MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

STATE:	MONTANA	**PROJECT TITLE:**	STATEWIDE FISHERIES INVESTIGATIONS
PROJECT NO:	F-46-R-5	**STUDY TITLE:**	SURVEY AND INVENTORY OF COOLWATER AND WARMWATER ECOSYSTEMS
JOB NO:	V-c	**JOB TITLE:**	SOUTH CENTRAL MONTANA WARMWATER FISHERIES INVESTIGATIONS

PERIOD COVERED: April 1, 1991 Through June 30, 1992

ABSTRACT

Water levels in Bighorn Lake were generally favorable for the fishery during both 1990 and 1991. Inflows were below normal for most of 1990, but the reservoir still filled to 98% of normal. Inflows in 1991 were the second highest on record, and lake levels entered the exclusive flood pool twice during the year.

Walleye catch rates continued to increase in 1990, but dropped off significantly in 1991 despite sampling data that indicated the walleye population was continuing to expand in response to planting.

Walleye egg taking operations continued during both 1990 and 1991, with 6.3 and 8.04 million eggs being collected, respectively.

Walleye tag return and movement data was summarized. Most movement appeared to be related to spawning activities. Analysis of age and growth data for walleye up to 15 years old provided evidence that some natural walleye reproduction was occurring in Bighorn Lake.

Eleven ponds were stocked with largemouth bass in 1990, and 13 in 1991. Channel catfish were introduced into two new waters, and tiger muskie were stocked into one new pond.

A summary of historical information is presented on many of the smaller lakes and ponds and warmwater sections of streams in the region.

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OBJECTIVES AND DEGREE OF ATTAINMENT

1) To provide optimum conditions for walleye forage production on Bighorn Lake by implementing water-level control guidelines in cooperation with the Bureau of Reclamation.

Maintained close working relationship with USBR personnel, and achieved water level controls during the spring within constraints imposed by power demand and water supply. Met with the USBR, the National Park Service, and Wyoming Game and Fish each spring to discuss options and make recommendations on operation for the next year that would benefit forage fish production in Bighorn Lake.

2) To optimize water-level conditions in area irrigation reservoirs in order to enhance production of warm and cool-water species by formalizing and adopting water-level controls prior to the irrigation season on Lake Elmo, and other waters. (State funded).

Met with Billings Bench Water Association and Huntley Irrigation District concerning Lake Elmo and Anita Reservoir. Discussed water levels and habitat projects for both water bodies, and developed a working relationship with both groups.

3) To improve habitat conditions for both warm and cool-water species in area bass ponds by installing artificial habitat and enhancing natural cover.

Assisted the Billings Fishing Club in installing underwater habitat structures in Anita Reservoir for largemouth bass and in placing catfish condos and stake beds in Lake Elmo for channel catfish, bass and crappie. Cabled large trees along the shoreline of Lake Elmo for fish habitat. Worked cooperatively with Big Horn County in installing an aeration system in Arapooish Pond to prevent winter kill of largemouth bass.

4) To at least maintain the existing flow conditions in the Musselshell River by analyzing instream flow needs, and participating in the reservation process and pursuing other options which may supplement existing flows.

Submitted formal application for instream flow water reservations for three reaches of the Musselshell River (Harlowton, Roundup and Mosby sections) and five tributaries (Careless Creek, American Fork Creek, Flatwillow Creek, Swimming Woman Creek and Big Elk Creek) to the Board of Natural Resources and Conservation. Testified as a professional witness for the Department in the formal hearings on the reservation requests.

5) To maintain streambanks and channels in their present or improved conditions by administering existing laws.

Reviewed projects affecting stream habitat through the Montana Stream Protection Act of 1963 (SPA) and the Natural Streambed and Land Preservation Act of 1975 (310). Processed 8 SPA's and 46 310's on the lower Bighorn and Musselshell drainages during FY91 and FY92.

6) To maintain water quality at or above current levels as measured at U. S. Geological Survey water quality monitoring stations.

Encountered no significant water quality problems during this report period. Maintained contact with the local irrigation districts so affected waters could be monitored when herbicides were applied to area ditches.

7) To develop at least 30 producing bass ponds in the region that are open to public use, supporting at least 15,000 man-days of angling per year by 1992.

Had eleven ponds stocked with 44,750 largemouth bass fingerlings in 1990, including three new ponds where bass had not been stocked in the past. Had thirteen ponds (including one new one) planted with 108,664 largemouth bass fingerlings in 1991. Have planted more than 40 ponds in the region with largemouth bass since 1985.

8) To acquire two new access sites on the Yellowstone River downstream from Billings. (State funded)

Acquired two new access sites (Gritty Stone and Voyagers Rest) on the Yellowstone River between East Bridge FAS and Captain Clark FAS. Began improvements including signing, bank stabilization, road work and installing a boat ramp at both sites in 1990, and continued through 1991.

9) To develop plans for construction of at least two new public fishing ponds in the region by 1992. (State funded)

Started working with the BLM on plans to enlarge a BLM pond just outside of Melstone to create a 56 acre public fishing lake. Plans stalled when local landowner decided he did not want to participate.

10) To intensify management of existing urban area pond fisheries (Lake Elmo, Josephine, Arapooish, Chief Joseph, Broadview) by developing artificial reef projects, fishing docks, etc. to maximize the productivity of these fisheries.

Conducted three habitat enhancement projects in Lake Elmo in cooperation with the Billings Fishing Club. Placed an aeration system in Arapooish Pond to prevent winter kill of bass. Introduced an additional fish species (channel catfish) to Chief Joseph Pond, and Lake Josephine. Trapped and removed stunted crappie from Lake Josephine and transplanted them to Lake Elmo.

11) To convert marginal trout fisheries such as Glaston and Lebo lakes into productive warm and cool-water fisheries, and diversify the existing trout fishery at Cooney Reservoir by developing a two-story fishery supporting both walleye and trout.

Was unable to stock additional tiger muskie in Lebo Lake and Glaston Lake in 1990 because fish were unavailable. Stocked 1,500 6.5 inch tiger muskie in Lebo Lake and 2,000 6.4 inch tiger muskie in Glaston Lake in August 1991. Stocked 50,000 walleye fingerlings into Cooney Reservoir in both 1990 and 1991. Continued monitoring the development of the fisheries in all these lakes. Captured the first "legal" sized (> 30 inches) tiger muskie in Lebo Lake in the fall of 1990, and in Glaston Lake in 1991. Weighed a 11.5 pound, 34.5 inch tiger muskie caught by an angler from Lebo Lake in 1991.

12) To broaden and diversify existing warm and cool-water fishing opportunities by developing a yellow perch fishery in the area and exploring potential for new species introduction. (State funded)

Have not yet identified any good yellow perch ponds. Introduced 528 6.5 inch tiger muskie into Broadview Reservoir in August 1991. Expanded the catfish fishery in the region by introducing channel catfish into a new pond in both 1990 and 1991. Planted 13,825 channel catfish into four lakes in 1990, and 12,192 channel catfish into five lakes in 1991.

13) To monitor developing warm and cool-water fisheries and to make recommendations to enhance the forage base where necessary.

Monitored forage fish production in Bighorn Lake in cooperation with Wyoming Game and Fish in 1990. Planned to transplant spottail shiners into Bighorn Lake in cooperation with Wyoming Game and Fish during both 1990 and 1991, but was unsuccessful due to low water conditions in the Missouri River reservoirs where the spottails were to be collected.

14) To create a smallmouth bass fishery in the lower Bighorn River capable of supporting 10,000 angler days of use per year.

Planted 50,000 smallmouth bass into the lower Bighorn River in July 1990, and 100,000 in July 1991. Shocked the lower Bighorn River from Two Leggins access to the mouth during both 1990 and 1991 to look for smallmouth bass. Also shocked the Yellowstone River between the Bighorn River and Huntley Diversion. Found a few smallmouth in the Bighorn River, but most of the planted bass appear to be moving downstream to the Yellowstone.

15) To develop a walleye egg source in Bighorn Lake or Cooney Reservoir. (State funded)

Captured 377 walleye during four nights of electrofishing on Bighorn Lake in April 1990, and collected 6.3 million eggs from 47 ripe females. Captured 282 walleye during seven nights in April 1991, and collected 8.0 million eggs from 46 females. Planted over 5 million fry and 124,000 fingerlings back into this reservoir in 1990, and 3.9 million fry and 137,000 fingerlings in 1991.

16) To develop contingency plans for walleye and bass fingerling production ponds in the region. (State funded)

Abandoned objective 16 in FY91 and FY92. FY91 was the first year the Miles City hatchery became fully operational after reconstruction. The hatchery successfully raised walleye and bass fingerlings during 1990 and 1991. As long as their program is successful, will not attempt to develop rearing ponds locally.

17) To determine the amount of fishing effort expended and success rates for warm and cool-water species in the region's mixed-species fisheries by utilizing existing warden and parks division contacts in the field and supplementing with fisheries division follow-up where necessary. (State funded)

Abandoned this program because warden and parks division contacts have not provided much usable data on warm and cool-water fisheries within the region in the past. Plan to rely more on the state-wide mail survey for this information. Initiated joint creel study involving Montana, Wyoming and the National Park Service on Bighorn Lake in January 1992 and will continue for a full year.

18) To increase public awareness of the availability of warm and cool-water fishing opportunity and the resource that provides them. (State funded)

Maintained bass pond database used in directing the public to planted ponds. Worked with media to promote warm and cool-water fisheries on public waters such as Lake Elmo.

Summary

Abandoned objective 16 during FY91 and FY92. Made progress on all other objectives.

PROCEDURES

Water level data for Bighorn Lake was obtained from the Montana Projects Office of the Bureau of Reclamation in Billings and from summaries in the USBR annual operating plans (USBR 1990, 1991). All data was collected and summarized using the USBR Hydromet system.

Creel census data for Bighorn Lake was collected by National Park Service personnel incidental to other work. They contacted anglers and collected data on hours fished, catch rates and residency when time allowed during their normal boat patrols. Surveys were not conducted on a standardized schedule or using any established sampling program. No attempt was made to randomize contacts based on any established criteria.

Most electrofishing was conducted using a fixed-boom electrofishing boat powered by an outboard jet motor. Electrofishing equipment included a 6,500 watt generator and Coffelt VVP-15 shocking box. direct current at 250 to 300 volts and 10 - 12 amps was used on most waters. Due to high conductivity in Arapooish Pond, only about 50 volts and 5 amps could be maintained without overloading the shocking box. Walleye and largemouth bass shocking were conducted at night. Rivers were electrofished during the day. A Coffelt backpack shocker was used to sample for smallmouth bass in the lower Musselshell River in 1991.

All walleye collected during spring egg-taking operations were separated by sex and held in live cages suspended from the government dock in Box Canyon. Eggs were stripped from the females into a large, flat, dry pan and fertilized using milt from two or three males. Milt was expressed into a quart of water, mixed and poured over the eggs for fertilization. Once fertilized, eggs were treated with a solution of Fullers earth to prevent clumping, water hardened in screen trays in the lake for 3 - 4 hours, placed in plastic bags of water, and shipped to the Miles City Fish Hatchery. All walleye were weighed, measured and tagged with a numbered Carland tag or T-tag before release. Scales from walleye under 8 in long and pectoral spines from larger walleye were collected for age analysis.

