection & monitoring
Remove all artificial containers containing water: flower pots, vases, cans, tires, etc.
Check all temporary ponds, water impoundments, ruts or depressions with water for mosquito larvae or pupae.
Adult mosquitoes present
No
Larvae or pupae present
Find all tree holes containing water; aspirate the water or drill & drain.
Remove water. Fill ruts or depressions with soil & reseed, apply biodegradable oil to surface or apply Bti briquettes to water.
Adult mosquitoes present
No
Adult mosquitoes present
Provide information on mosquito presence & suggest insect repellents for use on clothing & cuffs.
Monitor natural ponds, swamps or estuaries for mosquito larvae or pupae. Introduce native dragonfly larvae, predacious diving beetle (Dytiscidae) & other native mosquito predators.
Provide a mosquito danger sign to indicate the bite count.
Adult mosquitoes present.

CANADA GOOSE *(Branta Canadensis* [Linnaeus])

This goose is mainly terrestrial, feeding on young grass shoots. It was migratory but now overwinters wherever food is abundant. Adults are up to 1 m (45 in) long with brownish-grey bodies, head and neck black with a white patch on cheeks and chin. Canada geese nest at the edges of ponds, lakes or swamps. The females lay four to eight white eggs per clutch, and they incubate for about 28 days. The young have down when hatched, usually can feed themselves, and will leave the nest in two to three weeks.

The FIIS environment offers ideal habitat for Canada geese. These geese are a nuisance, owing to the geese grazing, droppings and noise. Geese may exhibit an aggressive behavior in the spring and early summer when guarding nests and goslings. There is growing concern that migratory geese may become a reservoir for the avian flu that is transmitted through contact with fecal droppings.



Grazing Canada Geese

Start managing goose problems before the geese arrive in early spring/early summer. Erect temporary barriers at least 76.2 cm (30 in) high with mesh openings no more than 7.62 cm (3 in) square so that a barrier is between the grazing area and a water source.

Geese prefer a large, unobstructed lawn area in close proximity to open water. Altering the habitat is considered the most effective, long-term approach to discouraging geese from an area. The objective of habitat modification is to deny geese access to water from land. Geese prefer young grass shoots such as fine-bladed grass species like Kentucky blue grass. Seeding with less palatable plants such as native grasses, tall fescue (K-31), ground cover or wildflowers should be substituted. Reduce fertilizer and allow the grass to grow taller (don't mow), making it difficult for geese to reach young, tender shoots. Plant native grasses and wildflowers to grow to a height of 15.24 cm (6 in) or more as a meadow to deter geese grazing. However, grass kept mowed short along pathways reduces the potential for tick development. It may take more than one season for the habituated geese to leave and not return. Temporary barriers may be installed until permanent barriers have been planted and have grown to the appropriate size and density.

Plant low-growing shrubs between the lawn and the lake to obstruct the view of the water. Other obstructions such as a barrier of large boulders can be used. These visual barriers should also be at least 76.2 cm (30 in) high, dense and solid to the ground.

For best results, all feeding of geese by staff or visitors must be discouraged and eliminated. Providing food handouts to geese is not good for the geese, and it will make it very difficult to make them leave.

Canada geese prefer to roost, feed and loaf near water where they can escape if threatened. Restricting that capability, especially during the molt, may deter them from occupying the lawn. Planting shrubs or placing boulders that predators can hide behind near grazing areas may also cause geese to avoid the area. Placing a dead goose decoy in a usual landing site may also cause geese to not use the area.

Hazing geese inside the compound may reduce the attractiveness of the area to the flock. Geese are afraid of dogs and will avoid an area where dogs are present. Border collies are successful at hazing geese as they are bred for herding sheep.

The most successful management programs for geese incorporate multiple methods.

A repellent product for geese is Rejex-It Migrate and Flight Control. There are no other contact repellents registered by EPA. The geese must eat it on the grass before they will learn to avoid it. The product must be reapplied after mowing or after rain. For the large acreage to be protected, this product may be more expensive than making the permanent habitat modifications.

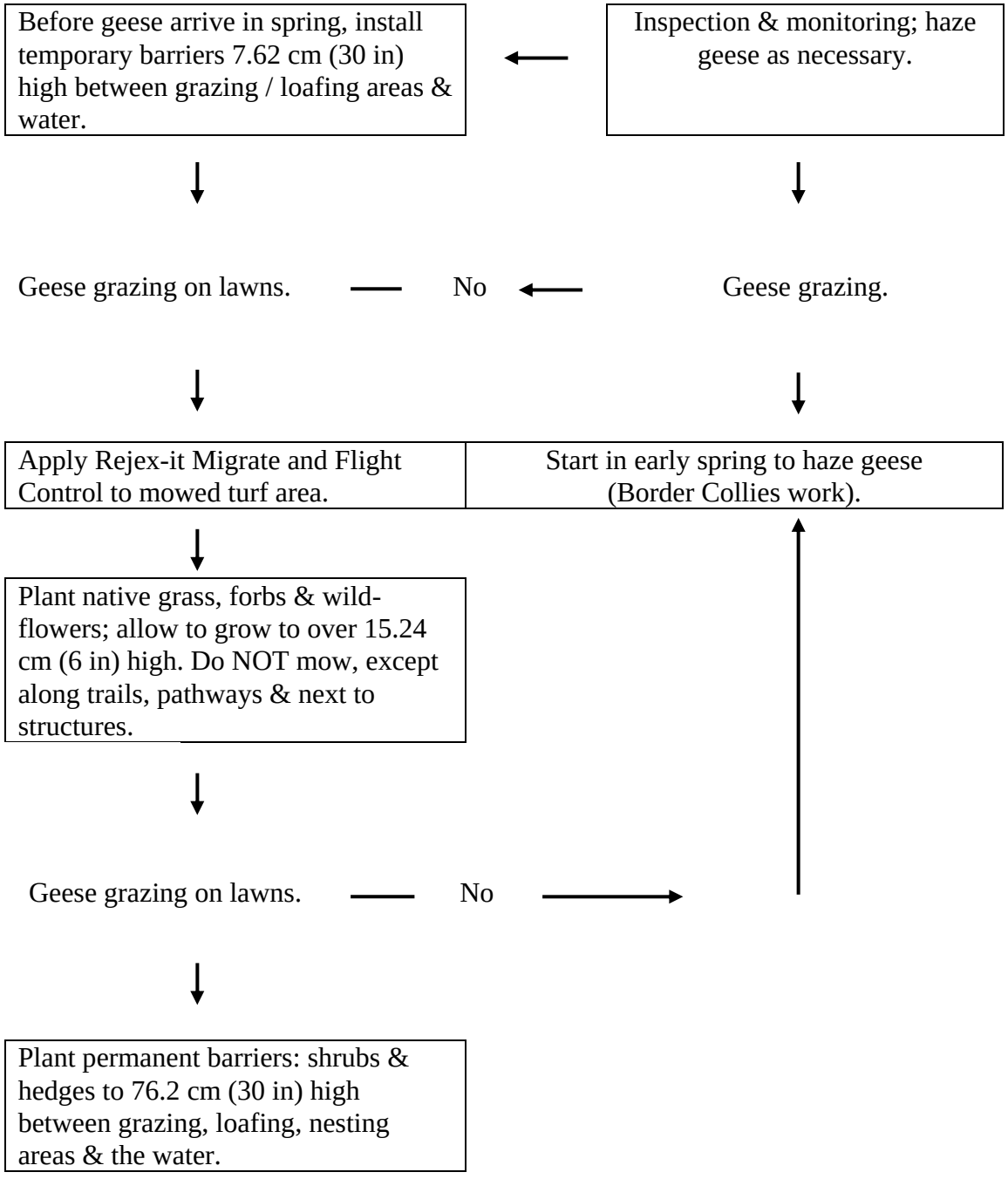
Canada geese are protected by the Migratory Bird Treaty Act. They can be legally hunted in the fall and early winter. Adult geese, their nests, eggs or young cannot be harmed outside the legal hunting season without necessary permits. Canada geese are also protected by federal and state laws.

BIRD DROPPINGS REMOVAL AND CLEAN-UP

Workers removing large quantities of bird droppings should follow these precautions to minimize risk from disease organisms in the droppings:

- Wear a respirator that is labeled to filter particles down to 0.3 microns.
- Wear disposable protective gloves, hat, coveralls, and boots.
- Wet down the droppings to keep disease spores from becoming airborne, and avoid drying them out.
- Put droppings into sealed plastic garbage bags and wet down the outside of bags.
- Dispose of trash bags. Disposal should be permissible through standard trash pick-up.
- When finished, and while still wearing the respirator, remove the protective clothing and place them in a plastic bag.
- Wash up or shower.

CANADA GOOSE



NOTE: Canada geese are protected under the Migratory Bird Act and cannot be disturbed while nesting; eggs and goslings may not be harmed. Hunting is only allowed during the fall and early winter migration season.

POISON IVY *Rhus toxicodendron*



Poison Ivy

Poison Ivy is a woody vine that is known for its ability to produce urushiol, a skin irritant that causes an itching rash for most people. The oil is in the leaves, vines and roots. Poison ivy grows throughout much of North America. It can grow as a shrub up to about 1.2 m (4 ft) tall, as a ground cover 10 – 25 cm (4 – 10 in) high, or as a climbing vine on various supports. Older vines on substantial supports send out lateral branches that may at first be mistaken for tree limbs. Poison ivy rarely grows at altitudes above 1,500 m (5,000 ft).

The leaves are compound with three almond-shaped leaflets. The berries are a grayish-white color and are a favorite winter food of some birds.

The color ranges from light green (usually the younger leaves) to dark green (mature leaves), and bright red in the fall. The leaf surface is smooth and has few or no teeth along the edges. The stem and vine are brown and woody.



Poison Ivy in the Fall

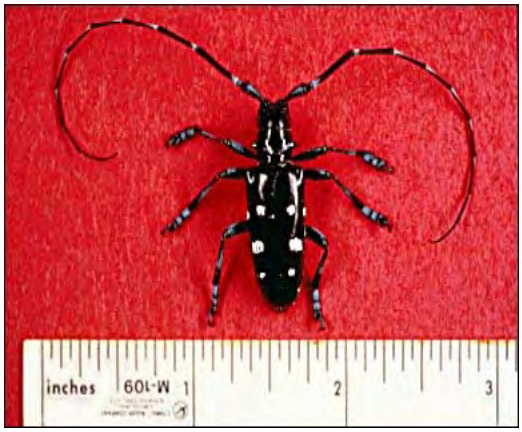
The reaction caused by poison ivy, urushiol-induced contact dermatitis, is an allergic reaction. For this reason, some people are immune to its effects. However, sensitivity can develop over time. If poison ivy is burned and the smoke then inhaled, this rash will appear on the lining of the lungs, causing extreme pain and possibly fatal respiratory difficulty. If poison ivy is eaten, the digestive tract and airways will be affected, in some cases causing death.

Due to the potential human risks from exposure to the urushiol in poison ivy, management of this native plant can be difficult. Wear gloves, dust mask, goggles and other skin protection. Small plants can be mowed (repeatedly) when it moves into turf areas. Herbicides can be used to kill poison ivy; however, the dead vines must be removed and bagged for disposal. Do NOT burn poison ivy. Provide signage to warn visitors of the presence of poison ivy along pathways or other areas where it is present.

LANDSCAPE

PESTS

ASIAN LONGHORNED BEETLE *Noplophora glabripennis*



Asian Longhorned Beetle

The Asian longhorned beetle was introduced from China in 1996 in wood pallets and other wood packing material in cargo shipments, and is currently limited to areas of New York, New Jersey and Chicago. It is large, ranging from 1.92 – 3.18 cm (3/4 – 1 ¼ in) long with very long black and white antennae. The body is shiny black with white spots. The beetles post no threat to public health, however, they feed on many species of hardwood trees, including several species of maple (Norway, sugar, silver and red), box elder, horsechestnut, buckeye, elm, London plane, birch and willow. The adults can be seen from late spring to fall, depending on the climate.

The Asian longhorned beetle is a member of the wood-boring beetle family, *Cerambycidae*. After mating, adult females chew depressions into the bark of various hardwood trees in which they lay their eggs. Once the eggs hatch, small white larvae bore their way through the bark into the tree, feeding on the vascular layer beneath the bark. The larvae continue to feed deeper into the heartwood forming galleries in the trunk and branches. This damage weakens the integrity of the tree and, if the infestation is severe enough, will kill it entirely.



Over the course of a year, the larvae mature and pupate under the bark. From the pupa, an adult beetle emerges, chewing its way out of the tree, forming round holes about .9 cm (3/8 in) in diameter. Many of these holes will be seen on a heavily infested tree along with frass and sap oozing from the holes. The beetles emerge from June through October, with adults flying in search of mates and new egg-laying sites to complete their life cycle.

Currently there are no chemical or biological defenses against the beetle, and in North America there are few natural predators. After an infestation is confirmed, in all cases, the affected trees are cut down and the wood is chipped and burned. No infested wood should be transported outside the infested area before chipping. Replanting is then suggested to maintain and replenish forested areas.

AUTUMN OLIVE *Eleaganus umbellate* Thumb.



Autumn Olive

Autumn olive is a medium to large shrub in the Oleaster family often reaching a height of 6.1 m (20 ft). The leaves are generally oval in shape, approximately 2.54 – 7.62 cm (1 – 3 in) long. The upper surface of the leaves is dark green in color, while the underneath side is covered with silvery scales. Small light yellow flowers bloom in late April and May after the first leaves have appeared. Small fleshy fruits range in color from pink to red.

Autumn olive was introduced into the United States in 1830 from Asia, and is found from Maine south to Virginia, and west to Wisconsin. In the eastern U.S., autumn olive has been planted for revegetation of disturbed areas. It is rarely encountered in dense forests or in very wet sites. It has nitrogen-fixing root nodules which allow it to thrive in poor soils. Autumn olive is drought tolerant and may invade grasslands and sparse woodlands. Birds forage on its fruits and contribute to seed dispersal.

Autumn olive is a very troublesome invasive species. In addition to its prolific fruiting, seed dispersal by birds, rapid growth and ability to thrive in poor soils, autumn olive resprouts vigorously after cutting or burning. It creates heavy shade which suppresses plants that require direct sunlight.

