MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA
PROJECT NO: F-46-R-5
JOB NO: II-f

TITLE: STATEWIDE FISHERIES INVESTIGATIONS
TITLE: SURVEY AND INVENTORY OF COLDWATER LAKES
TITLE: CANYON FERRY, HAUSER, HOLTER RESERVOIRS STUDY

PROJECT PERIOD: JULY 1, 1991 THROUGH JUNE 30, 1992

ABSTRACT

Fisheries and limnological data were gathered on Canyon Ferry, Hauser and Holter reservoirs to provide information needed to develop five year fisheries management plans for the three reservoirs and to evaluate impacts of existing reservoir operations on the sport fisheries. Water temperatures, water transparency and zooplankton densities were monitored at stations on all three reservoir during both the ice free period and the ice cover period. In all three reservoirs, zooplankton densities were much less abundant during the winter ice cover period than during the ice free period. Cyclops was the most numerous genera during the ice cover period. Floating gill net catches for rainbow trout in Canyon Ferry Reservoir reached a 6 year low during the spring, 1991, averaging 3.0 trout per net. During the fall of 1991, the rainbow population exhibited a moderate rebound, averaging 6.7 trout per net. Declines in the abundance of rainbow trout in Canyon Ferry Reservoir appeared to be closely associated with the poor success of recent hatchery plants. About 94% of all rainbow trout collected in gill nets were of hatchery origin. Yellow perch dominated the catch in sinking gill nets, with the number collected per net being similar between 1990 and 1991. One walleye, likely an illegal plant, was also captured in sinking gill nets. The average catch of YOY yellow perch in beach seines was about 4 times greater in 1991 than in 1990. Yellow perch collected in Canyon Ferry averaged 5.5, 6.9, 7.8, 9.9 and 9.9 inches in total length in their second, third fourth, fifth, and sixth year of life, respectively. A total of 1,904 anglers were interviewed during the summer on Canyon Ferry Reservoir. Angler catch rates for rainbow trout and yellow perch averaged 0.11 and 0.15 fish per hour, respectively, in 1991. Angler catch rates for yellow perch continued to decline in the winter of 1991/92. The number of burbot caught by anglers during the winter has steadily increased since the winter of 1988/89. A total of 271 anglers were interviewed on the Toston section of the Missouri River during the fall of 1991. Angler catch rates for rainbow trout in the Toston section remained similar between 1991 and previous years of survey. Catch rates for brown trout averaged 0.07 fish per hour, about four fold lower than in previous surveys. In Hauser Reservoir, kokanee dominated the catch in floating horizontal gill nets in 1991.

Analysis of age data from kokanee collections indicated that strong year classes were produced in Hauser in 1987 and 1989. Based on collections made from sinking gill net catches, the abundance of walleye in Hauser Reservoir appears to be increasing as a result of hatchery plants that were begun in 1989. The number of kokanee collected in vertical nets averaged 29.0 fish per net, about half the number of kokanee collected in 1990. Fewer kokanee collected in vertical nets was primarily a result of a substantial decrease in the abundance of yearling fish in the reservoir. Apparently, a very weak year class was produced in 1990. A comparison of growth rates among six consecutive year classes of kokanee indicated growth has not changed significantly over the period of survey. The number of YOY yellow perch collected in beach seines from Hauser Reservoir was less than in the two previous years of survey and was substantially less than collections made in Canyon Ferry. A total of 3,341 anglers were interviewed on Hauser Reservoir during the summer of 1991. Angler catch rates for rainbow trout and kokanee averaged 0.02 and 0.46 fish per hour, respectively. Catch rates for kokanee in 1991 were the highest recorded over the six year period of survey. In Holter Reservoir, the number of kokanee collected in floating horizontal gill nets has tended to steadily increase since 1989. The number of walleye collected in sinking gill nets continued to remain relatively constant in 1991. The number of kokanee collected in vertical gill nets set in Holter Reservoir in 1991 was greater than in the five previous years of survey, reflecting a continued expansion of the population. The number of YOY yellow perch per seine haul in Holter Reservoir was less than in Canyon Ferry Reservoir but greater than in Hauser Reservoir. Walleye in Holter Reservoir averaged 12.5, 16.8, 19.2, 21.4, and 22.7 inches in total length, respectively during their second, third, fourth, fifth and sixth year of life. A total of 1,851 anglers were interviewed on Holter Reservoir during the summer of 1991. Angler catch rates for rainbow trout and kokanee averaged 0.27 and 0.10 fish per hour, respectively. Results from a comprehensive night creel census on Holter Reservoir indicated that the night fishing controversy was more of a social issue than a biological issue. The estimated number of hatchery rainbow trout returned to the creel in Canyon Ferry Reservoir averaged 8.29, 9.05, 3.47, and 2.55 percent of the total number of trout stocked, respectively, for 1986, 1987, 1988 and 1989. With the exception of fall plants, wild strains of rainbow trout (Desmet and Eagle Lake) provided a greater return to the creel than the Arlee strain. Stocking success tended to be very poor for rainbow trout planted into Canyon Ferry Reservoir after mid-August. For Holter Reservoir, the estimated number of hatchery rainbow trout (Arlee) returned to the creel was 28.25, 13.10, 20.76, 17.29 percent of the hatchery plant for 1986, 1987, 1988 and 1989, respectively. The greater rate of return for Arlee rainbow stocked in Holter Reservoir in comparison to Canyon Ferry may be due to greater fishing pressure per surface acre for Holter (15.6 angler days/surface acre versus 2.45 angler days per surface acre). The rate of return to the angler's creel appears to be quite variable and, as a result, strain evaluation should be conducted within the same year of stocking and not between year classes.

ACKNOWLEDGEMENTS

Numerous people provided valuable assistance to this project. Dave Yerk provided help in all aspects of the project, contributing to data collection, analyses and summary of information. Eric Jeanes provided assistance in data collection and mounting of walleye spines. Tom Tompkins and Ed Pettit gathered numerous interviews from anglers fishing on the mid-Missouri reservoirs. Brad Flickenger gathered angler interviews and made angler counts on the Toston section of the Missouri River. Brad also conducted the creel census on the mid-Missouri reservoirs during the ice fishery. Robert Jakubowski donated personal time to conduct the night creel census on Holter Reservoir. All of the individuals mentioned above participated in marking about 1.5 million rainbow trout stocked into the three reservoirs. Volunteers from the Great Falls area and Region 4 personnel aided in clipping the hatchery rainbow trout stocked into Hauser Reservoir. Hatchery managers from Great Falls, Bluewater and Lewistown exhibited tolerance and provided assistance and cooperation in the marking program and in the distribution of hatchery fish. The author wishes to thank all those who contributed to this project.

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JOB OBJECTIVES

1. Maintain densities of rainbow trout in Canyon Ferry and Holter reservoirs and densities of rainbow trout and/or kokanee in Hauser Reservoir based on an index of abundance of an average of 15 yearling or older fish captured per 125 feet of experimental gill net set during the spring.

2. Quantify downstream escapement of hatchery reared rainbow trout from the three reservoirs.

3. Monitor distribution and food supply of sport fishes in the three reservoirs.

4. Identify the extent of natural reproduction occurring in the reservoir complex and identify areas where reproduction could be enhanced.

5. Provide for a stable salmonid fisheries with an average catch rate of 0.30 fish/hour in Canyon Ferry Reservoir and 0.40 fish/hour in Hauser and Holter reservoirs.

