Integrated Pest Management Plan

Management Plan for the Responsible Control of household and other pests within National Parks

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1. INTRODUCTION AND BACKGROUND

1.1 PEST CONTROL: Aiming towards natural and barrier methods (mechanical control) as opposed to chemical control.

All chemicals that are artificially introduced into the natural environment may create an imbalance and have a negative effect on that environment. These effects can range from slight to catastrophic, but will be largely dependant on the type of chemical, the method of application and the dosage applied. Chemicals must be controlled and used in such a way as to impact as little as possible on the natural diversity and functioning of ecosystems.

1.2 WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read carefully and follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food and out of reach of children and unauthorized persons. Consult the pesticide label to determine active ingredients and signal words. Pesticides applied in your home and landscape can move and contaminate streams, lakes and rivers. Confine chemicals to the property being treated and never allow them to reach drainage areas. Do not place containers containing pesticide into the rubbish bin, down the sink, toilet or outside drain. Either use the pesticide according to the label until the container is empty, or take unwanted pesticide to a household hazardous waste collection site. Dispose of empty containers by following label directions. Never reuse or re-burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

2. TERMINOLOGY

Pest: Any organism occurring in unnaturally high numbers due to human development, that has a deleterious effect on the human population in terms of health and well being.

Pesticide: A species specific chemical component designed to combat a particular pest species that is deemed as having deleterious effects on the resident human population.

Herbicide: A chemical component designed to eliminate a specific type or species of vegetation.

Active ingredient: the chemical compound within the pesticide that produces the required

negative effect on the target species

Synergist: Substance added to pesticide in order to make the active ingredient more effective by performing a catalytic function.

Wetter (spreader): enables the chemical to stick evenly onto the target.

Coloring agent: used to discourage birds, animals and people from consuming the pesticide.

Bitter compound: prevents animals from swallowing the compound.

Carrying medium: usually inactive and wont have an effect on the pest.

Pesticide toxicity: All pesticides must be considered to be toxic. The relative toxicity, however, varies considerably as does the susceptibility of the human being, animal or plant. Species, age, sex, physical and nutritional state and type of formulation are some of the more important factors influencing the potential toxicity and hazard.

LD50: The toxicity of a chemical is expressed as an LD50 value. This is the lethal dosage expressed as mg per kg body mass which will kill 50 % of a random sample of a population of test animals (usually white laboratory rats). This standard makes comparison of toxicity possible. The potential hazard of a pesticide may not be judged only by it's oral toxicity, as many pesticides can be absorbed through the skin, eyes and or lungs.

Pesticide hazard: Both the concentration of a pesticide and it's formulation affect the hazard of a remedy. The higher the concentration of an active ingredient, the more hazardous it becomes. A pesticide formulated as a solution or as an emulsifiable concentrate, is more hazardous than when formulated as a dust or as a wettable powder.

Pesticide formulations: Nearly all pesticides have to be formulated in order to enhance their efficacy and to make them suitable for application in a particular manner. Sometimes certain materials such as sticking or wetting agents are added to increase the terminal effectiveness.

AE – Aerosol dispenser

AL – Other liquids to be applied

BB – Bait block

CB – Bait concentrate (solid or liquid for dilution before used as a bait)

CS – Capsule suspension (normally diluted in water)

DP – Dusting powder

EC – Emulsifiable concentrate (applied as liquid after dilution in water)

EW – Emulsion, oil in water (pesticide within oil droplets in water)

FD – Smoke tin

FK – Smoke candle

FT – Smoke tablet

FU – Smoke generator

GA – Gas

GB – Granular bait

GE – Gas generating product

GR – Granule

HN – Hot fogging concentrate

KN – Cold fogging concentrate

OL – Oil miscible liquid – dilute in an oil before application

PA – Paste (water based film forming)

SC – Suspension concentrate

SL – Soluble concentrate

SP – Water soluble powder

RB – Ready bait

TB – Tablet

UL – Ultra low volume liquid

VP – Vapor releasing product

WP – Wettable powder

First generation poison: A poison that will only affect the target species, in that it requires multiple feeds to be fatal.

Second generation poison: A poison that will have immediate deadly effects on the target population, as well as any predatory populations feeding on the dead target or other effected animals.

3. CHEMICAL CLASS OF ACTIVE INGREDIENT

Chemical class: Classification of chemicals based on the composition of the active ingredient.

3.1 **Organochlorine :** Eg. DDT. These compounds take a long time to decompose (eg. 8 tonnes of DDT will take 90 years to decompose). This means that the long-term effects are much worse than short-term effects, due to the buildup in the environment. All these products should be banned from use in terms of the environmental damage caused. Organochlorines should not be permitted for use in a National Park.

3.2 **Organophosphate:** These are acutely toxic in most cases, however, only to animals not plants. Organophosphates should not be permitted for use within a National Park.

3.3 **Pyrethroid:** These compounds are made from the carnation flower, by extracting pyrethrin from the oil. They are made in Kenya. They are mostly highly toxic to insects, fish and amphibians, but not so toxic to reptiles, birds and mammals. When used correctly, this is the least harmful class of all chemicals. When chemicals are used within a National Park, it is preferable that they are Pyrethroid in nature.

