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Earl W. Mortenson
California Department of Health

George L. Rotramel
California Department of Health

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A REGIONAL APPROACH TO RODENT CONTROL IN THE SAN FRANCISCO BAY AREA

EARL W. MORTENSON and GEORGE L. ROTRAMEL, California Department of Health, Vector Control Section, 2151 Berkeley Way, Berkeley, California 94704

ABSTRACT: A federally funded rat control project is being conducted by the Vector Control Section, California State Department of Health in cooperation with local health agencies in the San Francisco Bay Area. Four community demonstration areas were selected in urban poverty areas in the region. The objective of each demonstration program is to reduce the rat infestation to a level that will not have significant adverse health or economic effect. Environmental improvement and community participation are emphasized. Concurrent studies are being conducted to determine the status of anticoagulant resistance, the occurrence of rodent-borne diseases, and the significance of rat infestations in sewer systems. The information gained from the project will provide improved methods and management criteria for rat control programs in the San Francisco Bay Area and other areas of the State with similar rodent problems.

There has been an increasing need for the state of California to seek an innovative realistic solution to the rat problem in urban poverty areas (Ecke, 1970). The close association of people living in substandard environments with high populations of domestic rodents increases the threat of food contamination, disease transmission and injuries from rat bites. The need to develop community oriented rat control programs emphasizing environmental improvement becomes even more critical in the light of recent evidence (Jackson et al., 1975) indicating that rat and mouse populations are developing resistance to anticoagulant rodenticides. Continued unilateral reliance upon rodenticides will continue to cause control failures into the future.

The availability of federal funds through Section 314e of Public Law 89-749 from the Department of Health, Education, and Welfare afforded an excellent opportunity for the State Department of Health to develop a community demonstration rat control program in urban high risk areas in the nine county San Francisco Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties).

In June 1974 the State Department of Health was awarded a grant for an initial 3 year period to continue selected aspects of the Rat Control Environmental Improvement Project previously conducted by the Bay Area Health Association. The grant also made it possible to contract with local public health agencies to conduct rat control demonstration programs in East Palo Alto, the Mission District of San Francisco, the City of Richmond, and East Oakland. The Public Health Service guidelines for applicants securing grant funds require selected urban poverty areas with an exterior rat infestation that exceeds 6% of the premises. The guidelines further stipulate that the majority of personnel recruited to carry out the rat control programs must be from the selected demonstration areas.

The basic goal of the project is to reduce rat populations and the environmental conditions responsible for rat infestations in substandard urban areas to a level that will not have a significant public health or adverse economic effect. Specific goals established by the Public Health Service for projects receiving federal funds specify that not more than 2% of the premises should show active exterior rat sign, not more than 15% of the premises should have evidence of exposed garbage, and not more than 30% of the premises should have substandard facilities for refuse storage. A program area attaining this degree of environmental improvement is considered to have reached a maintenance level. An additional basic goal is to provide improved methods and management criteria for rat control programs in the county and city health departments in the San Francisco Bay Area -methods which have been developed and applied successfully in the Community Demonstration Programs. These methods and procedures are also expected to serve as models for other areas with similar rodent problems.

The more immediate objectives of the project are: (1) to provide technical guidance to the Community Demonstration Programs from the standpoint of vector control technology, program evaluation, solid waste management, community health education, training, data analysis, vector identification and disease detection; (2) to undertake studies in cooperation with Dr. William B. Jackson of Bowling Green State University to evaluate the susceptibility levels of rats and mice to anticoagulant rodenticides; (3) to document the

nature and extent of rat infestations associated with sanitary sewer systems, and the relationship of these populations to above ground rat infestations in the demonstration areas and other areas of the region; (4) to improve the refuse storage and collection practices in the region; and (5) to evaluate the disease potential associated with domestic rodents and their ectoparasites.

COMMUNITY DEMONSTRATION ACTIVITIES

Qualified personnel for the field supervisor, environmental aide and the clerical positions in each of the four Demonstration Programs are residents of their respective target areas. Field personnel are given an initial two weeks of orientation and intensive training by State Health Department and local health agency staffs in rat control techniques, survey methods and community relations. Additional time is devoted to on the job training and visits to operating rat control programs in local health agencies. Field supervisors receive specialized training in personnel management.

