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## RODENT POPULATION CONTROL FOR PUBLIC HEALTH AND SAFETY

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**ABSTRACT:** Rodent populations - particularly those that live in close proximity to man - constitute a perennial and often severe threat to man's health as reservoirs and often as direct sources of infection for a wide variety of viral, rickettsial, and bacterial disease producing agents. The following will discuss the place of rodent population reduction for the control of plague, a bacterial disease of rodents transmitted by fleas endemic in the western United States.

Bubonic plague was first detected in North America in 1900, coincident with a worldwide pandemic which produced cases on every inhabited continent. Although the epidemic form of the disease is associated with rats and rat fleas, it was isolated from California ground squirrels in 1908 and subsequently traced as an infection of wild rodents and their fleas to as far east as the 100th meridian. Rat-borne epidemics occurred in both Pacific and Gulf Coast ports until the early 1920's.

The epidemic phase in North America ended with the last rat-borne epidemic in Los Angeles in 1924. Nevertheless, isolated individual cases continued to occur - almost all of them contracted from wild rodents, rabbits, or wild rodent fleas. From 1925 to the mid-1960's, human cases averaged somewhat less than two per year. In 1965, seven cases occurred on the Navajo Reservation in western New Mexico and northeastern Arizona, plus one case from northern California. This was the beginning of an increase in human cases with cyclic peaks at about 5-year intervals as shown in Figure 1. From 1974 through 1977 there were 62 human plague cases from the western United States, all attributable to wild rodent or rabbit sources, as many cases as occurred during the previous 25 years. Concurrent with the increase

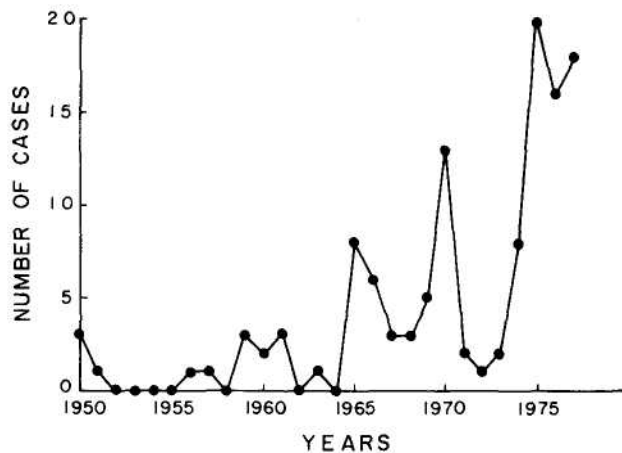


Figure 1. Confirmed human plague infections in the United States by year, 1950 - 1977.

in cases, an eastward shift occurred; California case occurrence remained about the same and most of the increase occurred in the southern Rocky Mountain area, particularly New Mexico (Figure 2). Much of our effort during the past 10 years has been directed toward defining the disease in the southern Rocky Mountain focus in order to develop predictive surveillance methods. We also are faced with the need for development of both short-term and longer term control methods for the prevention of human cases.

Rat control programs, both urban and rural, have been instrumental in reducing and almost eliminating the hazard of epidemic plague in the United States and other developed countries. These programs have evolved over a long period of time and have been accompanied by increased economic capability, improved control technology, increasing standards of sanitation, and increasing intolerance on the part of the public toward rats in the environment. Such capabilities and attitudes at state, local and individual levels constitute the major barrier between the endemic plague focus involving wild rodents and the reoccurrence of epidemic plague in western cities.