6. Provide for an average winter catch rate of 2.0 yellow perch/hour with an average size of 8.5 inches and an annual harvest of 300,000 in Canyon Ferry Reservoir.

7. Determine the status of walleye populations in Hauser and Holter reservoirs.

8. Maintain requested instream flows in the Missouri River and minimize the loss of fish over mid-Missouri River dams during spill periods.

9. Develop comprehensive five year management plans for the mid-Missouri Reservoir complex.

Degree of Attainment

Progress was accomplished on all objectives and findings are presented in appropriate sections of this report. A draft version of a five year fisheries management plan for Canyon Ferry Reservoir has been completed. This draft is currently being reviewed by the public. Following a public comment period, the plan will be presented to the Fish, Wildlife and Parks Commission for final approval in October, 1992.

PROCEDURES

The study area has been previously described by Rada (1974), Berg and Lere (1983), and MDFWP (1985).

Water temperature and transparency were measured at permanent sampling stations established on each of the three reservoirs (Figures 1 and 2). Temperature was measured to the nearest 0.5 F at three foot intervals using a hydrographic thermometer. Water transparency was measured to the nearest 0.5 foot using a 20 cm. diameter Secchi disc.

Zooplankton densities were determined at permanent sampling stations using a conical plankton net (1 foot diameter). Vertical tows were made bi-weekly at each of the sampling stations from mid April through early December. Vertical tows were also made through the ice in January and February. At stations of adequate depth, tows measured 45 feet in length. At shallower stations, the length of tow covered the entire water column. Duplicate vertical tows were made at each station. Procedures used to process zooplankton samples followed those described by Leathe and Graham (1982).

All rainbow trout planted in the reservoir complex since 1986 were marked with either fluorescent pigment or a fin clip. Techniques used in spray marking with fluorescent pigment followed those described by Phinney and Mathews (1973) and Pribble (1976). To evaluate retention of pigment marks, all sprayed fish were also marked with tetracycline by feeding terramycin mixed meal in the hatcheries prior to stocking. Rainbow trout collected from gill netting, electrofishing and creel census activities were examined in a viewing box under black light to identify fluorescent pigment marks. Vertebrae were removed from selected samples of rainbow trout and frozen for later examination. Collected vertebrae were viewed with a dissecting microscope under black light in the lab to examine for tetracycline marks.

Reservoir fish were sampled with floating and sinking 6 X 125 foot experimental gill nets (3/4 to 2 inch mesh) set during the spring and fall. Nets were set in each reservoir in similar locations and at similar times of the year through the period of survey. Distribution of fish species by depth was determined by using a bank of four vertical gill nets that were 150 feet deep and 12 feet wide (3/4, 1, 1.25, and 1.5 inch mesh). Vertical nets were set monthly from July through October at permanent sampling stations located in the lower end of each reservoir.
Vertical nets were set to fish the entire water column.

Beach seine hauls were used to monitor the abundance of young of the year perch in all three reservoirs. Seine hauls were made using a 1/4 inch mesh net that measured 100 feet long and 4 feet deep. Hauls were made in August at established permanent

locations. Seining was accomplished by extending the net parallel to the shoreline and then dragging the ends of the net towards the shore forming a complete circle with the net. All captured fish were sorted and enumerated. In large collections, fish were subsampled by half pound increments. The number of fish counted in a half pound subsample was proportioned to the total weight of the seine haul. Juvenile perch were measured to the nearest 0.10 inch in total length.

A partial creel census was conducted on Canyon Ferry, Hauser and Holter reservoirs from mid April through late November. Procedures for this partial creel census are described in Lere (1987). An additional partial creel survey was conducted during the ice fishery on the three reservoirs from late December through mid-March.

A comprehensive creel census was conducted on the Toston section of the Missouri River during the periods of September 28 through November 16, 1985; September 20 through November 28, 1986; and September 23 through November 24, 1991. Surveys were structured within two week strata. Normally, 8 days were sampled within each stratum. All weekend days were sampled, while two days during the week were selected randomly without replacement within each two week stratum. Anglers counts were spaced at 3.5 hour intervals and starting times were selected randomly within each strata. Anglers were interviewed during hours between counting times. The section of river surveyed began at Toston Dam and extended downstream about 2.5 miles to the U.S.G.S. cable crossing the river.

A comprehensive creel census was also conducted on Holter Reservoir in 1989, 1990 and 1991 to estimate fishing pressure and angler harvest during daylight versus night fishing hours. Only the lower one third of the reservoir, between Split Rock and Holter Dam, was surveyed during each year of the census. Procedures were similar to those described for the Toston section of the Missouri River.

Collected fish were measured to the nearest 0.10 inch in total length and weighed to the nearest 0.01 pound. Subsamples of scales were taken from all salmonids for age and growth analysis. Anal spines were taken from subsamples of yellow perch collected in all three reservoirs and dorsal spines were taken from subsamples of walleye collected from Hauser and Holter reservoirs for aging. Spines were mounted in a fiberglass resin and were cross-sectioned using a Dremel tool with a cut-off wheel. Cross-sections were placed in mineral oil and were examined with a binocular microscope for aging. Subsamples of walleye collected from shoreline electrofishing by consultants from the Montana Power Company, as well as fish captured in gill netting and fish caught by anglers, were marked through the caudal peduncle with individually numbered dangler tags attached with stainless steel wire.

