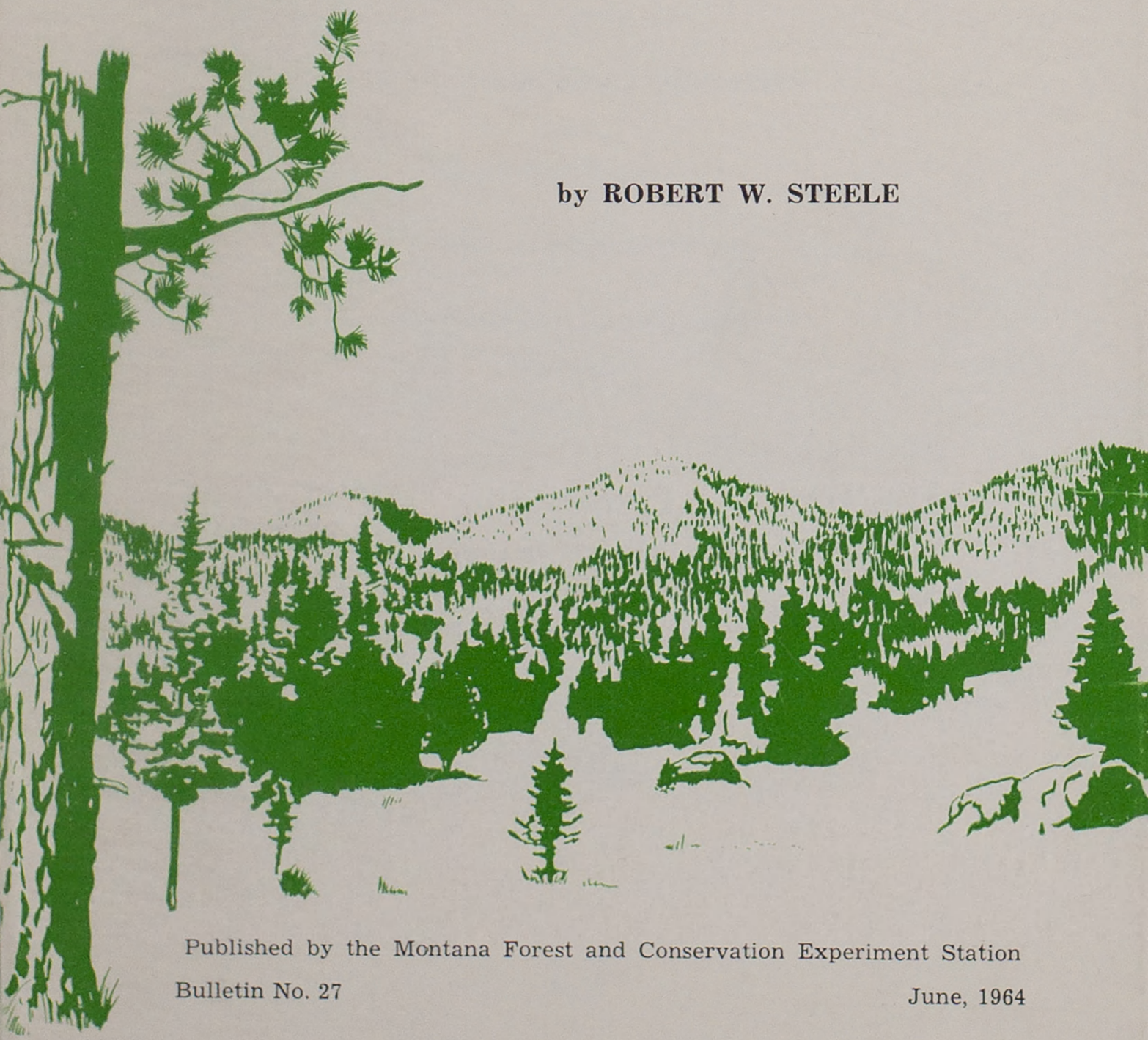
The Lubrecht Forest

by **ROBERT W. STEELE**



Published by the Montana Forest and Conservation Experiment Station

Bulletin No. 27

June, 1964

The Lubrecht Forest

by

ROBERT W. STEELE

Designed and edited by Elizabeth Hannum

MONTANA FOREST CONSERVATION

and

EXPERIMENT STATION

SCHOOL OF FORESTRY

MONTANA STATE UNIVERSITY

MISSOULA

Contents

Introduction

The Lubrecht Experimental Forest is a 27,000-acre tract of land located 35 miles northeast of Missoula, Montana. It is owned by the State of Montana and managed by the Forest and Conservation Experiment Station of Montana State University, with some 7,000 acres of the land administered in cooperation with the State Forestry Department.

Dedicated to the advancement of forestry knowledge through research and training, the Lubrecht Forest has been used for experimental work since 1950. Many research projects have been completed or are in progress. It is the purpose of this guidebook to explain in brief the objectives and present status of these studies and to provide such background information as is necessary to an understanding of the work. A map of the forest showing past and present installations is included.

History[1]

Much of the land now comprising the Lubrecht Forest was acquired by the Northern Pacific Railroad through government grant in 1864. In the 1890s, the Anaconda Company purchased some of the Northern Pacific holdings as a timber source for the Butte mines.

The earliest significant activity in the area began in 1865 with the discovery of placer gold and the establishment of the Reynolds City and Yreka mining camps on Elk Creek. Mining declined over the next two decades as surface gold was depleted, but had a strong revival in the 1890s with the development of hard rock mines. The gold towns of Coloma and Garnet—with populations of perhaps 2,000 or more—were built in the late 1800s and flourished