3.4 **Carbamate:** These compounds are medium in toxicity when compared to organophosphates but more toxic than pyrethroids. They do however break down rapidly (chemicals last 4 weeks indoors and only a few days outdoors) and are not very toxic to fish and amphibians. Carbamates should not be used in a National Park.

4. RESTRICTED USE OF CHEMICALS WITHIN A NATIONAL PARK

A management plan for the use of chemicals within National Parks was written by D.A. Zeller and L.E.O. Braak in January 1995. This document contained policies regarding the use of

chemicals within National Parks as well as list of restricted chemicals, prohibited chemicals and chemicals to be phased out. This list has since been updated by L. Foxcroft in January 2004. The new edition has one list of chemicals, for which the importation and use of within National Parks are strictly prohibited. A second list has been included outlining chemicals that are not recommended for use within National Parks, based on the chemical class of their active ingredients. Although the prohibited list has been part of the management plans since 1995, a large number of pesticides containing chemicals on these restricted and prohibited lists, are currently available and being sold within both staff and tourist retail outlets inside National Parks.

4.1 RATS AND MICE

4.1.1 General information

Rats and mice are mostly active at night. They have poor eyesight, but they make up for this with their keen senses of hearing, smell, taste and touch. Rats and mice constantly explore and learn about their environment memorizing the locations of pathways, obstacles, food and water, shelter and other elements in their domain. They quickly detect and tend to avoid new objects placed in a familiar environment. Thus, objects such as traps and baits are often avoided for several days or more following their initial placement. Mice and young rats can squeeze beneath a door with only 2cm gap. If the door is made of wood, rats may gnaw to enlarge the gap. Rats and mice eat a variety of foods including cereal grains, meats, fish, nuts, fruits, slugs and snails. When searching for food, rats and mice can travel up to 150m from their nests or burrows. Females can wean between 3 – 6 litters per year, each litter containing between 3 – 5 young. Rats consume and contaminate foodstuffs and damage storage containers. They can also cause damage by gnawing electrical wires and wooden structures.

4.1.2 Management

Three elements are necessary for a successful rat and mouse management program: sanitation, building construction and rodent proofing and, if necessary, population control.

4.1.2.1 Mechanical Control

4.1.2.1.1 Sanitation: Sanitation is fundamental to rat control and must be continuous. If sanitation measures are not properly maintained, the benefits of other

measures will be lost and rats will quickly return. Good housekeeping in and around buildings will reduce available shelter and food sources for rats and mice. Neat, off-the-ground storage of pipes, timber, crates, boxes, gardening equipment and household goods will help reduce the suitability of the area for rats and will also make their detection easier. Garbage and garden refuse should be collected frequently and all garbage containers should have tight fitting covers. Thinning dense vegetation will make the habitat less desirable including climbing hedges such as jasmine and ivy. Trees with branches hanging closer than 1m to the roof should be trimmed.

4.1.2.1.2 Building construction and rodent proofing*:* The most successful and long lasting form of rat control in buildings is to "build them out". Seal off cracks and openings in building foundations, and any openings for water pipes, electric wires, sewer pipes, drain spouts and vents. No hole larger than 7mm should be left unsealed. Make sure doors, windows and screens fit tightly. Their edges can be covered with sheet material if gnawing is a problem. Coarse steel wool, wire screen and lightweight sheet material are excellent materials for plugging gaps and holes. Plastic sheeting, wood, caulking and other less sturdy materials are likely to be gnawed away. Because rats and house mice are good climbers, openings above ground level must all be plugged, especially all access points in the roof. Chimneys should be covered with wire netting or gauze to prevent rat and mice entry. Check all screens on windows, doors, and air vents are in good condition. Make sure all exterior doors are tight fitting and weatherproofed at the bottom.

4.1.2.1.3 Trapping: This is the safest and most effective way of controlling rats in and around homes. Traps can be used more than once therefore it is a cost effective but more labor-intensive method. The kind of bait used for the trap is important. Dried fruit or bacon makes excellent bait for rats. The bait should be fastened securely to the trigger of the trap with a light string or bit of glue. Soft baits such as peanut butter or cheese can also be used, but rats sometimes take soft baits without setting off the trap. Leaving traps baited but unset until the bait has been taken at least once improves trapping success by making the rodents more accustomed to the traps. Set traps so the trigger is sensitive and will spring easily. The best places to set traps are in secluded areas where rats are likely to travel and seek shelter. Droppings, gnawing and damage indicate the presence of rodents and

areas where such evidence is found are usually the best places to set traps, especially when these areas are located between their nests and food sources. Place traps in natural traveling paths such as along a wall, so the rodents will pass directly over the trigger of the trap. Position traps along a wall at right angles, with the trigger end nearly touching the wall. If traps are set parallel to the wall, they should be set in pairs to intercept rodents traveling from either direction. If a rat sets of a trap without getting caught, it will be very difficult to catch the rat with the trap again. Other good places for traps are behind objects, in dark corners, on ledges, shelves, branches, fences, pipes or overhead beams. In overhead places, the traps should be attached securely with screws or wire. In areas where children or birds and other animals might contact traps, place the trap in a box or use a barrier to keep them away. Use as many traps as are practical so trapping time will be short and decisive. A dozen or more traps for a heavily infested home may be necessary. Place rat traps about 5-10 meters apart. Dispose of dead rats by burying them. Do not touch the dead rodent with bare hands and wash thoroughly after handling traps. Live traps are not recommended because trapped rats must either be killed or released elsewhere. Releasing rat's outdoors is not recommended because of health concerns.