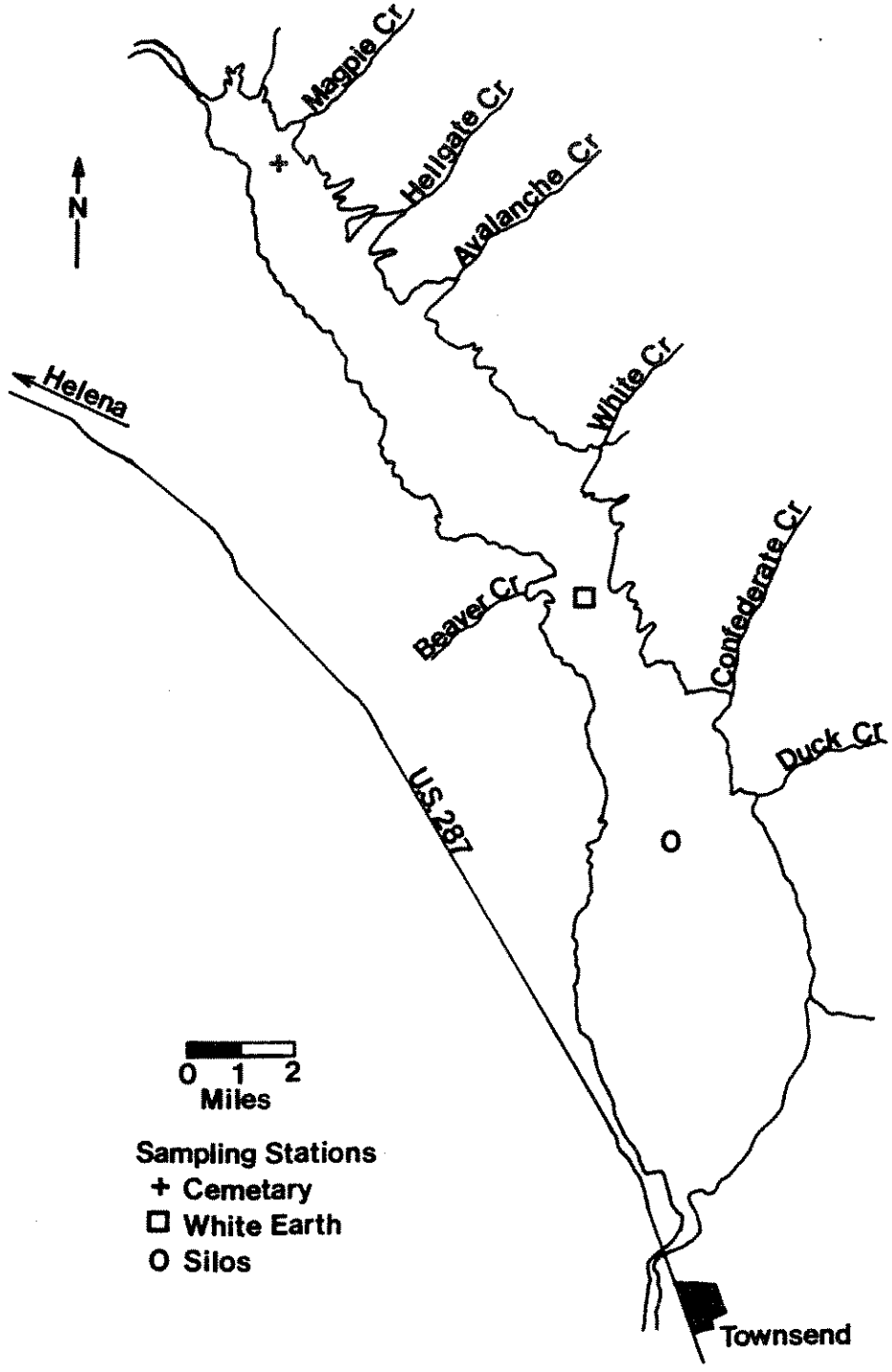

Figure 1. Map of Canyon Ferry Reservoir showing locations of permanent sampling stations.

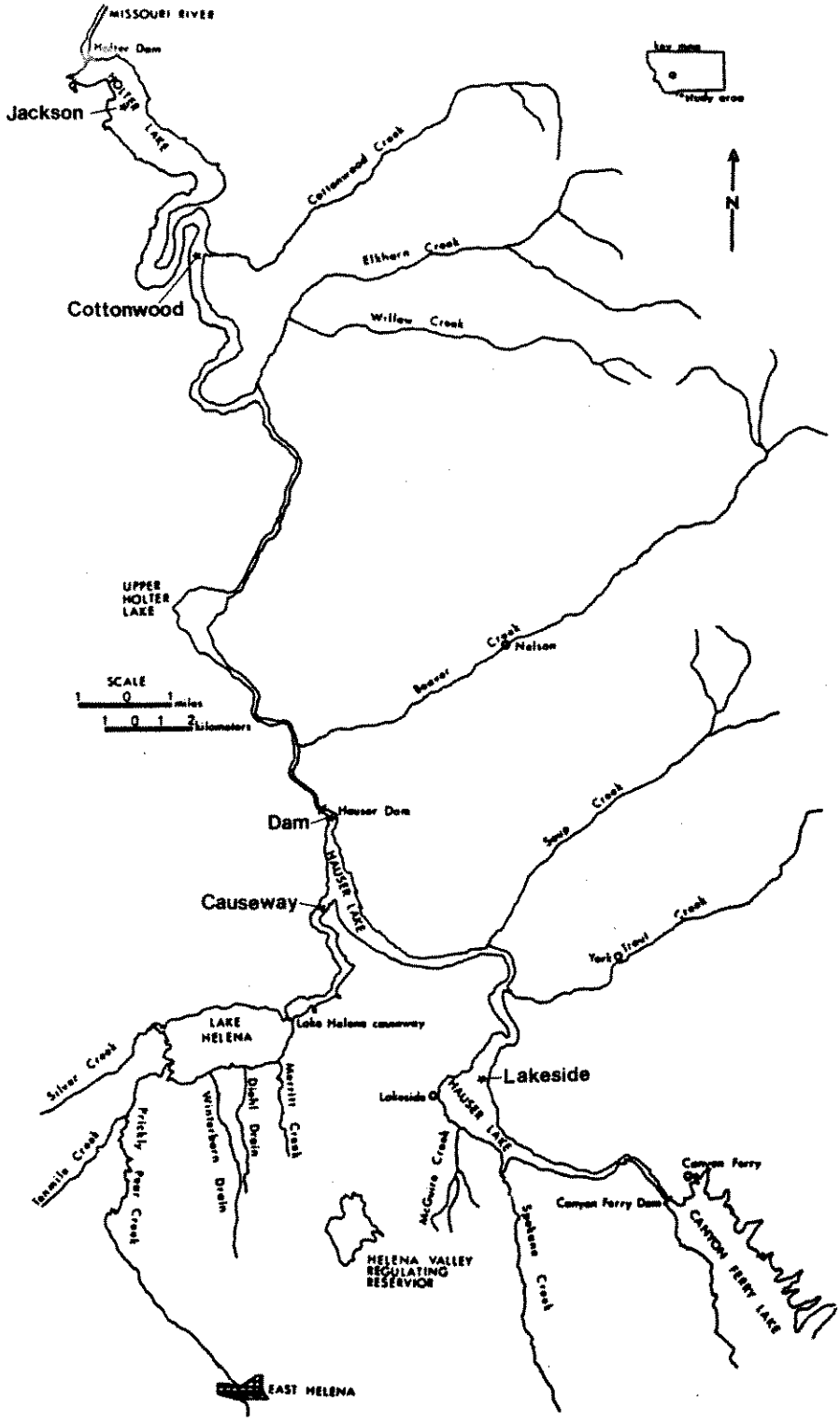

Figure 2. Map of Hauser and Holter reservoirs showing locations of permanent sampling stations. Lakeside, Causeway and Dam stations are on Hauser Reservoir. Cottonwood and Jackson stations are on Holter Reservoir.

RESULTS

CANYON FERRY RESERVOIR

Physical Limnology and Zooplankton

Water temperature, water transparency and zooplankton densities were monitored at permanent sampling stations on a monthly or a biweekly basis during the ice free period from mid-March through mid-November in 1991. Collected data have been analyzed and summaries will be presented in a future report. Additionally, limnological parameters and zooplankton densities were monitored during the ice cover period in January and February of 1991. During the ice cover period, surface water temperature (to 15 feet) averaged 33.0 F at all three sampling stations. Water temperatures warmed slightly as measurements descended deeper in the water column, reaching 36.0 F at upper (Silos) and middle (White Earth) stations and 39.0 F at the lower (Cemetery) station.

Secchi disk readings during the ice cover period averaged 11.8, 10.3 and 15.0 feet, respectively, in upper, mid and lower stations of the reservoirs. Secchi reading obtained during January and February were similar to readings obtained during the ice free period.

Total zooplankton densities measured during January and February averaged 4.81, 4.17 and 4.07 organisms per liter, respectively, in upper, mid and lower stations of the reservoir. As one would expect, zooplankters were much less abundant during the winter than during the ice free period (21 to 26 organisms per liter). During January and February, Cyclops was the most numerous genera, followed by Daphnia, Bosmina, Diaptomus and Leptodora (Table 1).

Table 1. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in monthly vertical tows from three stations in Canyon Ferry Reservoir during January and February (ice cover) in 1991.

