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Fish, Forests, and Floods

By Gordon E. Grant, Frederick J. Swanson, and Sherri L. Johnson

Last February, warm torrential rains fell atop deep mountain snowpacks in the Pacific Northwest, leading to massive floods. Landslides and debris flows, combined with record high waters, wreaked havoc across an area extending from Oregon's Willamette Valley to southwestern Washington, and all the way to northern Idaho. Not since the winter of 1964-1965 had the region experienced such widespread and destructive flooding. The floods sparked renewed debate about the extent to which timber harvesting and other land use practices contribute to the magnitude and effects of flooding. In the polarized climate that now marks forestry, this debate is often presented in black and white terms: either logging caused the flood's destruction or it had no effect at all. But more than 40 years of research into the ways in which logging practices affect the environment has taught us that nature resists such simplistic characterizations. The flood of 1996 offers an opportunity to examine land management practices of the past, present, and future, gleaning useful lessons from the detritus that the flood left behind.

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To capitalize on this opportunity, a joint program involving the Forest Service and the Bureau of Land Management was organized to evaluate impacts of the flood on federally managed lands in western Oregon and Washington. One component of this study calls for scientists to examine how hard-hit areas — both managed and unmanaged — responded to the flood. The overall purpose is to provide a scientifically credible study of the interactions among floods, landforms, and land use activities, and to explore the consequences that these impacts have for hillslopes, riparian zones, stream channels, and aquatic organisms. We hope to understand how flood-related phenomena such as channel changes, landslides, and debris flows moved across the landscape, and how forest management activities influenced these processes.

The 1996 flood can be viewed as a test of watershed conditions, allowing us to explore how new and old management practices may have predisposed watersheds to respond in certain ways. Much has changed since the last regional floods hit in 1964 and 1965 — road-building practices, for example, changed significantly in the 1970s, logging was greatly reduced in the early 1990s, and streams may now contain less woody debris than they did when big storms hit in the past. With new management practices being implemented in the region, we also have the opportunity to consider how floods might respond to changing conditions in the future.

What are we finding? One theme that has emerged is that the overall pattern of landslides and streamflows was very strongly influenced by precipitation intensities and, in some areas, by snowpack dynamics. For example, it appears that much of the flood's water came from lower elevations where the snowpack was not deep enough to store large quantities of rainwater, but instead melted rapidly. Overall distributions of rain and snow probably were not greatly influenced by human activities, although snowmelt rates may have been affected by the age and pattern of vegetation. Our results also show that flood processes were affected by changing landscape conditions. In the Lookout Creek watershed of Oregon's upper McKenzie River, for example, the number of landslides in old-growth forests was about the same in the 1996 floods as in the 1964-1965 floods. In 1996, however, there were less than a third as many slides in new and replanted clearcuts as there were in the 1964-1965 floods. That perhaps reflects increased landscape stability, due to the regrowth of areas that had been cut prior to 1964, and the very low level of cutting around Lookout Creek since 1970. All of the 1996 slides from clearcuts in the Lookout Creek watershed were from areas cut within the last 20 years. The neighboring Blue River watershed, where forests were cut more recently, had landslide rates that were twice as high as Lookout Creek's. These results are consistent with the belief that clearcuts are more susceptible to sliding during the first two decades after harvest, but then stabilize as root strength and vegetation recover. In 1996, the rate of slides from roads in Lookout Creek was about half of the 1964-1965 rate, suggesting that the susceptibility of roads to landsliding may diminish over time as well. Slide rates from roads, however, are still substantially higher than they are in forested areas.

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But these numbers tell only part of the story. The flood had a wide variety of unpredictable and sometimes enigmatic consequences. In some watersheds, many landslides that began in headwater areas and became debris flows did not reach mainstem channels. Instead, they were stopped by roads, by landforms in valley floors such as alluvial fans or terraces, or by riparian forests. However, major channel changes occurred even without debris flows, as channels charged with wood and sediment overtopped their banks and inundated valley floors. Yet some channels that received massive amounts of sediment and wood from tributaries experienced little change, due to the presence of bedrock or cohesive channel boundaries that resisted erosion. Even where significant channel changes did occur, the effects on organisms varied from species to species and site to site. Populations of bottom-dwelling fish, such as sculpins and dace, were dramatically reduced, while fish such as trout that live farther off the stream bottom and have more mobility were much less affected. That's possibly because they were better able to find protected areas. Even among individual species, the numbers of fish before and after the flood either decreased, remained the same, or increased, depending on the site.

These preliminary observations emphasize the difficulty of making blanket statements about how land use influences floods. All floods are strongly affected by pre-existing conditions and by the legacies of human actions and natural events. Practices and policies have changed dramatically since 1964 and appear to be reducing certain types of flood hazards. New policies, however, such as those called for by Oregon's State Forest Practice rules and the federal Northwest Forest Plan, are barely evident on the landscape, because not enough time has passed for them to be widely implemented. Therefore we don't know whether these policies will meet their stated objectives. Ultimately, when the data are in, people must decide for themselves whether the interplay of flooding and managed landscapes during the floods of 1996 had effects that we can live with in future floods.

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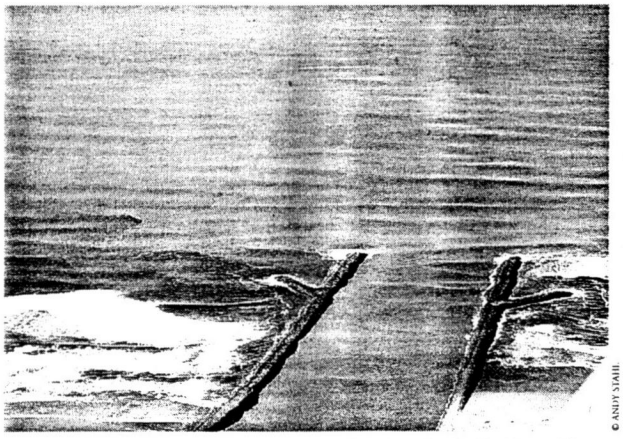

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The silt-laden waters of Oregon's Siuslaw River dump into the Pacific Ocean following major floods in February 1996.