STATE OF NEW JERSEY

N.J. DEPARTMENT OF INSTITUTIONS AND AGENCIES. Division of Mental Health and Hospitals Environmental Sanitation Committee

STANDARD OPERATING PROCEDURES FOR INSTITUTIONS AND AGENCIES

CONTROL OF RODENTS AND OTHER ANIMAL PESTS

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RODENT CONTROL

In New Jersey institutions, rats and mice are occasional nuisances. When present, they despoil food and are potential disseminators of disease organisms. Diseases that are transmitted from these rodents to man are:

1. Salmonellosis - caused by a bacillus that causes food poisoning resulting from the contamination of food by rat feces;
2. Endemic typhus - caused by a rickettsial organism transmitted from rat to man by the rat flea;
3. Plague - caused by a bacillus transmitted to man by the rat flea;
4. Leptospirosis or Weil's disease - caused by a spirochete passed from the rat to man through the rat's urine on food or in water;
5. Rat bite fever - caused by a bacillus found on the teeth and gums of rats; and
6. Rickettsial pox - caused by a rickettsial organism for which the house mouse is reservoir and which is transmitted to man by the mouse mite.

I. DISTRIBUTION

Rats and mice originated on the plains of Asia, migrated to the Mediterranian region, and then to Western Europe. From Europe they accompanied man in his ships and supplies to various parts of the world. The roof, or black rat, Rattus rattus, favors tropical and semitropical climates. In the United States it is commonly found in the southeastern and Gulf Coast states and the west coast states up into Canada. In New Jersey the roof rat is seldom encountered and will not be considered in this manual. The Norway, or brown rat, Rattus norvegicus, is of later genesis and appeared in Europe in the early 1700's. It is found primarily in temperate regions but it does establish itself in tropical and semitropical regions where it successfully competes with and may eliminate the roof rat.

The house mouse, Mus musculus, is found from the tropics to the arctic. It is not dependent upon man and is found in the open from the fields of the southern states to the tundra of Alaska.

Rodents commonly found in institutions are the Norway rat and the house mouse. At institutions in rural settings the meadow mouse (Microtus) and the pine mouse (Pitymys) frequently invade buildings, especially during the autumn and winter months.

II. DESCRIPTION

The Norway rat varies in color. Its back and sides may be reddish brown or grayish brown or black. The underside is light gray or tinged with yellow white. Occasionally white spotted and albino rats are noted. The head is blunt and the body thick and heavy. The ears are small and close set. Full grown rats weigh from 10 to 17 ounces. The tail is shorter than the length of the head and body combined.

The house mouse is one of the smallest of rodents. It weighs about $\frac{1}{2}$ to $\frac{3}{4}$ ounce. The color is grayish to brown with the underside a lighter gray. Variations in color occur. The ears are large for the size of the body, the feet are shorter and broader than most wild mice, and the tail is equal to or longer than the length of the body and head combined.

III. HABITS

Movements: Rats and mice are primarily nocturnal in habit. Their greatest activity takes place between dusk and midnight. There is a lesser period of activity between midnight and dawn. When there is a shortage of food or water the period of activity may be changed to coincide with a time when food or water is available or may be extended to search for food or water. In going from harborage to food source, a rat or mouse will always follow a route that gives it protection although such route may be considerably longer than one that is more direct but exposed. Such routes have at least one vertical surface against which the rat or mouse may have body contact. Once the route has been established any object placed in the route will cause the animal to be very wary and investigative. When an object to which the animal is accustomed is removed from the path the animal tends to go around the space which the object occupied.

Food: Although rats and mice originated in the grain producing areas of Asia, they have adapted themselves to eat about any food that man eats. Norway rats feeding on garbage were observed to prefer meats, grain and grain products, cooked eggs, and potatoes. When food is found, it is usually taken back to the nest or to a protected place to be eaten. Small pieces are taken back by the mouthful while larger pieces are dragged back. If the food is too big to be dragged or under conditions of starvation, the food may be eaten where it is found providing there is reasonable protection. Rats are usually steady eaters while mice are nibblers taking bits here and there. As a result several baits should be supplied for mice to make sure that they get a lethal dose of the poison. Rats eat about one ounce of dried food or 1 to 1 1/3 ounce of garbage a day and drink $\frac{1}{2}$ to one ounce of water. Mice eat about 1/10 ounce of dry food and drink 1/20 ounce of water. When furnishing bait material it should be determined that sufficient poison is contained in the amounts that will be eaten in order to provide a lethal dose. Frequently, when a new type food is introduced to a rat population, the rats will take only a small amount of it. If it makes them sick they will not touch that food again. It is for this reason that prebait programs are conducted to get rats to accept the bait in quantities before the poison is added.

Nesting: A rat or mouse will build its nest in any protected area near a source of food and water. Out-of-doors it may be in a burrow or in debris. Indoors it may be between walls, between a ceiling and floor enclosure and enclosed areas between floor and shelving, in debris in a corner, between stacked boxes, etc. as well as in many unusual places. The nests are lined with pieces of cloth, paper, grass, or small twigs. Rat nests are approximately 8 inches in diameter and are frequently covered. Mouse nests are 5 inches in diameter and are covered over leaving only a small hole for entry and exit.

Burrowing: Norway rats and house mice are good burrowers. The Norway rat seldom burrows more than 1½ feet in depth in compacted earth and its burrows are not extensive. Rats will not or cannot burrow in sand. Burrows usually have one or more bolt holes that are loosely packed with dirt or covered with grass or debris. Whenever a rat is distributed in its burrow, it can readily charge out of anyone of these openings. In burrowing near buildings, the Norway rat will start a short way from the building and burrow toward it until hitting the foundation wall. It then follows the wall down. If the building has been rat proofed by the placement of a horizontal projection from the foundation, the burrowing is terminated. In fields, house mice are excellent burrowers and produce extensive runways within their area of activity.