Management: Young seedlings can be hand-pulled in early spring when the root system is small enough to allow total removal. It is easily seen in early spring because its leaves appear when most native vegetation is still dormant. Cutting the plant off at the main stem and wiping or spraying each stump with Glyphosate or Triclopyr is an effective control measure. Repeated pruning of established plants without cut-stump herbicide application is not effective for control. Each regrowth results in a thicker stem base and denser branches. Burning during the dormant season also results in vigorous resprouting.

BAMBOO



Tree Bamboo

Bamboo is just grass, but it varies in height from 30 cm (1 ft) plants to giant bamboos that can grow to over 30 m (100 ft) tall. It can grow in many different climates, and some spread exuberantly and others slowly spread from the original planting.

Bamboo is both decorative and useful as windbreaks. However, bamboo is very invasive as it spreads outward from its original plants, and can become a real nuisance when spreading to areas where plants are not wanted. The aggressive bamboo can emerge through concrete walks, home foundations and garages. As bamboo was observed planted by homeowners who live around the perimeter of the William Floyd Estate, the following suggestions are offered in the event the plants spread onto park property.

Management: When plants are first observed, they can be pulled or dug out. The root system is close enough to the surface that this is not difficult. All pieces of the shoots and rootstocks must be removed or regrowth will occur. Cutting bamboo shoots close to the ground and then removing the regrowth each time it reaches 50.8 – 63.5 cm (20 – 25 in) in height will eventually kill established plants. This is manpower-intensive as it must be done many times over a period of a year or more, but this method is successful as it exhausts the food reserves stored in the roots of the plants.

Bamboo barriers can be installed to force the shallow, underground rhizomes to grow in a certain direction. Trenches must be dug 71.1 cm (28 in) deep around the proposed site. One type of barrier used is a high density polyethylene plastic sheet, 60 mil (.06 in) thick and 76.2 cm (30 in) tall have proven to be an effective method to control spread. Check the perimeter of the barrier once or twice a year, removing any rhizomes which are trying to escape over the top of the barrier.

Another management method would be to cut the stalks and spot-treat with Glyphosate or Triclopyr. Even with these herbicides, repeated treatments would be necessary to completely eradicate established plants.

BLACK LOCUST *Robinia pseudoacacia* L.

Black locust is a fast growing tree that can reach 12.2 – 30.48 m (40 – 100 ft) in height at maturity. Its native range is from the lower slopes of the Appalachian Mountains throughout the southeastern United States; however, black locust has been planted in many climates and is naturalized through the U.S.



Black Locust

The bark of the mature tree is dark brown and deeply furrowed with flat-topped ridges, while the young saplings are smooth and green. They are easily identified by long paired thorns. Fragrant white flowers appear in May and June. The black locust prefers full sun and well drained soils, and is commonly found in disturbed areas. Because of its rapid growth, the black locust has been promoted by government agencies and nurseries as a desirable landscape plant. It has been planted extensively for its nitrogen fixing abilities, as a source of nectar for honeybees, and for fence posts and hardwood lumber.

The black locust reproduces vigorously by root suckering and stump sprouting to form groves of trees connected by a common root system. Physical damage to roots and stems increases suckering and sprouting, making management difficult. Even though the black locust produces many seeds, they seldom germinate.

Black locust poses a serious threat to native vegetation outside of its historic range. Once introduced to an area, black locust expands readily into areas where their shade reduces competition from other plants.

Management: Mowing and burning are effective in reducing the further spread of young shoots from a parent tree. Cutting alone is ineffective. Using Glyphosate or Triclopyr to cut stumps provides good control. However, monitoring is necessary as resprouting and suckering may require follow-up treatment even several years after the herbicide treatments.

BRONZE BIRCH BORER (*Agrillus anxius Gory*)



Bronze Birch Borer

The adult bronze birch borer, *A. anxius*, is a slender beetle about .94 – 1.27 cm (3/8 – 1/2 in) long. The larvae are about .06 – 3.17 cm (1/16 – 1 1/4 in) long and .24 cm (3/32 in) wide.

Adults emerge leaving a D-shaped hole in the bark of the birch. They feed on leaf margins; they mate and lay eggs, usually on the sunny side of birch trees. Mated females lay eggs in crevices in the bark near branch scars, under loose outer bark flakes or around wound areas. The eggs are creamy white to yellowish. The larvae bore through the egg shell directly into the bark in about 10 to 14 days. The larvae bore in the cambium layer or occasionally into sapwood. The larvae tunnel and feed laterally around a branch in a zigzag manner, girdling an upper branch which then suddenly wilts and dies. Reinfestation results in most of the branches dying from the top down, and when the trunk is girdled the tree dies. Many larvae may overwinter and take an additional year before pupation and emergence as an adult.

Birches prefer shady, cool and moist wooded areas. Providing adequate fertilization and management of aphids and leaf miners (with predators or parasites) will help keep the trees vigorous and better able to withstand the *A. anxius*. Preventive surface insecticide sprays applied to the tree bark before eggs are laid may provide a barrier to larvae attacking the tree. Thorough drenching of the trunk and larger than 3.81 cm (1 1/2 in) diameter branches will be necessary. Degree day (heat unit) models for *A. anxius* have been developed for timing of treatments to anticipate egg laying and larvae emergence.

Pruning out wilting or dead upper branches may help prevent reinfestation of the affected birch tree. *Betula pendula*, *B. papyrifera,* and *B. populifolia* are very susceptible to attack by *A. anxius*. Birches that are in a weakened condition from repeated attack, defoliation, adverse weather or old age are much more susceptible to *A. anxius* boring. The larvae do not survive in healthy trees. Chlorotic leaves and sparse foliage evident in the upper crown may be accompanied by increased adventitious growth in the lower crown. If such growth develops, it will be accompanied by twig die-back in the upper crown. Lumpy bark is another sign of attack by *A. anxius*.

The monarch birch, *B. maximowicztana, B. platyphyla* var. *japonica* and *B. nigra* are said to be more tolerant or resistant to *A. anxius*. Woodpeckers and a parasite (*Phasganophora sulcata* Westwood) are natural control agents. Vigorously growing birch trees are less likely to be damaged. Resistant birch species should be cultivated as replacements if the present trees succumb to *A. anxius*.

BULL THISTLE *Circium vulgare*



Bull Thistle

Bull thistle is an biennial, herbaceous plant that invades any type of disturbed area throughout the United States. It may have been introduced to the eastern U.S. during colonial times, and is now found in all 50 states. The tall, spiny, winged stems grow up to 2.14 m (7 ft) tall and have many spreading stems. Leaves are long (7.62 – 30.48 cm [3 – 12 in]) and very hairy. The purple flower heads are 3.81 – 5.08 cm (1 ½ – 2 in) in diameter. It often forms dense thickets which displaces other vegetation. This spiny plant is unpalatable to wildlife and livestock, and reduces the forage in potential pastures.

Management: The plants can be cut off at ground level before the flower heads turn purple to stop production. Pulling or mowing plants and disposing off-site will avoid reseeding. If flower heads have turned purple, they can be cut off and placed in bags. If not bagged, these seeds will mature and blow free, germinating and spreading the plants. Using a weed wand or spot spraying with Glyphosate or Triclopyr when plants are in the rosette stage (first year) is effective. Spot-spray in the fall when non-target plants are less susceptible.



Bull Thistle in Rosette Stage

EMERALD ASH BORER *Agrilus planipennis* Fairmaire



Emerald Ash Borer

The emerald ash borer is an exotic beetle that was discovered in southeastern Michigan in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage, but leave a D-shaped exit hole in the bark when they emerge in the spring. The larvae feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients.

Emerald ash borer probably arrived in the U.S. on solid wood packing material carried by cargo ships or airplanes originating in its native Asia. In Asia, the borer attacks and kills only ash trees that are already weakened by disease, stress or damage. However, thus far in North America, it attacks and kills healthy trees as well. This devastation is possible because our native trees have no built-in resistance to the borer. Many of the predators, parasites and diseases that help to keep the emerald ash borer populations low in Asia are not present in North America.

The adult beetles are bright metallic green in color. Adults are .84 cm (1/3 in) long and .15 cm (1/16 in) wide. They have rounded abdomens and flat backs, and are present from mid-May through late July. The larvae are creamy white in color and have flattened, segmented bodies. Older larvae grow up to 2.54 cm (1 in) long. They feed under ash tree bark from mid-summer through spring. As woodpeckers like emerald ash borer larvae, heavy woodpecker damage on ash trees may be a sign of infestation.



Emerald Ash Borer Larvae

Management: At present, research is currently being done at universities to understand the beetle's life cycle, find ways to detect new infestations, control both borer adults and larvae, and contain the infestation. Eradication efforts by state and federal agencies are under way to prevent small infestations from growing into large infestations. Quarantines are in place in Michigan, Ohio and Indiana to prevent infested ash firewood, logs or nursery trees from being transported and starting new infestations. Any ash trees suspected of being infested with emerald ash borer should be cut down and burned. Ash firewood should also be burned. At present, no other information is available on chemical, physical or biological control of emerald ash borer.

GARLIC MUSTARD *Alliaria petiolata* [Bieb] Cavara & Grande



Garlic Mustard Rosette

Garlic mustard (an invasive plant from Europe) is a cool season biennial herb with stalked, triangular to heart-shaped, coarsely toothed leaves that give off an odor of garlic when crushed. First-year plants appear as a rosette of green leaves close to the ground. Rosettes remain green through the winter and develop into mature flowering plants the following spring. Flowering plants of garlic mustard reach from .61 - .91 m (2 – 3 ½ ft) in height and produce buttonlike clusters of small white flowers, each with four petals in the shape of a cross.

Recognition of garlic mustard is critical. Several white-flowered native plants, including toothworts (*Dentaria*), sweet cicely (*Osmorhiza claytonii*), and early saxifrage (*Saxifraga virginica*), occur alongside garlic mustard and may be mistaken for it.



Garlic Mustard in Bloom

Beginning in May in the mid-Atlantic Coast Plain region, seeds are produced in erect, slender pods and become shiny black when mature. By late June, when most garlic mustard plants have died, they can be recognized only by the erect stalks of dry, pale brown seedpods that remain, and may hold viable seed, through the summer.

Garlic mustard poses a severe threat to native plants and animals in forest communities. Many native widlflowers that complete their life cycles in the springtime (e.g., spring beauty, wild ginger, bloodroot, Dutchman's breeches, hepatica, toothworts, and trilliums) occur in the same habitat as garlic mustard. Once introduced to an area, garlic mustard outcompetes native plants by aggressively monopolizing light, moisture, nutrients, soil and space. Wildlife species that depend on these early plants for their foliage, pollen, nectar, fruits, seeds and roots, are deprived of these essential food sources when garlic mustard replaces them.

Garlic mustard also poses a threat to one of our rare native insects, the West Virginia white butterfly (*Pieris virginiensis*). Several species of spring wildflowers known as "toothworts" (*Dentaria*), also in the mustard family, are the primary food source for the caterpillar stage of this butterfly. Garlic mustard is causing local extirpations of the toothworts, and chemicals in garlic mustard appear to be toxic to the eggs of the butterfly, as evidenced by their failure to hatch when laid on garlic mustard plants.



Garlic mustard is found from eastern Canada, south to Virginia and as far west as Kansas and Nebraska. Garlic

mustard frequently occurs in moist, shaded soil of river floodplains, forests, roadsides, edges of woods, trails edges and forest openings. Disturbed areas are most susceptible to rapid invasion and dominance. Though invasive under a wide range of light and soil conditions, garlic mustard is associated with calcareous soils and does not tolerate high acidity.

After spending the first half of its two-year life cycle as a rosette of leaves, garlic mustard plants develop rapidly the following spring into mature plants that flower, produce seed and die by late June. Seeds are produced in erect, slender, four-sided pods, called siliques, beginning in May. Siliques become tan and papery as they mature and contain shiny black seeds in a row. By late June, most of the leaves have faded away and garlic mustard plants can be recognized only by the dead and dying stalks of dry, pale brown seedpods that may remain and hold viable seed throughout the summer.

A single plant can produce thousands of seeds, which scatter as much as several meters from the parent plant. Garlic mustard flowers either self-fertilize or are cross-pollinated by a variety of insects. Self-fertilized seed is genetically identical to the parent plant, enhancing its ability to colonize an area. Although water may transport seeds of garlic mustard, they do not float well and are probably not carried far by wind. Long distance dispersal is most likely aided by human activities and wildlife. Additionally, because white-tailed deer prefer native plants to garlic mustard, large deer populations may help to expand it by removing competing native plants and exposing the soil and seedbed through trampling.

Garlic Mustard Seed Pods

MANAGEMENT

Because the seeds of garlic mustard can remain viable in the soil for five years or more, effective management requires a long term commitment. The goal is to prevent seed production until the stored seed is exhausted. Hand removal of plants is possible for light infestations and when desirable native species co-occur. Care must be taken to remove the plant with its entire root system because new plants can sprout from root fragments. This is best achieved when the soil is moist, by grasping low and firmly on the plant and tugging gently until the main root loosens from the soil and the entire plant pulls out. Pulled plants should be removed from site, especially if flowers are present.

For larger infestations of garlic mustard, or when hand-pulling is not practical, flowering stems can be cut at ground level or within several inches of the ground, to prevent seed production. If stems are cut too high, the plant may produce additional flowers at leaf axils. Once seedpods are present, but before the seeds have matured or scattered, the stalks can be clipped, bagged and removed from the site to help prevent continued buildup of seed stores. This can be done through much of the summer.

For very heavy infestations, where the risk to desirable plant species is minimal, application of the non-selective, systemic herbicide Glyphosate (e.g., Roundup) is also effective. Herbicide may be applied at any time of year, including winter (to kill overwintering rosettes), as long as the temperature is above 10ºC (50ºF) and rain is not expected for about eight hours. Spray shields may be used to better direct herbicide and limit non-intentional drift. A weed wand with Glyphosate for rosettes during winter or early spring eliminates drift and is effective.

Regardless of the management method employed, annual monitoring is necessary for a period of at least five years to ensure that seed stores of garlic mustard have been exhausted.

Researchers are investigating potential biological control agents for garlic mustard which may greatly improve management.

