



Impacts of a fire-flood event on physical and biological characteristics of a small mountain stream
by Mark Anthony Novak

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management

Montana State University

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Abstract:

A forest fire burned 4811 ha of the lower Beaver Creek drainage and was followed by an intense convective rainstorm causing extensive soil erosion. Runoff from the event caused physical and biological degradation of the stream. This study evaluated recovery of trout and aquatic macroinvertebrates, use of the stream by spawning adfluvial rainbow trout, emigration of young-of-the-year rainbow trout to the Missouri River, and changes in substrate composition. Two months after the fire and flood trout populations in the impacted portion of the stream were nearly eliminated; within 2 years, numbers of age-0 to age-III rainbow trout had increased to 5978/ha (68.68 kg/ha), compared to an abundance of 3841/ha (49.34 kg/ha) before the event. The resident brown trout stock did not recover during the period of the study. Numbers of adfluvial rainbow trout spawners using Beaver Creek did not differ significantly from pre-event years, however, there was a large increase in recruitment of young-of-the-year rainbow trout to the Missouri River.

Fine sediments <0.85 mm increased significantly ($P < 0.05$) in riffle areas following the event; fine sediments decreased 7.7% in riffle areas in 2 years. Adult rainbow trout selected spawning sites containing significantly less fine sediments ($P < 0.05$) than were measured in randomly sampled riffles. The benthic community was assumed to have been severely reduced by scouring of the substrates during the flood. The benthic community had recovered by fall 1986, however, percent occurrence of several taxa was lower in the impacted area due to greater embeddedness of cobble substrates.

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 12 August, 1988

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ABSTRACT

A forest fire burned 4811 ha of the lower Beaver Creek drainage and was followed by an intense convectional rainstorm causing extensive soil erosion. Runoff from the event caused physical and biological degradation of the stream. This study evaluated recovery of trout and aquatic macroinvertebrates, use of the stream by spawning adfluvial rainbow trout, emigration of young-of-the-year rainbow trout to the Missouri River, and changes in substrate composition. Two months after the fire and flood trout populations in the impacted portion of the stream were nearly eliminated; within 2 years, numbers of age-0 to age-III rainbow trout had increased to 5978/ha (68.68 kg/ha), compared to an abundance of 3841/ha (49.34 kg/ha) before the event. The resident brown trout stock did not recover during the period of the study. Numbers of adfluvial rainbow trout spawners using Beaver Creek did not differ significantly from pre-event years, however, there was a large increase in recruitment of young-of-the-year rainbow trout to the Missouri River. Fine sediments <0.85 mm increased significantly ($P < 0.05$) in riffle areas following the event; fine sediments decreased 7.7% in riffle areas in 2 years. Adult rainbow trout selected spawning sites containing significantly less fine sediments ($P < 0.05$) than were measured in randomly sampled riffles. The benthic community was assumed to have been severely reduced by scouring of the substrates during the flood. The benthic community had recovered by fall 1986, however, percent occurrence of several taxa was lower in the impacted area due to greater embeddedness of cobble substrates.

INTRODUCTION

The North Hill Fire in Helena National Forest began on 27 August, 1984 approximately 30 km north of Helena, Montana (Figure 1). Sixty-four-kilometer-per-hour winds drove the fire rapidly to the northeast and across the Missouri River near the mouth of Beaver Creek. By 30 August, the fire had advanced approximately 20 km into the Gates of the Mountains Wilderness Area and affected 11,000 ha, including 26% (4811 ha) of the lower Beaver Creek drainage. On 31 August an intense convectional rainstorm moved over the burn area depositing 32.5 mm of precipitation in 20 minutes (Putnam 1985). Runoff from the burn area caused a flood exceeding that of a 100-year event. This study was initiated to assess the effects of the fire-flood event on biota and habitat of Beaver Creek.

Fire is a natural occurrence; suppression of such natural perturbations by man results in build-up of fuel on the forest floor, increasing the potential severity of fire events. In some landform types, fire may be the major contributor to landform shaping processes and cartographic characteristics (Swanston 1971). In pyrolytic ecosystems, fire is a major factor in nutrient cycling and energy flow,

