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Effects of contemporary forest harvesting on suspended sediment in the Oregon Coast Range: Alsea Watershed Study Revisited

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ABSTRACT

Forest harvesting practices can expose mineral soils, decrease infiltration capacities of soils, disturb the stream bank and channel, and increase erosion and fine sediment supply to stream channels. To reduce nonpoint source sediment pollution associated with forest management activities and to maintain the high water quality typically provided from forests, best management practices (BMPs) were developed and implemented. While BMPs have evolved over time, the effectiveness of contemporary BMPs, particularly for harvesting practices, have not been thoroughly investigated, especially in comparison to historical practices. The objectives of this study were to (1) determine the effects of contemporary harvesting practices on suspended sediment concentrations and yields and (2) examine the legacy effects from historical harvesting on suspended sediment concentrations. The Alsea Watershed Study was an important early research site that lead to the development of contemporary forest management practices to protect water quality and fish habitat in Oregon and elsewhere. By returning to the same watersheds that were harvested in 1966, this is one of the few times that a watershed-scale study is able to directly compare and contrast the effects of historical practices with contemporary practices. The Alsea Watershed Study Revisited includes the same three watersheds as the original study. Flynn Creek (FCG, 219 ha) is an old-growth dominated reference watershed. Deer Creek (DCG, 315 ha) is an extensively managed watershed that was patch-cut during the original study. Needle Branch (NBLG, 94 ha) was clearcut harvested in the original study and again in the recent study, but with contemporary BMPs, including riparian buffers. The upper portion of Needle Branch was harvested in 2009 (Phase I), while the lower portion of the watershed was harvested in 2015 (Phase II). We monitored suspended sediments and discharge from WY 2006–2016, and analyzed this data using multiple linear regression procedures and ANCOVA. Average suspended sediment yields ranged from 55–313 $\mathrm{Mg\,km^{-2}\,yr^{-1}}$ in FCG, 31–102 $\mathrm{Mg\,km^{-2}\,yr^{-1}}$ in NBLG, and 69–127 $\mathrm{Mg\,km^{-2}\,yr^{-1}}$ in DCG. We found no evidence that contemporary harvesting techniques affected suspended sediment concentrations or yields. Overall, suspended sediment concentrations and yields after contemporary harvesting were similar to historical pre-treatment levels.

1. Introduction

Increased suspended sediment concentrations, loads, or yields after forest management activities remain a concern for land managers due to potential degradation of drinking water quality and harmful effects of excessive sediment to many aquatic species, including salmonid fishes (Gomi et al., 2005; Greig et al., 2005; Cristan et al., 2016). Forest operations, such as road building, timber yarding, machine trail development, and slash disposal, can expose mineral soils, decrease infiltration capacities of soils, and increase erosion and fine sediment supply to stream channels (Wemple et al., 1996; Motha et al., 2003; Litschert and MacDonald, 2009). After forest management activities on steep hillslopes, mass movements can result in substantial increases in suspended sediment transport to stream channels (Beschta, 1978). Historical practices conducted without riparian buffers or other stream-protection measures increased the potential for disturbance of stream