Wild rodent control, on the other hand, has had mixed success in reducing rodent-borne disease and often has been viewed with skepticism by the scientific community, the public, and environmental groups. California is the only state which has consistently exerted control measures against wild rodents for plague control. The program, which began early in the century with the avowed objective of "eradicating" plague by the destruction of California ground squirrels, failed to achieve this sweeping goal, but, nevertheless, continued until recent years on a management basis in conjunction with agriculturally oriented programs. Plague cases have not increased in California for the past 50 years despite a vast increase in human population and a continuing high level of plague activity among

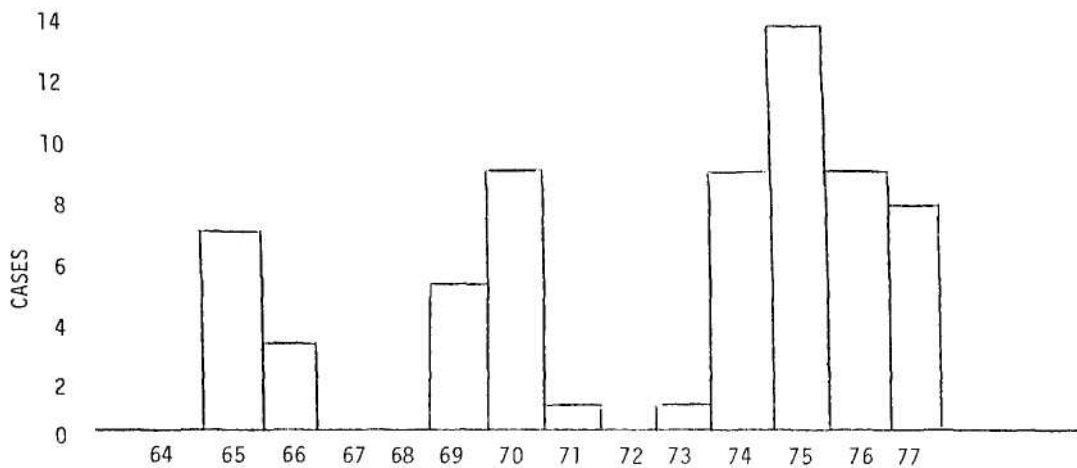


Figure 2. Human plague cases in New Mexico by year, 1964-1977.

other rodent species in the state. Epidemiologic investigations of cases acquired from wild rodent sources in California since 1908 have shown that the California ground squirrel and its flea, Diamanus montanus, have played a dominant role as reservoirs and as rodent to human vectors, respectively. In contrast to California, the southern Rocky Mountain focus (northern New Mexico, northeastern Arizona, and southernmost Colorado and Utah) produced 53 of the 62 cases which occurred in the United States from 1974-1977. The majority of these cases have been epidemiologically associated with epizootics among rock squirrels, a close relative of the California ground squirrel, and the flea, Diamanus montanus, which it shares with the California ground squirrel.

Many other rodent species in other foci in the U.S. are subject to plague infection and epizootics and many of their fleas are good rodent-to-rodent vectors, but relatively few human cases result from such sources. When cases are acquired from them, they most often occur as a result of direct contact with infectious body fluids during the handling of a sick or dead animal rather than from flea-bite, the usual means of transmission. One exception is found in the Sierra-Cascade area in California where chipmunk fleas appear to be an important vector.

Control programs by State and Federal agencies in the southern Rocky Mountain focus have consisted of public education oriented toward evasion of potentially hazardous situations, issuance of insecticides to treat domestic dogs for wild rodent fleas which they might carry back to their owners, and insecticidal control actions against fleas in areas where a case or an epizootic is identified and people are at risk. No organized control program has been undertaken against rock squirrels in the southwest despite the fact that their populations are highly amenable to environmental and rodenticidal control actions. Rock squirrels tend to live in clusters or small aggregates associated with man-made harborage or along washes, canyons, and river bottoms. Nowhere are their populations widespread and diffuse as with the California ground squirrel. Removal of man-made harborage accompanied by rodenticidal reduction of populations along the dry stream beds that intersect many southwestern towns could significantly reduce the potential for human exposure to plague.