Portions of this document were taken from a paper done by Jil M. Swearingen, U.S. National Park Service, Washington, DC.

GILL-OVER-THE-GROUND *Glechoma hedercea*
aka CREEPING CHARLIE, GROUND IVY



Gill-Over-The-Ground

Gill-over-the-ground (ground ivy) is a trailing European aromatic plant of the mint family having rounded leaves and small purplish flowers. It is often grown in hanging baskets and has naturalized in North America.

It is a perennial herbaceous plant with creeping square stems that grow about .61 m (2 ft) long with erect flowering stems. The leaves are opposite, long stalked, bright green and shiny. The flowers are light blue to purple, tubular, and bloom from April to June. The roots grow from each leaf node that creeps along the soil surface spreading vegetatively as well.

It is not a threat to healthy native plant communities. Ground ivy grows best in semi-shaded to shaded moist soils and forms a dense mat which can smother other vegetation. It is a common garden weed and grows mostly in disturbed soils, and is found in most moderate climates all over the world.

Management: Repeated pulling can manage small infestations. Spraying with herbicides is not recommended.

GYPSY MOTH



Gypsy Moth Caterpillar

Gypsy moth is a recent addition to the long list of insects that defoliate oak, aspen and other hardwood species in the United States. This exotic pest did not occur in North America until it was accidentally introduced into Massachusetts in 1869. Since then, gypsy moth populations have spread west and south.

Gypsy moth outbreaks can last one to five years. Outbreak populations then decline because of the buildup of disease, natural enemies and starvation. Low gypsy moth populations may be held in check by birds, insect predators and small mammals before the next outbreak occurs. In oak-dominated stands, gypsy moth outbreaks usually persist two to five years before collapsing. Populations then remain low for four to 12 years before increasing again. Outbreaks may build and decline faster in aspen dominated stands than in oak stands.



Gypsy Moth Egg Mass with Hatching Larvae

Effects of gypsy moth defoliation are usually most severe during the initial outbreak in a newly infested area. If more than 60% of the canopy is consumed by gypsy moth caterpillars, trees typically "refoliate," producing a second flush of leaves later in summer.

The amount of tree mortality and top kill sustained during a gypsy moth outbreak depends on the severity and frequency of defoliation and on tree health. Vigorous trees can often withstand severe defoliation for a few years. However, each refoliation stresses the tree, reducing its energy reserves. Subsequent stress, including additional defoliation, drought or frost injury, may kill the tree. Suppressed, diseased or low-vigor trees may be killed after one year of heavy defoliation.

Severe gypsy moth defoliation, accompanied by an abundance of large hairy caterpillars and frass (fecal pellets), can be unsightly and may reduce the enjoyment of visitors at recreational areas.

Gypsy moth defoliation is primarily based on tree species composition. Stands dominated by oaks, aspen, birch, basswood, willow or other species preferred by gypsy moth will be at high risk of defoliation. Defoliation will be lower in stands dominated by tree species that are less preferred by gypsy moth, such as maples, ash and most conifers. Defoliation may also be higher

where many dead branches, bark flaps and stem wounds are present because these areas provide good hiding places for gypsy moth caterpillars and pupae.

Stand hazard is increased by factors that reduce stand vigor such as overmature trees, suppressed or diseased trees, compacted soil or severe competition. Hazard also increases when drought, late spring frosts, flooding or other stressful environmental conditions occur. Tree mortality has been observed primarily in oak-dominated stands where gypsy moth defoliation coincided with drought or late spring frosts.

MANAGEMENT OPTIONS

Appropriate strategies for gypsy moth management depend on the specific management objectives for each stand, and the quality of the site.

Release of the parasite (*Cotesia melanoscelus*) on gypsy moth larvae may be useful in reducing the population and thus reduce defoliation.

Remove suppressed and low-vigor trees that will be highly vulnerable to damage by gypsy moth and other pests. Leave healthy trees with large crowns that are likely to survive defoliation. Residual trees will require one to two years to recover from defoliation, drought or other stress and adjust to increased exposure.

Thinning to reduce stand density can increase vigor of residual trees and reduce stand risk and hazard. Thinning is most appropriate on medium- and high-quality sites, where costs are economically justified.

To reduce stand hazard, cut suppressed, wounded, diseased or low-vigor trees with poor canopies. Thin to levels appropriate for the species and the quality of the site. Prevent soil compaction, wounds and other injuries to residual trees. Anything that reduces vigor of the residual trees can increase stand hazard.

Selecting against tree species that are preferred hosts of gypsy moth will reduce long-term risk of defoliation. On fertile, mesic sites, altering the species mix can result in stands of high-quality hardwoods. Favoring ash, tulip poplar, maples or conifers in northern or mixed hardwood stands can help increase stand diversity while reducing the risk of defoliation. Increasing species diversity within stands may also reduce the long-term risks of damage by other forest pests.

High-value oak-dominated stands approaching economic or pathological rotation age can be protected with an aerial application of Bt (Bacillus thuringiensis var. kurstaki), a short-lived microbial insecticide that causes a bacterial disease in foliage-feeding caterpillars. Bt is not toxic to other insects or to fish, birds, humans or other animals. An alternative pesticide for killing gypsy month larvae is Dimilin (diflubenzuron) as an aerial application. It is applied at 1.7 g (0.06 oz). per acre and is effective. Other effective materials are Gypchek (gypsy moth neucleopolyhedrosis virus, NPV) and disparlure (Disrupt II) pheromone. The naturally occurring fungus *Entomophaga maimaiga* has also managed large gypsy moth populations in the environment.

Sometimes taking no action is the best alternative. Young, vigorously growing stands are likely to tolerate even severe defoliation for two to three years or longer. Stands with a mixture of species are less likely to sustain severe, repeated defoliation than are stands of nearly pure oak or aspen. No action may also be the best option when stands are at or near optimal levels, especially if vigorous non-host species are present.

Managing stands to provide wildlife habitat may result in greater numbers of natural enemies that feed on gypsy moth. Understory plants and shrubs, trees with cavities and fallen trees are important for maintaining populations of predatory and parasitic insects, insectivorous birds, rodents and other small mammals. When leaving trees for wildlife, select species that are not preferred by gypsy moth.

Avoid using *Bt* to protect foliage in stands managed primarily for wildlife. Bt can kill caterpillars of "non-target" butterfly and moth species that are present during spraying. However, high gypsy moth populations may also temporarily reduce diversity and abundance of some native insect species.

Recreational areas experiencing a gypsy moth outbreak can be unpleasant places for camping or picnics. The swarms of large caterpillars and frass are distasteful, and the hair on the caterpillars may trigger allergic reactions in some people.

Use burlap, sticky or Teflon-coated bands on the lower trunk of gypsy moth host trees in recreation areas. Use burlap and sticky bands to trap or destroy caterpillars as they move up and down tree stems. Use Teflon-coated bands to prevent caterpillars from crawling up into tree canopies to feed. Banding is economically viable for high-value ornamental or shade trees. Where practical, water defoliated trees during warm dry periods. Prevent soil compaction and wounds to gypsy moth host trees.

JAPANESE BLACK PINE *Pinus thunbergii*



Japanese Black Pine

This non-native species has been planted in the United States since the 1940's, mostly as a wind screen. Although it is so widely planted that it seems a natural feature of this coastal landscape, it was actually introduced from Japan and Korea where it is native. Even with its salt tolerance, the Japanese black pine seems to be more susceptible to disease in salty environments. For about the last ten years, Japanese black pines older than 15 or 20 years of age and planted in stressful sites, such as near the coast, have been dying in large numbers. These trees mostly were receiving little maintenance and were growing in sandy soils. The pines are susceptible to both the black turpentine beetle *(Dendroctonus terebrans)* and the pinewood nematode *(Bursaphelenchus xylophilus)*, which have been identified as major factors in the death of the Japanese black pine. Two minor pests, the pine vole and the Cenangium canker, are also factors in the death of Japanese black pines.

Management: Acceptable replacements should be considered for Long Island's seashore landscapes. As the Japanese black pine are considered an invasive or pest ornamental, removal within the park's jurisdiction should be done by cutting the tree at ground level and treating the stump with Glyphosate or Triclopyr. As the trees are declining when they age, they become more attractive to the black turpentine beetle which deposits its eggs under the bark in the lower 2 m (6 ft) of the trunk. The black turpentine beetle pair excavates a large cave-like gallery where they deposit up to 200 eggs. The larvae feed on the inner bark during their life cycle at 10 – 16 weeks. The black turpentine beetle is native to the east coast from New Hampshire to the southern states.

JAPANESE HONEYSUCKLE *Lonicera japonica* Thunb.



Japanese Honeysuckle

Japanese honeysuckle was introduced to the United States from Japan and Korea in the 1800s as an ornamental plant, for erosion control, and for wildlife forage and cover. It is a perennial vine that climbs by twisting its stems around vertical structures, and often remains evergreen except in the colder winter temperatures. Leaves are oblong to oval and flowers are white, yellow and very fragrant.

Japanese honeysuckle occurs across the U.S. from California to New England and the Great Lakes region. It is a ubiquitous invader and thrives in a wide variety of habitats, including all types of disturbed lands. It has few natural enemies which allows it to spread widely and out-compete native plant species. Shrubs and young trees can be killed when the vines twist tightly around the stems and trunks.

Management: Repeated pulling of entire vines and root systems when soil is moist can be effective. Monitor frequently and remove new plants. Cut and remove twining vines to prevent them from killing other plants. Mowing large patches twice a year may be useful if repeated regularly. Burning plants does not kill the underground rhizomes which will continue to sprout. In some cases, tethered goats have been used to remove growth. The goats must be monitored to keep them in the desired area. Spot treatment with Glyphosate or Triclopyr in late fall when native plants are dormant is effective. There are no biological control agents currently available for Japanese honeysuckle.

JAPANESE KNOTWEED *Fallphia japonica*



Japanese Knotweed

Japanese knotweed was introduced to North America in the late 19th century from Japan where it rapidly spread to become a problem weed. It is now regarded as a serious pest which is difficult to manage. Japanese knotweed has spread through most of North America and has been observed as far north as Alaska. It spreads quickly to form dense thickets that exclude native species. The rhizomes can reach 15 – 20 m (50 – 75 ft) in length.

Japanese knotweed grows in a variety of soil types and is found primarily in moist, unshaded areas. Its growth and abundance are decreased in shady sites. After overwintering, shoots appear from underground rhizomes early in the spring. Rapid growth, which can exceed 8 cm (3 1/2 in) per day, means that full height can exceed 4 m (15 ft) by early summer.

Management: To be effective, Japanese knotweed control will need to be undertaken on a watershed-wide basis as is being done with *Arundo donax* L., an ecologically similar species. Use of Glyphosate or Triclopyr are effective, however, herbicide costs may be prohibitive. Studies are under way at present to find natural enemies for Japanese knotweed, however, surveys have not yet been completed and not much information is yet available. Some species of Lepidoptera and fungal pathogens are being tested and look promising.

JIMSON WEED *Datura stramonium*



Jimson Weed

Jimson weed (locoweed or stinkweed) is a plant which has been used for centuries as a medicine and intoxicant. The plant's main ingredients are belladonna alkaloids atropine and scopolamine. Jimson weed is native to much of the U.S., from New England to Texas.

Jimson weed can reach a height of 1.52 m (5 ft) , has white flowers and prickly seed pods. All parts of the plant are toxic. Atropine and scopolamine cause dry mouth, dilated pupils, high temperature and blurred vision. Psychological effects include confusion, euphoria and delirium.

Management: As Jimson weed was observed only at one location outside SH-103, these plants can be pulled out and bagged to prevent spreading. Herbicide treatment should not be necessary in this small area.

LESPEDEZA *Lespedeza cuneata* (Dumont)



Lespedeza

Lespedeza is a warm season, perennial plant from eastern Asia. It is now found throughout the United States. Lespedeza grows erect and ranges from about .91 – 1.55 m (3 – 5½ ft) in height. It is primarily a threat to open areas such as meadows, wetland borders and fields. Once it gains a foothold, it can crowd out native plants and develop an extensive seed bank in the soil. Its high tannin content makes it unpalatable to native wildlife and livestock.

Management: Hand pulling is impractical due to lespedeza's extensive root system. Mowing plants in the flower bud stage for two or three consecutive years may reduce the vigor of lespedeza stands and control further spread. Plants should be cut as low to the ground as possible. If spot treatments are done with Glyphosate or Triclopyr, they should be done in early to mid-summer. Treatments should cover the leaves and stems of the plants, however, care should be taken to minimize impact to adjacent native plants.

MUGWORT *Artemisia vulgaris* (Linn.)



Mugwort (Common Wormwood)

Mugwort is a tall-growing plant, frequently rising .91 m (3 ft) or more in height. The leaves are smooth and of a dark green color. The flowers are small oval heads and are either reddish or pale yellow.

Mugwort dates back to the Middle Ages and was probably planted as a medicinal plant during the early years of the colonization, having been brought over from Europe. It is a beneficial herb and all parts of the plant are used medicinally from teas to baths.

Management: As Mugwort was observed on the Lighthouse grounds only, plants can be pulled out by hand or with a weed wrench. Cut-stump treatment with Glyphosate or Triclopyr can also be done to prevent spreading.

COMMON MULLEIN *Vergascum thapsus* L.



Common Mullein

Mullein was brought over from Europe by settlers in the mid-1700's and used as a medicinal herb as a remedy for coughs and diarrhea, and as a respiratory stimulant for the lungs when smoked. It is an erect herb. First year plants are low-growing rosettes of bluish-gray-green felt-like leaves. Mature flowering plants are produced the second year and grow 1.52 – 3.05 m (5 – 10 ft) in height.

Mullein can be found where annual precipitation is greater than 7.62 – 15.24 cm (3 – 6 in) and the growing season lasts for a minimum of 140 days. It will grow in almost any sunny, open area including natural meadows, forest openings and road cuts. Mullein threatens natural meadows and forest openings where it adapts to a wide variety of site conditions. Once established, it grows more vigorously than many native herbs and shrubs.

Management: Because mullein seedling emergence is dependent on the presence of bare ground, planting sites with early native grasses or other plants may decrease seed germination. Mullein plants are easily hand pulled as they have shallow tap roots. This is a very effective method if the plant is pulled before seed set. If blooms or seeds are present, reproductive parts should be removed, bagged and properly disposed of in a sanitary landfill. The first year rosette can be hand pulled or treated with a weed wand using Glyphosate.

