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TREE PLANTING AND SEEDING ON MOUNTAIN HOME STATE FOREST 1950 - 1962

Floyd L. Otter 1/

This report summarizes the artificial reforestation work carried on over a 13-year period on Mountain Home State Forest in Tulare County, California. It outlines the scope of reforestation activity and briefly describes the methods and results of these planting and seeding efforts. Little attempt is made to analyze the causes of successes and failures, nor to describe in detail the circumstances surrounding the various

Fig. 1. Ponderosa pine planted 1950 near Enterprise mill site in an opening resulting from logging circa 1900.

1/ Forest Manager, Mountain Home State Forest, California Division of Forestry, Fresno, California.

field trials. These trials point out some methods that have not proven successful and are therefore to be avoided, at least until the subject is given further study. Described are methods of planting and seeding which now appear to be most successful for this type of forest area.

General Explanation of the Work

Reforestation by artificial seeding and planting has been tested on this forest in 11 of the 13 years from 1950 through 1962. These trials have all been in the elevation range between 6,000 and 6,700 feet. This zone is forested typically by a mixed-conifer type. The reforestation areas originally supported stands of white fir (Abies concolor), Sierra redwood (Sequoia gigantea), and sugar pine (Pinus lambertiana) with mixtures of ponderosa pine (Pinus ponderosa), incense-cedar (Libocedrus decurrens), and California black oak (Quercus kelloggii) on the warmer slopes.

Records are available in varying detail for 47 plantings and 17 seedings, totaling 36,000 planted trees and 4,500 seed spots. A few other plantings were made, particularly before 1954, for which there is little information other than that secured from the trees that have become established.

All of these plantings and seedings were operational in nature, but small-scale comparisons were made of different planting stock, species, site preparation, and methods of protecting seed from rodents. Protection by artificial shading was also tried. Reforestation work was done in accordance with annual plans, based upon such factors as availability of planting stock and seed, site, weather, accessibility, labor supply, and the observed results of the previous trials. Seed was collected on the forest when available, and sent to the Division's nursery at Davis, Yolo County for processing. Requests for planting stock were made from several months to several years in advance of need.

The sites used for the planting and seeding trials may be described as openings (usually not exceeding 400 feet in width) in a forested area. These openings had all been caused by timber harvesting operations, and on many of them the soils had been significantly modified by bulldozing or debris-burning. The elapsed time between logging and planting varied from less than one year to about twenty years, except for one planting on an area that had been logged 50 years previously (fig. 1). Of course the vegetative cover of such areas varied within wide limits. Disturbed ground in this locality usually becomes rapidly clothed with either lupine (Lupinus polyphyllus) or with a mixture composed mostly of bracken fern (Pteris aquilina var. lanuginosa) or thick-leaved lotus (Lotus crassifolius). A very few areas dominated by mountain

misery (Chamaebatia foliolosa), mountain white-thorn (Ceanothus cordulatus), or gooseberry (Ribes sp.) were planted or seeded. These shrubs gradually succeed the perennial forbs so that they or bush chinquapin (Castanopsis sempervirens) or bitter cherry (Prunus emarginata) form a closed cover within 10 to 20 years. Grass has been a very minor component of the vegetation of the reforestation sites.

Fig. 2. Bulldozer preparing a site for planting. This area was covered several feet deep with old Sierra redwood waste.

Special site preparation was undertaken on only a few of the areas. Brush was grubbed by hand on a few areas; killed or weakened by chemical sprays on others. Hand-dug contour furrows were tried. Where no other site preparation was employed, the trees or seeds were usually planted in "scalped" spots from one to two feet in diameter. Several areas were cleared. Three were systematically terraced by bulldozer. Light to extremely heavy burning was employed on parts of many of the reforestation areas. In several instances "mountains" of waste from the manufacture of redwood split products were burned to clear areas for planting and seeding (fig. 2).

Almost all of the stock planted prior to 1961 was either ponderosa pine or Jeffrey pine (Pinus jeffreyi). Red fir (Abies magnifica) was added that year. Except for a planting in 1950,

all stock was supplied by the nurseries of the Division. Beginning in 1958 some of the stock received from the nurseries was transplanted each year into a bed at 6,000 feet elevation on the forest. This locally conditioned transplant stock was first out-planted in 1959.