The contrast between California and other southwestern states with regard to wild rodent control may be attributable, at least in part, to differences in public values and attitudes toward the animals involved. California has a background of 70 years of ground squirrel control during which the populace and public agencies have come to consider the California ground squirrel as a pest and a potential health hazard. California ground squirrel infestations are rarely tolerated around residences and in public areas. Both local and state agencies exist to assist residents in coping with the problem much as they would assist with a commensal rodent problem. The fact that California ground squirrels are well-known as an agricultural pest also contributes to the public attitude toward them. Conversely, rock squirrels in the southern Rocky Mountain region are not considered a pest species, do little damage to agriculture, and are accepted by most residents as a normal and attractive part of the biota. Infestations near residences and public areas are viewed as part of nature even though human artifacts such as rock walls, refuse piles, and streamside rip-rap encourage their presence and increase local population densities. The southwestern life style includes a tendency to "live close to nature", thus the poorest to the wealthiest seek to live in a "natural" rather than an artificially landscaped setting. Proposals to control rock squirrels in this setting by the use of rodenticides are certain to encounter significant resistance from environmentalists. Nevertheless, a program combining environmental management and rodenticidal control is being considered by several agencies.

The above comparison suggests that recent strong environmentalist pressure against California ground squirrel management in the state, while well-intended, is ill-advised. Those who conduct such programs obviously should be required to carry out their operations in a scientific and environmentally safe manner. It should be equally clear that the management of known plague reservoir and vector

populations in an area of high human contact is a primary obligation of health authorities. Well-planned, effective and cost-efficient rodenticidal control is indispensable in carrying out this obligation and it makes little sense to abandon it in the face of unilateral opposition.

The development of high rodent populations, particularly of the smaller sciurids such as Eutamias spp., Spermophilus lateralis, S. richardsoni, and others in response to feeding by tourists in western montane recreation areas is by now a commonly recognized problem. Our experience indicates that such areas typically support four to five times as many rodents as do ecologically similar areas without tourist food input. Such populations are more subject to epizootic plague morbidity and mortality than are lower density populations in natural habitats and as a result the plague organism is amplified, leading to greatly increased human exposure potential.

Rodent control has been suggested as one means of reducing risk of human exposure to rodent-borne diseases in such situations but to date little has been done about it. One example of attempted rodent population reduction in a Rocky Mountain montane recreation area serves to illustrate the necessity for investigation and careful planning before such programs are undertaken. In the area in question, Spermophilus richardsoni were extremely abundant in a large campground located in a meadow-open ponderosa pine edge habitat at 7700 feet elevation. Other prominent species present were S. lateralis and the chipmunk, Eutamias minimus. In 1974, a bubonic plague epizootic was detected among S. richardsoni and S. lateralis in the campground. The facility was closed to permit insecticidal control measures to be carried out, then reopened. In the summer of 1975, the epizootic recrudesced, again necessitating control actions. The S. richardsoni population suffered an estimated 10 to 20 percent mortality from plague during the second epizootic.

In the spring of 1976, approximately 1200 S. richardsoni were removed by shooting from the campground area during the mating season, causing a drastic and obvious reduction in animals present. The effect, however, was nullified in a matter of weeks by in-migration from adjacent populations. In the spring of 1977, a similar shooting spree was carried out. The second year effort significantly reduced S. richardsoni, but S. lateralis and Eutamias minimus from adjacent areas immediately migrated into the ecotone formerly dominated by S. richardsoni. These observations were based on the results of trap and release studies on ear-tagged animals within the campground and in adjacent areas. The complete results will be published elsewhere.

Differences from one place to another in the species composition and structure of rodent populations, the natural habitat plus its manmade alterations, and the impact of human usage must be considered carefully before control strategies are selected. Rodent control represents only one of several alternatives which should be considered. At the present time, public education, surveillance, closing of campgrounds, and insecticidal control of fleas are the primary tactics used for plague prevention in montane recreation areas. Rodent population management remains an attractive alternative for the long-term prevention of human disease in such areas; but at the present time, we simply do not know how to plan and carry out an effective program against the small sciurids which, with their fleas, serve as sources of human plague infection in western montane recreation areas. The need for appropriate research, planning, and for the use of sound judgment and common sense before rodent control is attempted is apparent.