An initial comprehensive survey is made by Environmental Aides in each of the demonstration areas to determine the location and extent of rat infestations, to record the degree of improper garbage storage and the magnitude of other food sources, to document the availability of rat harborage, and to determine the accessibility of rats to the interior of dwelling units throughout each program area. The size of the four Demonstration Program Areas varies from 166 to 428 blocks. The East Palo Alto area has 174 blocks, the San Francisco Mission District includes 282 blocks, the Richmond area covers 428 blocks and East Oakland comprises an area of 166 blocks. Survey data are recorded on a field form (Fig. 1), and are analyzed to determine the nature of environmental defects and the characteristics of rat infestations. The levels of rat activity and refuse deficiencies are recorded on city maps.

Based on an analysis of the initial survey information, follow-up visits are made to each problem premises to discuss alternative solutions with householders. Special efforts are made to demonstrate rat proofing techniques, to eliminate food sources and to place traps or rodenticides on premises having active rat infestations. Control efforts are carefully timed to correspond with the removal of food sources being undertaken immediately prior to poisoning or trapping and followed by the elimination of harborage. The program staffs and residents cooperate in removing accumulations of garbage and rubbish from vacant lots and public rights-of-way during initial area-wide cleanups. In addition, refuse bins and special curbside service are provided in a planned block-by-block rotation to remove bulk discard items that have accumulated in the residences. This is a supplement to the regular one can per week basic refuse collection service. The direct rat killing and rat proofing services, along with community cleanup activities, are particularly important in the early months of a program in order to demonstrate that active, visible steps are being taken to control the problem. The level of citizen cooperation and participation in the program increases significantly after the program staff has demonstrated what can be done.

After the initial control effort, each target area is surveyed twice a year to determine the degree of improvements made and to contact new residents. When a code violation is discovered, an attempt is made through education and persuasion to encourage residents to comply voluntarily. If this approach is not successful, the problem is referred to the appropriate local agency for code enforcement.

An important aspect of the activities of each Demonstration Program is the interaction of the program staff with the residents of the area. Each program is encouraged to have a citizens committee that provides advice and helps to guide program activities. Awareness and participation of the citizens is vital to insuring that environmental conditions associated with rat propagation continue to be corrected and that areas which have reached the maintenance level remain at least at that level. Illustrated talks and demonstrations on rat control and sanitation practices are given on a continuing basis by program staff to neighborhood groups, church and service organizations, and to elementary and intermediate schools.

In the East Oakland Program, as part of the base line data bank, a special householder attitude survey was undertaken during the early phase of the program to determine the level of community awareness and commitment. A follow-up survey will determine the impact that personal contacts and educational activities have had on the residents as the program continues.

REGIONAL ACTIVITIES

In addition to the administrative, coordinating, technical guidance and program evaluation role of the State Health Department staff, several technical development tasks have also been undertaken. Since 1971, Bay Area Programs have been collecting rats, largely *Rattus norvegicus*, for anticoagulant resistance testing by the Environmental Studies Center at Bowling Green.

Increasing problems with house mice, *Mus musculus*, in the Bay Area in recent years have focused attention on control failures and the potential for transmission of lymphocytic choriomeningitis virus (LCM) to residents. In 1975 *M. musculus* was sampled from all four community program areas to evaluate LCM virus activity in these areas. Specimens were obtained using snap traps in houses with reported mouse infestation. Mice were placed on dry ice and submitted within 24 hours to the State Health Department's Viral and Rickettsial Disease Laboratory for testing. *M. musculus* have also been sent to the Environmental Studies Center in Bowling Green for resistance testing.

The evaluation of *R. norvegicus* association with sanitary sewer systems, and their impact on above ground rat problems in residences, is being carried out in 12 blocks adjacent to the East Oakland Program Area. The rat population is evaluated by setting live and snap traps, making pellet counts, and observing bait consumption on manhole ledges in the study area. The live-caught rats are toe clipped for marking and recapture and their ectoparasites are removed. The snap trap specimens are weighed, aged, and examined for internal parasites and uterine scars for reproductive information. These evaluation procedures extend over a period of 3 weeks each quarter.