Gnawing: The incisor teeth of rats and mice are very sharp and well adapted to gnawing. During life these four teeth continue to grow and even when gnawing is not required, control of growth of these teeth must be accomplished by gnawing or grinding to keep the teeth short enough to use. Wherever rats can obtain an edge, a rough area, or make a rough area they can produce a hole. Cinder block, aluminum shielding, asbestos, and anything softer than the hard enamel of their teeth can be successfully penetrated.

Climbing: Rats and mice are very good climbers, jumpers, and swimmers. Any projection or roughened area that will give them a toe-hold enables them to raise themselves. Adult rats have a reach of 13 inches that permits them to "swing" around joists, pipes, and other similar obstructions. A rat can do a standing high jump of two feet and with the aid of a wall can jump to a height of three feet. Similarly, off a wall, a mouse can jump to a height of two feet. From a height of 15 feet a rat can jump and cover a horizontal distance of eight feet. The distance can be increased if a running jump is used. Rats placed in a vat of water from which they cannot extricate themselves at the surface, will dive looking for a subsurface outlet. They are frequently found in open sewers and have been observed to swim across a half mile of open water.

IV. SENSES

The senses of touch, hearing, and balance in rats and mice are superior to those of man; smell is good; and sight and taste are poorer than in man.

The sense of touch in rats and mice is acute. Each of the long vibrissae or whiskers, on the face has a highly sensitive nerve net at its base. The longer guard hairs that are scattered among the normal body hairs provide a greater sensitivity than do the normal hairs. The sensitivity of the various special hairs appears to be used to guide the rat or mouse along pathways in the dark.

The sense of hearing is also acute. Rats and mice can locate a sound within six inches.

The sense of balance is developed to the extent that rats and mice can climb, jump, and walk wires with considerable agility.

The sense of smell is developed to the extent that rats and mice will readily follow in runways that others of the species frequent.

The sense of taste does not appear to be very well developed. Practically any food will be accepted. However, if a rat or mouse has eaten a food that makes it sick, it will shun such food in the future. They do not eat decayed food unless they have to, so all baits should be fresh in order to be readily acceptable.

Vision in rats and mice is relatively poor and they are apparently color blind. Hence, poison baits may be colored to deter human beings without reducing acceptance by the rat or mouse.

V. BIOLOGICAL CHARACTERISTICS

The period of gestation in the Norway rat averages 22 days and mating can take place as soon as two days after the young are born. There are usually 4 to 6 litters a year with each litter consisting of 8 to 12 young. However, only about 20 young a year are weened by each female.

At birth the young are helpless and a high mortality occurs during the first days of life. In the Norway rat the ears open in about 3 days but apparently do not respond to sound until the 12th day. Indications are that the young mouse may be sensitive to sound at 4 day but does not respond until the 11th day. The eyes of both species open at about the 12th to the 17th day. After the eyes open the young take short excursions from the nest by following the mother. As the young get older, the distance of the excursions from the nest increase in distance.

Sexual maturity is gained at about three months in the rat and between 6 and 8 weeks in the mouse.

VI. RODENT SIGNS

A survey of a building for rodent signs is made (1) to determine if rodents are currently present, (2) to estimate the degree of infestation, and (3) to learn general conditions of the infestation.

Live Rodents: The observance of live rodents is the most positive recognition of their presence but such is seldom encountered until the rodent population is very high. The finding of a dead rodent may also be taken as evidence of their presence. If the carcass is old and dry, it may be indicative of a past infestation. If two or more fresh carcasses are found, it should be determined if a rodent poisoning program is being conducted. If a control program is not in operation, it is possible that the deaths have been caused by a disease to which man is susceptible.

Droppings: Droppings are the most frequently observed sign of the presence of rats and mice. The feces of the Norway rat is up to ¾th inch in length and ¼ inch in diameter. Generally the ends are blunt. The droppings of young rats are, of course, smaller than those of adults and mixed sizes is usually indicative of the presence of both young and adults. Rats defecate one or more times an hour, (30 - 180 pellets per day) so droppings may be found anywhere the rat goes. They are most commonly found along runways, in the vicinity of their harborage, in corners, or on stored foods. Fresh droppings are dark, moist, shiny, and putty like. They can be pressed out of shape with a stick. After a few days, the droppings begin drying out, become hard and crumbly, and take on a grayish appearance. Mouse droppings are approximately 1/8th inch long and are pointed at both ends.

Runways: Once a protected runway is established, a rat or mouse will tend to use that runway for all excursions to its source of food and water. Out of doors or on earthen surfaces the runways appear well packed and clean of debris. Rat runways are usually 2 to 3 inches wide. Indoors the runways may be detected by dark, greasy smears caused by the dirt and grease rubbed off the rat's body. Such runways are found along walls, along the inside of pipes or wires, on steps and rafters, and as swing marks under and around rafters or other obstructions. The presence of debris, cobwebs, and dust on the runways indicates that the runways have not been used for some time. Rat runs can be used to trace rats to their harborage, place of entrance to a building, and to the location of their food and water. Mice seldom produce detectable rubmarks.

Tracks: The observance of foot marks on runways freshly dusted with talc or flour may be used to determine if the runway is in present use and the extent of the rat or mouse population. The 5-toe hind foot mark is more commonly seen than that of the 4-toe front foot. Tail marks of the Norway rat may also be noted in the dust patches, or in dusty areas.

Gnawing: All rats must gnaw to keep the front teeth from growing too long. Gnawing is used to gain entrance into a building or room, or to enter the space between walls. Fresh gnawing is characterized by rough edges, definite teeth marks, and gnawed pieces of material on the floor. With continued use of the opening, the rats tend to gnaw off the rough edges and passage through the hole soils and darkens the edges.

Burrows: Burrows are the historical shelter of rats and mice. Around buildings rats burrow around the foundation. In basements with dirt floors, they frequently burrow along the walls. In the open, rats burrow in embankments, hedgerows, and under heavy brush. In buildings mice do no burrowing but in fields they will burrow for harborage, nest sites, and protected runways. The burrows of both rats and mice are not usually extensive or deep. Mouse burrows are about one inch in diameter and rat burrows are three inches in diameter.

Other Signs: Nests of rats and mice are very well concealed and it is difficult to find them. When found, it is practically impossible to determine the age of the nest unless it contains young or a rat or mouse is seen coming from it.