Seines (100 ft and 30 ft) with 1/4 in mesh, 100 X 6 ft monofilament gill nets with 1/2 in mesh and 1/2 in mesh trap nets were fished at various locations throughout Bighorn Lake to sample for forage fish and small gamefish. Standard 125 ft and 200 ft sinking experimental gill nets were used to sample for larger fish. All trap and gill nets were set overnight.

Smaller ponds and lakes were sampled using various combinations of seines, gill nets, trap nets, electrofishing and/or angling.

RESULTS AND DISCUSSION

Bighorn Lake

Water Levels

Water levels in Bighorn Lake were generally favorable for the fishery during both 1990 and 1991. Snowpack in the Bighorn drainage in 1990 was near normal; however, much of the runoff was absorbed directly into the ground to replenish depleted soil moisture resulting in an unseasonably low inflow into the lake every month except October. Annual runoff in 1990 was only 76% of normal. The lake reached a minimum pool of 3593.39 on April 13, just before the walleye started to spawn, and water levels increased slowly from there. A cooperative agreement in 1990 between the Bureau of Reclamation (USBR), Montana Department of Fish, Wildlife and Parks (MDFWP), Wyoming Game and Fish and the National Park Service allowed the USBR to reduce discharges into the Bighorn River earlier in the spring. This agreement combined with excess releases from Buffalo Bill Dam allowed reservoir levels to reach a maximum elevation of 3635.57 ft on August 6, 1990, which was about 98 % of normal and 15.32 ft higher than 1989 (USBR 1990).

Lake levels were again drafted to a minimum elevation of 3594.77 ft on April 11, 1991 (before the walleye started to spawn), and water levels began to rise immediately. A heavy spring snow storm in April 1991 on top of a normal snow pack, combined with heavy rains during June, resulted in the second highest June inflow into Bighorn Lake on record. Storage entered the exclusive flood pool on June 12 and crested at an elevation of 3647.15 on June 16. Releases into the Bighorn River were increased to near 12,000 cfs in early June and remained at these levels into early July. Lake levels dropped slowly during the summer, but heavy rains in September raised the lake elevation back into the exclusive flood pool in mid-September. These conditions resulted in unusually high lake elevations during most of 1991 (USBR 1991).

Creel Census

National Park Service personnel continued to conduct a cursory creel census on Bighorn Lake during 1990 and 1991. Because this census was not conducted using any standardized sampling schedule or format, no more than general trends could be drawn from these data. A total of 493 anglers fishing 1,845 hours were contacted in the Montana portion of the reservoir in 1990, and 488 anglers fishing 2913 hours were contacted in 1991. There appeared to be a significant increase in the number of hours anglers spent on the water in 1991 compared to previous years, which may have been a result of the improved facilities at Ok-A-Beh (Figure 1). Summer of 1991 was the first time the docks and gas concessions were in full operation at Ok-A-Beh. Anglers and boaters had more time to spend on the water because they had a place to dock their boats without having to pull them out each night. They also had a reliable source of gas at the north end of the lake.

The walleye/sauger catch rate increased in the Montana end of the lake between 1989 and 1990 from 0.23 fish per hour to 0.30 fish per hour. This catch rate was the best reported since the Park Service started their creel census in 1984. The average size of walleye caught decreased from 17.4 inches in 1989 to 15.6 inches in 1990. The trend of increasing catch rates for walleye and sauger reversed itself in 1991 with the catch rate dropping to 0.12 fish per hour in the Montana end of the lake. The average size of walleye caught in 1991 increased slightly to 16.25 inches. Several factors may have been involved in the observed decline in walleye catch rates at a time when the walleye population appears to be increasing. Extremely high water levels may have affected catch rates in 1991. Opening of the marina and other facilities at Ok-A-Beh in 1991 probably attracted more new anglers not familiar with Bighorn Lake. These novice anglers could have a major impact on perceived catch rates if they represented a large part of the anglers contacted by the Park Service. Walleye continued to be the most important fish in anglers' creels, so trends in walleye catch were also reflected in the total catch rates each year. Good crappie catches reported in 1989 (Frazer 1990) did not continue in 1990 or 1991. A large increase in the yellow perch harvest was noted in 1991.

Walleye catch rates continued to decline at the Wyoming end of the lake in both 1990 and 1991, dropping to only 0.03 fish per hour in 1991. This drop was probably a reflection of the low water conditions which severely limited angler use in the Wyoming end of the lake in the early spring when many of the walleye are usually caught. As in the past, the average length of walleye caught in the Wyoming end of the lake was greater than the length of walleye from the Montana end.

Wyoming anglers constituted 19.1% and 26.0% of the licensed anglers censused in Montana in 1990 and 1991, respectively. In comparison, Montana anglers constituted 6.8% (1990) and 3.6% (1991) of the licensed anglers contacted in Wyoming.

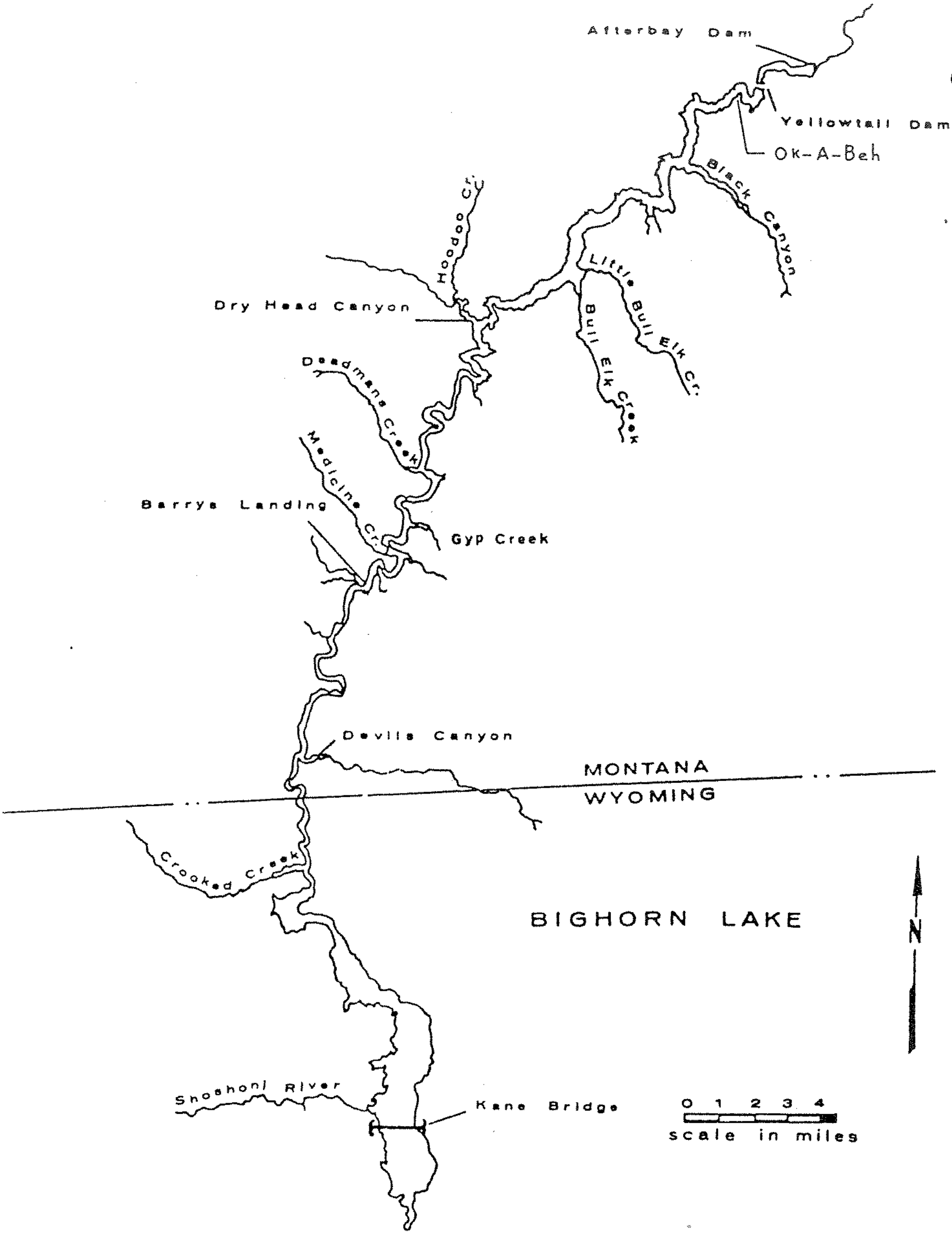

Figure 1. Map of Bighorn Lake.

Walleye Sampling

Spring Electrofishing. Major electrofishing efforts for walleye in both 1990 and 1991 revolved around egg-taking efforts in the spring. In 1990, survey shocking was initiated in the area between Ok-A-Beh and Bull Elk (Figure 1) on April 16 when water temperatures were about 41°F. Two nights of shocking produced 70 immature walleye ranging from 10 to 13 inches long, along with 9 ripe male and 6 gravid females. Egg-taking efforts began on April 19 when water temperatures ranged from 44°F in Ok-A-Beh to 48°F in Box Canyon. The first night a crew from Wyoming Game and Fish shocked in the area around Bull Elk while the Montana crew sampled the Ok-A-Beh area. The Bull Elk area produced mostly immature walleye with only four mature fish being captured. The first night of shocking in the Ok-A-Beh area produced 17 gravid, 1 ripe and 2 spent females, and 27 ripe male walleye. Shocking continued in the Ok-A-Beh area for the next three nights before the spawning ended. The fourth night of shocking produced only two spent females, nine ripe males and three immature walleye.

Spring shocking efforts in 1990 collected a total of 377 walleye including 123 mature males, 68 mature females and 186 immature walleye. The combined average length of these walleye was 16.2 inches with an average weight of 1.90 lbs (Table 1). Consistent with past reports (Fredenberg 1985), the average size of walleye was quite variable depending on sex and maturity, with mature females in 1990 averaging over 5 inches longer and three pounds heavier than mature males. All fish appeared to be in good condition coming out of winter with a combined condition factor of 31.9. This was down from the combined condition factor of 34.5 observed in 1987, but better than the spring condition factor of 28.3 reported for 1986 (Fredenberg 1987, 1988). As in the past, females showed a higher average condition factor than males or immature fish: 35.5 for females compared to 33.3 for males and 29.7 for immature fish.

Spring electrofishing in 1991 started on April 17 when water temperatures reached 38°F in Ok-A-Beh. The first night's catch included 6 gravid, 2 ripe, and 1 spent female, 9 ripe males and 38 immature walleye. The Ok-A-Beh area was electrofished on 5 nights between 4/17 and 4/23 before a spring snow storm closed the road into Ok-A-Beh. On 4/22 & 4/23 a second shocking boat was used to prospect for mature walleye in the Bull Elk Creek area (Figure 1). As in the past, no concentrations of mature walleye were found there. Only 3 ripe and 2 gravid female walleye were collected in two nights of shocking.