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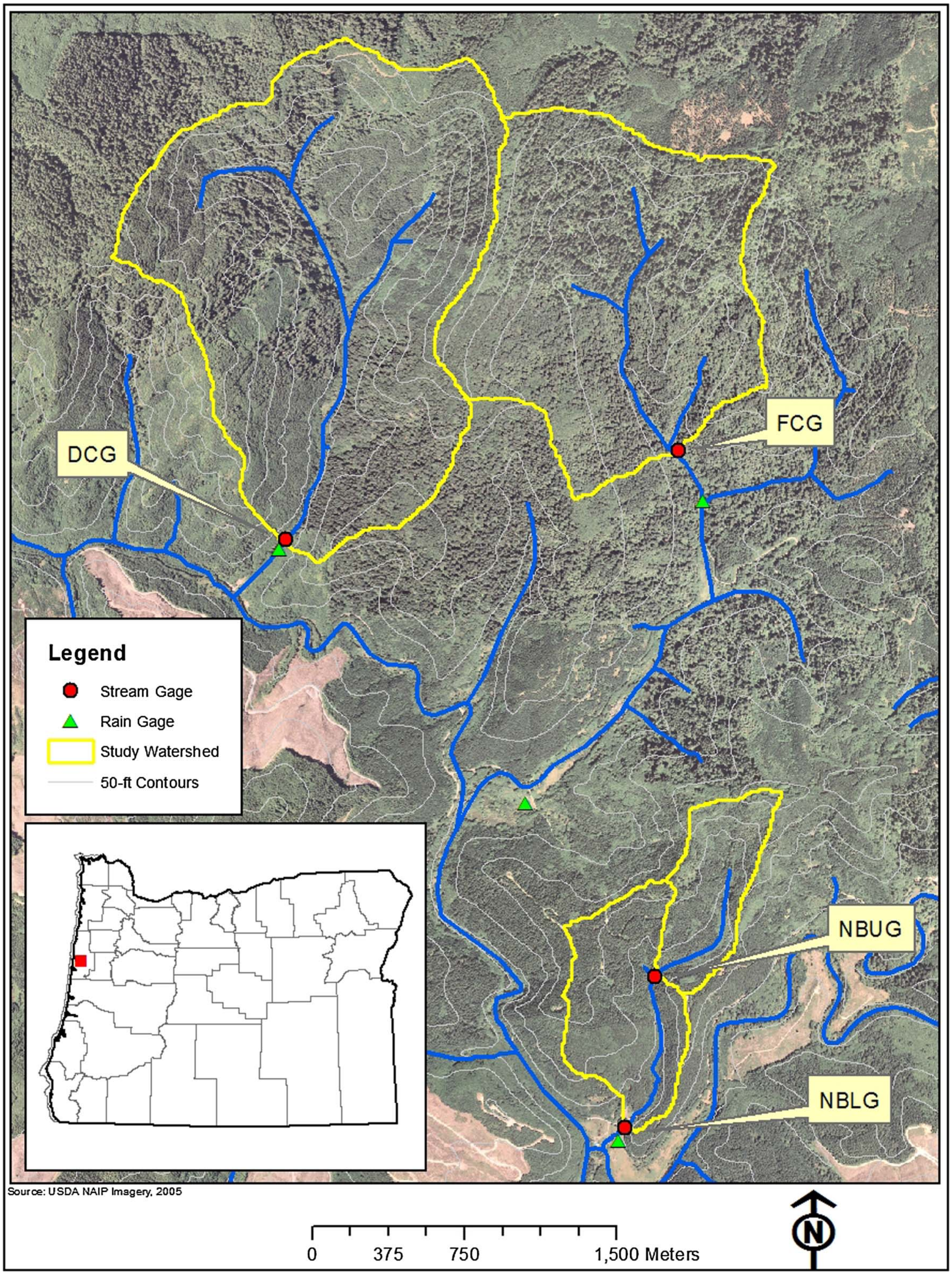

Fig. 1. Overview of study site. Inset shows location of study with the state of Oregon, USA. FCG was the unharvested reference, DCG has been extensively managed since the 1960s, and NBLG and NBUG were clear-cut as part of this study.

banks and channels by both yarding and site preparation practices (Beasley, 1979; Van Lear and Kapeluck, 1989). Harvesting can also change the hydrologic regime and drainage density, which may affect the sediment transport capacity of streams (Croke and Mockler, 2001; Grant et al., 2008).

To reduce nonpoint source pollution associated with forest management activities and maintain the high water quality typically provided from forests, Best Management Practices (BMPs) have been developed and implemented by many individual states (Ice, 2004). However, many questions remain about BMP effectiveness at mitigating nonpoint source pollution to protect beneficial uses of water (Ice et al., 2004; Cristan et al., 2016). Much of the uncertainty is due to contradictory results from different studies, which have included a broad range of forest harvesting practices, harvesting intensities, watershed characteristics (e.g., forest type, soils, geology, climate, and physiography), and applications of BMPs (Aust and Blinn, 2004; Anderson and