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.

Bald Faced Hornet Nest

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.

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.

Yellowjacket & Underground Nest

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 Wasp

Cicada Killer with Cicada

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 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 Bee

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.

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.

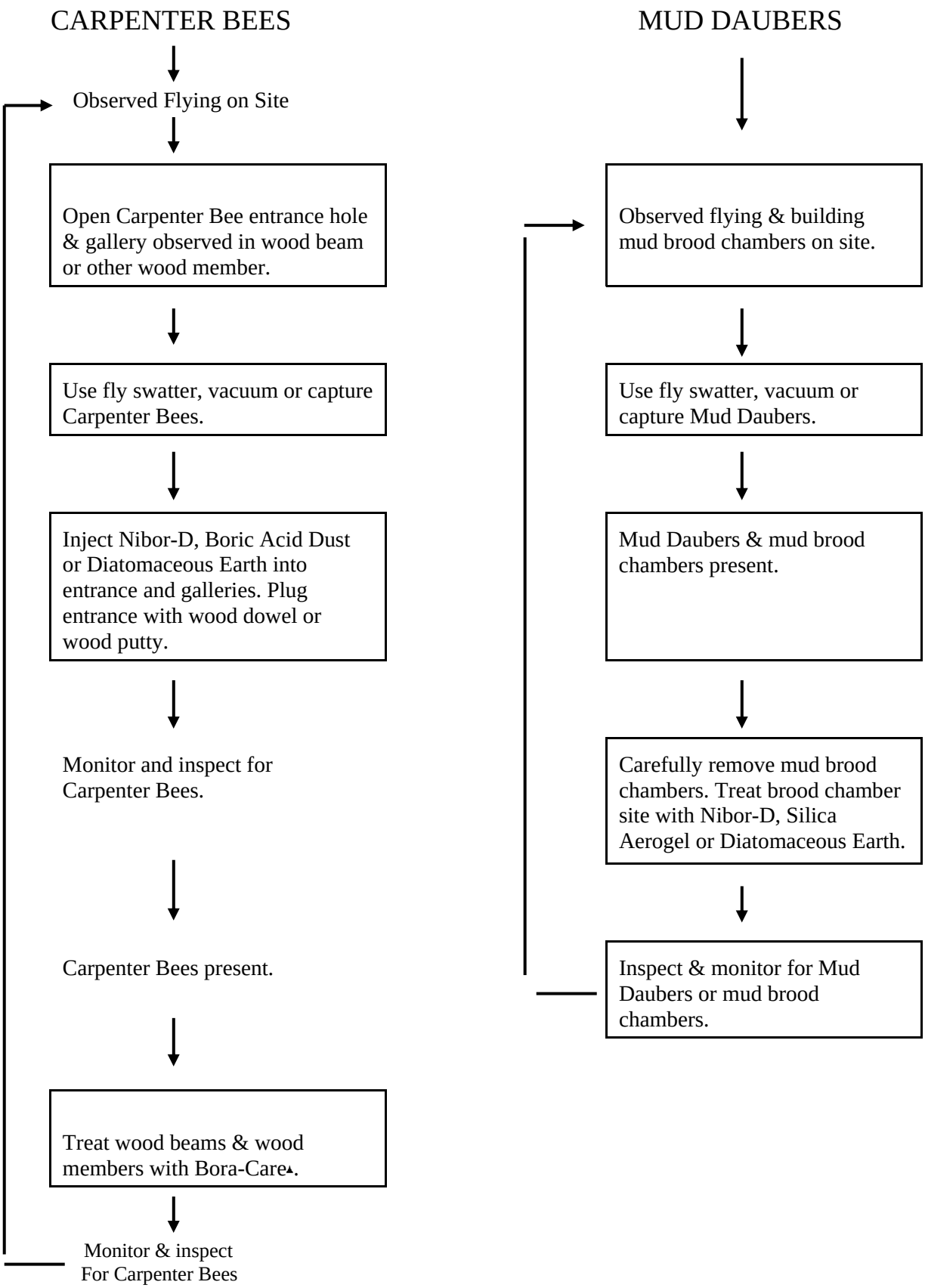
Applications shall be made according to National Park Service policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

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.

