Research Bulletin No. 8

SOME EXPERIMENTS IN BAITING FOREST LANDS

for the control of

SMALL SEED EATING MAMMALS

By
EDWARD F. HOOVEN

OREGON STATE BOARD OF FORESTRY
George Spaur, State Forester
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FOREWORD

Many thousands of acres of Oregon's potentially highly productive timberlands remain barren because of a number of interrelated conditions. One of the major factors contributing to this situation is the loss of tree seed to the small seed eating mammals.

These creatures, which are low in numbers in the normal forest, rapidly invade cut-over and burned-over areas. Here, in a habitat highly suited to their biological needs, they multiply in tremendous numbers. Although they maintain large populations on the foods available on cut-over lands, tree seeds are a preferred part of their diet when they are available.

Reforestation through natural means may be delayed for years by the loss of seeds to these creatures. When they are present reforestation by artificial sowing of edible seeds is impossible, without the distribution of economically impractical quantities of seeds.

To expedite reforestation by natural seeding and to make artificial seeding possible, economic and effective control of these small mammals is necessary. The experiments described in this bulletin are one phase of the Oregon State Board of Forestry program of research directed toward solution of the problems common to both private and public foresters.

George Spaur, State Forester

ABSTRACT

In the fall of 1950 the Oregon State Board of Forestry undertook a research study in the Tillamook Burn to determine the effects of several rodenticides on small mammal populations. Specific objectives were:

1. To test and compare the effectiveness of several rodenticides.
2. To determine the width of buffer-strip necessary to protect seeded areas.
3. To study population behavior and the rate of reinvasion after baiting.
4. To determine the effect of spring baiting.

There were several mammals involved. Of these only the white-footed deermouse and the vagrant shrew were present in the experimental area in significant numbers. Both the deermouse and the shrew are capable of consuming large quantities of forest tree seeds.

The toxic chemicals to be tested were formulated into rodenticides with wheat as the carrier. Three basic materials were employed: thallous sulphate, sodium fluoroacetate (1080) and castrix picrate.

The baits were applied to separate 500 acre blocks singly and in combinations, as follows:

1. Thallous sulphate soaked wheat applied at the rate of 1/4 lb. per acre.
2. 1080 soaked wheat applied at the rate of 1/4 lb. per acre.
3. 1080 coated wheat overcoated with safflower oil applied at the rate of 1/4 lb. per acre.

4. Equal parts 1080 and thallous sulphate soaked wheat applied at the rate of 1/2 lb. per acre.

5. Castrix picrate coated wheat applied at the rate of 1/4 lb. per acre.

Each 500 acre plot contained a centrally located 100 acre seeded block. Both the bait and the seed were distributed from a helicopter. Fall baiting was completed in November 1950. In the spring of 1951 the plots originally baited with 1080 and thallous sulphate were both rebaited with 1/4 lb. per acre of thallous sulphate bait, and one additional plot was baited with 1/4 lb. per acre of safflower overcoated 1080 wheat. In the spring of 1952 still another plot was established with 1/4 lb. per acre of safflower overcoated 1080 wheat as the bait.

Censuses of mammal populations were made prior to baiting and periodically thereafter until the population had returned to the level approximating normal for the adjacent untreated areas. Census techniques consisted of placing 120 traps 22 feet apart in a straight line usually beginning at the exterior boundary of the baited area and extending into the interior. In some instances 60 traps were extended into the immediately adjacent untreated area. Traps were baited with raisins and peanut butter and exposed for three nights, and were checked and reset daily. In addition, a check trapline or control was maintained throughout the study period.

All the baits but the castrix picrate provided a reasonably high level of initial control. This (except on the soaked 1080 plot) persisted until late April of the following spring. The castrix picrate treated wheat failed to reduce the population to any great extent but the results are not entirely conclusive because the extremely unfavorable weather may have interfered with its action.

Rebaiting in the spring also proved successful as did the initial spring baiting with the safflower overcoated 1080 wheat. From the results obtained a buffer zone approximating 1/4 mile in width appears to be necessary to prevent undue loss of seeds.

Regardless of effectiveness of the original baiting, populations show a definite tendency to return to the normal level for the area in early spring. By April, mammal activity increases to the point where pressures from untreated areas may make spring rebaiting desirable. Such retreatment provides, during the germination period, an additional 8 to 10 weeks of relatively rodent-free protection.

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INTRODUCTION

In large scale field applications of forest tree seeds the results have not always been satisfactory. It is recognized that one of the major drawbacks to success has been the small seed eating mammal populations.

Previous projects conducted by Oregon State Board of Forestry have indicated that success in baiting for the control of the seed eaters depends upon two major interrelated factors. These are the initial efficacy of the bait and the size of the area treated.

Two rodenticides have been found to be reasonably effective in field operations. In previous projects thallous sulphate (Tl_2SO_4) impregnated wheat appeared to provide a reasonable degree of initial control when applied at approximately 1/4 pound per acre. In the fall of 1949, sodium fluoroacetate (1080) was applied with the thallous sulphate in a large scale seeding project in the Tillamook Burn. This combination appeared to provide a much more effective control of the resident mammal population than did the thallous sulphate alone.

Moore[1], in some studies of small seed eating mammal movements, indicated that a buffer strip might be necessary to prevent infiltration of seeded areas before germination of the seeds in the spring. A zone 1/4 mile in width, based on the known range of some small mammals, was presumed to be adequate and had been employed with the use of these two rodenticides.

Experimental emphasis had, up to 1950, been directed primarily toward the silvicultural problems of direct seeding. Although such an approach had resulted in the general techniques which made aerial seeding practical on a large scale, a thorough study of the small mammal control phases of the

process appeared desirable. Since the effects of many of the materials and procedures employed had never been adequately evaluated, a comprehensive experimental program was initiated in the fall of 1950. The project described in this bulletin was an early phase of these studies.

PURPOSE OF EXPERIMENT

The general purpose of the project was to provide as much information as possible within the limitations of staff and available funds. The experimental plan included several definite but closely related objectives, many of which were of sufficient magnitude that they might have warranted separate investigations.

These major objectives were:

1. To determine the relative effectiveness of the several rodenticides employed at the same time of the year on small mammal populations under similar physiographical conditions.
2. To determine the rate of reinvasion and population buildup with each treatment.
3. To determine, if possible, the width of a buffer strip necessary to prevent reinvasion of seeded areas.
4. To determine the effect of spring baiting.
   a. Rebaiting with initial rodenticide.
   b. Rebaiting with a different rodenticide.
   c. Initial spring baiting.

THE SEED EATING MAMMALS INVOLVED

Most of the small mammals with which forest seeding is concerned belong to the order Rodentia. The only other important creature is the shrew (Soricidae), which belongs to the order Insectivora.

Shrews

Shrews are generally characterized by a long nose, plush pelage and a body size generally smaller than that of a mouse. There are, ranging in western Oregon, six species that could influence seeding; but little is actually known of their feeding habits. Since shrews are highly sensitive to foreign stimuli and nearly always die of fright when captured, their seed eating potential is difficult to determine. Stomach contents, however, indicate that under normal conditions they do eat tree seeds. Moore(1) found that it is not uncommon to have a shrew hull as many as one hundred Douglas fir seeds in one night when caught in a live trap. During some recent studies, Dr. Rudolph Kangur of the Oregon State Board of Forestry captured a shrew in a specially camouflaged cage and found that under these conditions it had succeeded in devouring over one thousand Douglas fir seeds in three nights before dying.

Squirrels

Chipmunks (Eutamias spp.) are well distributed over all of western Oregon and are occasionally found in rather large numbers in restricted localities. Generally, however, they do not provide any great problem in direct seeding. Another squirrel, the gray digger (Cittelus Douglasii), may in some localities be quite prevalent but is also a rather minor factor

in artificial regeneration. Other squirrels confine their activities to the established forests, where they are generally low in numbers, harvesting cones as they ripen rather than gathering individual seeds from the ground.

Mice

The three mice most commonly found in the Tillamook Burn are, in the order of prevalence, the white-footed deermouse (Peromyscus maniculatus rubidus), the meadow mouse (Microtus spp.), and the jumping mouse (Zapus spp.).

Zapus hibernate in the early fall and do not emerge until midspring and therefore are a minor factor in seed destruction during most of the period when the seed is exposed. They were taken in such low numbers that they are given no special consideration in this study.

Microtus are found only slightly more frequently than the jumping mouse. They also are present in such low numbers that they constitute only a minor factor here, but they do eat Douglas fir seeds and the tops of newly germinated seedlings.

Characteristics of the White-footed Deermouse

Of all the mice on the areas included in this study only those of the genus Peromyscus are sufficiently abundant to cause serious interference with planned regeneration. This mouse outnumbers all the other small mammals on old burns and cutover lands. It is widely distributed from sea-level to the vegetation line in the mountains. The species most commonly found in the area covered by this study is Peromyscus maniculatus rubidus.

Range and Physical Characteristics.

Peromyscus maniculatus rubidus inhabits the humid Pacific Coast regions from the Columbia River to San Francisco Bay and eastward to the Cascades(2). This dark-colored form of the white-footed mouse is large for the maniculatus group. The overall length averages 193 mm.; the tail, 96mm; the foot, 21.5 mm.; and the ear, 16 mm.

The tail is about as long or longer than the head and body combined, slender but not crested; the ear is medium in size and nearly naked; the mustaches are long, reaching the tips of the ears; the fur in summer is close and dense, in winter longer and softer.

The upper part of adults in the summer is a rich cinnamon brown, more or less darkened with dusky hairs; the top of tail is dusky brown; the feet and the whole lower half of the tail and the body are white. In winter they are slightly brighter colored. The immature are plumbeous (lead colored) above and whitish below. Males weigh an average of 15 grams and the females 13.2 grams

Feeding Habits.

The diet of the white-footed mouse varies, as shown by Cogshall(4) and Hamilton(5). Cogshall studied the food habits of four varieties and found that 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 of 20 groups of insects and animals. In his examination of 526 Peromyscus stomachs, Hamilton found that the diet does not differ markedly by seasons, except for the addition of fruit in the summer. Examination of cheek pouches, stomachs and food caches indicated 42 plant species. Deer mice eat 30 percent of their

weight in twenty-four hours during which time their stomachs are filled at least twice. They can under cage conditions eat over 350 Douglas fir seeds daily.*

While primarily woodsmice, Peromyscus maniculatus rubidus are able to adapt themselves to almost any habitat affording cover and food. They do not hibernate and are nocturnal feeders. Burt (6) gives the average range per night as 1,312 square yards for males and 1,012 square yards for females. The author, live trapping and ear tagging mice on a 100 acre plot in October 1951, found that the average range of 94 mice was 27 yards, indicating an area range of 2,190 square yards or 0.47 acres. One exceptional individual was found six nights later, 418 yards from where it was originally trapped. Murie and Murie(13) released marked Peromyscus at varying distances from place of capture on the home range. Of these, 10 percent returned from a distance of one mile, taking about one week for the return journey. In the home range trapping they concluded the mice move about freely over an area 100 yards in diameter. Thomsen(7) found that there was a decrease of activity during the winter, when the home range was not over 10 linear yards.

Breeding Habits.

Females begin to breed at approximately $2\frac{1}{2}$ months of age, producing several litters of from 4 to 6 during the year. Howard(8) states that females which are born between March and May breed upon maturity, usually $4\frac{1}{2}$ to 9 weeks of age. Those born after May are not likely to breed until September. The gestation period is between 23-27 days, nursing is approx-

*From 225 measurements made by Denis P. Lavender, of Oregon State Forestry Department, from mice captured for laboratory tests: (Obviously immature and all other specimens under 10 grams not included in data.).

imately 25 days. The number of litters is smallest during July and August. Clark[14] gives the average age of females upon attainment of sexual maturity as about seven weeks. Burt [6] estimates that under optimum conditions there could be 578 mice originating from a single pair by the end of the second season.

Population Behavior.

Mouse populations vary from year to year and from season to season as they are affected by changing food supplies and other natural cycles. Populations also vary from area to area according to local availability of food, cover and the presence of other conditions both favorable and unfavorable. The maximum number of mice is limited by such conditions. The maximum, thus limited, may be referred to as a population potential. When populations are reduced below the potential by unnatural causes migration pressures from adjoining areas cause prompt colonization.[15]

Krauch [9] found indications that mice are much more numerous on cutover lands than in uncut timber. After a fire, they will immediately invade the area burned, having been caught on the warm ashes of a severe burn (Tom Rock, Oregon 1950). Kverno[10] reports a 95 percent increase in mice one month after a clean slash burn on a 40 acre area. The population builds up to the peak that can be carried by food and cover, slowly decreasing as the area is recovered by brush and trees. It is at its lowest when the timber becomes dense.

GENERAL PROJECT PLAN

Personnel

The technical phases of the project were under the direction of the Oregon State Board of Forestry. The U. S. Fish and Wildlife Service supplied several of the baits tested. Most of the field work involved in this experiment was accomplished by the author and his assistant Dr. Rudolph Kangur. However, acknowledgment of the contributions of Dale N. Bever and Jack F. Gartz must be made for their preparatory work on the project plan, on plot selection and on boundary determination before their recall to active military duty in October 1950.

The bait and seed distribution was accomplished on a contract basis by Central Helicopters of Yakima, Washington. Pilots were Kermit Jones and Robert Murray, who did the baiting and Arni Sumaralidason, who was responsible for the seeding.

Bait Preparations

Three basic chemicals were selected for the tests. Two of these, sodium fluoroacetate, (1080) and thallous sulphate had been employed successfully in conjunction with previous aerial seeding projects. Castrix picrate, which has a lethal action similar to that of 1080 but is less hazardous to carnivores and scavengers, was offered as a candidate by the U. S. Fish and Wildlife Service.

The bait medium employed for all of the chemicals was wheat. Wheat offers many desirable characteristics and had been found by previous experience to be quite suitable. It is readily acceptable by small mammals, it

will assimilate the toxic materials and will retain them under normal conditions for a reasonable length of time. It is readily available in a uniform quality and size which permits uniform distribution by mechanical means. It retains its shape, size, palatability and lethal qualities reasonably well under the heavy precipitation of western Oregon. Wheat, however, will not persist long enough to maintain the desired protection throughout the entire period when tree-seeds are vulnerable to small mammal depredations and will sometimes germinate during periods of moderate fall temperatures.

Previous applications of the toxicants to the wheat had been accomplished through impregnation by soaking in an aqueous solution of the chemical employed. The use of an adhesive coating containing the finely ground or dissolved chemical had been perfected in the laboratory stage and was to be tested accurately under field conditions.

In all five baits were selected for field tests. These were as follows:

1. Thallous sulphate impregnated wheat applied at the rate of 1/4 lb. per acre
2. 1080 impregnated wheat at the rate of 1/4 lb. per acre
3. 1080 coated wheat overcoated with safflower oil applied at the rate of 1/4 lb. per acre
4. A combination of equal parts of thallous sulphate and 1080 soaked wheat applied at the rate of 1/2 lb. per acre
5. Castrix picrate coated wheat applied at the rate of 1/4 lb. per acre

All of these baits, except castrix picrate, were colored by the addition of a green dye to prevent acceptance by birds.

Costs of castrix picrate and the safflower overcoated baits could not be determined since they were prepared in small experimental lots only. Quotations by a commercial chemical company in 1952 on lots of 1,000 pounds or better of treated wheat were: 1080 soaked, $0.82 per pound, and thallous sulphate, $0.65 per pound. It was estimated that the castrix picrate and the safflower overcoated baits could be prepared within a similar cost range.

Thallous Sulphate (Tl_2SO_4)

The bait was prepared from White Holland seed wheat by soaking in a 5 percent aqueous solution by weight of thallous sulphate for 24 hours at a temperature of 65 to 70 degrees Fahrenheit. The wheat was colored with a green dye during the impregnation process. In addition the wheat received an overtreatment with a coating of cooking oil (soya or cottonseed), in which was dispersed a monastral green light-fast pigment. The overtreatment was applied at the rate of one lb. green pigment and 40 ounces of cooking oil to each 400 lbs. of wheat. This treatment resulted in a bait containing 0.52 parts of thallous sulphate to 100 parts of wheat by weight.

Sodium Fluoroacetate (1080) Soaked

This rodenticide was prepared by soaking White Holland seed wheat in an 8 percent aqueous solution by weight of 1080 for 24 hours at a temperature of 65-70 degrees Fahrenheit. The wheat was colored with a green food dye during the impregnation process. In addition, it received an over-treatment with a coating of cooking oil in which was dispersed a monastral green light-fast pigment. The over-treatment was applied at the rate of 1 lb. green

pigment and 40 oz. of cooking oil to each 400 lb. of wheat. This resulted in a bait containing 0.199 parts 1080 to 100 parts wheat by weight.

Sodium Fluoroacetate (1080) Coated

Safflower overcoated bait was prepared by the U. S. Fish and Wildlife Service of Pocatello, Idaho. The following techniques and materials were employed.

The 1080, at the rate of 3 grams per pound of grain, in commercial powder was ground into the following spreader:

Light viscous linseed oil	50 cc.
Mineral spirits	21 cc.
Six percent cobalt drier	3 cc.
Manganese drier	1 cc.

This was applied to 130 lbs. Jenkins Club white spring wheat at the rate of 7.5 cc. per pound of grain plus green GT-486-D dye at the ratio of 0.25 grams per pound of grain. Later the bait was overcoated with two coats of safflower oil which had been heat treated to secure proper polymerization.