Two more nights of electrofishing were conducted in the Ok-A-Beh area on 4/29 and 4/30 once the road, closed by heavy snowfall, was reopened. Water temperatures, which had reached 44°F by April 22, were back down to 41°F on the 29th. Spawning activities were about over by 4/29, but most of the mature walleye which had been held in cages through the snow storm were ripe and successfully spawned on the 29th.

Two hundred and eighty-two walleye were worked during the spring of 1991 including 176 mature males, 55 mature females and 51 immature walleye. This was down almost 100 fish from 1990. A major factor in this decline was a reduction in the number of immature walleye handled declining from 186 fish in 1990 to 51 in 1991. The average size of the immature walleye handled also declined between 1990 and 1991 (Table 1). A change in the sex ratio of mature walleye was also noted shifting from 1.8 males/female in 1990 to 3.2 males/female in 1991. This was probable a result of males from the 1988-1990 plants entering the spawning population earlier than females from the same year classes. The average length of the mature males declined between 1990 and 1991 while the average length of mature females increased (Table 1). Again, this decline probably reflected the contribution of younger males to the spawning population in 1991.

The average condition factor for all groups of walleye in 1991 increased noticeably from levels seen in 1990 (Table 1). The combined average condition factor for all walleye was up over 4 points to 35.99. The greatest increase was in the mature females which reflected the presence of numerous large, ripe fish in the sample.

Table 1. Average size and condition factor of walleye collected during spring electrofishing in Bighorn Lake during 1990 and 1991.

	Sample Size		Avg Length (in)		Avg Weight (lbs)		Average Condition Factors	
Year	1990	1991	1990	1991	1990	1991	1990	1991
Immature Fish	186	51	11.8	9.5	0.52	0.32	29.71	30.13
Mature Males	123	176	18.5	17.5	2.17	2.17	33.32	36.34
Mature Females	68	55	23.9	24.8	5.21	6.57	35.55	40.32
Combined	377	282	16.2	17.5	1.90	2.70	31.94	35.99

Summer and Fall Netting. A week was spent sampling Bighorn Lake in cooperation with Wyoming Game and Fish during late August 1990. A combination of nets, seines and night electrofishing were used at sites established in 1988 and 1989 to sample for forage and small game fish. Several experimental gill nets were also used in 1990 to collect larger walleye and sauger.

Total forage fish numbers throughout the reservoir appeared to be down from 1989 levels. The prominent forage fish in the Wyoming end of the reservoir in 1990 were young-of-year (YOY) carp compared to a strong year class of river carpsuckers observed in 1989. Large numbers of YOY crappie were observed throughout the reservoir in 1990. Crappie along with yellow perch and green sunfish were the major forage in the Montana end of the lake. Only seven spottail shiners were collected throughout the lake in 1990, but one specimen was collected in Box Canyon (Figure 1) just above the dam. This was a downstream extension from previous years, and indicated that spottail had spread throughout the entire lake.

Nine experimental gill nets set at various locations throughout the lake captured 90 walleye and 32 sauger. Walleye averaged 13.5 in long and ranged from 6.1 in to 23.4 in. Most walleye were in the 13 in to 15 in range. Sauger averaged 10.1 in long and ranged from 5.4 in to 22.6 in. The average catch of 10 walleye per net in 1990 was better than the best catch rate of 9.8 walleye per net reported in the summary of 18 years of fall gill netting on Bighorn Lake between 1967 and 1984 (Fredenberg 1985). These values are not totally comparable due to differences in sampling time, but they do give some indication of the strength of the walleye population in the reservoir.

Late summer forage fish sampling was not conducted on Bighorn Lake in 1991, however six 125 ft sinking experimental gill nets were set overnight between the dam and Bull Elk Creek in early October. Walleye, the most common game fish collected, were captured in all six nets; sauger were captured in five of the six nets (Table 2). Walleye averaged 16.5 in long and ranged from 10.1 in to 24.4 in in length. The increase of 3 in over the average length of walleye captured in August 1990 probably represents the continued contribution of a strong year class to the population. The catch rate of 13.2 walleye per net was well above the best walleye catch rate reported by Fredenberg (1985) when he summarized fall gill netting data for Bighorn Lake from 1967-1984. Catch rates during this period ranged from 1.7 to 9.8 walleye per net with catch rates greater than 6 walleye per net reported in only 4 of the 18 years. The average length of walleye captured in 1991 was greater then the average length reported for 14 of the 18 years summarized (Fredenberg 1985). Even the sauger catch rate of 3.3 sauger per net in 1991 was greater than the walleye catch reported for six years between 1967 and 1984.

Table 2. Number and average size of fish captured in six experimental gill nets set in Bighorn Lake, October 1991.

Species	Number Captured	Mean Length (in)	Mean Weight (lbs)
Walleye	79	16.5	1.79
Sauger	20	16.1	1.44
Yellow Perch	50	6.6	0.12
Black Crappie	24	6.1	0.14
Channel Catfish	3	25.5	7.37
Largemouth Bass	3	11.7	1.13
Brown Trout	4	18.6	2.85
Rainbow Trout	1	8.1	0.22
Burbot	1	17.1	1.15
Longnose Sucker	2	13.9	1.04
Carp	2	18.1	--
Shorthead Redhorse	3	15.8	1.97

Other game species captured in the fall of 1991 included yellow perch, channel catfish, black crappie, largemouth bass, trout and one 17.1 in burbot (Table 2). The good catch of yellow perch observed in the fall corresponded to the large increase in perch harvest observed during the National Park Service creel census.

Walleye Egg-Taking

Montana first attempted to collect walleye eggs from Bighorn Lake on an experimental basis in 1988 and has been taking eggs each spring since (Table 3). Four nights of electrofishing in 1990 produced 47 ripe female walleye that were successfully spawned. These fish produced an average of about 134,000 eggs per female for a total take of approximately 6.3 million eggs. The average fecundity was similar to levels observed in 1988 and 1989. Only one gravid female was released without spawning, and approximately 11 spent females were handled. Seven nights of electrofishing in 1991 produced 55 mature female walleye. Forty-six females were spawned successfully and produced over 8 million eggs (Table 3). Average fecundity increased to approximately 174,800 eggs per female, reflecting the larger average size for females seen in 1991. Seven of the 46 females spawned in 1991 were greater than 10.0 pounds. The largest female spawned was 31.5 in long and weighed 14.3 pounds.

Table 3. Summary of walleye egg-taking results on Bighorn Lake, 1988-1991.

Year	No. Females Spawned	Average Eggs/Female	Total Eggs Collected
1988	46	154,000	7.1 million
1989	82	130,000	10.7 million
1990	47	130,000	6.3 million
1991	46	172,782	8.04 million

Walleye Stocking

MDFWP first planted walleye into Bighorn Lake in 1966, and planted approximately 5,700,000 fry between 1966 and 1968. Montana did not make any additional walleye plants in Bighorn Lake until 1988 (Table 4). Wyoming Game and Fish started planting walleye into Bighorn Lake in 1976 and continued to stock walleye on an intermittent basis through 1984. They planted over 40 million walleye fry between 1976 and 1984. Since 1987, Wyoming has been planting walleye on an annual basis. Montana began planting walleye annually in 1988. All walleye planted through 1989 were fry. In 1990 and 1991, MDFWP planted a combination of fry and fingerlings.

Table 4. Historical summary of Montana and Wyoming walleye stocking into Bighorn Lake.

	Montana		Wyoming	Total	
Year	Fry	Fingerling	Fry	Fry	Fingerling
1966	3,900,000			3,900,000	
1967	576,300			576,300	
1968	1,233,000			1,233,000	
1969					
70					
71					
72					
73					
74					
75					
1976			13,161,000	13,161,000	
1977			6,000,000	6,000,000	
1978			1,177,784	1,177,784	
1979			5,000,000	5,000,000	
80					
81					
82					
1983			5,500,000	5,500,000	
1984			9,263,112	9,263,112	
85					
86					
1987			2,250,000	2,250,000	
1988	4,700,000		2,260,072	6,960,072	
1989	5,000,000		1,999,049	6,999,049	
1990	4,300,000*	123,876	2,460,000	6,760,000	123,876
1991	3,900,000	136,956	2,996,000	6,896,000	136,956

* An additional 2.2 million fry from South Dakota were planted but survival was very poor.

Past attempts to correlate walleye year class strength with planting records and/or lake water levels met with only limited success (Fredenberg 1985). The contribution of natural reproduction to the walleye population in Bighorn Lake is not well understood or documented.

Results from 1990 and 1991 spring shocking indicated that recent stocking was increasing the walleye population in the lake. Although shocking efforts both years concentrated on collecting mature walleye for egg taking, over 49% of the walleye handled in 1990 were immature fish, mostly two-year-old fish from the 1988 year class. Walleye from the 1987, 1988, and 1989 year classes comprised over 50% of the fish aged in 1991. Fish from the 1987 year class (four-year-old fish) comprised 31% of the walleye collected in 1991. Wyoming planted approximately 2.25 million walleye in Bighorn Lake in 1987, and both Montana and Wyoming planted walleye in the lake in 1988 and 1989 (Table 4). Since the contribution of natural walleye reproduction in Bighorn Lake is not well understood, it is impossible to attribute these strong younger age classes totally to stocking. However, these data do provide strong evidence that planting is having a major impact.

The best evidence that some natural walleye reproduction is occurring in Bighorn Lake comes from walleye age analysis. Past attempts to quantify natural walleye reproduction in Bighorn Lake using larval tows have been unsuccessful (Fredenberg 1988). Larval tows have not been attempted since 1988 when Montana started planting walleye fry in the lower end of the lake. Fry plants are made about the same time wild fry would be hatching, so it would be impossible to tell wild fry from planted fry in a sample. Spines appear to be more reliable for ageing walleye than scales used in the past. Walleye from every year class between 1976 and 1989 were collected in 1991. Several years between 1980 and 1986 received no walleye plants yet most of these years were strongly represented in the 1991 walleye sample. Thirty-seven percent of the walleye aged from 1991 were from years when no walleye were planted in Bighorn Lake. These data provide strong evidence that some natural reproduction is occurring somewhere in the system. More work is needed to try and identify where this reproduction is occurring and how important it is to the lake.

Walleye Tagging and Movement

High tag loss of Floy T-tags from walleye in Bighorn Lake have been reported in the past. Recapture of walleye that had been marked with both a T-tag and a tail punch indicated a 60% tag loss over a one year period from 405 walleye tagged with T-tags in 1987 (Fredenberg 1988). Based on these results, plastic Carland tags attached with stainless steel wire inserted through the caudal peduncle have been used on walleye since 1988. Additional experimentation was conducted in 1990 to compare tag retention between T-tags and Carland tags. During the spring egg taking operation in 1991 150 walleye were tagged with Carland tags and 231 were tagged with Floy T-tags. An attempt was made to randomly distribute both kinds of tags between all sizes and both sexes of fish. Tag returns during 1990 and 1991 confirmed the problem of tag loss using T-tags. Between the spring of 1990 and the fall of 1991, 16 of the 150 Carland tags put out in 1990 were returned by anglers for an exploitation rate of 10.6%. Five additional fish tagged with Carland tags (3.3%) were recaptured during electrofishing in 1991. Of the 231 T-tags put out in 1990, only 8 tags were returned by anglers (3.5% exploitation rate) and only one tagged fish (0.6%) was recaptured during spring electrofishing in 1991. These results appear to verify the problem with tag retention using T-tags reported by Fredenberg.