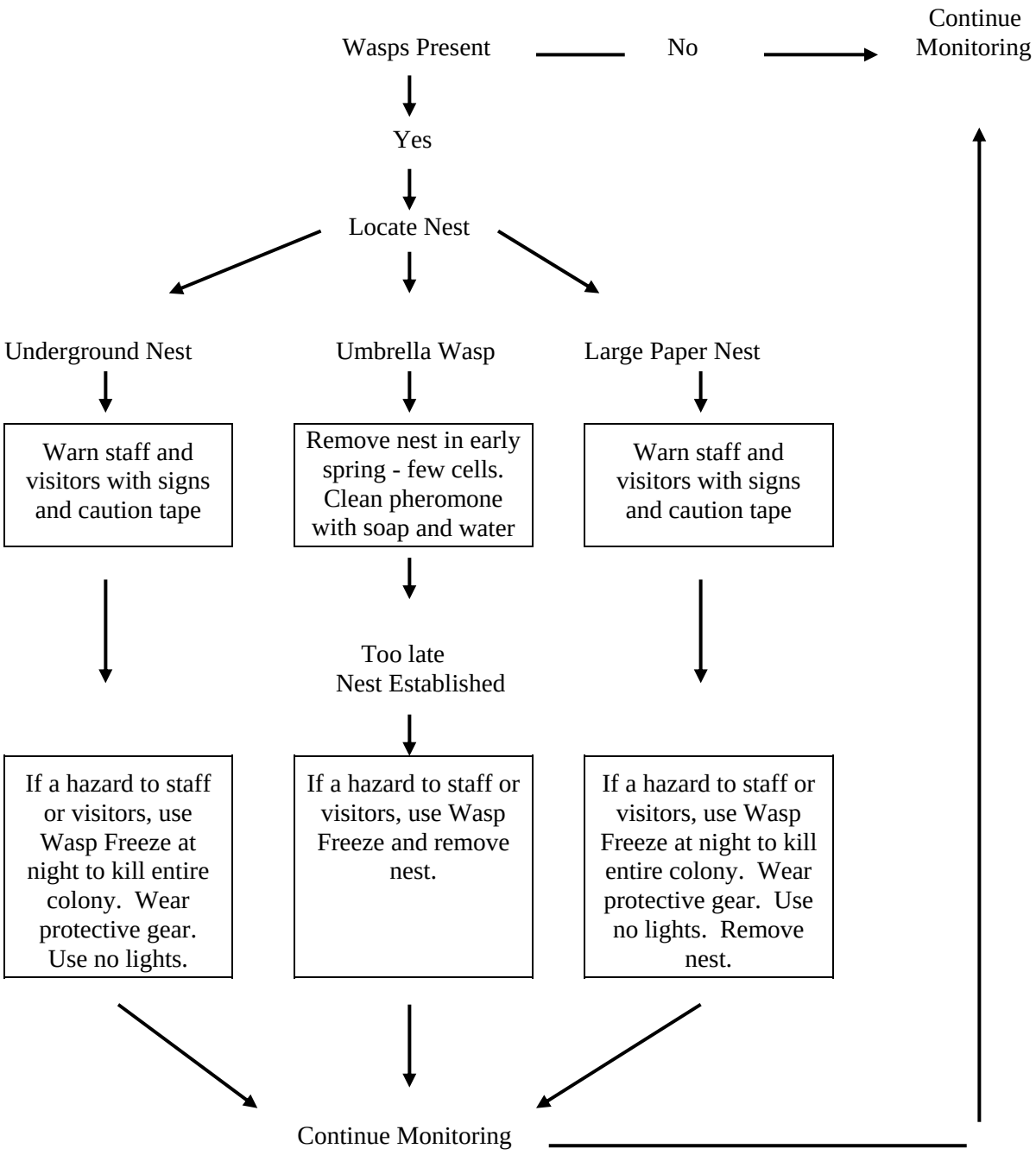
Aerosol Sprays for Aerial Nests
A number of commercial aerosol preparations are available that quickly and safely destroy aerial wasp and bee nests. Follow label directions.

