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ARTIFICIAL PROTECTION OF NATURAL FIRST-YEAR WHITE FIR INCREASES SURVIVAL

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ABSTRACT: A simple method of artificial protection given to newly emerged natural white fir seedlings resulted in considerably greater first season survival.

Figure 1. Two seedlings (left) were unprotected and marked by wire pins, and two seedlings (right) were protected by the wire mesh protector held by the author. The seedlings were about 4 months old.

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THE PROBLEM

Vast numbers of white fir, Abies concolor, (Gord. & Glend.) Lindl., seedlings appeared in May and June, 1966, on Mountain Home State Forest in Tulare County. The 1965 cone crop of this species had been a bumper one. In some previous years of good germination it had been noted that very few such seedlings survived the first season. A previous study (Otter 1964) showed that artificial protection had benefitted first year sugar pine. It also has been shown that artificial shading improves survival of planted Douglas-fir and white fir seedlings (Adams, et al, 1966). Accordingly, artificial protection was given to some of the newly emerged white fir (fig. 1) to test the effectiveness of such protection in the establishment of a stand.

AREA DESCRIPTION

The project is located at 6,500 feet elevation in a mixed stand of Sierra redwood, Sequoia gigantea (Lindl.) Buchh., sugar pine, Pinus lambertiana, Dougl., incense-cedar, Libocedrus decurrens, Torr., and white fir, Abies concolor (Gord. & Glend.) Lindl.

Three separate experiments were used in testing the effects of protection. Experiments 1 and 2 were located in a one-acre forest opening created by 1965 logging. The slope of the opening was approximately 30 percent with a south to southwest exposure. Since logging occurred just before and during the white fir seed fall, an excellent seed bed was available, particularly in skid trails where most of the A-horizon had been removed. Bracken fern Pteridium aquilinum (L.) Kuhn var. lanuginosum (Bong.) Fern. covered about 25 percent of the surface. The remainder was bare of vegetation. Soils are deep, sandy, loams of granitic origin. The primary difference in site between experiments 1 and 2 was the duration of shade. Experiment 1 was shaded for about two hours per day and experiment 2 about twice that amount.

Experiment 3 was in a one-fourth acre opening created by 1962 logging. The slope was approximately five percent, facing southeast. Most of the soil surface was more compacted than in the 1965 logged area, and light litter covered about 25 percent. Root competition appeared to be high. Soils are similar in texture, depth and origin to those in experiments 1 and 2. The opening received little or no shade.

THE SEEDLINGS

The majority of seedlings emerged between May 5 and June 10, 1966. Germination was best in experimental areas 1 and 2, particularly where the A-horizon had been removed and redeposited in a loose layer two to four inches deep. On such areas approximately 15 seedlings per square yard were found; where partial shade was present, the count was much higher. On undisturbed areas adjacent to skid trails an average of only about five seedlings per square yard was found. Seedlings in experiment 3 were much less numerous than in 1 and 2.

METHOD

Experiments 1 and 2 were laid out contiguously, covering about 1/10 acre of a skid trail. Experiment 3 occupied most of the 1/4 acre area.

After the majority of seedlings had emerged, conical, galvanized wire mesh protectors (Anon. 1953), hereafter called protectors, were placed over some seedlings. The protectors were spaced from 3 to 15 feet apart and over one to several seedlings depending upon how closely they were spaced. The size and shape of the experimental areas depended upon the natural continuity of the groups of seedlings. All of the experiments were checked periodically from June 10 to November 2, 1966. Dates of observations varied due to the difficulty of recording all of the experiments in one day with the personnel available. The number of seedlings protected and unprotected are shown in the May column of table 1.

Table 1. Numbers of live seedlings by months[1/] for protected and unprotected seedlings[2/].