Between 1988 and 1991 the MDFWP tagged 601 walleye in Bighorn Lake with Carland tags. Tag return rates between 1988 and 1991 (Table 5) were higher than those reported by Fredenberg (1987, 1988), but this was probably due more to variability in tag loss than changes in harvest rates. Fredenberg (1988) noted a possible trend towards higher harvest rates of the large females tagged in 1987, but indicated these results were tenuous based on the small sample size. The high exploitation rate recorded in 1989 was for large females, because all of the walleye tagged in 1989 were large females. However, only 7.6% and 8.8% of the mature females tagged in 1988 and 1990 respectively, were recaptured through 1991.

Table 5. Number of walleye tagged in Bighorn Lake with Carland tags between 1988 and 1991 and tag return data through fall 1991.

Year	No. Walleye Tagged	Total Angler Tag Returns Through Fall 1991	Total Exploitation Rate
1988	193	24	12.4%
1989	28	7	25.0%
1990	150	17	11.3%
1991	230	5	2.2%
Total	601	53	58.8%

Over 50% of the angler tag returns were from fish that had moved less than five miles from where they were tagged, while 25.5% were from fish that had moved 25 miles or more (Table 6). All of the walleye that had moved 25 miles or more were sexually mature fish when tagged. One mature 20" female tagged 4/21/90 at Ok-A-Beh was caught and released by and angler 6/23/90 approximately 26 miles up the lake. This same fish was recaptured in Ok-A-Beh during the spring egg take in 1991. These data indicate that most major walleye movement within Bighorn Lake is related to spawning movements. Since all walleye were tagged at the north end of the lake during the egg taking operation, most of the recorded movement was in an upstream southerly direction.

Table 6. Summary of movement data for walleye (WE) tagged with Carland tags in Bighorn Lake 1988-1991, based on angler tag returns through fall 1991.

Year	No. Walleye Tagged	No. Tags Returned	<5 miles (% WE Moving)	Distance Moved 5-25 miles (% WE Moving)	>25 miles (% WE Moving)
1988	193	23	14 (60.9)	3 (13)	6 (26.1)
1989	28	7	3 (42.9)	1 (14.2)	3 (42.9)
1990	150	17	10 (58.8)	3 (17.7)	4 (23.5)
1991	230	4	1 (25)	3 (75)	
Total	601	51	28 (54.9)	10 (19.6)	13

Two walleye tagged during the egg-taking operation in 1988 were recaptured in the Ok-A-Beh area during egg-taking in 1989, and three were recaptured during egg taking in 1990. One ripe male tagged in Ok-A-Beh on 4/18/88 was recaptured in the same general area on 4/19/89 and again on 4/22/90. All of these were mature fish when tagged, and were either remaining in the same area for extended periods of time or returning to Ok-A-Beh each spring for spawning.

Five walleye tagged in the spring of 1990 were recaptured during egg-taking operations in 1991. This included the female mentioned above that was caught and released 26 miles upstream during the interim.

Despite evidence of significant tag loss with T-tags, 8 of the 231 walleye tagged with T-tags in the spring of 1990 were recaptured later that year, and one was recaptured in Ok-A-Beh during spring electrofishing in 1991. Movement patterns for these fish were similar to those reported above. One ripe female tagged 4/22/90 at

Ok-A-Beh was recaptured 6/3/90 at the Horseshoe Bend fishing beach. This fish moved almost 50 miles upstream in a little over a month.

Walleye Age and Growth

Several interacting factors make it difficult to draw any reliable conclusions from our walleye age data. In the past, scales used to age walleye have often proved to be difficult and unreliable, especially for older fish. The large variation in growth rates between sexes (Table 1), makes it difficult to establish any age class patterns in older fish based on size.

Walleye spines were collected for the first time for aging in 1991 and appeared to be easier to read and more reliable than scales. Walleye up to 15 years old were aged with a fair degree of confidence in 1991 (Table 7). Again there was a wide range in sizes for most older age groups, although ranges were generally smaller than those reported for scale data collected in 1986 (Fredenberg 1987). Kent Gilge, MDFWP biologist in Chinook, compared scales and spines from the same walleye and found that ages of older walleye were often under-estimated using scales (personal communications). This bias could account for some of the range spread reported in 1987 if older (and larger) fish from a given age class were included in a younger age group.

Growth rates observed in 1991 were slower than those reported for young walleye in 1986 and 1987 (Fredenberg 1987, 1988), but were better for older fish, again perhaps reflecting the difference in aging between scales and spines and the differential growth rates between sexes.

Table 7. Summary of age data from spines collected from walleye in Bighorn Lake during April 1991.

Age	Year Class	Number	Avg Length (in)	Length Range (in)
2	1989	22	8.5	7.0-9.1
3	1988	14	9.9	8.7-13.5
4	1987	58	15.6	13.4-17.5
5	1986	17	18.5	14.5-23.9
6	1985	24	20.4	15.6-23.8
7	1984	11	18.8	16.1-22.2
8	1983	6	21.6	17.1-26.0
9	1982	7	23.2	20.2-27.5
10	1981	13	23.6	20.3-29.3
11	1980	8	25.8	21.8-29.8
12	1979	1	-	27.2
13	1978	2	-	27.5-29.1
14	1977	1	-	27.9
15	1976	1	-	30.5

Age data from spines collected in the fall of 1991 complicated the picture even more (Table 8). The size of three year old walleye in the fall looked reasonable when compared to spring samples from this same year class. However, the average length and size ranges for four-year-old and older walleye reported for the fall actually declined from the spring samples. Spring samples were collected by electrofishing in the Ok-A-Beh area when mature fish were concentrated near the shoreline for spawning. Fall samples were collected in gill nets set in deeper water in various areas of the lake. One possible explanation for the reported differences in average size may be that the gill nets captured more immature and/or male walleye than spring electrofishing. Without the contribution from the larger females, the average size of any given year class would decline significantly. The fall samples again contained fish from two year classes when no walleye were planted in the lake. Over 53% of the of the walleye collected in the fall of 1991 were from the 1986 year class. No walleye plants were made in Bighorn Lake in 1986.

Table 8. Summary of age data from spines collected from walleye in Bighorn Lake during October 1991.

Age	Year Class	Number	Avg Length (in)	Length Range (in)
3	1988	16	12.4	10.1-14.1
4	1987	8	15.3	11.9-18.2
5	1986	38	17.7	13.1-20.8
6	1985	4	17.7	16.6-19.7
7	1984	2	-	15.4-19.3
8	1983	3	18.6	17.3-20.4

Warmwater Ponds and Reservoirs

Efforts continued towards developing at least 30 producing largemouth bass ponds in the Southcentral region by 1992. Bass populations in many of the smaller ponds in the region were lost due to winterkill during the low water conditions experienced in 1988 and 1989. Most of these ponds were restocked with largemouth bass during 1988 and 1989 in an attempt to reestablish self-sustaining bass fisheries. Recent management on many of the private ponds has been limited to monitoring of developing fisheries. Efforts continued to find and develop new ponds. Established ponds continue to receive supplemental plants of bass as needed. During 1990 and 1991 much of the warmwater pond work was concentrated on regional ponds and lakes with open public access. Efforts included habitat enhancement projects, additional stocking efforts and introduction of new species.

Eleven ponds and lakes were stocked with 44,750 largemouth bass fingerlings in 1990. Most of these bass (34,000) were planted into five waters with open public access. The remaining 7,500 fish were planted into six privately owned ponds where the owners allow some public access. Three of these ponds were stocked for the first time, and three received additional plants to supplement existing fisheries.

Thirteen ponds and lakes were stocked with 108,664 largemouth bass in 1991. These included five waters open to general public access, seven ponds being replanted to supplement existing plants or to try and reestablish previous fisheries that had been lost, and one pond being planted for the first time. The majority of these bass were again planted into waters with good public access. The large increase in the numbers of bass planted in 1991 was due predominantly to a substantial increase in stocking rates in Lake Elmo. Miles City produced an excess of largemouth bass in 1991 so 40,000 of these were stocked into Lake Elmo to try and overcome predation by small perch, as discussed in more detail in the Lake Elmo section.

Sampling was conducted on most public ponds during both 1990 and 1991. Sampling on small privately owned ponds amounted to visual observation and hook-and-line sampling to determine whether fish were present and what size they were. Results from this sampling determined which ponds received additional plants of bass. Several new private ponds were evaluated each year with four of these being planted with bass for the first time. Several other ponds are still being considered for future plants. Time was also spent with local Bureau of Land Management (BLM) personnel looking at the fisheries potential of numerous ponds on BLM ground. Donaldson Reservoir, just northwest of the town of Melstone, was identified as one BLM pond that had the potential to be developed into a nice fishing reservoir. Considerable time was spent in study and developing a plan for this lake before the adjoining landowner decided he did not want to be involved in the project. This project is currently on hold. Several habitat improvement projects were undertaken on Lake Elmo and Anita Reservoir in cooperation with the Billings Fishing Club.

Channel catfish were also planted in 1990 and 1991 to increase the diversity of warm and cool-water fisheries available in Region 5. Four ponds received a total of 13,825 channel catfish in 1990. One of these, Chief Joseph Pond in Harlowton, was planted with catfish for the first time. The other three ponds had previously been planted with channel catfish. These catfish were planted in early September at about 3.6 inches long. In early September 1991, 12,192 3.4 inch channel catfish were planted into five ponds. Lake Josephine received channel catfish for the first time. The other four ponds had been planted in 1990.

Tiger muskie were also stocked into three regional waters in 1991. Broadview Reservoir received tiger muskie for the first time. The other two (Lebo and Lower Glaston lakes) already had established tiger muskie populations.

Public Ponds

Anita Reservoir. Anita Reservoir is a 30 acre irrigation reservoir located on the Huntley Project irrigation system. It is connected directly to the Yellowstone River by the canal system, so any fish species found in the Yellowstone River can potentially get into the reservoir. Because this is an irrigation reservoir, water levels can be drawn way down to meet irrigation demands which can result in fish kills during the irrigation season or the following winter. Past attempts to secure a formal agreement for minimum water levels for fisheries have been unsuccessful, so no attempt was made to manage the fishery in Anita. According to irrigation district personnel, the normal operating plan for the reservoir calls for refilling the reservoir in the fall before shutting down the ditch. Based on this, the Department felt it was worth trying to develop a fishery in this reservoir.

In 1981 5,000 2 in largemouth bass were stocked into Anita Reservoir to establish a fishery. These fish appeared to do well, and bass up to about 8.5 in long were collected in the fall of 1984, before dam repairs required the reservoir be almost totally drained. No additional stocking occurred in Anita until 1989 when 10,000 1.8 in largemouth bass were planted. An additional 10,000 1.5 in bass were planted in 1991.