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

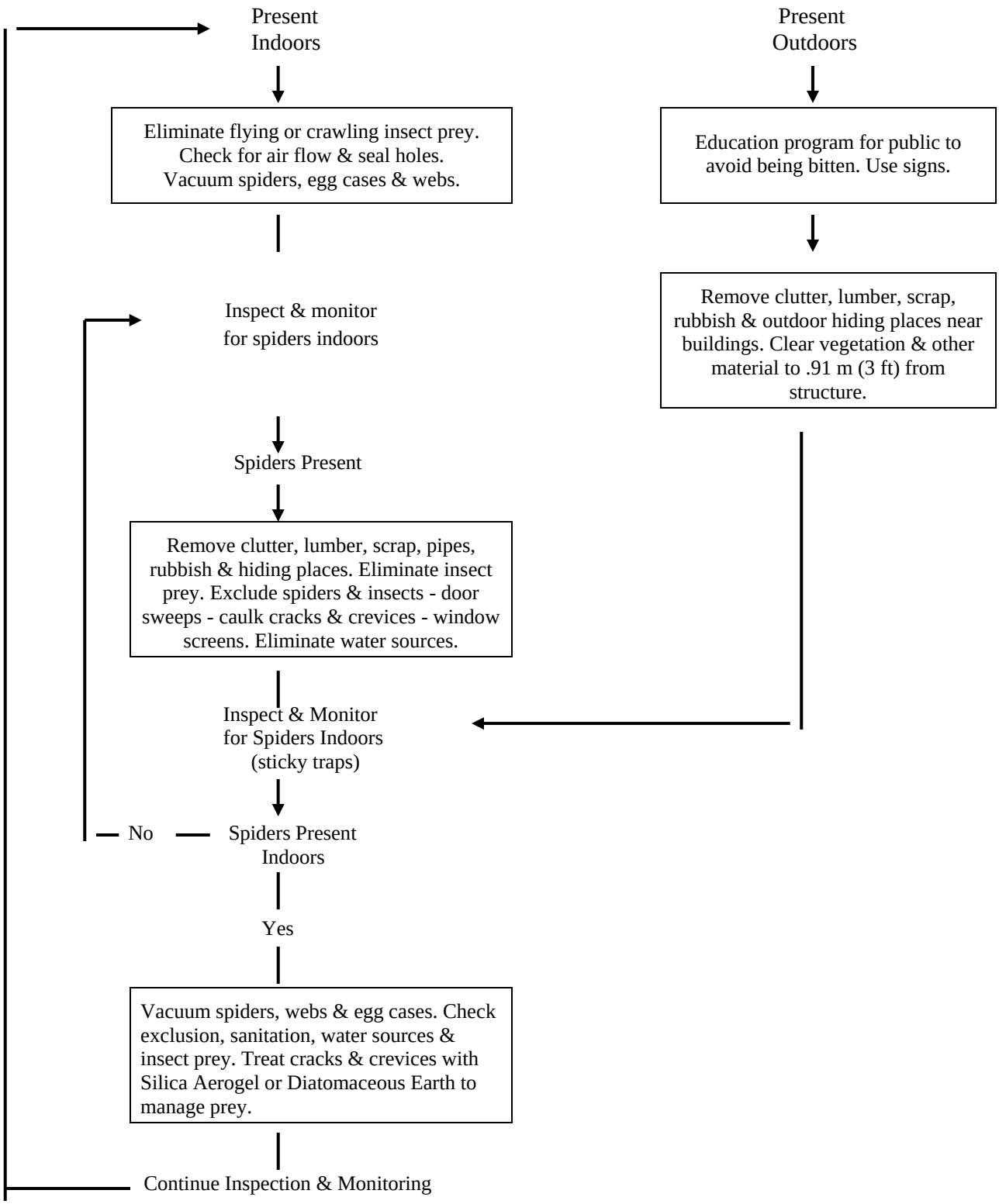
If necessary, use crack-and-crevice application dusts such as diatomaceous earth to treat the structure, including attic and crawlspace, window and door frames and casings, baseboards, cracks and crevices, room corners, beneath and behind furniture, closet bottoms, and garage in order to reduce insects 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.
Inspect & monitor for spiders indoors
Remove clutter, lumber, scrap, rubbish & outdoor hiding places near buildings. Clear vegetation & other material to .91 m (3 ft) from structure.
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 MORR. 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.

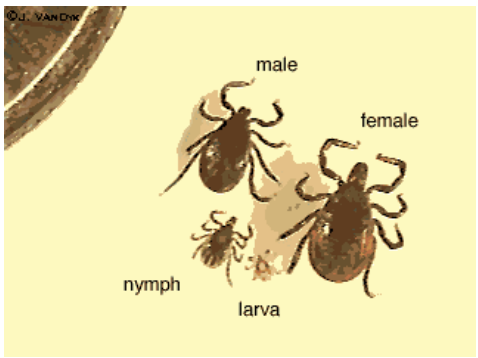
The adults, which are slightly over .3 cm (1/8 in) long, are found on dogs and people. The adult female is brown with a pearly light anterior dorsal shield. Males are brown-backed with pearly streaks. Both sexes have eyes, or unpigmented light-receiving areas, at the edges of the shield.

