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Oregon State University

Forest Research Laboratory
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CLEARCUT LOGGING AND LOW FLOWS IN OREGON COASTAL WATERSHEDS[1]

R. Dennis Harr
Assistant Professor of Forest Hydrology

James T. Krygier
Coordinator, Forestry Extension
Formerly Forest Hydrologist

Increased water yield after clearcut logging has been well-documented (4). Few studies, however, have indicated changes in minimum flows that result from tree removal (6, 7, 8). Increases in minimum flows can be of considerable importance for resident fish populations and domestic water use during the period of greatest demand.

This report describes the portion of the Alsea Watershed Study that deals with the effects of clearcut logging on low flows in the Oregon Coast Range. Other hydrologic results and a more detailed description of the Alsea study are reported elsewhere (1, 2, 5).

The three study watersheds are located in the Alsea River basin in upper Drift Creek about 8 miles south of Toledo and 10 miles from the Pacific Ocean. Mean annual precipitation is about 100 inches. Summers are dry, with only about 10 percent of total annual precipitation occurring between May and October.

Before treatment, the study watersheds were covered with various amounts of red alder and 120-year-old Douglas-fir. Pure stands of Douglas-fir covered about 76 percent of Needle Branch and 17 percent of Deer Creek, but alder covered 39 percent of Flynn Creek. The remainder of each watershed supported mixed stands of Douglas-fir and alder.

After an 8-year calibration period, two watersheds were logged during the spring and early summer of 1966. All of the 175-acre Needle Branch watershed was clearcut, but only 25 percent of the 750-acre Deer Creek watershed was clearcut. Cutting in Deer Creek was distributed in three patch-cut areas that left buffer strips from 50 to 100 feet wide along perennial streams. The 500-acre Flynn Creek watershed served as control and was left undisturbed. The effects of these cuttings on streamflow were measured at three specially designed concrete V-notch weirs. The U. S. Geological Survey collected and compiled basic data.

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LOW-FLOW ANALYSIS

Regression analysis was used to test the effect of clearcut logging on low flows. The number of days of flow below a predetermined level was compared between the control watershed and the logged watersheds before and after clearcutting. The low-flow day was selected for analysis because it represents a discrete, easily determined value. A low-flow day is defined as having a mean daily streamflow of less than 1 cubic foot per second per square mile, which corresponds to measured streamflows of 0.27 cubic feet per second for Needle Branch, 0.78 for Flynn Creek, and 1.17 for Deer Creek. A decrease in the number of low-flow days would indicate an increase in minimum flow.

Low-flow days were tabulated for each watershed for the 1959-1965 water years. Regression analyses were used to develop the prelogging relations between the treated and control watersheds, as shown in Figure 1. A one-tailed confidence limit of 95 percent was constructed for each regression to evaluate low-flow data for the post-treatment water years of 1967-1971. Because logging occurred during the water year of 1966, this year was excluded from the analysis for both the pre- and post-treatment periods. This year, however, is included in Figure 1 for comparative purposes.

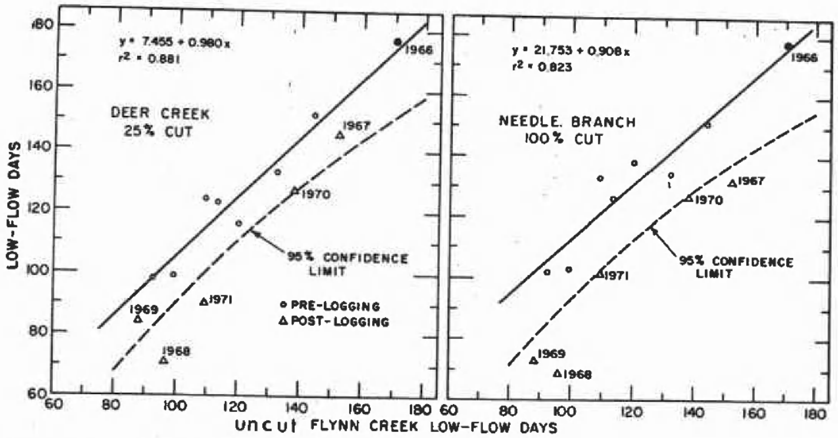

Figure 1. Relationship of low-flow days between logged and unlogged watersheds.

RESULTS AND CONCLUSIONS

The regression lines for the period without logging shown in Figure 1 fit the data points quite well. Regression equations account for 82 and 88 percent of total variation in the two prelogging relations of control to treated watersheds.

The location of the postlogging data points in Figure 1 shows that logging generally increased low flows. The number of low-flow days was decreased significantly (minimum flows increased) in each postlogging water year for Needle Branch, the 100 percent clearcut watershed. This response is consistent with those of other clearcut watersheds (6, 8) and is related to a wetter soil mass untapped by transpiring vegetation (3).

Attempts were made to determine the timing and volume of the increase in low flow for Needle Branch, but no consistent relations were found. The number of low-flow days was decreased in the spring and fall and occasionally after summer storms. On the average, annual minimum streamflow in Needle Branch increased about 60 percent after logging. Variation in minimum streamflow values also increased, however, which makes conclusions about volume difficult. In 1970, for example, annual minimum streamflow equaled the minimum for the entire prelogging period.

We anticipated a small increase in low flow in Deer Creek, where only 25 percent of the area was clearcut. Deer Creek, however, showed a significant decrease in low-flow days in only 2 of the 5 postlogging years. Any increase obtained probably was masked by natural variation in low flow in the other 3 years.

In summary, clearcutting all of a small watershed decreased the number of low-flow days. The effect of clearcutting 25 percent of another watershed was less pronounced. Five years after logging no trends toward prelogging levels are apparent.

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