Angler reports indicated that a bass fishery was developing and becoming quite popular by 1991. One attempt was made to electrofish the reservoir at night in September 1991, but a bad lighting storm cut the sampling short. Twenty minutes of shocking produced 29 largemouth bass ranging from 2.0 in to 8.3 in long with two different size groups represented. Nine smaller bass averaged 2.3 in long while 19 others averaged 7.0 in. Numerous white suckers and a few carp were also observed. There was also a strong population of small crappie and some sunfish present. The crappie may have been introduced illegally since it is unlikely that they got into the reservoir from the Yellowstone River.

In the fall of 1990, members of the Billings Fishing Club placed several fish habitat structures in the middle of the reservoir. These structures consisted of wood pallets wired together with brush packed in the middle and several large weighted trees. Future management plans for Anita call for continued stocking of bass as needed and increased monitoring of the developing fishery. Future options may look at stocking channel catfish in the reservoir. A few channel catfish already reach the reservoir from the river.

<u>Arapooish Pond</u>. Arapooish Pond is a flooded gravel pit located on a Bighorn County fishing access site along the Bighorn River near Hardin. The pond covers about 30 acres with a maximum depth of 8 to 10 feet. It is being managed as a largemouth bass pond.

Largemouth bass were stocked in Arapooish in 1986 after it was rehabilitated in 1985 to get rid of rough fish. By 1988, the pond was providing an excellent and popular bass fishery for largemouth up to 13 in long. Growth rates were excellent and reproduction was so successful that almost 10,000 YOY bass were seined and transplanted to other ponds in August of 1988.

Low water levels under ice cover during the winter of 1988-1989 resulted in total winterkill of the bass population. Largemouth bass were restocked in July of 1989, but apparently did not survive the winter of 1989-1990. In the fall of 1989, Bighorn County attempted to deepen several areas in the pond with a large drag-line, but were unable to dig into the hard clay bottom.

In July 1990, 5,000 largemouth fingerlings were again stocked into Arapooish. At the time they were planted the pond was clear with good visibility, as it had been since the carp were removed in 1985. During early August 1990, a very heavy algae bloom occurred in the pond and the water turned pea soup green with only a few inches of visibility. At this time a number of small bass from the July plant, as well as some fathead minnows and some insects, were found dead. It could not be determined if there was a total summer-kill of bass, but a few fathead minnows were observed alive in mid-August. In mid-September 1990 a second plant of 500 4.3 in bass was made to try and establish a year class if the summer-kill had been complete. Also in the fall of 1990, Bighorn County, in cooperation with MDFWP, installed an aeration system at Arapooish. The county ran these aerators through the winter of 1990 which helped maintain a large section of open water throughout the winter.

Arapooish was electrofished in late June of 1991. The water was still very turbid and no fish of any kind were observed. Five thousand largemouth were stocked in July 1991 with a second plant of 3,864 in August. The MDFWP asked the Water Quality Bureau to look at Arapooish and try to determine what was causing the pond to remain so turbid. The Water Quality Bureau collected both water chemistry and algae samples in late August. No abnormally high levels of nutrients were found in the water sample, but a heavy algae bloom was occurring with three species of bluegreen algae present (Appendix A). Two of these bluegreen algae were very abundant.

Arapooish was again electroshocked in September and this time nine bass were collected. Eight of these were age 1 fish from the 1990 plant ranging from 5.1 in to 7.0 in in length. One 2.8 in bass from the 1991 plant was also captured.

The aeration system was operated through the winter of 1991 and again maintained a large area of open water. At ice-off the pond was still very turbid with very limited visibility, but no dead fish were seen. On June 10, 1992 a crew went down to electrofish for bass, and the pond had cleared up. Two hours of shocking produced 17 largemouth bass from two different size groups. Ten bass ranged from 7.5 in to 9.2 in in length and were probably from the 1990 plant. Seven other bass ranged from 4.2 in to 4.7 in long and were probably from the 1991 plant.

Factors responsible for the heavy algae bloom first seen in the summer of 1990, the turbid water that continued through the spring of 1992, and then the sudden clearing up of the water in June of 1992 are not understood. Fertilization in the adjoining agricultural field may be an important factor. More work needs to be done on this. Currently it appears that a good bass fishery is developing in Arapooish Pond, and that the aeration system installed in 1990 is preventing winterkill.

Broadview Reservoir. Broadview Reservoir is about a 7 to 8 acre pond that was first developed by the Great Northern Railroad as a water stop for their steam engines. It was first stocked by the state in 1944 and since then has received more or less annual plants of fish. In the 1950's-1970's it provided an excellent mixed trout-crappie fishery. Carp were introduced from an unknown source in the late 1970's and immediately overpopulated the pond, causing high turbidity and seriously reducing the quality of the fishery. An attempt was made to rehabilitate the pond in 1983 with rotenone, but this was only partially successful and the carp have repopulated the pond. After the rehab efforts, Broadview was restocked with a combination of trout, crappie and largemouth bass. The fishery has remained marginal. The trout plants have provided some recreation on a more or less put-and-take basis. Crappie have successfully reproduced in the pond, but are generally stunted. Bass appear to be surviving with an occasional report of a nice bass being caught. The ability to sample bass in Broadview is limited because of the high conductivity which makes electrofishing difficult and because bass are very good at avoiding most nets.

Recent management efforts on Broadview Reservoir have included annual plants of catchable trout to try and provide some recreation, and heavy plants of largemouth bass to encourage some survival with all the small crappie in the pond. If a good largemouth population could be established, it may be able to reduce numbers of small crappie and increase the average size of the remaining fish. In 1990, 1,000 6.2 in Arlee rainbow and 4,000 1.8 in largemouth bass were planted in Broadview Reservoir. One thousand Arlee rainbow and 6,000 largemouth bass were stocked in 1991. Also in 1991, 528 6.5 in tiger muskie were stocked into Broadview. It is hoped that the latter will prey on the carp and small crappie in the pond as well as provide a potential trophy fishery in the future. Plans are to plant tiger muskie for at least two more years to establish enough of them in the pond to have an impact as predators.

Broadview Reservoir was sampled with a 100 ft seine in the spring of 1990. Two seine hauls captured 56 stunted black crappie ranging from 5.2 in to 6.6 in in length, one 7.7 in white crappie and two largemouth bass, 3.1 in and 8.3 in long. Electrofishing in mid-summer captured 2 rainbow, 1 black crappie, 13 carp, and 43 largemouth bass. Numerous other fish were observed but not captured. Most of the bass were 1 year old fish from the 1989 plant. They ranged from 4.5 in to 5.5 in long. Several 1.5 in to 2.8 in bass from the 1990 plant were also captured. Only two larger bass were captured: one 7.7 in, two-year-old fish, and one 17.7 in bass that weighed 3.88 pounds. The large bass appeared to be about 7 years old and was probably from one of the original plants after the pond was rotenoned.

Broadview Reservoir was sampled in the fall of 1991 using a gill net, trap net and seine. Fish species collected included black crappie, rainbow trout, carp and tiger muskie from the August plant (Table 9). Two size groups of crappie were collected, with the larger crappie averaging only 6.7 in. Only 5 of the carp collected were greater than 7 in long with most of them ranging between 4 in to 6 in. The tiger muskie had grown about 3 inches in less than two months. If they continue to grow at this rate they may be able to feed on a majority of the carp in Broadview by late 1992.

Table 9. Summary of catch from one floating gill net, one 1/2" mesh trap net and one seine haul in Broadview Reservoir, 10/3/91.

SPECIES	NUMBER	MEAN LENGTH (in)	LENGTH RANGE (in)
Black Crappie	50	6.7	5.3 - 7.9
Black Crappie	12	3.3	2.6 - 3.8
Tiger Muskie	6	10.5	10.0 - 11.2
Carp	50	6.6	4.1 - 15.2
Rainbow Trout	6	8.9	8.0 -9.8

Chief Joseph Pond. Chief Joseph Pond, a small pond located in a city park in Harlowton, provides fishing for local residents and visitors staying in the park. It has been managed as a put-and-take trout fishery and normally receives three plants of 500 catchable rainbow during the summer. Attempts to establish a largemouth bass fishery have been unsuccessful. In 1990, Chief Joseph received three plants of 7 in to 9 in rainbow between May 4 and July 2. Six hundred 3.6 in channel catfish were also stocked for the first time in 1990 in hopes of establishing a catfish fishery. In 1990, four plants of 500 rainbow each were put into Chief Joseph along with a second plant of 600 channel catfish. This pond was not sampled in 1990 or 1991.

Lake Elmo. Lake Elmo is a 64 acre irrigation reservoir located in Lake Elmo State Park on the northeastern outskirts of Billings. The lake is filled from the Billings Bench Water Association Canal originating from the Yellowstone River at Laurel. Water from the lake is released as needed resulting in water level fluctuations of up to 3 feet on a weekly basis. Maximum depth of the lake is 16 ft when full.

Lake Elmo is heavily used by swimmers and sailboarders in the warmer months. Use by anglers appears to be increasing. The demand for warm-water fishing is high in the Billings area and such opportunities are limited close to the city. Lake Elmo has the potential to meet some of this demand.

Largemouth bass, yellow perch, crappie, and sunfish were stocked in the lake in the 1930's and still inhabited the lake in 1983 when management of the fishery was begun by the MDFWP. Stocking was resumed by the State of Montana in 1984. Largemouth bass and channel catfish are planted on a yearly basis with occasional transplants of adult black crappie (Table 10). A number of other fish species inhabit the lake including rainbow trout, brown trout, carp, goldfish, flathead chub, lake chub, emerald shiner, Hybognathus sp., fathead minnow, shorthead redhorse, longnose sucker, white sucker, mountain sucker, stonecat, burbot, and pumpkinseed. These may have entered through the canal feeding the lake (even though the length of the canal from the headgate on the Yellowstone River to Lake Elmo is 30 miles), or been introduced from bait buckets in the past (MDFWP 1985).

Habitat Improvement. Lake Elmo has been used in its present form as an irrigation reservoir since the early 1900's. Deposited sediment from the canal has given the lake a rather smooth, unbroken bottom. Fluctuations in lake elevation may cause the water's edge to move as much as 40 ft, probably reducing spawning success of bass and crappie, and preventing the establishment of rooted aquatic plants.

An effort to improve fish cover by adding various structures to the lake has been ongoing since 1983. All structure has been placed in the southern half of the lake to avoid conflicts with swimming and boat launching facilities. Twenty structures composed of five Christmas trees each were placed in the southern bay of Lake Elmo March 24, 1984. Short pieces of rebar placed through the base of each tree anchored each group of five in a cardboard box filled with concrete. These groups were placed in the lake in an upright position in 10-14 ft of water (at full pool). One hundred thirty-five similar structures, using a total of 645 trees at 2-6 trees per structure, were sunk in the southern bay in March 1986. Many of these structures were still upright and in good shape in 1991.