The habit of rats to bring food back to the shelter to store it may serve as an indication of their presence. If the foods are fresh, they may indicate a current infestation. If the foods are dried, they may indicate a past infestation.

Urine stains and body hairs also offer evidence of an infestation. Rodents drop urine as they move about and such deposits may be located by use of an ultraviolet light. However, caution should be exercised because things other than urine will fluoresce under ultraviolet light. In areas where there is or where there has been a heavy rat population, a trained person may detect the odor of rat urine. Such odor may continue to be present for some time after a rat population has been eliminated.

Rat and mouse hairs may be found around openings and on food stuffs and may be used as supplemental evidence of a present or past population.

VII. CHARACTERISTICS OF RODENT POPULATIONS

In any given area the population level of rats or of mice reaches an equilibrium that varies little unless the environment is altered. The level is dependent upon the amount of food, water and harborage that is available. The movement of individuals is dependent upon the distance between the harborage and the source of food and water. When both are in close proximity the area of movement may be only a few feet. Under most conditions Norway rats seldom move more than 100 to 150 feet between harborage and food, and mice seldom move more than 30 feet.

Animal predation and parasites have relatively little effect on population levels. Predation by man, e.g., poisoning, trapping, etc., may cause a sharp reduction in population but the level soon rises to the limit of the supportive factors when the predation ceases.

When the population is at equilibrium by limitation of a supply of food, water or harborage, increased fighting to establish and maintain the social order, fewer litters, and fewer weened young are noted.

VIII. CONTROL

The control of rodent populations is contingent upon depriving the rodents of food, water, and harborage. Inasmuch as the elimination of these factors seldom can be accomplished in full, supplementary practices such as the rodent proofing of buildings, poisoning, and/or trapping, are used to obtain and maintain satisfactory degrees of control.

SANITATION

Premise sanitation is the basic means of controlling rodents. The elimination or reduction of food, water, and harborage will eliminate or reduce rodent populations.

Foods: All garbage and other food wastes should be stored in rodent proof containers. Garbage cans should be made of sturdy, rust resistant metal, the bottoms should be depressed, and the lids should be tight fitting. The cans should have handles or a bail for lifting and transportation. When out-of-doors, the cans should be stationed on a concrete slab, or other

suitable platform, to keep them away from the moisture in the soil and, to some extent, to keep them out of reach of animals. It is preferable that the covers be secured by a chain attached to a wall or post to keep them off the ground where they may be stepped on or run over by a truck and bent out of shape. Chains will also prevent the covers from being blown away by a strong wind or otherwise becoming lost. When the can is used for garbage only, it should have a capacity not in excess of 10 or 12 gallons. When it is used for garbage and rubbish its capacity should not exceed 30 gallons. Fifty-five gallon drums should not be permitted for they, in themselves, are heavy and when filled they weigh more than can be conveniently lifted. Where 55 gallon drums have been used they have been found to be the primary cause of disability (hernia) to handlers.

Garbage cans should be cleaned, preferably by steam, after each use. When garbage is mixed with other rubbish it should be bagged or wrapped to prevent soiling of the can and spillage. Cans should be of sufficient strength and durability so that they do not become malformed with normal usage. *(More detailed information on the disposal of wastes is to be found in the chapter on Refuse Disposal.)* Plastic containers may have certain applications but they are not recommended for garbage or heavy use. They are not resistant to the gnawing of rats and they crack and break from the rim in the vicinity of the handles.

All stored bagged and boxed foods should be stacked in tiers on platforms or pallets that are elevated 5-12 inches above the floor and located two or more feet from any wall. The elevation above the floor level and the space between pallet and wall permits easy cleaning of spilled foods, reduces the number of possible harborage sites, and provides an opportunity to note rodent signs along the base of the wall. The latter is enhanced if a six inch wide strip of the floor at the base of the walls is painted white. *(See Chapter on Food Service Sanitation, Appendix 3).* There should be a 2 to 4 inch space between tiers to permit the free circulation of air and to reduce the number of possible sites for rodent harborage.

Broken lots of bulk packed foods such as beans, cereals, sugar, etc., should be stored in metal cans with tight fitting covers and the covers and the can placed on an elevated platform. The outside or near side of the platform should have a raised edge to prevent the can from sliding off and the inside or far side of the platform should be elevated an additional six inches. The can is thus tipped so that one reaches straight into the can and not over and down into the can.

When a carton containing packages or bags is opened, all the packages or bags should be stored orderly on a shelf and the empty carton discarded. If only one package is removed from the carton and the carton placed on the floor or elsewhere there will soon be a number of open cartons scattered around, possibly two or more containing the same product. Such cartons may serve as harborage for rodents and insects and create a hazard to personnel.

Water: Where only dry foods are available to rodents, water constitutes a critical item. Dripping faucets should be repaired, containers holding water should be discarded or kept empty, and basement sumps should

be kept dry or protected. Out-of-doors, depressions that hold water should be filled or graded and containers capable of holding water discarded.

Harborage: No refuse should be permitted to accumulate on a premise. As rubbish is created it should be placed in containers and set out for pick-up. Piles of refuse or other debris into which rodents can burrow or under which they can find harborage should be disposed of. All boards, pieces of sheet metal, or other flat pieces that could serve to protect burrows should not be permitted to remain on the ground, especially near buildings. Cardboard cartons are usually replaceable and should not be kept. When use of them will be made within a few days, they may be stored on an elevated platform. In cases where lumber is to be kept, it should be stored on racks at least 18 inches above the ground or floor level. If barrels are to be stored they should be inverted and stored on racks.

The frequency of garbage and rubbish collection is dependent upon the volume produced. At most institutions, garbage should be collected at least three times a week.

Collection vehicles may consist of packer trucks or covered dump trucks. On dump trucks the cover may consist of a permanent metal enclosure or a heavy canvas that fits over the body of the truck sufficiently tight to preclude the loss of papers or other materials.