Castrix Picrate

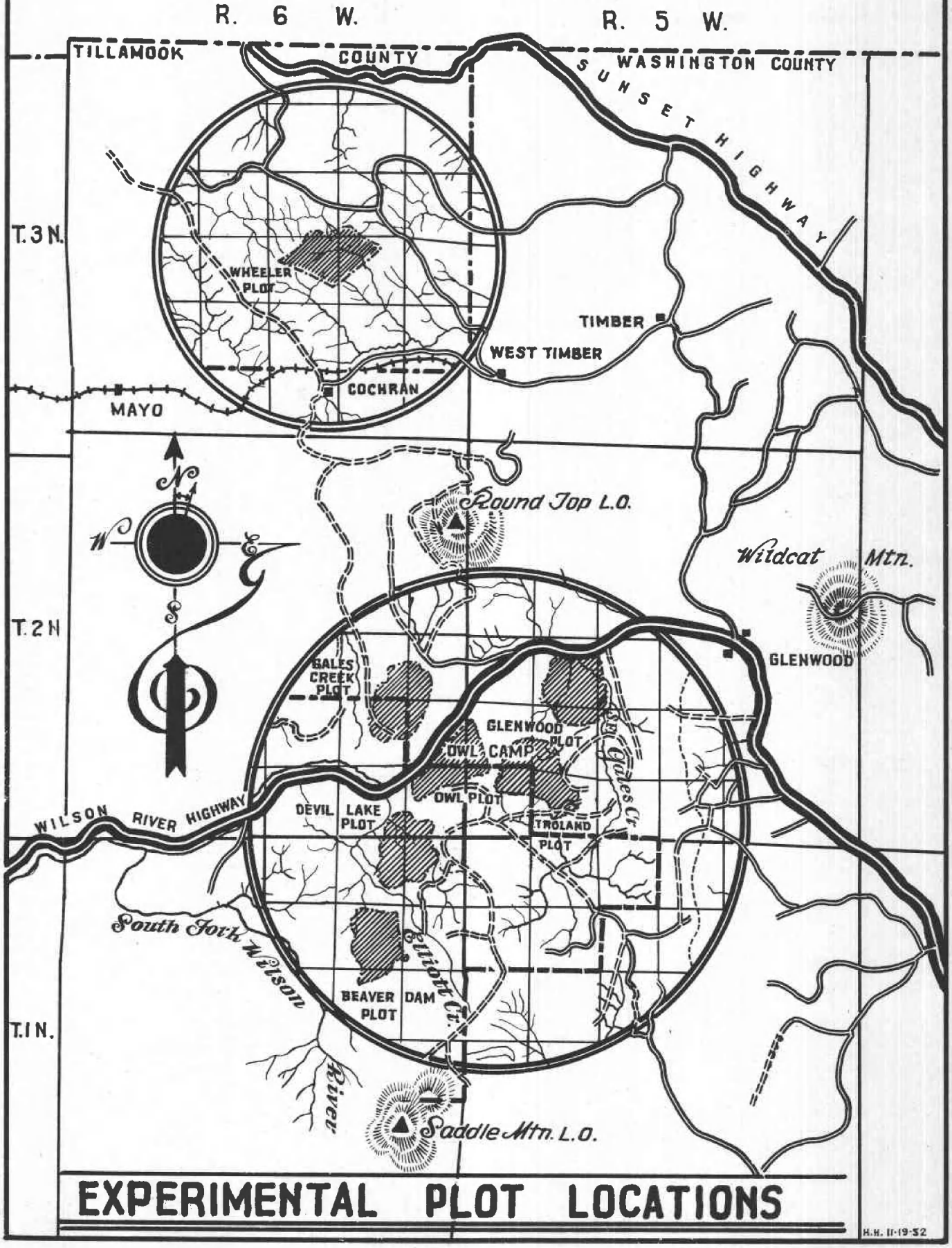
This bait was prepared by the U. S. Fish and Wildlife Service as follows.

The castrix picrate was applied to 130 lb. of Jenkins Club White spring wheat at the rate of 3 grams per pound of grain. The material was mixed with Duco 1907 clear lacquer in which it was largely dissolved. This was distributed over the grain at a rate of 10 cc. per pound.

After drying it was overcoated with the following spreader:

Light viscous linseed oil	50 cc.
Mineral spirits	21 cc.
Six percent cobalt drier	3 cc.
Manganese drier	1 cc.
Dupont oil Yellow N	0.25 gram per lb. of grain

Figure I.


R. 6 W.
R. 5 W.
TILLAMOOK COUNTY
WASHINGTON COUNTY
SUNSET HIGHWAY
T. 3 N.
T. 2 N.
T. 1 N.
WHEELER PLOT
TIMBER
WEST TIMBER
COCHRAN
MAYO
Round Top L.O.
Wildcat Mtn.
GLENWOOD
GALES CREEK PLOT
GLENWOOD PLOT
OWL CAMP
OWL PLOT
Gales Cr.
DEVIL LAKE PLOT
TROLAND PLOT
WILSON RIVER HIGHWAY
South Fork Wilson
Elliott Cr.
BEAVER DAM PLOT
River
Saddle Mtn. L.O.
EXPERIMENTAL PLOT LOCATIONS
H.H. 11-19-52

The Experimental Plots

Five hundred acres was chosen as the most practical plot size considering the multiple purposes of the project. An area of this acreage was considered large enough to approximate baiting on a seeding-project scale. Five hundred acres would permit the establishment of a 100 acre seeded plot in the interior. It would also provide adequate space for study of population behavior in relation to a baited buffer zone, a baited seed area and an adjacent unbaited control.

Four of the five plots were located near the summit of the Coast Range in the northeast portion of the Tillamook Burn. The fifth plot (castrix) was located eight miles to the north in a partially restocked cutover area. (Figure I)

Thallous Sulphate - Gales Creek Plot No. 56

This plot lies at an elevation of 1300-2200 feet on an easterly exposure. The west portion, which makes up approximately one-half the area, is on a gentle slope while the remainder is somewhat precipitous. The area was burned over in 1933, reburned in 1939 and again in 1945. The principal cover consisted of bracken fern (Pteridium aquilinum), fireweed (Epilobium angustifolium), pearly everlasting (Anaphalis margaritacea) and blackberry (Rubus vitifolius). There were very few trees or shrubs present. (Figure II)

1080 Soaked - Troland Plot No. 58

This plot is located on gently rolling land of approximately 1600 feet elevation with a general southwest slope. This area was burned over in 1933, reburned in 1939 and 1945. The principal cover consists of willow (Salix spp.),

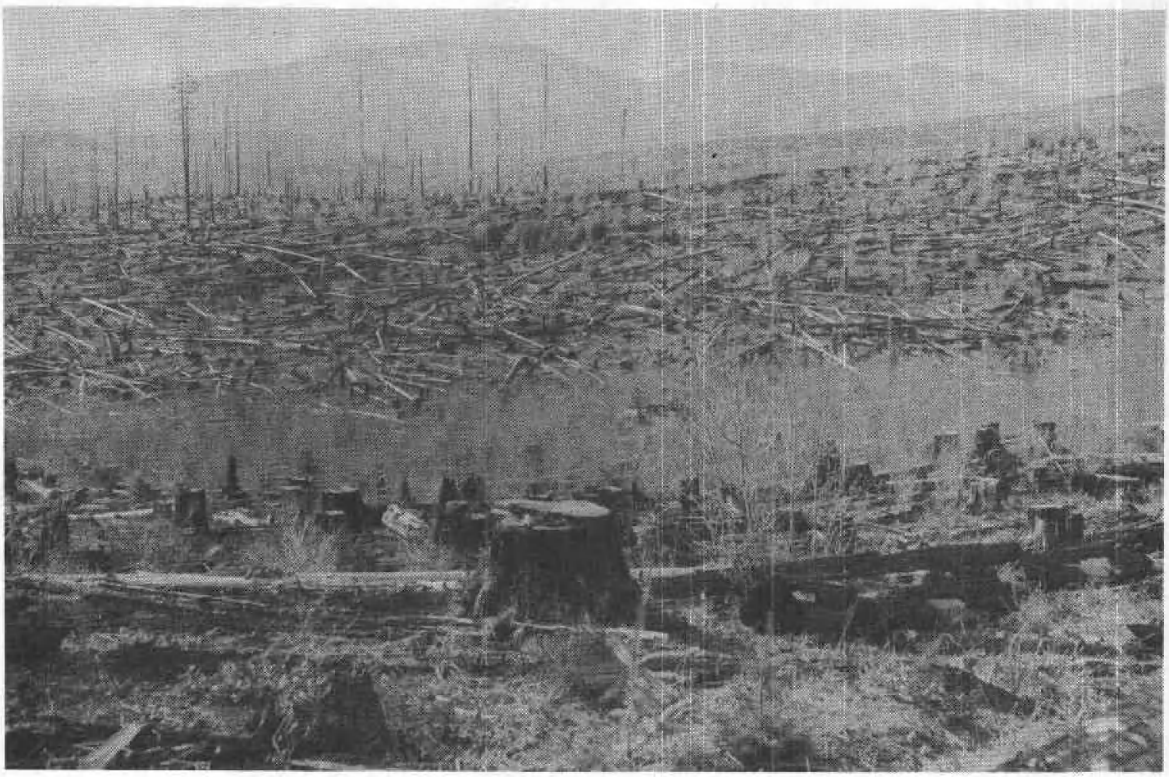


Figure II. Gales Creek Plot

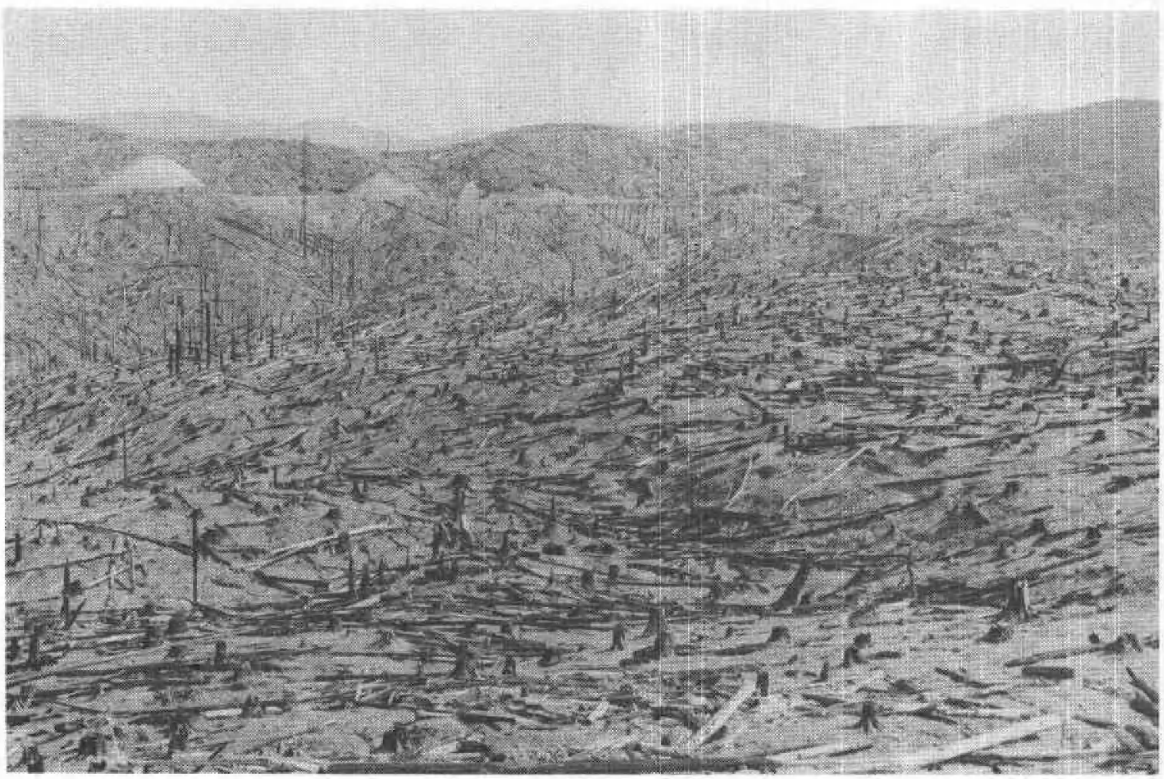


Figure III. Troland Plot

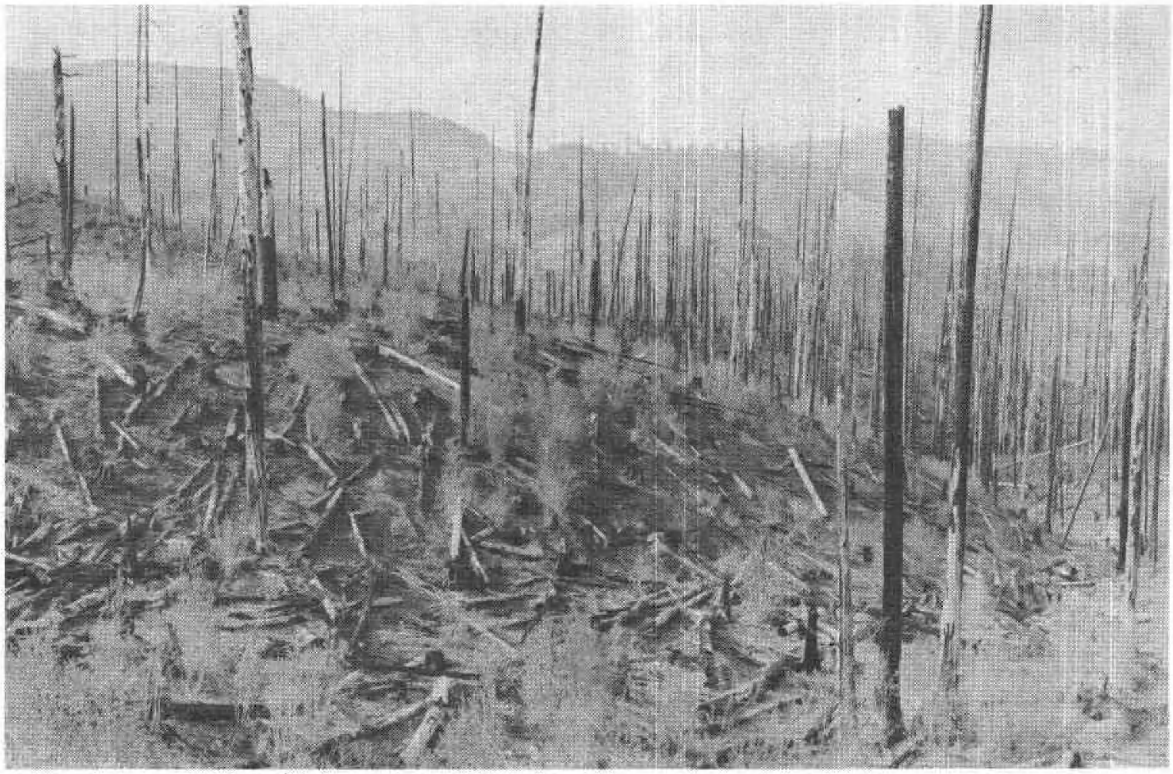


Figure IV. Glenwood Plot

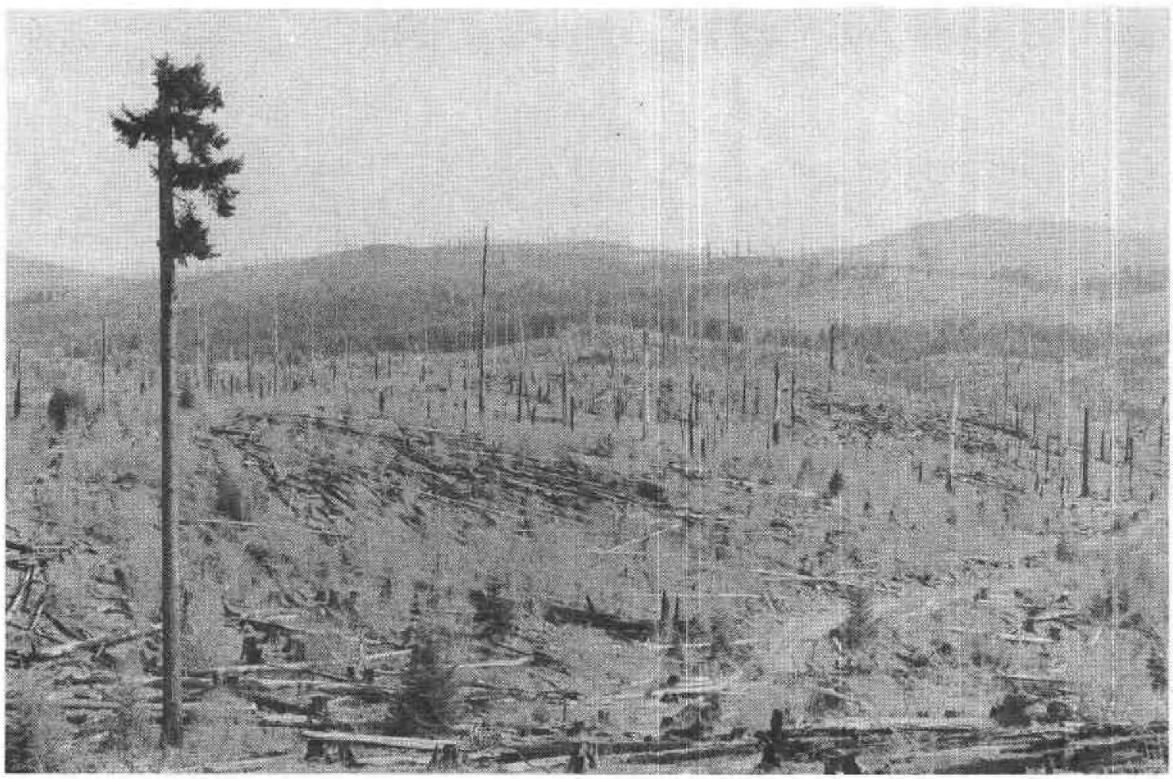


Figure V. Owl Plot

bracken fern, blackberry and some fireweed. Some natural reproduction is appearing from natural sources located east of the plot. (Figure III)

1080 Coated - Glenwood Plot No. 57

This plot is located on a medium northeasterly exposure with elevations from 700 to 1500 feet. This area was also burned over in 1933, 1939 and 1945. Willow predominates as a cover species although bracken fern is quite common. There is also some blackberry, sticky laurel (Ceanothus velutinus), fireweed and a little Oregon grape (Mahonia nervosa). (Figure IV)

Combination Tl_2SO_4 and 1080 - Owl Plot No. 55

This plot is located on a medium southerly exposure of 1500-1900 feet elevation. Its burn history is the same as for the aforementioned plot, having been burned in 1933, in 1939 and again in 1945. The principal cover is bracken fern, although willow, blackberry, Oregon grape, fireweed and pearly everlasting are quite common. (Figure V)

Castrix Picrate - Wheeler Plot No. 59

This plot has a slightly higher elevation than the others, being from 2100-2500 feet. Exposure is southwesterly. The area was burned in 1933 and was partially reburned by a slash fire in 1936. Approximately one third of the areas has a good stand of reproduction, some trees reaching 25 feet in height. The reburned portion is covered chiefly with willow and bracken fern with some blackberry and fireweed.