Table 10. Lake Elmo Stocking History

	Size	Number
1991		
Largemouth bass	1.5"	60,000
Channel catfish	3.4"	5,800
Black crappie[1]	6.1"	242
1990		
Largemouth bass	1.8"	10,000
Channel catfish	3.6"	6,600
Black crappie[1]	6.1"	222
1989		
Largemouth bass	2"	20,000
Channel catfish	3.5"	5,000
Black crappie[1]	6"	369
1988		
Largemouth bass	0.5"	50,000
	3.5"	7,660
Channel catfish	4"	11,700
1987		
Largemouth bass	0.5"	98,655
Rainbow trout[3]	3.5"	20
1986		
Largemouth bass	2"	7,638
1984		
Largemouth bass[4]	7"	545
Channel catfish	1"	5,000
1936		
Largemouth bass	3"	5,600
Crappie	3"	4,200
1931		
Largemouth bass	3"	1,900
Crappie	1"	18,750
Yellow perch	4"	2,000
Sunfish	2"	6,250

1 Transplanted from Lake Josephine
2 Transplanted from Arapooish Pond
3 Planted as part of a Boy Scout project
4 Transplanted from Castle Rock Reservoir

Eleven structures for catfish were placed in the lake May 13, 1991. These were composed of 4-8 in sections of plastic, steel, and tile pipe stacked horizontally on wooden pallets and sunk into 10-12 ft of water. Two other structures of stacked pallets were also placed in the lake.

May of 1992 saw the addition of more habitat to the lake. Thirteen pallet stake beds were placed in two groups on the south shore in 16 ft of water (full pool) at the edge of shallower water. Cottonwood snags from Park grounds were loaded into the lake, floated to the west shore, and anchored to the bank in eight groups. Five gallon plastic buckets (107) with half lids, weighted with concrete, were also spread from the inlet to the outlet along the south shore at the 8 to 10 foot contour.

The majority of time and materials necessary for these habitat projects was donated by various local fishing clubs.

Fish Species.

Yellow Perch. The addition of Christmas tree cover in the lake in the mid 1980's should have provided structure for perch spawning. Strong year classes of perch were produced in 1988 and 1991. In Lake Elmo, small perch provide the bulk of forage available for largemouth bass, channel catfish, and the larger black crappie and yellow perch.

While yellow perch are the most numerous fish in Lake Elmo they have failed to provide a quality fishery in that few perch are greater than the minimum size desired for easy filleting (arbitrarily 8.5 in, 0.25 lb). Between 1983 and 1991, 21 gill net sets, 32 trap net sets, and 7 electrofishing runs were made on Lake Elmo. This sampling captured only 12 yellow perch ≥ 8.5 in, of which only 4 fish were 9.0 in or more.

Craig (1987) reports yellow perch longevity ranges from 6 to about 21 years. Yellow perch in Lake Elmo exhibit comparatively rapid growth (Paxton and Stevenson 1978) reaching just under 8 in at the end of their third summer (Table 11). The fact that strong year classes of young perch produce few older, large perch in Lake Elmo indicates the exploitation rate on perch is quite high. An informal creel census conducted by Parks Division personnel in June, July, and August 1987 showed yellow perch catch rates were 1.96 fish/hour, by far the highest for any species found in the lake. Large numbers of fish-eating ducks present in spring and fall may also contribute heavily to yellow perch exploitation. Predation by large crappie, largemouth bass, and channel catfish may also play a role.

Table 11. Approximate length (in) at age of Lake Elmo yellow perch collected 1983-1991 from analysis of length frequencies and scales.

	Age			
	0	I	II	III+
Spring		3.4	6.2	7.5+
Summer	2.7	5.3	7.2	
Fall	3.5	6.3	7.8	

Largemouth Bass. While largemouth bass over 4 lbs have been taken from Lake Elmo, the bass fishery could be considered poor. A combination of lack of cover, fluctuating water levels, and large numbers of yellow perch probably limit the reproduction and recruitment of bass. Largemouth bass fry and fingerlings have been stocked in Lake Elmo since 1986 (Table 10) with marginal results for the fishery. On the assumption that past stockings have been ineffective due to inadequate numbers or size of fish, stocking of fingerlings in 1991 was tripled over the highest previous plant to 60,000. This boost was made possible by utilizing excess hatchery production. Initial results were encouraging. Late summer/early fall night electrofishing counted dozens of bass most years except in 1989 and 1991 when hundreds if not thousands of fingerling bass were observed. The 1989 plant of 20,000 2 in bass was the second largest fingerling plant on record. Night electrofishing in 1992 may confirm whether this high initial survival will result in improved recruitment to older age classes.

Black Crappie. Lake Elmo consistently produces black crappie 9-12 in long in moderate numbers. Scale analysis shows these large fish to be from 6 to 12 years old, but confidence in aging Lake Elmo crappie over 4 years old using this technique is low. Future use of fin ray cross sections may improve accuracy of aging these fish.

In an effort to boost the numbers of larger crappie and augment reproduction, 6 in crappie were transplanted from nearby Lake Josephine: 369, 222, and 242 in 1989, 1990, and 1991 respectively. The Christmas trees placed in Lake Elmo should increase the carrying capacity for large crappie as well as improve yellow perch spawning success. Christmas trees were placed in Lake Elmo in 1984 and 1986. Large year classes of crappie were produced in 1985, 1986, 1988, and 1991. How many of these fish will reach the 9-12 in size attainable in Lake Elmo remains to be seen.

Channel Catfish. Channel catfish were introduced into Lake Elmo in an attempt to provide a sporty, good eating fish that could be easily caught by children, and still withstand the potential heavy fishing pressure of an urban fishery.

Channel catfish were first stocked into Lake Elmo September 21, 1984. None of these 5,000 1 in fish have been sampled since. Vulnerability of stocked channel catfish to predation decreases with increasing size of fish stocked and increasing complexity of bottom cover (Spinelli et al. 1985). Almost total lack of bottom cover and the very small size of catfish stocked in 1984 may account for the failure of this plant. Also, the light body weight and thus energy reserves of such small fish stocked in the fall may have been inadequate to carry this plant through their first winter.

Subsequent stocking with larger catfish and the addition of bottom cover have resulted in better survival. One to two pound catfish were gill-netted in the fall of 1991 and reports from anglers indicated these were beginning to enter the creel. Growth of these fish appears very good at present. Definitive ageing using spine cross sections will be done in the future to accurately assess growth.

A fish kill occurred on Lake Elmo the week of 4/24/90. Ice-off had taken place weeks earlier. A total of 126 channel catfish, 2 adult white suckers, and 1 adult longnose sucker were found dead in a walk around the lake. The catfish averaged 6.7 in. Two gill-nets set the same week caught suckers, a carp, a brown trout, approximately 150 yellow perch, and 14 channel catfish 7.2-10.6 in. These channel catfish were examined while alive by the State Fish Health Biologist. Though in fairly good condition, they were heavily parasitized, especially on the gills, with Trichodina sp., a protozoan, and Cleidodiscus sp., a trematode. Although there was no sign of bacterial infection, three species of bacteria were found on these fish, Alcaligenes sp., Pseudomonas sp., and Enterobacter sp. The combination of stress from overwintering combined with heavy parasitism and possible bacterial infection may have placed these fish at mortal risk from another unknown factor such as a temporary lowering of dissolved oxygen in the lake (Peterson pers. comm.)

Lake Josephine. Lake Josephine is a 20 acre lake formed from an old gravel pit on the southern edge of Billings. It was originally purchased by MDFWP and has since been leased to the city of Billings. It is now part of Riverfront City Park, and gets considerable use, especially by young anglers.

The lake is located on the floodplain of the Yellowstone River, and is also connected to the river by an irrigation canal, so it can potentially contain any fish species found in the Yellowstone. For many years no attempt was made to manage this fishery, and it was entirely dependent on fish from the Yellowstone River and unauthorized introductions.

In 1987, the MDFWP made an experimental plant of 40,000 largemouth bass fry into Lake Josephine to try and supplement a bass population already present in the pond. Although some natural bass reproduction was occurring, survival and recruitment was thought to be limited due to the large number of small predators (crappie, sunfish and yellow perch) present in the pond. A second plant of 10,000 1.5 in largemouth was made in 1989, and 10,000 more were planted in 1991. Current management calls for supplemental bass plants on an every-other-year basis. In recent years, Lake Josephine has become one of the best largemouth bass fisheries in the region with a few bass over 5 pounds being caught.

In 1991, channel catfish were introduced into Lake Josephine for the first time. A total of 1,800 3.4 in channel cats were stocked in the fall. It is hoped these catfish will provide an additional fishing opportunity by providing a fish that will grow to a larger size, be fairly easy to catch, and be good eating. Hopefully, they will also prey upon the stunted populations of crappie, sunfish and perch in the lake.

The local Billings Fishing Club has been involved in recent efforts to improve the fishery in Lake Josephine. In 1988, they placed 25 fish habitat structures in the main lake. These consisted mostly of different brush and tree structures weighted down with cinder blocks and concrete. During 1989, 1990 and 1991, the club has also helped trap and remove stunted crappie from Lake Josephine in hopes of improving the size of the remaining fish.

Sampling efforts on Lake Josephine during 1990 and 1991 were conducted as part of a kids aquatic education class on the lake or during trap netting to remove crappie. Black crappie and pumpkinseed sunfish were the most common fish caught (Table 12). A kids fishing derby the following week produced many of the same fish along with two black bullheads. Sunfish were again the most common fish captured. Fall trap netting to remove stunted crappie produced 222 crappie that were transplanted to Lake Elmo. These crappie averaged 6.1 in long.

Spring sampling during a kids class in 1991 was less productive than in 1990, but produced the same results. Crappie and sunfish were again the most common species captured. The Billings Fishing Club helped transplant another 242 crappie out of Lake Josephine in May, 1991. These fish again averaged 6.1 in long.

Table 12. Species list, number, and size range of fish captured in gill nets, trap nets and seines fished in Lake Josephine in June 1990.

SPECIES	NUMBER	LENGTH RANGE (in)
Pumpkinseed sunfish	110	3.0 - 4.5
Green sunfish	2	3.1 - 4.1
Black crappie	80	3.2 - 7.7
Largemouth bass	5	1.0 - 5.3
Yellow perch	1	5.5
Longnose sucker	4	6.0 - 8.8
River carpsucker	9	18.5 - 22.5
Shorthead redhorse sucker	12	9.8 - 17.4
White sucker	34	5.8 - 13.5
Carp	2	15.0 - 16.1
Lake chub	1	4.0
Flathead chub	3	5.9 - 6.1

Other Waters

Lebo Lake. Lebo Lake is a large, privately-owned lake located near Two Dot, Montana. It covers about 314 surface acres with a maximum depth of about 14 ft. Lebo Lake is used primarily for irrigation storage. The State first stocked trout in Lebo in 1936, and continued to plant most years through 1957. Most plants were with rainbow trout although some brown trout, cutthroat trout and even some bullheads were legally introduced. Bluegill and crappie were also introduced from unknown sources. Lebo Lake was predominantly a trout fishery with some very nice trout being caught.