4.1.3 Chemical control

While trapping is generally recommended for controlling rats indoors, when the number of rats around a building is high, it may be necessary to use toxic baits to achieve adequate control, especially if there is a continuous infestation from surrounding areas. Most toxic baits for rodents contain active ingredients that work as an anticoagulant, causing death by internal bleeding. Most anticoagulant baits have been considered as relatively safe baits to use around the house and garden because they require multiple feedings to be effective. This is referred to as a first generation poison, as only the target animal will be killed. Some of the more lethal rodent poisons that are prohibited for use in a National Park, contain a single feed, second generation poison, that will result in death to anything that eats the poison directly from the baits, or indirectly, by eating the dead rodents (eg. Predators including owls, genets etc.). Rodent bait should only be used, when placed in a bait station (Rodent bait station made by Bayer). These bait stations protect the bait from weather and restrict accessibility to rodents, providing a safeguard for people and other animals. Place bait stations next to walls or in places where rats will encounter

them. Stations that may be accessible to children must be made of sturdy, tamper resistant material and be secured in a way that they cannot be tipped. All bait stations should be clearly labelled. The use of bait stations help rats to feel secure when feeding. Place all bait stations in rat travel-ways or near their burrows. Do not expect rats to go out of their way to find the bait. If you place bait stations above the ground (on fences, eves), make sure they are securely fastened, and wont fall onto the floor where children may find them. Because rats are often suspicious of new or unfamiliar objects, it may take several days for them to enter and feed in bait stations. For best results, make sure there is a continuous supply of bait until feeding stops. It usually takes 5 days or more once the rats start feeding for them to succumb. During the baiting process, dispose of dead rodents by burying them, or placing them in a marked plastic bag, and putting them in the rubbish for incineration at the dump. Use gloves and wash hands thoroughly after handling dead rodents, traps or bait stations. Additionally, poisoned rats often die in inaccessible locations within a building, leading to persistent and unpleasant odors, so rodent proof the building before you use toxic baits outside. A successful bait formula that can be administered in a Bayer Rodent Bait station can be made up as follows: Dilute 1 part ***Racumin*** (made by Bayer) in 30-40 parts water (8g/l). Dilute 1litre of lecol pinenut with 7 litres of water, and add 40ml of Racumin. Keep this available for 16 days and refill as required. This is a first generation poison, so animals need multiple feeds to die. It will therefore not affect predators feeding on them. Rats drink every 24 hours, therefore bait after dark, in secluded spots to minimize contaminating other small animals. Remove bait stations during the day.

4.2 COCKROACHES

4.2.1 General information

Cockroaches may become pests in any structure that has food preparation or storage areas. They contaminate food and eating utensils, destroy fabric and paper products, and impart stains and unpleasant odors to surfaces they contact. They may transmit bacteria that cause food poisoning. The skin shed by cockroaches may cause asthma in children if inhaled. In South Africa, the exotic German cockroach is the main pest. Cockroaches are common in kitchens and bathrooms because they favor warm, humid areas that are close to food and water. The German cockroaches are the fastest reproducing of all the pest cockroaches and a single female and her offspring can produce over 30,000 individuals in a year. Egg laying occurs more frequently during warm weather. The female carries around a light tan egg case

(6mm long) for about 28 days (1-2 days before the eggs hatch), when she drops it. Each case contains about 30 young and a female may produce a new egg case every few weeks. Young or immature cockroaches undergo gradual metamorphosis resembling the adult visually and in feeding habits, but do not have fully developed wings and are not reproductively active. Cockroaches are white after molting, but their outer covering thickens and darkens as it hardens within hours. Cockroaches are nocturnal; hiding in dark, warm areas especially narrow spaces where surfaces touch them on both sides.

4.2.2 Management

Cockroaches are tropical and like warm hiding places with access to water. If cockroaches have access to food, baits will have limited effect. Sprays lone will also not be effective against cockroaches. An integrated approach is required. The keys to controlling cockroaches are sanitation and exclusion: cockroaches will continue to re-invade as long as the habitat is suitable for them (i.e. available food, water and shelter). In addition to sanitation and exclusion, baits can be effective. Sprays or dusts that are registered for use on cockroaches may temporarily suppress populations, but they do not provide long-term solutions.

4.2.2.1 Mechanical control

Sanitation: Cockroaches thrive where food and water are available to them. Even tiny amounts of crumbs or liquids caught between cracks provide a food source

Important sanitation measures include:

- Store food in insect-proof containers such as glass jars or sealed plastic containers
- Keep rubbish in containers with tight fitting lids. Remove rubbish, newspapers, magazines, piles of paper bags, rags, boxes and other items that provide hiding places. Do not store rubbish indoors or close to the house.
- Eliminate plumbing leaks and correct other sources of free moisture. In crease ventilation where condensation is a problem.
- Vacuum cracks and crevices to remove food and debris. Be sure surfaces where food or beverages have been spilled are cleaned up immediately.