Application of Baits and Seeds

Bait and seed distribution was planned for a helicopter operating from nearby Owl camp which is maintained by the Oregon State Board of Forestry. The baiting date was set for early November, with the seed to be distributed approximately one month later.

Spring Rebaiting

Careful checks were to be made of population developments and at least two plots were to be rebaited in the spring when population levels within the interior (seeded) areas appeared to be approaching a par with the populations in the untreated areas. Because of the distinct possibility that survivors of fall baiting might possibly develop an aversion to the toxic chemicals, thus not permitting effective spring control, one plot was to be rebaited with the same material and one with a bait different from that which had been used on it the previous fall. The plots chosen for rebaiting were the Gales Creek plot, originally baited with thallous sulphate, and the Troland plot, originally baited with soaked 1080. Both of these plots were to be rebaited with thallous sulphate treated wheat at the rate of 1/4 lb. per acre.

EXPERIMENTAL PROCEDURES

Plot Establishment

The plots were tentatively located and laid out by approximating 500 acres on a planimetric map. These rough locations were then transferred to aerial photos from a recently completed flight. Boundaries for both baited and seeded areas were chosen from the photos mainly in relation to natural topographical features which were later to serve as guides for the helicopter pilots. The natural features used were roads, ridges, streams and old logging landings. The tentative boundaries were then redrawn on the planimetric map and the area measured by a planimeter. Whatever corrections necessary were made to obtain the desired acreage as closely as possible. Each plot was then checked in the field by ground reconnaisance and further corrected if necessary.

Aluminum foil markers approximately 18 inches by 25 feet were placed at all points where the boundaries departed from natural landmarks and at corners. The foil proved to be a very economical marker and was readily visible from the air.

Bait and Seed Distribution

Actual baiting was done November 8, 1950. Distribution was by helicopter which was employed on a bid and contract basis. The helicopter was equipped with two large hoppers - one on each side of the machine. Bait or seed was poured into these hoppers with an equal quantity on each side. Each hopper was equipped at the bottom with an adjustable rotary metering device operated by a constant speed electric motor. The flow of bait from the hoppers could

be calibrated readily with a high degree of accuracy. When the helicopter was in flight the pilot was able to start or stop the mechanism instantly by conveniently located switches. With the metering mechanism in operation the bait or seed flowed into a circular pan and out through a number of plastic tubes radiating outward as spokes in a wheel. This device was operated by a flexible shaft from the transmission at approximately 1500 rpm. It provided a 200 foot swath width for wheat bait and 100 foot for Douglas fir seed. The helicopter was flown at approximately 60 mph and from 150-200 feet above the tops of the snags. Wind velocities when the flying was done did not exceed 5 mph. Distribution was quite uniform and accurate.

On December 6, 1950, the 100 acre interior plots of each baited area were seeded to Douglas fir at the rate of 1/2 lb. per acre. This provided a distribution of approximately one seed per 2.2 square feet.

Small Mammal Censuses

A census was made of the small mammal population on each plot before the bait was distributed. The 4 areas around Owl Camp were trapped for 3 days beginning September 25 and the Wheeler plot for 3 days beginning October 23rd. The traps were common snap mouse traps available at any general hardware store. These were baited with a mixture of peanut butter and raisins and placed at 22 foot intervals in as nearly a straight line as the topography would permit. With this spacing 120 traps set per line covered approximately 1/2 mile in linear distance. This, theoretically, placed 60 traps in the 1/4 mile buffer zone and the other 60 in the interior, or seed area. Traps were usually visited daily for 3 days, with the catch noted by trap number. After baiting, the same procedure was followed. A two week trapping schedule

was followed as consistently as weather conditions would permit. Traplines were always relocated after 3 consecutive nights exposure if any mammals were taken.

Check traplines were exposed on non-baited areas adjacent to the treated plots whenever any of these plots were trapped. Check line control trapping differed only in the number of traps exposed. The first 5 lines consisted of 50 traps per line. The number was then increased to 60 traps per line.

Spring Rebaiting

The specific objective of spring rebaiting was to compare the population on a plot retreated with the initial fall bait with that of a plot retreated with a different bait, and to compare these with populations of similar but unbaited areas. Normally, with the approach of spring, a small mammal population tends to increase rather rapidly. What actually constitutes a critical population in the spring is unknown, but spring rebaiting was begun and completed on May 2, 1951 after April trapping had produced the following number of mammals per 100 trapnights: Owl Plot - 1.52; Gales Creek Plot - 2.50; Glenwood Plot - 1.99; Troland Plot - 2.87; untreated control - 5.28. (Spring census not available for Wheeler plot because of late melting snows.)

April 15 was selected as the date for rebaiting both plots but weather unfavorable for flying delayed the operation until May 2nd.

The Gales Creek plot, which was originally treated with thallous sulphate, was rebaited with the same material. The last trapline census,

before rebaiting, indicated 2.50 rodents per 100 trapnights as compared to 5.56 for the check plot.

The Troland plot had been originally treated with soaked 1080 bait and was rebaited with thallous sulphate. This plot had a census of 2.78 rodents per 100 trapnights on the last trapping as compared to 5.56 for the check plot.

New Spring Plot Establishment

In addition to rebaiting the two plots established the previous fall, the excellent results obtained with the safflower overcoated bait indicated the desirability of repeating the process in the spring.

1951 Spring Established Plot (Devils Lake Plot No. 57A)

In May 1951, a 500 acre plot was laid out in the same manner as the plots of the preceding fall with the exception that no seed was broadcast in the interior. This plot is located 1/2 mile SW of the Owl Plot, (Figure I) and lies at an elevation of from 1500-2000 feet with a southerly exposure. It has a fire history similar to the other plots, having been burned in 1933, 1939, and again in 1945. The cover is chiefly bracken fern although in some portions willow predominates. Some fireweed and blackberry are also present. The plot was baited May 2nd at a rate of 1/4 lb. per acre with coated 1080 wheat overcoated with safflower oil. The formula was prepared at the Denver Laboratory of the U. S. Fish and Wildlife Service by the following method:

> Ten ounces of compound 1080 were dissolved in two gallons of warm tap water and poured slowly over 125 lbs. of Holland soft white wheat while it was in motion in a Hobart paddle mixer.

Mixing was continued until no free liquid remained, then the wheat was allowed to dry briefly. While still damp, the wheat was overcoated with 300 cc. of bodied safflower oil containing a 6 percent cobalt drier into which 25 grams of monastral green GT-486-D pigment had been ground. This overcoating was thoroughly mixed at slow speed in the same Hobart mixer. The grain was then removed and air dried at 70-75 degrees Fahrenheit for 48 hours. It was then returned to the mixer and given a second coat of 300 cc. of safflower oil containing a 6 percent cobalt drier and again air dried for 48 hours.

A trapline which had served as a check for the fall baited plots was located within the plot and provided the baiting data necessary before the project was undertaken. The 60 traps exposed for 3 nights provided a catch of 5.56 mammals per 100 trapnights.

1952 Spring Established Plot (Beaver Dam No. 57B)

In the spring of 1952 an additional plot was established near Owl Camp primarily for population behavior studies. The general procedures employed were identical with those used on the plots established the previous year and the applicable results are included with this report. The plot is 500 acres in size and was laid out in the same manner as the previous plots. It is located approximately 1/2 mile south of the Devils Lake plot at an elevation of from 1500 to 2000 feet. The exposure is generally southern with a central ridge extending north and south through the plot. The cover consists principally of bracken fern and fireweed with some blackberry and willow appearing. It was baited May 13, 1952 at a rate of 1/4 lb.

per acre with wheat coated with a 10 percent aqueous solution and overcoated with safflower oil. The bait was supplied by the U. S. Fish and Wildlife Service and was prepared in the following manner:

> 12.5 ounces of compound 1080 were dissolved in 2 gallons of warm water and added at intervals to 125 lbs. of soft white wheat in a special wooden tumble drum mixer. After all the liquid had been absorbed by the wheat, it was removed from the drum, spread out and air dried for 24 hours. It was returned to the tumble mixer and overcoated with one pint of bodied safflower oil containing a 6 percent cobalt drier. When the grain was uniformly oily, 4 ounces of monastral green pigment of GT-476-D was dusted on to the grain and mixing continued until an even brilliant coloring resulted. The grain was removed and air dried in shallow layers for 24 hours before sacking and shipping.

Prebaiting census was obtained by live traps. Trapping was started May 6, 1952 and continued until May 13, the day of baiting. The traps used were the Sherman live trap, 3 x 3 x 10 inches, baited with whole oats. The trap spacing was at 22 foot intervals with the line extending from the outside boundary into the plot, a distance of 33 chains. A total of 17 rodents was caught in 8 nights of exposure. This provides a prebaiting figure of 2.12 rodents per 100 trapnights. After the plot was baited, trapping was carried on as in the previous plots, using snap traps set out for 3 nights and checked daily, with the traplines being removed and reset at two week intervals.

RESULTS

Prebaiting Censuses

A snap trap census of the plots prior to baiting indicated that there was present an adequate population to permit a good comparison of the baits to be tested. The results produced by these prebaiting trap lines are listed in Table I below.

TABLE I

PREBAITING SMALL MAMMAL POPULATIONS

Plot	Date	No. of Traps	No. of Nights	No. of Trapnights	No. of Mice	No. of Shrews	Catch per 100 trapnights		
							All Mammals	Mice	Shrews
No. 55	9/25/50	120	3	360	44	14	16.11	12.22	3.89
No. 56	9/25/50	120	3	360	59	6	18.06	16.39	1.67
No. 57	9/25/50	120	3	360	32	6	10.55	8.89	1.67
No. 58	9/25/50	120	3	360	42	8	13.90	11.67	2.23
No. 59	10/23/50	120	3	360	78	4	22.78	21.67	1.11
					Mean		16.28		

The mean of 16.28 mammals (rodents and shrews) caught per 100 trapnights compares very closely with other censuses made in other areas during the same period. The Wheeler Plot (No. 59) produced the greatest catch, 22.78 per 100 trapnights. The Glenwood Plot (No. 57) provided the smallest. Both of these are well within the normal range varying but 5.50 and 5.72 respectively from the mean of all the plots.

Check Trapline

The results from the check, or control, traplines which were placed in areas adjacent to the treated plots are shown in Table II. The traplines from which these data were obtained were for the most part placed at least 1/4 mile from the baited plots to avoid populations which might be depleted as an indirect result of the baiting.

To facilitate comparison of results from treated plots with those from the untreated areas, a population development curve was prepared (Figure VI). Monthly means were computed from both check line and prebaiting censuses. Data were available for all months except October and March. The means expressed in mammals caught per 100 trapnights were plotted over time by months, and a freehand curve drawn to indicate relative population levels.

Fall Baited Plots

Owl Plot No. 55

This plot was baited with a mixture of equal parts of thallous sulphate impregnated wheat and 1080 impregnated wheat distributed at a rate of 1/2 lb. per acre. The prebaiting census indicated 16.11 mammals per 100 trapnights. (Table I) It was baited on November 8, 1951 and 120 snaptraps were set out the same afternoon. The catch for the 3 succeeding days was 2 mice and 2 shrews or 2.77 small mammals per 100 trapnights as compared to the 16.11 prior to baiting. For three nights beginning November 22 nothing was caught, but five weeks after baiting, three mice were taken. The two following trappings, December 26, 1950 and January 25, 1951 provided nothing and it was not until three months after baiting that the traps again produced a mouse or a shrew.

TABLE II

CHECK TRAP LINE RESULTS

Date	No. Traps	No. Nights Exposed	Mice	Shrews	Total Mammals	Mammals Per 100 Trapnights
11-19-50	50	3	10	7	17	11.21
11-22-50	50	4	12	1	13	6.50
12-18-50	50	3	11	0	11	7.34
12-26-50	50	3	12	14	26	17.32
1- 9-51	60	3	21	4	25	14.86
1-24-51	50	5	6	0	6	2.40
1-29-51	60	3	1	0	1	0.55
2-13-51	60	3	12	2	14	7.78
2-19-51	60	4	4	3	7	2.92
2-19-51	60	4	6	7	13	5.42
2-28-51	60	2	6	3	9	7.50
4- 2-51	60	3	13	0	13	7.23
4- 3-51	60	3	3	3	6	3.33
4- 9-51	60	3	5	0	5	2.77
4 -9-51	60	3	9	0	9	5.00
4-16-51	60	3	13	3	16	8.89
4-16-51	60	3	6	1	7	3.88
4-23-51	60	3	8	1	9	5.00
4-24-51	60	3	6	4	10	5.56
5- 7-51	60	3	5	1	6	3.33
5- 7-51	60	3	3	0	3	1.66
5-14-51	60	3	8	0	8	4.44
5-21-51	60	3	9	0	9	5.00
5-28-51	60	3	4	0	4	2.22
6- 5-51	60	3	9	1	10	5.56
6-11-51	60	3	10	3	13	7.23
6-18-51	60	3	11	2	13	7.23
6-26-51	60	3	9	3	12	6.67
7- 2-51	60	3	7	0	7	3.88
7- 9-51	60	3	5	1	6	3.33
7-16-51	60	3	2	4	6	3.33
8- 6-51	60	3	21	4	25	13.88

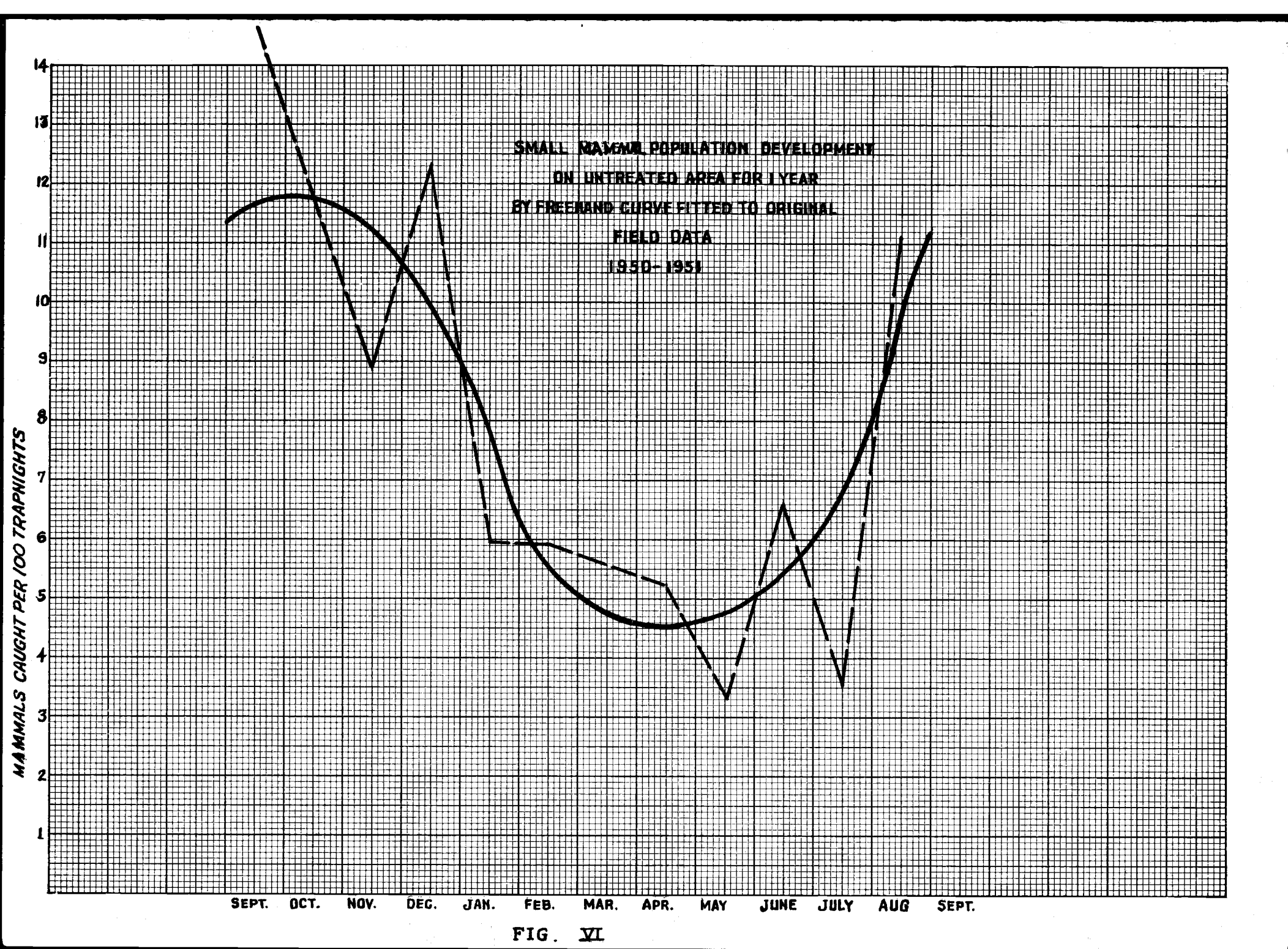

SMALL MAMMAL POPULATION DEVELOPMENT
ON UNTREATED AREA FOR 1 YEAR
BY FREEHAND CURVE FITTED TO ORIGINAL
FIELD DATA
1950-1951
MAMMALS CAUGHT PER 100 TRAPNIGHTS
14
13
12
11
10
9
8
7
6
5
4
3
2
1
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG
SEPT.