There is an insect that has possible biological control implications. USDA has approved use of a European curculionid weevil *(Gymnaetron tetrum)*, which is specific to mullein. For situations where hand pulling of plants is not practical or safe, cut-stump treatment of second year plants with Glyphosate or Triclopyr is an effective option.

MULTIFLORA ROSE *Rosa multiflora* Thunb.

Multiflora rose is a thorny, perennial shrub with arching canes. It occurs in most areas in the U.S. and has a wide tolerance for various soil conditions.

Multiflora rose was introduced to the east coast from Japan in 1866 as rootstock for ornamental roses. In the 1930's, the Soil Conservation Service promoted it for use in erosion control and fences to confine livestock It has also been planted as wildlife cover and in highway median strips for crash barriers.



Multiflora Rose

Multiflora rose reproduces both by seed and by forming new plants that root from the tips of canes that touch the ground. Birds eagerly eat the fruit and serve as the primary dispersers of the seed.

Management: Frequent, repeated cutting or mowing three to six times per growing season for two to four years has been shown to be effective in achieving high mortality of multiflora rose. In some areas, cutting of individual plants is preferred to site mowing to minimize habitat disturbance. Cut stump treatments with Glyphosate or Triclopyr are effective in achieving die-back, however, follow-up treatments may be necessary because of the long-lived stores of seed in the soil. Biological control is not available for management of multiflora rose at this time, however, several options are being investigated.

ORIENTAL BITTERSWEET *Celastrus orbiculatus* Thunb.



Oriental Bittersweet

Oriental bittersweet, an invasive exotic plant, is a deciduous, woody, perennial vine which sometimes occurs as a trailing shrub. Also known as round-leaved and Asiatic bittersweet, stems of older plants sometimes grow to four inches in diameter. Leaves of oriental bittersweet are glossy, rounded, finely toothed and arranged alternately along the stem. Clusters of small greenish flowers emerge from leaf axils, allowing each plant to produce large numbers of seeds. At maturity, globular, green to yellow fruits split open to reveal three red-orange, fleshy arils that contain the seeds. These showy fruits have made oriental bittersweet very popular for use in floral arrangements. Since this plant is easily confused with our native climbing bittersweet vine (*Celastrus scandens*), which flowers at the tips rather than along the stems, it is imperative that correct identification be made before management is attempted.

Oriental bittersweet is an aggressive invader that threatens all vegetation levels of forested and open areas. It grows over other vegetation, completely covering it, and kills other plants by preventing photosynthesis, girdling, and uprooting by force of its massive weight. Oriental bittersweet appears to be displacing the native climbing bittersweet (*Celastrus scandens)*, which occurs in similar habitats, through competition and hybridization. Oriental bittersweet occurs from New York to North Carolina, and westward to Illinois.

Oriental bittersweet infests forest edges, woodlands, early successional fields, hedgerows, coastal areas and salt marsh edges, particularly those suffering some form of land disturbance. While often found in more open, sunny sites, its tolerance for shade allows oriental bittersweet to invade forested areas.

Oriental bittersweet reproduces prolifically by seed, which is readily dispersed to new areas by many species of birds. Its seeds germinate in late spring in partial to dense shade. It also expands vegetatively by stolons (above-ground stems), and rhizomes (underground stems), and through root suckering.

MANAGEMENT

Where hand labor is practical, vines can be pulled out by the roots and removed from the site, preferably before fruiting. If fruits are present, vines should be bagged and allowed to bake in the sun long enough to kill the seeds.

Systemic herbicides, such as Glyphosate or Triclopyr, that are taken into the roots and kill the entire plant, have been used successfully in bittersweet management. This method is most effective if the stems are first cut by hand or mowed and herbicide is applied immediately to cut stem tissue. In areas where spring wildflowers or other native plants occur, application of herbicides should be conducted prior to their emergence, delayed until after the last killing frost

occurs, or carefully targeted. Herbicidal contact with desirable plants should always be avoided. No biological controls are currently known for oriental bittersweet.

A portion of this information was taken from a paper by Jil M. Swearingen, U.S. National Park Service, Washington, DC.

COMMON REED *Phragmites australis*



Common Reed (*Phragmites australis)*

European forms of *Phragmites* were probably introduced into North America by accident in ballast material in the late 1700's. The species is invasive, particularly in the eastern states along the Atlantic coast as far south as North Carolina. (In coastal areas, preserved native rhizome fragments dating back 3,000 – 4,000 years have been found in salt marsh sediments.) Introduced species can grow up to 6 m (20 ft) high in dense stands and is long-lived. *Phragmites* is capable of reproduction by seeds, but primarily does so by means of rhizomes. It is a clonal grass species with woody hollow canes. Below ground, *Phragmites* forms a network of roots and rhizomes which can go down several feet in depth. It spreads horizontally by sending out runners which can grow 3.05 m (10 ft) or more in a single growing season.

Spread to new sites is typically by seed. Along rivers and shorelines, rhizomes may be washed down to new sites where they can establish. Along roadsides, fragments may also be transported by heavy machinery between sites. It is very difficult to distinguish native from introduced *Phragmites* without genetic testing.

Management: A combination of cutting the plants followed by cut stump application of Glyphosate or Triclopyr has been found to be effective. If possible, entire areas should be treated at one time.

RUSSIAN OLIVE *Elaeagnus augustifolia* L.



Russian Olive

Russian olive, natuve to Eurasia, was planted as an ornamental and escape cultivation in the central and western United States. Its leaves appear silvery on the lower surface and are narrow and elongated. The branches are usually thorny and the fruit is yellow and dry.

Russian olive is found along streams, in fields and open areas in dry to moist soils and has become a troublesome invasive species. It grows rapidly, fruits prolifically and resprouts vigorously after cutting or burning; thus crowding out native plants. The nitrogen-fixing capability of this species can also interfere with the nitrogen cycle of native plants.

Management: Plants should be removed as soon as possible if they are found in areas not previously seen. Small plants and seedlings can be hand pulled or pulled with a Weed Wrench. Cut stump treatment with Glyphosate or Triclopyr is also effective for eradicating larger, well-established plants as cutting sometimes stimulates sprouting and leads to thicker growth.

SPOTTED KNAPWEED *Centaurea maculosa*



Spotted Knapweed

Spotted knapweed was probably introduced in the 1890's as a contaminant in alfalfa or hay seed from Europe and Asia. It has become a serious problem throughout the U.S.

Spotted knapweed is a biennial which grows to .91 – 1.22 m (3 – 4 ft) in height. The slender stems grow in an erect arrangement. Single thistle-like, pinkish-purple flowers reach 1.91 cm (3/4 in) in diameter and occur from mid-June through August. Spotted knapweed reproduces solely by seed. Plants average about 1,000 seeds per plant. Seeds are viable for seven years and terminate throughout the growing season.

Management: The most effective control is early detection and hand removal of new plants in the first year rosette stage. Small populations can be easily removed by digging or pulling. The entire root should be removed. Mowing has not been successful with this species – the plants merely reflower at a lower height. Spot treatment with Glyphosate or Triclopyr is an effective means of eliminating spotted knapweed. Care should be taken to minimize disruption to the surrounding native habitat. Several biological controls exist and are promising; however, they are not yet available for general use. These include two seed-head attacking flies, *Urophora ffinis* and *U. quadrifasciata*; two root mining moths, a flower moth and a root mining beetle. The USDA Cooperative Extension can be contacted to determine the current status and availability of these control agents.

TREE-OF-HEAVEN *Ailanthus altissima* (Mill.) Swingle



Tree-of-Heaven

Tree-of-heaven, an exotic invasive plant from China, is also known as ailanthus, Chinese sumac, and stinking shumac, is a rapidly growing, deciduous tree in the mostly tropical quassia family (*Simaroubaceae*). Mature trees can reach 24 m (80 ft) or more in height. Ailanthus has smooth stems with pale gray bark, and twigs which are light chestnut brown, especially in the dormant season. Its large compound leaves, 30 cm – 1 m (1 – 4 ft) in length, are composed of 11 – 25 smaller leaflets and alternate along the stems. Each leaflet has one to several glandular teeth near the base. In late spring, clusters of small, yellow-green flowers appear near the tips of branches. Seeds are produced on female trees in late summer to early fall, in flat, twisted, papery structures called samaras, which may remain on the trees for long periods of time. All parts of the tree, especially the flowers, have a strong, offensive odor.

Correct identification of ailanthus is essential. Several native shrubs, like sumacs, and trees like ash, black walnut and pecan, can be confused with ailanthus. Staghorn sumac (*Rhus typhina*) native to the eastern U.S. is distinguished from ailanthus by its fuzzy, reddish-brown branches and leaf stems, erect, red, fuzzy fruits and leaflets with toothed margins.

Tree-of-heaven is a prolific seed producer, grows rapidly, and can overrun native vegetation. Once established, it can quickly take over a site and form an impenetrable thicket. Ailanthus trees also produce toxins (allelopathy) that prevent the establishment of other plant species. The root system is aggressive enough to cause damage to sewers and foundations. Tree-of-heaven is widely distributed across the United States, occurring in forty-two states, from Maine to Florida and west to California.

Tree-of-heaven is a common tree in disturbed urban areas, where it sprouts up just about anywhere, including alleys, sidewalks, parking lots, and streets. In rural areas, it is found in fields, and along roadsides, fencerows, woodland edges and forest openings. Ailanthus has become an agricultural pest and may occur as seedlings that pop up by the hundreds in recently planted fields, or as persistent thickets in rocky, untillable areas.

Tree-of-heaven reproduces both sexually (seeds) and asexually (vegetative sprouts). Flowering occurs late in the spring (June in the middle Atlantic region). The species is *dioecious*, with male and female flowering on separate trees. Fruits are papery, somewhat twisted, winged structures called samaras that are tan to pink-colored. Samaras occur in large clusters from September to October, and may persist on the tree through the winter. An individual tree can produce as many as 325,000 seeds per year. Established trees also produce numerous suckers from the roots and resprout vigorously from cut stumps and root fragments.

MANAGEMENT

Elimination of ailanthus requires diligence, due to its abundant seed production, high seed germination rate, and vegetative reproduction. Follow-up monitoring and treatment when needed should be an integral part of ailanthus management. Regardless of method selected, treated areas should be rechecked one or more times a year and any new suckers or seedlings treated (cut, sprayed or pulled) as soon as possible, especially before they are able to rebuild root reserves. Establishing a thick cover of trees (preferably native and non-invasive) or grass sod will help shade out and discourage establishment of ailanthus seedlings. Targeting large female trees for removal will help reduce spread of ailanthus by seed.

Young seedlings may be pulled or dug up, preferably when soil is moist. Care must be taken to remove the entire plant including all roots and fragments, as these will regrow. Root suckers appear similar to seedlings, but would be connected to a pre-existing lateral root, and may be difficult to remove effectively.

Ailanthus responds to cutting by producing large numbers of stump sprouts and root suckers. If possible, the initial cutting should be in early summer in order to impact the tree when its root reserves are lowest. Cutting large seed producing female trees would at least temporarily reduce spread by this method.

The most effective management of ailanthus may be through the use of herbicides, which are applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. It is not difficult to kill the above ground portion of ailanthus trees; you must kill the root system to prevent or limit stump sprouting and root suckering.

Foliar sprays applied when trees are in full leaf are effective, and may be the method of choice where ailanthus size and distribution allow effective spray coverage of all foliage without unacceptable contact with nearby desirable vegetation. The non-selective herbicide glyphosate (Roundup) will kill or injure almost any plant, herbaceous or woody, contacted by the spray. Triclopyr (Garlon 4) is selective for broadleaf and woody plants and does not kill grasses contacted by the spray. Both glyphosate and triclopyr are systemic herbicides as they are absorbed by plants and carried to the root systems. These herbicides have low soil activity, so do not pose a threat to groundwater if applied properly and at recommended label rates.

Basal bark application is an easier method and does not require any cutting. It works best during late winter/early spring and in summer. The base of the tree stem must be free of snow, ice, or water on the bark, though precipitation following application is inconsequential. Late winter/early spring is generally the most effective time, since vegetation near the base of the trees is usually absent or leafless. Application during the summer works very well as long as vegetation is not a hindrance. Some companies market diluents based on mineral or vegetable oils specifically designed for basal bark application, which should be considered for use in sensitive areas. Another option is to use a pre-mixed, ready-to-use triclopyr product designed for basal bark (and cut stump) application. Using a handheld or backpack type sprayer, apply the mixture in a 31 cm (12 in) wide band around the entire circumference of the tree base with no “skips”. The basal bark method is generally used for trees that are less than 15 cm (6 in) in diameter, though slightly larger stems may also be treated effectively by thoroughly treating bark

up to 61 cm (24 in) in height. Follow-up foliar herbicide application to basal sprouts and root suckers may be necessary.

The hack-and-squirt or injection method is very effective and minimizes sprouting and suckering when applied during the summer. Root suckering will be an increasing problem in the fall, winter and spring. This method requires first making downward-angled cuts into the sapwood around the tree trunk at a comfortable height, using a hand ax. With spray bottle or wand in the other hand, squirt a straight (100%) concentration of a water-soluble triclopyr product into the cuts within a minute or two, applying 1 – 2 ml into each cut (typically one to two squirts of a trigger squirt bottle) so that the bottom of the cut is covered, but liquid doesn't run out of it. Generally, you would make about one hack cut for each inch of diameter plus one (i.e., for a 25 cm (10 in) diameter tree, make about 11 cuts). Space the cuts so that about 3 – 6 cm (1 – 2 in) of uncut living tissue remains between them. A continuous line of cuts around the trunk would cause the tree to react by producing basal sprouts and root suckers. For this reason, girdling or frilling (girdling followed by herbicide) is not recommended unless long term follow-up treatment is possible. While spaced injection works well for ailanthus, it is not as effective on some other species. This method can be used with trees of any size, though it is most productive with stems over 6 cm (2 in) in diameter. This method is relatively easy for one person to do, with hatchet in one hand and spray bottle in the other, but should be done with a helper nearby in case of an accident. Monitor the treatment area and be prepared to follow-up. Glyphosate products have sometimes shown poor long-term suppression of basal sprouts and root suckers.