In 1963 Lebo Lake was rehabilitated to eliminate a large population of suckers, stunted bluegill, and crappie. Between 1964 and 1982, Lebo received annual plants of 30-40,000 4-6 in rainbow and provided a good trout fishery. Changes in the early 1980's increased turbidity in the lake and a tremendous sucker population again took over the lake. A small plant of white crappie was made in 1984, but they never developed into a viable fishery. In 1988 approximately 1,200 1.7 in to 2.3 in tiger muskie were stocked into

Lebo Lake. Another 1,900 1.5 in tiger muskie were planted in 1989. Plans were to stock tiger muskie for a third year in 1990, but fish were not available. In 1991, Miles City hatchery held tiger muskie through the spring and early summer, and planted them in August rather than May. As a result, the 1,500 tiger muskie stocked into Lebo Lake in 1991 averaged 6.5 in long.

Growth rates for these tiger muskie have been very good. Several fish from the 1988 spring plant were recaptured in the fall and averaged 15.9 inches long. This was a growth rate of almost 0.10 inches per day. One fish from the 1988 plant was seen during fall netting in 1989 and appeared to be about 24 inches long.

Three floating gill nets, three sinking gill nets and two 1/2 in trap nets were set in Lebo Lake in May 1990. Only one 2 year old tiger muskie from the 1988 plant was caught. This fish was 23.2 in long and weighed 2.85 pounds. Six gill nets and two trap nets set in the fall of 1990 captured three tiger muskie from the 1988 plant and one from the 1989 plant. The three larger fish were 27.8 in, 28.4 in and 30.7 in long with the largest one weighing 7.25 pounds. The smaller fish was 20.9 in long and weighed 1.92 pounds. This fall 1990 outing was the first time a "legal" (>30 in) tiger muskie was captured from Lebo.

An early onset of bad weather prevented fall netting on Lebo in 1991; however, anglers captured several tiger muskie during the summer and saw several others. The largest of these was 34.5 in long and weighed 11.59 pounds.

Based on recent netting results, tiger muskie appear to be having the desired impacts on the sucker population in Lebo Lake. The average number of suckers less than 12 in long ranged between 13 and 82 per gill net from 1980 through 1987. This number dropped to 3.8 per net in 1989, after tiger muskie had been in the lake for a year, and only 1.2 per net in 1990. In the fall of 1990 only two suckers less than 12 inches long were captured in six gill net sets. Other factors may also be involved in the decline of smaller suckers such as the maturing of some dominant year classes with weak year classes filling in behind. No sucker age data is available for evaluating this factor. As the average size of the tiger muskie continues to increase they should be able to feed on larger and larger suckers which should reduce the adult breeding population in the lake. If there is no strong year class of small suckers to fill in behind these older fish, the total sucker population in the lake should continue to decline over the next few years.

Lower Glaston Reservoir. Lower Glaston Lake is a 768 acre privately-owned irrigation reservoir located 18 miles north of Big Timber. Its maximum depth is approximately 22 feet. The lake is fed by a small creek connecting to Upper Glaston Lake which receives water from Sweet Grass Creek. A portion of the shoreline is composed of broken pieces of sedimentary rock. Dense weed beds are prevalent in midsummer at the southern and northern ends of the lake. Water levels historically fluctuate rather severely due to irrigation withdrawals, and water temperatures normally warm into the low 70°F range during August.

Since 1929, Lower Glaston has been stocked with nine species of fish including rainbow, brown, brook and cutthroat trout; kokanee and coho salmon; largemouth bass, crappie and tiger muskie. Yellow perch of unknown origin also inhabit the lake. Brown trout, suckers and mountain whitefish have access to the lake via the inlet canal from Sweet Grass Creek. From 1980 to 1984, excess McBride strain cutthroat brood fish were stocked. In September 1984, 20,000 Eagle Lake strain rainbow and 20,000 McBride strain cutthroat were planted to compare growth and survival of these two species. Although the results were influenced by drought and resultant low reservoir levels, growth and survival of the two species was similar. Two McBride cutthroat from the 1984 plant were netted in 1990. Four thousand 4-7 in Arlee rainbows were stocked in 1988 and 7,000 4.4 in in 1989. In 1990, 5,104 7.9 in McBride cutthroat were planted to enhance the fishery.

Over the years, Lower Glaston Reservoir has been stocked with many species of fish but none of these plants has produced a satisfactory fishery. The most successful species in the lake is the white sucker. To establish a trophy fishery and to help control suckers, tiger muskie were selected as a management alternative. Twenty-eight hundred 1.2 in tiger muskie were planted into Glaston on May 25, 1989. Growth of these fish over the first summer was excellent and comparable to growth rates of tiger muskies introduced into Lebo Lake. By the spring of 1990 they averaged 15.5 in long and by 1991 they had grown to an average length of 25.2 in and 3.69 lbs. An additional plant of two thousand 6.4 in tiger muskies was made in August 1991. During the latest sampling in April 1992, fish from the original plant averaged 28.8 in and 5.56 lbs. Tiger muskies between eight and ten pounds have been caught. No fish from the 1991 plant were sampled. White suckers netted during 1991 and 1992 had increased an average of 1.5 to 2.0 in over suckers sampled in 1987, 1988 and 1990. The tiger muskies are using the smaller suckers as forage. In 1992, rainbow trout from the 1988 plant averaged 15.9 in and 1.42 lbs and McBride cutthroat from the 1990 plant averaged 15.6 in and 1.39 lbs.

Unfortunately, access problems for anglers have developed at Glaston Reservoir. Since 1929, this lake has provided a lot of fishing recreation for locals in an area with very few lowland lakes. An additional plant of tiger muskie scheduled for 1992 was canceled and no other fish plants are planned. Unless the access problems can be resolved, the MDFWP will no longer manage the fishery in this lake.

Warmwater Sections of Streams

Lower Bighorn River

Efforts have been on-going to establish a smallmouth bass fishery in the lower Bighorn River downstream from Two Leggins Access (Figure 2) since 1986, when 62,000 smallmouth were stocked in this section of river. After the initial plant, no smallmouth were available due to reconstruction of the Miles City Fish Hatchery until 1989. The first year the full request of 100,000 smallmouth bass was available for the Bighorn was 1989. Stocking of smallmouth bass continued in the lower Bighorn in 1990 and 1991. Only half of the requested plant or 50,735 smallmouth were stocked in 1990, but the full 100,000 were planted in 1991.

To date, efforts to sample smallmouth in the lower Bighorn River have met with limited success (Frazer 1990). Based on the size of the larger smallmouth sampled in 1989, it appeared that some bass from the first plant would have been able to spawn in 1990. Three days of survey electrofishing in October 1990 from Two Leggins Access to the mouth of the Bighorn only produced 8 smallmouth bass. These fish ranged from 4.1 in to 13.0 in long and averaged 8.4 in. They were scattered throughout the entire river section, but were always found in association with either riffle habitat or rock structure along the bank.

One day of shocking in May 1991 in the lower end of the Bighorn River produced five smallmouth bass. These fish averaged 9.2 in long with the largest fish being 13.2 in long and weighing 1.37 pounds. Three days of survey shocking from Two Leggins Access to just below General Custer Fishing Access Site in August and September 1991 collected 31 smallmouth bass. The largest fish, a 12.7 in bass, was found dead near Two Leggins Access with a hook in its mouth. One other 10.0 in bass was captured. The rest of the bass ranged from 3.2 in to 4.3 in long and were probably from plants made in July. Some of these fish could have been from natural reproduction in the river, but there was no way to distinguish wild fish from hatchery plants. These bass were, again, all closely associated with rock structure along the bank. The section of river downstream from Manning Dam, 4 miles upstream from the mouth of the Bighorn, was not sampled in the fall of 1991. This section of river has been most productive in previous smallmouth sampling.

Observations and sampling results since smallmouth bass were first introduced into the Bighorn River in 1986 indicate that many of the smallmouth are not staying in the Bighorn River. Anglers have reported catching smallmouth as far upstream in the Yellowstone River as Huntley Diversion the past couple of years. These fish are likely from plants made in the Bighorn River. The limited availability of rocky habitat along the entire lower Bighorn may be a major cause of smallmouth moving out into the Yellowstone River after they are planted. The lower Bighorn contains a very good

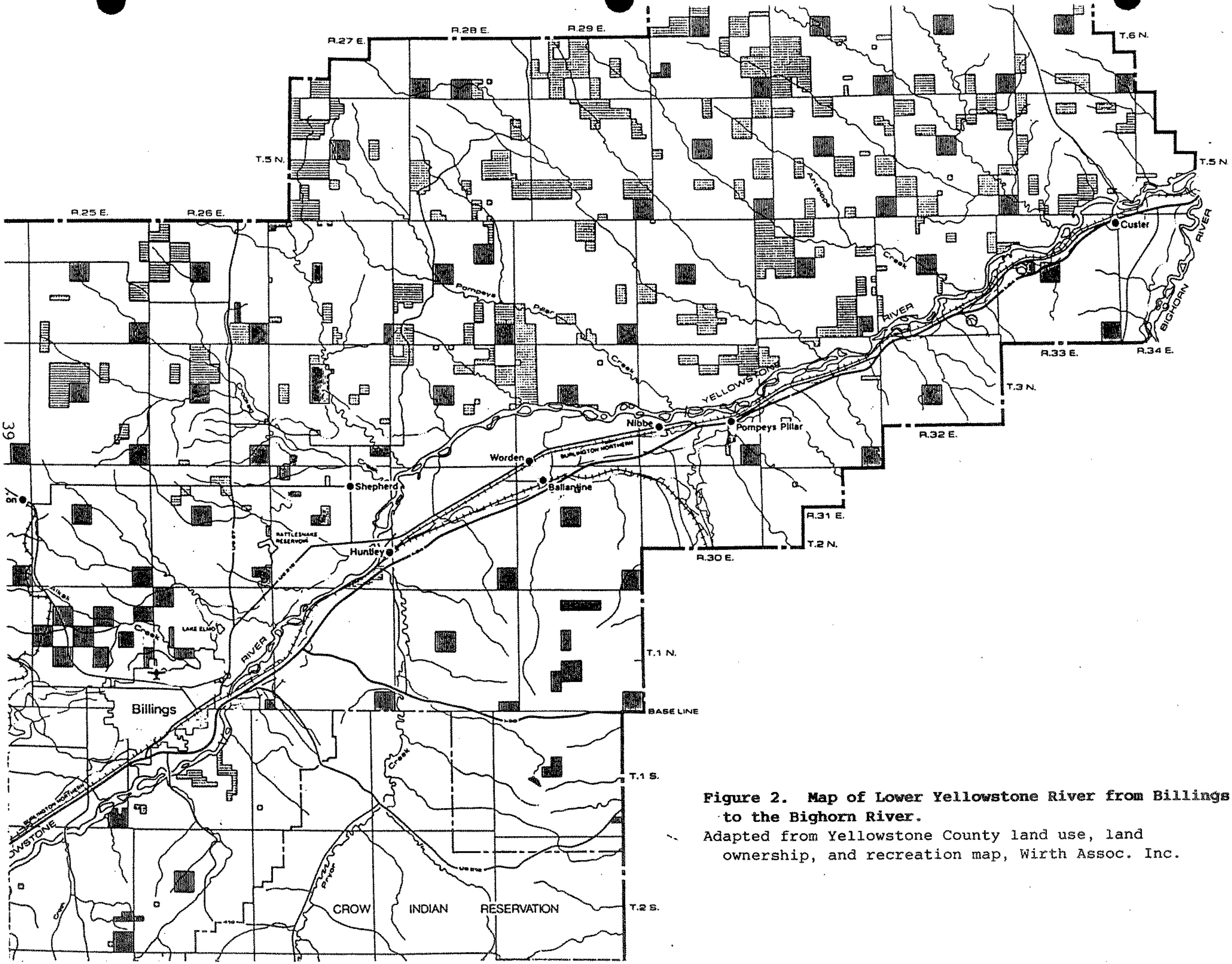

Figure 2. Map of Lower Yellowstone River from Billings to the Bighorn River.
Adapted from Yellowstone County land use, land ownership, and recreation map, Wirth Assoc. Inc.

forage fish population and has excellent cover along the banks from undercut banks, exposed roots, and fallen cottonwoods, but rocky areas are very limited. Most of the lower river actually contains better habitat for largemouth bass than smallmouth bass as long as the current isn't too strong for largemouth.

