



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

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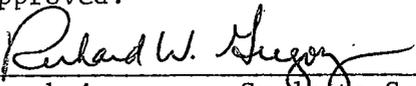
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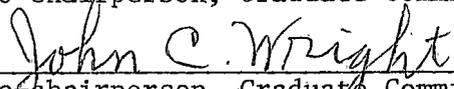
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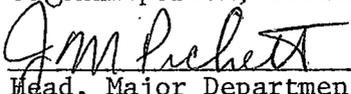
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## TABLE OF CONTENTS

	Page
VITA.....	ii
ACKNOWLEDGMENTS.....	iii
TABLE OF CONTENTS.....	iv
LIST OF TABLES.....	vii
LIST OF FIGURES.....	x
ABSTRACT.....	xv
INTRODUCTION.....	1
DESCRIPTION OF THE STUDY AREA.....	6
METHODS AND MATERIALS.....	11
Inflow, Outflow, and Mine Discharge Waters.....	11
Temperature and Dissolved Oxygen.....	11
Specific Conductance, pH, and Alkalinity.....	12
Turbidity.....	13
Additional Water Chemistry.....	13
Reservoir.....	17
Light.....	18
Temperature and Dissolved Oxygen.....	18
Specific Conductance, pH, and Alkalinity.....	19
Turbidity.....	19
Additional Water Chemistry.....	19
Phytoplankton Standing Crop and Chlorophyll $\alpha$ .....	20
Phytoplankton Primary Production.....	22

	Page
Statistical Analyses.....	25
RESULTS AND DISCUSSION.....	26
Hydrology.....	26
Inflow and Outflow Waters.....	34
Turbidity.....	34
Temperature and Specific Conductance.....	36
Major Cations and Anions.....	38
pH.....	41
Nutrient Concentrations and Loads of the Inflowing and Outflowing Tongue River.....	44
Reservoir.....	58
Turbidity and Light.....	58
Temperature and Specific Conductance.....	61
Dissolved Oxygen and pH.....	66
Major Cations and Anions.....	70
Nutrients.....	75
Phytoplankton Standing Crop and Chlorophyll <i>a</i> .....	90
General Taxonomic Analysis.....	90
Horizontal Distribution.....	91
Class Composition of the Standing Crop.....	103
Seasonal Succession and Periodicity.....	105
Chlorophyll <i>a</i> and Cell Volume Relationships.....	122

	Page
Analysis of Factors Governing Standing Crop.....	124
Phytoplankton Primary Production.....	129
Evaluation of the Trophic Status of the Tongue River Reservoir.....	150
Mine Discharge.....	166
SUMMARY AND CONCLUSIONS.....	184
REFERENCES CITED.....	195

vii  
LIST OF TABLES

	Page
Table 1. Morphometric data for the Tongue River Reservoir at maximum pool elevation.....	8
Table 2. Summary of hydrologic data for the Tongue River Reservoir during the calendar years 1975 and 1976.....	33
Table 3. Ranges and averages of some chemical and physical parameters of the inflow and outflow waters from November 1975 through November 1976.....	39
Table 4. Average seasonal distribution of cations and anions ( $\text{me}\cdot\text{L}^{-1}$ ) in the inflow water from November 1975 through November 1976.....	42
Table 5. Average seasonal distribution of cations and anions ( $\text{me}\cdot\text{L}^{-1}$ ) in the outflow water from November 1975 through November 1976.....	43
Table 6. A summary of the nitrogenous nutrient loads (kg of nitrogen) of the inflow and outflow waters from 15 November 1975 through 15 November 1976.....	56
Table 7. A summary of the phosphorus loads (kg of phosphorus) of the inflow and outflow waters from 15 November 1975 through 15 November 1976 and a comparison of molar ratios of some inorganic nutrients.....	56
Table 8. Monthly mean daily solar radiation ( $\text{langley}\cdot\text{day}^{-1}$ ) from several sources compared with that recorded at the Tongue River Reservoir. Also, monthly mean extinction coefficients and monthly mean euphotic depths for the entire Tongue River Reservoir.....	62
Table 9. Ranges and averages of some chemical and physical parameters of the Tongue River Reservoir from November 1975 through November 1976.....	71