FIG. VI

Table III contains the complete results of all censuses made on the plot. Mammals caught within the first 1/4 mile (first 60 traps) from the bait boundary are recorded separately from those further into the interior (last 60 traps) of the plot. The first 1/4 mile is designated as buffer and the second as the interior. "Interior" seldom coincided exactly with the seeded area.

Figure VII shows the positions of the various trap lines and the relative location of each mammal taken. The mammals per 100 trapnights were plotted over census dates by freehand curves drawn to fit. (Figure IX) These curves portray population increases both in the buffer strip and in the interior after baiting. The population curve developed from check trapping has also been imposed upon the graph for ready visual comparison.

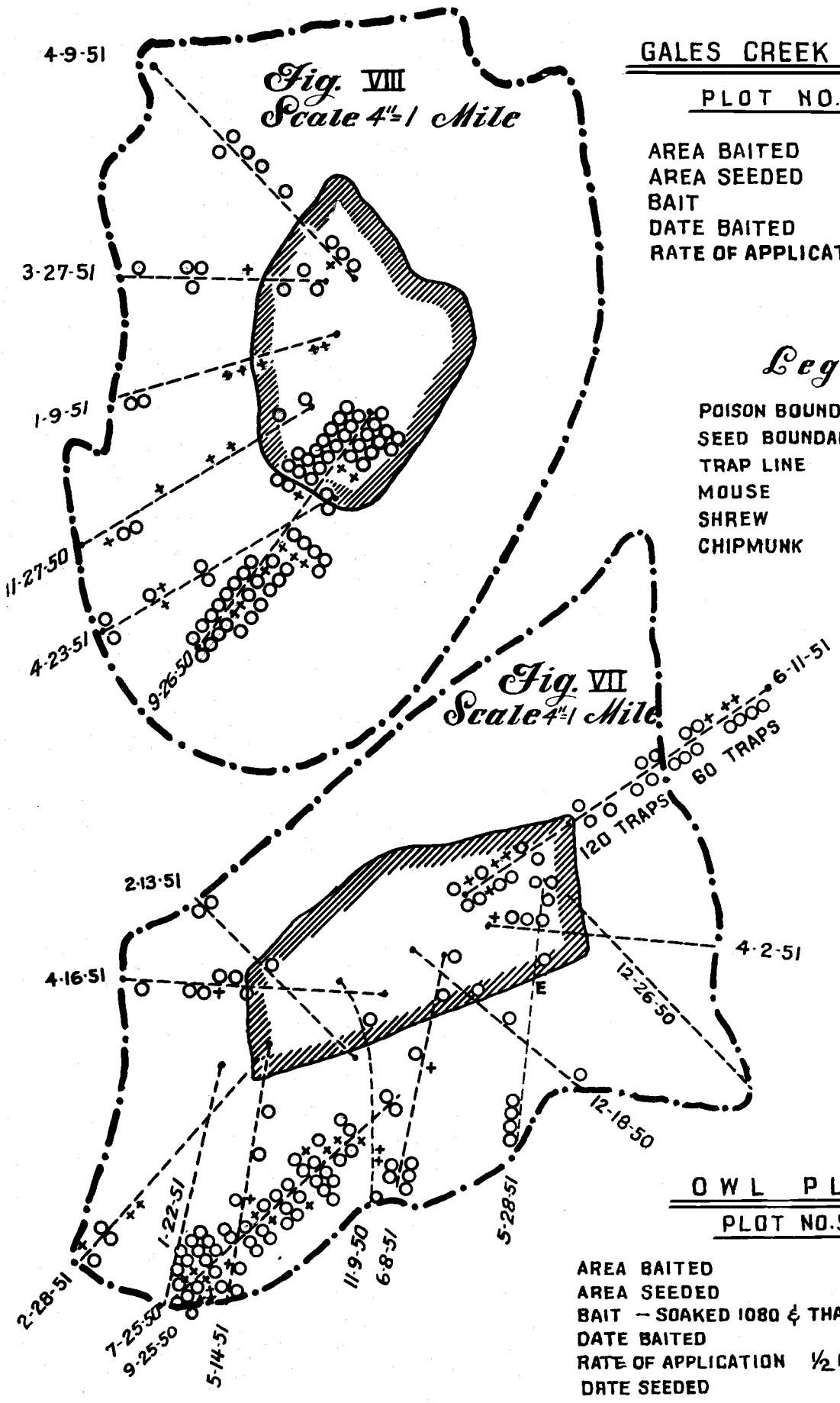
TABLE III

PLOT NO. 55 OWL PLOT

POST-BAITING CENSUS - MIXTURE OF EQUAL PARTS THALLOUS SULPHATE) 1/2 pound per acre
IMPREGNATED WHEAT AND SODIUM FLUOROACETATE IMPREGNATED WHEAT)

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals in Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
9/25/50	120	3	44	14					16.11	
11/ 9/50	120	3	2	2	1		1.67	0.56	1.11	11.21
11/22/50	120	5	0	0			0	0	0	6.50
12/18/51	120	3	3	0	1		1.10	0.56	0.83	7.34
12/26/51	120	3	0	0			0	0	0	17.32
1/25/51	120	4	0	0			0	0	0	2.40
2/13/51	120	3	3	0			1.66	0	0.83	7.78
2/28/51	120	2	3	4		1	5.00	0.84	2.92	7.50
4/ 2/51	120	3	3	1	3	1	2.22	0	1.11	7.23
4/16/51	120	3	6	1			3.34	0	1.67	6.38
5/ 8/51	120	3	8	2	3	1	3.34	2.22	2.78	2.50
5/14/51	120	3	8	1	1		3.88	1.12	2.50	4.44
5/28/51	120	3	8	0	4		2.22	2.22	2.22	2.22
6/11/51	120	3	15	4	8	4	6.66	3.90	5.28	7.23

TRAPLINE LOCATION



GALES CREEK PLOT

PLOT NO. 56

AREA BAITED	511 ACRES
AREA SEEDED	100 ACRES
BAIT	SOAKED 1080
DATE BAITED	11-8-50
RATE OF APPLICATION	1/4 LB./ACRE

Legend

POISON BOUNDARY	•—•—•
SEED BOUNDARY	//////
TRAP LINE	•- - - - -
MOUSE	O
SHREW	+
CHIPMUNK	E

OWL PLOT

PLOT NO.55

AREA BAITED	512 ACRES
AREA SEEDED	100 ACRES
BAIT	— SOAKED 1080 & THALLOUS SULPHATE
DATE BAITED	11-8-50
RATE OF APPLICATION	1/2 LB./ACRE
DATE SEEDED	12-6-50

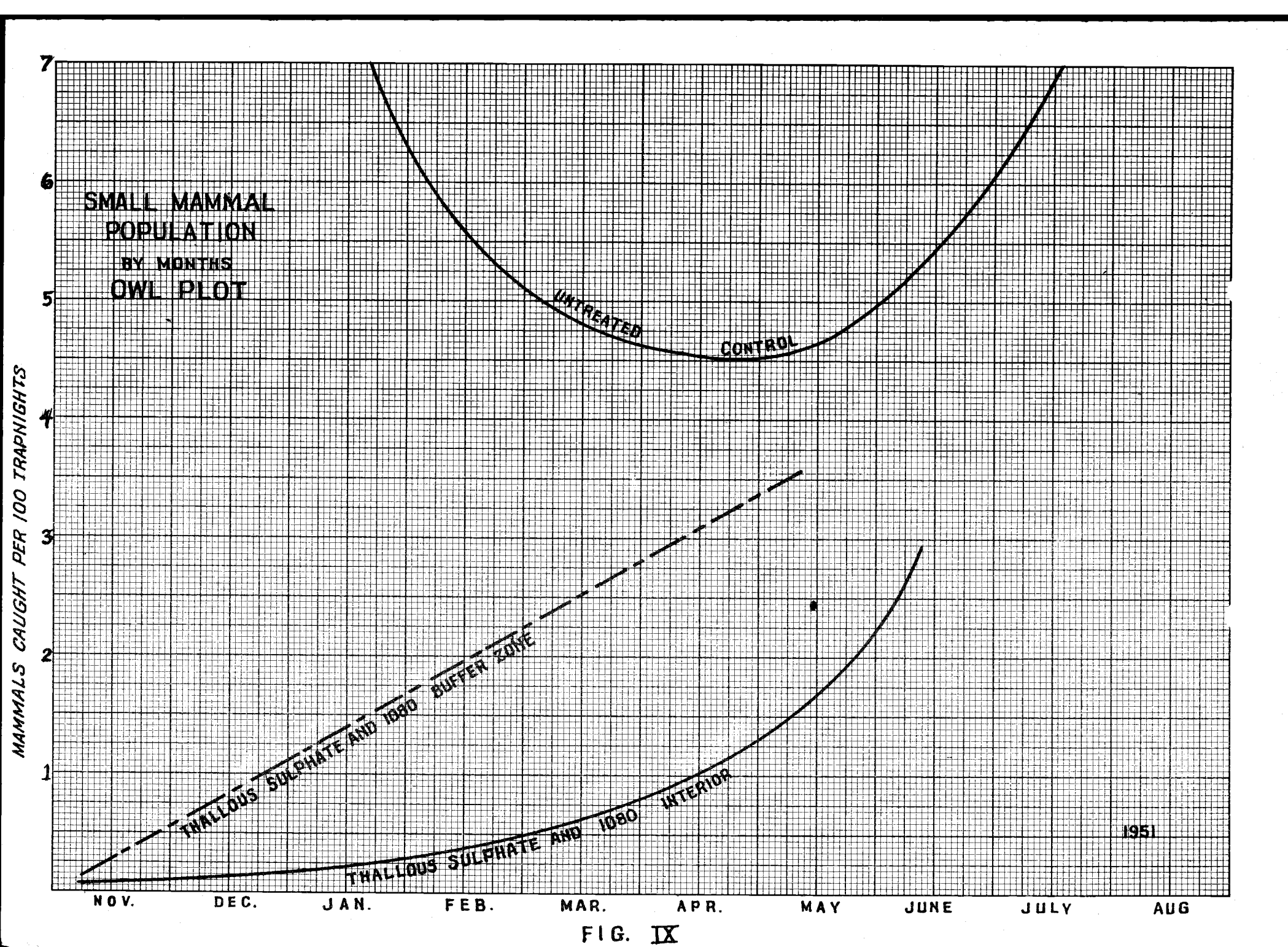

SMALL MAMMAL POPULATION
BY MONTHS
OWL PLOT
MAMMALS CAUGHT PER 100 TRAPNIGHTS
7
6
5
4
3
2
1
UNTREATED
CONTROL
THALLOUS SULPHATE AND 1080 BUFFER ZONE
THALLOUS SULPHATE AND 1080 INTERIOR
1951
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG

FIG. IX

Gales Creek Plot - No. 56

This plot was baited with thallous sulphate impregnated wheat at the rate of 1/4 lb. per acre. The prebaiting census indicated 18.06 mammals per 100 trapnights. It was baited on November 8, 1950 but post-baiting trapping was delayed for 19 days because of the snow which fell immediately after baiting. The first post-baiting trapping resulted in four mice and four shrews in three days, or 2.22 mammals per 100 trapnights.

Table IV contains the complete results of the trapping censuses made on the plot. Intermittent snowfall prevented a more adequate sampling. The positions of the traplines are shown by Figure VIII with the relative position of each mammal caught. Figure X shows the freehand curve drawn for the comparison of the mammal populations taken in the 1/4 mile buffer zone and the interior after baiting. This plot was the only one with the buffer zone population apparently remaining stable as the interior population increased in numbers. This presumed condition may have been attributable to the inadequate sampling.

TABLE IV

PLOT NO. 56 GALES CREEK PLOT

POST-BAITING CENSUS - THALLOUS SULPHATE IMPREGNATED WHEAT 1/4 POUND PER ACRE

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals In Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
9/25/50	120	3	59	6					18.06	
11/27/50	120	3	4	4			4.40	0	2.22	6.50
1/ 9/51	120	3	2	1		1	1.12	0.56	0.83	14.86
3/27/51	120	2	4	0			3.34	0	1.67	
4/ 9/51	120	3	8	1	5	1	1.66	3.34	2.50	3.88
4/23/51	120	3	7	2	4		2.78	2.22	2.50	5.00

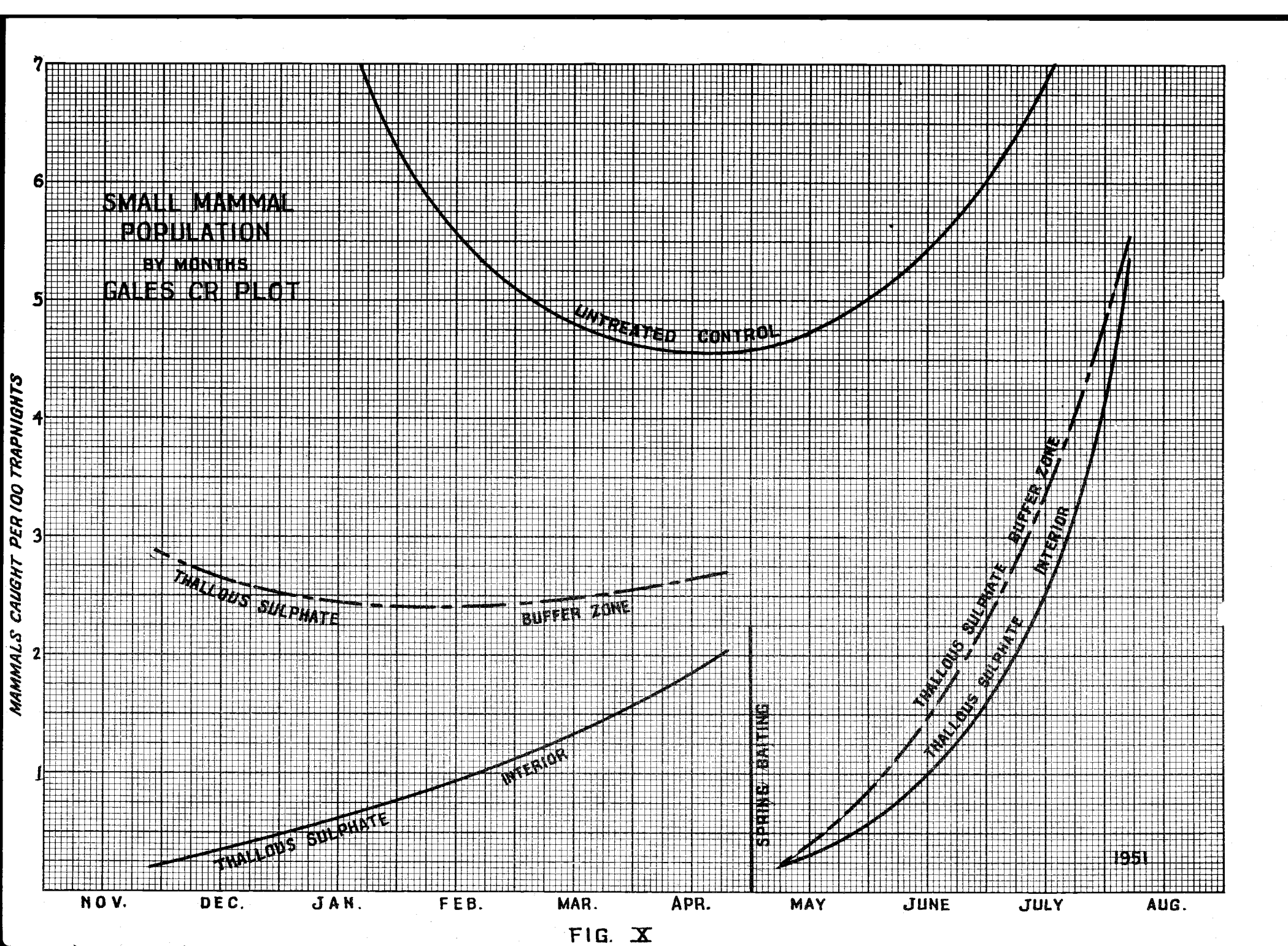

SMALL MAMMAL POPULATION
BY MONTHS
GALES CR. PLOT
MAMMALS CAUGHT PER 100 TRAPNIGHTS
7
6
5
4
3
2
1
UNTREATED CONTROL
THALLOUS SULPHATE
BUFFER ZONE
INTERIOR
THALLOUS SULPHATE
INTERIOR
THALLOUS SULPHATE
BUFFER ZONE
SPRING BAITING
1951
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. X

Glenwood Plot - No. 57

The Glenwood plot was baited November 9, 1950 with a wheat bait which had been coated with 1080 and overcoated with two applications of safflower oil. One hundred twenty traps set out 4 days later and exposed for 3 nights failed to catch a single rodent or shrew. (Table V) Similar trapping in December and on January 7, 1951 provided one mouse each. Both mice were caught on the outside edge of the 1/4 mile buffer zone. (Figure XI) Not until April 9 were any mice caught in the interior of the plot although 1 shrew was taken there in February.

The curves plotted in Figure XIII portray the rapidity with which the catches in the buffer and in the interior approach equality in April, May, and June. They also indicate how the rodent population in the baited area rapidly approaches the mean for the unbaited check areas.