Musselshell River. No smallmouth bass sampling was conducted on the Musselshell River in 1990. In 1991, one day of hook-and-line sampling below three diversion dams downstream of Roundup produced only one 9.0 smallmouth. Efforts to sample below one dam with a backpack shocker in 1991 were also unsuccessful. Reports from anglers indicate the smallmouth bass population in the Musselshell is maintaining itself, at least on a limited basis, despite chronic low water problems. Additional work is needed to determine how to successfully sample smallmouth bass in the Musselshell.

Lower Yellowstone River. Two days of electrofishing on the lower Yellowstone River downstream of Billings (Figure 2) in early October 1990 were very productive. Two boats were used to shock several sections of river near Worden. Channel catfish were by far the most common game fish collected. Two hundred and seven channel catfish were collected ranging from 11.9 in to 30.2 in long with an average length and weight of 18.6 in and 2.44 pounds. The largest catfish collected weighed 11.00 pounds. Numbers of other game fish captured and their respective size ranges were: 5 ling (12.9 in-24.9 in), 3 sauger (18.8 in-24.5 in), 3 rainbow trout (4.4 in-16.8 in), 2 brown trout (10.6 in & 12.9 in), 2 whitefish (6.5 in & 6.7 in), 2 largemouth bass (4.1 in & 4.5 in) and one 3 in smallmouth bass. This smallmouth provided the first evidence that smallmouth were reproducing in the Yellowstone.

Survey shocking during April and May 1991 from near Worden to the mouth of the Bighorn River produced a similar catch (Table 13). Channel catfish were again the most common game fish captured. Most of the smallmouth bass were captured in the lower end of the section, just upstream from the mouth of the Bighorn River.

Table 13. Number and average size of fish collected during 4 days of electrofishing on the Yellowstone River between Worden and the mouth of the Bighorn River during April and May, 1991.

SPECIES	NUMBER	MEAN LENGTH (in)	MEAN WEIGHT (lbs)
Channel catfish	143	16.3	2.66
Sauger	14	16.2	2.83
Ling	16	11.6	0.40
Smallmouth bass	15	6.4	0.14
Rainbow trout	1	5.9	0.07
Brown trout	1	9.0	0.26
Whitefish	6	12.0	0.88
Yellow bullhead	3	7.0	0.18

A commercial minnow seiner from Huntley called twice during 1991 to report seeing large schools of YOY smallmouth while seining along the Yellowstone near Worden. Although these sightings were not confirmed, they provided some evidence that smallmouth were successfully reproducing in the Yellowstone River.

One day of electrofishing near Worden in October 1991 captured 31 channel catfish, 7 sauger, 4 ling, 3 rainbow trout, 1 brown trout, 1 stonecat and 1 smallmouth bass. The catfish averaged 20.9 in long and weighed an average of 3.82 pounds. The smallmouth bass was 4.9 in long and probably from natural reproduction in this area of the Yellowstone River. It is unlikely that a bass of this size would have moved almost 38 miles up the Yellowstone after being planted in the Bighorn River.

CONCLUSIONS

Management efforts have increased on Bighorn Lake in recent years. A good working relationship has been developed with the Bureau of Reclamation and other agencies involved in water level management on the lake. A viable walleye egg taking operation has been developed. Increased stocking of walleye in Bighorn Lake appears to be having a positive impact on the fishery. An ongoing creel census will provide information on recreational use, angler preferences and catch rates which will be used in developing future management options for the lake.

Efforts have also increased to develop and expand the warm and cool-water fishing opportunities on many of the smaller waters in the region. Work continues to identify and develop new pond fisheries whenever possible. Management efforts are being increased on regional ponds and reservoirs. Habitat improvement projects are being undertaken in cooperation with local groups. Stocking efforts are being expanded now that the Miles City hatchery is fully operational, and new species are being introduced to increase the diversity of fishing opportunities in the area.

Work is ongoing to increase the warm and cool-water fishing opportunities in regional streams, and to identify and evaluate existing stream fisheries.

One of the major factors affecting the warm and cool-water fishing opportunities in the region is the availability of water. Many fisheries are still recovering from the effects of poor water conditions in 1988 and 1989. As long as water is available, the future of the warm and cool-water fisheries program in Region 5 looks good.

MANAGEMENT RECOMMENDATIONS

Bighorn Lake

1. Continue annual walleye egg taking operations at Ok-a-Beh, and continue prospecting in other parts of the lake to try and locate additional concentrations of mature walleye that can be included in the egg taking efforts.

2. Continue to stock a combination of walleye fry and fingerlings in Bighorn Lake each spring.

3. Continue to monitor the walleye population by collecting data on all walleye sampled during spring electrofishing, and by gill netting in the fall as needed.

4. Monitor the development of the spottail shiner population in cooperation with Wyoming Game and Fish. Collect spottail from Fort Peck Reservoir when available and transplant to Bighorn Lake.

5. Continue annual spring meeting with Wyoming Game and Fish, the Bureau of Reclamation, and the National Park Service to discuss water levels and management options. Obtain the best water levels possible for the fishery that can still meet the requirements of the Bighorn River downstream from the dam and of the other agencies involved.

6. Utilize results of the joint creel census and angler survey to determine if any regulation changes are needed for the lake. Coordinate all changes with Wyoming Game and Fish.

Warmwater Ponds and Reservoirs

1. Continue efforts to locate additional ponds suitable for planting and obtain permission to stock them for public use.

2. Continue to monitor existing bass fisheries and stock additional largemouth bass where needed to supplement natural reproduction or to reestablish fisheries lost due to low water.

3. Continue efforts to increase fishing opportunities in warm- and cool-water lakes and ponds open to general public access.

a) Work with local sportsmen's groups on habitat enhancement projects for these waters.

b) Monitor developing catfish fisheries in Lake Elmo, Lake Josephine, and Chief Joseph Pond. Evaluate other waters for potential catfish plants.

c) Continue to remove stunted crappie from Lake Josephine and transplant crappie to Lake Elmo when available.

d) Evaluate the need for additional regulations to protect heavily used fisheries such as the largemouth bass fishery in Lake Josephine.

e) Monitor the tiger muskie fisheries in Broadview Reservoir and Lebo and Lower Glaston lakes. Continue to stock tiger muskie in Broadview Reservoir for two more years.

f) Seek public access to Lower Glaston Lake.

Warmwater Sections of Streams

1. Continue to monitor the developing smallmouth bass fisheries in the lower Bighorn River and lower Yellowstone River.

2. Evaluate the potential of stocking largemouth bass in the lower Bighorn River if a smallmouth bass fishery can not be established.

3. Develop methods for sampling smallmouth in the Musselshell River and collect data on this fishery.

4. Continue to collect information on the channel catfish and sauger populations in the lower Yellowstone River. Work with Region 7 to improve fish passage over barriers in the Yellowstone River downstream from the Bighorn River.

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Prepared by: Kenneth J. Frazer, Michiel Poore and Michael W. Vaughn

Date: August 10, 1992

APPENDIX A

Results of analysis of water chemistry and algae in Arapooish Pond by the Water Quality Bureau during August 1991.

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59620

STATE	MONTANA	COUNTY	BIGHORN
LAT.-LONG.	454523N 1073412W	SAMPLE LOCATION	1S 34E 07CAB
STATION CODE		ANALYSIS NUMBER	91W2888
DATE SAMPLED	08-23-91	DRAINAGE BASIN	0430 -L.BIGHORN
TIME SAMPLED		WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	LAKE/POND	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	DFWP	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: ARAPOOISH POND E OF HARDIN

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
			FLUORIDE (F)		
			PHOSPHATE(PO4 AS P)	.030	0.003
			NO3+NO2 (TOT AS N)	<.01	0.001
SUM CATIONS	0.0	0.000	SUM ANIONS	0.0	0.004

LABORATORY PH		TOT HARDNESS(MG/L-CACO3)	
FIELD WATER TEMPERATURE (C)		TOT ALKALINITY(MG/L-CACO3)	
SUM-DISS. IONS MEAS.(MG/L)		LABORATORY TURBIDITY (NTU)	
LAB CONDUCTIVITY-UMHOS-25C		SODIUM ADSORPTION RATIO	

A D D I T I O N A L P A R A M E T E R S

NITROGEN,KJL,TOT(MG/L-N)	3.6	ALKALINITY,FLD(AS CACO3)	282
HARDNESS,FIELD(AS CACO3)	380	PH,FIELD(SU)	84

REMARKS: ALGAL BLOOM INVESTIGATION

NOTES: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVALENTS/L UG/L=MICROGRAMS/L
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
TR=TOTAL RECOVERABLE (M)=MEASURED (R)=REPORTED (E)=ESTIMATED M=METERS

SAMPLE NO- SAMPLER-KH HANDLING-31 2 ANALYST-LAB LAB-WQBH SCAN-N
COMPLETED-09/05/91 COMPUTER RUN-09/19/91 DATA-0684/PGM-0984 FUND-

STND DEV. ION BALANCE=	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
MPDES-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CALC. MEQ/L= SC N/A, NO CALC.

91W2888

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

Office Memorandum

September 3, 1991

TO: Glenn Phillips, DFWP

FROM: Loren Bahls, WQB

SUBJECT: Algae in Arapooish Pond near Hardin

I examined subsamples of the algae samples collected by Kurt Hill on August 23 and came up with the following cast of characters:

"Floating Algal Mat"

Oscillatoria sp.	bluegreen	very abundant
Anabaenopsis sp.	bluegreen	abundant
Euglena sp.	euglenoid	common
Merismopedia sp.	bluegreen	common
Scenedesmus sp.	green	very common
Ankistrodesmus sp. (?)	green	common
diatoms	yellow-green	common

"Net Plankton"

Anabaenopsis sp.	bluegreen	very abundant
Oscillatoria sp.	bluegreen	very common
Peridinium sp.	dinoflagellate	common
Scenedesmus sp.	green	common
Ankistrodesmus sp.	green	common
Euglena sp.	euglenoid	common
filamentous bacteria	---------	abundant
diatoms	yellow-green	common

The Oscillatoria and the Anabaenopsis are two possible sources of toxicity, although Anabaena is the only documented toxic algae in Montana. The Euglena and the heavy bacterial growth both indicate substantial organic enrichment of the pond, which may have resulted in a dissolved oxygen deficit.