Experiment	May	June	July	August	Sept.	Oct.	Nov.
1	117/81		110/66	95/45	86/41	78/34	77/32
2	56/57		53/42	52/33	48/29	45/20	43/17
3	38/45		5/0	2/0	2/0	2/0	2/0

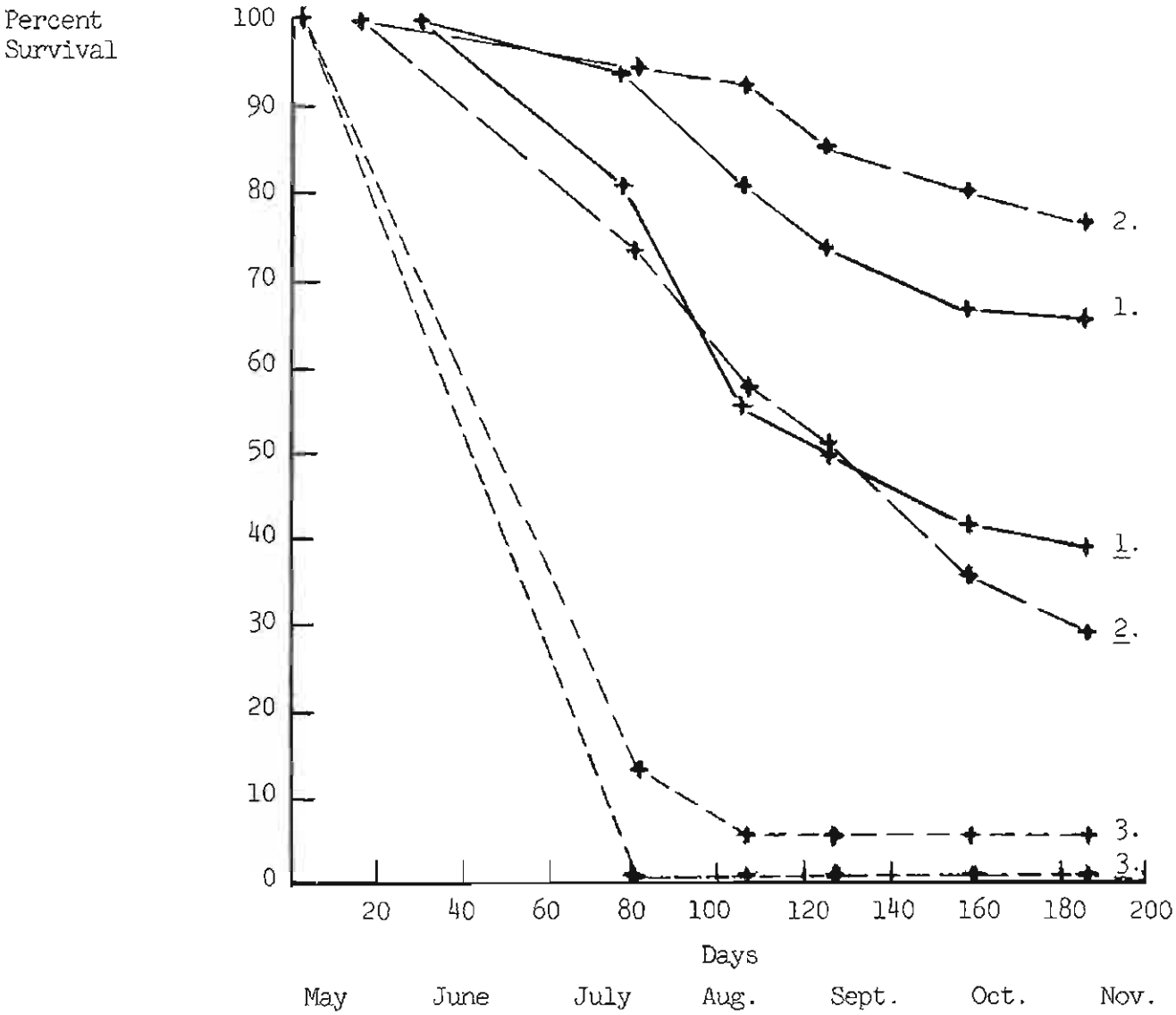
1/ The dates of observation can be obtained from the graph.

2/ The numbers to the left of the slash denote the number of live seedlings under the protectors; the numbers to the right of the slash denote the number of live seedlings outside.

In experiment 1, 54 protectors were placed over 117 seedlings. Each protector was numbered, and a record was made of each seedling under the protector. A total of 81 seedlings outside the protectors were recorded by azimuth and was distance from the center of the protector. Only those seedlings two feet or less from the protector center were recorded. The protectors were anchored on each side with a long wire pin or nail driven into the ground.