through the early years of the 20th century. Now they are ghost towns, having gone the way of thousands of such communities in the years between the two world wars when the cost of mineral operations became prohibitive. Reynolds City and Yreka have vanished, and present day mining in the Lubrecht Forest area consists of only a few barite operations conducted by the Baroid division of the National Lead Company.

Logging—the second important activity to reach the area—commenced in 1904 when most of the sections to the west were cut over by the Anaconda Company. At that time logs were moved from the forest to a railroad landing at Potomac. Skidding was done by horse and, on steep ground, by chutes. Logs were milled at Bonner and lumber shipped to the Butte mines. Remnants of the horse logging camp may be seen along Highway 20 east of Potomac and old railroad grades are still in evidence on the western part of the forest.

The remainder—and greater part—of the forest was logged between 1925 and 1934 when the Anaconda Company built railroad spurs from the Milwaukee line below Greenough up Elk Creek and into an area near present forest camp headquarters. Horses and chutes carried logs to the Blackfoot River for stream driving, or to railroad landings. Tractors were first used in 1927. Camps for these operations were located along the Blackfoot River, at several places up Elk Creek, east of the present headquarters, and near the town of Greenough.

Sheep and cattle ranching have occupied the valleys and prairies east and west of the forest since before the 1890s, and animals have been grazed on the forest from that time on. This use of

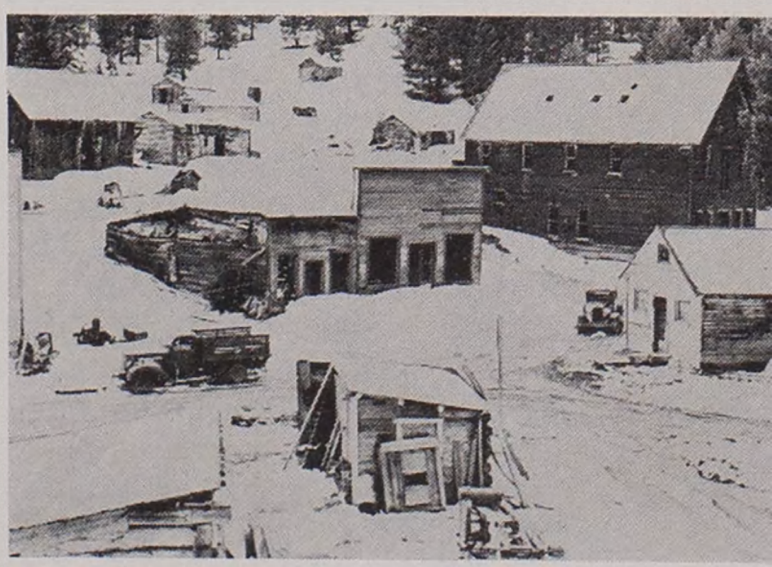
---

[1]History written by Dr. Lawrence Merriam, Associate Professor, School of Forestry.

the land by nearby ranchers continued uncontrolled until 1939 when the first range management plan regulating livestock grazing was put into effect.

