Black bass populations of the Tongue River Reservoir, Montana
by Russell Frank Penkal

A thesis submitted in partial fulfullment of the requirements for the degree of MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
Black bass population parameters were studied during the summers of 1975 and 1976 prior to expansion of coal strip mining adjacent to the Tongue River Reservoir, The reservoir was divided into three subsections (A, B, and C) based on habitat type.

Spawning conditions were favorable both years as suitable spawning temperatures occurred at a time of rising or stable water levels. Bass reproductive success was limited within the reservoir by suitable spawning substrate and turbidity. Shoreline seining in areas A, B, and C resulted in 0.0, 2.3 and 7.5 smallmouth fingerlings per haul and 1.2, 3.7 and 16.9 largemouth fingerlings per haul in the three, respective areas. Although the spawning population of smallmouth bass (Micropterus dolomieui) was 181% larger than that of largemouth bass (Mioropterus salmo-ides), large-mouth fingerlings were more abundant both years. Growth and length-weight relationships are favorable for both species in a northern water. Largemouth bass had greater growth, length-weight relationships, and condition values than smallmouth bass. Differences in smallmouth bass growth and condition between areas, highest in areas A and B and lowest in area C, may be related to availability of forage fish. Turbidity levels in the Tongue River Reservoir had no apparent effect on black bass growth. Greater fingerling growth in 1976 compared to 1975 was attributed to earlier warming of the reservoir and earlier spawning in 1976. Spring and fall population estimates were obtained during 1976 with boat electrofishing gear. The fall age-1 and older smallmouth bass population of 13.0 fish/ha and standing crop of 2.03 kg/ha represented 80 and 84% of the total black bass population and standing crop, respectively. The fall largemouth bass population and standing crop was 3.2 fish/ha and 0.32 kg/ha, respectively. The dominance of all year classes of black bass, except age-1, by smallmouth bass may be attributed to a much higher fingerling to age-1 mortality of largemouth bass. Summer mortality of age-2 and older smallmouth bass, estimated from the reduction of marked fish, was 39.7%. Tag returns, population estimates and distribution of marked fish indicated smallmouth bass concentrated in areas A and C during the spring and in area B during the fall. The observed fall concentration may be attributed to competition for forage fish or habitat selection.

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Signature Russell F. Penkal

Date April 7, 1977

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Approved:

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Head, Major Department

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ABSTRACT

Black bass population parameters were studied during the summers of 1975 and 1976 prior to expansion of coal strip mining adjacent to the Tongue River Reservoir. The reservoir was divided into three subsections (A, B, and C) based on habitat type. Spawning conditions were favorable both years as suitable spawning temperatures occurred at a time of rising or stable water levels. Bass reproductive success was limited within the reservoir by suitable spawning substrate and turbidity. Shoreline seining in areas A, B, and C resulted in 0.0, 2.3 and 7.5 smallmouth fingerlings per haul and 1.2, 3.7 and 16.9 largemouth fingerlings per haul in the three respective areas. Although the spawning population of smallmouth bass (*Micropterus dolomieui*) was 181% larger than that of largemouth bass (*Micropterus salmoides*), largemouth fingerlings were more abundant both years. Growth and length-weight relationships are favorable for both species in a northern water. Largemouth bass had greater growth, length-weight relationships, and condition values than smallmouth bass. Differences in smallmouth bass growth and condition between areas, highest in areas A and B and lowest in area C, may be related to availability of forage fish. Turbidity levels in the Tongue River Reservoir had no apparent effect on black bass growth. Greater fingerling growth in 1976 compared to 1975 was attributed to earlier warming of the reservoir and earlier spawning in 1976. Spring and fall population estimates were obtained during 1976 with boat electrofishing gear. The fall age-1 and older smallmouth bass population of 13.0 fish/ha and standing crop of 2.03 kg/ha represented 80 and 84% of the total black bass population and standing crop, respectively. The fall largemouth bass population and standing crop was 3.2 fish/ha and 0.32 kg/ha, respectively. The dominance of all year classes of black bass, except age-1, by smallmouth bass may be attributed to a much higher fingerling to age-1 mortality of largemouth bass. Summer mortality of age-2 and older smallmouth bass, estimated from the reduction of marked fish, was 39.7%. Tag returns, population estimates and distribution of marked fish indicated smallmouth bass concentrated in areas A and C during the spring and in area B during the fall. The observed fall concentration may be attributed to competition for forage fish or habitat selection.

INTRODUCTION

Accelerated demand on western coal as an energy source necessitates accurate knowledge of eastern Montana's present aquatic ecosystems. Baseline information should be established to detect future environmental changes caused by increased mining activity. For this reason, biological parameters of black bass in the Tongue River Reservoir were investigated during 1975 and 1976, prior to expansion of coal strip mining adjacent to the reservoir. The objective was to provide detailed information on the populations, life history, and age and growth of black bass and correlate the results with concurrent water quality studies. The study will also increase the amount of information on smallmouth bass (*Micropterus dolomieui*) and largemouth bass (*Micropterus salmoides*) in Montana, about which very little is known at present.

