The water quality and fishery resource in a surface coal mine sediment pond in eastern Montana
by Anne Elizabeth Tews

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

Abstract:
The water quality and productivity in a coal strip mine sediment pond near Colstrip, Montana, were studied in 1983 and 1984 to determine the pond's potential to produce fish. Although the sediment pond received water from the mine pit, it had higher concentrations of dissolved oxygen and total alkalinity than two area stock ponds (controls). It contained amounts of calcium, magnesium, sodium, sulfate and hydrogen ions that were intermediate to those in the control ponds. Soluble reactive phosphorus, maximum chlorophyll a_ and maximum surface phytoplankton productivity were lowest in the sediment pond.

Integrated phytoplankton productivity in the sediment pond was similar to one stock pond but much less than what was found in the other stock pond. Cladocera, Copepoda, and Rotatoria were found in all three study ponds. In the sediment pond, biomass estimates of the introduced largemouth bass were very high at 184 and 145 kg / ha in 1983 and 1984, respectively. However, the total lengths of age 1-5 bass increased only 55, 18, 15 and 29 mm per year, respectively. The fathead minnows and crayfish introduced into the sediment pond did not become established. Sediment ponds with water quality similar to the study sediment pond appeared to have good potential as fish ponds. However, such sites should have adequate drainage areas to maintain suitable pond depths.

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APPROVAL

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Anne Elizabeth Tews

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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ABSTRACT

The water quality and productivity in a coal strip mine sediment pond near Colstrip, Montana, were studied in 1983 and 1984 to determine the pond's potential to produce fish. Although the sediment pond received water from the mine pit, it had higher concentrations of dissolved oxygen and total alkalinity than two area stock ponds (controls). It contained amounts of calcium, magnesium, sodium, sulfate and hydrogen ions that were intermediate to those in the control ponds. Soluble reactive phosphorus, maximum chlorophyll a and maximum surface phytoplankton productivity were lowest in the sediment pond. Integrated phytoplankton productivity in the sediment pond was similar to one stock pond but much less than what was found in the other stock pond. Cladocera, Copepoda, and Rotatoria were found in all three study ponds. In the sediment pond, biomass estimates of the introduced largemouth bass were very high at 184 and 145 kg/ha in 1983 and 1984, respectively. However, the total lengths of age 1-5 bass increased only 55, 18, 15 and 29 mm per year, respectively. The fathead minnows and crayfish introduced into the sediment pond did not become established. Sediment ponds with water quality similar to the study sediment pond appeared to have good potential as fish ponds. However, such sites should have adequate drainage areas to maintain suitable pond depths.

INTRODUCTION

Since the early 1970's strip mining of the Fort Union coal formation in eastern Montana and parts of adjoining states has increased substantially as the demand for low sulfur coal has accelerated (Van Voast et al. 1977). As this mining has increased so have the number of sediment ponds, which are built to hold water pumped from mine pits. In an arid region like eastern Montana, these sediment ponds could become a valuable resource if they are suitable for fish production, waterfowl habitat, and stock water. The limited data available indicate mine effluents from western coal strip mines do not have the high acidities which cause the biological degradation found in mine waters in the eastern United States (Warner 1973, Turbak et al. 1979, Canton and Ward 1981, Goering and Dollhopf 1982).

The purpose of this study was to determine the water quality and fish production in a coal strip mine sediment pond in eastern Montana. The specific objectives of the study were to: 1) compare the water chemistry, primary productivity, and zooplankton in a sediment pond with those in two local stock ponds; 2) estimate the standing crop and growth rate of largemouth bass (Micropterus salmoides) in the sediment pond; 3) introduce forage

species for the largemouth bass into the sediment pond; and 4) make recommendations concerning the development of coal strip mine sediment ponds for fisheries.

This study was conducted from June 1983 to November 1985. The majority of the field work was completed during the summers of 1983 and 1984.

DESCRIPTION OF STUDY AREA

The study area is located in Rosebud County, southeastern Montana (Figure 1). This area is composed of sandstone, siltstone, shale, and coal deposits which have been formed into rolling hills, buttes and ridges capped with erosion resistant clinker (Veseth and Montaque 1980). The native vegetation is a mixed prairie type interspersed with conifer associations on the buttes (Goering and Dollhoph 1982). The climate of this area is typified by cold winters and hot summers (Table 1). During this study the average annual temperatures at Colstrip were less than 1 degree Celsius (C) from the 30 year annual average of 7.9 C. Much of this area's precipitation comes from localized storms. In 1983 and 1984 precipitation at Colstrip (Table 2) was 29 and 37 percent (%) respectively, below the 30 year annual average of 39.40 centimeters (cm).

