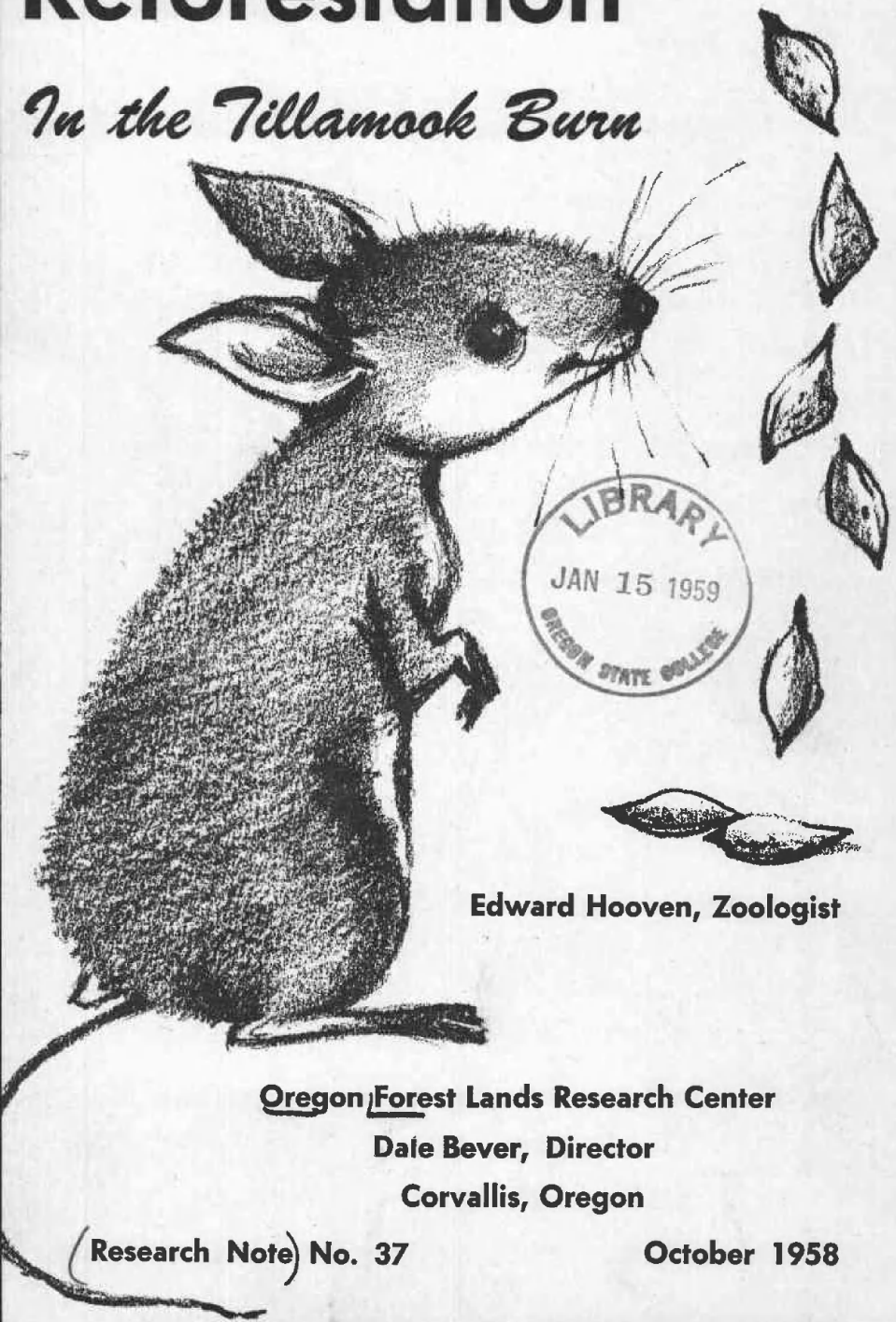
Deer Mouse and Reforestation

In the Tillamook Burn



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Research Note No. 37 **October 1958**

Forest Lands Research Center

. . . Its Purpose

Develop the full potential of Oregon's timber resource by:

increasing productiveness of forest lands with improved forest practices.

improving timber quality through intensified management and superior tree selection.

reducing losses from fire, insects, and diseases—thus saving timber for products and jobs.

Keep development of the forest resource in harmony with development of other Oregon resources.

. . . Its Current Program

Seed production, collection, extraction, cleaning, storage, and germination.

Seedling production, establishment, and survival for new forests.

Growth and development of trees, quality of growth, and methods of thinning and harvesting to grow improved trees.

Study of forest fire behavior and fire weather to prevent fires.

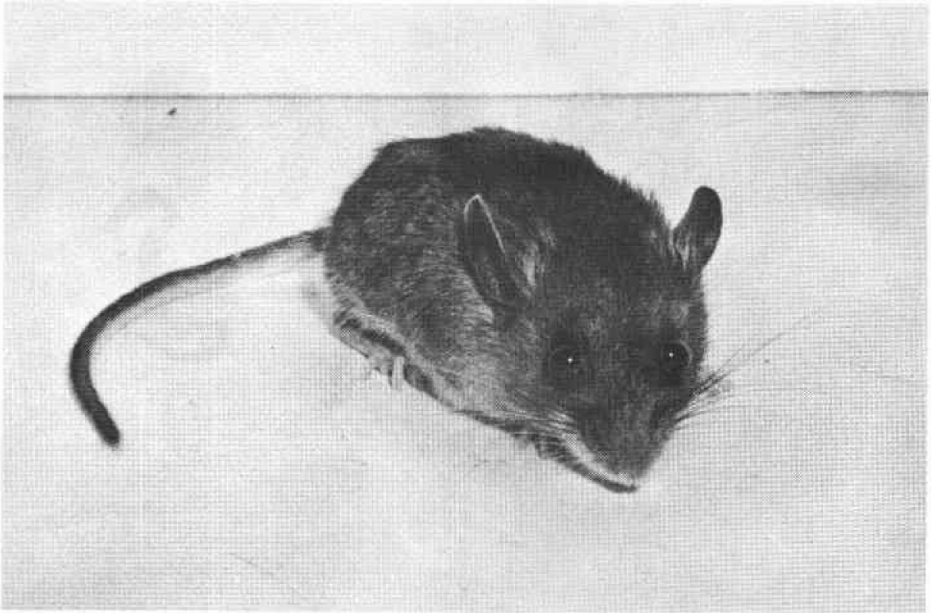
Insect pests and their control, to save trees.

Disease control and prevention in Oregon forests.

Mammal damage and the controls to help regrowth.

Soils and their relationship to growth.

Development of improved forests through selection and breeding.



Peromyscus maniculatus rubidus (Osgood), approximately six months of age.

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To
Al Moore
United States Department of the Interior
Fish and Wildlife Service, Retired

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Introduction

The white-footed deer mouse, *Peromyscus maniculatus rubidus* (Osgood) (frontispiece) destroys more coniferous tree seed than any other small mammal in western Oregon. It has an enormous capacity for coniferous tree seed, eating it on the spot or storing for future use. This seed-eating characteristic of the deer mouse presents a serious problem in the rehabilitation, by natural or artificial means, of nonstocked forest lands.

Seed sown for reforestation usually is applied during the fall. An interval of approximately six months elapses before germination, and it is during this time the destruction of the seed occurs by the white-footed deer mouse. Only two mice per acre, each eating 300 Douglas fir (*Pseudotsuga menziesii,* [Mirb.] Franco) seed per night, in approximately 35 nights can consume the one-half pound of seed per acre usually sown in artificial seeding.

Little information is available concerning the habits of the white-footed deer mouse in relation to seedling establishment. The purpose of this study is to add to the available information so those concerned with reforestation may be better able to cope with the problem this rodent presents. These data are considered necessary so control methods now in use, and those yet to be tried, may be coordinated with an accurate knowledge of the habits of the species.

Observations reported were taken to seek answers to the following questions concerning population fluctuations of the white-footed deer mouse:

1. What is the composition of the small mammal community inhabiting the same general area?

2. What is the normal population and the population fluctuation of *Peromyscus m. rubidus* for a given area throughout the year?

3. What is the average home range of *Peromyscus m. rubidus* for a given area throughout the year?

4. What is the general life span of *Peromyscus m. rubidus* for a given area throughout the year?

In the winter of 1952 a plot of 100 acres was established in northwest Oregon in the "Tillamook Burn." Douglas fir seed was sown by helicopter, at the rate of one-half pound per acre. The seed had been treated with a nonphytotoxic rodenticide, tetramine (Tetramethyl disulpho tetramine), to inhibit consumption by rodents. The number of germinants was more than satisfactory from the practical standpoint of the forester, resulting in 650 seedlings per acre one year after aerial seeding, It appeared that protection of the seed would result without destroying the original mouse population on the area. These observations could not be verified, however, because no control plot had been established for comparison

and no thorough study of the small mammals was made.

In 1953 a further study of the effectiveness of tetramine, as a protectant when applied directly to viable tree seed, was initiated. Four plots were established. Two were sown with plain untreated Douglas fir seed and two were sown with tetramine-treated seed (figures 1 and 2). The study described in this report of the white-footed deer mouse was conducted on these same plots.

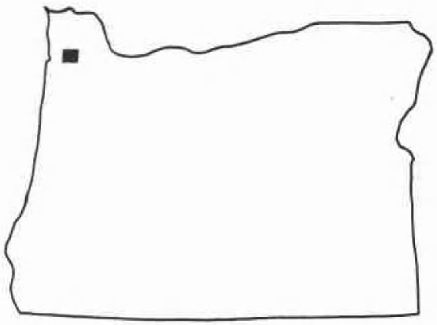

FIGURE 1. Location of Tillamook Burn.