As early as 1927, Dean T. C. Spaulding of the School of Forestry at Montana State University began negotiations to obtain the area as an experimental forest. The land is ideally situated for this purpose, containing site, soil, and timber aspects representative of the northwest Montana region. Through the efforts of Dean Spaulding and Mr. W. C. Lubrecht, manager of the Anaconda Company lumber operations at Bonner (for whom the forest is named), acquisition was accomplished. Most of the land—19,058 acres—was donated to Montana State University by the Anaconda Company in 1937, the Northern Pacific Railroad gave an additional 1,310 acres in 1939, and since then a few more tracts have been procured from various individuals. Some private holdings still exist within the forest boundaries.

Established as an experimental forest in 1937, the Lubrecht Forest was formally dedicated as such by the Montana State Board of Forestry on September 30, 1960. Construction of camp and headquarters facilities began in 1950, and the forest was put to active use as a site for research and training.



Old mining town of Garnet, Montana

Description

The Lubrecht Forest includes parts of six townships (see map) of the Montana principal meridian. The entire forest, bisected by State Highway No. 20, is in the Blackfoot River drainage system. The Blackfoot flows west into the Clark Fork River, joining the latter at Bonner, Montana, 20 miles to the southwest.

The Lubrecht Forest from Union Peak Lookout

Major drainages on the forest itself are Elk Creek on the east and Washoe and Union creeks on the west. These streams are fed by numerous small tributaries, most of which are intermittent.

The greater part of the land is wooded, with some grassy openings on high ridges and along the stream bottoms. The topography varies from flat and gently-rolling terrain near camp headquarters to extremely steep sidehills and canyons. Huge granite boulders dominate the site on the east side of Elk Creek—the only large stretch of very rocky, non-forested land in the area.

Soils

Soils on Lubrecht Forest belong to 23 distinct soil series and five soil series combinations. The most extensive of these is the Garnet series, which includes the minimal gray wooded soils formed from weathered, metamorphosed argillites and quartzites. Developed in place under open coniferous forests, these soils are generally stony, occupying hilly to steep mountainous relief. Another important soil type—The Elk Creek series formed from weathered granite—exists in the drainage south of the Cap Wallace road.

All the soils in the forest may be divided into four great groups —the gray wooded and brown podzolic on the timbered sites and the chestnut and chernozem of the open grasslands. The soils were mapped in 1957, but there are plans to re-map them since completion in 1963 of a geologic survey of the area.

Photo by Blackfoot Forest Protective Association

Geology

Six broad rock types have been encountered within the forest: (1) gravels are found along the Blackfoot River in the northwest part; (2) siltstones, sandstones, and conglomerates form a wide band diagonally through the center; (3) a widespread quartz monzonite stock in part occupies the southeastern portion; (4) calcareous marble forms a relatively narrow band along the northern and eastern boundaries of the quartz monzonite stock; (5) quartzites and argillites crop out in many places; and (6) several types of igneous dikes and sills with possible associated flows are found in scattered areas throughout the forest.

Structurally, the forest is situated on a broad syncline which has an east-west-trending axis. The area is faulted, but with no apparent topographical expression. This is partially due to the lack of glaciation. The relief within the forest is about 2,700 feet, with the elevation varying from 3,700 feet in the valley to about 6,400 feet near Coloma.

Timber types

Eight distinct timber types are found on the Lubrecht Forest. Their acreages are shown in Table 1. Table 2 gives volumes by species.