It was discovered during the LCM study that *M. musculus* feeding on anticoagulant grain bait mixed with a blue dye (DuPont Oil Blue A) resulted in a retention of the dye in the fatty tissue. This finding suggested the possibility of using the dye in a nontoxic bait as a marking technique to evaluate rat movement and to test the acceptability of baits. Initial evaluation of the dye technique indicates that Norway rats retain the blue coloring in fatty tissues for several days after one feeding on .025% bait. A separate publication will account for this work.

RESULTS AND DISCUSSION

Results of the initial comprehensive survey of the demonstration program areas indicated the infestation rate of *R. norvegicus* ranged from 8% in East Palo Alto to a high of 28% in Richmond. An analysis of the environmental factors showed an exposed garbage deficiency ranging from 15 to 51%. Accessibility of rats to houses suggested an overall rat proofing deficiency of about 70%. Missing or damaged foundation vents were the most common potential portal of rat entry, followed by openings around utility pipes and electrical conduits leading into houses. A computer analysis of environmental factors associated with rat infestations is being undertaken on data from Richmond. Results to date suggest that exposed garbage is the most significant single factor in support of rat infestation. In the absence of exposed garbage, pet food provides the most important source of food for rats. Abandoned appliances and lumber on ground are the most significant harborage factors.

Surveys of the four Demonstration Programs show the overall progress of Bay Area Programs toward achieving a maintenance level, compared with the national average (Fig. 2). These data indicate that an average program in California, beginning its third year, has achieved 65% of its initial goal and is rapidly approaching maintenance. Rat killing and environmental improvement during the attack phase of the program makes a major impact on community conditions up to the 60 to 70% level. However, the effort and resources required to reach the 80% maintenance level is greater, and once this level is reached, it is considerably more difficult to sustain. As programs approach maintenance, their problems lie primarily with substandard refuse containers, a condition which is extremely difficult to control, requiring a comprehensive community education and code enforcement effort. This situation is illustrated in Fig. 3. When a program area achieves maintenance in 80% or more of its blocks, a verification survey of a random sample of blocks will be conducted by the Vector Control Section and a representative from the U.S. Public Health Service. Grant funds will gradually be withdrawn and the maintenance program will be supported by local funds.