TABLE V

PLOT NO. 57 GLENWOOD PLOT

POST-BAITING CENSUS - SODIUM FLUOROACETATE COATED WHEAT AND SAFFLOWER OIL OVERCOATED 1/4 POUND PER ACRE

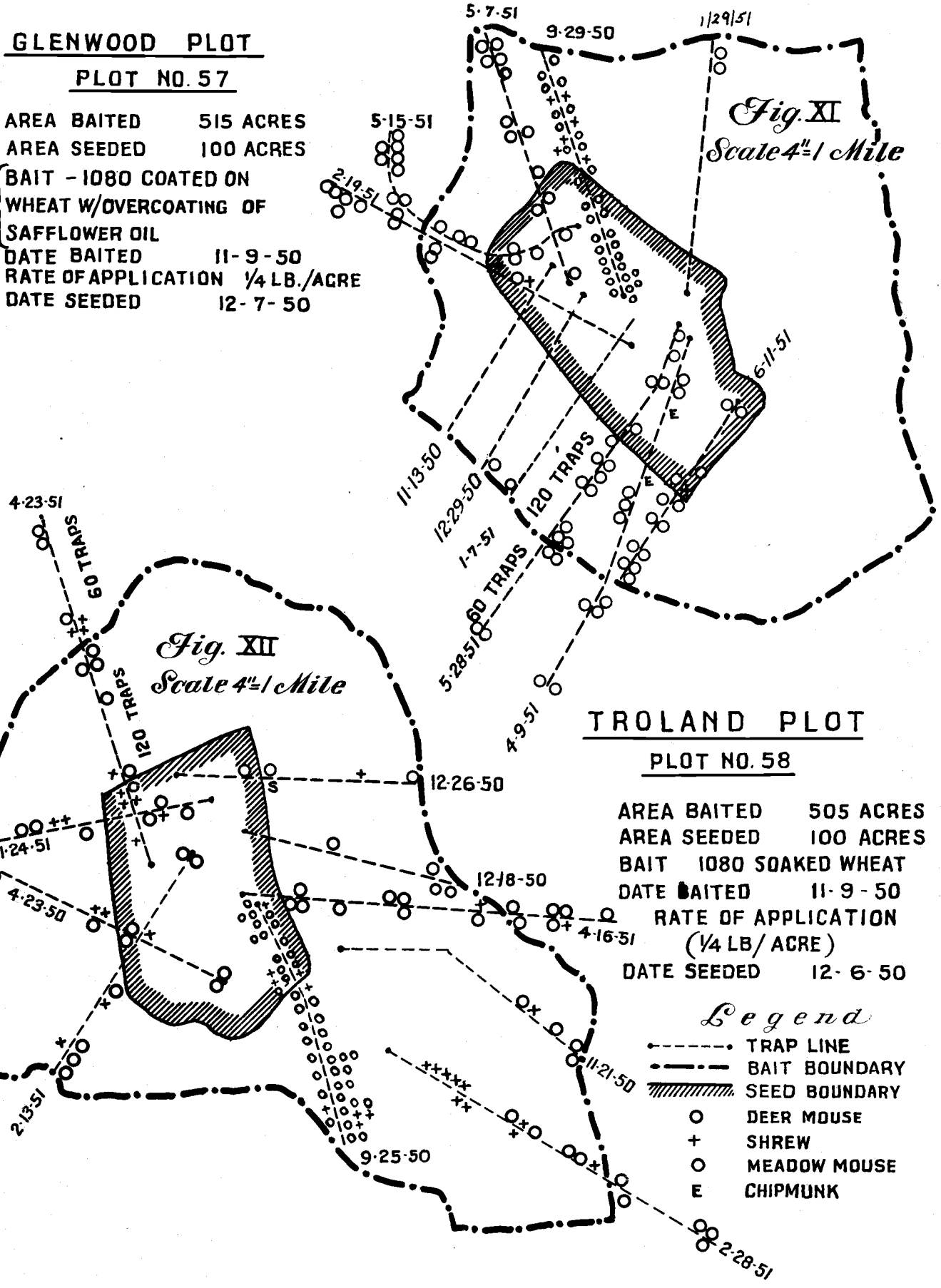
Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals In Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
9/25/50	120	3	32	6					10.55	
11/13/50	120	5	0				0	0	0	11.21
12/29/50	120	8	1				0.20	0	0.10	17.32
1/7/51	120	5	1				0.34	0	0.17	14.86
1/29/51	120	3	2				1.12	0	0.56	0.55
2/19/51	120	4	3	2		1	1.66	0.42	1.04	4.17
4/ 9/51	120	3	5		2		1.66	1.10	1.38	3.88
5/ 7/51	120	3	12		4		4.44	2.22	3.33	2.50
5/14/51	120	3	7		2		2.78	1.10	1.94	4.44
5/28/51	120	3	14	1	6		4.98	3.36	4.17	2.22
6/11/51	120	3	13		4	1	4.44	2.80	3.62	7.23

TRAPLINE LOCATION

GLENWOOD PLOT

PLOT NO. 57

AREA BAITED 515 ACRES
AREA SEEDED 100 ACRES
BAIT - 1080 COATED ON WHEAT W/OVERCOATING OF SAFFLOWER OIL
DATE BAITED 11-9-50
RATE OF APPLICATION 1/4 LB./ACRE
DATE SEEDED 12-7-50



TROLAND PLOT

PLOT NO. 58

AREA BAITED 505 ACRES
AREA SEEDED 100 ACRES
BAIT 1080 SOAKED WHEAT
DATE BAITED 11-9-50
RATE OF APPLICATION (1/4 LB/ACRE)
DATE SEEDED 12-6-50

Legend

- TRAP LINE
- BAIT BOUNDARY
- SEED BOUNDARY
- O DEER MOUSE
- \+ SHREW
- O MEADOW MOUSE
- E CHIPMUNK

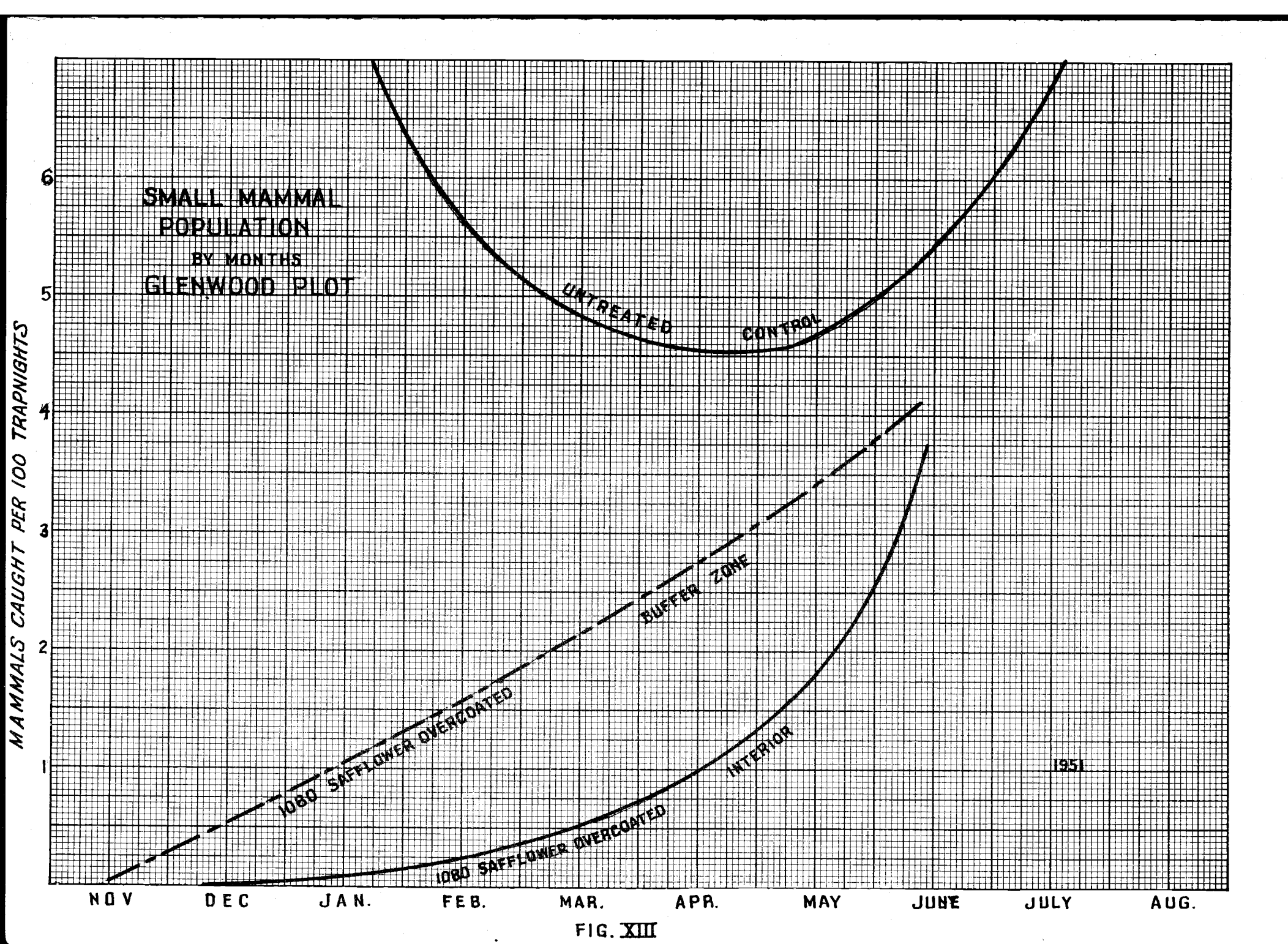

SMALL MAMMAL POPULATION
BY MONTHS
GLENWOOD PLOT
MAMMALS CAUGHT PER 100 TRAPNIGHTS
6
5
4
3
2
1
UNTREATED
CONTROL
BUFFER ZONE
1080 SAFFLOWER OVERCOATED
INTERIOR
1080 SAFFLOWER OVERCOATED
1951
NOV
DEC
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XIII

Troland Plot - No. 58

This plot was baited November 9, 1950 with wheat impregnated with 1080 applied at the rate of 1/4 lb. per acre. Traps were not set out until November 21, when 4 mice and 1 shrew were caught in the buffer strip after the line had been exposed for 6 nights. The buffer zone remained high in population in relation to the other baited plots throughout the period preceding spring baiting. Population as determined by trapping results built up very rapidly in the interior also. By February it apparently exceeded the population in the buffer strip (Table VI), and at the time of the April 13 census the total number of mice and shrews caught in the interior exceeded those caught in the untreated control. (Figure XIV)

Since the plot was rebaited on May 2, the trend established earlier could not be authenticated but it is quite evident from these data that the control provided by the fall baiting was transitory.

TABLE VI

PLOT NO. 58 TROLAND PLOT

POST-BAITING CENSUS - SODIUM FLUOROACETATE IMPREGNATED WHEAT 1/4 POUND PER ACRE

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals in Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
9/25/50	120	3	42	8					13.90	
11/21/50	120	6	4	1			1.38	0	0.69	6.50
12/18/50	120	3	4		1		1.66	0.56	1.11	7.34
12/26/50	120	3	3	2	2	1	1.12	1.66	1.39	17.32
1/24/51	120	5	6	4	3	2	1.68	1.66	1.67	2.40
2/13/51	120	3	7	3	3	1	3.32	2.22	2.77	7.78
4/ 3/51	120	3	6	5	3	5	1.68	4.44	3.06	3.33
4/16/51	120	3	8	1	4		2.78	2.22	2.50	5.88
4/23/51	120	3	6	4	5	3	1.10	4.44	2.77	5.00

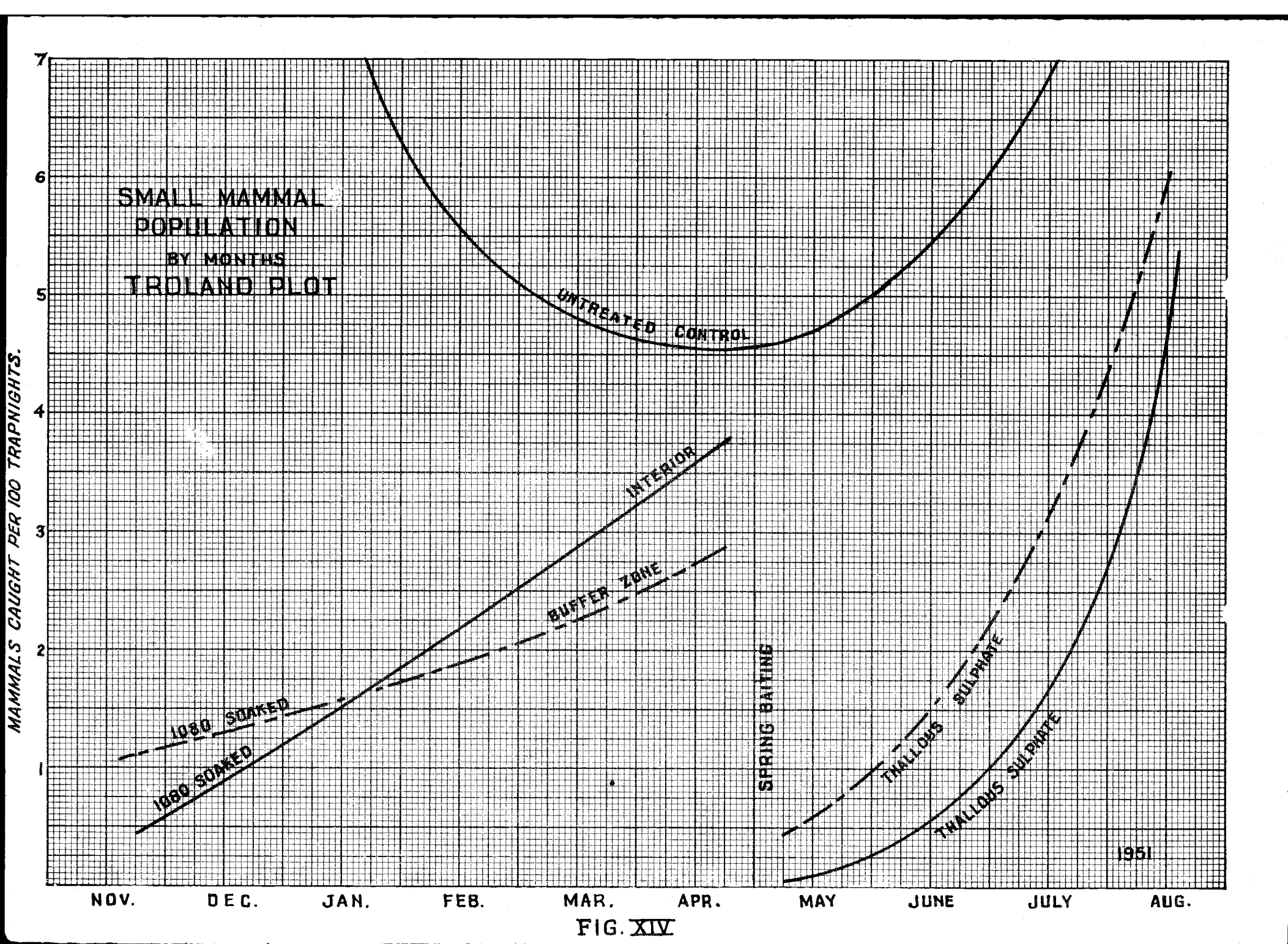

SMALL MAMMAL POPULATION
BY MONTHS
TROLAND PLOT
MAMMALS CAUGHT PER 100 TRAPNIGHTS.
7
6
5
4
3
2
1
UNTREATED CONTROL
INTERIOR
BUFFER ZONE
1080 SOAKED
1080 SOAKED
SPRING BAITING
THALLOUS SULPHATE
THALLOUS SULPHATE
1951
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XIV

Wheeler Plot - No. 59 (Abandoned)

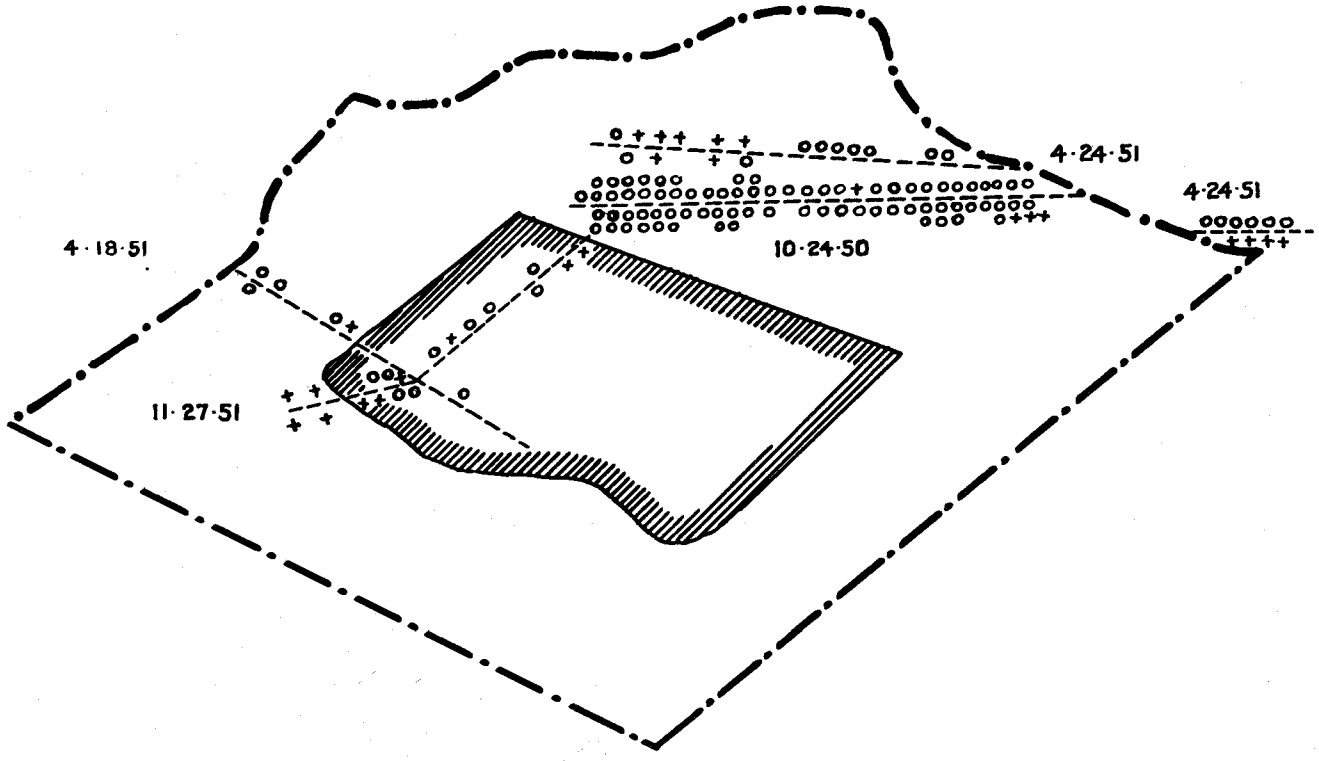
The population as indicated by prebaiting trapping on this plot was exceptionally high. Eighty-two mammals were caught for a ratio of 22.78 mammals per 100 trapnights on October 23, 24, and 25, 1950. Castrix picrate overcoated wheat was applied at the rate of 1/4 lb. per acre on November 11, 1950. The post-baiting census was also quite high, with 18 mammals caught during the trapping period beginning 16 days after baiting. Sampling was complicated by the fact that snow fell on the first day the traps were placed and was on the ground during the entire three day period. It was impossible to make another census until April 18, 1951 when six rodents were taken. Trapping the following week found 18 mammals inside the plot in the 120 traps and 10 mammals in 60 traps outside the plot boundary.