	NUMBER PER LITER				#/M³
MONTH	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
JAN.	1.71 (1.0-3.0)	0.86 (0.8-0.9)	1.28 (0.8-1.6)	0.67 (0.2-1.2)	0.33 (0-1.0)
FEB.	0.97 (0.7-1.2)	0.49 (0.3-0.6)	1.86 (1.6-2.1)	0.87 (0.8-1.0)	0 (0)

Fish Abundance and Distribution

Horizontal gill nets

Relative abundance of fish captured in floating gill nets since 1986 are presented in Appendix Table 1. Rainbow trout continue to dominate the composition of the catch in floating gill nets, followed by white suckers in the spring and utah chub in the fall. Mean catch rates (fish per net night) for rainbow trout collected in floating gill nets during the spring and fall are shown in Figure 3. Gill net catches for rainbow trout reached a 6 year low in the spring of 1991, averaging 3.0 fish per net. During the fall of 1991, the rainbow population in the reservoir exhibited a moderate rebound, averaging 6.7 fish per net. Rainbow trout collected in floating gill nets during 1991 averaged 15.6 inches in total length and 1.57 pounds in weight. Approximately 94% of all rainbow trout collected in gill nets in 1991 were of known hatchery origin.

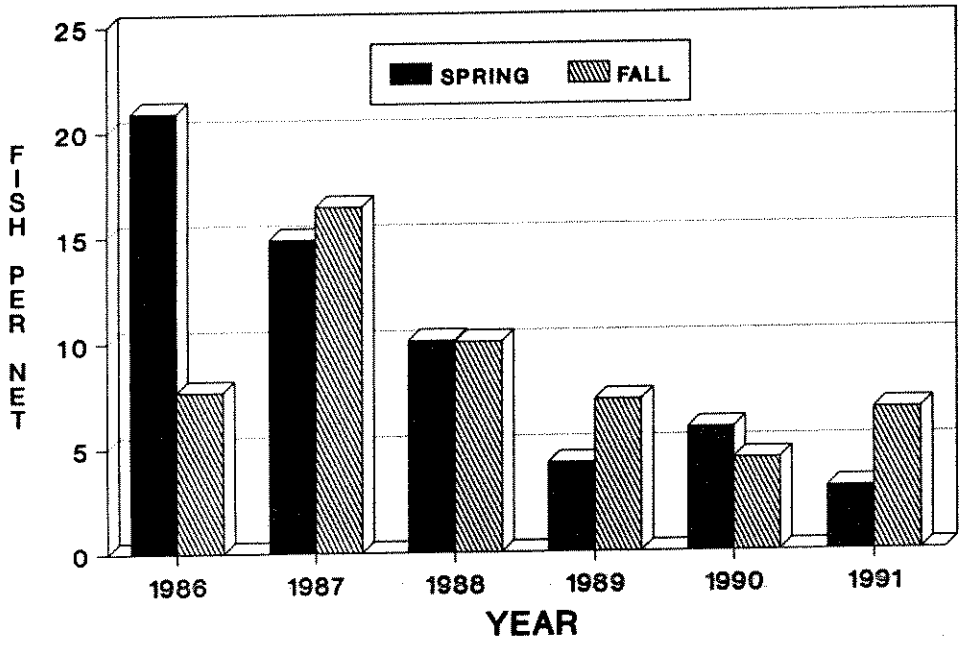

Figure 3. Average catch of rainbow trout per net night by season in floating gill nets set in Canyon Ferry Reservoir from 1986 through 1991. Catch reported in fish per net night.

Declines in the abundance of rainbow trout in the reservoir appear to be closely associated with the varying success of the Department's hatchery plants. This varying success may be due, in part, to differences in the strain of rainbow stocked, the timing of hatchery plants or the hardiness of stocked fish originating from different hatcheries. Since there has been wide variation in the type of strain stocked, in the timing of plants and in the source of fish from the hatchery system, it is difficult to identify specific reasons for some of the poor stocking performance that has occurred in the past six years (Table 2).

Table 2. Rainbow stocking records for Canyon Ferry Reservoir from 1986 through 1991.

YEAR	STRAIN	NUMBER	PLANTING DATE	HATCHERY
1986	0+ Arlee	985,449	May thru June	Bluewater/Lewistown
	I+ Desmet	62,100	May	Gt. Falls
1987	0+ Arlee	724,686	May thru June	Blue./Lewis./Gt.Falls
	0+ E.Lake	251,303	July	Lewistown
1988	0+ Arlee	766,045	May	Blue./Lewis./Gt.Falls
	0+ E.Lake	121,587	August	Bluewater
	0+ Desmet	135,513	Late August	Bluewater
1989	0+ Arlee	852,158	May	Blue./Lewis./Gt.Falls
	0+ E.Lake	130,000	September	Creston
1990	0+ E.Lake	474,623	June & Sept.	Bluewater/Creston
	I+ Desmet	196,431	April thru May	Bluewater/Lewistown
1991	I+ Desmet	442,234	April thru May	Blue./Lewis./Gt.Falls

There are two factors associated with past variations in stocking success (type of strain and timing of stocking) that the Department is capable of regulating in the hatchery system. In an attempt to improve the rainbow fishery in the reservoir, adjustments to the stocking program were made in 1990 and 1991. First, the strain of rainbow trout stocked into Canyon Ferry was changed in 1990 from predominantly stocking the "domestic" Arlee to stocking "wild" Desmet and Eagle Lake rainbow. Longer lived "wild" strains should improve the fishery because a greater number of age classes will be present in the reservoir. A less than successful plant of trout for whatever reason will have less impact on the population because more age groups will be present to dampen the loss of the unsuccessful hatchery plant. In addition, the "wild" strains have the ability to reproduce naturally, potentially recruiting additional fish to the population.

Secondly, an attempt is being made to stocked a majority of

hatchery rainbow into the reservoir during May and June. Past observations have indicated that hatchery fish stocked into Canyon Ferry in late summer or fall exhibit very poor survival. As a result of these observations, the plant of young of the year Eagle Lake rainbow scheduled for the fall of 1991 was delayed until the spring of 1992 (stocked as over-winter yearlings) in an attempt to increase their chance of survival in the reservoir. A more thorough discussion of strain evaluation is discussed later in this report.

Relative abundance of fish captured in sinking gill nets since 1986 are presented in Appendix Table 2. In 1991, yellow perch dominated the catch in sinking gill nets, followed by white suckers, burbot, brown trout and carp. The abundance of burbot in the reservoir, although relatively low, appeared to increase between 1988 and 1991. The number of yellow perch collected in sinking gill nets was similar between 1990 and 1991. A walleye, measuring 13.4 inches in total length was captured in a sinking gill net set near Hellgate Bay. The number of walleye in Canyon Ferry Reservoir appears to be increasing, likely as a result of illegal introduction by misguided anglers.

Beach seining

Griswold and Bjornn (1989) found that seine hauls along the shoreline were effective for catching young of the year and yearling yellow perch in Cascade Reservoir, Idaho and that age composition of the perch population was apparently dependent on the strength of individual year classes. They recommended utilizing beach seine hauls for establishing an index of abundance for yellow perch in Cascade Reservoir. In an attempt to develop an index of abundance for yellow perch in Canyon Ferry, a series of permanent beach seining stations have been established in upper, mid and lower portions of the reservoir. Table 3 presents results of seining efforts conducted on Canyon Ferry. Data obtained during 1987 and 1990 are included in Table 3 although permanent sampling stations were not established until 1991. The average catch per seine haul indicated about a four fold increase in the number of young of the year perch between 1990 and 1991. Future efforts will attempt to relate seine haul data with gill net and creel census data. Interestingly, young of the year perch during August tended to be larger in the upper reservoir than in the lower reservoir. Reasons for these size differences remain unknown.