The forest area as a whole is well stocked with second-growth timber that has followed early logging and slash burning. Along the Blackfoot River trees occur in clumps and patches rather than in uniform expanses. The north-facing slopes generally favor larch and Douglas-fir, while ponderosa pine is found on south-facing slopes and well-drained bottomlands. Lodgepole pine—a result of early fires—grows in dense, even-aged stands scattered throughout the forest.

AREA BY TIMBER TYPES[1]

Timber Type	Area in Acres
Douglas-fir	11,479
Ponderosa pine - Douglas-fir	5,854
Ponderosa pine	3,913
Western larch - Douglas-fir	1,077
Lodgepole pine	729
Douglas-fir - lodgepole pine	70
Engelmann spruce - alpine fir	13
Non-forested	125
TOTAL	23,260

TABLE 2

TOTAL TIMBER VOLUMES[1]

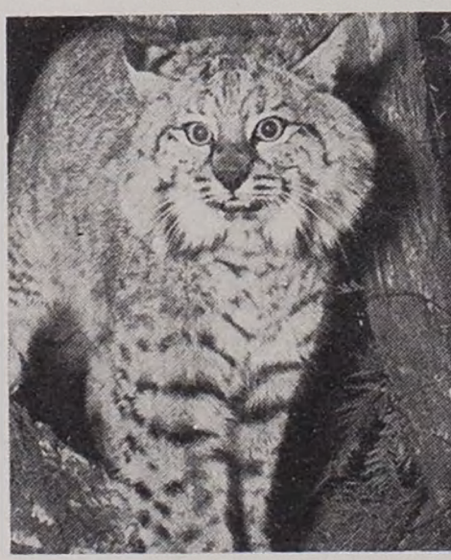
Species	Volume in Board Feet
Douglas-fir	31,295,904
Ponderosa pine	12,539,744
Western larch	8,138,292
Lodgepole pine	609,028
Engelmann spruce	600,643
Alpine fir	56,975
TOTAL	53,240,586

[1]Based on 23,260 acres.

Most of the area has been cut over, the latest large-scale operation, as mentioned, occurring in the 1930s. There are, however, some parts of the forest which were left unlogged. A 500-foot-wide strip along Highway 20 contains many old-growth trees of Douglas-fir, ponderosa pine, and larch, and is a handsome example of the original forest. A small stand of old-growth larch can be found near the summit of Greenough Mountain on the north edge of the forest, and there is one isolated section of old-growth spruce, Douglas-fir, and alpine fir in the southwest corner. The upper portion of the north fork of Elk Creek and a small part of the Skimmerhorn drainage also contain virgin timber.

Early logging took only the largest merchantable timber and left many trees that have since grown to merchantable size. These are present in small clumps or as scattered individuals interspersed with reproduction and sapling stands of varying densities.

*Pine Marten**



*Bobcat**

Wildlife

The Lubrecht Forest supports a considerable diversity of birds and mammals. Over 30 species of passerine birds have been either sighted or collected there. Hawks, owls, and grouse are quite common, as are the turkey vulture, mourning dove, golden eagle, and raven.

The 36 species of mammals either collected, sighted, or identified by sign on the forest include black bear, coyote, bobcat, mule deer and white-tailed deer, and American elk (wapiti). Also present are hare, rabbit, skunk, shrews, various large and small members of the weasel family, and 22 species of rodent.

Animal activities are of particular interest in certain portions of the forest: the open snow-free area along the Case Road provides exceptionally good winter range for deer, black bear engage in their usual raiding endeavors around headquarters, and porcupines are causing some damage to young timber, especially ponderosa pine, throughout most of the lower elevations.

Less common animals such as the mountain lion and bald eagle may also inhabit Lubrecht Forest, since it is within their range and offers suitable habitat. Continued study and observation will probably add to the list of species comprising the wildlife resource.

Roads

A skeleton road system exists on Lubrecht Forest. The two major access routes are the Elk Creek Road along the bottom of that stream and the Coloma Road up the ridge separating Washoe Creek from Elk Creek. The Case Road serves the northwestern part of the forest as a secondary road. Other roads dating back to the early mining and logging days have not been maintained. The existing road system is of limited service to the area, and a complete road development program is now being planned.