	page
Table 10. Average seasonal distribution of cations and anions ( $\text{me}\cdot\text{L}^{-1}$ ) in the Tongue River Reservoir from November 1975-November 1976.....	73
Table 11. Phytoplankton species observed at all sampling stations in the Tongue River Reservoir from June 1975 through November 1976 with the corresponding mean volume of each organism.....	92
Table 12. A comparison of the areal class composition of the phytoplankton standing crops ( $\text{cm}^3\cdot\text{m}^{-2}$ ) at three Tongue River Reservoir stations.....	104
Table 13. The Bray-Curtis Measure of Dissimilarity applied to the 1976 Tongue River Reservoir growing season standing crop data. Causative factors are indicated in parenthesis for values greater than 0.5.....	118
Table 14. Rank of the major phytoplankton taxa in the euphotic zone of the Tongue River Reservoir according to absolute mean cell volume ( $\text{cm}^3\cdot\text{m}^{-2}$ ).....	119
Table 15. Rank of the major phytoplankton taxa in the euphotic zone of the Tongue River Reservoir according to frequency of occurrence (%).....	120
Table 16. Results of Spearman's Rank Correlation Test as applied between the 1976 growing season areal whole lake standing crop ( $\text{cm}^3\cdot\text{m}^{-2}$ ) and several environmental parameters of the Tongue River Reservoir.....	128
Table 17. Results of Spearman's Rank Correlation Test as applied between <i>in situ</i> $^{14}\text{C}$ determined assimilation ratios ( $\text{g C}\cdot\text{g Chl}\text{a}\cdot\text{hr}^{-1}$ ) and several environmental parameters.....	135

	Page
Table 18. A statistical analysis (Paired $t$ -tests) of several mean estimates of photosynthetic production ( $\text{gC}\cdot\text{m}^{-2}\cdot\text{day}^{-1}$ ) at Station 2 of the Tongue River Reservoir.....	142
Table 19. A comparison of two estimates of photosynthetic production ( $\text{g C}\cdot\text{m}^{-2}$ ) at Station 2 of the Tongue River Reservoir from November 1975 through November 1976.....	143
Table 20. A summary of the means of several parameters measured in the Tongue River and Tongue River Reservoir from November 1975 through November 1976.....	152
Table 21. An analysis of the seasonal loading patterns of inorganic and organic nutrients in the inflow and outflow waters.....	162
Table 22. The calculated and measured effects of the mine discharge upon the Tongue River with respect to several parameters.....	171
Table 23. Contribution of the mine discharge to the Tongue River flow rate from June 1975 through November 1976.....	174
Table 24. Calculated chemical influence of mean monthly mine discharge on mean monthly Tongue River Flow.....	176
Table 25. Calculated chemical influence of maximum predicted flow of highly mineralized mine effluent on average Tongue River Flow.....	179
Table 26. Calculated chemical influence of maximum predicted flow of highly mineralized mine effluent on minimum Tongue River Flow.....	180
Table 27. Average values of selected parameters measured in the mine discharge water and in the Tongue River above and below the site of discharge from June 1975 through November 1976.....	182

x  
LIST OF FIGURES

	Page
Figure 1. Location map.....	2
Figure 2. Map of the Tongue River Reservoir detailing the study area.....	3
Figure 3. Mean water discharge rates ( $m^3 \cdot sec^{-1}$ ) of the Tongue River Reservoir inflow and outflow waters.....	29
Figure 4. Pool elevation and storage capacity of the Tongue River Reservoir in 1975 and 1976.....	31
Figure 5. Water storage history of the Tongue River Reservoir from 1956 through 1977.....	32
Figure 6. Turbidity of the inflow and outflow waters of the Tongue River Reservoir versus the inflow rate.....	35
Figure 7. Annual temperature regime of the inflow and outflow waters of the Tongue River Reservoir..	37
Figure 8. Annual specific conductance regime of the inflow and outflow waters of the Tongue River Reservoir.....	37
Figure 9. Seasonal concentrations of inorganic and organic nitrogen in the inflow.....	45
Figure 10. Seasonal concentrations of orthophosphorus and organic + hydrolyzable phosphorus in the inflow.....	45
Figure 11. Seasonal concentrations of inorganic and organic nitrogen in the outflow.....	49
Figure 12. Seasonal concentrations of orthophosphorus and organic + hydrolyzable phosphorus in the outflow.....	49