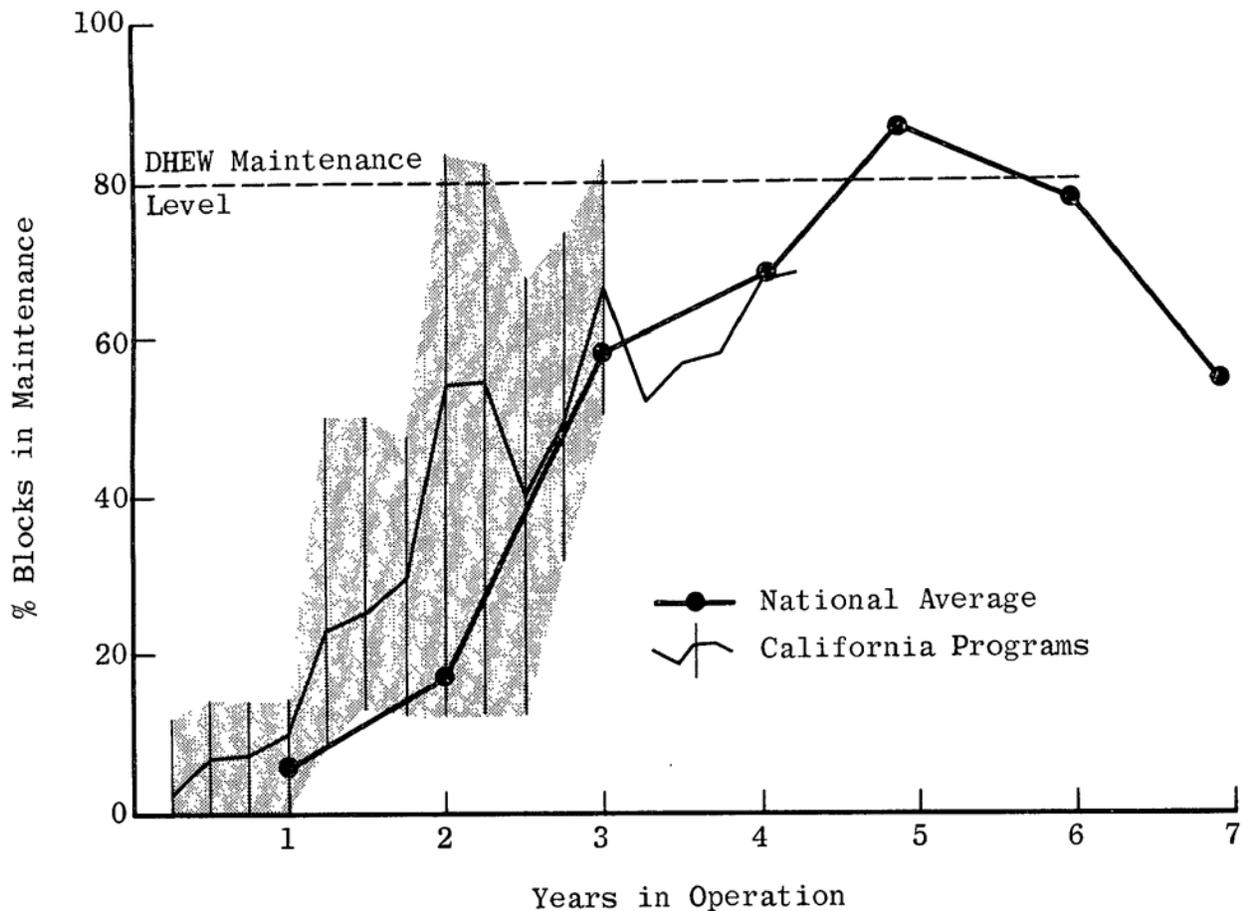


Figure 2. Progress of federal rat control projects toward maintenance.

The contribution of anticoagulant resistance to rat problems in the Bay Area is unclear. Initial samples of *R. norvegicus* collected for resistance testing from the Richmond area suggested about a 10% level of resistance. The rat populations in this area have been subjected to fumarin control for about 10 years. It is difficult to understand why the susceptible level remains static and doesn't increase as one might expect if the population is being selected for the resistance factor. This situation is under study.

The survey results for LCM virus (Fig. 4) suggest that this disease is more prevalent in mice than was expected. The highest infection rate was 15% in mice in East Palo Alto where LCM was found in 50% of the houses sampled. Data for Richmond were 8% of the mice infected in 25% of the houses; for Oakland 8% of the mice infected in 33% of the houses; and for San Francisco 5% of the mice infected in 8% of the houses. These results have stimulated local programs to place increased emphasis on advising residents of the importance of mouse control.

Of the 106 captures of marked rats to date in the East Oakland sewer study, only one Norway rat that had been marked in a manhole was recovered above ground within the same block where it had been marked. This low recovery suggests that there is little movement to and from sewers and perhaps, that this may be limited by increased pressure from the uncontrolled above-ground populations. Another reason may be that the upward movement of rats from sewers is reduced by a low population pressure in the sewers, and the existence of unexploited food resources in the sewers in the wake of periodic poisoning. An understanding of these population phenomena is critical to proper planning of control strategy. A series of field experiments will be performed in cooperation with local health agencies to determine how sewer rat populations relate to the above ground populations under a variety of control regimes.