The cut stump method is useful in areas where the trees need to be removed from the site and will be cut as part of the process. Felling trees is usually less effective in killing the root system, slower, more labor intensive, and more hazardous to personnel than other methods. This method is likely to be most successful during the growing season, with diminishing success through the early fall. Dormant season applications may prevent resprouting from the stump itself, but will do little to inhibit root suckering. However, at any time of year, if the tree must be cut it is better to treat the stump than not. Application of herbicide to the cut stumps must be conducted immediately after cutting, within 5 – 15 minutes of the cut with water soluble formulations or oil mixtures, to ensure uptake of the chemical before the plant seals the cut area off. The mixture may be painted on with a paint brush or sprayed on using a spray bottle or backpack sprayer. A mixture of 20% Garlon 4 plus 80% oil diluent, as for basal bark spraying, may be used. In this case the whole stump surface and sides to the ground line would be covered. Be prepared to follow-up with a foliar application to manage any stump sprouts or root suckers which emerge.

A potential biological control for ailanthus may be in fungal pathogens, (*Verticillium dahliae* and *Fusarium oxysporum*) that have been isolated from dead and dying ailanthus trees in New York and in southern and western Virginia.

Many native trees and shrubs are available as substitutes for ailanthus. Some examples include deciduous shrubs such as staghorn sumac *(Rhus typhina)*, smooth sumac *(Rhus glabra*), box elder *(Acer nigrum*), fringetree *(Chionanthus virginicus*), ash *(Fraxinus* spp.), and black walnut *(Juglans nigra*). Because U.S. native plants can become invasive outside their natural, historical ranges, use plant species native to this ecological region.

A portion of the above data was obtained from a paper by Jil Swearingen, Integrated Pest Management Coordinator, National Capital Region, Washington, DC.

CHINESE WISTERIA *Wisteria sinensis*



Wisteria

Chinese wisteria was brought to the United States from China in 1816. It has been grown extensively as an ornamental landscape plant and most infestations in natural areas are a result of escapes from landscape plantings.

Wisteria is an exotic, showy, woody ornamental vine that can climb trees and have been observed to each 19.81 m (65 ft). Exotic wisteria flower in the spring and produce a fuzzy brown seed pod. Exotic wisteria can overtake native shrubs and trees through both strangling and shading. Climbing wisteria vines can kill substantial trees which opens the forest canopy, increases sunlight to the forest floor, and in turn favors its aggressive growth. They are hardy and aggressive, capable of forming thickets so dense that little else grows.

Wisteria is long-lived, with some vines surviving 50 years or more. Vegetative reproduction is their primary means of expansion. The ideal habitat is in full sun, but established vines will persist and reproduce in partial shade.

Management: Cut climbing or trailing vines as close to the root collar as possible. This labor-intensive technique is feasible for small populations. Wisteria will continue to resprout after cutting, so a cut stump treatment using either Glyphosate or Triclopyr is recommended. Coiled vines around tree trunks should be removed entirely as they may eventually girdle the tree as they continue to grow and increase in girth. Removal of entire plants with a Weed Wrench is effective in small initial populations. All roots and runners must be removed as they may resprout. All plant parts should be bagged and disposed of in a trash dumpster to prevent re-establishment. Cut stump treatments are effective as long as the ground is not frozen.

APPENDIX III

SAFETY

SAFETY

PESTICIDE SAFETY

Pesticides are insecticides, herbicides, fungicides, rodenticides and other chemicals used to control, prevent, destroy, repel or regulate pests. Pesticides have an EPA registration number on the label. This includes personal repellant products. As poisons, they can affect living organisms and usually may have adverse effects on other nontarget plants or animals, including humans. Because of their biological activity, pesticides can injure (or kill) adults, children, pets, livestock, wild animals, insects, birds, fish and plants. Pesticides must be carefully stored, handled and used to avoid exposure to nontargets.

Certification

Any person (park staff or contractor) who is involved in handling or applying pesticides should be trained in proper procedures. Protective equipment must be worn by the person handling, loading, mixing or applying any pesticide. Pesticides will only be applied by personnel who are properly trained and are supervised by a certified applicator or who are certified themselves. In New York, certified applicators must receive training, pass a test and attend periodic updating continuing education workshops or training to keep their certification current. The IPM Coordinator should be a state certified pesticide applicator.

Pesticide Information

Pesticide labels contain information on precautions for the safety of the pesticide applicator and cautions to be taken to protect or reduce exposure to other workers and/or visitors. The label is the law. Violating the label directions is a violation of FIFRA. Chemical (pesticide) labels on containers must not be removed or defaced. OSHA Hazard Communication Standard requires workers be trained and provided appropriate protective equipment and information (MSDS) on any hazardous material they might handle. Treated areas will be posted to provide the public (staff and visitors) with information on the pesticide used, the area treated, and the safe re-entry time (5 half lives). Keep an inventory of all pesticides used or stored in the park; copies of labels and MSDS should be stored with the products and also with the IPM Coordinator and the park safety officer.

Pesticide Storage

The pesticide storage facility should contain copies of labels, MSDS and inventory information. The pesticide storage structure must be properly posted with warning signs and securely locked. The structure must be fireproof and ventilated to the outside. Other materials such as cleaning fluids, paint, solvent, fuel oil, gasoline, kerosene or other chemicals should not be placed or stored in the pesticide storage structure because of the increased risk of fire or explosion. Different types of pesticides will be stored on separate shelves or compartments. The local Fire Department will be made aware of the storage location(s) and the types of pesticides stored so that a fire emergency plan is prepared.

Pesticide Disposal

The pesticide label has directions for procedures to follow to dispose of pesticide containers, pesticide and equipment rinsates. U.S. EPA and state regulations also address the disposal of hazardous substances. Limit the amount of material that needs to be disposed by:

- Purchasing only the amount needed for each treatment
- NPS policy limits the quantity of pesticide that can be purchased
- Mixing only the amount needed for the treatment
- Apply remaining mixed pesticide to the treated area according to label instructions
- Upon completion, triple rinse the spray equipment and apply the rinsate to the treated area (follow the label directions)
- Use single dose syringe applicator to apply gel baits
- Use containerized aerosol pesticides which can be reused until empty
- Use dust or granular pesticides that can be returned to the original container, if necessary, for storage

Excess unopened product can be considered to be "surplus property" and transferred to another agency in accordance with federal and state laws and regulations. Retain records of all donations of surplus pesticides.

Training

The IPM Coordinator should have attended the NPS IPM course, or be scheduled to take the course as soon as possible. Other key staff that have responsibilities related to pest management may also attend (forester, maintenance, natural resources, and supervisors). Pesticide applicators must take state certification classes and attend periodic updates. College or university courses on pesticide toxicology, wildlife management, botany, entomology and other life sciences can be useful.

The curator will complete the basic NPS curatorial training course and, if possible, the NPS 40-hour IPM training course. The curator may also maintain state pesticide applicator certification. Staff performing inspections or monitoring should receive at least eight hours of documented IPM training that includes methods of inspecting structures. Staff involved in rodent management should receive at least 16 hours of instruction including inspection and monitoring techniques, disease prevention, rodent management methods, sanitation, safety; tuning, setting and recovery of snap traps; rodenticide use processes and risks. Staff required to manage stinging insects (hornets, honey bees, yellowjackets) will receive at least four hours of training including protective equipment, insect and colony removal procedures, bystander management and emergency first aid. The IPM Coordinator will maintain copies of all staff IPM training documents.

Notification

Areas on the park (structures, grounds, forests, etc.) that are scheduled to be treated with any pesticide should be posted at least 24 hours prior to the treatment with warning information (target pest, pesticide to be used, signal word, date of treatment, area of treatment, re-entry date, information phone number). The posted notice should be of a material that will not deteriorate

in weather, and should be removed on the re-entry date. The local fire, police and EMS units should also be made aware of the treatment information. Members of the staff and local neighbors who are known to suffer from environmental illness (EI) or multiple chemical sensitivity (MCS) must also be notified at least 48 hours before the treatment so they can leave the area or protect themselves. Please refer to the Pesticide Treated Area Posting Form at the end of this section.

Spills

Pesticide spills need more detailed attention than spills of other materials. The spilled pesticide may also present a long-term hazard at the spill site and to responding or present personnel. If a pesticide spill has occurred, immediate procedures must be taken. The first action is to protect yourself: put on protective clothing, gloves, boots, tyvek coveralls, goggles and respirator. The second action is to isolate the area: do not allow unauthorized and unprotected personnel into the area. Identify the material and determine the hazard. If an unprotected person is involved or has succumbed, perform the rescue and administer first aid, then decontaminate the victim. Contain the spill. For liquids or dusts, dike off the area, stop any leaks, and use absorbent material to soak up the spill. A small spill (one pint or less, or one-half pound or less) may be contained with absorbent cloths, sand, bagged clay, or diatomaceous earth. A larger spill may necessitate soil dikes, sand snakes, commercial bagged clay or other containment efforts. For large spills, the Fire Department or other emergency responders may be called. For large spills of highly toxic pesticides, CHEMTREC can be called for containment and cleanup information. CHEMTREC may call the Pesticide Safety Team Network (PSTN) if a large quantity of pesticide is involved. Removing and decontaminating the material may require special procedures. Exposed staff or other personnel may need to be taken to hospitals for examination and treatment. Additional tests may be necessary over time, depending upon the pesticide exposure. The lesson is to not have toxic pesticides on site, and, if at all possible, avoid spills. Develop procedures for handling pesticides to avoid spills.

Spill kits can be developed and placed at storage, mixing and application sites. The kit should have diking or absorbent material sufficient to contain the amount of pesticide that may be involved (storage areas may need more than mixing areas), protective clothing and equipment, and emergency phone numbers. Absorbent material can be bagged clay, activated charcoal, diatomaceous earth or other highly absorbent material. There are also absorbent pads now available for absorbing pesticides.

HUMAN HEALTH

Disease Concerns

Most arthropod, bird and mammal pests come into direct contact with soil, dead and rotting organic material, and other sources of disease organisms which may provide opportunity for transmission to humans. This potential adverse effect of disease transmission to humans (park staff and visitors) is an important reason for an aggressive pest management program.

The advent of Hantavirus illness and death from exposure to rodent urine, feces and saliva poses a real concern for the presence of rodents in structures. Anyone involved in rodent management actions should be aware of the risks of exposure to the deadly Hantavirus, which may be present in rodent urine, feces and saliva. Minimal protection may be necessary when inspecting for rodent activity, monitoring or setting traps (dust mask, surgical gloves). Trapped rodents can be removed by placing a zip loc bag inside-out over your hand, grabbing the trap and captured (dead) rodent with the zip loc bag, then turning the bag right-side out over the trap and dead rodent, zipping the bag closed and placing it into another sealable bag for disposal. If a person is involved in cleaning rodent-infested, enclosed areas (inside a structure) or removing rodent urine, fecal droppings, nesting or other rodent debris, that person must wear approved protective equipment and follow Department of Health or CDC guidelines. Minimum protective equipment includes rubber gloves, goggles, coveralls, and a respirator with a HEPA filter. Other rodent-borne diseases associated with rodents are bubonic plague (flea transmitted), murine typhus, rat bite fever, hemorrhagic fever, and several others.

Other sources of human disease can be transmitted by ectoparasites on rodents, other mammals, birds and insects feeding on dead animals or other organic material. Allergies, asthma and other serious health effects can manifest from contact with exuviae, pheromones and cockroach and other insect body parts and droppings.

Wildlife Concerns

Mice often nest in, under and around structures, and are particularly fond of the cavities (and warmth) in stoves and other kitchen appliances and cupboards. Their gnawing (to keep their teeth worn down) on wiring and other electrical appliances has been the cause of many fires. Some migratory birds are implicated in harboring and transmitting Avian flu through contact with the fecal droppings.

Insect stings by ants, bees, wasps and yellowjackets can also be a concern for human safety, especially those who are sensitized to the stings. Managing these pests where there may be contact by visitors or staff is important. In some cases, notices to wear repellants may be necessary to attempt to ward off mosquitoes, black flies, ticks or other biting pests.

WARNING

PESTICIDE TREATED AREA

An application of a pesticide was deemed necessary to manage pests that are invading this area.

This notice is: a 24-hour a 48-hour a 72-hour an Emergency posting

Product Name: _____ Mfg. Name: _____

Active Ingredient: _____ USEPA Reg. No.: _____

Target Pest(s): _____

Date of Application: _____

Date Sign May Be Removed: _____ (No less than 72 hours from application)

Signal Word: Danger Warning Caution

If you have questions regarding this notification or require additional information, please contact the Site IPM Coordinator at 631-687-4769.

APPENDIX IV

SUPPLIES

`SUPPLIES

Inspection Tools

- Flashlight
- Hand lens, 16x or better
- Probe for testing wood for rot
- Spatula for checking cracks and crevices
- Notebook and pen
- Digital camera
- Moisture meter
- UV light for detecting rodent urine stains



Inspection Tools

Exclusion Materials

- **¼ in. hardware cloth** (stainless steel or galvanized). Used for excluding rodents, birds and larger pests
- **Stuf-Fit** (copper mesh – won't rust). Used for closing small holes, cracks, crevices and around pipes penetrating walls and ceilings. Easy to stuff into openings to prevent access by insects, rodents and other small pests. Compresses easily.
- **Stainless steel wool or scrubbies** (won't rust). Used for filling larger holes to prevent pest access. May be difficult to compress.
- **Dap Brand Caulk**. Many different sealants and fillers to cover cracks, crevices, small holes or openings filled with Stuf-Fit or stainless steel wool, and varied surfaces.
- **Door sweeps**. Metal framed with rubber or neoprene blade to prevent insects and mice from entering a structure under the door. Wooden thresholds may be installed on the floor below the door to close the gap if it is historic. Brush-type door sweeps do not exclude mice, large beetles or cockroaches.

Monitoring Materials

- **Unscented talc**. Used for tracking patches to determine runways of rats, mice or insects inside structures (non-toxic).
- **Lo-Line Crawling Insect Sticky Traps.** Used for monitoring and capturing crawling insects inside structures. Best designed trap on the market at this time.
- **Insects Limited Flying Insect Pheromone Traps.** Many different traps for monitoring presence and capturing flying and other insects. Traps are usually specific to species or groups of species.