Disposal of the institutional wastes is commonly accomplished by one of two methods. When the institution is located in an urban setting, the regular city collection facilities may service preselected collection points. At most institutions a sanitary land fill is maintained or utilized. Small free burning incinerators have limited application. They may be used to burn papers and other combustibles but when wet garbage is included, it is not completely burned and the resultant residue constitutes a rodent attractant. High temperature incinerators, requiring 1,200 to 1,800° F., are not usually economical for institutions.

RODENT PROOFING

In order for any poisoning or trapping program to be effective, it must be first determined if the building is sufficiently tight to prevent easy ingress and reinfestation by rodents. This may be determined by a thorough inspection of the lower parts of the building for openings where rats may enter. Particular locations to look for are those where utility lines enter the building, openings through exterior walls and foundations, sidewalk vents and gratings, and accessible first floor windows and doors. Openings found around utility pipes in brick or masonry walls should be filled with cement. Openings in frame buildings should be shielded or patched with metal squares. Foundation openings may be filled with a suitable material. Vents and windows should be screened with quarter inch hardware cloth. Doors should be fitted with a metal kick plate and/or a metal channel fitting on the bottom of the door plus metal cuffs on the corners.

Upon the completion of the rodent proofing the eradication of the rats and mice within the building should be begun immediately. To defer such action may cause the rats to do more damage than usual since they no longer have egress from the building.

BAITS AND POISONS

There is no one best bait for rats. Baits acceptable to rodents in one area or one building may not be acceptable to rodents in another area or building. Also, baits acceptable at a given time may not be acceptable a few months later. Consequently, prior to starting a poisoning program, it may be desirable to bait test the area where poisoning will be done. If an adequate quantity of several baits are placed out on one day, a determination can be made on the following day as to which bait or baits are acceptable.

Common rat baits are: (1) ground meats and animal parts; (2) fish, both fresh and canned; (3) cereals and grains; (4) fruit; (5) non-leaf parts of vegetables; and (6) miscellaneous items such as seeds, the meat of nuts, peanut butter, coconut, and candy. The addition of one per cent sugar or molasses increases the take of the baits.

In preparing baits, thorough mixing of the poison and the bait is essential and only the amount of poison required to obtain a kill should be included. Excessive amounts of the poison will tend to cause non-acceptance of the bait. When ground or loose baits are used, greater acceptance will be obtained if they are made into "torpedoes". Torpedoes are made by using a 4 inch square of kraft or thin waxed paper. A quantity of the bait is placed in the middle and the four corners are drawn together and twisted. Rodents prefer to take their food to their harborage and to eat it there. Thus, the torpedoes constitute a convenient means of transporting it. Torpedoes may also be tossed into harborage areas where loose bait would be difficult to place and they may be conveniently placed 12 inches from a hole or runway. When baiting an area care should be taken to make sure that there are enough baits set out to satisfy the demand. This may be 20 baits for lightly infested areas to 200 baits for heavily infested areas. If all baits are taken, then enough baits were not put out.

Of the various poisons available as rodenticides, the anticoagulants and fortified red squill are the safest for use in institutions.

The anticoagulants, consisting of prolin, pival, and fumarin, kill by causing internal hemorrhages. To be effective, these materials must be taken in small amounts over a period of several days. A single massive dose is ineffectual and this factor constitutes their safety value with children and animals. The anticoagulants are mixed at the ratio of one part of 0.5 per cent concentrate to 19 parts of the bait material.

Red squill is a gritty, bitter, material that is acceptable to the Norway rat. It is an emetic and the fact that rats cannot vomit contributes to its effectiveness. It is not effective against the roof rat or the house mouse. The strength of red squill varies. Therefore, only fortified red squill that has been tested by the producer should be used. It is applied as one part fortified red squill to 9 parts of bait material.

ANTU (Alpha-naphthylthiourea) is effective against the Norway rat but not against the black rat or house mouse. It produces an edema of the lungs that causes the rat to "drown" within 48 hours. If a lethal does is not obtained initially the rat builds up a very high tolerance and bait shyness to the material. Therefore, ANTU should not be used more than once a year and the single baiting must be thorough. ANTU is also very toxic to cats, dogs, hogs, and baby chicks. ANTU is applied by mixing one part ANTU with 32 parts of bait to which one part tartar emetic is added.

A ten per cent DDT dust spread along runways is effective for mouse control.

There are several single dose poisons that are very effective rodenticides but their use is discouraged in State institutions because of their high toxicity to man. As a safety measure, tartar emetic is added to each of these poisons in the recommended proportions to induce vomiting in man and other animals.

Zinc phosphide is a black powder with a very disagreeable odor that repels pets but is apparently attractive to rats. One-half inch cubes of apple or sweet potato are coated with the zinc phosphide powder at the rate of one part zinc phosphide to 99 parts apple or sweet potato. One-third part of tartar emetic should be added.

Thallium sulphate is an accumulative poison that is slow acting but very effective. Its great danger to man lies in the fact that it is absorbed through unbroken skin and, therefore, should never be handled without using rubber gloves. It is used at the rate of 0.75 part to 99 parts of bait plus 0.3 part tartar emetic.

Arsenic trioxide is used as a micronized powder at the rate of 3 parts to 96 parts of bait and to which one part of tartar emetic is added.

Of all the rodenticides in use, sodium fluoroacetate (Compound 1080) at $\frac{1}{2}$ oz. per gallon of water is the most effective and quick acting. At the same time, it is extremely toxic to man and other animals and is to be used only by qualified professional pesticide operators under conditions of strict and exacting control. There is no emetic that works fast enough to be effective and no antidote. The importance of exercising extreme caution cannot be over emphasized with the use of this material.

Seeds impregnated with strychnine and coated give effective control of mice.

TRAPPING

Trapping is a more arduous, time consuming, and expensive procedure of controlling rodents than is poisoning and it is used only when poisons fail, or are too risky, or when odors from dead rodents must be avoided.

Snap traps are the type most commonly used for both mice and rats. With mousetraps the bait should be securely affixed to the trigger. For rats an expanded trigger may be used unbaited. Expanded triggers are formed by attaching a piece of cardboard or screen wire to the standard trigger or

substituting it for the standard trigger. The trap is placed across the runway with the trigger end facing the vertical wall so that the rodent accosts the side of the trap rather than the end of the trap. Snap traps usually kill their victim.