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.

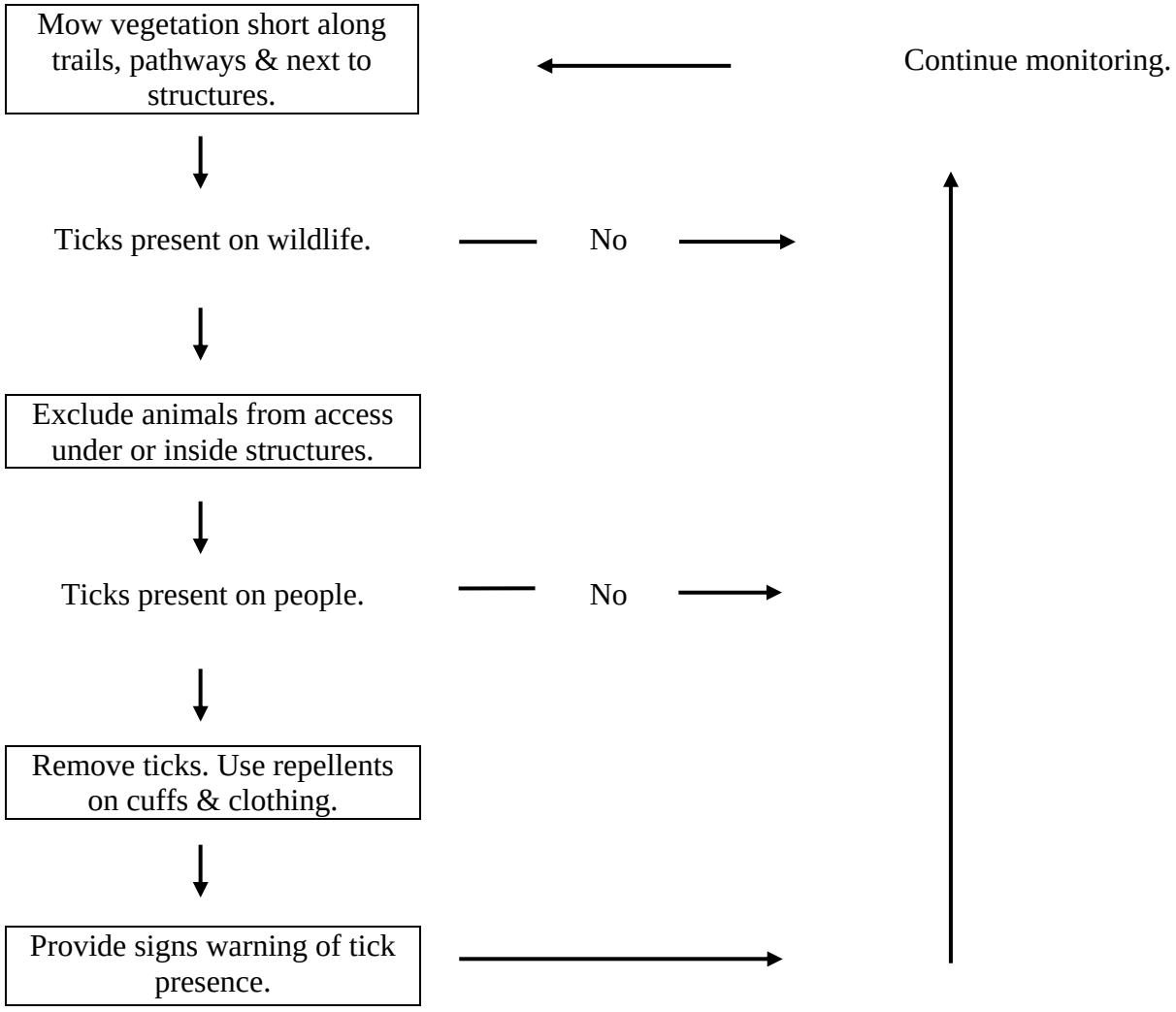
Precautions for At-Risk Group Members
Wear long pants tucked into socks while working or hiking in tick habitat. Use insect repellents on clothes and cuffs. Schedule regular body inspections for ticks at noon and at bedtime: Nymphal deer ticks are small, but they can be seen with close inspection. Larval 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.