Vacuuming also removes cockroaches, shed skins and egg capsules. Removing cockroaches reduces their numbers and slows development.

- Trim shrubbery around buildings to increase light and air circulation, especially near vents, and eliminate ivy or other dense ground covers near the house as these may harbor cockroaches.

- Remove trash and stored items such as piles of wood that provide hiding places for cockroaches from around the outside of buildings.

Exclusion and removal of hiding places: During the day, cockroaches hide in cupboard cracks, stoves, crawl spaces, outdoor vegetation and many other locations. They invade kitchens at night. Limiting hiding areas or avenues of access to living areas is an essential part of an effective management strategy. False-bottom cupboards, hollow walls and similar areas are common cockroach refuges. Prevent access to the inside of buildings through cracks, conduits, under doors of through other structural flaws:

- Seal cracks and other openings to the outside

- Look for other methods of entry such as from items being brought into the building, especially appliances, furniture and items that have been in storage.

- Look for egg sacs glued to undersides of furniture, in refrigerator and other appliance motors, boxes and other items. Remove and destroy any that are located.

- Locate and seal cracks inside the treatment area where cockroaches can hide.

4.2.2.2 **Chemical control**

Insecticides are most effective in controlling cockroaches when combined with sanitation and exclusion practices that limit the cockroaches ability to establish or re-invade; **chemical control alone will not solve the problem.** If insecticides are used, they must always be used with extreme care. Indoor chemical control is warranted only in the cockroach population is established but not for an incidental intruder or two.

4.2.2.2.1 ***Fendona*** (Made by Cyanamid, active ingredient = Alpha-cypermethrin) should be diluted at the specified rate, and sprayed onto surfaces frequented by cockroaches. Use a higher rate for longer residual action or where infestation is severe. Repeat when necessary.

4.2.2.2.2 ***Staryside*** (made by Bayer, active ingredient = Triflumuron) should be diluted at 10ml per 10l, and applied simultaneously (in the same sprayer) with the adult treatment. In summer, it can be effective for up to 3 months, and in winter, up to 6 months.

4.2.2.2.3 ***Premise cockroach bait gel*** (made by Bayer, active ingredient = imidacloprid). Use in pistol gun, apply in small cracks and holes. Very effective and long lasting. Most insecticides used in baits are slow-acting; cockroaches quickly learn to avoid fast acting ones.

Consequently, an effective bait program does not give immediate results, but may take 7 days or longer. Baits can be quite effective for long-term control of cockroaches unless the cockroaches have other food sources available to them. Baits to not control all cockroaches equally. Female cockroaches with egg cases do very little feeding and avoid open spaces; consequently they are less likely to be immediately affected by bait. Baits do not attract cockroaches, so place them near hiding places or where cockroaches are likely to encounter them while foraging. Bait can also be placed near to fecal specks and droppings of cockroaches, which contain a natural aggregation pheromone. Look for these fecal specks and droppings under kitchen counters, behind kitchen drawers and in the back on cabinets. The German cockroach has developed resistance (or tolerance) to many insecticides used for their control. If cockroaches seem to be unaffected a day after the application of the spray, a different material or strategy may be required. After a cockroach control program has been started, evaluate the effectiveness visually. If populations persist, re-evaluate the situation. Look for other sources of infestation, making sure all possible entryways are blocked, be certain that food and water sources are eliminated as much as possible, and continue sealing and eliminating hiding places. When populations are

under control, continue monitoring on a regular basis to make sure re-infestation is not taking place. Maintain sanitation and exclusion techniques to avoid encouraging a new infestation. If severe re infestations continue to occur, consider having the infested area modified or remodeled to reduce the amount of suitable habitat for cockroaches.

4.3 FISH MOTHS

4.3.1 General information

Fish moths hide during the day, but are active at night looking for food and water. Fish moths eat cereals, moist wheat flour, books, paper on which there is glue or paste, wall paper, bookbindings and starch in clothing. They can live for several months without food. Fish moths live and develop in damp cool places particularly in basements and laundry rooms.

4.3.2 Management

4.3.2.1 Mechanical control

To keep fish moths away, keep basements, laundry rooms and bathrooms (especially shower stalls) clean and dry. Plug or putty holes or spaces around pipes. Repair leaks and drips in plumbing. Clean out closets periodically. Collections of magazines, papers and books provide food for them. Move books around in bookcases occasionally. Keep foods in containers with tight lids.

4.3.2.2 Chemical control

Fish moths can be controlled using the same chemicals used to control cockroaches. A properly and thoroughly applied insecticide will show results in a few weeks. If control is not achieved in 2 or 3 weeks, fish moths are probably coming from untreated areas. Seek these areas out for treatment and also eliminate water sources. Large populations of fish moths cannot be controlled unless their water sources are eliminated. Chemical control advised for cockroaches will also work on fish moths, no additional pesticides are necessary.