Decker Coal Company is presently operating a large surface mine near the southwest end of the reservoir. Mining will extend to the east side of the reservoir within one year and a northward expansion of the present mine is expected within the next several years (Fig. 2). Mine effluent from present and future mines will empty directly or indirectly into the Tongue River Reservoir.

DESCRIPTION OF STUDY AREA

The Tongue River Reservoir, located in Big Horn County of southeastern Montana, is 32 kilometers north of Sheridan, Wyoming, the closest population center. The Tongue River originates in the Big Horn Mountains of Wyoming and flows in a northeast direction for 105 river kilometers until reaching the reservoir. The drainage area above the reservoir is 4584 km^2 (U.S.G.S. 1975). The river continues downstream for another 271 kilometers to its confluence with the Yellowstone River near Miles City, Montana.

The soils of the surrounding area, situated in the eastern sedimentary plains, have a texture of loamy sand to clay loam and receive 30 to 40 centimeters of precipitation annually. The parent material is primarily sandstone, siltstone and shale of the Tongue River Member of the Fort Union Formation. Carbonaceous material and clinker beds are also common. Seven major coal seams lie within the Tongue River Member (Draft Environmental Impact Assessment for the Proposed East Decker Coal Mine unpublished).

The Tongue River Reservoir was completed in 1940 for irrigation and flood control. Height of the earthfill dam is 27.7 meters with a spillway elevation of 1043.7 meters above sea level (U.S.G.S. 1975). At storage capacity the reservoir has an average depth of 6.1 meters, a maximum length of 12.5 kilometers, and a maximum

breadth of 1.4 kilometers (Garrison, Whalen, and Gregory 1975). Surface area and length of shoreline at spillway elevation are 1277 hectares and 60 kilometers, respectively. The shoreline development index is 4.74. Total storage capacity in 1947 was 85.6 hm^3 (U.S.G.S. 1975), but subsequent sedimentation has undoubtedly reduced this capacity to some extent. Average annual inflow and discharge is 459 hm^3 and 414 hm^3, respectively (U.S.G.S. 1975). Present maximum depth at spillway elevation is 18 meters while the bottom of the outlet is located 15.2 meters from the surface of the spillway. Because of an annual water level fluctuation of three to six meters, submerged and emergent vegetation have not become established. The recent history of water storage fluctuation of the Tongue River Reservoir is depicted in Figure 1. Thermal stratification occurs for a short period in late spring and early summer but disappears quickly due to wind mixing and deep water withdrawal. Dissolved oxygen concentrations decrease to values less than 3 mg/l at depths greater than 8 meters in late summer (Whalen and Leathe 1976). Some physical characteristics of the reservoir are listed in Table 1.

The reservoir and part of the river upstream were chemically treated in 1957 to remove rough fish. Rainbow trout (*Salmo gairdneri*) were planted from 1958 through 1960 but planting was