Age and Growth of Yellow Perch

Age and growth of yellow perch in Canyon Ferry were estimated by analyzing cross sections of anal spines taken from fish collected in fall gill nets and from fish caught by anglers during early January. Analysis of this data should be considered preliminary because back-calculated lengths at age have not been completed and because the sample size is relatively small. Age analysis for 72

yellow perch ranging from Age 2+ to Age 9+ are presented in Table 4. Samples collected from fall gill netting (late October) were advanced to the next annulus to correspond with other samples. Length at age for yellow perch in 1991 was similar to data obtained in 1968 for fish less than five years of age (Bandow 1969). Bandow reported that he had difficulty accurately aging fish older than four years using scale analysis. Inaccurate aging of older fish using scale analysis may, in part, explain some of the differences between the 1991 and 1968 data for older aged fish. Spine cross-sections proved to be very useful for aging older fish and appear to be a more accurate than scale analysis.

Table 3. Catch per haul of young of the year and yearling yellow perch utilizing a beach seine (4 X 100 foot, 0.25 inch mesh) towed along the shoreline of Canyon Ferry Reservoir during August.

YEAR	LOCATION	# OF HAULS		MEAN # PERCH/HAUL		MEAN SIZE AGE 0+ (inches)
		WITH YP	EMPTY	AGE 0+	AGE I+	
1987	Upper	2	0	400.0	0	—
	Lower	3	1	124.8	0	--
	TOTAL	5	1	216.5	0	--
1990	Upper	9	8	224.8	0.8	1.96
	Lower	18	3	548.4	56.6	1.87
	TOTAL	27	11	403.6	31.5	1.89
1991	Upper	10	0	2967.2	1.8	2.26
	Middle	9	1	689.0	12.5	2.19
	Lower	8	2	814.8	2.3	1.98
	TOTAL	27	3	1490.3	5.5	2.20

Table 4. Average length at age and growth increments (inches) for yellow perch collected from Canyon Ferry Reservoir during October, 1991 and January, 1992. Fall samples were advanced to the next annulus to correspond with other samples. 1968 data from Bandow (1969). 1958 data from Heaton (1959).

Year		AGE 1	2	3	4	5	6	7	8	9
1991	Mean length	--	5.5	6.9	7.8	9.9	9.9	10.7	10.6	10.6
	Sample size	0	3	17	12	2	6	28	3	1
1968	Mean length	3.4	5.8	6.8	7.6	8.1	9.2	9.8	--	--
	Sample size	45	151	87	129	65	13	10	0	0
1958	Mean length	--	4.8	6.7	8.4	9.9	12.4	--	--	--
	Sample size	0	21	28	32	4	3	0	0	0

Summer Creel Census

Interview distribution, party size and angler day

A total of 1,904 anglers were interviewed on Canyon Ferry Reservoir during the summer period (April through November) in 1991. Distribution of interviews, mean hours per fishing trip and mean number of anglers per fishing party are presented in Table 5.

Table 5. Distribution of interviews by day of week and by method of fishing with mean hours per completed fishing trip and mean party size obtained on Canyon Ferry Reservoir during the summers of 1986 through 1991.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
	WEEKDAY	WEEKEND	SHORE	BOAT		
1986	43	57	63	37	3.64	2.46
1987	51	49	78	22	3.40	2.12
1988	48	52	61	39	3.77	2.15
1989	42	58	73	28	3.65	2.07
1990	39	61	63	37	3.45	2.00
1991	39	61	75	25	2.87	1.98
OVERALL	44	56	69	31	3.46	2.13

Composition of catch and catch rates

Table 6 presents the composition of the catch by anglers during the summer fishery in 1991. As in previous years, yellow perch and rainbow trout dominated the catch made by anglers. However, the number of rainbow trout observed in the summer creel in 1991 was the fewest over a six year period of record, reflecting a decline in rainbow trout abundance in the reservoir.

Table 6. Composition of the catch made by anglers on Canyon Ferry Reservoir during the summers of 1986 through 1991.

YEAR	NUMBER CAUGHT	% COMPOSITION OF CATCH			
		RAINBOW TROUT	BROWN TROUT	YELLOW PERCH	MOUNTAIN WHITEFISH
1986	3,146	42.6	2.0	55.4	<0.1
1987	5,815	22.9	0.4	76.7	<0.1
1988	5,477	38.3	0.6	61.1	<0.1
1989	1,323	53.0	1.8	45.1	<0.1
1990	1,310	79.9	2.9	17.2	0
1991	1,119	41.2	1.6	57.1	0

Annual summer catch rates for rainbow trout and yellow perch (fish per angler hour) are presented in Table 7. Catch rates for rainbow trout continued to decline in 1991. This continued decline may be due, in part, to stocking fewer fish into the reservoir in 1990 and 1991 and to stocking more than half the 1990 plant in September. Fall plants of rainbow trout have exhibited poor survival in the past. Fewer fish were stocked into the reservoir in 1990 and 1991 because the hatchery system required time to adjust to raising "wild" strains of trout in place of the "domestic" Arlee rainbow. In addition, fewer fish than originally scheduled were stocked into the reservoir in 1991 in attempt to avoid planting fish after July. Eagle Lake rainbow raised at the Creston National Fish Hatchery were held over in 1991 to avoid the associated poor survival of a fall plant. These held over yearlings were stocked into Canyon Ferry during the spring of 1992. The future hatchery program for Canyon Ferry Reservoir calls for annually stocking a minimum of 1.5 million "wild" strain rainbow trout into the reservoir. An attempt will be made to stock all fish prior to June 30.

Table 7. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986 through 1991 on Canyon Ferry Reservoir.

	RAINBOW TROUT				YELLOW PERCH			
	FISH/HOUR			%	FISH/HOUR			%
YEAR	SHORE	BOAT	TOTAL	KEPT	SHORE	BOAT	TOTAL	KEPT
1986	0.21	0.38	0.28	83.3	0.48	0.19	0.37	92.5
1987	0.17	0.29	0.20	92.9	0.79	0.36	0.68	72.9
1988	0.20	0.26	0.23	93.5	0.50	0.16	0.36	83.1
1989	0.14	0.20	0.16	92.7	0.15	0.11	0.14	82.2
1990	0.13	0.15	0.14	92.4	0.03	0.03	0.03	60.4
1991	0.11	0.10	0.11	93.1	0.20	0.02	0.15	42.6
OVERALL	0.17	0.26	0.20	91.0	0.39	0.17	0.32	78.2

Characteristics of harvested gamefish

The average length, weight and condition factor for rainbow trout harvested from Canyon Ferry Reservoir during the 1991 summer census are presented in Table 8. Approximately 98% of all rainbow trout harvested in 1991 and examined for marks were of known hatchery origin. The Arlee strain dominated the harvest (42.4%), followed by Eagle Lake (30.9%) and Desmet (16.5%). The remainder of the harvest (11.2%) was comprised of hatchery fish of unknown origin, fish that could not be identified as either hatchery or wild, and wild fish. A more thorough discussion of strain evaluation is presented later in this report.

