



The chemical limnology and limnetic primary production of the Tongue River Reservoir, Montana  
by Stephen Charles Whalen

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE  
in Botany

Montana State University

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**Abstract:**

The Tongue River Reservoir is a shallow, warmwater impoundment in southeastern Montana. Water stored in the reservoir is used primarily for irrigation, but recreational use of the reservoir is becoming increasingly popular. The Tongue River provides the only significant source of inflowing and outflowing surface water to and from the reservoir. The water chemistry and limnetic primary production of the reservoir system were studied from June 1975 through November 1976 to assess the early operational impact of surface coal mining activity on selected physical, chemical and biological parameters of the system. Data collected will also provide information against which future studies can be compared to detect any long-term changes resulting from continued and expanded mining activity.

The Tongue River Reservoir acted as a sediment trap for the in-flowing Tongue River. A thermal gradient and a density current were present in the reservoir from late May through most of June in 1976. However the reservoir was typically polymictic due to the deepwater penstock of the outflow structure. Although no thermal or chemical stratification was generally evident, a mild oxygen deficit developed in the bottom water late in the summers of 1975 and 1976. The Tongue River and Tongue River Reservoir waters were a calcium-magnesium bicarbonate-sulfate type. The annual surface nutrient loading rates of 4.1 g total-P.m<sup>-2</sup> and 22.0 g total-N.m<sup>-2</sup> were indicative of a hypereutrophic system. However, the water withdrawal characteristics, temporal nutrient loading pattern and flushing rate of 7.78.yr<sup>-1</sup> held the average phytoplankton standing crop to 8.91 cm<sup>3</sup>.m<sup>-2</sup> and the average photosynthetic rate to 0.77 g C.m<sup>-2</sup>.day<sup>-1</sup>. The typical algal standing crop was dominated by the Bacillariophyceae.

The dominant cation in the West Decker Mine discharge water was sodium while the most abundant anions were bicarbonate and sulfate. From June 1975 through November 1976 the mean percent contribution of the West Decker Mine discharge water to the Tongue River volume of flow was 0.09%; no change in river water quality was noted. The effluent discharged from three mines operating simultaneously should not significantly alter the water quality of the Tongue River or Tongue River Reservoir with respect to the parameters measured.

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OF THE TONGUE RIVER RESERVOIR, MONTANA

by

STEPHEN CHARLES WHALEN

A thesis submitted in partial fulfillment  
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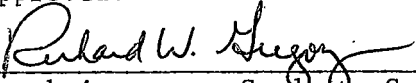
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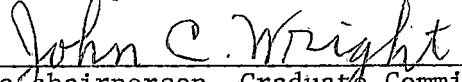
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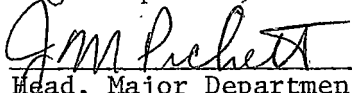
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## ABSTRACT

The Tongue River Reservoir is a shallow, warmwater impoundment in southeastern Montana. Water stored in the reservoir is used primarily for irrigation, but recreational use of the reservoir is becoming increasingly popular. The Tongue River provides the only significant source of inflowing and outflowing surface water to and from the reservoir. The water chemistry and limnetic primary production of the reservoir system were studied from June 1975 through November 1976 to assess the early operational impact of surface coal mining activity on selected physical, chemical and biological parameters of the system. Data collected will also provide information against which future studies can be compared to detect any long-term changes resulting from continued and expanded mining activity.

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## INTRODUCTION

The surface mining of coal has become an increasingly important industry in the Northern Great Plains and adjacent western states in recent years. Because the mining and combustion of fossil fuels will be essential to meet the nation's projected energy needs, future exploitation of the largely untapped coal reserves underlying this region is certain.

In the past, considerable effort has been directed toward the documentation of the ecological impact of strip mining operations on the aquatic and terrestrial resources of the eastern United States. However, the effects of surface coal mining on the semi-arid environment of the western United States are not well defined.

The Tongue River Reservoir is located near Decker, Montana, just north of the Montana-Wyoming border (Figure 1). In the summer of 1972 an open pit coal mining operation was initiated on the southwest side of the reservoir (Figure 2) by the Decker Coal Company, a subsidiary of Peter Kiewit Sons' Company. In the summer of 1977 a second mine was started on the southeast shore of the reservoir, and a future northward extension of the West Decker site is planned (Figure 2). Present mining operations at the West Decker Mine are discharging wastewater into the Tongue River immediately above the Tongue River Reservoir. When in full operation, all three mine sites will discharge effluent, either directly or indirectly, into the Tongue River

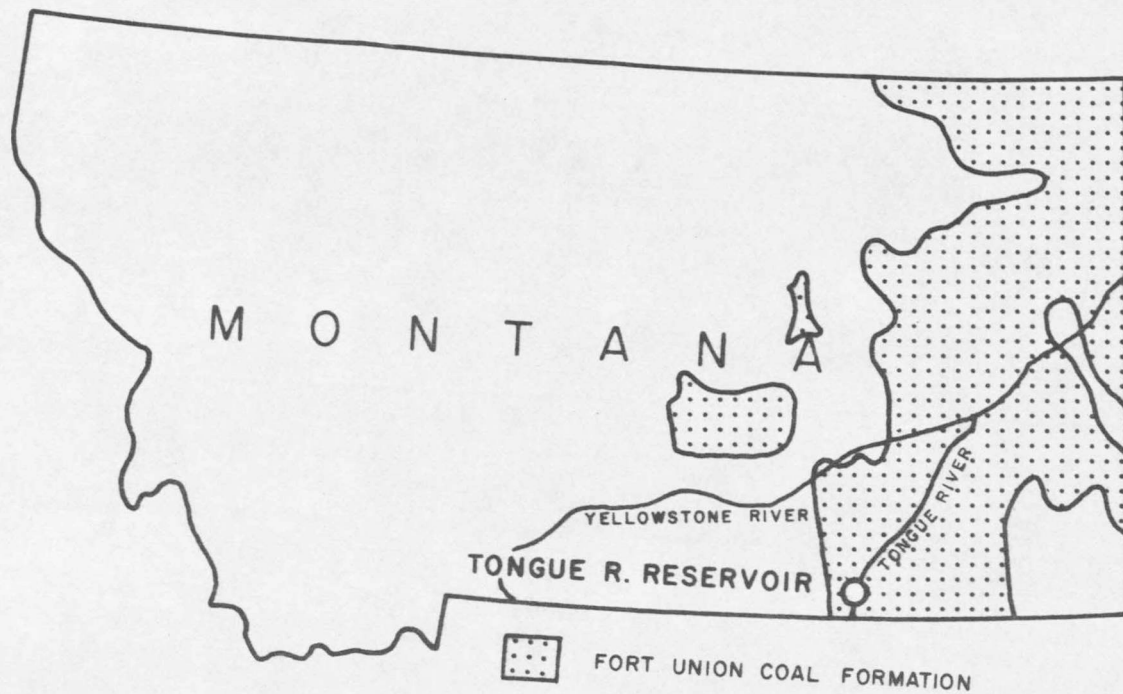


Figure 1. Location map.









































































































































































































































































































































































































































