Management

The management plan for the Lubrecht Forest permits many research installations but prevents duplication or overlapping of areas. This plan, developed with the help of graduate students, includes an inventory of the timber volume on the forest, an

*Photos courtesy Montana Fish and Game Department.

analysis of growth, and a scheme for timber cutting to perpetuate the supply and provide a modest yearly harvest of logs.

Timber sales are valuable as a source of research data in addition to providing revenue. Timber is sold at public auction with the price adjusted to current market values and the demands of the particular sale area. Part of the Lubrecht road system will be developed along with these timber sales—the roads to be constructed by the logging operators.

Headquarters

Lubrecht Forest headquarters is located a short distance from the Blackfoot Highway, half a mile northeast of the Greenough Post Office. It consists of 23 structures, including two classroom buildings, a library, mess hall, wash house, shop, office, storage shed, and 15 student cabins. The buildings were constructed by students in the early 1950s, using lumber from the forest. A graveled access road was completed in 1952. More living quarters were added after 1957 when the Anaconda Company donated some bunkhouses from a logging camp. Since then, summer crews from the School of Forestry have improved and expanded the facilities.

Mess hall at the headquarters

Typical student cabins at the headquarters

Cattle grazing on the Elk Creek allotment

Headquarters installations serve as home for the sophomore class in forestry during the spring quarter and as a center for research personnel in summer. Occasionally, special schools or workshops are held at forest headquarters.

Range

The range resource of the Lubrecht Forest is currently used by livestock, primarily cattle. Most of the usable forage areas support livestock except for the headquarters region and small sites where special studies are in progress. The range management plan allows approximately 2,400 cow months of grazing use. This allotment is divided into nine distribution units, and stock is spread throughout the forest by well-placed salt grounds to insure uniform use by the grazing animals. Boundary fences control the stock of the various permittees, and fees for grazing are a source of revenue.

Fire protection

Fire protection on the Lubrecht Forest is the responsibility of the Blackfoot Forest Protective Association, with headquarters in Milltown, Montana. A small annual assessment covers the cost of this protection. There have been no large wild fires within the forest boundaries since 1937. Two lookouts—Union Peak and Hunters Point—provide coverage of the area, and fires are also spotted from aircraft as part of the overall detection system of the Blackfoot River region.

Class in forest ecology

Training

As part of its dual function of research and training, the Lubrecht Forest serves as a field laboratory for the education of foresters. The sophomore class of the Forestry School, as noted previously, spends spring quarter at the headquarters. During their 11-week stay, students receive instruction in cruising, surveying, ecology, and forest protection. They become directly acquainted with the work required of a professional forester, including working together in crews. A teaching staff from the School of Forestry lives at the forest during this quarter and other faculty members assist for special classes.

Due to its diverse conditions the Lubrecht Forest is a perfect environment for field instruction. The second-growth forest is typical of those which future foresters will be called upon to manage and the variety of timber age classes offers wide experience in cultural operations such as thinning, weeding, and pruning. The wildlife and range resources provide opportunities for training in the techniques of those specialties.

In addition to the sophomore camp, both graduate and undergraduate students use the forest to conduct studies. Several master's theses have already been written on the basis of data obtained from the forest. A laboratory building at the headquarters site is planned, which will augment the graduate study program.

Research Installations

The Lubrecht Forest is in continuous use as a research laboratory for studies conducted by staff members, cooperators from government and private agencies, and graduate and undergraduate students. Completed and current studies, including experimental projects, plantations, and demonstrations, are described on the following pages. More detailed information may be obtained by writing to the staff members directing the experimental projects or by simply addressing correspondence to the School of Forestry, Montana State University, Missoula, Montana. In the latter instance, the file reference number (in parentheses following the titles of experimental projects) should be included. Numbers preceding titles appear on the map as a guide to location of the studies. Published material on many of these research installations is available from the library at the School of Forestry.