Snap Traps

- **Victor Brand** mouse and rat snap traps. The oldest and best snap trap available today. Use only those with the metal trigger (the plastic ones are slower). The metal trigger can be fine-tuned (hair-triggered) with a file and minor adjustments. Must be checked each morning.
- **Rat Zapper** by AgriZap, Inc. An electronic trap that electrocutes rats and mice that enter the tunnel for the bait. Must be checked each morning.

Low-Risk Pesticides (for use in structures, museum and garden areas)

- **Avert Cockroach Bait Stations.** Abamectin bait station for cockroaches for use in and around structures.
- **Borid.** 99% Boric Acid powder which can be applied into cracks and crevices in structures to manage crawling insects.
- **Dekko Paks**. Borate based bait station designed for management of silverfish.
- **Drax Liquidator.** Boric Acid in sugar water bait for sweet-feeding ants. This slow-acting stomach poison is very effective for eliminating ant colonies. An excellent bait station for either inside or outdoor placement.
- **EcoEXEMPT IC.** An organic insecticide concentrate containing rosemary and other oils for use indoors and outdoors for crawling and flying insects.
- **Flea 'n Tick B Gone.** An enzyme treatment made from natural plant sources which has proven to effectively remove fleas, ticks, lice and other pests.
- **Hinder Deer & Rabbit Repellant.** Contains ammonium high fatty acid soaps to protect plants by forming a mild odor barrier. For use on vegetable, fruit and flower plants and shrubs.
- **Matran 2.** A FIFRA 25b exempt, non-selective, post-emergence herbicide which contains clove oil, water and lecithin. Can be used in and around all crop areas.
- **Max Force Roach Control System.** Contains Hydramethylnon to control cockroaches in structures.
- **Nisus Corporation. BoraCare.** DOT insecticide with solvent to aid wood penetration for wood-destroying organisms (WDOs). Solution can be mixed with water and applied as a spray.
- **Nisus Corporation. Jecta.** DOT in a gel to be injected into posts or wood in contact with soil to prevent or treat for termites, mold, fungi and wood rot; can be used for a spot treatment.
- **Nisus Corporation. Niban FG Bait.** Boric Acid for the control of ants, cockroaches, crickets and silverfish. Can be used both inside and outside.
- **Nisus Corporation. Niban Granular Bait C.** Boric Acid for the control of cockroaches and ants in structures.
- **Nisus Corporation. Nibor-D.** A borate powder used as a dust, liquid or mop solution to kill and prevent infestations of carpenter ants, silverfish and mildew. For both interior and exterior use.
- **Nisus Corporation. TimBor Professional.** Disodium Octaborate Tetrahydrate [DOT] insecticide. For use on insects in cracks and crevices, and treating wood to prevent (or treat) termites, wood-destroying insects, mold and fungi. A powder material for crawling insects that can also be mixed with water and applied as a spray; will penetrate into (and through) the raw wood member.
- **Perma-Guard Commercial Insecticide.** Diatomaceous Earth mixed with Pyrethrin and Piperonyl Butoxide which can be dusted into cracks and crevices to manage crawling insects such as cockroaches, ants and silverfish.
- **Perma-Guard Fossil Shell Flour.** Pure Diatomaceous Earth powder which can be used to manage museum pests such as Indian Meal Moth, grain weevils, etc.
- **Perma-Guard Garden and Plant Insecticide.** Diatomaceous Earth mixed with Pyrethrin and Piperonyl Butoxde. This is an effective material for insect management on field crops, yards and gardens.

- **Tri Die.** Pressurized Silica and Pyrethrin dust for management of museum pests and crawling insects in structures.
- **Victor Wasp and Hornet Spray.** Contains Mint Oil and Sodium Lauryl Sulfate for the management of wasps, hornets and yellow jackets.
- **WOODguard.** A petroleum oil and solvent with Copper 8-Quinolinolate which can be sprayed or brushed on raw wood surfaces to prevent fungus, mold, wood rot and mildew. Provides water repellency.
- **WOW (Without Weeds).** Contains Maize Gluten Meal for pre-emergent weed management for lawns and gardens.

APPENDIX V

GLOSSARY

GLOSSARY

ABSORPTION-The process by which a chemical or fluid is taken into the systems of human beings, plants, and animals.

ACARICIDE-A pesticide used to kill mites and ticks. A miticide is an acaricide.

ACTIVE INGREDIENT-The chemical or chemicals in a pesticide responsible for killing, poisoning, or repelling the pest. (Listed separately in the ingredient statement.)

ACUTE TOXICITY-The ability of a pesticide to cause injury within twenty-four hours following exposure. LD_{50} and LC_{50} are common indicators of the degree of acute toxicity. (See also Chronic Toxicity.)

ADJUVANT-A substance added to a pesticide to improve its effectiveness or safety. Same as additive. Examples: penetrants, spreader-stickers, and wetting agents.

ADSORPTION-The process by which chemicals are held or bound to a surface by physical or chemical attraction. Clay and high-organic soils tend to adsorb pesticides.

AEROSOL-A material stored in a container under pressure. Fine droplets are produced when the material dissolved in a liquid carrier is released into the air from the pressurized container.

ALGAE-Simple aquatic plants that contain chlorophyll and are photosynthetic.

ALGICIDE-A pesticide used to kill or inhibit algae.

ANTI-SIPHONING DEVICE-A device attached to the filling hose that prevents backflow or backsiphoning from a spray tank into a water source.

ANTICOAGULANT-A chemical that prevents blood clotting. An active ingredient in some rodenticides.

ANTIDOTE-A treatment used to counteract the effects of pesticide poisoning or some other poison in the body.

ARACHNID-A wingless arthropod with two body regions and four pairs of jointed legs. Spiders, ticks, and mites are in the class Arachnida.

ARTHROPOD-An invertebrate animal characterized by jointed body and limbs. It is usually covered by a hard exoskeleton covering that is molted at intervals. For example, insects, mites, and crayfish are in the phylum Arthropoda.

ATTRACTANT-A substance or device that lures pests to a trap or poison bait.
AVICIDE-A pesticide used to repel or kill birds.

BACTERIA-Microscopic organisms, some of which are capable of producing diseases in people, plants and animals. Some bacteria are beneficial.

BACTERICIDE-Chemical used to kill bacteria.

BAIT-A food or other substance used to attract a pest to a pesticide or a trap.

BAND APPLICATION-Application of a pesticide in a strip alongside or around a structure, a portion of a structure, or any object.

BARRIER APPLICATION-See band application.

BENEFICIAL INSECT-An insect that is useful or helpful to people, such as insect parasites, predators, or pollinators.

BIOLOGICAL CONTROL-Management of pests using beneficial arthropods as predators, parasites, and disease-causing organisms which may occur naturally or are introduced to reduce pest populations.

BIOMAGNIFICATION-The process by which one organism accumulates chemical residues in higher concentration from other organisms which they have consumed.

BOTANICAL PESTICIDE-A pesticide produced from chemicals found in plants. Examples are nicotine, pyrethrins, and strychnine.

BRAND NAME-The name, or designation of a specific pesticide product or device made by a manufacturer or formulator. (A marketing name.)

CALIBRATE, CALIBRATION OF EQUIPMENT OR APPLICATION METHOD-Measurement and adjustment to control the output or rate of dispensing pesticides.

CARBAMATES-(N-Methyl Carbamates). A group of pesticides containing nitrogen, formulated as insecticides, fungicides, and herbicides. The N-Methyl Carbamates are insecticides and inhibit cholinesterase in animals.

CARCINOGENIC-The ability of a substance or agent to induce malignant tumors (cancer).

CARRIER-An inert liquid, solid, or gas added to an active ingredient for delivering a pesticide to the target effectively. A carrier is usually water, oil, or other solvent, used to dilute the formulated product for application.

CARRYING CAPACITY-The number of organisms for which a specific site can provide life support.

CERTIFIED APPLICATORS-Individuals who are certified by the state to use or supervise the

use of restricted-use pesticides.

CHEMICAL NAME-The scientific name of active ingredients found in formulated products. This complex name is derived from the chemical structure of the active ingredient.

CHEMICAL CONTROL-Pesticide application to kill pests.

CHEMOSTERILANT-A chemical compound capable of preventing animal reproduction.

CHEMTREC-The Chemical Transportation Emergency Center which has a toll-free number (800-424-9300) for providing 24-hour information only for chemical emergencies such as a spill, leak, fire, or accident.

CHLORINATED HYDROCARBON-A pesticide containing chlorine, carbon, and hydrogen. Many are persistent in the environment, such as Chlordane and DDT. Only a few are registered for use in the U.S.

CHOLINESTERASE, ACETYLCHOLINESTERASE-An enzyme in animals that helps regulate nerve impulses. This enzyme is depressed by N-Methyl carbamate and organophosphate pesticides.

CHRONIC TOXICITY-The ability of a pesticide chemical to cause injury or illness (beyond 24 hours following exposure) when applied in small amounts repeatedly for a longer period of time. Chronic effects can also result from a single exposure. (See also Acute Toxicity.)

COMMERCIAL APPLICATOR-A state-certified applicator who for compensation uses or supervises the use of pesticides classified for restricted use for any purpose or on any property other than that producing an agricultural commodity.

COMMON NAME-A name given to a pesticide's active ingredient by a recognized committee on pesticide nomenclature. Many pesticides are known by a number of trade or brand names, but the active ingredient has only one recognized common name.

COMMUNITY-The different populations of animal or plant species that exist together in an ecosystem (See also Population and Ecosystem.)

COMPETENT-Individuals properly qualified to perform functions associated with pesticide application. The degree of competency (capability) required is directly related to the nature of the activity and the associated responsibility.

CONCENTRATION-Refers to the amount of active ingredient in a given volume or weight of formulated product.

CONTACT PESTICIDE-A pesticide that causes death or injury to pests when in contact with it. The chemical does not have to be ingested. It is often used to describe a spray applied directly on a pest.

CONTAMINATION-The presence of an unwanted substance (sometimes pesticides) in or on a plant, animal, soil, water, air, or structure.

CULTURAL CONTROL-A pest management method that includes changing human habits, such as sanitation, changing work practices, or cleaning or garbage pick-up schedules.

DECONTAMINATE-To remove or break down a pesticidal chemical from a surface or substance.

DEGRADATION-A process by which a chemical compound or pesticide is reduced to simpler compounds by the action of microorganisms, water, air, sunlight, or other agents. Degradation products are usually, but not always, less toxic than the original compound.

DEPOSIT-The amount of pesticide on a treated surface after application.

DERMAL TOXICITY-The ability of a pesticide to cause acute illness or injury to human beings or animals when absorbed through the skin (see Exposure Route.)

DESICCANT-A type of pesticide that draws moisture or fluid from a plant or arthropod pest, causing it to die. Certain desiccant dusts destroy the waxy outer coating that holds moisture within an insect's body.

DETOXIFY-To render a pesticide's active ingredient or other poisonous chemical harmless.

DIAGNOSIS-The positive identification of a problem and its cause.

DILUENT-Any liquid, gas or solid material used to dilute or weaken a concentrated pesticide.

DISINFECTANT-A chemical or other agent that kills or inactivates disease-producing microorganisms. Chemicals used to clean or surface-sterilize inanimate objects.

DOSE, DOSAGE-Quantity, amount, or rate of pesticide applied to a given area or target.

DRIFT-The airborne movement of a pesticide spray or dust beyond the intended target area.

DUST-A finely ground, dry pesticide formulation containing a small amount of active ingredient and a large amount of inert carrier or diluent such as clay or talc.

ECOSYSTEM-The pest-management unit. It includes a community (of populations) with the necessary physical (harborage, moisture, temperature), and biotic (food, hosts) supporting factors that allow a population of pests to persist.

EMULSIFIABLE CONCENTRATE (EC)-A pesticide formulation produced by mixing or suspending the active ingredient (the concentrate) and an emulsifying agent in a suitable carrier. When added to water, a milky emulsion is formed.

EMULSIFYING AGENT (EMULSIFIER)-A chemical that aids the suspension of a liquid in another that normally would not mix together.

EMULSION-A mixture of two liquids which are not soluble in one another. One is suspended as very small droplets in the other with the aid of an emulsifying agent.

ENCAPSULATED FORMULATION-A pesticide formulation with its active ingredient enclosed in tiny capsules of polyvinyl or other materials; principally used for slow release. The enclosed active ingredient moves out to the capsule surface as pesticide on the surface is removed (volatilizes, or rubs off).

ENDANGERED SPECIES-Individual plants or animals with a population that has been reduced to the extent that it is near extinction and that has been designated to be endangered by a federal agency.

ENTRY INTERVAL-See Re-entry Interval.

ENVIRONMENT-Air, land, water, plants, people, animals, and the interrelationships which exist among them.

EPA - ENVIRONMENTAL PROTECTION AGENCY-The federal agency responsible for ensuring the protection of people and the environment from potentially adverse effects of pesticides and other contaminants.

EPA ESTABLISHMENT NUMBER-A number assigned to each pesticide-production plant by the EPA. The number indicating the plant at which the pesticide product was produced must appear on all labels of that product.

EPA REGISTRATION NUMBER-An identification number assigned to a pesticide product when it is registered by the EPA for use. The number must appear on all labels of pesticide products.

ERADICATION-The complete elimination of a (pest) population from a designated area.

EXPOSURE ROUTE OR COMMON EXPOSURE ROUTE-The manner - dermal (through the skin), oral (through the mouth), or inhalation/respiratory - in which a pesticide may enter an organism.

FIFRA-The Federal Insecticide, Fungicide, and Rodenticide Act; a federal law and its amendments that controls pesticide registration and use.

FLOWABLE-A pesticide formulation in which very finely ground solid particles are suspended (not dissolved) in a liquid carrier.

FOG TREATMENT-A pesticide in aerosol-sized droplets (under 40 microns). Not a mist or gas. After propulsion, the fog droplets fall on exposed surfaces.

FORMULATION-The pesticide product as purchased, containing a mixture of one or more active ingredients, and carriers (inert ingredients), with other additives making it easy to store, dilute, and apply.

