

# COOPERATION ENHANCES REVEGETATION EFFORTS IN GLACIER NATIONAL PARK

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THE SCENIC GOING-TO-THE-Sun Road in Glacier National Park, Montana, is currently being reconstructed. Several cooperating agencies, including the Federal Highway Administration, U.S. Department of Agriculture, Forest Service (Intermountain Research Station), Natural Resources Conservation Service (formerly the Soil Conservation Service), and the National Park Service participated in the construction and revegetation planning efforts that began in the mid-1980s. Provided for in the 1982 National Surface Transportation Assistance Act, road rehabilitation began in 1991. However, initial revegetation planning for the 16 km (9.8 mile) Lake McDonald section of the road was hampered because information regarding natural regeneration by conifers and revegetation success of several native herbaceous species was lacking.

Research was needed to determine the best way to restore native vegetation to the disturbed road corridor while providing adequate soil stability and minimizing the number of invasive exotic species. Study sites were established in both Glacier National Park and the nearby Coram Experimental Forest (administered by the Intermountain Research Station and located on Flathead National Forest), two biosphere reserves, which are units of the United Nations Program on Man and the Biosphere. The two areas combine a large natural park managed for ecosystem conservation (Glacier National Park) with a field research site (Coram Experimental Forest), a beneficial pairing for the needed revegetation research. The common biosphere reserve designation stimulated cooperation between personnel at both reserves to study dispersal and viability of conifer seedfall and planting of native species for revegetation.

## OBJECTIVES

A dense conifer forest canopy paralleled the road, and we expected that most, if not all, disturbed areas would quickly regenerate with conifers. The purpose of the conifer seedfall study was to estimate by species the number of conifer seeds that (1) dispersed from cones maturing from 1987 through 1995 above and below the road, (2) germinated on cut slopes from 1992 (the first year after treatment) through 1996, and (3) produced surviving seedlings through 1996.

Research on planting native species required a recent road cut. To minimize disturbance from the study in Glacier National Park, we chose a comparable site on Coram Experimental Forest to determine if (1) seeding with native forbs and grasses could provide a stable cover and reduce volunteer exotics or if a rapidly growing agronomic mix would be necessary, (2) fertilizer presence or timing would benefit natives or exotics, (3) specific native species would establish from seed, and (4) seeding or transplanting would be a better way to establish pinegrass (*Calamagrostis rubescens*) and beargrass (*Xerophyllum tenax*).

## STUDY AREAS AND METHODS

The seedfall study is located along the Lake McDonald section of the road within Glacier National Park. This section lies along the 975 m (3,200 ft) contour within the western red cedar (*Thuja plicata*)-western hemlock (*Tsuga heterophylla*) forest type (Eyre 1980), and is composed mostly of stands originating after fires in 1735 (Barrett 1988). Other conifers within this predominantly cedar-hemlock forest are Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), spruce (probably hybrids of Engelmann [*Picea engelmannii*] and white spruce [*Picea glauca*]), lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), and subalpine fir (*Abies lasiocarpa*). Seedfall from the conifer trees was estimated along the road using forty



Figure 1. A researcher shows one of the seed traps used in the study to catch and measure seedfall.

0.4 m<sup>2</sup> (4.4 ft<sup>2</sup>) seed traps (fig. 1). We positioned two seed traps about 15 m (50 ft) apart above the road cut and also below the road fill at each of 10 locations. Contents of the traps were emptied periodically after seeds began to disperse in early September each year. Time and amount of seedfall for each species was determined each year. Near each group of seed traps, four 0.25 m<sup>2</sup> (2.7 ft<sup>2</sup>) plots were established in the new road cut to monitor germination of conifer seed and mortality of seedlings once a month from May through September beginning in 1992.

For the planting study, we chose a section of road in the Coram Experimental Forest for its similarity to the Lake McDonald road section. Research staff regraded approximately 2.5 m (8.2 ft) of high cut slopes above the road. In the fall of 1987, crews installed ten treatments in 1 m<sup>2</sup> (10.8 ft<sup>2</sup>) test plots, each with four replicates. Treatments on the cut slopes were (1) a native grass and forb seed mix (Table 1) that received (a) no fertilizer, (b) fertilizer at planting, and (c) fertilizer the spring after planting; (2) a control treatment with no seed or fertilizer, (3) pinegrass seed, (4) pinegrass rhizome sections, (5) beargrass seed, and (6) small beargrass transplants. We planted two treatments in the ditch using (1) the same native mixture as on the slopes, and (2) an agronomic mixture consisting of Kentucky bluegrass (*Poa pratensis*), Canada bluegrass (*Poa compressa*), and red fescue (*Festuca rubra*). We measured percent of coverage, seedling density, and transplant size for 3 years following planting.