Measuring timber volume by cruising

Experimental Projects

1. **The Effect of Grazing and Ground Cover on Survival of Conifer Transplants** (610)

Project directed by: Professor Melvin S. Morris

Plantings of Douglas-fir and ponderosa pine were made in seven places in four successive seasons starting in 1957 to contrast the survival of trees planted in competition with grass sod and those planted in spots where the sod had been scalped away just prior to planting. These tests were made where grazing was excluded and where it was allowed. The planted trees of both species survived much better in the scalped areas. This was true of both grazed and ungrazed sites.

2. **Intensity and Effect of Fire in Clear-cut Logging Slash at Various Seasons** (302)

Project directed by: Professor Robert W. Steele

This study, started in 1963, is designed to measure the intensity of prescribed fire in logging slash in the spring and in the fall of the year. A clear cut, divided into suitable blocks where burning had been done in both seasons, was selected for the experiment. The test shows the practicality of using a water-type calorimeter for measuring fire intensity and the difference in depth of burn between spring and fall. Fall burning is more intense, with a greater depth of burn. Spring burning is considered only because it lengthens the period of time in any one year when such burning can be done.

Prescribed burning of clear-cut logging slash

3. **Ecosystem Study** (1001)

Project directed by: Dr. George M. Blake, Dr. Thomas J. Nimlos, Professor Robert W. Steele, and Dr. Richard D. Taber

A study was begun in 1962 to determine the role of available soil moisture in the distribution and productivity of plants and animals in major forest communities. Seven "ecosites" chosen as study areas are located along a gradient from the driest to the most moist sites on the forest. At each of these stations detailed meteorological data are gathered on air temperature, precipitation, and snow. These in turn are correlated with available soil moisture. Data on tree growth and phenology are also taken, and the vegetative ecology at each site carefully described. In addition, the animal species present—their abundance, physical condition, habits, and home ranges—are examined and reported upon as affected by environmental conditions at each site. An animal and bird collection and an herbarium of native plants is in the headquarters building. The study is expected to continue for five years.

4. **Growth Study** (1602)

Project directed by: Dr. William R. Pierce

Annual growth is an important consideration in the management of any forest. It is being determined on the Lubrecht Forest by a series of permanent growth plots measured at five-year intervals. Thirty such plots, established in 1960 as a supplement to the management plan, are samples of the representative timber types on the forest and provide a measure of timber volume and growth. They show that the periodic annual growth on the forest is approximately one million board feet. (Note: The 30 growth plots are not indicated on map.)

5. **Root Distribution in Ponderosa Pine Stands** (1102)

Project directed by: Dr. Gene Cox

A study was started in 1956 to determine the distribution of roots in ponderosa pine stands growing on coarse, medium, and fine-textured soils. Soil wells were dug on several sites on the forest for this purpose. The greatest number of roots occurred in the medium-textured soil, and the concentration of roots decreased markedly in succeedingly deeper horizons.

6. **Small-watershed Research** (1201)

Project directed by: Dr. George M. Blake

The north fork of Elk Creek has been selected for hydrologic analysis in order to determine if water yields can be predicted from physiographic, vegetative, geological, and meteorological information about the area. The installation includes a water-measuring weir at the mouth of the stream and a network of rain- and snow-measuring gauges throughout the watershed. This project is expected to start in 1964.

7. **Wildlife Management Research** (701)

Project directed by: Dr. Richard D. Taber

Between 1959 and 1963 a study was made of the density, movement, and home ranges of the principal seed-eating mammals on the Lubrecht Forest. Densities of seed-eating rodents fluctuated according to the irregular seed production in the ponderosa pine type. In other forest types, where animals rely on seed from many species of trees, large populations occurred annually. As noted in project Number 3, the birds and mammals inhabiting the forest are also being studied at the seven sites selected for the ecosystem study.

8. **Snow-measuring Sites** (102)

Project directed by: Mr. Manfred L. Haiges and Mr. Robert A. McKinsey

Snow depth and water content have been measured at 13 places on the forest since 1950. Four of these have been selected as permanent measuring sites to aid in predicting soil moisture and water yields in the other formal studies. The 13 sites cover a range of elevations from 4,000 to 6,000 feet. Observations are taken monthly from the first snowfall to the spring melt-off. Average monthly snow depths vary from two feet at the lower elevations to six feet at the higher elevations.