	Page
Figure 13. Seasonal loads of inorganic nitrogen ( $\text{NO}_2 + \text{NO}_3 + \text{NH}_3\text{-N}$ ) and inorganic phosphorus ( $\text{PO}_4\text{-P}$ ) carried by the inflow and outflow waters.....	52
Figure 14. Seasonal loads of organic nitrogen and organic + hydrolyzable phosphorus carried by the inflow and outflow waters.....	54
Figure 15. Average turbidity profiles in the Tongue River Reservoir from June 1975 through November 1976	60
Figure 16. Penetration of total visible light, mean extinction coefficients (k) and euphotic zone depths in the Tongue River Reservoir from 6/75 - 11/76.....	60
Figure 17. Seasonal isotherms ( $^{\circ}\text{C}$ ) in the Tongue River Reservoir.....	64
Figure 18. Seasonal conductivity ( $\mu\text{mhos}\cdot\text{cm}^{-1}$ ) isoclines in the Tongue River Reservoir.....	64
Figure 19. Seasonal dissolved oxygen ( $\text{mg}\cdot\text{L}^{-1}$ ) isopleths in the Tongue River Reservoir.....	68
Figure 20. Seasonal oxygen saturation (%) isopleths in the Tongue River Reservoir.....	68
Figure 21. Seasonal pH isopleths in the Tongue River Reservoir.....	74
Figure 22. Seasonal total alkalinity ( $\text{me}\cdot\text{L}^{-1}$ ) profiles in the Tongue River Reservoir on selected dates.....	74
Figure 23. Seasonal $\text{NO}_3\text{-N}$ ( $\mu\text{g}\cdot\text{L}^{-1}$ ) isopleths in the Tongue River Reservoir.....	76
Figure 24. Seasonal $\text{NH}_3\text{-N}$ ( $\mu\text{g}\cdot\text{L}^{-1}$ ) isopleths in the Tongue River Reservoir.....	76

	Page
Figure 25. Seasonal $\text{PO}_4\text{-P}$ ( $\mu\text{g}\cdot\text{L}^{-1}$ ) isopleths in the Tongue River Reservoir.....	80
Figure 26. Seasonal total -P ( $\mu\text{g}\cdot\text{L}^{-1}$ ) isopleths in the Tongue River Reservoir.....	80
Figure 27. Variation in chemical composition of water overlying sediment in the Tongue River Reservoir during the summers of 1975 and 1976.....	84
Figure 28. Seasonal storage of inorganic nitrogen, orthophosphorus, and organic + hydrolyzable phosphorus in the Tongue River Reservoir.....	88
Figure 29. Seasonal variations in the volumetric phytoplankton standing crop and chlorophyll <i>a</i> concentration at three Tongue River Reservoir sampling sites.....	98
Figure 30. Seasonal variations in the areal phytoplankton standing crop and chlorophyll <i>a</i> concentration at three Tongue River Reservoir sampling sites.....	100
Figure 31. Seasonal variations in class composition of the phytoplankton standing crop at Station 2 in the Tongue River Reservoir.....	107
Figure 32. Seasonal variation and successional pattern of phytoplankton at Station 2 in the Tongue River Reservoir.....	108
Figure 33. Seasonal succession of <i>Aphanizomenon flos-aqua</i> and <i>Glenodinium gymmodinium</i> in 1976 at three sampling sites in the Tongue River Reservoir..	115
Figure 34. Mean relative standing crops of the five major phytoplankton species in the Tongue River Reservoir during the 1976 growing season plotted against the absolute areal phytoplankton standing crop.....	121