As for the seedings, most of them were made with sugar pine and Sierra redwood seed collected on the forest. Minor amounts of seed of Jeffrey pine and red fir were tried. Most of the seed spots were covered with wire mesh protectors or plastic berry boxes to provide protection from rodents, birds, and deer. The direct seeding trials were begun in 1955 and have been continued each year since.

Plantings or seedings were made as early as September 13 and as late as December 3 in the fall, and from April 11 to June 5 in spring. They varied in size from 48 to 4,000 trees or seed spots.

The labor used was mainly Conservation Camp inmates supervised by Division personnel. Before 1954 California Youth Authority wards were used. A few plantings and many of the seedings were put in by employees of the Division.

Conventional methods of planting and seeding were used. Trees were planted with axe mattocks or long-handled planting mattocks. Seed spots were usually prepared with the McLeod tool. The standard method of protecting the seeding from rodents was by use of cones made from 1/3-inch galvanized wire mesh (hardware cloth). 2/ Trials were made with plastic berry boxes instead of wire-mesh cones, and with unprotected seed spots. Rodent control tests were carried out with endrin-treated seed and untreated seed. Some relatively large areas were poisoned with "1080" (sodium fluoroacetate), strychnine, or thallium.

Survival counts for most of the reforestation trials were made on the basis of staked samples ranging from 5 percent to 100 percent of the trees or seed spots. Many were checked more than once the first year to define the periods of heaviest mortality. No set schedule for survival counts was followed but observations were made periodically as long as appreciable numbers of trees remained alive.

Results

The 64 planting and seeding trials may best be considered in three categories: 1) plantings of 1959 and before, 2) plantings made since 1959, and 3) direct seeding.

2/ Anon. 1953. "Direct Seeding." Timber Tip No. V. Small Woodland Council publ. Calif. Div. Forestry, Sacramento, May 1953.

Plantings of 1959 and Before

Considered as a group early plantings have been very disappointing. A check made at the close of the 1960 growing season showed that only about 7½ percent of the 20,000 trees planted during this period were still alive.

The highest survival (95 percent the first year) was for two small plantings of 2-1-1 ponderosa and Jeffrey pine stock transplanted from the local transplant bed to bulldozed sites (fig. 3) in May 1959. The next best were some plantings of the same two species made in November 1953 on sites logged in 1949 and 1951 (fig. 4). Survival rates for these 1953 plantings were approximately 50 percent after 2½ years. By fall of 1962 these trees were making a good showing above the bracken and other vegetation.

Survival checks made during the first season to determine the dates and probable causes of mortality showed the heaviest losses to be in mid-summer at about the same time that other vegetation showed the effects of drought. There were enough trees that died earlier, however, to raise some doubts as to the vigor of the stock when planted.

The many failures and few successes from the plantings prior to 1959 yielded some information that, although not conclusive, provided guides for later work. There appeared to be no consistent correlation of survival with season of planting (fall vs. spring), seasonal weather patterns, depth of soil, stoniness of soil, source of seed, type of labor, or artificial shading. But there were strong indications that:

1. freshly dug stock was preferable to stock that had undergone nursery storage, long shipment, or planting-site storage,

2. late fall planting was better than early fall planting,

3. early spring planting was better than later,

4. recently cut-over land bare of vegetation was the most favorable site condition,

5. recently burned spots were favorable if the burning was of moderate intensity,

6. large stock usually gave better results than smaller stock,

7. Jeffrey pine survived a little better than ponderosa, and

8. both pines survived much better than Sierra redwood.

Fig. 3. Planting and seeding test on recent skid trail and log landing. Stakes mark natural seedlings on a small plot.

Fig. 4. View in 1960 of a 1953 planting of Jeffrey and ponderosa pines. Vegetation is mostly thick-leaved lotus and bracken fern.

The two indicated changes in practice that appeared most promising were to use stock conditioned in the local transplant bed and to thoroughly eliminate competing vegetation from the planting sites.