Study Sediment Pond

The mine sediment pond studied is located on the Rosebud Mine about 2 kilometers (km) southeast of Colstrip (T1N, R41E, Sec. 4). From 1978 - 1979 it was used only as a sediment pond. Then in 1980 the Western Energy Company (WECO) enlarged and deepened this pond to convert it into

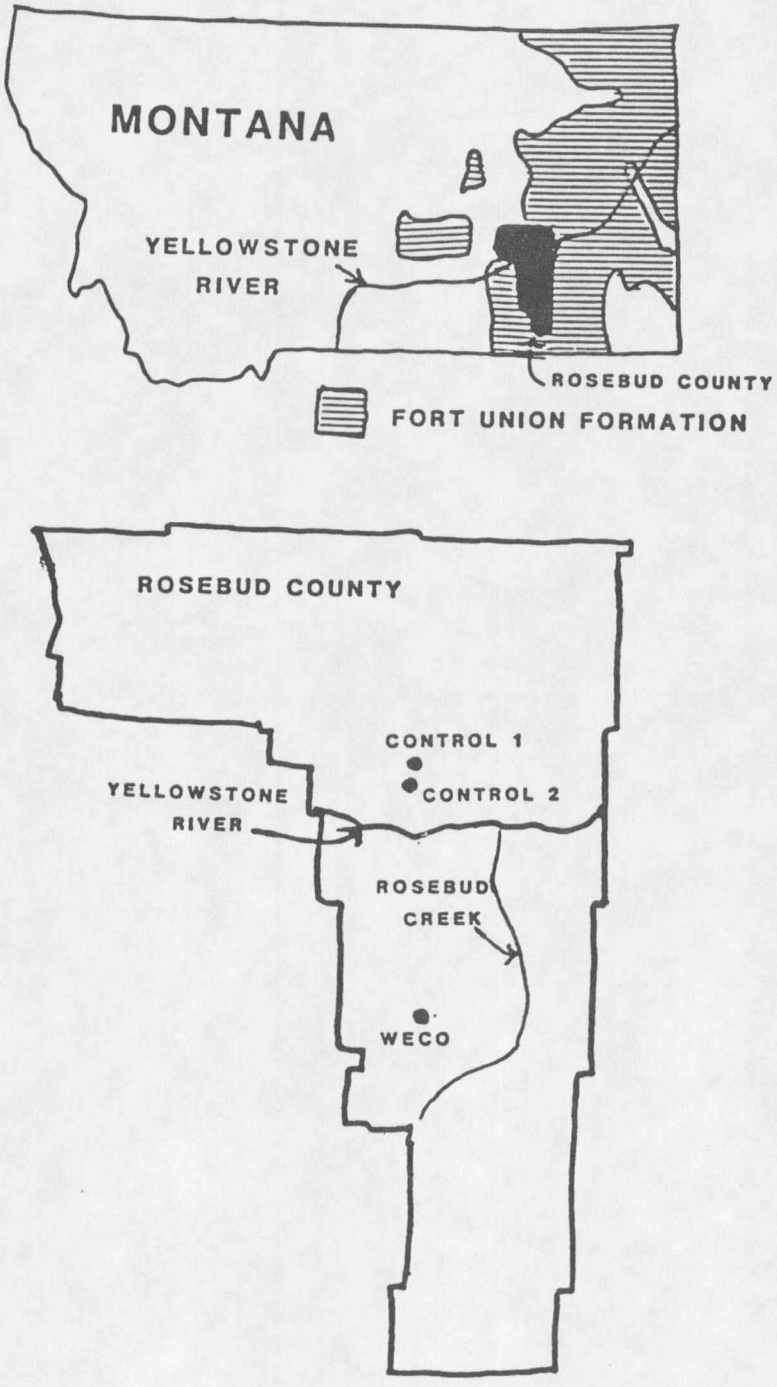

Figure 1. Locations of study area and study ponds.