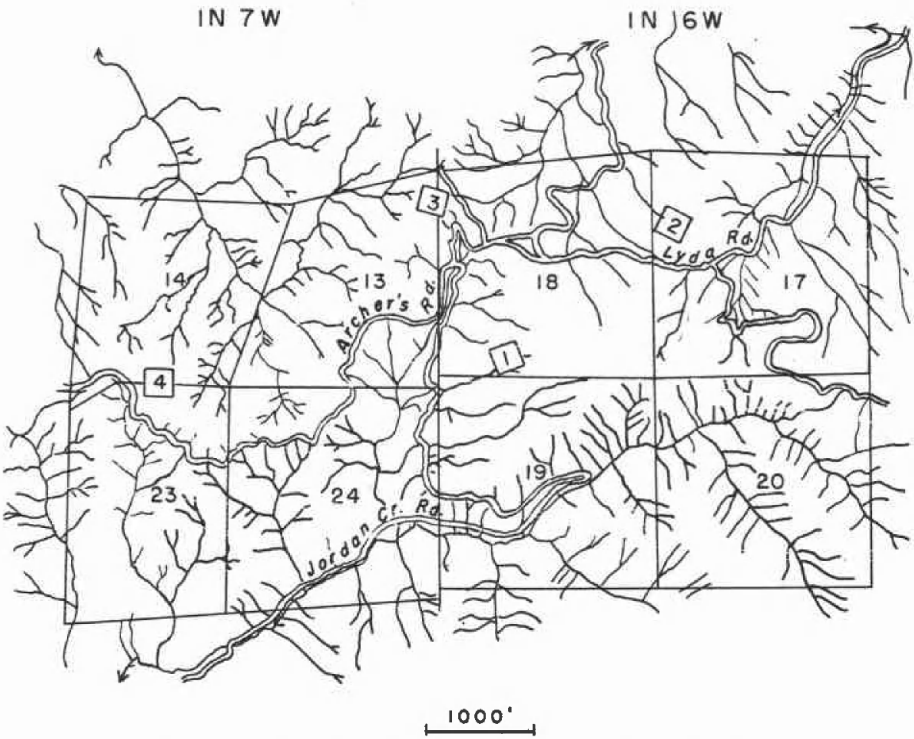

FIGURE 2. Map of general study area.

Review of Previous Studies

Distribution

Peromyscus maniculatus (Osgood) is the most widely distributed species of the genus. The species occurs from the Pacific Ocean to the Atlantic Ocean and from the barrens of the Arctic Circle to the humid jungles of southern Oaxaca, Mexico. It is a formative group zoologically since it has been modified into 43 geographical races or subspecies. The subspecies *Peromyscus maniculatus rubidus* (Osgood) displays the generic characteristics of adaptability. It inhabits the humid Pacific Coast regions from the Columbia River to the San Francisco Bay area and eastward to the Cascade mountains. It occurs from near sea level to altitudes well above timberline. It usually outnumbers any other small mammal with which it happens to be associated.

Food

The deer mouse also has a very adaptable appetite. Four varieties studied in captivity all ate readily of the seeds, fruits, and nuts of 51 plant species, the buds and bark of 16 species of trees and shrubs, and 20 groups of insects and animals. One researcher examined the stomachs of 526 mice and concluded that their diet does not differ markedly by seasons except for the addition of fruits in the summer. Another found that in the Pacific Northwest coniferous seed was readily eaten by deer mice, especially the seed of Douglas fir. Others found that although 44 species of mammals and 37 species of birds feed on coniferous seed, *Peromyscus* is the most widely distributed and does the most damage.

Effect on reforestation

One of the first known attempts at reforestation by the direct seeding method was in northern California. One of the major factors contributing to its failure was that of seed-eating animals. Other trials have had mediocre results or were complete failures. Experiments in Arizona showed that few seedlings, if any, would become established where deer mice were present. Other experiments proved that either the deer mouse had to be controlled or seeding abandoned. Other studies also indicated the necessity for rodent control in British Columbia.

Importance of control

It has been found that protecting a seeded area from animals would result in adequate restocking. Various methods of control have been evolved, such as screening seed spots and offering various lethal baits. Among the baits that first showed promise of good control was wheat treated with either thallous sulphate or sodium fluoroacetate (1080). The success of these rodent control projects further illustrated the extent of the destruction of tree seed by the deer mouse on logged or burned over lands.

Life history

The white-footed deer mouse is dark colored and large for the *maniculatus* group. The upper parts are dark brown to ruddy, the underparts white. An adult specimen weighs approximately 19 grams, and has an overall length of about 17 centimeters. The ears are large, measuring about 1.4 centimeters

from notch to tip. The hind foot reaches its maximum length in 36 days, but overall lengthwise growth continues rapidly until the seventh week, at which time it levels off and the animal does not reach its full weight and length until it is about six months old.

Females of the genus *Peromyscus* are polyoestrous. Although the female reaches sexual maturity in seven weeks, she does not conceive until she is about 10 weeks of age. The males become sexually active about nine weeks after birth. Although young mice may be found throughout the year, the breeding season usually is restricted to the seven-month period between April 10 and October 31. However, the species becomes sexually quiescent in midsummer. Peaks of reproductive activity occur from February to June and often again in August and September. The gestation period varies from 22 to 35 days. Litters average four young, which weigh about 1.72 grams each. The eyes open in 15 days and in about 30 days the young are weaned. Since the females are polyoestrous, they generally conceive within a few hours after dropping a litter. However, a female usually has only two litters in the spring and two in the fall.

Marking methods

Marking methods have varied with different workers, depending upon the species under observation. Aluminum tags have been used on muskrats by attaching the tag to the skin between the shoulder blades. Toe clipping and ear punching have been used, but ear splitting can cause loss of identification. Ear tags on beavers usually have been lost before recapture of the animals. Tattooing on the hind feet and tail became unreadable after four months. However, punching the webbing of the hind feet has proved satisfactory. The application of a fingerling tag to the basal joint of the outer toe of the hind foot of the squirrel gave good results, and use of monel fingerling tags and colored pyralin markers gave good results when used as ear tags on the

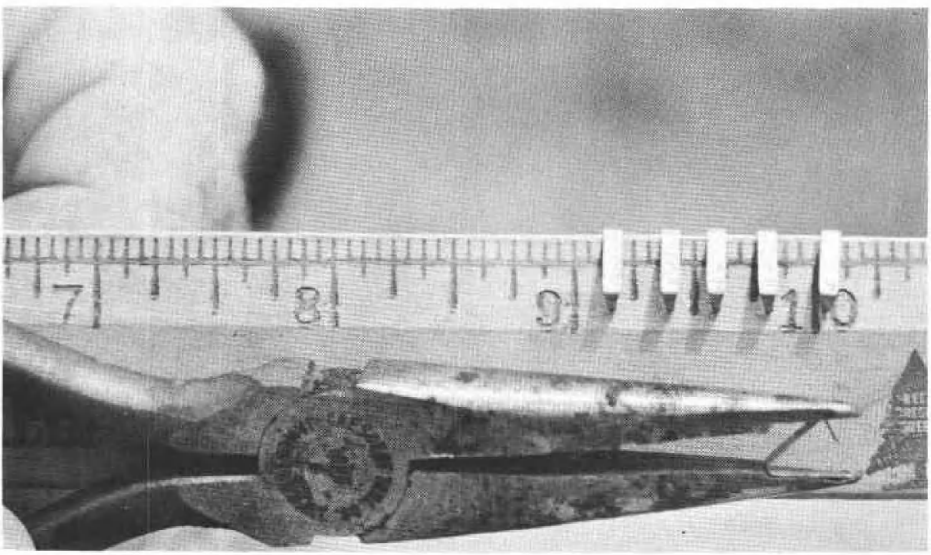

FIGURE 3. Monel fingerling marking tags and pliers for application.

smaller animals. The mammals trapped for the work done in the Tillamook Burn during 1952 were eartagged with monel fingerling tags, numbered from 1 to 1,000. They were easily applied and easily read (figures 3 and 4). No discomfort was noticeable after the original application of the tag, and loss of tags by the marked animals appeared to be few.

Home range

The measurement by trapping of an animal population, per given area, does not give an exact figure. Trapping records reveal only certain selected points of activity. These points of activity do not reveal, to a degree of certainty, the normal activity of the animal, only an area over which an animal enters traps with a greater or lesser frequency. The delineation of home range is affected by food supply, cover, and population density or, basically, the environmental conditions. The reluctance to enter traps affects the degree of success of trapping as does the preference for natural foods when they are in season and when available. The trap location and distance between traps also may affect the numbers caught.