4.4 BEDBUGS

4.4.1 General information

Female bedbugs lay from 200-500 eggs (in batches of 10 – 50) on rough surfaces such as wood or paper. Eggs are covered in a glue and hatch in about 10 days. There are 5 progressively larger nymph stages each requiring a single blood meal before molting to the next stage. The entire life cycle from egg to adult requires anywhere from 5 weeks to 4 months, depending on temperature. Nymphs and adults generally feed at night and hide in crevices during the day. Common hiding places include seams in mattresses and box springs, cracks in bed frames, under loose wallpaper, behind picture frames and inside furniture and upholstery. Bed bugs can go without feeding for 80-140 days; older stages can survive longer without feeding than younger ones. Adults have survived without food for as long as 550 days. A bed bug can take 6 times it's weight in blood and feeding can take 3 – 10 minutes. Adults live about 10 months and there can be 3-4 generations of bed bugs per year. In addition to leaving a bite wound on their hosts, bed bugs have stink glands that leave odors; they also leave fecal spots on bed sheets and around their hiding places.

4.4.2 Management

Infestations of bed bugs can be detected by looking for their fecal spots, egg cases and shed skins under wallpaper, behind picture frames, and inside cracks and crevices near beds.

4.4.2.1 Mechanical control

Indirect measures can go a long way in controlling bed bugs: keep bats and birds away from houses; clean furnishings, launder bedding and mattress pads and stem-clean mattresses; and prevent bed bugs from getting into homes by removing debris from around the house, repairing cracks in walls, and caulking windows and doors. Simple physical control methods include standing the legs of beds in soapy water, coating the legs with petroleum jelly or double-sided sticky tape. Bed bugs cannot climb polished glass or metal easily and they don't fly. Legs of beds can also be placed inside glass jars or metal cans. Heating to 50 degrees C, or freezing to below 0 will kill most bed bugs.

4.4.2.2 Chemical control

Doom dual Action Fogger Insecticide (made by Robertsons homecare, and

contains pyrethroid active ingredients) lasts for about 6 months. Also kills adult cockroaches. Ignite and let smolder for 2-3 hours.

4.5 TERMITES

4.5.1 General information

Termites are small white, tan or black insects that can cause severe destruction to wooden structures. They belong to the insect order Isoptera, dating back more than 100 million years. Although many people think termites have only negative impacts, in nature they make positive contributions to the world's ecosystems. Their greatest contribution is the role they play in recycling wood and plant material. Their tunneling efforts also help to ensure that soil are porous, contain nutrients and are healthy enough to support plant growth. Termites are very important in the Sahara desert where their activity helps to reclaim soils damaged by drying heat and wind and overgrazing by livestock. Termites have become a problem where they consume structural timber. Termites may also damage utility poles, food, books and household furniture. Termites are social and can form large nests or colonies consisting of very different looking individuals (castes). Physically, the largest individual is the queen. Her function is to lay eggs, sometimes thousands in a single day. A king is always at her side. Other individuals have large heads with powerful jaws, or a bulblike head that squirts liquid. These individuals are called soldiers. The largest groups of termites in a colony are the workers. They work long hours tending to the queen, building the nest or gathering food. While other species of social insects have workers, termites are unique in that they have both male and female workers. Termites can be long-lived: queens and kings can live for decades while individual workers can survive several years.

4.5.2 Management

Successful termite management requires special skills including a working knowledge of building construction and an understanding of termite biology. An integrated program is required to manage termites. Combine methods such as modifying habitats, excluding termites from the building by physical and chemical means, and using mechanical and chemical means to destroy existing colonies.

4.5.2.1 **Inspection***:* Before beginning a control program, thoroughly inspect the building. Verify that there are termites, identify them, and assess the extent of

their infestation and damage. Look for conditions in and around buildings that promote termite attack, such as excessive moisture or wood in contact with the soil.

4.5.2.2 **Mechanical control**

Prevention*:* Building design may contribute to termite invasion. Keep all substructural wood at least 30 cm above the soil beneath the building. Alternatively, sink subterranean wood in concrete as a barrier against termites. Identify and correct other structural deficiencies that attract or promote termite infestations. Keep foundation areas well ventilated and dry. Reduce chances of infestation by removing or protecting any wood in contact with the soil. Look for and remove tree stumps, stored wood, untreated fence posts and buried scrap wood near the structure that may attract termites. Foundation sand barriers can be used for subterranean termite control. Sand with particle size in the range of 10-16 mesh, is used to replace soil around the foundation of a building. Subterranean termites are unable to construct their tunnels through the sand and therefore cannot invade wooden structures resting on the foundation.

4.5.2.3 **Chemical control**

4.5.2.3.1 *Pre-infection treatment of wood:* Wood used in foundations and other wood in contact with the soil may be chemically treated to help protect against termite damage in areas where building designs cannot be altered or concrete or sand cannot be used. Treated wood is toxic to termites and discourages new kings and queens from establishing colonies in it. If susceptible wood is used above the treated wood, subterranean termites can build their shelter tubes over chemically treated wood and infest untreated wood above. Use only “exterior grade” treated wood for areas that are exposed to weather; otherwise the chemical that is in the wood may leach from the wood. All topical (applied to wood by painting on) treatments that will be exposed to weather must also have a sealer coat to prevent leaching into the soil following rain. Also, **because they contain pesticides, disposal of treated wood requires special handling**. **CCA** (chromated copper arsenate) can be used to treat wood prior to construction. It gives the wood a green tint. Although this is a natural poison, it will not leach much into the soil. **Creosote** is a natural treatment. Wood can be soaked in a hot bath (almost boiling) of creosote until it has

penetrated 1/3 of the way into the wood.