	Page
Figure 35. Seasonal euphotic zone phytoplankton chlorophyll <i>a</i> /cell volume ratios in the Tongue River Reservoir.....	123
Figure 36. Regression line correlating euphotic zone phytoplankton cell volumes and euphotic zone chlorophyll <i>a</i> concentrations in the Tongue River Reservoir during the 1976 growing season.....	125
Figure 37. Differences in day rate estimates of photosynthesis at Station 2 in the Tongue River Reservoir as estimated by the <sup>14</sup> C technique and the method of Ryther and Yentsch (1957)...	132
Figure 38. Regression line correlating <i>in situ</i> derived assimilation ratios and euphotic zone temperatures at Station 2 in the Tongue River Reservoir from November 1975 through November 1976.....	136
Figure 39. Regression line correlating theoretical assimilation ratios (based on <sup>14</sup> C estimates of diel photosynthesis) with euphotic zone temperatures at Station 2 in the Tongue River Reservoir from November 1975 through November 1976.	139
Figure 40. Comparisons of <sup>14</sup> C estimates of diel photosynthesis with estimates obtained by two modifications of the Ryther and Yentsch (1957) formula. Modifications incorporate a temperature dependent assimilation ratio.....	140
Figure 41. A. Comparison of estimates of day rate photosynthesis at Station 2. Estimates were obtained by the <sup>14</sup> C method and by a modified Ryther and Yentsch (1957) formula. B. Diel photosynthesis at three Tongue River Reservoir sampling sites during the growing season of 1976 as estimated by Equation 2.....	144

	page
Figure 42. Vollenweider's (1970) model for the trophic classification of lakes based on annual surface loading of total phosphorus as a function of mean depth.....	154
Figure 43. Vollenweider's (1970) model for the trophic classification of lakes based on annual surface loading of total nitrogen as a function of mean depth.....	155
Figure 44. Schematic representation of the origin and fate of the West Decker Mine discharge water.....	168
Figure 45. Ionic polygonic diagrams of the mean relative concentrations in equivalent percentages of the major cations and anions at several sampling sites. The number in parenthesis represents the sum of the cations ( $\text{me}\cdot\text{L}^{-1}$ ).....	169
Figure 46. Ammonia and nitrate concentrations in the mine discharge water from June 1975 through November 1976.....	172

## 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

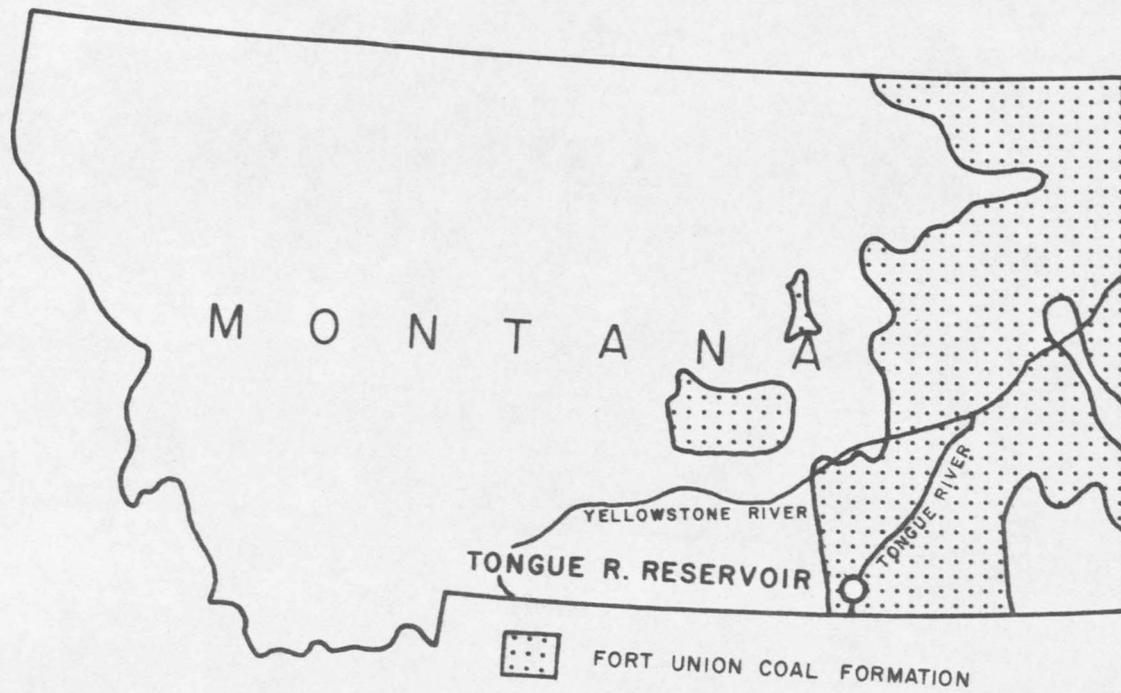


Figure 1. Location map.























































































































































































































































































































































































