Table 8. Mean length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the summers of 1986 through 1991. Ranges are in parentheses.

YEAR	MEAN LENGTH (INCHES)	MEAN WEIGHT (POUNDS)	MEAN CONDITION FACTOR
1986	14.9 (7.3-24.4)	1.40 (0.13-4.80)	39.5
1987	16.4 (6.5-23.0)	1.92 (0.12-5.75)	40.9
1988	17.2 (9.4-24.1)	2.20 (0.46-5.25)	41.4
1989	17.9 (9.1-22.8)	2.18 (0.36-3.88)	37.1
1990	18.5 (12.3-23.2)	2.57 (0.78-5.00)	38.9
1991	19.0 (11.6-22.6)	2.57 (0.55-4.35)	35.9

Winter Creel Census

Composition of catch and catch rates

Yellow perch dominated the composition of the catch during the 1991/92 winter ice fishery, followed by rainbow trout, burbot and brown trout (Table 9). The number of burbot harvested by anglers during the winter, although relatively few, has increased steadily since the winter of 1988/89. The reasons for the recent expansion of the burbot population in Canyon Ferry Reservoir remain unknown.

Table 9. Composition of the catch made by anglers on Canyon Ferry Reservoir during the winter ice fishery from 1986/87 through 1991/1992.

		% COMPOSITION OF CATCH				
YEAR	NUMBER CAUGHT	RAINBOW TROUT	BROWN TROUT	YELLOW PERCH	MOUNTAIN WHITEFISH	BURBOT
1986/87	9,525	8.9	<0.1	90.9	<0.1	0
1987/88	8,850	11.4	0.2	88.3	<0.1	<0.1
1988/89	2,156	8.9	<0.1	91.0	<0.1	0
1989/90	2,586	11.1	0.4	88.1	0	0.4
1990/91	2,657	7.5	0.1	91.4	<0.1	0.9
1991/92	2,004	7.6	0.4	90.0	<0.1	1.9

Annual winter catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 10. Catch rates for both

rainbow trout and yellow perch continued to decline in the winter of 1991/92. Likely reasons for the decline in the rainbow fishery have been discussed previously. Reasons for the decline in the yellow perch fishery remain unknown. Beach seining data indicated an apparently strong year class in 1991. It remains to be seen if this apparent strong year class will translate into better fishing since it will take 3 to 4 years for these fish to reach catchable size.

Table 10. Average catch rates (fish per angler hour) and percent harvested for rainbow trout and yellow perch obtained during the winters of 1985/86 - 1991/92 on Canyon Ferry Reservoir.

YEAR	RAINBOW TROUT/HOUR	%KEPT	YELLOW PERCH/HOUR	%KEPT
1985/86	0.11	95.5	3.68	92.6
1986/87	0.25	98.0	2.29	98.3
1987/88	0.26	96.6	1.74	90.3
1988/89	0.19	99.0	1.94	92.5
1989/90	0.12	95.1	0.92	99.8
1990/91	0.08	100.0	0.95	97.7
1991/92	0.06	99.3	0.66	98.6
OVERALL	0.15	97.6	1.74	95.7

Characteristics of harvested gamefish

Rainbow trout harvested during the 1991/92 winter creel averaged 17.9 inches in total length and 2.12 pounds in weight. Although fewer rainbow trout can be identified by strain during the winter because vertebrae are not collected for examination of tetracycline marks, 81% of the rainbow trout examined during the winter creel were of known hatchery origin. Reflecting changes in the stocking program begun in 1990, Desmet rainbow dominated the winter harvest in 1991/92 (42.9%), followed by Arlee (20.4%) and Eagle Lake rainbow (17.7%).

Yellow perch harvested during the 1991/92 winter creel averaged 10.0 inches in total length and 0.51 pounds in weight. Yellow perch harvested in 1991/92 were slightly smaller than perch harvested in the winter of 1990/91 (10.2 inches).

Toston Section of the Missouri River

Interview distribution, party size and angler day

A total of 271 anglers were interviewed on the Toston section of Missouri River during the fall (late September through late November) of 1991. Distribution of interviews, mean hours per

fishing trip and mean number of anglers per fishing party are presented in Table 11.

Table 11. Distribution of interviews by day of week and by method of fishing with mean hours per completed fishing trip and mean party size obtained on the Toston section of the Missouri River during the fall of 1985, 1986 and 1991.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
	WEEKDAY	WEEKEND	SHORE	BOAT		
1985	33	67	99	1	3.6	1.98
1986	38	62	98	2	3.7	2.15
1991	40	60	93	7	3.3	1.68

Characteristics of anglers

About one third of anglers interviewed on the Toston section in 1991 were from out of state, representing a two fold increase since 1985 (Table 12). Residents from Gallatin and Silver Bow counties comprised a majority of in-state anglers interviewed. Nearly all anglers fishing this section of river in 1991 were simply seeking to catch any form of trout (99%). Less than 1% of all anglers interviewed were fishing specifically for brown trout. About 74% of the interviews were conducted between Toston Dam and Big Spring. Bait was the most popular method of fishing in 1991 (50%), followed by lures (33%), flies (13%) and a combination of tackle (4%).

Table 12. Residency of anglers fishing on the Toston section of the Missouri River during the fall of 1985, 1986 and 1991.

YEAR	PERCENT OF TOTAL INTERVIEWS						
	LEWIS& CLARK	GALLATIN	SILVER BOW	BROAD-WATER	OTHER MT (EAST)	OTHER MT (WEST)	OUT OF STATE
1985	6.7	31.1	21.6	6.7	10.2	7.7	16.0
1986	6.1	24.9	18.2	7.1	12.7	11.0	20.0
1991	5.9	29.5	13.7	7.0	4.8	8.8	30.3

Fishing pressure

Monthly summaries of estimated fishing pressure obtained during the fall, 1991 are presented in Table 13. Shore anglers comprised about 87% of the fishing pressure during the period of survey. Fall fishing pressure on the Toston section was substantially less during the 1991 than during 1985 or 1986. The decline in fishing pressure in 1991 was likely due, in part, to recent poor fishing success on this section of river and to the inclement weather conditions experienced during the fall. Several cold fronts moved

through the area in 1991 during the survey period creating early snows and cold temperatures.

Table 13. Monthly summaries of estimated fishing pressure (angler-hours) for the Toston section of the Missouri River obtained during 1985, 1986 and 1991.

	1985			1986			1991		
MONTH	SHORE	BOAT	TOTAL	SHORE	BOAT	TOTAL	SHORE	BOAT	TOTAL
SEPT.	250	25	275	942	215	1157	369	45	414
OCT.	2459	357	2816	2591	314	2905	933	187	1120
NOV.	684	86	770	564	29	593	267	8	275
TOTAL	3393	468	3861	4097	558	4655	1569	240	1809

Catch rates and estimated harvest

Catch rates for rainbow trout, brown trout and mountain whitefish are presented in Table 14. Angler catch rates for rainbow trout remained similar over the three years of survey. However, catch rates for rainbow trout in the Toston section are less than catch rates observed below Hauser and Holter dams. Habitat in the Toston section, as a result of high water temperatures and poor spawning areas likely limit the rainbow trout population.