4.5.2.3.2 *Post-infection treatment of wood:* Subterranean termites in structures cannot be adequately controlled by fumigation, heat treatment or freezing because the reproductives or nymphs are concentrated below ground level in structures out of reach of these control measures. The primary methods of controlling these termites are the application of insecticides. Treating infested wood in a structure requires drilling and injecting chemicals into the wood to reach the colony. Alternatively, the infested wood can be sprayed liberally with the insecticide (**Premise**). Spray wood at least 1 m above ground level, and spray the soil all around the infected wooded structure. Use of insecticides should be supplemented with the destruction of their access points or nests. To facilitate control of subterranean termites, destroy their shelter tubes whenever possible to interrupt access to wooden substructures and to open colonies to attack from natural enemies such as ants.

4.5.2.3.3 *Treatment of soil*: Insecticides are applied to the soil either in drenches or by injection. Special hazards are involved when applying insecticides to the soil around and under buildings. Applications in the wrong place can cause insecticide contamination of plumbing used for water under the treated building. Soil type, weather and application techniques influence the mobility of insecticides in the soil. Soil applied insecticides must not leach through the soil profile to contaminate groundwater. **Premise** (made by Bayer) is effective in combating subterranean termites. It is expensive, but very concentrated and long lasting. One application should be effective for up to 6 years. Dilute as specified (350g/l) and apply in a trench around the building along foundations (6 x 6 inches wide). For existing buildings, apply 3 – 6 l per linear meter (trench treatment). Where possible, treat similarly treat inside along outer foundation walls (suspended floors), of, if impossible, (solid floors), drill through floor adjacent to our foundation walls, flood soil below by injecting emulsion through holes and seal. Ensure that soil along the whole length of the foundation walls, is thoroughly treated. For new buildings, prior to construction, apply as an overall drench to soil under floor area at 5l per square meter. Use higher rate on heavy (clay eg. basalt) soils. Apply to bottom of foundation and service trenches, and to soil on both sides of outer foundation walls at 6l per linear meter (trench treatment). For infested wooden structures, apply Premise in a spray (mix

as above) liberally to the infested wood, and surrounding soil.

4.6 ANTS

4.6.1 General information

Ants are among the most prevalent pests in the household. They are found in any environment where they have food and water. Once ants have established a colony inside or near a building, they may be difficult to control. On outdoor (and sometimes indoor) plants, ants protect and care for honeydew-producing insects such as aphids, increasing damage from these pests. Ants also perform many useful functions in the environment, such as feeding on other pests (eg. Fleas, caterpillars and termites), dead insects, and decomposing tissue from dead animals. Ants are close relatives of bees and wasps, and are often confused with termites. Three main characteristics distinguish ants from termites:

- The ant's abdomen is constricted where it joins the thorax, giving it the appearance of having a thin waist; the termites abdomen is broad where it joins the thorax.
- The ant's hind wings are smaller than it's front wings; the termites front and hind wings are about the same size (shortly after their flights to find new colonies, both ants and termites remove their wings so wings may not always be present).
- Winged female ants and worker ants have elbowed antennae; the termite's antennae are never elbowed.

Ants undergo complete metamorphosis, passing through egg, larval, pupal and adult stages. Larvae are immobile and wormlike and do not resemble adults. Ants are social insects with duties divided among different types or castes of adult individuals. Queens conduct the reproductive functions of a colony and are larger than any other ants: they lay eggs and sometimes participate in the feeding and grooming of larvae. Female workers, who are sterile, gather food, feed and care for the larvae, build tunnels and defend the colony; these workers make up the bulk of the colony. Males do not participate in colony activities; their only apparent purpose is to mate with the queens. Few in number, the males are fed and cared for by the workers. Inside a building,

household ants feed on sugars, syrups, honey, fruit juice, fats and meats. Long trails of thousands of ants may lead from nests to food sources, causing considerable concern among building occupants. Outdoors they are attracted to sweet, sticky secretions, or honeydew, produced by aphids. Ant usually nest in soil; nests are often found next to buildings, along sidewalks, or in close proximity to food sources such as trees and plants that harbour honeydew producing insects. They also construct nests under boards, stones, tree stumps or plants, and sometimes under buildings or other protected places. Ants enter buildings seeking food and water, warmth and shelter, or a refuge from dry, hot weather or flooded conditions. They may appear suddenly in buildings of other food sources become unavailable or weather conditions change. A new colony is typically established by a single newly mated queen. After weeks or months of confinement underground, she lays her first eggs. After the eggs hatch, she feeds the white, legless larvae with her own metabolized wing muscles and fat bodies until they pupate. Several weeks later the pupae transform into sterile female adult workers, and the first workers dig their way out of the nest to collect food for themselves, for the queen (who continues to lay eggs) and for subsequent broods of larvae. As numbers increase, new chambers and galleries are added to the nest. After a few years, the colony begins to produce winged male and female ants, which leave the nest to mate and form new colonies.