FUMIGANT-A pesticide formulation that volatilizes, forming a toxic vapor or gas that kills in the gaseous state, penetrating voids to kill pests.

FUNGICIDE-A chemical used to kill fungi.

FUNGUS (plural - fungi)-A group of small, often microscopic, organisms in the plant kingdom which cause rot, mold, and disease. Fungi need moisture or a damp environment (wood rots require at least 19%). Fungi are extremely important in the diet of many insects.

GENERAL USE (UNCLASSIFIED) PESTICIDE-A pesticide which can be purchased and used by the general public. (See also Restricted Use Pesticide.)

GRANULE-A dry pesticide formulation. An active ingredient is either mixed with or applied as a coating to an inert carrier to form a small, ready-to-use, low-concentrate chemical which normally does not present a drift hazard. Pellets differ from granules only in their precise uniformity, larger size, and shape.

GROUNDWATER-Water source located beneath the soil surface from which springs and well water are drawn (see also Surface Water.)

HABITAT MODIFICATION-Removing food, water, shelter, and other conditions that support pests, or excluding access by pests to the site.

HALF LIFE-The time required for half of something (i.e. pesticide) to undergo a specific process (chemical degradation), so that only one-half of the applied material is still active (i.e. half life of Chlordane in soil is about 75 years).

HANTAVIRUS-A deadly virus transmitted to humans through contact with rodent feces, urine and saliva resulting in acute respiratory failure.

HARBORAGE-Shelter that provides the basic needs, including a safe place for the pest population.

HAZARD-See Risk.

HERBICIDE-A pesticide used to kill or inhibit plant growth.

HIGH-RISK PERSON-A person who has some condition that may put him or her at risk from exposure to pesticides. Such persons include children, the elderly, pregnant women, newborns, asthmatics, the neurologically impaired, the environmentally ill (EI), and those with multiple chemical sensitivity (MCS).

HOST-Any animal or plant on or in which another lives for nourishment, development, or protection.

IGR, INSECT GROWTH REGULATOR JUVENOID-A pesticide which mimics insect hormones that control molting and the development of insect systems affecting the change from immature to adult (see Juvenile Hormone.)

INERT INGREDIENT-An inactive material without pesticidal activity in a pesticide formulation, but which may be hazardous for some other reason; i.e., petroleum derivatives.

INGREDIENT STATEMENT-A portion of the label on a pesticide container that gives the name and amount of each active ingredient and the total amount of inert ingredients in the formulation.

INHALATION-Taking a substance in through the lungs (breathing in). (See Exposure Route.)

INSECT GROWTH REGULATOR-See IGR.

INSECTICIDE-A pesticide used to manage or prevent damage caused by insects.

INSECTS, INSECTA-A class in the phylum Arthropoda characterized by a body composed of three segments and three pair of legs.

INSPECTION-A process for detecting pests, pest damage, and evidence of pest activity in a managed site. (See Monitoring.)

INTEGRATED PEST MANAGEMENT-See IPM.

IPM-Integrated pest management. The coordinated use of pest and environmental information with available pest management methods to prevent unacceptable levels of pest damage by the most economical means, and with the least possible hazard to people and the environment. IPM includes reducing pests to a tolerable level. Pesticide application is not the primary management method, but is an element of IPM, as are cultural and structural alterations. IPM programs stress communication, monitoring, inspection, and evaluation (keeping and using records).

JUVENILE HORMONE-A hormone produced by an insect that inhibits change or molting. As long as juvenile hormone is present the insect does not develop into an adult, but remains immature.

LABEL-All printed material attached to or on a pesticide container.

LABELING-The pesticide product label and other accompanying materials that contain directions for use that pesticide users are legally required to follow.

LARVA (plural - larvae)-The developmental stage of insects with complete metamorphosis that hatches from the egg. A mature larva becomes a pupa.

LC_{50}-Lethal concentration. The concentration of a pesticide, usually in air or water, that kills 50 percent of a test population of animals. LC_{50} is usually expressed in parts per million (ppm). The lower the LC_{50} value, the more acutely toxic the chemical.

LD_{50}-Lethal dose. The dose or amount of a pesticide that can kill 50 percent of the test population of animals when eaten or absorbed through the skin. LD_{50} is expressed in milligrams of chemical per kilogram of body weight of the test animal (mg/kg). The lower the LD_{50}, the more acutely toxic the pesticide.

LEACHING-The movement of a substance with water downward through soil.

LYME DISEASE-A debilitating disease mainly affecting joints that is transmitted to humans through the bite of ticks, especially the Deer Tick.

METAMORPHOSIS-A change in the shape or form of an animal. Usually used when referring to insect development.

MICROBIAL DEGRADATION-Breakdown of a chemical by microorganisms.

MICROBIAL PESTICIDE-Bacteria, viruses, fungi, and other microorganisms used to manage pests. Also called biorationals.

MICROORGANISM-An organism so small that it can be seen only with the aid of a microscope.

MITICIDE-A pesticide used to kill mites (see Acaricide.)

MODE OF ACTION-The way in which a pesticide exerts a toxic effect on the target plant or animal.

MOLLUSCICIDE-A chemical used to kill snails and slugs.

MONITORING-Ongoing surveillance. Monitoring includes periodic inspection and record-keeping. Monitoring records allow technicians to evaluate pest population suppression, identify infested or non-infested sites, and manage the progress of the pest-management program.

MSDS-Material Safety Data Sheet required by Department of Labor to be provided by manufacturers to those who request information on chemical substances. Included is data on flammability, eye hazards, protective equipment necessary, spill/clean-up instructions, and other hazard information.

NECROSIS-Death of plant or animal tissues which results in the formation of discolored, sunken, or necrotic (dead) areas.

NONTARGET ORGANISM-Any plant or animal other than the intended targets of pesticide application.

NYMPH-The developmental stage of insects with gradual metamorphosis that hatches from the egg. Nymphs become adults.

ORAL TOXICITY-The effect of a pesticide resulting in injury or acute illness when taken by mouth.

ORGANOPHOSPHATES-A large group of pesticides that contain phosphorus and inhibit cholinesterase in animals; i.e., Malathion and Diazinon.

PARASITE-A plant, animal, or microorganism living in, on, or with another living organism for the purpose of obtaining all or part of its food.

PATHOGEN-A disease-causing organism.

PERSONAL PROTECTIVE EQUIPMENT-Devices and clothing intended to protect a person from exposure to pesticides, including items like long-sleeved shirts, long trousers, coveralls, hats, gloves, shoes, respirators, and other safety items as needed.

PEST MANAGEMENT-See IPM.

PEST-An undesirable organism including any insect, rodent, nematode, fungus, weed, or some terrestrial and aquatic plants and animals, virus, bacteria, or micro-organism which the US EPA Administrator declares to be a pest under FIFRA, Section 25(c)(1).

PESTICIDE-A chemical or other agent used to kill, repel, or otherwise manage pests or to protect from a pest.

pH-A measure of acidity/alkalinity of a liquid: acid below pH7; basic or alkaline above pH7 (up to 14).

PHEROMONE-A substance emitted by an animal to influence the behavior of other animals of the same species. Some are synthetically produced for use in insect traps.

PHOTODEGRADATION-Breakdown of chemicals by the action of light.

PHYSICAL CONTROL-Habitat alteration or changing the infested physical structure, such as by caulking holes, cracks, tightening around doors, windows, moisture reduction, ventilation, and other means.

PHYSIOLOGICAL SENSITIVITIES-Human physiological reaction from exposure in the environment to perhaps minute amounts of chemicals that produce an adverse response.

PHYTOTOXICITY-Injury to plants caused by a chemical or other agent.

POINT OF RUNOFF-The point at which a spray starts to run or drip from the surface to which it is applied.

POISON CONTROL CENTER-A local agency, generally a hospital, which has current information on the proper first-aid techniques and antidotes for poisoning emergencies. Such centers are listed in telephone directories.

POPULATION-Individuals of the same species. The populations in an area make up a community (see Ecosystem.)

PORT-Small sealable hole that allows injection of pesticidal material into a wall or other void in a structure.

PRECIPITATE-A solid substance that forms in a liquid and settles to the bottom of a container; a material that no longer remains in suspension.

PREDATOR-An animal that attacks, kills, and feeds on other animals. Examples of predaceous animals are hawks, owls, snakes, spiders, lady-bird beetles and other insects.

PROFESSIONAL-One who is trained to conduct an efficient operation and able to make judgments based on training and experience.

PROPELLANT-The inert ingredient in pressurized containers that forces an active ingredient from the container.

PUPA (plural - pupae)-The developmental stage of insects with complete metamorphosis when major changes from larval to adult form occurs.

QUALIFIED APPLICATOR-An applicator who is certified (and licensed in some states) to apply restricted-use pesticides in the state. Qualification may also include training or experience.

RATE OF APPLICATION-The amount of pesticide applied to a plant, animal, unit area, or surface; usually measured per acre, per 1,000 square feet, per linear foot, or per cubic foot.

RE-ENTRY INTERVAL-The length of time following an application of a pesticide during which entry into the treated area is restricted. Also known as Entry Interval.

REGISTERED PESTICIDES-Pesticide products which have been registered by the Environmental Protection Agency for uses listed on the label.

REPELLENT-A compound that keeps insects, rodents, birds, or other pests away from plants, domestic animals, buildings, or other treated areas.

RESIDUAL PESTICIDE-A pesticide that continues to remain effective on a treated surface or area for an extended period following application.

RESIDUE-The pesticide active ingredient or its breakdown products which remain in or on the target after treatment.

RESTRICTED USE PESTICIDE-A pesticide that can be purchased and used only by certified applicators or persons under their direct supervision. A pesticide classified for restricted use under FIFRA, Section 3(d)(1)(C).

RISK-A probability that a given pesticide will have an adverse effect on people or the environment in a given situation.

RMSF-Rocky Mountain Spotted Fever is an acute infectious rickettsial disease transmitted to humans by the American dog tick.

RODENTICIDE-A pesticide used to kill rodents.

RUNOFF-The movement of water and associated materials on the soil surface. Runoff usually proceeds to bodies of surface water.

SANITATION-The practice of removing undesirable substances that support a pest or pest population (for instance, food or water).

SIGNAL WORDS-Required wording which appears on every pesticide label to denote the relative toxicity of the product. Signal words are DANGER-POISON, DANGER, WARNING, or CAUTION.

SITE-Areas of actual pest infestation. Each site should be treated specifically or individually.

SOIL INJECTION-The placement of a pesticide below the surface of the soil, a common application method for termiticides.

SOIL DRENCH-To soak or wet the ground surface with pesticide. Large volumes of pesticides are usually needed to saturate the soil to a sufficient depth.

SOIL INCORPORATION-The mechanical mixing of a pesticide product with soil.

SOLUTION-A mixture of one or more substances in another substance (usually a liquid) in which all the ingredients are dissolved. Example: sugar in water.

SOLVENT-A liquid which will dissolve another substance (solid, liquid, or gas) to form a solution.

SPACE SPRAY-A pesticide which is applied as a fine spray or mist to a confined area.

STOMACH POISON-A pesticide that must be eaten by an animal in order to be effective; it will not kill on contact.

SURFACE WATER-Water on the earth's surface such as rivers, lakes, ponds, and streams. (See Groundwater.)

SUSPENSION-A pesticide mixture consisting of fine particles dispersed or floating in a liquid, usually water or oil. Example: wettable powders in water.

TARGET-Plants, animals, structures, areas, or pests toward which the pesticide or other management method is directed.

TECHNICAL MATERIAL-Pesticide active ingredient in pure form, as it is manufactured by a chemical company. It is combined with inert ingredients or additives in formulations such as wettable powders, dusts, emulsifiable concentrates, or granules.

TOXIC-Poisonous to living organisms.

THRESHOLD-A level of pest density. The number of pests observed, trapped, or counted that can be tolerated without an economic loss or aesthetic injury. Thresholds in pest management may be site specific. For example, different numbers of flies may be tolerated at different sites (canoe warehouse and kitchen would have different thresholds).

TOLERABLE LEVELS OF PESTS-The presence of pests, at certain levels, is tolerable in many situations. Totally eliminating pests in certain areas is sometimes not achievable without major structural alterations, excessive control measures, unacceptable disruption, or unacceptable cost. The tolerable level in some situations will be near zero. Urban pest management programs may have lower tolerable levels of pests than rural programs.

TOXICANT-A poisonous substance such as the active ingredient in a pesticide formulation.

TOXICITY-The ability of a pesticide to cause harmful, acute, delayed, or allergic effects. (The degree or extent that a chemical or substance is poisonous.)

TOXIN-A naturally occurring poison produced by plants, animals, or microorganisms. Examples: the poison produced by the black widow spider, the venom produced by snakes, the botulism toxin.

UNCLASSIFIED PESTICIDE-See General-Use Pesticide.

USE-The performance of pesticide-related activities requiring certification including application, mixing, loading, transport, storage, or handling after the manufacturing seal is broken; care and maintenance of application and handling equipment; and disposal of pesticides and their

containers in accordance with label requirements. Uses not needing certification are long-distance transport, long-term storage, and ultimate disposal.

VAPOR PRESSURE-The property which causes a chemical to evaporate. The higher the vapor pressure, the more volatile the chemical or the more easily it will evaporate.

VECTOR-A carrier, an animal (such as an insect, nematode, mite) that can carry and transmit a pathogen from one host to another.

VERTEBRATE-Animal characterized by a segmented backbone or spinal column.

VIRUS-Ultramicroscopic parasites composed of proteins. Viruses can only multiply in living tissues, and they cause many animal and plant diseases.

VOID-Space inside walls or other inaccessible space that may harbor pests.

VOLATILITY-The degree to which a substance changes from a liquid or solid state to a gas at ordinary temperatures when exposed to air.

WATER TABLE-The upper level of the water-saturated zone in the ground.

WEST NILE VIRUS-A disease transmitted to humans and other animals by the bite of a mosquito. Birds (notably Corvids) act as a reservoir and may die as a result.

WETTABLE POWDER-A dry pesticide formulation in powder form that forms a suspension when added to water.

ZONE-The management unit, an area of potential pest infestation made up of infested sites. Zones will contain pest food, water, and harborage. A kitchen-bathroom arrangement in motel units might make up a zone; the canoe warehouse may make up another. Zones may also be established by eliminating areas with little likelihood of infestation and treating the remainder as a zone. A zone will be an ecosystem.