Plantings Made Since 1959

The recent plantings have given much more encouraging results than those of earlier years. For the three years 1960 through 1962, about 7,500 trees were planted. Nearly all had been kept one year in a transplant bed on the forest, and were planted on prepared sites. The average first-season survival of the 14 separate plantings of these three years was 53 percent.

Three plantings were made in 1960 (fig. 5) to compare locally transplanted ponderosa and Jeffrey pine stock with seedlings received direct from Division nurseries. The first year survival of the 717 locally transplanted trees was 48 percent as compared to 22 percent for the 732 directly received from nurseries. In apparent contradiction of these results, by far the best looking plantation was of 500 1-0 ponderosa pine seedlings lifted from the Division nursery in Santa Cruz County on May 4, 1962 and planted the following day in bulldozed terraces on the forest. The first season survival (73 percent) understates the success of this planting because the losses were mostly due to accidental causes and the vigor and height-growth were phenomenal. Both this planting and the stock from the local transplant bed had two things in common: no artificial storage and very short hold-over periods between digging and field planting.

General observations indicated that stock from the local transplant bed suffered noticeable deterioration when not planted promptly after lifting. For example, of 400 ponderosa pine that were lifted from the local bed on May 2 and planted alongside the above-mentioned Santa Cruz County nursery stock, 71 percent survived the first summer; whereas some plantings of the same stock stored in the field for three weeks before planting showed very poor vigor and the first season survival was as low as 10 percent.

Stock held in the local transplant bed suffered losses that were extremely variable. Thrifty-appearing lots that had not undergone storage or delay before transplanting usually survived almost 100 percent. Other lots survived only 10 to 50 percent.

Of course, all comparisons of results of different plantings are complicated by many uncontrolled factors. In 1962 one of these was the poor condition of the tops of the local pine transplant stock caused by severe browsing by deer.

Fig. 5. Planting site (1960) to compare planting stock from a local transplant bed with stock received direct from a Division nursery. Gooseberry and white-thorn removed from test plot by hand.

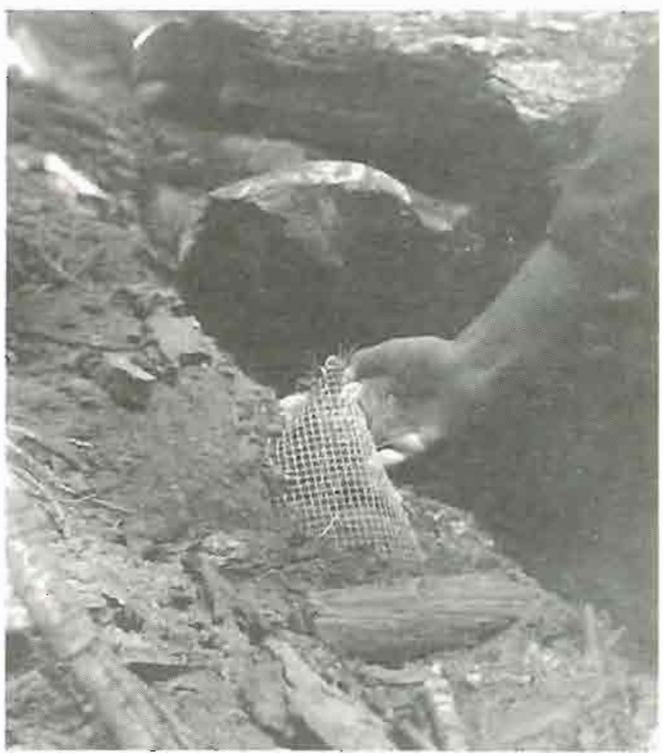

Fig. 6. Seed spot protector on a sugar pine seed spot in a slash burn. Protectors are removed when seedlings begin to grow through the mesh.

Red fir was added to the Jeffrey and ponderosa pine in the field plantings of the fall of 1960 and the spring of 1961. This stock was very low in vigor, only a small percentage having survived the summer in the irrigated transplant bed on the forest. It quickly failed in the out-planting. The plantings of 575 trees of this species in the spring of 1962, however, did as well or better than the pines in first-year survival. This stock was handled similarly to that of the preceding season but had survived well in the transplant bed and was larger and much healthier in appearance when out-planted.