4.6.2 Management

Ant management requires diligent efforts and the combined use of mechanical, cultural, sanitation and sometimes chemical methods of control. It is unrealistic and impractical to attempt to totally eliminate ants from an outdoor area. Focus your management efforts on excluding ants from buildings and eliminating their food and water sources. Become aware of the seasonal cycle of ants in your area and be prepared for annual invasions by sealing the building in time.

4.6.2.1 Mechanical control

Exclusion and sanitation: To keep ants out of buildings, seal cracks and crevices around foundations that provide entry from the outside, using silicon. Ants prefer to make trails along structural elements, such as wires or pipes, and frequently use them to enter and travel within a structure to their destination.

Indoors, eliminate cracks and crevices wherever possible especially in kitchens and other food preparation and storage areas. Store attractive food items such as sugar, syrup, honey and other sweets in closed containers that have been washed to remove residues from outer surfaces. Rinse out empty soft drink containers and remove them from the building. Thoroughly clean up grease and spills. Do not store rubbish indoors. Look for indoor nesting sites such as potted plants. If ants are found, remove containers from the building and submerge the pot for 20 minutes in standing water that contains a few droplets of liquid soap. Ant nests may be associated with plants that support large populations of honeydewproducing insects. Avoid planting such trees and shrubs near to buildings.

4.6.2.2 **Chemical control**

Coopex ant dust (made by AgrEvo) is the only chemical that is legal to use against ants in National Parks. Dust freely along runs and around nests, repeating where necessary. ***Fendona*** (see cockroach control) is also an effective and approved chemical used in ant control. **This however, is for use on man-made structures only, not for application to vegetation/in gardens etc**.

4.7 BEES

Bees play a vital role in the functioning of the ecosystem.

4.7.1 Management

4.7.1.1 **Mechanical control**

Bees can be smoked out in most cases. Once the bees have been removed, (either by smoke or pesticide), ***Coltar*** (carbolic acid) can be sprayed onto the area to get rid of the smell of the pheromones. If not removed, the pheromones could attract the bees back to the same place. ***Jays fluid*** can be applied to the area after the Coltar to further clean it. These can then be washed off using soapy water. **Brown vinegar** is a bee repellent. Once bees have been removed, it can be applied directly to the area. Pieces of cloth swabbed in brown vinegar can be left in the area to repel the bees.

4.7.1.2 **Chemical control**

It not policy for pesticides to be used to remove bees from any man-made

structure except in extreme circumstances. If the bees are posing a threat to humans and the option of smoking them out is not viable, the pesticide *Raidyard* can be used to kill the bees. This can be sprayed from 6m away to avoid danger to the person applying the pesticide. *Permethrin* spray is also a good repellant, and can be sprayed on the cleaned area to repel the bees from re-occupying the space.

4.8 SPIDERS

4.8.1 General information

Unlike mosquitoes, spiders do not seek people in order to bite them. Generally a spider doesn't try to bite a person unless it is being squeezed, lain on or simply provoked to defend it's self. Moreover, the jaws of most spiders are so small that the fangs cannot penetrate the skin of an adult person. Sometimes when a spider is disturbed in it's web, it may bite instinctively because it mistakenly senses an insect has been caught. Spiders are primarily beneficial and their activities should be encouraged in the garden. Pesticide control is difficult and rarely necessary. The best approach to controlling spiders in and around the home is to remove hiding spots for reclusive spiders and regularly clean webs off the house with brushes and vacuums.

4.8.2 Management

4.8.2.1 Mechanical control

Spiders may enter houses and other buildings through cracks and openings. They may also be carried in on plants, wood and boxes. Regular vacuuming or sweeping of windows, corners of rooms, storage areas and basements and other seldom used areas helps remove spiders and their webs. Vacuuming spiders can be an effective control technique because their soft bodies usually do not survive this process. Indoors, a web on which dust has gathered is an old web that is no longer being used by a spider. Individual spiders can also be removed from indoor areas by placing a jar over them and slipping a piece of paper under the jar that then seals off the opening of the jar when it is lifted up. To prevent spiders from coming indoors, seal crack in the foundation and other parts of the structure and gaps around windows and doors. Good screening will keep out spiders but will also keep out the insects that attract the spiders in the first place. In indoor storage spaces, place boxes off the floor and away from

walls, where possible, to help reduce their usefulness as a harborage for spiders. Sealing the boxes with tape will prevent spiders from taking up residence within. Clean up clutter in garages, sheds, basements and other storage areas. Outdoors, eliminate places for spiders to hid and build their webs be keeping the area next to the foundation free of trash, leaf litter, heavy vegetation and other accumulations of materials. Trimming plant growth away from buildings will discourage spiders from first taking up residence near the structure and then moving indoors. Outdoor lighting attracts insects, which in turn attracts spiders. If possible, keep lighting fixtures off structures and away from windows and doorways. Sweep, mop, hose and vacuum spiders and webs off buildings regularly.