Since the early snow which fell and remained on the plot prevented adequate study immediately after baiting, and the early spring census indicated that the population had returned to normal for the area at that season, further study was discontinued.

Figure XV shows the trap line locations and the approximate position of each mammal caught.

TRAPLINE LOCATION

Fig. XV



WHEELER PLOT

Scale 4" = 1" Mile

PLOT NO. 59

BAIT – CASTRIX PICRATE		RATE OF APPLICATION	¼LB./ACRE
AREA POISONED	495A.	DATE BAITED	11-9-50
AREA SEEDED	100A.	DATE SEEDED	12-6-50

Legend

POISON BOUNDARY

SEED BOUNDARY

TRAP LINE

MOUSE o

SHREW +

CHIPMUNK E

TRAPLINE LOCATION

Spring Baited Plots

Spring Rebaited - Gales Creek Plot

On May 2, 1951, the Gales Creek plot, which had been baited the previous fall with thallous sulphate impregnated wheat, was rebaited with the same preparation. At the time of the last preceding census (April 23, 1951) the trap line of 120 traps had produced 2.78 mammals per 100 trapnights in the buffer strip and 2.22 in the interior (Table VII). The population in the unbaited areas at this time was represented by catches of approximately 5.00 per 100 trapnights.

Five days after rebaiting 120 traps exposed for 3 nights produced 1 mouse and 1 shrew for a total of 0.56 mammals per 100 trapnights. The check line for this period caught 2.50 per 100 trapnights. Two weeks later 3 mice were taken in the baited area for a total of 0.83 per 100 trapnights. Although the population in the buffer strip increased rather rapidly the interior portion of the plot remained relatively free of seed eating mammals until early in July, well after germination of Douglas fir seeds is normally completed. See Figures X and XVI.

TABLE VII

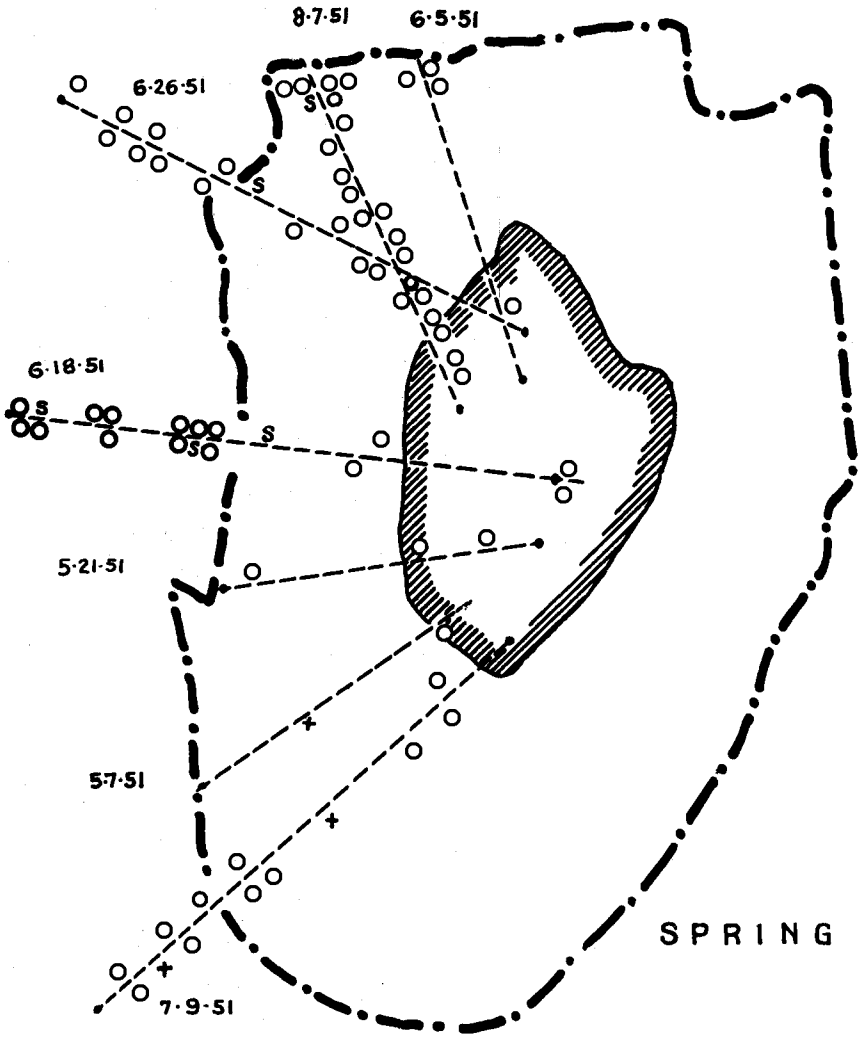
PLOT NO. 56 REBAITED GALES CREEK PLOT

POST-BAITING CENSUS - THALLOUS SULPHATE IMPREGNATED WHEAT 1/4 POUND PER ACRE
REBAITED WITH SAME BAIT 1/4 LB. PER ACRE 5/2/51

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals In Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
4/23/51	120	3	7	2	4		2.78	2.22	2.50	5.00
5/ 7/51	120	3	1	1	1		0.56	0.56	0.56	2.50
5/21/51	120	3	3	0	2		0.56	1.10	0.83	5.00
6/ 5/51	120	3	3	0	0		1.66	0	0.83	5.56
6/18/51	120	3	4	1	2		1.66	1.10	1.39	7.23
6/26/51	120	3	4	1	2		1.66	1.10	1.39	6.67
7/ 9/51	120	3	6	1	3		2.22	1.66	2.00	3.33
8/ 6/51	120	3	20	1	11		5.56	6.10	5.83	13.88

TRAPLINE LOCATION

Fig. XVI.



GALES CREEK PLOT

Scale 4" = 1 Mile

PLOT NO. 56

ORIGINAL AREA BAITED —— 511 A.
AREA REBAITED —— 511 A.
ORIGINAL BAIT - THALLOUS SULFATE
REBAITING PREPARATION - THALLOUS SULFATE

DATE REBAITED 5-2-51
RATE OF APPLICATION (¼ LB./ACRE)

Legend

BAIT BOUNDARY
SEED BOUNDARY
TRAP LINE

MOUSE —— o
SHREW —— +
CHIPMUNK —— E

Spring Rebaited Troland Plot

This plot had been originally baited in November 1950 with 1/4 lb. of soaked 1080 wheat per acre. It was rebaited May 2, 1951 with thallous sulphate impregnated wheat at the rate of 1/4 lb. per acre. The census made immediately prior to baiting (April 23) provided 2.77 mammals per 100 trapnights as compared to untreated area check of 5.00 per 100 trapnights. It is interesting to note that for a month prior to spring rebaiting the population in the interior of this plot was higher than in the buffer. During the month (1,080 trapnights) 20 mammals were taken in the interior and 10 in the buffer zone.

The first series of traps set out May 7, five days after rebaiting, produced nothing (Table VIII). Two weeks later 120 traps exposed for 3 nights caught 1 mouse and 1 shrew, both in the buffer zone (Fig. XVII). At the same time, 60 traps in the outside unpoisoned area produced 9 seed-eating mammals. From the initial census after rebaiting a uniform rate of increase is noted in the population until the final trapping August 16, 1951. Any tendency which may have existed for a greater interior population failed to reappear after rebaiting. See Table VIII and Graph in Figure XIV.

TABLE VIII

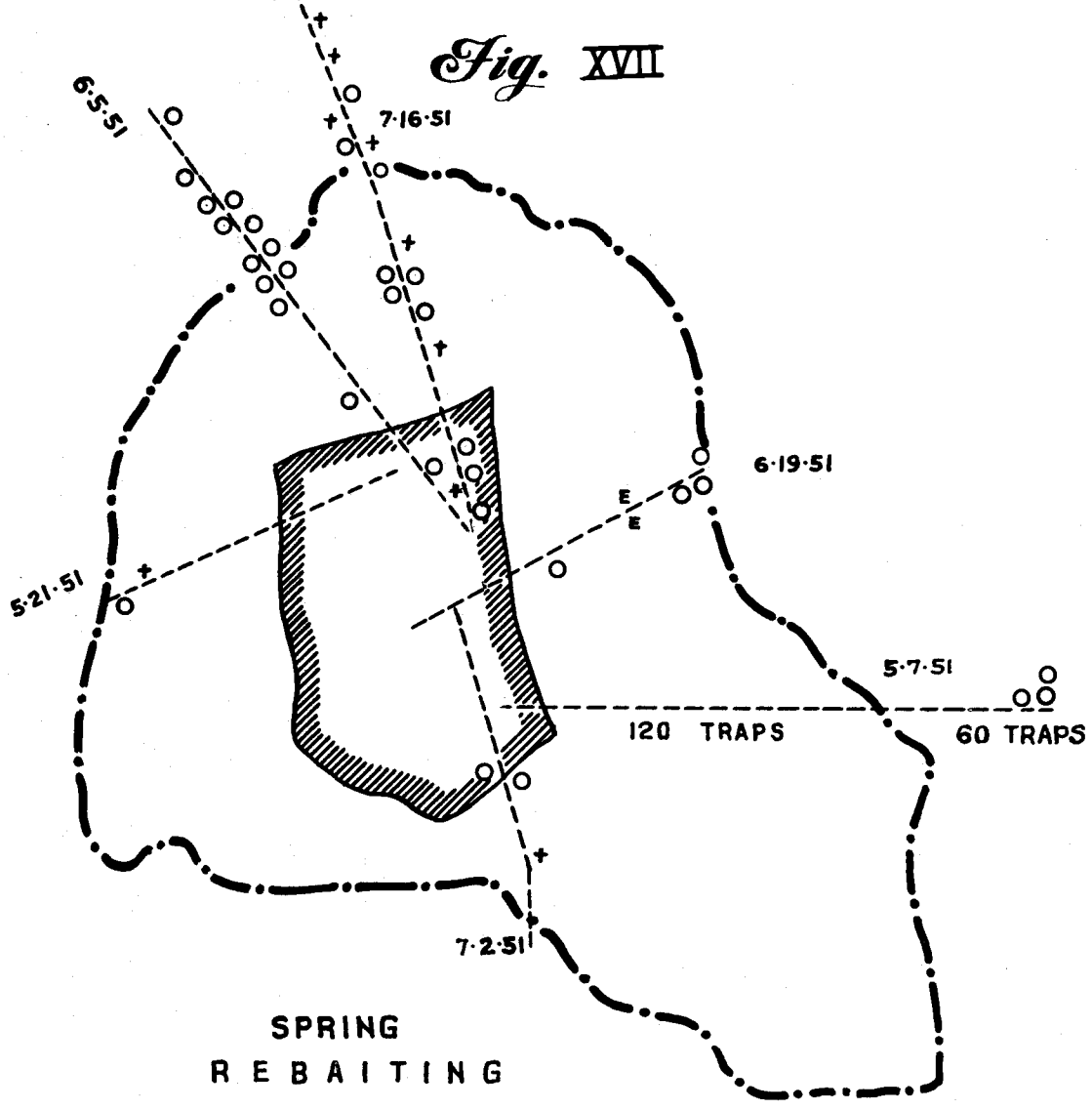
PLOT NO. 58 REBAITED TROLAND PLOT

POST-BAITING CENSUS - SODIUM FLUOROACETATE IMPREGNATED WHEAT 1/4 LB. PER ACRE
REBAITING 5/2/51 WITH THALLOUS SULPHATE 1/4 LB. PER ACRE

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals in Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
4/23/51	120	3	6	4	5	3	1.10	4.44	2.77	5.00
5/ 7/51	120	3	0				0	0	0	2.50
5/21/51	120	3	1	1			1.12	0	0.56	5.00
6/ 5/51	120	3	3		1		1.12	0.54	0.83	5.56
6/19/51	120	3	4		1		1.66	0.56	1.11	7.23
7/ 2/51	120	3	2	1			1.66	0	0.83	3.88
7/16/51	120	3	9	3	4	2	3.34	3.34	3.34	3.33
8/16/51	120	3	11	7	1	5	6.68	3.34	5.01	13.88

TRAPLINE LOCATION

Fig. XVII



TROLAND PLOT

Scale 4"= 1- Mile

PLOT NO. 58

ORIGINAL AREA BAITED 505 A. DATE REBAITED 5-2-51
AREA REBAITED 505 A. RATE OF APPLICATION ¼LB/ACRE
ORIGINAL BAIT SOAKED 1080
REBAITING PREPARATION THALLOUS SULPHATE

Legend

BAIT BOUNDARY	-—·—	MOUSE	o
TRAP LINE	------	SHREW	+
SEED BOUNDARY	▨	CHIPMUNK	E

Spring Baited Devils Lake Plot 1951

This 500 acre plot was baited May 2, 1951 with 1080 coated wheat to which had been applied 2 overcoats of safflower oil. A prebaiting census had resulted in a catch of 5.56 mammals per 100 trapnights. The first trapline established 5 days after baiting produced 0.76 per 100 trapnights, in the buffer zone and 1.10 in the interior. Another census begun May 21 produced 1.66 in the buffer and 0.00 in the interior. A June 5 trapping produced identical results. Although the numbers of mammals found in the buffer zone had risen rapidly the population had not increased appreciably in the interior until early in July when 4.46 mammals were taken per 100 trapnights. Complete results may be seen in Table IX and Figures XVIII and XX.

TABLE IX

PLOT 57A

1951 DEVILS LAKE PLOT

POST-BAITING CENSUS - SODIUM FLUOROACETATE COATED WHEAT WITH SAFFLOWER OIL OVERCOAT
1/4 POUND PER ACRE
SPRING BAITING ONLY

Trap Date	No. Traps	Nights Exposed	Mammals Caught		Mammals in Interior		Mammals per 100 Trapnights			Check Line
			Mice	Shrews	Mice	Shrews	Buffer	Interior	Total	
4/24/51	60	3	6	4					5.56	
5/ 7/51	120	3	2	1	1	1	0.76	1.10	0.83	2.50
5/21/51	120	3	3				1.66	0	0.83	5.00
6/ 5/51	120	3	3				1.66	0	0.83	5.56
6/18/51	120	3	8	1	1		4.44	0.56	2.50	7.23
7/ 2/51	120	3	14	1	7	1	3.88	4.46	4.17	3.88
7/16/51	120	3	9	2	5	2	2.24	3.88	3.06	3.33
8/ 6/51	120	3	11	11	5	2	8.34	3.88	6.11	13.88

TRAPLINE LOCATION

Fig. XVIII

DEVILS LAKE PLOT

PLOT NO. 57 A

AREA BAITED	500 ACRES
AREA SEEDED	NONE
BAIT	1080 OVERCOATED W/SAFFLOWER OIL
RATE OF APPLICATION	¼LB. PER ACRE
DATE BAITED	5-2-51

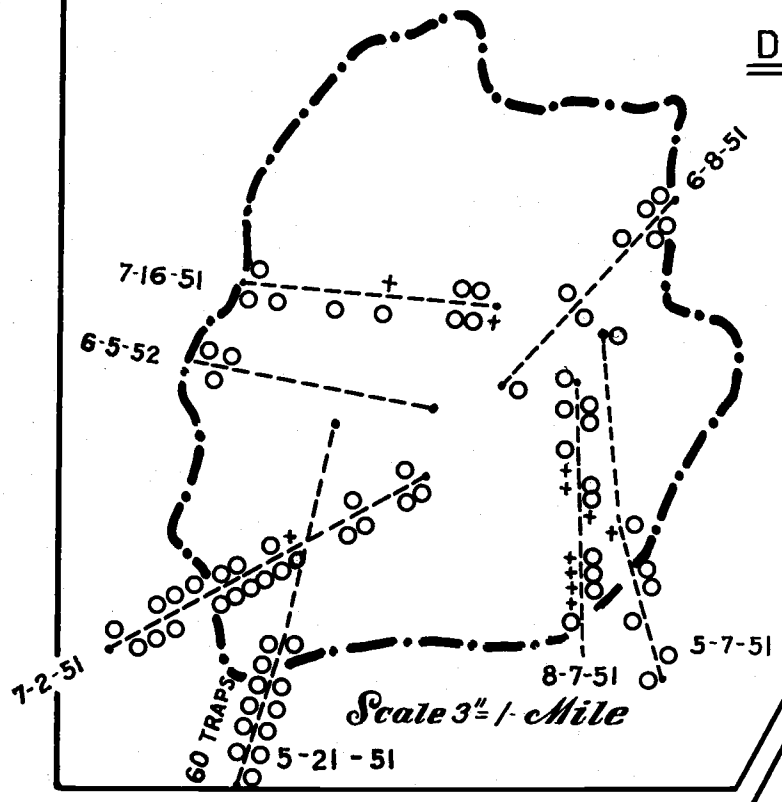
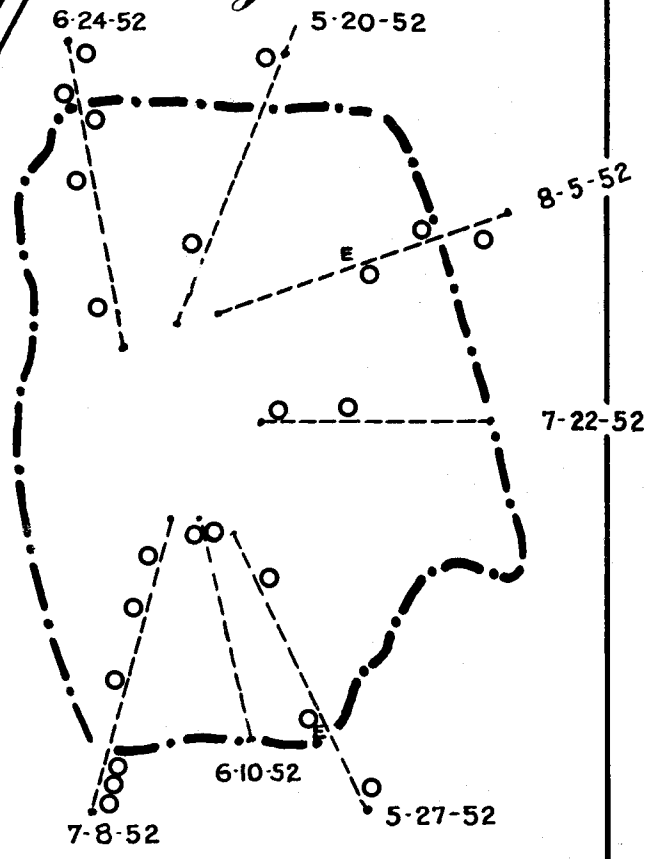


Fig. XIX.