In areas where a study of rats is desired and live rats are wanted for blood, ectoparasites, or other purposes, a number 0 steel trap or a box or cage trap is used. In setting steel traps the fulcrum of the jaws is placed along the direction of the rat run. If the trap is placed so that the outer parts of the jaws are in the direction of the rat run, the rat may be thrown clear of the trap when the jaws snap closed. Traps should be firmly secured.

Cage type traps are used to capture live, unharmed rats and are not practical for normal eradication purposes. Cage traps placed in dark areas or covered with heavy cloth give better results.

In using traps for eradication of rats and mice, determine the location of the rat or mouse runs, review rodent habits to ascertain correct positioning of traps, and use a large number of traps in the initial trapping attempt. When only a few traps are used, the rats become "trap shy" and the results of the eradication program are poor.

IX. CONTROL OF ECTOPARASITES

Prior to the start of any eradication program in areas having a medium or heavy rat population (10-50, 50 or more) all runways should be dusted with 10 per cent DDT dust from 3 to 30 days before the beginning of the eradication program. In traversing the pathways, the rats pick up the DDT on their bodies. The fleas, lice, mites, and ticks come in contact with the DDT and are killed. Also, the rats return to their harborage and nests with DDT on their bodies and fleas in the harborage come in contact with it and are killed. *(See chapter on Insect Control, pg. 9 Fleas).* The purpose of controlling the fleas prior to killing the rats is to prevent the fleas from seeking an alternate host - man - when their primary host has been killed.

X. CONTROL OF DEAD RODENT ODORS

Subsequent to a poisoning operation, some of the rats or mice are likely to die in out-of-the-way places. If the temperature in these places is above 50° F. an offensive odor may be produced by the decomposing carcass. Under applicable conditions the following suggestions may give complete or partial control of such odors.

When the dead rodent can be located in an accessible area, it should be removed and burned or buried.

When the area is partially accessible so that the rodent cannot be removed but materials may be injected to the carcass, a mixture of one part para-dichlorbenzene, one part hydrated lime, and 4 parts talc or a solution of $3\frac{1}{2}$ ounces of zinc chloride, $2\frac{1}{2}$ ounces of table salt, and one quart of water may be dusted or sprayed on or as close to the carcass as possible.

When the carcass cannot be located, the unpleasant odors may be masked by the use of isobornyl acetate (DuPont), Neutroleum Alpha (Fritzsche Bros.), Magnador No. 41 (Magnus, Maybee, & Reynaud), or other suitable masking agents. Such agents may be applied as an aerosol or mist, or by evaporation from a cotton wick or from a bowl. Solutions made from the oils of pine, peppermint, wintergreen, anise, or other aromatic substances may be used. They are applied as a mist sprayed into the air of a room.

Note:

The presence of rodents degrades an establishment to an unsatisfactory level. Food establishments with rodents in the storeroom or kitchen, dairies and milk plants with rodents in the building or surrounding areas, dripping water faucets from which rodents may drink or water systems to which rats have access, open sewage systems where rats may frequent, and housing areas, refuse collection sites, or disposal areas that harbor rats cannot be deemed to be in a satisfactory sanitary condition when the presence of rats may affect the well being of the individual, the neighborhood, or the community.

Consequently, all sanitarians and supervisors in the various fields involving environmental health, should have a working knowledge of the biology, habits, signs, and control of rats and mice.

XI. CHARACTERISTICS OF COMMON RODENTICIDES[1/]

POISON	PER CENT IN BAIT	EFFECTIVE-NESS	ACCEPTANCE	REACCEPTANCE	TOLERANCE DEVELOPED	HAZARD TO HUMANS	ANTIDOTE
Anticoagulants (Pival, Prolin, fumarin, etc.)	0.025	Good	Good	Good	No	Slight	Stomach lavage, Vitamin K and whole blood.
Red Squill (fortified)	10	Fair	Fair	Poor	No	Slight	Acts as its own emetic.
Zinc phosphide	1	Good	Good	Good	No	Moderate	¼ gram copper sulfate in glass of water. Repeat every 10 minutes until vomiting is induced. Then cathartic. Avoid fats and oils.
Arsenic tri-oxide	3	Fair	Fair	Fair	Yes	Moderate	Freshly mixed ferric hydroxide and magnesium oxide. Not effective unless given immediately. Then stomach lavage. Milk of magnesia, milk and water.
ANTU[2/]	3	Good	Good	Poor	Yes	Moderate	NONE KNOWN. Induce vomiting immediately. Keep patient warm. No cathartic or alkali.
Sodium fluoro-acetate (1080)	½ oz. per gal.	Good	Good	Good	No	Extreme	NONE KNOWN. Induce vomiting immediately. Give cathartic.
Thallium sulfate[3/]	0.7	Good	Good	Good	No	Extreme	NONE KNOWN. Induce vomiting immediately. Stomach lavage followed by cathartic may help.
Strychnine[4/] (alkaloid) (sulphate)	0.6 0.8	Fair	Fair	Poor	Yes	Moderate	Induce vomiting immediately. No emetic after 10 minutes. Charcoal in water and sedative. Keep patient in dark room.

1/ Modified from Bjornson and Wright.
2/ Effective against Norway rat only.
3/ Can be absorbed through unbroken skin. Chronic poisoning possible with absence of warning.
4/ Effective against mice only.

CONTROL OF OTHER ANIMALS

PIGEONS

Flocks of pigeons that are commonly observed in urban areas are composed of semi-wild individuals to whom no one lays claim of ownership. Where pigeons roost and/or nest on buildings they frequently become a nuisance and a public health hazard. Their droppings deface buildings and accelerate deterioration. If they rest over doorways or walkways their droppings may become the cause of accidents. Human diseases for which pigeons act as reservoirs are toxoplasmosis and salmonellosis. Pigeons are also carriers of Newcastle disease, coccidiosis, and ornithosis of domestic fowl. The fungi that cause histoplasmosis and cryptococcal meningitis in man develop in the droppings of pigeons and when the droppings dry, the spores become wind borne and are inhaled by man. When pigeons roost near inhabited areas their more common ectoparasites such as lice, fleas, mites, ticks, and bedbugs may infest man.