As might have been expected from previous experience, planting success within each plantation was correlated rather closely with thoroughness of site preparation. The best results were on carefully bulldozed terraces; the poorest where trees, shrubs, and "weeds" were allowed to compete with the planted trees.

Seedings

The results of the experimental sowing of tree seed as a reforestation method have been erratic. Rodent behavior appears to be responsible for most of the variation. The effects of rodent population cycles and of the variations in their natural food supplies upon artificial seedings are poorly understood, and the use of poisons and other methods to kill or fend them off have not given consistent results.

The seedings of 1955 to 1960, although variable and of low average survival, included some that gave promise of success. In a sugar pine seeding of 243 spots in November 1955, 25 percent of the spots were stocked five years later. Another of 396 spots seeded to both sugar pine and Sierra redwood together in November 1959 had 31 percent of the spots with sugar pine and 26 percent with redwood after three years. Wire mesh protectors (fig. 6) have been more satisfactory than plastic berry boxes, probably because of their conical shape, strength, durability, and greater size.

The conclusion seemed warranted during these years that seeding of untreated sugar pine seed in the fall on prepared sites, with the seed spots covered by wire mesh protectors, would result in good stands, even without any general rodent control work. The cost of this method was high, but not prohibitive. But these hopes met with disappointment following the seedings made in the fall of 1961 and 1962. These seedings were almost totally destroyed by rodents in spite of both wire mesh protectors and general poisoning of the seeding areas. The deer mouse (Peromyscus maniculatus) was apparently the principal culprit. Mice systematically burrowed under the wire mesh protectors and ate the untreated seeds. In one case, however, endrin-treated red fir seeds were used. They were sown with untreated sugar pine and redwood, all three species together under the same protectors. Rodents left treated red fir

seeds alone, but destroyed the untreated seeds. Because of these experiences, all seedings in the fall of 1962 were made with endrin-treated seed, both sugar pine and redwood, but those not given additional protection failed. Even mediocre results have not been obtained without the use of the mechanical protectors.

The mortality of the seedings on the forest from year to year for the first decade after seeding appears to be greater than for the plantings. Losses from competition with other vegetation and probably from other causes continue year after year, so that it cannot yet be said that any seeding has resulted in an established stand.

Natural Reproduction in Artificial Reforestation Areas

Many areas in which the plantings and seedings have been largely unsuccessful are nevertheless adequately stocked with tree seedlings. This is because of natural seeding of the same or other species of trees. In a few cases the natural seeding alone is adequate; in other cases both are needed. On the other hand the planting sites that have consistently resisted nature's efforts to reforest them have usually resulted in failure when artificial seeding or planting has been tried. Indications are that more thorough site preparation and more vigorous planting stock may change this.

Fig. 7. Site preparation by bulldozer in a timber sale revegetation area, 1962.

Conclusions

As a result of the experiences in tree planting and seeding on the Mountain Home State Forest, a few tentative conclusions are now warranted, even though further experience or experimentation may later require their modification.

1. Use freshly lifted stock for planting. Stored stock, if used at all, should be tried only as an experiment. If conditions do not permit the planting of stock within a very few days after lifting from a nursery, it should be held one year in a local transplant bed.

2. Planting and seeding sites should be practically free of vegetation. Mechanical removal (fig. 7) is the only proven method, but trials of chemical control should be continued. Chemicals may be the only practical way to reduce competition from lotus, lupine, bracken, and mountain misery.

3. Planting of vigorous stock on properly prepared sites is more reliable than direct seeding.

4. Keep planting plans flexible so that planting may be done at the latest possible dates in the fall or winter and as early as possible in the spring.

5. Artificial reforestation has so far proven so expensive and uncertain that natural reseeding should be encouraged and protected even when considerable costs may be incurred in so doing.

From
CALIFORNIA DIVISION OF FORESTRY
301 State Office Building No. 1
Sacramento 14, California

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