Various methods of computing home range area are in use although modifications depend upon the individual worker. Some workers use an admittedly conservative method of connecting the outside points of capture (figure 5A). If all the points do not lie in a straight line, a polygon will be formed and may be measured on cross-sectional paper upon which the points

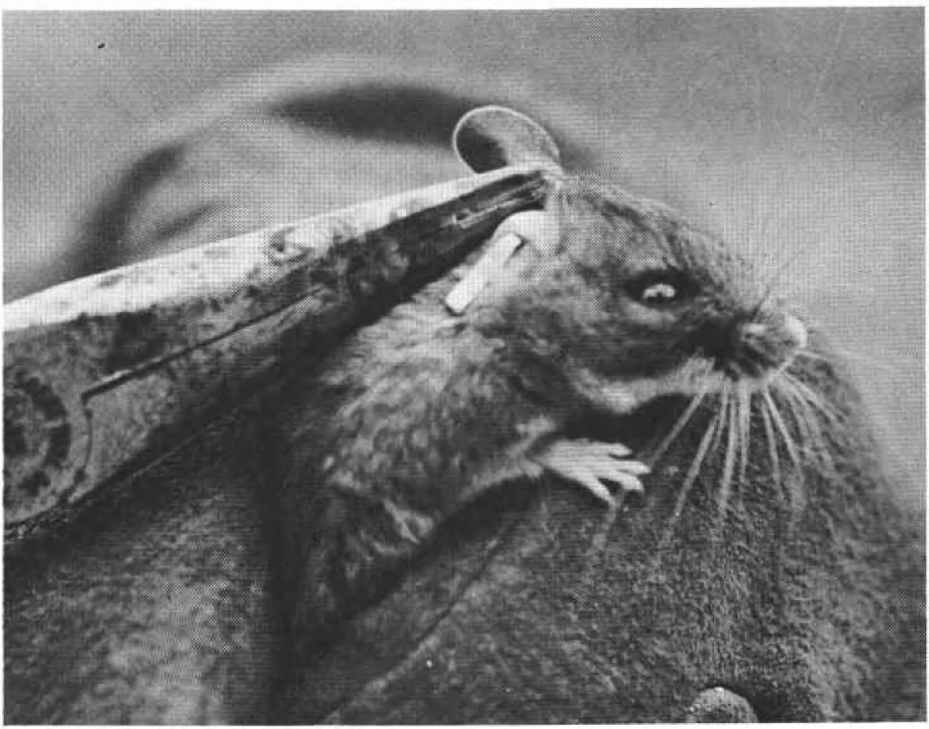

FIGURE 4. White-footed deer mouse with fingerling tag attached to base of ear.

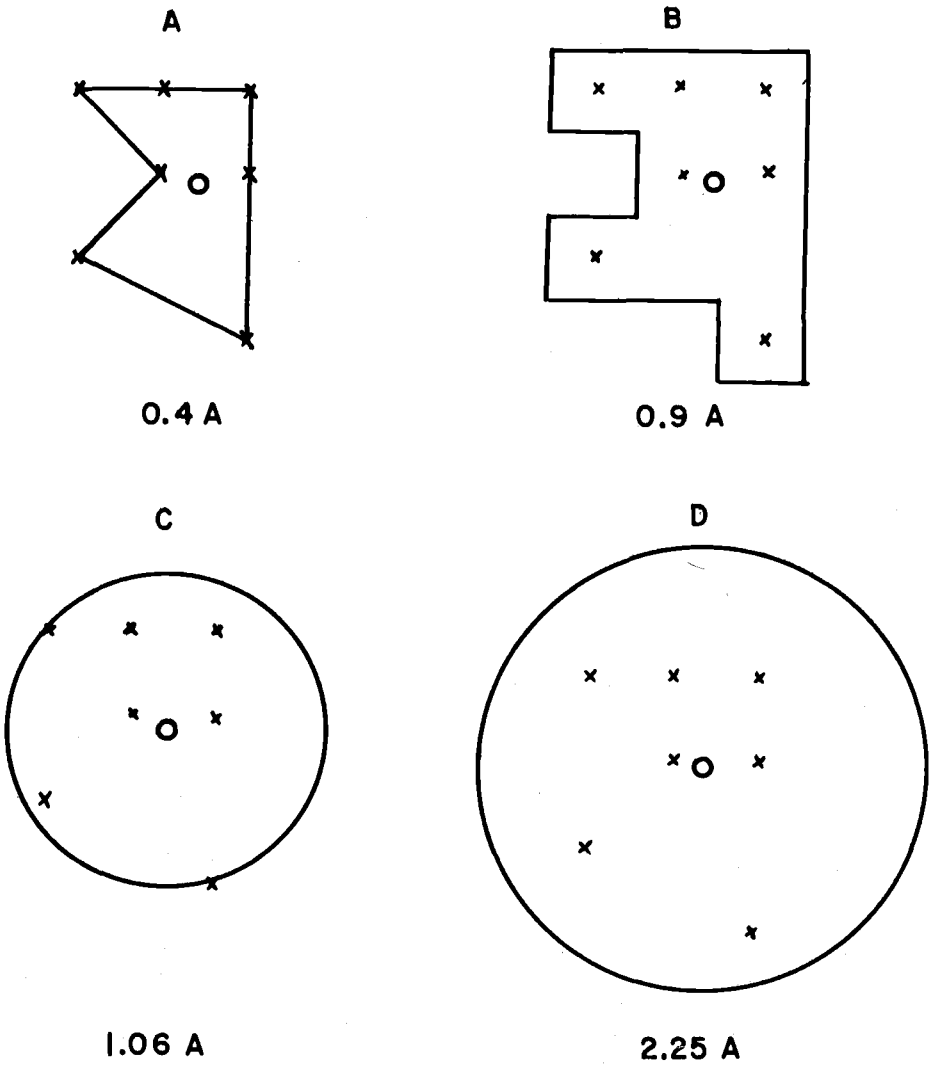

FIGURE 5. Differences in home range area size depend on the method of computation. A = Connecting points of actual capture; B = Connecting points midway to adjoining traps; C = Enclosing points of actual catch by using the distance between the two most distant points of capture as the diameter of a circle around the center of the activity; D = Enclosing points of actual catch by standard deviation of a circular bivariant normal distribution in which the animal will range 95% of the time.

of capture may be plotted to scale. Users of this method believe that the outside points of capture enclose an area of a definite known size. Other investigators credit one-half of the distance to the next trap as part of the indicated home range (figure 5B). Lines then connect the outside corners of the trapsites. Traps within the home range that have not caught an animal may or may not be considered.

Objections have been raised to this method, especially because the boundary area becomes more important as the distance between traps increases. Another method considers the greatest distance between observed points of capture as the diameter of a circle or the major axis of an elipse of the home range area figure 5C). Objections to this method have been on a basis that it assumes the home range to be circular and includes areas where the animal was not trapped.

These home ranges are described with the assumption that the animal caught is to a certain degree restricted to the area in which trapped; i.e., the trap revealed home range. The homing behavior of small animals indicates a greater home range area than that indicated by trapping records. Such behavior is aptly illustrated by the ability of the animal to return over great distances to its home range area.

Population measurement

Generally all trapping of deer mice has been done with snap traps or various forms of live traps. In recent years the Sherman Museum live trap (figures 11 and 12) has given good results and is now being used extensively. Some researchers do not believe snap trapping is a valid method for determining the size of actual population. However, in a comparison of the two methods, it has been concluded that both were reliable for indicating the size of a mouse population.

Area Description and Methods

Description of area

Four experimental plots were located in the Tillamook Burn in northwest Oregon west of the summit of the Coast Range. Geologically this area dates back to the middle and upper Eocene, approximately 40 million years ago. The bedrock is of the Tillamook volcanic series, overlayed by tuffaceous shale formed from volcanic dust that settled, presumably, while most of the present land area was submerged. The shale weathers rapidly and rains have eroded the land into many steep slopes.

With a changing of the original plant life from a virgin stand of old growth coniferous forest to bracken (*Pteridium aquilinum* [L.] Kuhn) and trailing blackberry (*Rubus vitifolius* C & S) interspersed with willows (*Salix* spp.), the character of the soil has been radically changed. Little or no humus remains and finer textured soil particles tend to move down the slopes during prolonged fall and winter rains. Little moisture remains in the upper A_1 horizon during dry summer months at a time when moisture is needed for seedling development. Prevailing winds are generally from the west or southwest. Winter months are characterized by heavy rainfall and high humidity (figure 6). The total precipitation, measured at a central point within the sample area, was 117.34 inches in 1953 and 92.31 inches in 1954. Temperatures are usually mild,

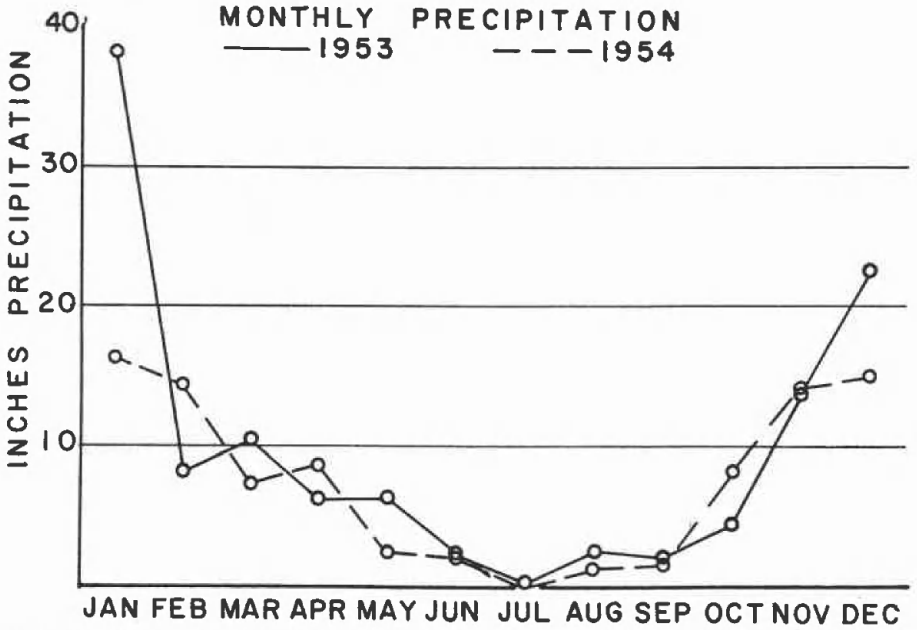

FIGURE 6. The total precipitation, measured at a central point within the sample area, was 117.34 inches in 1953 and 92.31 inches in 1954.

although snow occurs sporadically above the 2,000-foot level, especially during January, February, and March.