APPENDIX VI

IPM INSPECTION

FORMS

STRUCTURAL IPM INSPECTION FORM

Date_____ Inspector_____ Assisted by_____

Code Numbers for Problems on Form/Map:

1 = Roaches	2 = Flying Insects (flies, moths)	3 = Other Insects	4 = Rodent Sign	5 = Housekeeping
6 = Maintenance	7 = Bird Sign	8 = Squirrels	9 = WDOs	10 = Other

Abbreviations: PTW = Pressure Treated Wood FWJ = Floor Wall Junction

1. OUTSIDE - Curtilage:
Pests known present.....

Garbage/dumpster conditions.....
General area cleanliness.....
Dead trees/sod debris/termites.....
Pest harborage/debris on ground.....
Pest breeding (water, food, shelter).....
Paving/walk drainage problems.....
Wood too close to structure.....
Plants too close to building.....
General wood control.....
Hazardous trees/limbs.....
Shed/outbuilding problems.....
Rodent burrows/sign/holes.....
Pet/bird feeders/waterers.....
Insect evidence/harborage garden?.....
Vertebrate evidence/holes.....
.....
...

2. FOUNDATION - Exterior
Pests known present.....

A. Foundation:
Building corners square foundations.....
Foundation intact: dirt/wood contact?.....
Wood-concrete-soil contacts/PTW.....
Foundation cracks.....
36 in. clear area around structure (1 in. gravel).....
.....
...

B. Grade
Soil drainage characteristics.....
Grade from structure (6 in/10 ft.).....
Grade and water accumulations.....
.....
...

C. Siding/Building Exterior
Downspout drains splash on siding?.....
Splash blocks perforated pipe.....
Main siding peeling paint/buckling?.....
Water/air conditioner leaks.....
Rusty nails/wood streaking.....
Discolored/decayed wood siding.....
Wood pick test results.....
Wood moisture readings.....
Wood junctions caulked.....
Porch and soffit conditions.....
Tongue & groove flooring caulked.....
Door sweeps/good door closure.....
Metal kickplates on doors.....
Window frame conditions.....
Vents/exhaust/conduits screened.....
Cracks/holes around pipes/wires.....
Outside lights away from doors/on poles; high pressure sodium bulbs; covers clean.....
Trees touching/overhanging structure.....
Plants/plantings/planters/trellises.....
..
Trash/debris accumulations.....
Insect/vertebrate evidence/harborage.....
.....
...

D. Food Establishments
Loading docks/receiving areas clean.....
Garbage area removed from structure.....
Other outside storage/spills.....
Exterior wall/foundation cracks.....
.....
...

E. Structural Roof
Pests known present.....

Missing shingles/cracks in surface.....
Moss/lichen/algae/fungus on roof.....
Rusty iron nails in roofing.....
Shingles/roof intact.....
Shingle extension 1 ft. eave (12-24-30).....
Gutters clean, not clogged.....
Chimney/vents screened.....
Bird problems in eaves.....
Chimney flashing/construction tight.....
Dormer flashing/construction tight.....
Soffit flashing tight.....
Wires from roof pest-protected.....
Insect evidence/harborage.....
Fascia tight/painted (carpenter bees).....
.....
...

3. INSIDE - Crawlspace
Pests known present.....

Monitor (repair) structure twice a year (spring/fall) for moisture/

damage.....
.
Vents screened/open/in wells.....
Height of crawlspace (18 in.t joists).....
Wood/soil contact.....
Wood pick test results.....
Termite shields installed.....
Leaking pipes.....
Structural wood type.....
Wet areas? Why? Moisture readings.....
Mold/fungus/decay/insect damage.....
Wood debris present.....
Evident floor/wood shrinkage.....
Vapor barrier? Intact?.....
Pest access into structure thru floor.....
Active insect
Decorative plants……..
General sanitation/lint……...
Cracks/holes in floor……
Suspended ceilings/light fixtures.....
infestations?.....
Vertebrate sign?.....
Ventilation: 1 sf/150 sf; within 3 ft. of corner.....
Crawlspace access door clear.....

4. INSIDE - Structural
Pests known present.....

A. Basement
Walls dry/moisture readings.....
Storage condition/sanitation.....
Wood moisture in sill area.....
Floor drains clean/screened.....
Sticky trap monitoring.....
Trash collection practices.....
Insect evidence/harborage.....

B. Offices; Classrooms
Reception desk area.....
Exhibit area: general pest risks?.....
Exterior door conditions.....
Offices: neatness/problem areas.....
Eating/storing food at desks.....
Computers/elec equipment problems.....
Insect attracting items in building?.....
Insect evidence/harborage.....
Lunchroom/coffeemaking area.....
Vending machines.....
Trash collection practices.....
G. Additional notes

Floors:
……
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.....
...
.....
...

Walls:
……..
…
.....
...
.....
...

C. Service/Custodial Rooms
Custodial storage area.....
Wet mops/rags/sour drains.....

Electrical
boxes/equipment.....
Drains
cleaned/screened.....

D. Kitchens/Food Establishments
Countertops
caulked/intact.....
Exhaust
vents.....
Water leaks/pipe sweating/hot water
heater.....
Drains clear/good
condition.....
Food stored in
cans/glass.....
Shelves clean/no shelf
paper.....
Refrigerator
pan/motor.....
Windows tight/insect
presence.....
Condition of
walls/grease/moisture.....
Storage 6 in. off
floor.....
Dishwasher
cleanliness/pests.....
Stove vent
clean/screened.....
Stove/refrigerator doors
clean.....
Hollow legs on
tables/chairs/rails?.....
Equipment elevated on
legs.....
Conditions under lowest
drawers.....
Trash covered; out every
night.....
Dishes kept in water until
cleaned.....
Outside trash covered; cans cleaned
weekly.....
Insect
evidence/harborage.....
Dry storage
areas.....
Areas behind false fronts on
equipment.....
Loose floor tile/screened
drains.....
Regularly emptied trash
containers.....
Area around can opener/grease
hoods.....
Condition of window
frames.....
Employee
lockers.....
Air doors/vanes positioned
correctly.....
Door
sweeps.....

E. Bathrooms
Water leaks at tub/shower/toilet;
fungus.....
Floor strength near
toilet.....
Water leaks under
sink.....
Condition of window
frames.....
Blistered ceiling/wall
paint.....
Insect
evidence/harborage.....

F. Structural/Attic
Sufficient
ventilation.....
Insect/pest
evidence/harborage.....
Vents
screened.....
Temperature.....
..
Roof/wall junction tight
seal.....
Rodent
evidence.....
Exposed/chewed
wiring.....
Appliance
venting.....
Frozen condensation/ice
dams.....
Bat
presence.....

Windows/doors:
.....
.....
.....
.....

Ceilings:
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.....
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Other:
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EQUIPMENT CHECKLIST - personal protective equipment

- 9 Hard hat
- 9 Insect repellant
- 9 Knee pads
- 9 Gloves, heavy/medical
- 9 Face shield/goggles
- 9 Dust mask/respirator
- 9 Overalls and/or bee suit
- 9 Bee veil
- 9 Smoker and fuel
- 9 Wasp Freeze
- 9 Fly swatter
- 9 .....

TOOLS FOR SITE INSPECTIONS

- 9 Clipboard/grid/paper
- 9 Inspection forms
- 9 Pencil/pen
- 9 Insect keys/info
- 9 Aspirator/collecting vials
- 9 Flashlight/headlamp
- 9 Flashlight batteries
- 9 Hand duster
- 9 Vials w/alcohol
- 9 Polaroid/digital camera
- 9 Belt/leatherman/knife
- 9 15x Hand lens/loupe
- 9 Masking/filament tape
- 9 Portable vacuum cleaner
- 9 Ladders/rope/carabiner
- 9 Sharp probe (wood awl)
- 9 White coveralls
- 9 Belt pouch for tools
- 9 Extendable mirror
- 9 Tape measure/6 in ruler
- 9 Plastic zip locs
- 9 Slide camera
- 9 Colored sticky labels
- 9 Binoculars

- 9 Film/flash
- 9 Caulk
- 9 Lo-line sticky traps
- 9 Screwdriver/phillips/slot
- 9 Crescent/general wrench
- 9 Forceps
- 9 Pocket tape recorder
- 9 Pliers
- 9 .....
- 9 .....
- 9 Moisture meter/thermometer
- 9 Small hand trowel
- 9 Knee/elbow pads
- 9 Spatula
- 9 Rechargeable drill
- 9 Stethoscope
- 9 Optivisor
- 9 Hand mirror
- 9 .....
- 9 .....

ADDITIONAL
COMMENTS.....
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.....
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.....

LANDSCAPE IPM INSPECTION FORM

Site_____ Date_____ Inspector_____ Assisted by_____

PESTS PRESENT

VERTEBRATES	LOCATION	ACTION
INSECTS	LOCATION	ACTION
WEEDS	LOCATION	ACTION

INSECT PHEROMONE MONITORING TRAPS

SPECIES	COUNTS	LOCATION

OTHER OBSERVATIONS – i.e., Plants too Close to Structures, etc.

_____

_____

_____

_____

_____

APPENDIX VII

PEST SIGHTING

LOG

Fire Island National Seashore

Have you seen any pests lately? Please jot down your observations!



Pest Activity Log: _____

Report of Pest Sighting			
Date	Name/Phone	Location/Building	Pest/Problem Description

PLEASE RETAIN ORIGINAL FOR COPYING.



APPENDIX VIII

BIBLIOGRAPHY

BIBLIOGRAPHY

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APPENDIX IX

PRODUCT LABELS

See Files on Individual PDF Format Product Labels and MSDS

APPENDIX X

VENDORS

VENDORS

AGRIZAP, INC., 4535 McGrath Street, Building B, Ventura, CA 93003. 1-888-332-3728. www.ratzapper.com. Electronic rodent management device.

BENEFICIAL INSECTARY, 9664 Tanqueray Court, Redding, CA 96003. 1-800-477-3715. www.insectary.com. Provides beneficial critters for managing aphid, whitefly, mites and more.

BIOCONTROL NETWORK, 5116 Williamsburg Road, Brentwood, TN 37027. 1-800-441-2847. www.biconet.com. Provides an extensive list of low-risk pest control critters and products.

DO-IT-YOURSELF PEST CONTROL, INC., 2823 Chamblee-Tucker Road, Atlanta, GA 30341. 1-800-476-3368. www.doyourownpestcontrol.com. Provides Dekko Silverfish Paks (manufactured by Dekko Manufacturing, LLC) for control of silverfish and more.

GARDENS ALIVE!, 5100 Schenley Place, Lawrenceburg, IN 47025. 1-812-537-8650. www.gardens-alive.com. Informative catalog with a wide selection of many biological-based pest controls, including beneficial predators, parasites, beneficial nematodes, fertilizers and much more.

INSECTS LIMITED, INC. 16950 Westfield Park Road, Westfield, IN 46074. 1-317-896-9300. www.insectslimited.com Provides pheromone traps for museum, stored product and other pests.

IPM LABORATORIES, Main Street, Locke, NY 13092-0099. 1-315-497-2063. www.ipmlabs.com. This company produces a very informative catalog and newsletter with helpful, expert information on using its many beneficial insects. Provides whitefly egg parasites and predators as well as a number of wasp parasites for aphid control, including the difficult to find *Aphelinus abdominalis* and *Aphidius ervi*. They always carry a quality product.

M&R DURANGO, INC., P.O. Box 886, Bayfield, CO 81122 aka The Good Bug Company, 970-259-3521. www.goodbug.com. Provides *Encarsia Formosa*, thrips predator, spider mite predator, green lacewing and more.

NEEM RESOURCES, THE AHIMSA ALTERNATIVE, INC., 5317 Whiting Avenue, Edina, MN 55439. 1-877-873-6336 or 1-405-538-0280. www.neemresource.com. Provides pure neem oil, karanja oil and other neem products for natural pest management.

PERMA-GUARD, INC., 625 East 2150 South, Bountiful, UT 84010. 1-877-801-2025. www.perma-guard.com. Supplier of diatomaceous earth product and pyrethrin and diatomaceous earth insecticides.

PEST CONTROL SUPPLIES, 1700 Liberty Street, Kansas City, MO 64102. 1-800-821-5689. www.pcspest.com. Termite and rodent control, herbicides, insect traps.

PRESERVATION PRODUCTS UNLIMITED, 6929 Seward Avenue, P.O. Box 29109, Lincoln,

NE 68529. 1-800-648-7329.
RESIDEX, 8486-F Tyco Road, Vienna, VA 22182. 1-800-247-8528. www.residex.com. A source for pesticides, Lo-Line sticky monitoring traps, Victor snap traps and more.

RINCON-VITOVA INSECTARIES, INC., P.O. Box 1555, Ventura, CA 93002. 1-800-248-2847. www.rinconvitova.com. Provides a wide variety of pest management supplies and beneficial organisms.

TARGET SPECIALTY PRODUCTS, 15415 Marquardt Avenue, Santa Fe Springs, CA 90670. 1-562-802-2238. www.target-specialty.com. A source for pesticides, Lo-Line sticky monitoring traps, Victor snap traps and more.

UNIVAR USA. 150 Enterprise Road, Johnstown, NY 12095. 1-518-762-3500. www.univarusa.com. A source for pesticides, Lo-Line sticky monitoring traps, Victor snap traps and more.

VICTOR PEST AND SAFER PEST CONTROL PRODUCTS. 1-800-800-1819. www.victorpest.com. Provides a full line of poison-free and low-risk pest management products. There is a search feature on pests, what they are, what diseases they may carry, and how to prevent infestations.

NOTE:
These suppliers are known to IPMI as providing high-quality products and services. There are hundreds of pest management product suppliers in the U.S. that may also provide high-quality products and services.

- Victor brand snap traps are the oldest manufactured traps, are widely available, and can be easily “fine-tuned” for reliable kills.
- Lo-Line monitoring (sticky) traps for crawling insects are the best designed, reliable products on the market to date.

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-122 November 2006

ON THE BACK COVER
William Floyd Estate Residence
Photograph by: Fernando Villalba, FIIS IPM Coordinator

National Park Service
U.S. Department of the Interior

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