Catch rates for brown trout, in contrast, were about 4 times lower in 1991 than in 1985 and 1986, reflecting a decline in population abundance. Several reasons may be contributing to the decline of the brown trout population in the Toston section. First, the upper Missouri Basin has been experiencing a trend of below normal precipitation since 1985, resulting in low base flows and reduced spring runoff. Below normal stream flows likely reduce the drift of juvenile brown trout from upstream sources, elevate water temperatures to near lethal levels, and lessen the quantity of spawning and rearing habitat in the river. Secondly, unstable river flows due to difficulties in operating the automated flow releases from Toston Dam are likely adversely affecting brown trout spawning and rearing habitat.

Monthly harvest estimates for rainbow trout and brown trout are presented in Table 15. The harvest of rainbow trout for 1991 was about one half the rainbow harvest obtained in 1985 and 1986. The lower harvest of rainbow trout in 1991 was due, in part, to lighter fishing pressure. The estimated number of brown trout harvested in 1991 was about one tenth the brown trout harvest obtained in 1985 and 1986. The low brown trout harvest in 1991 was due to both lighter fishing pressure and poorer fishing success.

Table 14. Monthly summary of catch rates (fish per angler hour) for rainbow trout, brown trout and mountain whitefish obtained on the Toston section of the Missouri River during 1985, 1986 and 1991.

	ANGLER CATCH RATES (FISH PER HOUR)								
	RAINBOW TROUT			BROWN TROUT			MTN. WHITEFISH		
MONTH	1985	1986	1991	1985	1986	1991	1985	1986	1991
SEPT.	0.13	0.11	0.15	0.26	0.21	0.12	0.03	0.22	0
OCT.	0.16	0.10	0.18	0.35	0.29	0.06	0.05	0.08	0.02
NOV.	0.11	0.04	0.11	0.22	0.35	0.06	0.07	0.10	0.01
TOTAL	0.14	0.09	0.16	0.31	0.28	0.07	0.05	0.11	0.02
%KEPT	77	58	57	65	48	50	3	14	9

Table 15. Monthly summary of estimated harvest for rainbow trout and brown trout obtained on the Toston section of the Missouri River during 1985, 1986, and 1991.

	ESTIMATED HARVEST					
	RAINBOW TROUT			BROWN TROUT		
MONTH	1985	1986	1991	1985	1986	1991
SEPT.	13	72	45	38	111	29
OCT.	268	183	96	518	435	29
NOV.	112	20	20	179	79	8
TOTAL	393	275	161	735	625	66

Characteristics of harvested fish

The average length, weight, and condition factors for rainbow trout and brown trout harvested from the Toston section of the Missouri River during the fall, 1991 are presented in Table 16. Harvested rainbow trout averaged 16.0 inches in total length and 1.53 pounds in weight. Only two of 53 rainbow trout (4%) checked for marks were identified as hatchery fish. Both of these fish were Eagle Lake rainbow. Brown trout harvested in 1991 averaged 18.9 inches in total length and 2.07 pounds in weight. Mean condition factors for both rainbow trout and brown trout harvested in 1991 were less than those obtained in 1985 or 1986. Reasons for the poorer condition of trout harvested in 1991 are unknown.

Table 16. Mean length, weight and condition factors for rainbow trout and brown trout harvested from the Toston section of the Missouri River during the fall of 1985, 1986 and 1991. Length is in inches and weight is in pounds. Ranges are in parentheses.

	RAINBOW TROUT			BROWN TROUT		
YEAR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR
1985	17.5 (11.5-21.5)	1.98 (0.56-2.89)	36.1	17.7 (9.7-27.5)	2.15 (0.51-7.75)	34.6
1986	15.9 (10.7-20.2)	1.54 (0.48-3.28)	37.8	17.0 (8.4-24.1)	1.88 (0.20-5.33)	35.0
1991	16.0 (11.3-22.3)	1.53 (0.60-3.30)	31.9	18.9 (14.2-23.2)	2.07 (0.80-3.62)	29.8

HAUSER RESERVOIR

Physical Limnology and Zooplankton

Water temperature, water transparency and zooplankton densities were monitored at permanent sampling stations on a monthly or a biweekly basis during the ice free period from mid-March through mid-November in 1991. Collected data have been analyzed and summaries will be presented in a future report. Limnological parameters and zooplankton densities also were monitored during the ice cover period in January and February of 1991. During the ice cover period, surface water temperature (to 15 feet) averaged 35.7 F at the upper (Lakeside) station and about 34.5 F at the middle (Causeway) and lower (Dam) stations. Water temperatures warmed slightly as measurements descended deeper in the water column, reaching 37.0 F at all three stations.

Secchi disk readings during the ice cover period averaged 13.0, 10.3 and 11.3 feet, respectively, in upper, mid and lower stations of the reservoirs. Secchi reading obtained during January and February were slightly greater than readings obtained during the ice free period.

Total zooplankton densities measured during January and February averaged 2.36, 5.67 and 3.99 organisms per liter, respectively, in upper, mid and lower stations of the reservoir. Zooplankters were much less abundant during the winter than during the ice free period (17 to 29 organisms per liter). During January and February, Cyclops was the most numerous genera, followed by Diaptomus and Daphnia in January and Bosmina and Daphnia in February (Table 17)

Table 17. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in monthly vertical tows from three stations in Hauser Reservoir during January and February (ice cover) in 1991.

	NUMBER PER LITER				#/M³
MONTH	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
JAN.	0.56 (0.2-1.0)	0.78 (0.5-1.2)	1.32 (0.9-1.9)	0.34 (0.3-0.4)	0 (-)
FEB.	0.57 (0.5-0.8)	0.44 (0.3-0.6)	2.70 (0.6-5.0)	1.29 (0.5-1.7)	0 (-)

Fish Abundance and Distribution

Horizontal gill nets

Relative abundance of fish captured in floating gill nets since 1986 are presented in Appendix Table 3. With the exception of Utah chub, the composition of the catch from floating gill nets in 1991 was similar to 1990 data. Kokanee dominated the catch during both seasons, followed by rainbow trout in the spring and Utah chub in the fall. The large number of Utah chub caught in fall net sets in 1991 may simply have been an aberration of sampling, not a reflection of a change in population abundance, since there has not been any indication of an increasing trend in the number of Utah chubs in past years.

Mean catch rates (fish per net night) for rainbow trout and kokanee collected in floating gill nets during the spring and fall are shown in Figures 4 and 5. Rainbow trout collected in floating gill nets averaged 13.9 and 11.1 inches in total length during the spring and fall, respectively. Approximately 98% of all rainbow trout collected in gill nets in 1991 were of known hatchery origin. Two Eagle Lake rainbow, originally stocked into Canyon Ferry Reservoir in 1987 and 1988, were collected in gill nets set in Hauser Reservoir.