BEAVER DAM PLOT

PLOT NO. 57B

AREA BAITED	500 ACRES
AREA SEEDED	NONE
BAIT	1080 OVERCOATED W/SAFFLOWER OIL
RATE OF APPLICATION	¼ LB. PER ACRE
DATE BAITED	5-13-52



Legend

- BAIT BOUNDARY
- TRAP LINE
- O MOUSE
- \+ SHREW
- E CHIPMUNK

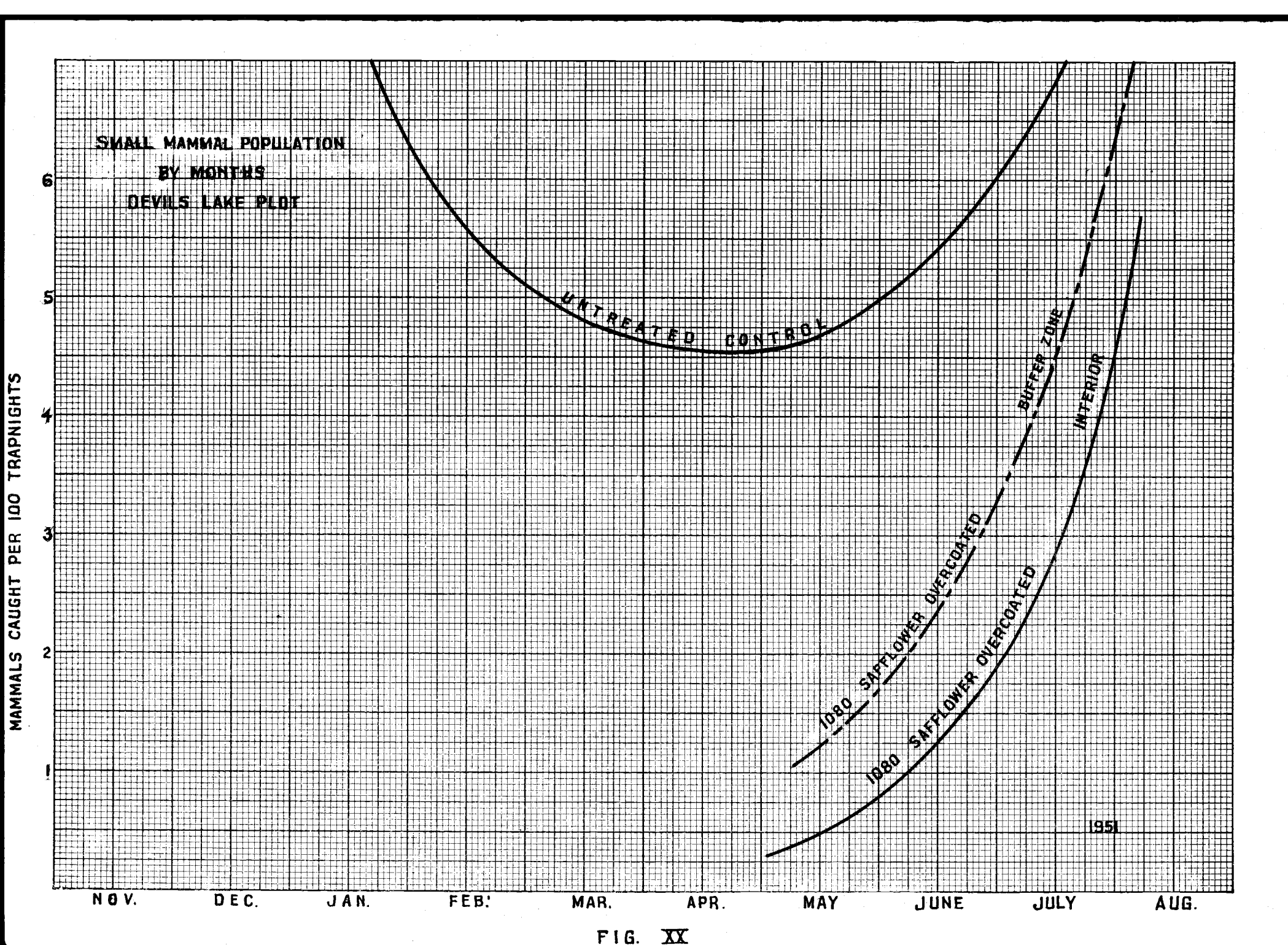

SMALL MAMMAL POPULATION
BY MONTHS
DEVILS LAKE PLOT
MAMMALS CAUGHT PER 100 TRAPNIGHTS
6
5
4
3
2
1
UNTREATED CONTROL
BUFFER ZONE
INTERIOR
1080 SAFFLOWER OVERCOATED
1080 SAFFLOWER OVERCOATED
1951
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XX

Spring Baited Beaver Dam Plot 1952

This plot was baited with wheat, to which 1080 had been added by a soaking process, at the rate of 1/4 lb. per acre. The mammal population in the plot before baiting was very low (Table X) compared to populations as determined by check trap lines of the previous spring. Censuses taken on other projects in the spring of 1952 indicate that a low population was general throughout the Tillamook Burn region.

The population remained low in the baited area throughout the trapping period and had not yet shown any tendency toward a rapid recovery in August when trapping was discontinued. Outside population levels also remained extremely low through the summer as compared to the previous year, e.g., 13.88 per 100 trapnights August 6, 1951 and 1.11 August 5, 1952. (See Figures XIX, XXI and Table X.)

TABLE X

PLOT NO. 57B — BEAVER DAM PLOT 1952

POST-BAITING CENSUS - SODIUM FLUOROACETATE COATED WHEAT WITH SAFFLOWER OVERCOAT 1/4 POUND PER ACRE SPRING BAITING ONLY

Trap Date	No. Traps	No. Nights	Mammals Caught	Mammals in Interior	Mammals per 100 Trapnights			Check** Line
					Buffer	Interior	Total	
*5-6	100	8	17				2.12	
5-20	120	3	1	1	0	0.55	0.28	1.11
5-27	120	3	2	1	0.55	0.55	0.55	1.11
6-10	120	3	2	2	0	1.11	0.55	
6-24	120	3	3	1	1.11	0.55	0.83	2.22
7-8	120	3	3	2	0.55	1.11	0.83	2.22
7-22	120	3	2	2	0	1.11	0.55	
8-5	120	3	2		1.11	0	0.55	1.11

*5/6 100 museum live traps
**Check line 30 snap traps

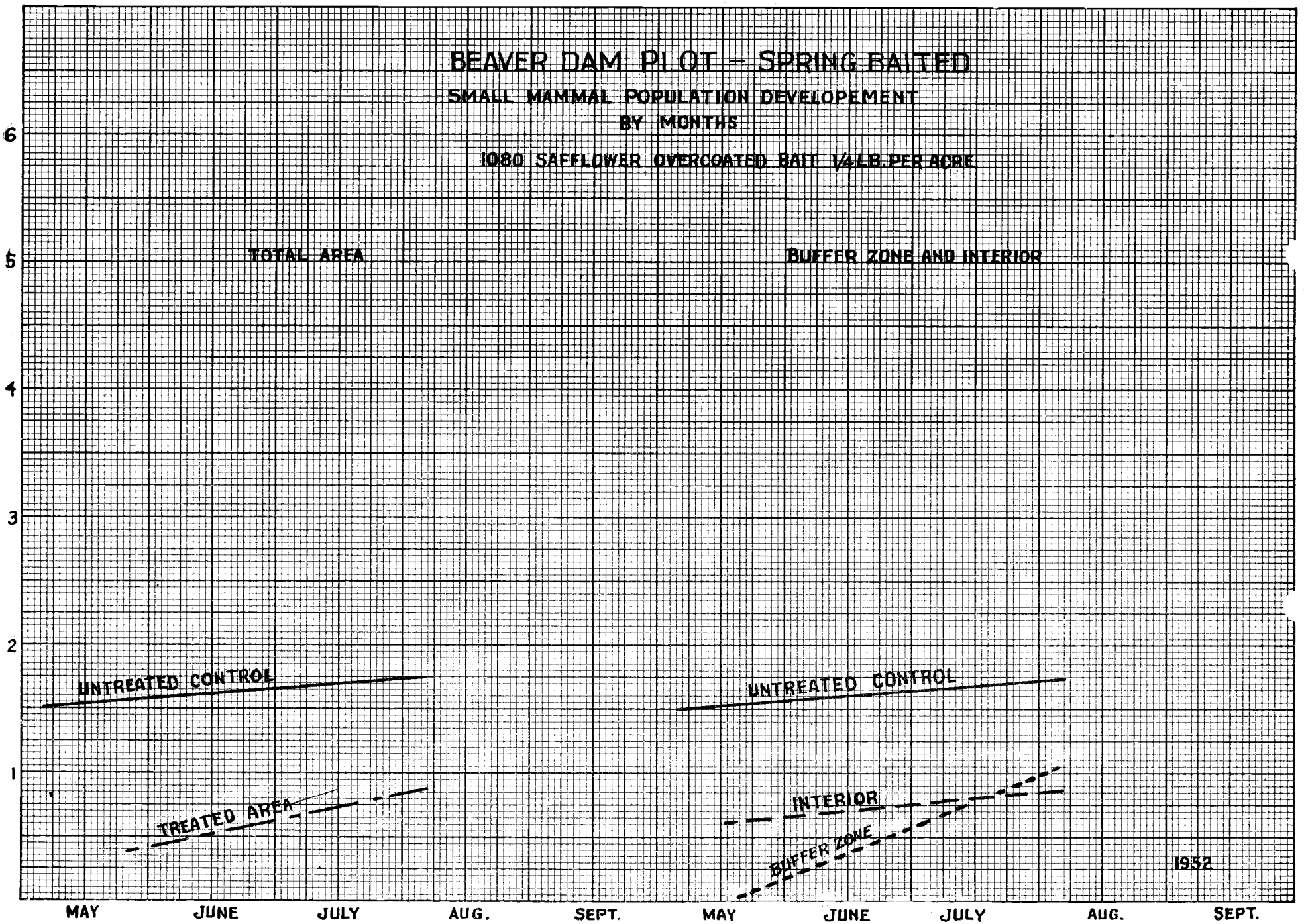

BEAVER DAM PLOT - SPRING BAITED
SMALL MAMMAL POPULATION DEVELOPEMENT
BY MONTHS
1080 SAFFLOWER OVERCOATED BAIT 1/4 LB. PER ACRE
TOTAL AREA
BUFFER ZONE AND INTERIOR
MAMMALS CAUGHT PER 100 TRAPNIGHTS
6
5
4
3
2
1
UNTREATED CONTROL
TREATED AREA
UNTREATED CONTROL
INTERIOR
BUFFER ZONE
1952
MAY
JUNE
JULY
AUG.
SEPT.
MAY
JUNE
JULY
AUG.
SEPT.

FIG. XXI

CONCLUSIONS

Since this study included multiple purposes and in addition actually consisted of several individual projects which were complete in themselves, there are several conclusions and inferences which may be drawn.

Relative Effectiveness of Rodenticides

Castrix Picrate

The wheat bait coated with castrix picrate apparently failed to reduce the population sufficiently to warrant its use as a rodenticide in forest seeding projects. However, the snow which fell immediately after baiting may have affected the results adversely. In addition, other chemicals applied in an adhesive coating without the protection of additional coatings, had often proved unsatisfactory in previous projects. Considering these two conditions castrix picrate should not be rejected entirely as a rodenticide since it had proven quite lethal in laboratory tests.

Thallous Sulphate

The results obtained from the study of baiting with wheat soaked in this material compared very closely with the observations made on previous seeding projects where it was employed as a rodenticide. The initial control as determined by trapping studies appears poorer than for most of the baits but this may have been influenced by the snow which fell immediately after baiting or to the sampling pattern which, because of the snowfall, was not complete.

Spring baiting with thallous sulphate also indicates that the fall baiting results may have been unduly influenced by unfavorable weather

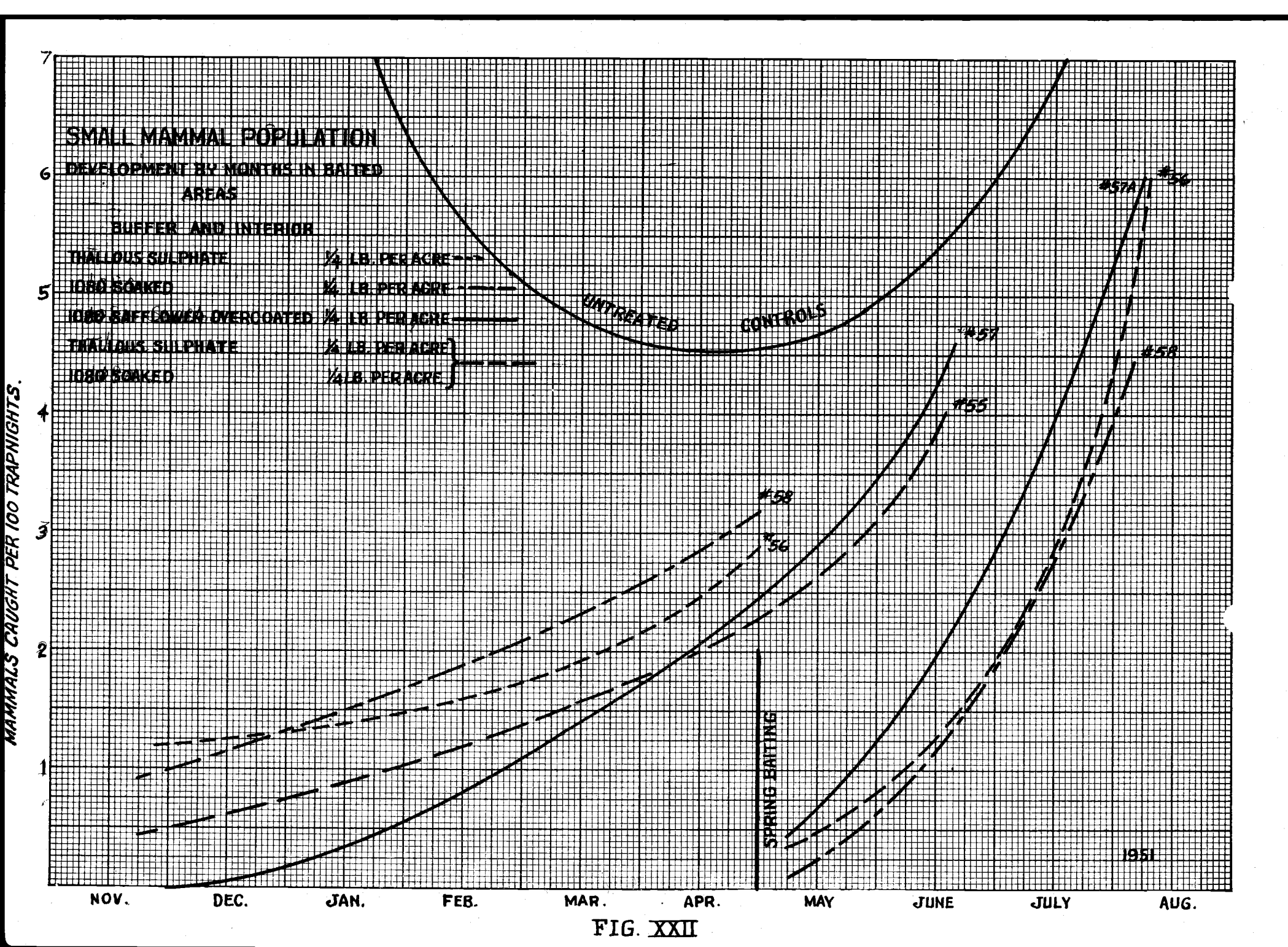

SMALL MAMMAL POPULATION
DEVELOPMENT BY MONTHS IN BAITED AREAS
BUFFER AND INTERIOR
THALLOUS SULPHATE 1080 SOAKED ¼ LB. PER ACRE
¼ LB. PER ACRE
1080 SAFFLOWER OVERCOATED ¼ LB. PER ACRE
THALLOUS SULPHATE 1080 SOAKED ¼ LB. PER ACRE
¼ LB. PER ACRE
UNTREATED CONTROLS
#57A
#54
#57
#58
#55
#58
#56
SPRING BAITING
1951
MAMMALS CAUGHT PER 100 TRAPNIGHTS.
7
6
5
4
3
2
1
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XXII

conditions. Rebaiting with wheat impregnated with this material in the spring may be quite effective whether applied to areas baited the previous fall with the same material or to areas previously baited with 1080.