Description of study plots

Four, square ten-acre plots were established in June, 1953. The areas chosen were generally typical of the burn. The plots were established on or near ridge tops, where the slopes were not steep and there would not be excessive wash of the tree seed during winter rains. The corners of each plot were marked by 2-inch by 2-inch by 3-foot yellow cedar stakes.

Density of vegetative cover on the plots was affected by exposure and moisture conditions. Bracken usually was the leading plant cover. On north slopes and in drainages it grew tall and dense. On south slopes it was shorter, the area more open, and trailing blackberry the chief ground cover.

Two of the plots had standing snags scattered over the areas (figures 7 and 8). Snags over 15 feet had been felled on the other two plots (figures 9 and 10). All areas were covered by debris resulting from salvage logging, which consisted primarily of unsalvable material from snags.

Plot treatments

The plots were sown with Douglas fir seed in December, 1953. Two of the plots, "Untreated Seed Plot A" and "Untreated Seed Plot B" were sown with untreated Douglas fir seed. The other two plots, "Treated Seed Plot A" and "Treated Seed Plot B" were sown with tetramine-treated Douglas fir seed. The sowing was accomplished with a cyclone seeder at the rate of one-half pound of seed per acre.

Trapping records for the period

FIGURE 7. Untreated Seed, Plot A. The elevation is approximately 2,000 feet, with a westerly exposure. Several small creeks have cut two minor gullies causing rock exposure. The vegetative cover is composed of moderate to heavy bracken, trailing blackberry, willow, and an occasional red huckleberry. There is some alder along the marshy areas and vine maple on the rocky ground between the creeks. Unmerchantable snags remain, and debris from salvage logging litters the ground.

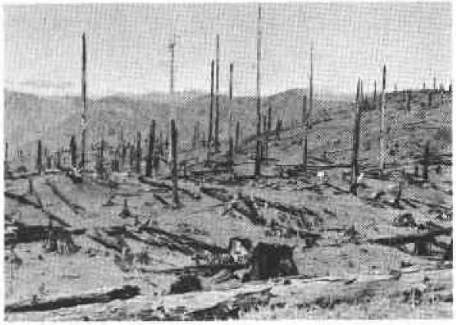

FIGURE 8. Untreated Seed, Plot B. The elevation is approximately 2,000 feet, with a northwest slope. Some igneous rock is exposed. An intermittent stream drains the west side of the area. The principal cover is bracken, trailing blackberry, pearly everlasting, and occasional red huckleberry, and salal. Where the rock is exposed or barely covered with soil, the vegetation declines in density and growth, consisting mainly of blackberry vines and salal. A few willows are along the stream.

FIGURE 9. Treated Seed, Plot A. The elevation is approximately 2,000 feet, with a southeasterly exposure. The ground cover varies from moderate to heavy, consisting of bracken, trailing blackberry, and lupine. A few willows and huckleberries are scattered over the area. When compared to the other test areas, this one is the cleanest of slash debris. All snags over 15 feet had been felled as a fire protection measure.

FIGURE 10. Treated Seed, Plot B. The elevation is approximately 2,000 feet, with a westerly exposure. The ground cover is from moderate to heavy, consisting of bracken, trailing blackberry, and an occasional willow and red huckleberry. All snags over 15 feet had been felled and considerable debris littered the ground. The highest part of the plot contained exposed rock of a crumbly basaltic porphyry.

after dispersal of the seed give no indication that the treated seed had any effect upon the populations. However, the original name will be used when referring to a particular plot.

Trapping methods

After the outside perimeter of each plot was established, 10 lines of stakes were set in each plot, 10 stakes to the

FIGURE 11. Sherman Museum live trap opened to show construction.

FIGURE 12. Sherman Museum live trap opened and baited.

line. Stakes were set at one chain intervals and were used as reference points for the traps. Thus, 100 traps were set per plot, with each trap servicing 0.10 acre.

The traps were Sherman Museum live traps of 22 gauge metal. They were so constructed that the weight of the animal accepting the bait would depress a floor pan which, in turn, released a door that was forced up and closed by a spring (figure 11).

Each plot was trapped once a month, except when weather conditions interfered, such as snow or freezing rain. Usually, two plots were trapped during the same week. Traps were examined daily for three consecutive days for each trapping period. Although a yellow-topped cedar stake marked each trap spot, the trap actually was placed anywhere within 10 feet of the stake. This was done to take advantage of shade offered by logs or stumps as a protection against the heat of the sun (figure 12). Direct exposure of a trap to the rays of the sun tended to raise the temperature of the air inside the trap. Without protection the condition became critical and was lethal to any animal within the trap. Where no protection was available, the trap was covered by a piece of bark or wood. The traps of each plot were examined as early in the day as was feasible.

Each trap was baited with whole oats. Some bait also was sprinkled in front of the trap entrance. Any animal caught was ear-tagged before being released. A record was kept for each animal showing tag number, trap number, genus, species, sex, and approximate age. The ear tags were small fingerling fish-tags of monel, numbered from 1 to 1,000. They were set at the base of the ear with a special pair of pliers.

Population Composition as Determined by Live Trapping (including recatches)

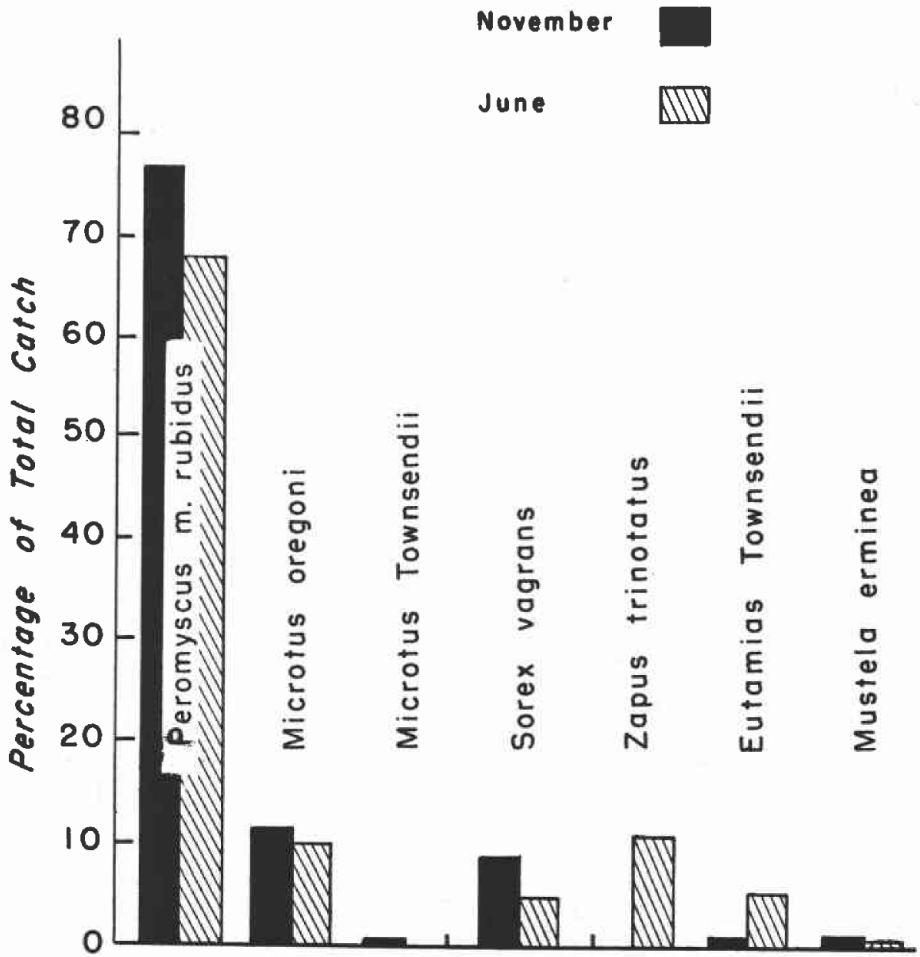

FIGURE 13.

Results

Population composition

The population composition was determined by live trapping. The period of observation on the four plots was from August 26, 1953, until November 23, 1954,—approximately 14 months duration. The total, or absolute, catch of 1,023 small mammals represents animals tagged and released plus those found dead in the traps. About one-half the number, 50.8%, was composed of deer mice (table 1). When the recaptures are included the overall average percent of deer mice present at any one time increases to 73.0% (figure 13).

Trapping upset the status of some of the other small animal species. Chipmunks had the tendency to enter other traps after being released and would die before the traps were checked the following day. For this reason the entire chipmunk population was removed when caught.

The lesser weasels were also found dead unless they were fortunate enough to enter a closed trap containing a mouse. All shrews were found dead when the traps were examined. These factors, no doubt, lowered the reproduction potential of these species.

Trapping mortality did not present a problem except on one exceptionally cold fall night when several juveniles were lost. It is presumed they died from lack of food because of their inability to eat the whole oats used as trap bait. During the summer days a few mice died, perhaps because of the heat, even though all traps were protected from the sun's rays.

Quite often two mice would be found in the same trap, apparently compatible. Neither age nor sex seemingly caused any friction. Their compatibility and adaptability give insight on why the deer mouse makes up such a large part of the total number of small animal population where it occurs.

Population fluctuations

Peromyscus populations usually reach their density peak in November in northwest Oregon as indicated by the trapping results (figure 14). The number of juveniles and young subadults caught indicate that the mice do not reproduce to any extent during the months of January, February, and March (figure 15). The total number of mice also decreases during this period, with an increase in numbers following the resumption of breeding. Total numbers fluctuate for an area with the advent of spring, but with the coming of fall a definite upward trend in mouse numbers occurs. Fluctuation of the catch during warm summer months could be due to reluctance on the part of the animal to enter the traps for bait when natural food was readily available.