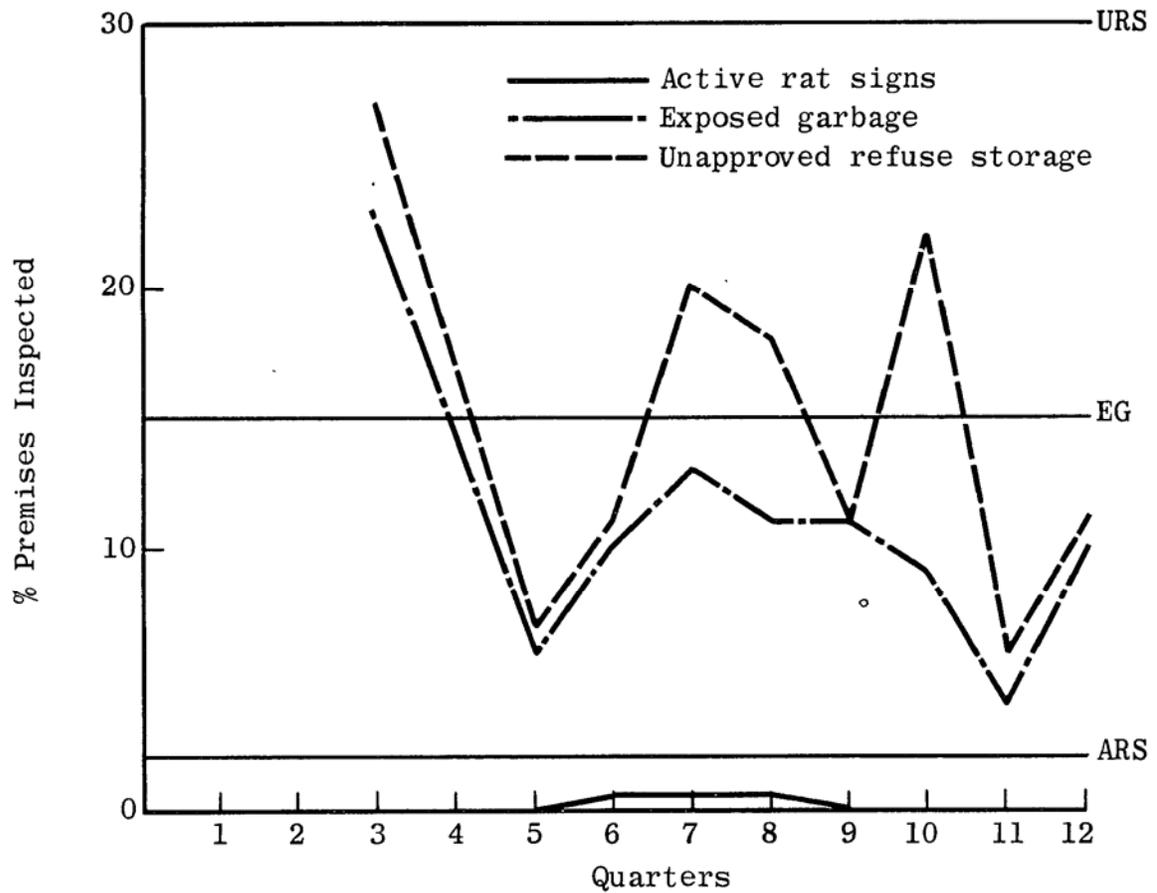


Figure 3. Maintenance Areas

It is our hope, as we progress further with these technical development activities and Community Demonstration Programs, that our results will form a qualified basis for improving control technology and developing the criteria necessary for a comprehensive rodent program in substandard urban areas of the State.

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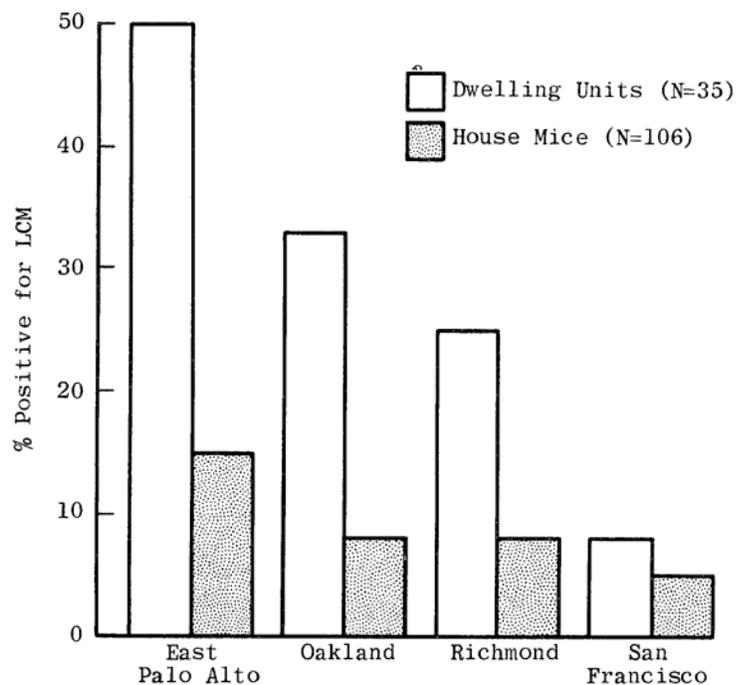


Figure 4. San Francisco Bay Area L.C.M. Virus Survey

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