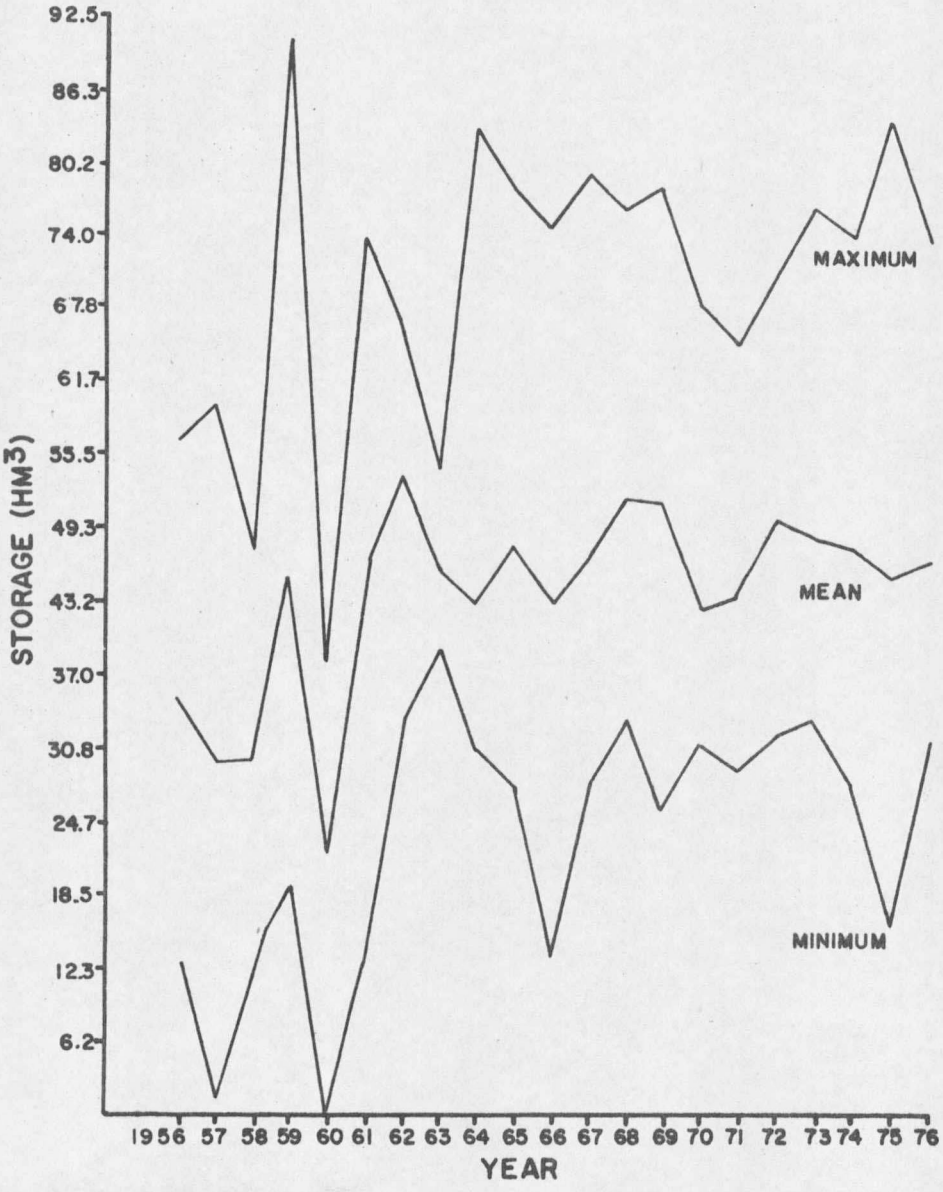

Figure 1. Water storage history, Tongue River Reservoir (Montana Dept. of Nat. Resources unpublished data).

TABLE 1. MORPHOMETRIC DATA OF THE TONGUE RIVER RESERVOIR AT SPILLWAY ELEVATION (1043.7 m)

Maximum depth[1]	18.0 m
Mean depth[1]	6.1 m
Depth of outlet[4]	15.2 m
Maximum length[2]	12.5 km
Maximum breadth[1]	1.4 km
Mean breadth[1]	1.1 km
Surface area[3]	1277 ha
Volume[4]	85.6 hm^3
Length of shoreline[2]	60 km
Index for shoreline development[2]	4.74

[1](Garrison *et al.* 1975).
[2]Measured with a cartometer from topographic maps.
[3]Measured with a planimeter from topographic maps.
[4](U.S.G.S. 1975).

discontinued when trout populations remained low and densities of rough fish increased. In 1963, a warm water fisheries program was implemented. Species introduced include northern pike (*Esox lucius*), channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*) and walleye (*Stizostedion vitreum*). Northern pike are the only fish presently stocked as they are unable to reproduce naturally. Largemouth bass planting history is as follows: 1964 - 150,000 fingerlings 2.5 cm long, 1972 - 199,290 fingerlings 5.0 cm long, and 1973 - 27,540 fingerlings 5.1 cm long. Smallmouth bass

first appeared in the reservoir in 1972, however, records of the Montana Fish and Game Department indicate smallmouths were never planted in the reservoir. This species probably entered the Tongue River system and then the reservoir from adjacent strip-mine ponds near Sheridan, Wyoming (Elser 1973). No stocking records exist for other species but crappie (*Pomoxis* sp.) were present when the reservoir was rehabilitated (Elser personal communication).

The reservoir was divided into three subsections based on habitat type (Fig. 2). Area A, the inflow section, was shallow with a maximum depth of six meters at the water quality station (Whalen unpublished data) and was most affected by summer water level reduction. In 1975, an abnormal year, area A was completely dewatered. During 1976, the spring surface area, 564.3 ha, and shoreline length, 23.6 km, were reduced 64 and 45%, respectively (Table 2). Area A

TABLE 2. SPRING AND FALL SHORELINE LENGTHS AND SURFACE AREAS IN THE TONGUE RIVER RESERVOIR, 1976. PERCENT REDUCTION IN PARENTHESIS.

Area	Length of Shoreline (km)			Surface Area (ha)		
	Spring	Fall		Spring	Fall	
A	23.6	13.1	(44.5)	564.3	205.5	(63.6)
B	17.8	12.5	(29.8)	394.2	250.4	(36.5)
C	18.2	14.6	(19.8)	318.0	253.9	(20.2)
Total	59.6	40.2	(32.6)	1276.5	709.8	(44.4)