Twenty-one protectors were placed over 56 seedlings in experiment 2, and records prepared as in experiment 1. A total of 57 seedlings outside the protectors was recorded by azimuth and distance from protector centers and located by placing a wire pin one inch to the south of each seedling. The protectors were not anchored down in order to compare such treatment with that in experiment 1.

Experiment 3 was set up in the same manner as experiment 2. A total of 20 protectors were placed over 38 seedlings, and 45 seedlings were recorded outside.



-LEGEND-

1. = Exp. 1 seedlings under protectors.
1. = Exp. 1 seedlings unprotected.
2. = Exp. 2 seedlings under protectors.
2. = Exp. 2 seedlings unprotected
3. = Exp. 3 seedlings under protectors
3. = Exp. 3 seedlings unprotected

Fig. 2. First year survival of protected and unprotected natural white fir seedlings on Mt. Home State Forest.

RESULTS

In all of the experiments, survival at the end of the season was greater for the protected than for the unprotected seedlings (fig. 2). In experiment 1, a total of 65.7 percent protected seedlings survived contrasted to 39.5 percent unprotected. In experiment 2, a total of 77.0 percent protected seedlings survived contrasted to 29.8 percent unprotected ones. Only 5.3 percent protected seedlings survived in experiment 3, and all unprotected seedlings died by July 21. Many seedlings severed or girdled by rodents, some clipped by birds or insects, and others damaged by fungi (Muelder and Hansen, 1961), or unknown microorganisms probably contributed to most of the losses early in the season. The seedlings under protectors in all experiments were nearly untouched. Seedlings outside protectors were found clipped off about 1/2 inch above the ground. In some cases seedlings were apparently girdled at this level. A few protectors, however, were not effective in guarding against damage from the above causes; they were smashed flat and moved several feet. It seemed to make little difference whether or not the cones were anchored with pins. Deer may have been responsible for this type damage, but few deer tracks were found. Vandalism by humans is another possibility.

Intense drought and high surface temperatures were probably prime factors in seedling mortality from mid July through early November. Both climatological and experimental data support this conclusion.

First, the summer of 1966 was one of the driest on record in the southern Sierra Nevada. Precipitation was only 22 percent of normal. Temperatures averaging 3.8 degrees above normal during August 1966 were recorded at Giant Forest some 23 miles north of the State Forest (U. S. Dept. of Com. and Dept. of Water Res., 1966).

Second, more desciccated seedlings were found outside than under the protectors from mid-July until heavy rains ended the drought period on November 6. The highest mortality rate also occurred during this period.

The protected seedlings of experiment 2 showed greater survival than protected seedlings of experiment 1, indicating more shade on experiment 2 was beneficial. However, survival of unprotected seedlings in experiment 2 was less than unprotected seedlings in experiment 1. Factors other than or in addition to shade were apparently at work here, such as soil pathogens.

The seedlings in experiment 3 were exposed to more intense drought and higher surface temperatures than in the other experiments. This was probably due to less shade during the day and a longer summer period, as the seedlings emerged an average of about one week earlier than those in experiments 1 and 2. Lastly, it was probably the result of keener competition for soil moisture as evidenced by less recently disturbed soil.

It is apparent that protectors in themselves provide a small amount of shade. In 1966 this protection evidently was not enough in experiment 3. In an average summer, however, it might have been sufficient to establish a stand.

Throughout all of the experimental areas some seedlings both inside and outside the cones were missing with no sign as to causal agent.

CONCLUSION

The results indicate that substantially greater survival of newly emerged white fir may be obtained through the placement of protectors in certain situations. The protectors benefit first-year white fir seedlings by providing some shade in addition to protection from some of the biotic factors. These benefits were especially evident on less severe sites.

Much work needs to be done before it can be determined whether such protection may be economically feasible for a given situation. More field studies in this and in other areas are necessary to determine the specific causes of seedling losses. Experiments should be undertaken that include shading experiments using shingles for the protection of seedlings, browsing experiments using different types of repellents, and damping-off experiments using various types of soil fumigants in the fall before emergence. Furthermore, since the severity of the season is so variable, such experiments should be undertaken during several successive seasons.

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