Another factor of significance is the periodic turnover or flux of individual mice to and from an area (figure 16). Such a turnover is caused by natural mortality, migration, or predation. Several individuals moved from 1.5 to 2.0 miles airline distance from the plot of original capture over exceedingly rough terrain. Predation must also tend to have a major influence in the constant change of individual members of a given population. The small lesser weasel, while seeming to have no effect on the total population, surely affects the individual. This small predator is

Table 1. TOTAL NUMBER OF INDIVIDUAL ANIMALS CAUGHT ON THE FOUR EXPERIMENTAL PLOTS*

Seed	White-footed deer mouse	Oregon creeping mouse	Shrews	Townsend's chipmunk	Northwest jumping mouse	Townsend's meadow mouse	Lesser weasel
Aug. 26, 1953 to Nov. 16, 1954 Untreated, Plot A	189	55	31	30	45	17	4
Sept. 9, 1953 to Sept. 8, 1954 Untreated, Plot B	86	21	37	28	7	0	3
Sept. 1, 1953 to Oct. 1, 1954 Treated, Plot A	141	68	32	14	9	0	8
Oct. 20, 1953 to Nov. 23, 1954 Treated, Plot B	104	32	17	26	8	1	10
Sub total	520	176	117	98	69	18	25
Percent of total	50.8	17.3	11.5	9.6	6.7	1.7	2.4

* One Gibbs mole was caught on Treated, Plot A, but is not included above.
Gray diggers, while fairly numerous, were too large to be caught in live traps.

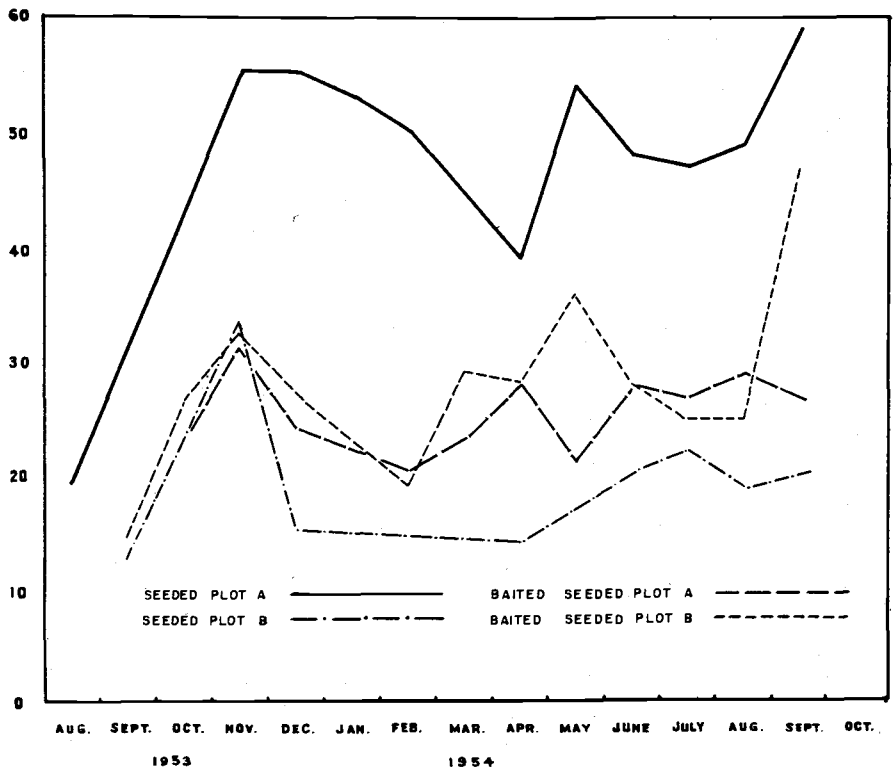

FIGURE 14. Total catch of *Peromyscius m. rubidus* per trapping period by plots.

not uncommon in western Oregon and often was found in a trap with its prey's remnants, usually fur and the identifying ear tag. Other predators were bobcats and coyotes, identified by their tracks. Owls and hawks also were noted on the study plots.

Sex ratio of trapped *Peromyscus*

The total catch of deer mice on the four plots consisted of 46.3% females. While the trapping period ratio between sexes varied, the differences were not extreme (figure 17). A study of the mice recaptured from any previous trapping period indicates that the percentage of recaptured females was also relatively stable. None of the trapping period records show that a mouse was reluctant to reenter a trap or that trapping affected the sex ratio. Thus, the live-trapped population consisted of slightly more males than females. Neither were unduly influenced by live-trapping.

Peromyscus reproduction

Age groups of the mice were set in an arbitrary manner. Those caught in gray pelage and of approximately four to six weeks of age, indicating they were just leaving the nest, were recorded as juveniles (j). The next group, obviously more mature and of about 7 to 10 weeks of age, were recorded as small sub-adults (sa). Adult animals not having the bright brown

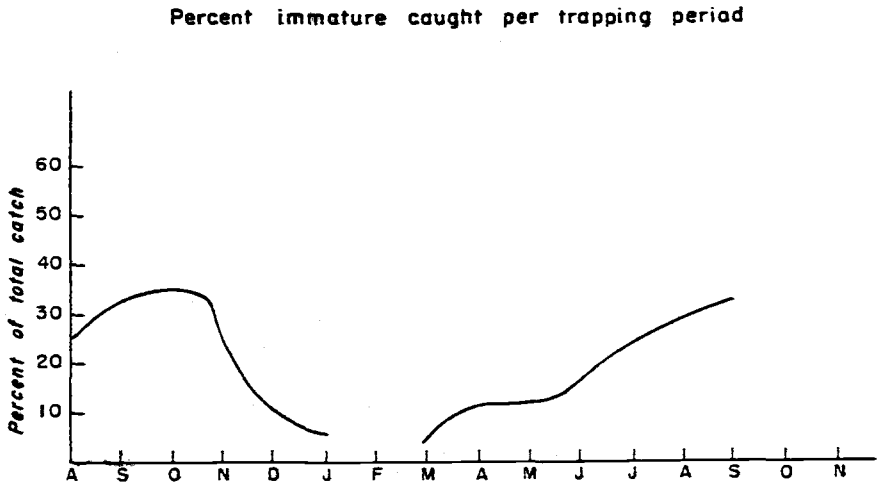

FIGURE 15.

pelage were recorded as large subadults (SA), and those having the bright pelage were termed adults (A). From observations and findings of other investigators, it has been concluded that sexual maturity cannot be used as a criterion of actual age of mice trapped. Therefore, the foregoing technique is not exact, but observations on animals periodically trapped on the plots for a year led to the conclusion that bright brown pelage does not become prominent until after the animal has reached at least eight months of age.

In the study areas there was little, if any, indication of breeding during the winter, although four individuals

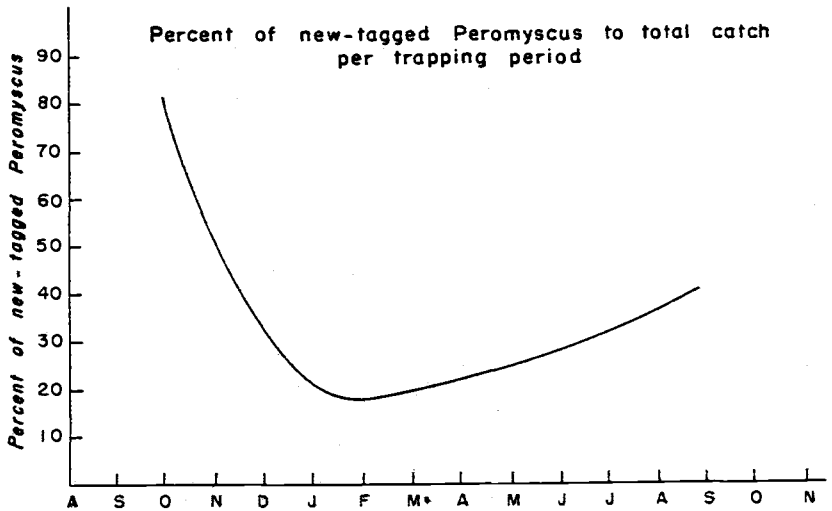

FIGURE 16.

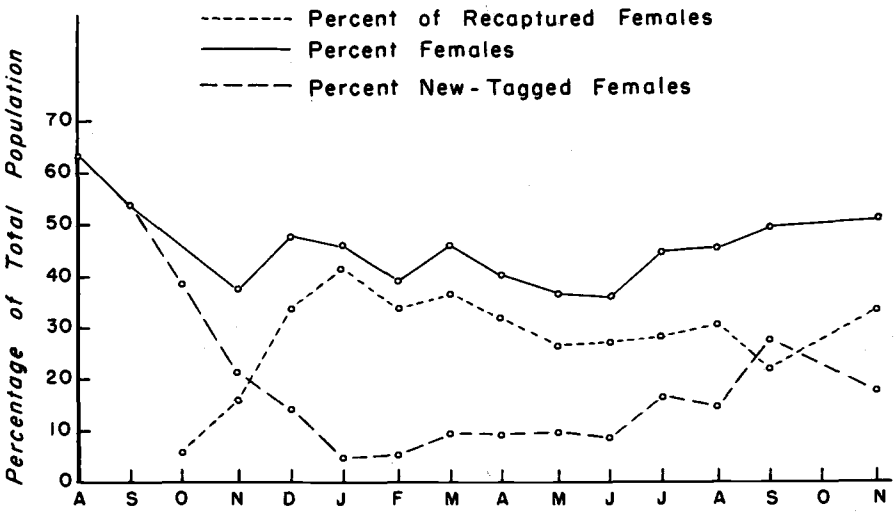

FIGURE 17.

