

EFFECTIVE MUNICIPAL RODENT CONTROL

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In order to carry out properly an effective rodent control program, the personnel utilized must have some good basic knowledge drawn from the fields of chemistry, architecture, engineering, pharmacology, veterinary medicine, and allied fields. Vector control generally, and rat control specifically, gives the sanitarian an excellent opportunity to exhibit his general skill in his chosen field of sanitary science (1).

Rats have been associated with man throughout recorded history. They have followed him into most of the habitable parts of the globe, and have become vectors of many of the communicable diseases of ancient and modern times. The rat has been charged with spreading typhus fever, bubonic plague, trichinosis and many other diseases. In addition to being spreaders of disease, rats are notoriously destructive because of their gnawing habits and it is an accepted fact that some of our worst fires have been attributed to rodents, such as rats and mice. Rats cost the United States \$500,000,000 each year. A rat costs and destroys \$200 worth of food annually (1).

Mice may also be considered an economic liability and are responsible for transmitting several forms of food poisoning, also typhus, plague, rickettsial pox and other communicable diseases. Mice quite obviously are incriminated as contaminators of food.

ORGANIZATION OF THE PROGRAM

Generally speaking, every practical method should be utilized in a permanent control program. These methods should include such items as:

1. Good general sanitation in the area.
2. Adequate rat proofing and eradication in existing buildings.
3. Adequate rat proofing and eradication in new buildings.
4. Rat poisoning.
5. Control of rat ecto-parasites.

A preliminary survey should be made *before* rodent control measures are actually attempted. The area should be surveyed in order to understand the nature of the problem. The survey should attempt to find out such facts as:

1. The prevalence and location of rodents.
2. The species of the rodents and their fleas.
3. The presence and availability of their food supply.
4. The location of, and types of, harborage.

5. If the town is a seaport, the potential hazards of migration from boats to shore.
6. Estimate of costs of materials for each building and cost of the entire program.
7. Methods of financing the program by:
 - a. Local government or other agency that provides a revolving fund for labor and material.
 - b. Municipalities that furnish labor and merchants that furnish material.
 - c. Merchants who furnish labor and material (1).

HABITS AND CHARACTERISTICS OF RATS AND MICE

There are three species of rats common to the North American continent. They are the brown rat or the Norway rat—*Rattus norvegicus*; the roof rat or Alexandrine rat—*Rattus rattus alexandrinus*; and the black rat or the ship rat—*Rattus rattus rattus* (2). Rats are nocturnal animals. Their principle harboring places are buildings, ships, dumps; wherever there may be a food supply. Contrary to popular opinion, rats are highly selective in their choice of food. They prefer fresh, wholesome, non-decomposed food. The rat is omnivorous but may have a capricious appetite, which poses some problems for the vector control specialist. Rats will, of course, scavenge when necessary.

An important trait of the rat is that of migration. Rats will migrate according to the variation in abundance and accessibility of food and the availability of shelter. Such migrations may be seasonal, for example, from the buildings to the fields in spring and back to the buildings in the fall. Buildings are often vacated permanently when the food source nearby is removed.

There are four subspecies of wild house mice which belong to the species *Mus musculus Linnaeus*. Three of these have been closely associated with man. The subspecies *Mus musculus wagneri* has evolved two commensal forms—*Mus musculus domesticus* and *Mus musculus brevirostris*—which were imported from Europe to the United States; the former being found in the Northern States and the latter, a smaller type, being found in the Southern States. There are, in addition, about 250 different forms of native mice in the United States; among them are the very prevalent white-footed and meadow mice. House mice vary widely in color, but generally are tawny to dark grey

on the back, with the color changing to an ashen grey on the abdomen. Their eyes are smaller than the native white-footed type; the feet are shorter, broader and darker; and the tail is shorter. House mice all have very much the same habits.

Mice are able to flourish in extremely hot or cold temperatures, and can exist in a variety of habitats ranging from tunnels beneath foundations to boxes of stored goods left in attics. They have keen senses and are excellent swimmers and climbers. They are omnivorous, but prefer seeds, grains and cereal products.

ENVIRONMENTAL SANITATION AS A FACTOR

Good general sanitation, insofar as rat control is concerned, entails a continuous program of rubbish and debris clean up, in proper sequence and relationship to the exterminating phase of the program. Adequate garbage and refuse collection, storage and disposal is also mandatory. There are a number of satisfactory disposal systems. The one that seems to be most popular throughout the United States is the Sanitary Landfill. This system combines good sanitary practices with good reclamation practices.