## RESULTS AND DISCUSSION

Conifers began to reforest cut and fill slopes the first year after treatment. Much of the seed that fell on cut slopes from a

poor cone crop that matured in 1991 washed into the ditch below in the spring of 1992 because there was no vegetation to hold it on the site during snowmelt and associated overland waterflow. Conditions improved the following years after vegetation established, holding more of the seeds where they fell. The amount of conifer seed dispersed varied greatly by species and year (Shearer and Potter 1994). During the study, over 90% of the seed fall, germination, and survival was western hemlock or western red cedar. Hemlock and cedar will be the major conifers to regenerate cut and fill slopes along the road naturally. Other conifer species will establish less frequently and provide diversity.

After three growing seasons, we summarized the results of the planting study at Coram. The unseeded control had higher cover of volunteer forbs and grasses and higher densities of volunteer forbs than the seeded treatments, indicating that seeding may reduce growth of volunteers, includ-

crease in the future. Competition, resulting from a high grass seeding rate (1,830 seed/m<sup>2</sup>), may have contributed to grass cover increasing the first 2 years and markedly decreasing thereafter. All seeded native species germinated and established satisfactorily, but cover of forbs and pinegrass was low (Table 1).

When pinegrass seeded by itself at 646 seeds/m<sup>2</sup>, it had canopy cover of 49%; however, when seeded in the mix with faster growing species, its cover was only 5%. Although only 11% of pinegrass rhizome sections sprouted, they quickly produced vigorous, large plants. When beargrass was seeded by itself, 29% of seeds established the first year. This increased to 49% the second year and did not increase thereafter, indicating that many seeds required 2 years of cold stratification. Beargrass seeds planted in a mix had 22% establishment the first year and the numbers remained constant. Ninety-five percent of beargrass transplants survived and were larger in the third year than at planting. All mortality occurred in the first summer.

Based on these results, the park planned to seed along the road to provide quick cover, increasing native species and reducing exotics. We did not need to use an agronomic mix because native species provided sufficient cover. A very light fertilizer was applied at seeding to balance carbon content of the mulch. Seeding rates of early establishing grasses were decreased and pinegrass and forbs were increased. All available native species in the study were included on the road seed mix. We seeded pinegrass and beargrass rather than use the more labor intensive transplants, but we did not plant

bluegrass as originally planned. Results of revegetation along the Lake McDonald section of the road parallel those from the cooperative studies. Ninety percent of germinating conifers were western red cedar or western hemlock with other conifer species establishing less frequently. Native species canopy cover, especially seeded grasses, has increased each year and to date usually exceeds weed cover by 10-25%. In control areas that were not seeded, weed cover exceeded native cover by the same amount; this result supports the use of native seed to increase native species and reduce exotic cover. Both pinegrass and beargrass, seeded on the road with fast-growing species, were not observed until the second year after seeding. Presently, each species provides less than 1% cover but both continue to increase in frequency. From 1992-94, beargrass has increased in frequency from 0-40%, while pinegrass has increased from 0-5%.

## SUMMARY

Work conducted in the experimental portion of one biosphere reserve has augmented protection of the core area of another biosphere reserve. The Man and the Biosphere Program promotes cooperative studies such as this, which enables input from several specialists and results in sound resource management decisions. Significant applicable information was obtained that the park could not have generated alone, due to the lack of subject expertise or ability to conduct manipulative experiments. Not only did Glacier National Park receive information that directed efficient and effective revegetation, but our basic silvicultural knowledge increased for several conifer species.



## LITERATURE CITED

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**TABLE 1.**

**MEAN CANOPY COVER OF SEEDED GRASSES AND FORBS AND MEAN ESTABLISHMENT OF SEEDED FORBS IN NATIVE MIX TREATMENTS IN THE CORAM STUDY DURING THE THIRD GROWING SEASON. (NM=NOT MEASURED)**

| Species                         | Mean Cover (%) | Seed Establishment (%) |
|---------------------------------|----------------|------------------------|
| <i>Agropyron spicatum</i>       | 4.8            | NM                     |
| <i>Bromus carinatus</i>         | 41.7           | NM                     |
| <i>Calamagrostis rubescens</i>  | 5.4            | NM                     |
| <i>Anaphyllis margaritaceae</i> | 2.9            | 34                     |
| <i>Antennaria microphylla</i>   | <.1            | 35                     |
| <i>Antennaria neglecta</i>      | <.1            | 14                     |
| <i>Arnica latifolia</i>         | 4.4            | 91                     |
| <i>Aster laevis</i>             | 7.1            | >98                    |
| <i>Xerophyllum tenax</i>        | <.1            | 25                     |

ing weeds. In the ditch treatments, the agronomic mix had higher grass cover than the native mix but no significant difference in the number of volunteer forbs occurred. Results from the fertilizer study were inconclusive. The unfertilized treatment had the highest cover of seeded forbs and the lowest cover of volunteer forbs, but it also had the largest number of volunteer forb species, suggesting that its cover may in-

crease in the future. Competition, resulting from a high grass seeding rate (1,830 seed/m<sup>2</sup>), may have contributed to grass cover increasing the first 2 years and markedly decreasing thereafter. All seeded native species germinated and established satisfactorily, but cover of forbs and pinegrass was low (Table 1).

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