about five weeks of age were caught in December, 1953. Fecundity was not noted until the following April, when a newborn mouse was found in a trap. During the next trapping period, in May, 1954, nine juveniles were caught of approximately four weeks of age, the age at which the mice first leave the nest. This would indicate, allowing for a gestation period of about 25 days, that breeding started during the middle of March. From the catch of juveniles

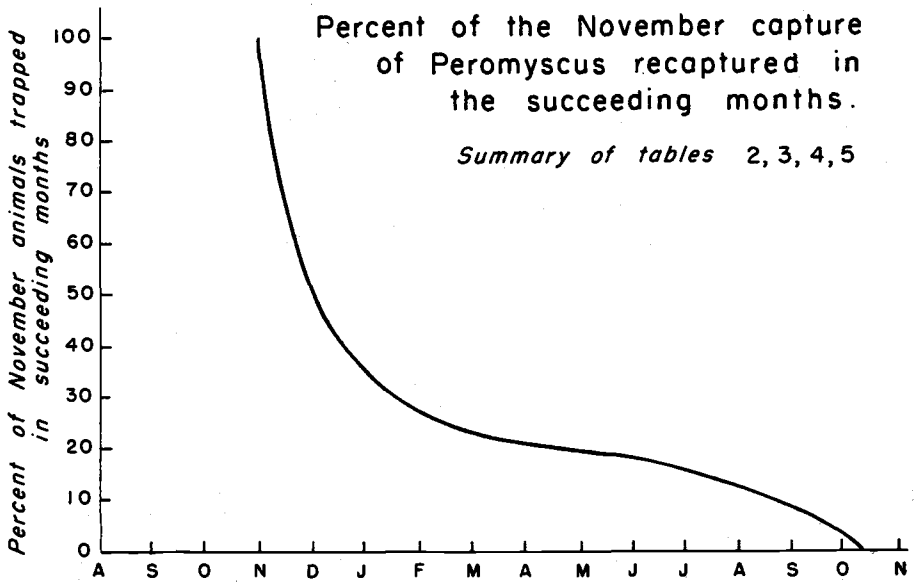

FIGURE 18.

in all of the plots, evidence showed a reproductive ebb during winter. With the coming of spring the appearance of juveniles increased until a peak was reached in the early fall, usually September or October.

Peromyscus in captivity have been kept three years and some individuals seven to eight years. Observation of a trapped individual permits, at best, a rough estimate of its age. The span of time from first to last capture does not take into consideration the age of the mouse from time of birth until its first capture.

Of the 520 *Peromyscus m. rubidus* caught on the plots, 22% were immature, consisting of 9% juveniles and 13% young sub-adults. The remaining 78% were recorded as adult animals. Mice caught 10 or more times included juveniles for an average period of 6.4 months, small sub-adults for an average age of 9.4 months, and more mature

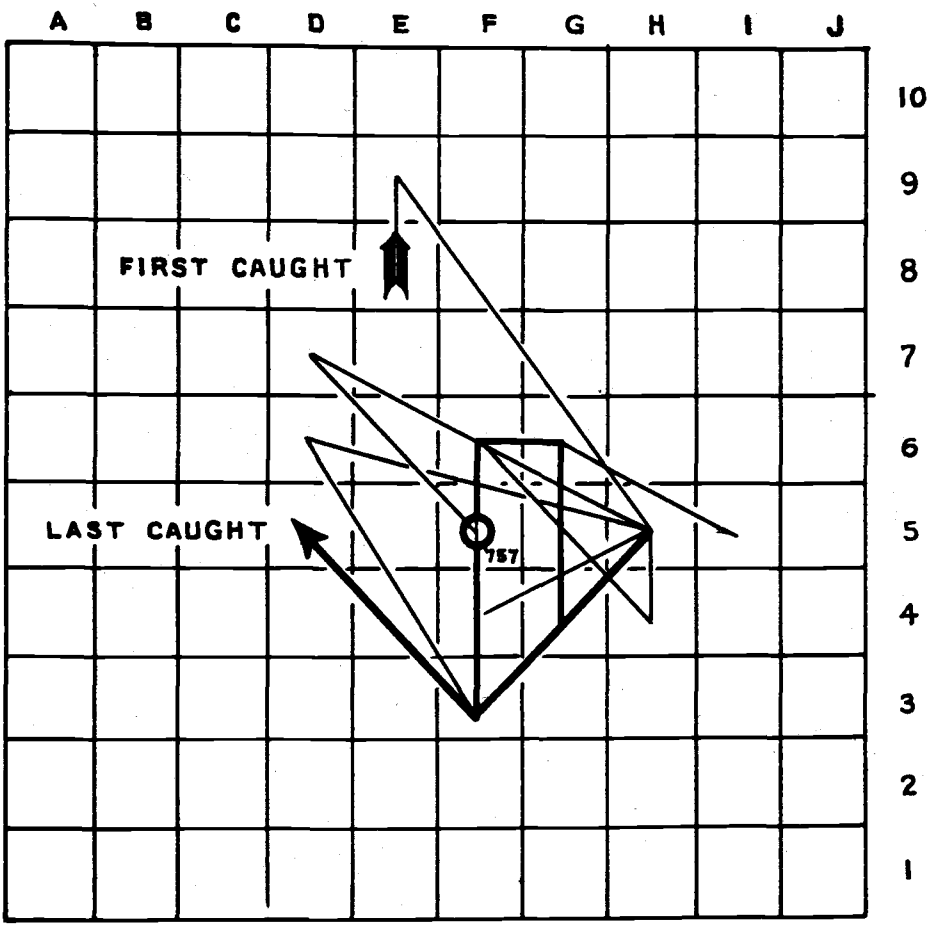

FIGURE 19. Illustrations of catches of a mouse trapped 30 times out of a possible 39, indicating lines of travel between traps and center of activity. The center of each square on the graph indicates trap-site. Heavy lines indicate repeated travel.

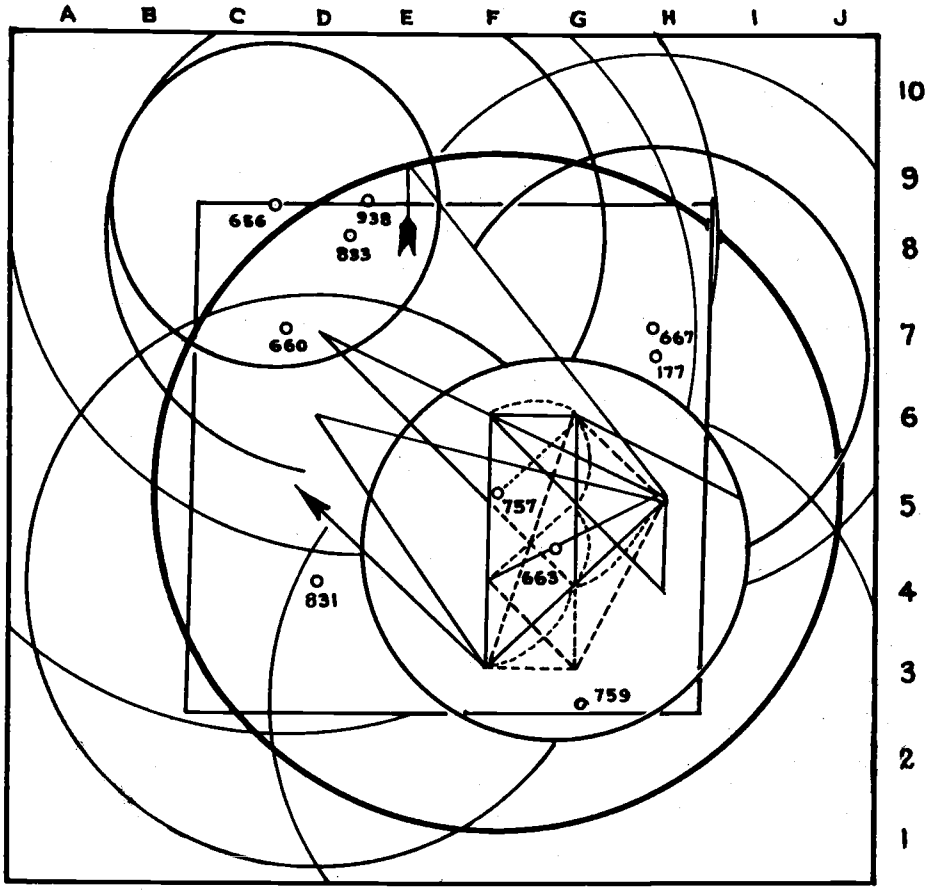

FIGURE 20. Illustrations of the perimeter of the home area af individuals whose center of activity is located on 3.6 acres in the center of the 10-acre square plot. The lines of travel are shown for 757 male and 663 female mice. Each was caught 30 times on Untreated Seed, Plot A.

individuals for an average of 7.3 months. From these figures it can be deduced that the age of a mouse in the natural state rarely reaches one year (figure 18).

Peromyscus home range

Because of the length of observation period, all movement, as indicated by trapping, was considered inside the home range perimeter. The home range was based upon a measure of the average radius fixed upon a point considered the center of activity. As the home range area is based upon not less than 10 captures per individual for the entire period, those caught first could be expected to have a larger record of points of movement than those caught later.

The plotted ranges of individual mice usually fell within a limited area. All of the mice, when released, appeared to have a definite retreat toward which they went unhesitatingly. Occasional records of long trips may rep-

resent a natural tendency to wander or explore and may explain the apparent familiarity of the individual mouse with large areas. Thus, though one cannot be sure how much the trapping tends to interfere with normal movements, it can be assumed that the catches are significantly related to the natural range.