Study of ponderosa pine root distribution

9. **Climatological Station** (102)

Project directed by: Professor Robert W. Steele

A climatological station is located behind the Greenough Post Office and is operated by the postmistress. Records taken include temperature, relative humidity, wind velocity, and rainfall. These data are useful for research projects being conducted on the forest. The station was established in 1956 and data from that year through 1963 have been published. Average annual precipitation on the Lubrecht Forest is 16 inches.

Plantations

There have been many plantations on the Lubrecht Forest. Four of these are described below.

10. **Missoula Grade School**

This, the largest single plantation, was started in 1950 and has been augmented each succeeding year. Planting is done in spring during Conservation Week by children from the Missoula grade schools and is supervised by forestry students. The plantation currently contains 20,000 trees.

11. **Severe Site**

This plantation was made in 1959 across Highway 20 from headquarters on a severe site where previous plantings had failed. Seedlings were protected by shading them with shingles set in the ground. The result has been the establishment of a fair stand of new trees on an area denuded by fire and sheet erosion.

11a. **Hybrid Pine**

This plantation, established in 1954, is part of a project designed to test some hybrid lodgepole and ponderosa pines developed by the Institute of Genetics of the California Forest and Range Experiment Station of the U. S. Forest Service. The purpose of the test is to determine whether or not the hybrids are suited to the climate and soils of this locality, and whether or not they are superior to the native species. The study was started by the Northern Rocky Mountain Forest and Range Experiment Station and is to be continued by the School of Forestry.

The lodgepole pine has made the greatest height growth. Subsequent examinations should reveal the differences between the hybrids and the native species.

12. **Contour Furrows**

This plantation was made in the spring of 1963 by the students of the silviculture class in an area where medium-sized openings in the timber had been created by sanitation-salvage cutting. Ponderosa pine seedlings were planted in deep furrows dug on the contour. These same furrows were used for a test of direct seeding of ponderosa pine. Early results indicate that survival of the planted trees in such furrows has been good.

13. **Fertilizer Test**

This plantation, within a fenced enclosure, was made in 1959 to test the effects of certain fertilizers on ponderosa pine seedlings. Seedlings were planted in rows where the sod had been scalped. Root development was observed during the first growing season and height and diameter will be observed periodically henceforth.

Grade school student planting a tree

Demonstrations

14. **Sanitation-salvage Cutting**

In the 1904-05 logging of the Lubrecht Forest area only the mature trees were removed. The understory contained clumps of young Douglas-fir with some scattered ponderosa pine. After logging, slash was burned in these dense clumps in such a way

that only a few of the larger remaining trees lived. They were often fire scarred and consequently began to decay. Many trees were decaying around the fire scars, many were infected with mistletoe, and some were attacked by spruce budworm. These fire-scarred trees, now of merchantable size, were removed in 1961 during the first of a planned series of sanitation-salvage timber sales. Small logging equipment was used and very little development was needed to get the logs out. The practicality of such sanitation-salvage logging was demonstrated on the sale area.

15. **Treatment of Slash After Sanitation-salvage Logging**

The logging slash resulting from sanitation-salvage operations (No. 14) was scattered and often mixed in with clumps of standing saplings or poles. The slash was piled with a dozer and later burned. Cost of piling and burning was considered justifiable because the area was left free of fire hazard and ready for natural or artificial regeneration.

16. **Clear Cutting and Partial Cutting in Douglas-fir**

A timber sale was made in 1962 in the Douglas-fir type demonstrating clear cutting in blocks and partial cutting where only individual trees or groups of trees were removed. Two methods of logging—jammer skidding and tractor skidding—were employed on the sale area. Jammer skidding proved to be best for clear cutting, tractor skidding for partial cutting. The clear-cut blocks serve as a study area for regeneration after logging and burning, and the partial-cut areas as places to study the release given to thrifty mature timber through this form of selective cutting.