CONTROL: Control of pigeons may be accomplished, in varying degrees, by the use of mechanical devises, poison baits, or by shooting.

Elimination of pigeons from eaves, ledges, etc., may be obtained by the installation of rust proof screening with $\frac{3}{4}$ inch or less openings or by metal sheeting. The screening or sheeting should be installed vertically or at such an angle that the pigeons cannot rest on it. Plates with sharp prongs or spikes may be attached to the roosting areas to discourage the use of an area. The prongs should be sufficiently close to prevent the pigeons from resting between them. Wires carrying low amperage voltage may also be effective. The intermittent shocks discourage roosting. Glues and adhesive tapes irritate pigeons by sticking to their feet. The adhesive material must be replaced or replenished every 2 to 3 months to remain effective. Noise devises consisting of high frequency vibrations inaudible to the human ear or recorded noises are usually not effective deterrents.

The above methods are designed to force the pigeons to seek less sensitive areas on which to roost and are relatively costly to install or maintain.

Trapping is an effective method of controlling pigeons in that they can be transplanted in a distant area or otherwise be disposed of. Screened enclosures of various shapes and sizes may be used. Where the pigeon population is considerable, a large trap of 6 to 8 feet in length and 3 or 4 feet in height and width is capable of catching relatively large numbers each day. The placement of two live pigeons with distinctive markings in the trap as decoys will enhance its effectiveness. A plate of free swinging "bobs" made of heavy aluminum or light weight metal should be used as an entryway. The "bobs" should swing inward and upward, only. At one end of the trap there should be a door or other type opening through which the birds can be removed. The cage should be made of 1 x 2 inch material to reduce the weight. The sides may be bolted onto the ends so that the trap can be dismantled for storage or transportation. If the pigeons are used to feeding on a definite type of food, then this same food should be used as bait. If they are feeding on miscellaneous foods, cracked corn or one part wheat to five parts cracked corn is usually well accepted. Scatter a small amount of the bait outside the trap door to

attract the birds. A generous amount of bait should be on the cage floor and near the entrance at all times. Water must be provided. The trap may be placed in areas where the pigeons normally feed or it may be placed in an area near their roosting place. It is desirable to place the trap in an inconspicuous location so that it will not be molested. The trap should be visited every day or two to remove birds and replenish bait.

Poison baits for the control of pigeons are effective and relatively safe when used by experienced operators. It must always be remembered that the poisons are toxic to man and other animals and that extreme caution should be exercised in handling and locating them. In conducting a poison control program the areas selected should be prebaited witn unpoisoned mixed grains and the type grain most acceptable noted. It should also be noted if song birds are attracted to the feeding area. If song birds are attracted and no other suitable location can be found, then only large, whole kernels of corn, that song birds cannot swallow, should be used. A flat roof near where the pigeons roost is usually an acceptable location to bait. The prebaiting program should be conducted for a week or more by the same person wearing the same identifiable clothing each day. When the poisoning program is begun, a liberal amount of the poisoned bait should be made available. Pigeons will eat the equivalent of 13 to 15 kernels of whole corn.

A poison commonly used is strychnine. In preparing the bait, one tablespoon of laundry starch should be added to ½ cup of cold water. Then add 1½ cups of boiling water and stir until free of lumps. Add one ounce of strychnine alkaloid and stir well. Mix this solution evenly into 8 quarts of corn-wheat mixture or 12 quarts of whole corn and stir thoroughly. Spread the treated grain thinly to dry and when dry place in containers clearly marked POISON until time of use. Alpha-chloralose and tribromethanol may also be used. Alpha-chloralose is a tranquilizer requiring a 30 minute lapse of time before the bird becomes unconscious. If an adequate amount is not consumed the pigeon will regain consciousness. Also, within the 30 minutes, the bird may fly to a location that is out of sight or out of reach. Tribromethanol is effective within 10 minutes. This material is not stable and becomes ineffective after a period of 2 hours. Pigeons feeding on strychnine usually succumb in about 8 minutes.

A reduction of a pigeon population may be attained by shooting them. If only a few pigeons are to be eliminated a .22 rifle using fine shot instead of single shot is effective. If a flock or flocks are feeding in an open area, a .410 gauge shotgun is effective. Shooting around buildings may be more harmful to roof gutters and other parts of the building than to pigeons. Before using a gun, a check should be made on local police regulations pertaining to its use.

Partial control of pigeons may be obtained by destroyed their nests at two week intervals during the spring and summer months. On low buildings the nests can be pulled apart and destroyed with a long pole to which a hook has been attached to one end.

NOTE: Pigeons are not protected by Federal or State laws but a check should be made for local laws pertaining to their destruction. Destruction of pigeons should always be by an approved method.

Manufactured trap entrances containing the free swinging "bobs" may be obtained locally.

SQUIRRELS

The activities of squirrels may afford a degree of pleasure to patients and others but the damage that they do by gnawing openings into buildings, introducing flamable nesting material, gnawing electric wires, and occasionally biting people classify them as nuisances at institutions.

CONTROL: Squirrels can be repelled from attics temporarily by the use of four or five pounds of naphthalene flakes or paradichlorobenzene crystals per room. After squirrels have been driven from an attic all openings in the eaves, cornices, etc., and open knot holes should be covered with hardware cloth or other metal that is resistant to gnawing. Where single trees are near buildings, the removal of branches within six feet of the building will deter the squirrels from jumping between tree and building. The placement of a smooth metal band two feet wide and located six to eight feet up on the trunk of the tree will minimize the chance of a squirrel getting up into the tree provided there are no branches extending within six feet of the ground. Paints containing copper carbonate, or copper naphthalate may be used to deter gnawing if their black and green colors are not aesthetically objectionable.