The Sanitary Landfill becomes a most effective part of the insect and rodent control programs of the modern community (3). It gives the city a profound psychological advantage to be able to show that it has taken the lead in removing a focal point of vector infestation; and in addition, plans to turn what very likely may be an insanitary, odorous, fly and rat breeding haven, into a clean and eventually useful piece of land.

RAT-PROOFING

The passage of an adequate ordinance requiring the rat-proofing of existing business buildings, of all future buildings, and of all residential buildings is mandatory. Upon inspection, information relative to the art of building out rodents must be given to the owner. This "building out" process is done by eliminating all of the enclosed spaces, such as openings in hollow walls, between floors and under foundations. These are all areas where rodents may live and breed. Property owners and householders should be told to eliminate or block all entrances into buildings via drain pipes, missing bricks in walls, and unflushed doors and windows. They also must be advised that all inadequately protected foundations must be eliminated or blocked. Foundations should be eighteen inches to twenty-four inches deep and have diverting aprons of twenty-nine gauge, galvanized, corrugated iron or sheet metal installed. Windows and grills may be satisfactorily protected by eighteen gauge, one-half inch mesh, galvanized, ex-

panded metal; or sixteen gauge, half inch, galvanized, wire cloth. Cement floors should be at least three inches thick and properly tied in with the foundation. In this connection, it should always be remembered that an adult rat can get through any opening that a man can put his thumb through.

The sanitarian or vector control specialist should not forget that the food supply of the rodents must also be eliminated once the area has been freed of the rats. The availability of food and shelter are of great importance to the rat. A municipality may help the householder starve rats out of an area by passing and enforcing an ordinance requiring that garbage be stored in tightly covered metal containers, which should be kept at least eighteen inches off of the ground. The premises must also be kept free from rubbish, and feeding stations for birds must be eliminated if the householder wishes to keep rats from his property.

EXTERMINATION

Although good environmental sanitation, which includes rat-proofing and the elimination of harborage and food, is still considered a major plank in the platform of a satisfactory rat control program, these tenets must be redefined in relation to the sequence in which they must be used in any specific area. They should not be recommended as steps which must precede the phase of extermination. The first step in the program for a specific area of infestation is that of the destruction of rats, with the steps of cleaning up, building out, and starving out following as preventive measures, to protect against reinfestation.

The anticoagulant rodenticides such as Warfarin ($C^{19}H^{16}O^4$) and Pival ($C^{14}H^{14}O^3$) have proven so effective that the strategy of extermination first and sanitation second has proven feasible. It must be admitted that the idea of considering sanitation as a secondary step, sequentially speaking, is difficult for a professional public health worker to accept. This logic runs counter to all of the training that the writer has received, and contrary to basic concepts instilled previously in my professional training (4).

It has been shown that the susceptibility of various species of rodents differs. Consequently, it is desirable that the lowest bait concentration, consistent with the most effective control, be used in the interest of economy and safety. Anticoagulants are highly effective rodenticides, and available to the private exterminator and to the government official. These may be offered to the rodent in several highly acceptable forms. The anticoagulant baits may be used for initial rodent control under essentially any conditions. A minimum baiting period of two weeks is

recommended (5).

Field tests indicate that the roof rat requires the use of a concentration of 250 ppm of anticoagulant in the finished bait which contains 0.025% anticoagulant. Satisfactory control of the Norway rat may be had with a concentration of an anticoagulant at 50 ppm. Mice react in the same general way as do Norway rats, although more individual variation is indicated. Where the species of rat involved is not definitely known, or where roof rats are concerned, a concentration of 250 ppm should be used (5).

Commercial concentrates generally contain 0.5% anticoagulant in corn starch. One pound of concentrate (0.5%) must be diluted with 19 pounds of bait to obtain a concentration of 250 ppm. Corn meal and some other ground grains have proven to be acceptable material when repeated use over a period of several days is desirable. Where there are a variety of foods other than bait available to the rodents, the anticoagulants should be offered in water to which 5% sugar has been added.

Mice can be controlled with anticoagulants by using the same exposure techniques that are employed for rat control. Because they are smaller, and eat more often, it is most effective to have a large number of bait stations in their feeding areas. A tablespoonful of bait should be sufficient (5).

SUMMARY AND CONCLUSION

In conclusion, it should be stressed that a municipal rodent control program must:

1. Have adequately trained personnel.
2. Make a preliminary survey to determine the scope of the problem.
3. Properly organize the program to effectively make use of personnel available and data obtained.
4. Operate under adequate municipal ordinances controlling food sources and harborage, by stipulating proper collection and disposal systems, and by setting forth adequate rat-proofing standards.
5. Choose an effective bait, and carry out the extermination of the rodents in the proper sequence.

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