17. **Christmas Tree Culture**

For several years (between 1954 and 1958) sales of Christmas trees were made from the forest. Definite areas were selected for carefully regulated cutting. These sales have been discontinued due to spruce budworm activity and the presence of needle blights that affect the quality of Christmas trees.

Clear-cut block prepared for burning

Ponderosa pine stand before thinning

18. **Seed Orchard**

A small seed orchard for Douglas-fir was started in 1959 along the Case Road. The trees selected for seed collection exhibit desirable qualities of form, branching habit, and vigor. Wide sheet-metal bands have been placed around the bases of these trees to prevent squirrels from cutting the cones. Seed will be collected from chosen trees and used to produce nursery stock for future plantings on the forest.

19. **Ponderosa Pine Thinned to Definite Spacings**

This thinning was a test of the effect of various spacings for ponderosa pine. It was carried out in 1958 in stands located along the Blackfoot River on a flat bench. The spacings vary from eight by eight feet to 16 by 16 feet. The crown canopy is beginning to close now on the narrow spacings, but openings still exist on the wider spacings.

20. **Lodgepole Pine Thinned to Eight by Eight Foot Spacing**

A thinning was made in 1960 along Highway 20 near the forest headquarters in a dense stand of lodgepole pine. The trees removed were used on the forest for small poles and stakes. Mortality in the stand following the thinning has been very light.

21. **Thinning of Ponderosa Pine by Dominance**

A young stand of ponderosa pine just east of the meadow at forest headquarters was thinned in 1950. The dominant and many of the codominant trees were freed of competition on at least two sides. The effect of this thinning lasted for ten years; now the crown canopy is closed and the area could support another thinning.

Ponderosa pine stand after thinning

22. **Thinning in Ponderosa Pine by the Diameter Rule**

A thinning according to the diameter rule was made in 1958 in a dense ponderosa pine stand south of headquarters. This rule provides for release of selected crop trees at a distance from one another in direct proportion to their diameter. The rule applied here determined the spacing by using the diameter of the trees in inches plus four expressed in feet. For example, the spacing between 10 inch trees was 14 feet.

Lubrecht Research Program

Present and past research on the Lubrecht Forest forms a good base from which to continue studies in forestry. The descriptions from the Ecosystem Study (1001), for example, are leading to a fundamental understanding of plant and animal ecological relationships over the entire forest. The timber sales have shown the benefit of research in timber harvesting and in the treatment of sites following harvest, and have focused future research needs toward this field. Range management studies are delineating the effects of grazing on forest regeneration and are emphasizing the importance of animal distribution as a means of maintaining and improving range productivity.

The research program for the coming years at the Lubrecht Forest is in a period of expansion. It will include more work in plant and animal ecology, genetics, silviculture, forest grazing, timber management, and fire use. Additional facilities will provide greater opportunity for professional exchange through workshops, short courses, and other special meetings. Meanwhile, there will be increased use of the forest as a laboratory for basic research by graduate students and staff members from the Montana State University School of Forestry.

Projects Shown on Map

1. The effect of grazing and ground cover on survival of conifer transplants.
2. Intensity and effect of fire in clear-cut logging slash at various seasons.
3. Ecosystem study.
4. Growth-study plots (not indicated on map).
5. Root distribution in ponderosa pine stands.
6. Small-watershed research.
7. Wildlife management projects.
8. Snow-measuring sites.
9. Climatological station.
10. Missoula grade school plantation.
11. Plantation on a severe site and hybrid pine plantation.
12. Plantation made in contour furrows.
13. Fertilizer-test plantation.
14. Sanitation-salvage logging area.
15. Slash treatment after sanitation-salvage logging.
16. Clear cutting and partial cutting in Douglas-fir.
17. Christmas tree culture plots.
18. Seed orchard.
19. Ponderosa pine thinning to definite spacings.
20. Lodgepole pine thinning to eight by eight foot spacing.
21. Ponderosa pine thinning by dominance.
22. Ponderosa pine thinning by the diameter-rule.