The *Peromyscus* population appears to be in a constant state of movement. Figures 19 and 20 illustrate the typical movements of a mouse. This male mouse was caught 30 times during a year. He was captured in 15 different trap locations. However, some mice were caught in but two different trap locations. Every trap on each plot caught a mouse, although some traps were entered much more frequently than others. Thus, no part of a plot went unexplored, but some areas were frequented more than others. The males, in general, had a tendency for a larger home range area, averaging 4.65 acres, while the average for the females was 3.45 acres.

The ranges indicated considerable overlapping, as illustrated in figure 19. This figure shows the connected points of capture of a male and female mouse as indicated by trapping results on "Untreated Seed, Plot A." The other eight individuals shown, whose center of activity falls within an area two chains inside the perimeter of the plot, have their home range indicated. The size of the home range area varies between individuals. The largest calculated was 13.07 acres for a juvenile male on "Treated Seed, Plot A" (table 4). The smallest for the younger mice was for a juvenile female whose home range area was 0.58 acres on "Untreated Seed, Plot A" (table 2). For the older mice the largest was 9.74 acres for a large sub-adult male on the "Treated Seed, Plot B" (table 5), while the smallest was 0.25 acres for a large sub-adult female on the "Untreated Seed, Plot A."

Description of small animals associated with *Peromyscus*

Although the white-footed deer mouse was caught most consistently and its population was of much greater numbers than any other small mammal, other animals were caught in sufficient quantities to warrant attention (figure 21). The knowledge of their effect upon reforestation in northwest Oregon is, at present, incomplete. The following descriptions and measurements are from the animals actually caught on the plots and the information is not necessarily a criterion of the animals on their overall range.

The Oregon creeping mouse (*Microtus oregoni oregoni* Bachman) was next in numbers caught, approximately 17% of the total. The creeping mouse is small, with a slender body. The overal length is about 14 cm., the weight about 18 gms. Its ears are short, barely projecting beyond the pelage. The pelage is soft and lax, giving the mouse a rough appearance. The color is dusky brown, with slightly lighter underparts. Breeding appears to occur in the summer months, with four to eight per litter. This mouse is not strictly nocturnal but appears most active at night. In captivity it preferred succulent green grass, bulbs, and roots. It may be a factor in tree seedling establishment because its food habits indicate that it will clip and consume the germinants during their first few weeks of growth before their stems harden.

The Townsend's meadow mouse (*Microtus townsendii* Bachman) contributed about 2% to the total popula-

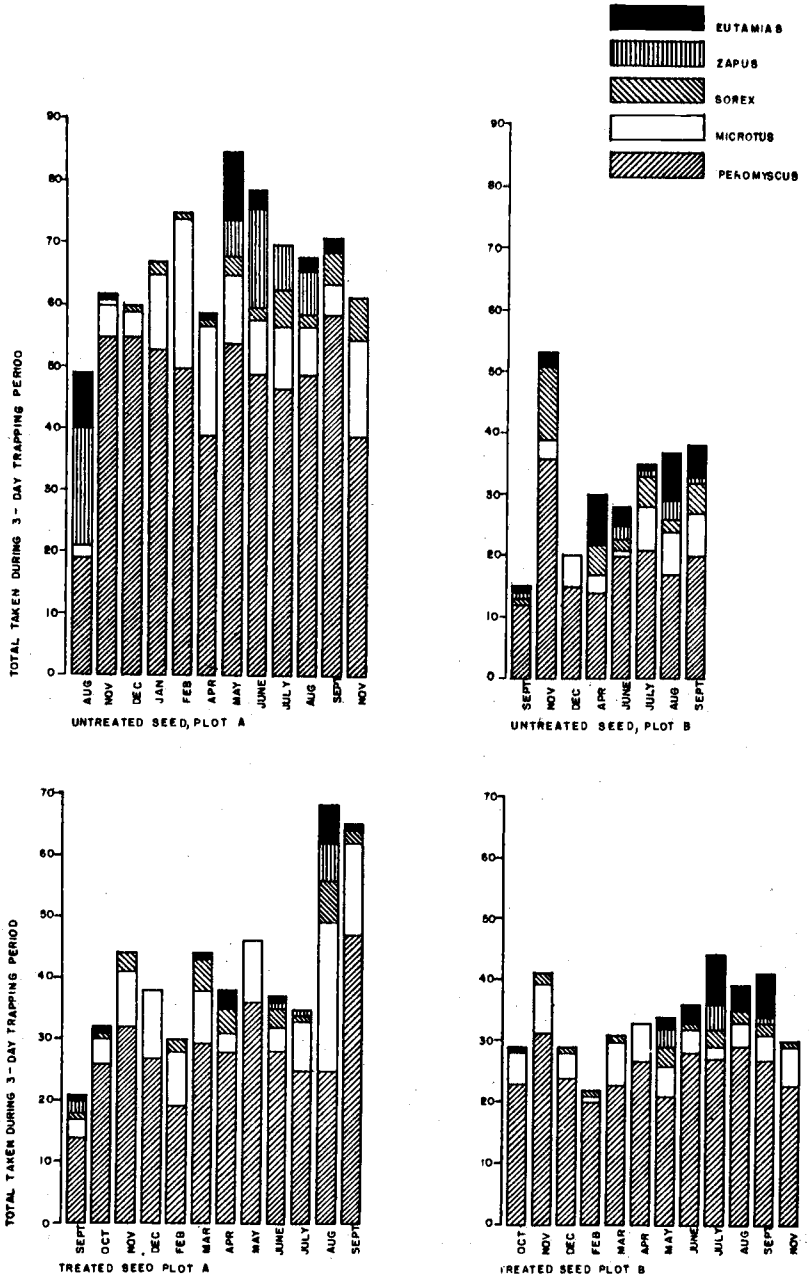

FIGURE 21. Comparison of catches of small mammals caught on the four study plots.

Table 2. UNTREATED SEED, PLOT A

Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range	Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range
female			*days*	*acres*	*male*			*days*	*acres*
177 J	12	10	116	3.91	829 SA	30	11	268	9.57
683 SA	32	10	239	0.16	876 SA	24	11	107	2.71
153 J	15	11	94	4.05	664 SA	33	12	144	2.94
654 SA	33	12	144	1.18	877 A	24	12	107	2.98
831 SA	30	12	122	3.69	938 J	17	12	191	5.25
860 SA	26	12	237	0.47	833 SA	30	13	149	2.41
936 A	18	12	122	7.42	841 SA	29	13	146	0.57
661 SA	33	12	192	0.78	861 SA	26	13	237	1.26
656 SA	33	14	165	0.92	834 SA	30	14	177	4.18
845 sa	29	14	326	0.58	759 A	35	18	260	4.37
873 SA	24	14	198	0.38	846 SA	28	19	239	1.38
766 A	34	15	259	0.56	652 SA	33	20	220	2.25
847 SA	28	15	337	0.61	839 SA	29	20	326	1.27
872 SA	24	17	266	0.25	894 A	22	20	266	5.46
651 A	33	18	239	1.29	674 SA	33	21	381	2.50
667 SA	33	21	240	1.53	675 sa	32	23	380	3.11
682 SA	32	21	283	1.06	673 sa	33	27	284	1.12
764 A	34	27	408	1.38	670 SA	33	29	331	2.15
668 SA	33	27	284	1.33	757 SA	35	30	409	5.15
663 SA	33	30	331	1.48	655 A	33	30	331	2.29
					660 sa	33	30	381	7.76
Average		16	230	1.65	•		19	254	3.38

Table 3. UNTREATED SEED, PLOT B

Ear tag number	Trapped Pos-sible	Trapped Ac-tual	Time between first and last catch	Computed home range	Ear tag number	Trapped Pos-sible	Trapped Ac-tual	Time between first and last catch	Computed home range
female			*days*	*acres*	*male*			*days*	*acres*
920 A	15	11	149	2.98	2 A	17	10	93	4.59
914 sa	15	12	149	3.65	946 A	12	10	91	3.82
810 SA	21	17	308	10.24	917 SA	15	13	150	6.96
					915 SA	15	14	150	6.28
					817 sa	21	17	309	7.31
Average		13	202	5.62			13	159	5.79

tion. The overall length is about 22.5 cm., weight of about 30 gms. Its ears are conspicuous. The pelage is dark brown in color on the upper parts and grayish on the lower parts, and is similar to *M. oregoni* except that it does not have the rough appearance. The breeding data are inadequate. General distribution was limited to wet ground and dense vegetative cover near marsh or meadow. It is usually active day or night. Its food consists mainly of the tender parts of grasses.

The Townsend's chipmunk (*Eutamias townsendii* Bachman) comprised about 10% of the total animal catch. It is a large chipmunk, with an overall length of about 26 cm., weight of about 33 gms. Its ears are narrow and erect and covered with short hairs. The pelage is striped with five dark and four light colored longitudinal stripes from the shoulder almost to the base of the tail. Breeding occurs in the spring, with only one litter of from four to six per year. The young appear sometime in June. The chipmunk is diurnal in habit. Hibernation occurs, but is highly irregular, depending upon climatic conditions. Food of the chipmunk consists of seed, berries, fruits, and insects.