1080 Soaked

Wheat impregnated with 1080 by soaking in an 8 percent aqueous solution initially reduces the resident small mammal population to a relatively low level when applied in the fall at the rate of 1/4 lb. per acre. However, when applied alone it fails to maintain control for a sufficient length of time to provide the desired protection for seeds sown in the fall. The very rapid rise in population is apparent from observations of the free-hand curve which portrays, in Figure XXII, the population development in both the interior and the buffer strip combined, for the plots treated. In Figure XXIII the curves which depict development in the interior, or seed areas, after baiting indicate the relatively poor protection provided. These factors indicate that the 1080 bait preparation employed in this project may be undesirable as a semi-permanent bait when used alone.

Combination 1080 and Thallous Sulphate

The combination of equal parts of soaked 1080 wheat bait and thallous sulphate soaked wheat bait when applied in the fall at a rate of 1/2 lb. per acre not only provides very effective initial population reduction but the protection provided by baiting with this combination persists well into the following spring. Although the buffer zone population tends to rise at about the same rate as it does in the buffer strips of areas baited with other preparations, the protection afforded the seeded area apparently remains consistently higher. (Figures XXIII and XXIV)

1080 Coated, Safflower Overcoated

Wheat bait coated with 1080 and overcoated with safflower oil provides a high level of control when applied either in the fall or in the spring. The excellent control in the seed area of the fall baited project persisted well into April. Later in the spring it was exceeded in persistence only by the combination 1080 and thallous sulphate bait. It remained sufficiently effective to prevent undue damage before most of the seeds had completed germination.

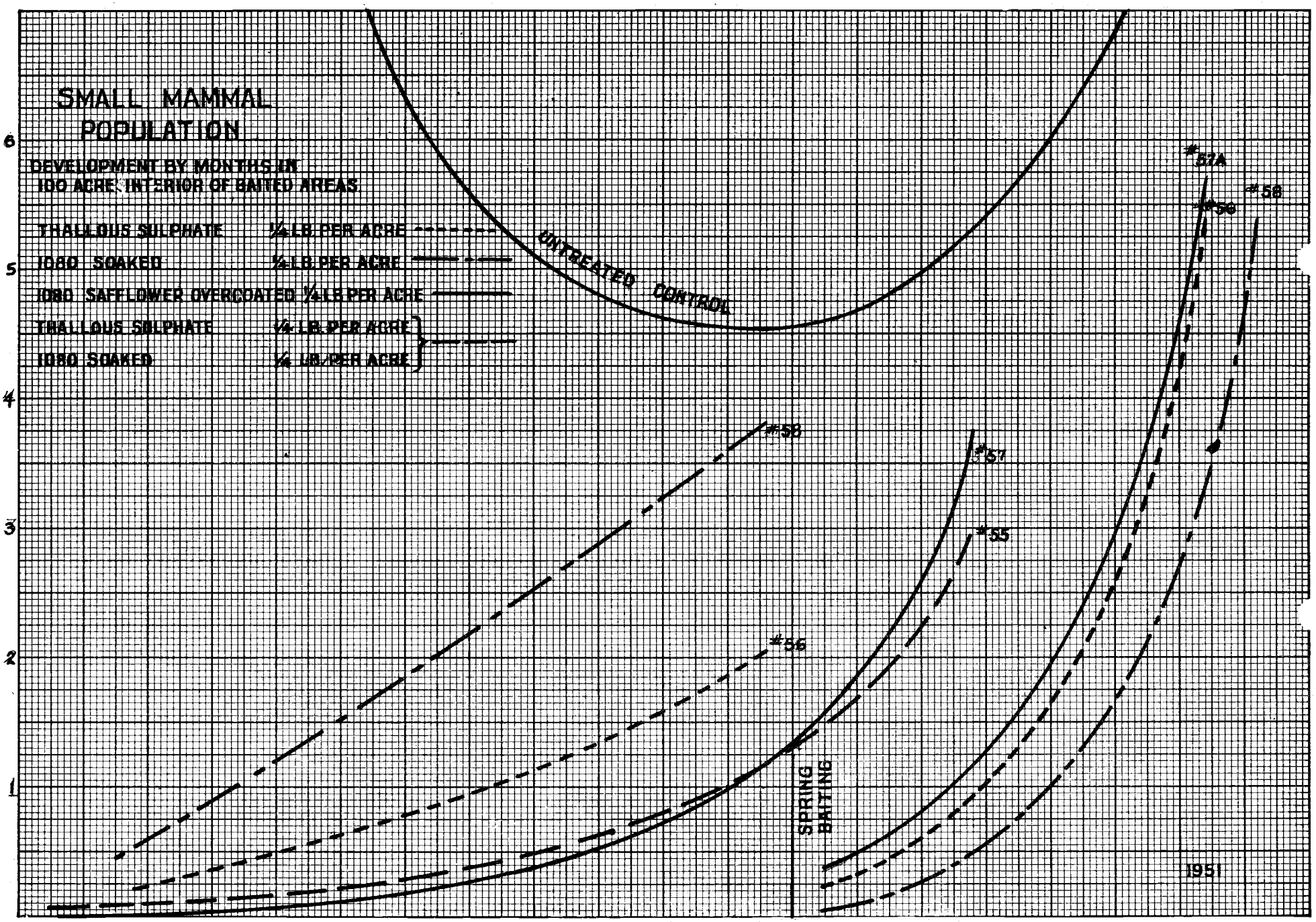

SMALL MAMMAL POPULATION
DEVELOPMENT BY MONTHS IN 100 ACRE INTERIOR OF BAITED AREAS
THALLOUS SULPHATE ¼ LB PER ACRE
1080 SOAKED ¼ LB PER ACRE
1080 SAFFLOWER OVERCOATED ¼ LB PER ACRE
THALLOUS SULPHATE ¼ LB PER ACRE
1080 SOAKED ¼ LB PER ACRE
UNTREATED CONTROL
#58
#57A
#56
#57
#55
#58
#56
SPRING BAITING
1951
MAMMALS CAUGHT PER 100 TRAPNIGHTS.
6
5
4
3
2
1
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XXIII

Buffer Strip

From a study of the areas baited in this experiment it appears that a buffer strip is necessary to prevent a too rapid invasion of seeded areas even though the resident population has been entirely destroyed. Although such protective zones do not provide permanent relief they do absorb the infiltration due to the pressure of the populations in the surrounding untreated areas until late April.

It appears that substantial reduction of the 1/4 mile wide buffer would not provide adequate protection for the period between baiting and the following spring germination. It is questionable whether minor increases in the width of the strip would provide effective additional protection. Any substantial increase is unwarranted for economic reasons. Where additional protection is indicated, it appears that rebaiting in April, of at least the outer perimeter of the seed area, would probably be much more effective.

Effect of Spring Baiting

Rebaiting in the spring may be desirable where populations have risen unduly before germination has begun. Baiting in the spring is equally as effective in the initial reduction of the resident population as fall baiting, but because of the greatly increased activity of the mammals in the spring of the year, the effect is much more transitory. The additional protection afforded, however, will relieve the pressure through May and June. This supplemental protection during these months is quite important considering that germination of Douglas fir normally begins in April and continues for from 8 to 10 weeks.

Baiting of previously undisturbed populations in the spring produces results similar to the rebaiting of plots treated the previous fall. The duration of control is similarly limited from 8 to 10 weeks by increased activity of the small mammals.

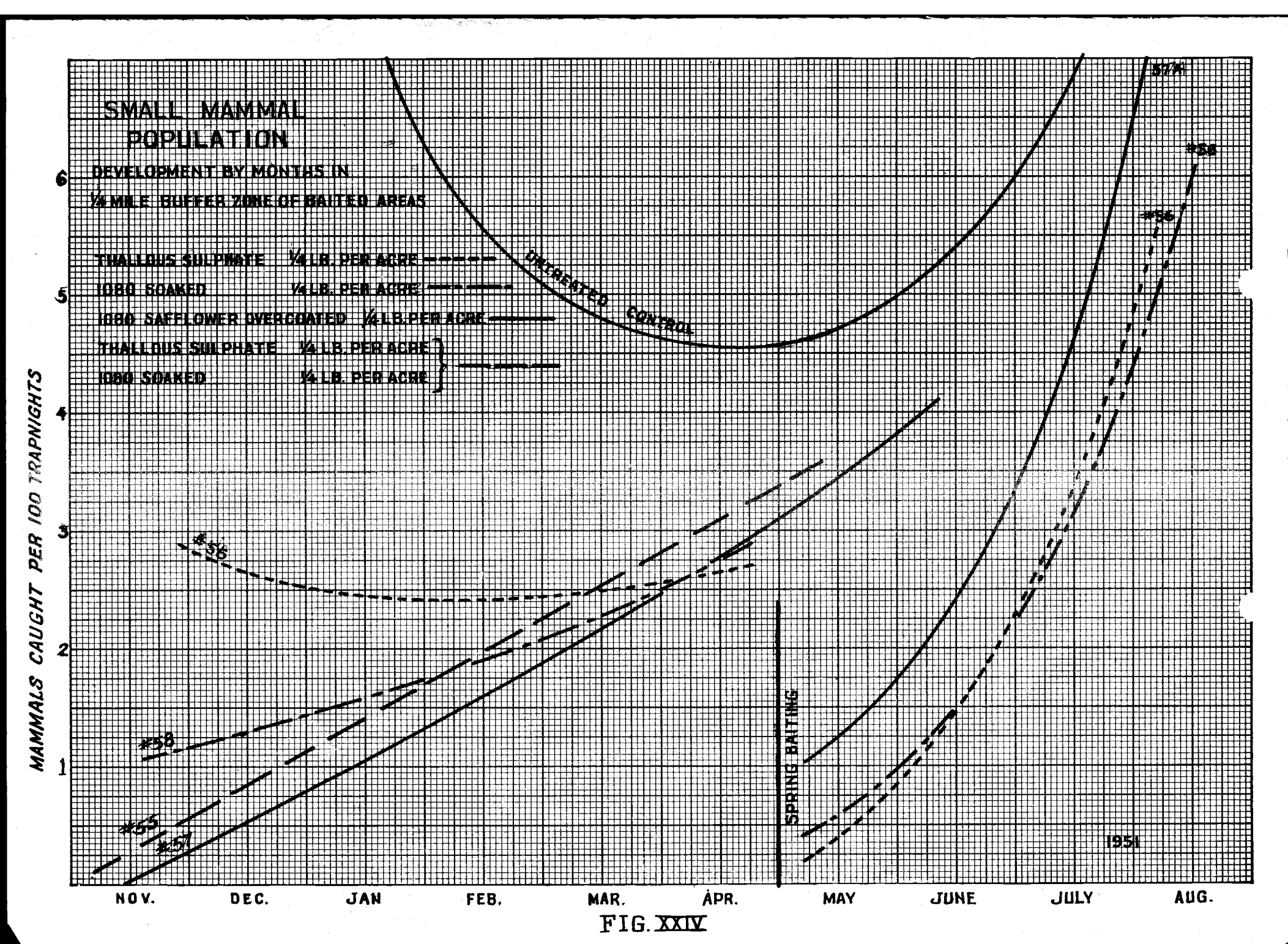

SMALL MAMMAL POPULATION
DEVELOPMENT BY MONTHS IN ½ MILE BUFFER ZONE OF BAITED AREAS
THALLOUS SULPHATE ¼ LB. PER ACRE
1080 SOAKED ¼ LB. PER ACRE
1080 SAFFLOWER OVERCOATED ¼ LB. PER ACRE
THALLOUS SULPHATE ¼ LB. PER ACRE
1080 SOAKED ¼ LB. PER ACRE
UNTREATED CONTROL
MAMMALS CAUGHT PER 100 TRAPNIGHTS
6
5
4
3
2
1
#56
#58
#55
#57
#56
#58
SPRING BAITING
1951
NOV.
DEC.
JAN
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.

FIG. XXIV

PROJECT WEATHER OBSERVATIONS MADE IN THE VICINITY OF OWL CAMP

Date Recorded	Period	Precipitation in inches	Remarks
December 1950			
11	8-11	0.75	
12	11-12	Trace	
14	13-14	0.16	
15	14-15	1.50	
18	15-18	1.28	
19	18-19	0.20	
21	19-21	0.16	
26	21-26	4.00	
27	26-27	0.72	
28	27-28	1.50	
29	29-29	0.20	
January 1951			
2	1-2	2.90	
3	2-3	0.87	
4	3-4	0.25	
9	4-9	0.29	
11	9-11	1.03	
15	11-15	3.68	
18	15-18	2.84	
24	18-24	5.07	
26	24-26	0.83	
February 1951			
2	1-2	1.50	
7	2-7	3.50	
9	7-9	2.10	
13	9-13	2.50	
19	13-19	1.46	Snowy
20	19-20	1.18	Snowy
28	20-28	4.97	Snow 6" deep at gauge
March 1951			
14	1-14	0.71	Snow over 2 ft. deep
19	14-19	1.96	
21	19-21	0.56	
26	21-26	0.15	
29	26-29	0.25	Snow 3" deep at gauge
31	29-31	1.32	
April 1951			
30	29-30	1.79	

PROJECT WEATHER OBSERVATIONS MADE IN THE VICINITY OF OWL CAMP
(Continued)

Date Recorded	Period	Precipitation in inches	Remarks
May 1951			
2	1-2	0.02	
7	2-7	0.69	
14	7-14	0.73	
23	14-23	0.33	
24	23-24	0.07	
25	24-25	0.24	
July 1951			
8	7-8	0.33	
September 1951			
7	6-7	0.40	No measurable precipitation
24	23-24	0.80	during July, August and
28	27-28	0.55	September until this date
31	28-31	5.32	
October 1951			
2	1-2	0.34	
12	11-12	0.68	
15	12-15	1.55	
16	15-16	0.29	
19	18-19	0.74	
22	19-22	4.75	
23	22-23	0.13	
November 1951			
3	2-3	0.93	
6	5-6	0.06	
12	9-12	5.87	
13	12-13	0.20	
14	13-14	0.12	
18	17-18	0.06	
19	18-19	0.08	
25	23-25	3.10	
29	27-29	3.03	
30	29-30	0.62	
December 1951			
2	1-2	3.26	
4	3-4	3.38	
16	15-16	1.38	
17	16-17	2.06	
21	20-21	1.82	

PROJECT WEATHER OBSERVATIONS MADE IN THE VICINITY OF OWL CAMP
(Continued)

Date Recorded	Period	Precipitation in inches	Remarks
January 1952			
15	1-15	3.50	Up to 3 feet of snow during
18	16-18	4.50	all of January.
30	29-30	2.50	
February 1952			
3	1-3	4.50	Snow gone at gauge.
10	9-10	0.65	Snowing
13	12-13	0.30	Up to 2" snow.
14	13-14	0.13	Up to 2" snow.
15	14-15	0.45	Snow nearly gone.
25	18-25	1.50	Up to 7½" snow.
March 1952			
3	2-3	0.37	Slushy snow.
4	3-4	0.69	Slushy snow.
6	5-6	1.05	
9	8-9	1.32	March 7 Sunny.
10	9-10	0.32	
16	12-16	1.50	
18	17-18	1.12	Up to 3" snow.
19	18-19	0.05	± 2" snow
20	19-20	0.05	
23	22-23	0.45	Snow gone.
24	23-24	Trace	
28	27-28	0.18	Cloudy
30	29-30	0.88	
April 1952			
2	1-2	0.68	Broken clouds
13	12-13	0.63	April 3-9 Sunny
19	18-19	0.35	
27	26-27	0.37	April 20-25 Sunny
28	27-28	0.06	
29	28-29	0.92	
30	29-30	0.50	
May 1952			
2	1-2	0.01	
5	4-5	0.08	May 2-4 broken clouds.
7	6-7	0.07	
12	11-12	0.20	
19	18-19	Trace	May 13-18 Sunny.
20	19-20	0.03	
21	20-21	0.01	
29	28-29	0.03	May 22-27 sunny and warm.

PROJECT WEATHER OBSERVATIONS MADE IN THE VICINITY OF OWL CAMP
(Continued)

Date Recorded	Period	Precipitation in inches	Remarks
June 1952			
2	1-2	0.03	
3	2-3	0.08	
9	8-9	0.12	
12	11-12	0.63	
13	12-13	0.01	
14	13-14	0.55	
19	18-19	0.09	
22	21-22	0.31	
23	22-23	0.07	
25	24-25	0.05	
26	25-26	0.09	
29	28-29	0.32	
30	29-30	0.03	
July 1952			
16	15-16	Trace	
17	16-17	0.12	
21	20-21	0.15	
August 1952			
13	12-13	Trace	
14	13-14	0.02	
16	15-16	Trace	
18	17-18	Trace	
22	21-22	0.18	
23	22-23	0.42	
24	23-24	0.63	
25	24-25	0.15	
26	25-26	0.25	

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