Squirrels may be trapped alive in baited cages fitted with a guillotine type door and transplanted in a wooded area at some distance from the institution. Institutional personnel will usually find their local or federal game warden cooperative in such a venture.

Squirrels are considered as game animals and, as such, are protected by law. If a means of eliminating them by killing is contemplated, the local game warden should be contacted for advice and written consent. Control may be effected by such means as shooting, trapping, or poisoning. The anti-coagulant rat baits may be effective in areas where any odor produced by a hidden carcass will not be offensive. If two tablespoonfuls of ground nuts or peanut butter are added per pound of anti-coagulant bait, the bait will be more attractive.

BATS

Bats are small, (3-5 inches) hairy mammals whose elongated forearms and fingers are connected by a thin membrane that enables them to fly. They are nocturnal in habit and feed primarily on insects. Their daytime resting places are usually dark enclosures such as caves, attics, hollow trees, etc. Under most circumstances bats do not constitute a public health hazard. However, in recent years in New Jersey some bats have been found to be infected with rabies. In enclosures where large numbers of bats roost, including some rabid bats, it has been shown that rabies can be transmitted to may by the inhalation of particulate matter containing the virus. An accumulation of droppings and urine may produce offensive odors associated with its chemical reduction. Also certain fungi e.g., that causing histoplasmosis, may develop in soil contaminated with bat droppings. Mites and a close relative (Cimex pilosellus) of the bedbug are common in bat colonies and may become a nuisance to persons living in close proximity to the roosting areas.

CONTROL: Bats may be eliminated or controlled by bat proofing a building or by the use of fumigants, repellants and, to some extent, chemicals.

Bat proofing required the sealing of all openings over $\frac{1}{4}$ inch wide that provide entrance to the roosting enclosure. Usually all bats leave the roost within 20 minutes of the time the first bat leaves. However, if they have been disturbed during the process of building them out this pattern may be altered and it is desirable to leave two of the principle entryways open for three or four days. When the bats have become accustomed to using the remaining entrance ways these may be sealed off during the night when all the bats are out feeding.

A bat colony may be killed off in its roost by the use of a fumigant. Calcium cyanide is usually the fumigant of choice but because of its high toxicity to man and other animals, the fumigation should be done only by highly trained and experienced personnel using the proper equipment.

Naphthalene flakes and paradichlorobenzene are extremely offensive to bats. Four or five pounds of either of these materials spread around and below the roosts is sufficient to drive them out of an average sized attic. However, inasmuch as bats are very persistent in returning to established roosts and odors from bat wastes attract bats to a roosting or former roosting area, the application of a repellent should be followed by bat proofing the roosting enclosure to prevent the area from being reused.

The water wettable type of DDT or of other chlorinated hydrocarbon insecticides sprayed on the roosting projections may produce sufficient mortality to eliminate or control bats. These chemicals function by being ingested by the bat when it is preening itself.

Poisons are not effective inasmuch as bats feed on flying insects.

SKUNKS

Skunks are beneficial in that they feed on insects and small rodents; detrimental in that they eat vegetables, small fruits, eggs, and kill chickens and birds; and objectionable in that the nauseous, penetrating odor they produce constitutes a nuisance and produces a fear psychosis in many people.

CONTROL: Skunks become objectionable when they use the under areas of buildings for dens or when they are foraging near a building for insect grubs. All openings under buildings, porches, etc., should be sealed off to prevent their use as entryways. If an enclosure is already being used as a den, all openings except one should be sealed. Flour or similar tracking material is then placed around this opening. Inasmuch as skunks are nocturnal in habit, an inspection of the tracking material made after dark will show if the skunk has left the den to forage. When it has left, the remaining opening should be sealed. Cement, sheet metal, or hardware cloth that is extended into the earth to deter burrowing should be used to close the openings. Rock piles and holes in the ground may also serve as dens. Skunks will forage for considerable distances from their dens so their occasional presence does not necessarily mean that they have a den close by.

When numerous small holes are observed to have been dug in a lawn, it may be the result of skunks digging up beetle grubs to feed on. Control of such damage may be attained by treating the lawn with chlordane, dieldrin, or other suitable insecticide to kill the grubs feeding on the grass roots.

If skunks are to be killed, they may be trapped with a No. 1 or 1½ steel trap baited with a chicken head, dead mouse, or ripened meat; gassed in their burrows with a cyanide cartridge that can usually be purchased in farmer cooperative stores; or trapped alive in a box trap and be disposed of by fumigating with chloroform or carbon disulfide, or by some other suitable means. When a skunk is to be shot, the shot should destroy the brain instantaneously if ejection of the scent producing material is to be avoided. In some areas skunks are protected by law and if they are to be killed, the local game warden should be contacted for advice.

Skunk odors in dens under buildings or on pets and clothing can be minimized by the use of a deodorant such as neutroleum alpha which can be purchased at hospital supply houses or at pest control supply houses. The use of weak solutions of vinegar or a household bleach will help to remove skunk odors from dogs and clothing.