The northwest jumping mouse (*Zapus trinotatus* Rhoads) comprised approximately 7% of the total animal catch. It is medium sized with elongated hind legs and a very long, slender tapering tail. The overall length is about 23.5 cm., weight about 27 gms. The ears are short, not projecting much beyond the pelage. Pelage is long and somewhat coarse. The color of the pelage is dusky from nose to tail, with sides of deep orange, and whitish underparts. Reproduction occurs in the early summer, with four to eight per litter. The jumping mouse

Table 4. TREATED SEED, PLOT A

Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range	Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range
female			*days*	*acres*	*male*			*days*	*acres*
774 A	36	10	241	1.87	639 J	32	10	217	9.82
781 A	34	13	162	2.21	549 J	15	10	118	13.07
555 SA	26	14	147	1.44	553 SA	27	12	122	1.23
561 SA	25	14	176	1.84	554 SA	26	12	147	4.56
565 A	15	15	274	1.82	582 A	21	12	94	7.82
558 SA	26	16	209	1.07	783 SA	34	14	358	5.08
648 SA	31	17	245	1.36	626 A	33	14	248	2.01
770 SA	36	20	242	2.62	580 A	21	15	128	7.92
564 SA	25	25	274	3.42	644 SA	31	16	180	1.03
649 sa	31	26	309	3.12	691 sa	30	19	213	2.15
					571 SA	24	19	200	1.87
					643 A	32	31	345	8.53
Average		17	228	2.08			15	198	5.42

Table 5. TREATED SEED, PLOT B

Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range	Ear tag number	Trapped Possible	Trapped Actual	Time between first and last catch	Computed home range
female			*days*	*acres*	*male*			*days*	*acres*
585 SA	21	11	124	1.21	102 A	17	10	157	1.00
172 A	15	11	99	3.20	533 A	23	11	93	1.85
521 sa	30	12	183	3.28	606 sa	35	14	222	5.23
601 SA	35	14	192	6.22	530 SA	24	14	287	1.90
550 A	18	15	127	2.32	525 sa	29	15	203	4.11
633 J	32	16	274	3.74	637 J	33	17	275	3.09
618 J	34	18	274	8.59	588 A	21	18	157	4.58
592 A	20	18	212	4.14	609 sa	34	20	274	1.60
569 SA	28	20	329	5.62	508 SA	32	20	240	5.78
602 SA	35	21	246	6.08	614 SA	34	23	275	5.36
					615 sa	34	25	312	3.42
					506 SA	32	25	278	9.74
					605 A	35	30	346	4.39
Average		17	206	4.44			17	240	4.00

is diurnal. It is also one of the few true hibernators in western Oregon, burrowing into the ground to make its winter nest. Food consists mainly of grasses, small grain, and seed.

The shrew (*Sorex vagrans vagrans* Baird) is a very small, nervous mammal belonging to the Order Insectivora. The overall length is about 10 cm., weight about 7 gm. It has minute eyes and a sharp muzzle. Its pelage is soft and dense. The color is brownish above and lighter on the underparts. Knowledge of its breeding habits are incomplete, but it is believed to produce one litter per year of four to five during midsummer. It is most active at night. It is quite common, generally found in damp or humid places. Its food consists chiefly of insects and larvae but indications are that it can consume large amounts of Douglas fir, hemlock (*Tsuga heterophylla*), and spruce (*Picea sitchensis*) seed. More than 11% of the entire catch of small animals consisted of shrews during the period of observation, nearly all of which were found dead in the traps.

One shrew mole was caught during the time the observations were made. The shrew mole (*Neurotrichus gibsii gibsii* Baird) is the smallest of American moles, belonging with the shrew to the Order Insectivora. It is about the size of a meadow mouse but shrewlike in appearance and habits. The overall length is about 11 cm., weight about 10 gm. The pelage is blackish, short and fine, with an irridescent sheen. The shrew mole is found generally throughout humid coastal slopes, where its food consists of insects and worms.

The gray digger (*Citellus beecheyi douglasii* Richardson) is as large as a gray squirrel, but it is terrestrial in habit. The overall length is about 45 cm., weight about 680 gm. Its ears are rather small. The pelage is coarse, of brownish-gray color, mottled with white specks. Breeding occurs in the early spring, the young appearing above ground during June. Only one litter is produced each year, of four to eight per litter. Its activities are confined to daylight hours only. Habitat is semi-open clearings. It hibernates, the hibernation period generally starting with the fall rains and continusing until late winter. Its food consists of vegetation, seeds, nuts, grain, and carrion. Many gray diggers were observed, although few were caught in the live traps during the period of study because of their large size. The gray digger is common in the Tillamook Burn along roads following river drainages. It is more rare in higher elevations.

The ermine or lesser weasel, (*Mustela erminea streatori* Merriam) comprised slightly more than 2% of the total animals caught. It is small for a weasel, with a small head and low, rounded ears. The overall length of a male is about 22 cm., weight about 54 gm. The male is one-third larger than the female. The pelage is chestnut brown on the upper part, yellowish-white along the chin, breast, and belly. The tip of the tail is black. Ermines were caught all year and those caught during the winter season continued to be in the brown pelage stage with no indication of a change to the white color for which the pelt is valued. The young are produced in the spring, about four to the litter. The ermine's food consists of any prey it is capable of subduing, usually animals smaller than the Townsend's chipmunk.

Discussion

The total catch on the four plots was 1,023 individual animals. Of these 520 were deer mice. When recaptures were included the number of deer mice present comprised 73% of the catch. The mice did not appear to be affected by the trapping as the numbers caught remained relatively stable, the majority having been caught previously. The difference between sexes was small, females comprising 46.3%. Previous work in the Tillamook Burn showed about the same percentage.

The deer mouse is polyoestrous, and therefore can breed throughout the year. Actual breeding occurs from mid-March to November, with a quiescent period during the late spring and early summer months. A sexually mature female is likely to drop one litter, if not two, averaging four mice per litter, during early spring. This is repeated again in the late summer or early fall. The peak in population occurs during the fall months.

Of the average catch for each trapping period, 30% of the mice were untagged, indicating continuous movement within the population. This unrest presumably is caused by continuous search for food and shelter. Some of the mice were caught, and then were not recaught for several trapping periods, indicating a possible absence of 60 to 90 days from the plot. Others were caught continuously, such as those caught 30 times out of a possible 39. Of the two situations, the continuous catches were more common, indicating that the others continued on to other fields or perished. That the travels of some mice were frequent and extensive was shown by three that were recaught 1.5 to 2.0 miles distant from the plots where they were originally trapped.

On the four plots 15% of the total *Peromyscus* catch was recorded 10 or more times. Of those, it was exceptional if an individual was recaught after a period of one year. The other 85% disappeared in 90 days or less, yet in captivity mice have been kept alive for 6 to 7 years.

The number of mice caught per trapping period fluctuated from two to

Table 6. Summary of Individual Plot Statistics

	Study time	Traps open	Newly-caught mice per period	Time from first to last catch		Times caught*		Home range	
	Days	*Days*	*Percent**	*Days**				*Acres**	
				female	*male*	*female*	*male*	*female*	*male*
Untreated Seed Plot A	450	39	30	230	254	16	19	1.65	3.38
Untreated Seed Plot B	366	24	50	202	159	13	13	5.62	5.79
Treated Seed Plot A	395	36	39	228	198	17	15	2.08	5.42
Treated Seed	402	35	27	206	240	16	19	4.44	4.00

* Average

six per acre, but was never more than six.

Both sexes showed considerable variation in the size of the home range area. The males, generally, tended to have the larger range, averaging 4.65 acres. The females averaged 3.45 acres. Both sexes also showed considerable overlapping of the areas used for the home range. The plotted ranges of individual mice usually fall within a limited area. Comparisons of the methods used by other workers show a tendency for the home range area to increase when the number of catches increases. The home range area as defined in this work tends to remain stable in size, indicating that the points of capture are significantly related to the natural home range.

In previous reforestation work, by direct seeding, cereal grain treated with a rodenticide was used. Rodent control was initially successful, especially when baiting a one-fourth mile buffer strip as an additional deterrent to reinvasion. However, as reinvasion by the mice usually was accomplished by early spring, following baiting, such attempts to reforest were often unsuccessful.

Previous field work for determining the census of small animal populations, in relation to direct seeding, was done with snap traps using bait of peanut butter and raisins. The results derived from such traps was indicative only of the white-footed deer mouse population. It was not reliable for the other animals present because of unattractiveness of the bait or small size of the traps. However, it should be noted that live-trapping was an improvement but not a complete solution in population sampling of small animals. A weakness in live-trapping may be that whole oats were used as bait. The meadow mice caught did not appear to have much desire for the oats and may have entered the traps for temporary shelter.

Of the 176 microtines caught, more than one-half were caught only once, and none were caught more than five times. The jumping mice were equally reluctant to reenter the traps. No reason can be offered as to why the shrews entered the live traps. The chipmunks, however, were readily attracted to the oats. Because of their desire for the grain they would readily reenter a trap after being released, which meant overnight confinement. Such confinement usually was lethal, and for this reason the chipmunks were removed from the area whenever caught.

From the foregoing observations it may be concluded that an accurate quantitative estimation of the small animal populations is difficult to obtain. However, the trapping was conducted for more than a year on the four plots and the results are felt to be reliable.

Success of control of the small seed eaters such as the deer mice would depend upon a knowledge of the breeding season, the replacement potential by reinvasion, and the time of highest population density. These factors would indicate the most advantageous time to initiate control measures.

A cereal grain bait distributed in the field in September or October loses its lethal qualities by the end of November because of prolonged fall rains. Meanwhile mouse populations on the adjacent unbaited areas are building up to their November potential. Migration pressures from these adjacent areas cause prompt colonization. This migration is accomplished by surplus animals seeking home range areas of their own. These mice normally make up the untagged 25% to 35% caught during the monthly trapping period. During the fall about one-quarter of

these would have a life expectancy of eight months, or until germination of the conifer seed normally would be ended. Removal of these invaders (by rebaiting) would leave the area open to reinvasion, but at a much slower rate than previously. The rebaiting should be done when or after the mouse population has reached its peak, and is declining naturally.

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FREEMAN SCHULTZ	Western Pine Association
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