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.

Mosquito Larvae & Pupae

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* Mosquito**

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.

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

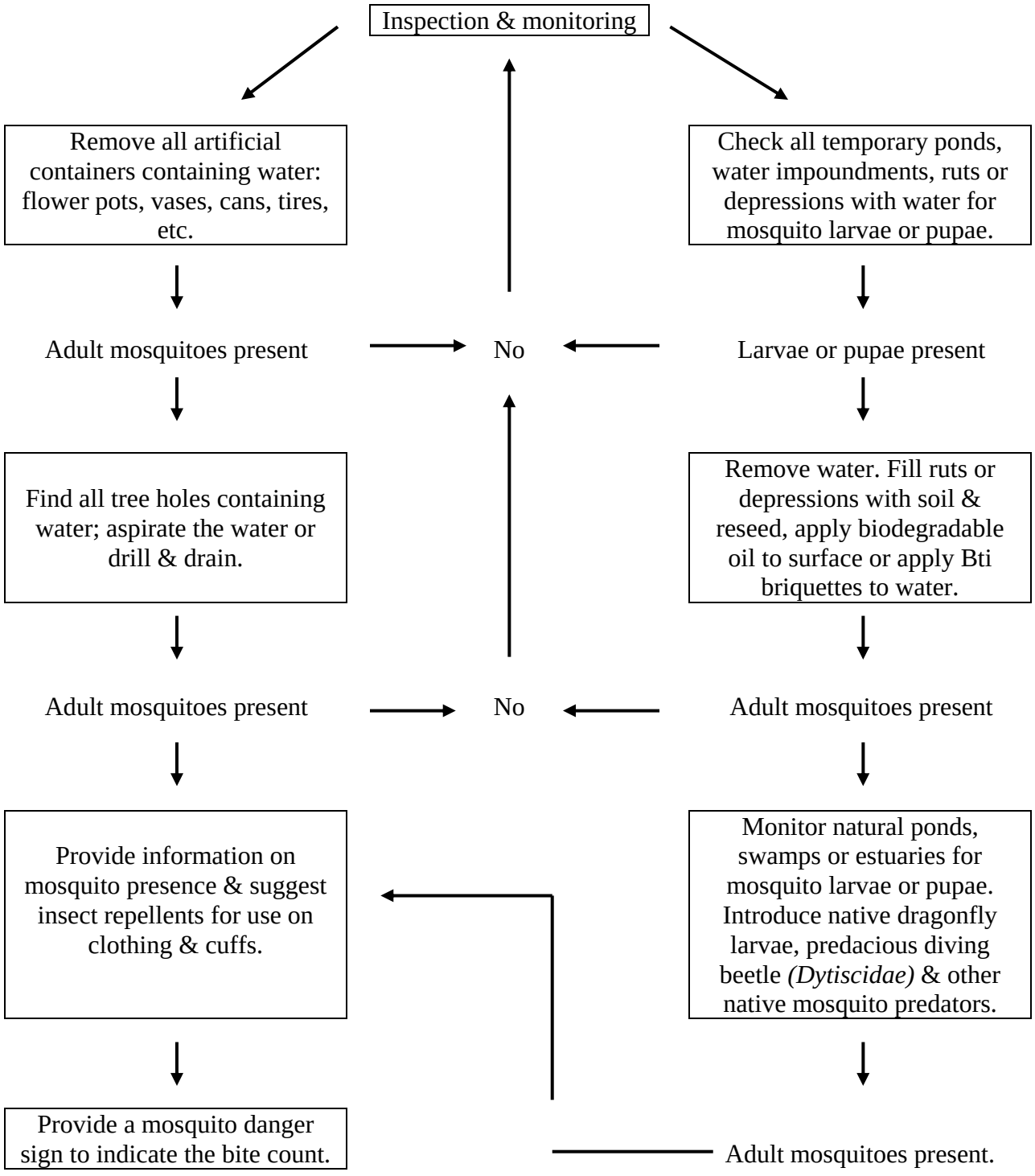
The best approach to managing mosquito populations is eliminating the larvae in their breeding habitat or the breeding habitat itself. A first step is not to keep water in pots, cans, or other containers. Often this just means letting plants dry out thoroughly between waterings. Major corrections may 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.