4.8.2.2 Chemical control

Insecticides will not provide long-term control and should not generally be used against spiders. Pesticide control of spiders is difficult unless you actually see the spider and are able to spray it. If you spray a spider, it will be killed only if the spray lands directly on it; the spray residual does not have a long-lasting effect. This means a spider can walk over a sprayed surface a few hours after treatment and not be effected. Control by spraying is only temporary if not accompanied by housekeeping. It is just as easy and much less toxic to catch and remove the spider from the building, or to simply vacuum it up.

4.9 SCORPIONS

4.9.1 General information

Scorpions are nocturnal, predatory animals that feed on a variety of insects, spiders and centipedes. Although they have two eyes in the center of the head and usually from two to five more along the margin on each side, they do not see well and depend on touch. Scorpions that hide under stones and other objects during the day tend to carry their stinger to one side, whereas burrowing scorpions hold their stinger up over their backs. Scorpions grow slowly. Depending on the species, they may take between 1-6 years to reach maturity. On average, scorpions may live 3-5 years, but some species can live as long as 10 – 15 years. Scorpions have an interesting mating ritual that may last several hours, with the male grasping the females pincers in his and leads her in a courtship dance. The male then deposits a sperm packet and maneuvers the female over it. The sperm packet is drawn into the females opening located near the front on the underside of her abdomen. The female stores

the sperm packet, and the sperm is later used to fertilize the eggs. After mating, unless he is quick and able to escape, the male is often eaten by the female. Once impregnated, the gestation period may last several months to a year and a half, depending on the species. A single female may produce 25-35 young. Scorpions are born live and the young climb onto their mothers back. The young remain on their mother's back until the first molt. They assume an independent existence once they leave their mothers back. Scorpions molt five or six times until they become fully grown adults. Scorpions generally hunt at night using their stinger to paralyze prey. However, if the scorpion is strong enough to overpower it's prey, instead of injecting venom, it will simply hold the prey and eat it alive. This conserves venom which can take up to 2 weeks to regenerate, during which time the scorpions main defense is inactive. Outside during the day, scorpions hide in burrows or debris, under wood, stones or tree bark and under floors of buildings in crawl spaces. Indoors, scorpions may be found in cracks and crevices of woodwork, behind baseboards, in closets and attics, and inside walls. Scorpions gain entry into buildings through poorly sealed doors and windows, cracks in foundations, vents that are not properly screened and through plumbing and other openings.

4.9.2 Management

4.9.2.1 Mechanical control

To prevent stinging encounters with scorpions, do not leave shoes, boots, clothing items or wet towels outdoors where scorpions can hide. Shake all clothing/bed linen and towels before use. Portable UV lights can be used to detect scorpions as they glow luminously under this light and are easily seen. Outdoor lights attract insects and thus the scorpions that feed on insects. Yellow outdoor lighting is less attractive to insects and is recommended in areas where scorpions are prevalent. The first strategy for control is to modify the area surrounding a house because scorpions are difficult to control with insecticides. Use the following checklist to protect a building:

- Clean the area by removing all rubbish, logs, stones, brick and other objects from around the foundation of the building.
- Prune overhanging tree branches away from the house because they can provide a path to the roof for scorpions.
- Install weather stripping (rubber seal) around loose fitting doors, between doors and floors and around windows.

- Seal all eves, pipes and other cracks that allow entrance into the home.
- Make sure window screens fit tightly in the window frame and keep them in good repair.

How to safely capture a scorpion

Scorpions can be captured by placing a medium sized jar over the scorpion and sliding a sheet of heavy paper under the jar, trapping the scorpion. With the sheet of paper securely over the mouth of jar, invert the jar and the scorpion will fall to the bottom of the jar. Scorpions can also be picked up safely with forceps (10-12 inches) or with other long mechanical devices made for picking up small objects.

4.9.2.2 **Chemical control**

Chemical control of scorpions is not recommended. Apart from the unnecessary negative effects on the environment, pesticides are not very effective against scorpions as they hide in cracks and crevices during the daylight hours. Adult scorpions are difficult to kill with pesticides because of their larger body size and thicker cuticle.

5. SAFE AND EFFECTIVE PESTICIDE USE

All pesticides are considered to be potentially poisonous and must be handled accordingly. On the label of each remedy, the minimum requirements for safe handling are given. In the case of many pesticides it is sufficient to follow a few basic rules. These may be summarized as follows:

- Wear rubber gloves when pouring or measuring a concentrate before dilution. This should be done is such a manner that any fumes or dust will drift away from the applicator. Immediately wash off any spillage on the body with soap and lots of water.
- Wear an overall or other old clothing that will cover most of the body. These should be regularly washed especially when applying pesticide over an extended period of time. When applying, always keep out of the spray drift or dust cloud.
- Never smoke, eat or drink during application. Wash at least the hands and face before doing so, during a break.
- Take a bath after completing the application and change into clean clothes never continue

with another job while still wearing clothes contaminated by a pesticide.

In the case of highly poisonous pesticides it is imperative that additional precautions be taken. Special protective clothing in good repair, rubber gloves and boots, headgear, goggles and mask or respirator must be worn. The eyes and respiratory tract must be adequately protected.

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