DOGS AND CATS

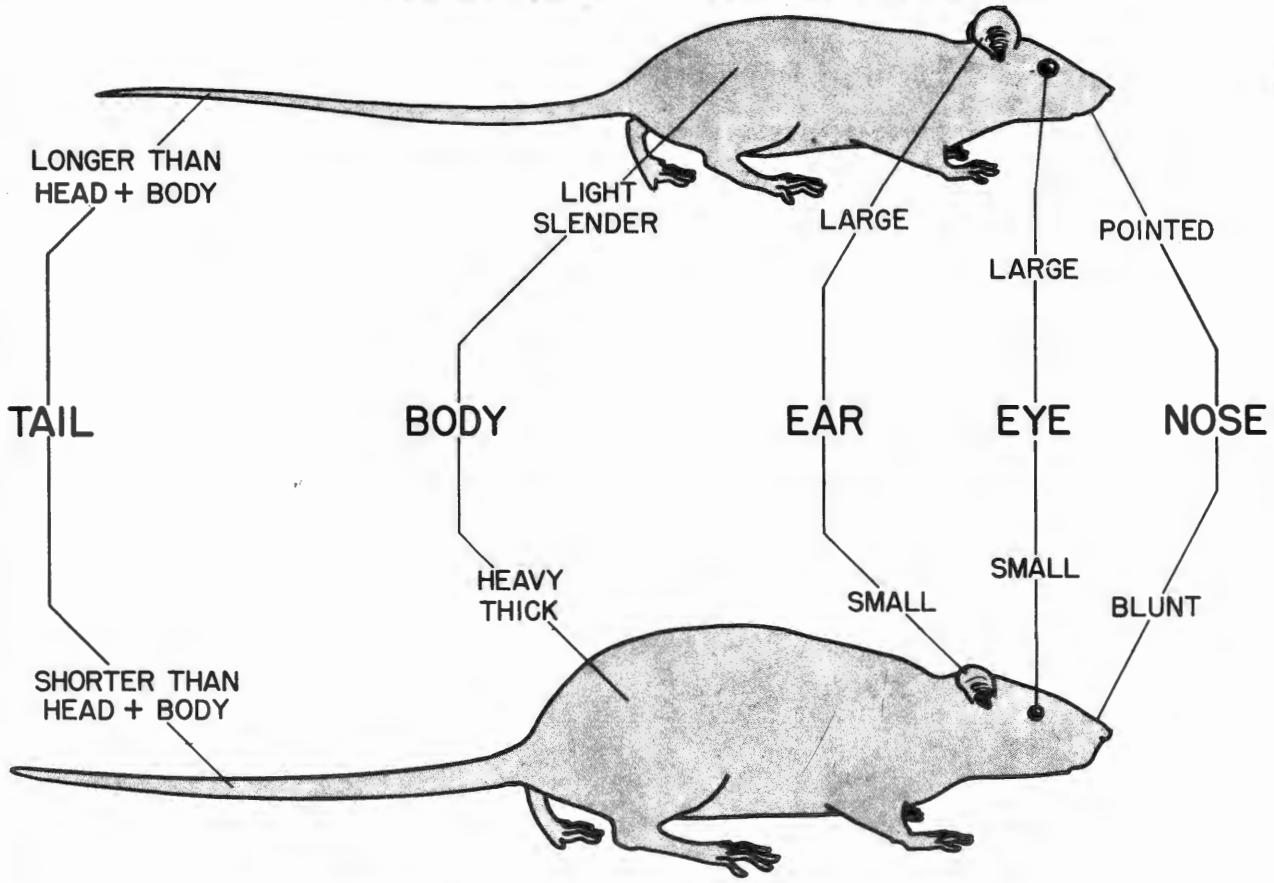
Dogs and cats unless kept under some control may become a nuisance or even a threat to health and safety. They should receive rabies vaccination annually and dogs should be confined to the area of the families housing units.

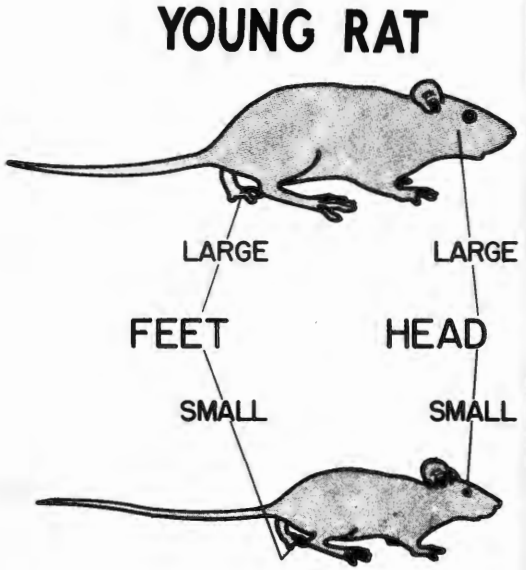
Usually the Superintendent of an Institution grants, to employees living on the grounds, permission to keep pets. This is accomplished through a requirement that a permit be issued by a designated officer of the institution.

These precautions must be taken to protect inmates, employees, and guests from being bitten, chased, or frightened. In addition, because of the fact that rabies has been found in bats throughout many areas of the State, there is the possibility of transmitting rabies to humans through the bite of dogs and cats that have previously been bitten by a rabid bat. Institution grounds would be subject to the State Law on Rabies Control and on all municipal rules and regulations of the municipality in which that institution is located.

The sanitarian has a responsibility to see that dogs and cats are kept under proper controls as set forth for each institution.

FIELD IDENTIFICATION OF DOMESTIC RODENTS





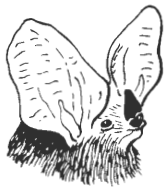
SCALE IN INCHES
0 1 2 3

PREPARED BY R. Z. BROWN
U.S. Department of
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Communicable Disease Center
Atlanta, Georgia
SEPT., 1953

BATS: PICTORIAL KEY TO UNITED STATES GENERA

Harold George Scott, Ph.D.

leaf nose



Macrotus
LEAFNOSE BATS

lump nose

Corynorhinus
BIG-EAR BATS

hog nose
rostrum long

Choeronycteris
HOGNOSE BATS

hog nose
rostrum short

Leptonycteris
LONGNOSE BATS

leaf chin

Mormoops
LEAF-CHIN BATS

plain face

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
ATLANTA, GEORGIA
1960

free tail

wrinkled lips

Tadarida
FREE-TAIL BATS

smooth lips

Eumops
MASTIFF BATS

enclosed tail

fur black silver-tipped

Lasionycteris
SILVER-HAIR BATS

fur brown or red silver-tipped

Lasiurus
RED AND HOARY BATS

fur spotted not silver-tipped

Euderma
SPOTTED BATS

fur not spotted not silver-tipped

long ears

pointed tragus

drab gray

Antrozous
PALLID BATS

brown

Myotis
LITTLE BROWN BATS

-C. Stojanovich-

blunt tragus

brown

Pipistrellus
PIPISTRELLS

tawny olive

Idionycteris
ALLEN BATS

short ears

under 4" long

Nycticeius
EVENING BATS

over 4" long

yellow

Dasypterus
YELLOW BATS

brown

Eptesicus
BIG BROWN BATS

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