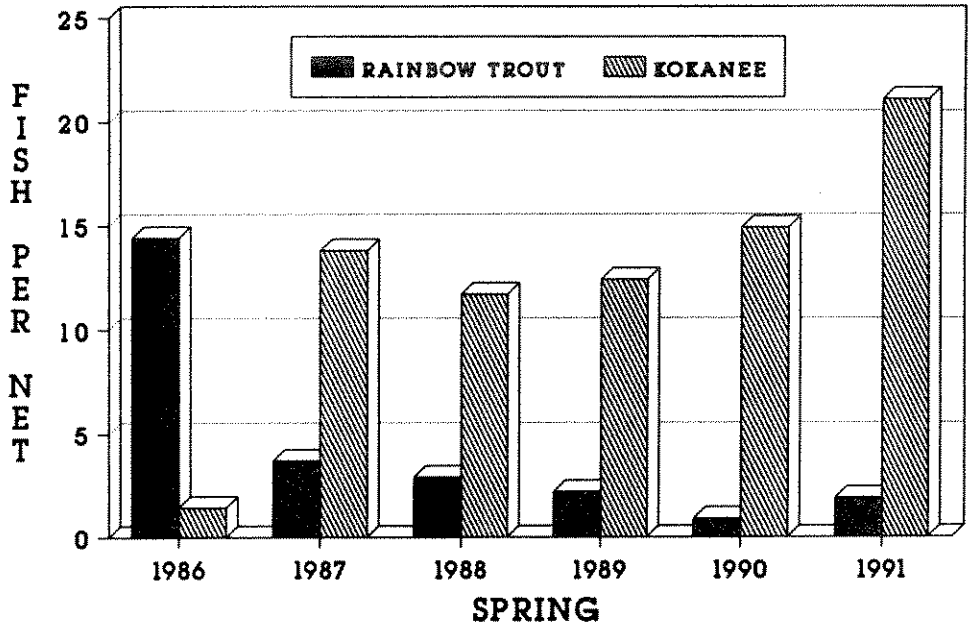

Figure 4. Average catch of rainbow trout and kokanee in floating gill nets set in Hauser Reservoir in the spring from 1986 through 1991. Catch reported in fish per net night.

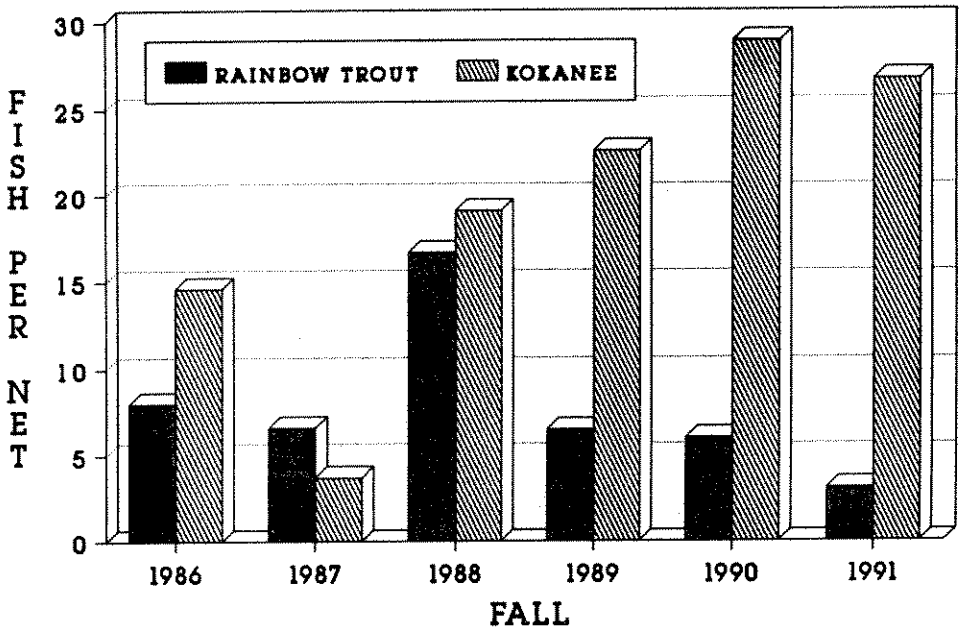

Figure 5. Average catch of rainbow trout and kokanee in floating gill nets set in Hauser Reservoir in the fall from 1986 through 1990. Catch reported in fish per net night.

For kokanee, collected fish averaged 12.1 and 15.3 inches in total length during the two respective seasons. Examination of age data for kokanee collected in horizontal gill nets indicates that strong year classes were produced in 1987 and 1989 (Table 18). This conclusion is based on the large number of Age II+ fish collected in gill nets set in 1989 and 1991, as well as the large number of Age III+ fish collected in 1990.

Table 18. Average catch rates (fish per net night) by age class for kokanee collected in floating horizontal nets set in Hauser Reservoir from 1986 through 1991.

	KOKANEE PER NET NIGHT					
	SPRING			FALL		
YEAR	AGE I+	AGE II+	AGE III+	AGE I+	AGE II+	AGE III+
1986	0	1.2	0.2	4.0	3.4	7.2
1987	0.5	11.0	2.3	1.3	2.0	0.5
1988	0.1	10.2	1.0	2.9	7.0	8.3
1989	0.2	11.6	0.7	0.2	20.2	2.1
1990	0.1	10.5	4.4	3.9	10.6	14.4
1991	0.1	17.6	1.6	3.3	19.3	4.2

Relative abundance of fish captured in sinking gill nets since 1986 are presented in Appendix Table 4. In 1991, white and longnose suckers dominated the catch in sinking gill nets, followed by yellow perch in the spring and kokanee in the fall. The abundance of walleye in the reservoir appears to be increasing as a result of hatchery plants that were begun in 1989. The Hauser Reservoir Management Plan (1989) called for stocking 3,000 to 5,000 fingerlings annually over the first three years of the plan to provide enhanced fishing opportunities at a level that would continue to be compatible with other fish species in the reservoir. Walleye ranging from 13.5 to 18.4 inches in length and of known hatchery origin were collected in gill nets in the fall of 1991. The larger walleye that were collected in sinking gill nets were from the initial stocking made in 1989. The 1989 plant of walleye are now beginning to be caught by anglers on the reservoir. Based on gill net collections made in 1991, the Department should continue to stock walleye into Hauser Reservoir at a similar rate through 1994 to meet the objective called for in the 1989 management plan.

Vertical gill nets

The number of kokanee in collected in vertical nets (number of kokanee collected per net night) averaged 29.0 fish per set in 1991, about half of the number collected in 1990 (Table 19). This decline was primarily a result of a substantial decrease in the number of yearling kokanee collected per net set. Although external factors, such as phase of the moon or variable weather

patterns, may have partially caused some of the discrepancy in yearling abundance between years, it is likely that results from vertical gill netting in 1991 are indicative of a very weak year class produced in 1990. If this index of abundance is truly reliable, few Age II+ kokanee will be available to the angler's creel in 1992, resulting in lower angler catch rates. Data collected in 1992 will be used to test this hypothesis.

Six walleye of known hatchery origin were collected in the series of nets set in September. All of these walleye, ranging from 10.6 to 12.7 inches in length, were stocked into the reservoir in 1990. Apparently, walleye fingerlings stocked into the reservoir are exhibiting good survival.

Table 19. Mean catch rates (fish per net night) by age class for kokanee collected in vertical nets set at the Dam Station in Hauser Reservoir from 1986 through 1991.

YEAR	NUMBER OF SETS	NUMBER OF KOKANEE PER SET				
		AGE 0+	AGE I+	AGE II+	AGE III+	TOTAL
1986	3	0	21.7	6.3	0	28.0
1987	4	0	32.3	7.5	0.2	40.0
1988	5	0.4	100.6	4.8	3.0	108.8
1989	6	0	36.7	44.0	0.6	81.3
1990	7	0.1	35.7	22.5	3.4	61.7
1991	5	0	4.2	24.4	0.4	29.0

A comparison of growth rates among six consecutive year classes of kokanee is shown in Figure 6. Growth rates for kokanee in Hauser Reservoir have not changed substantially over the six year period of survey. Apparently, the kokanee population in Hauser Reservoir has not yet expanded to a level that adversely impacts food supply.

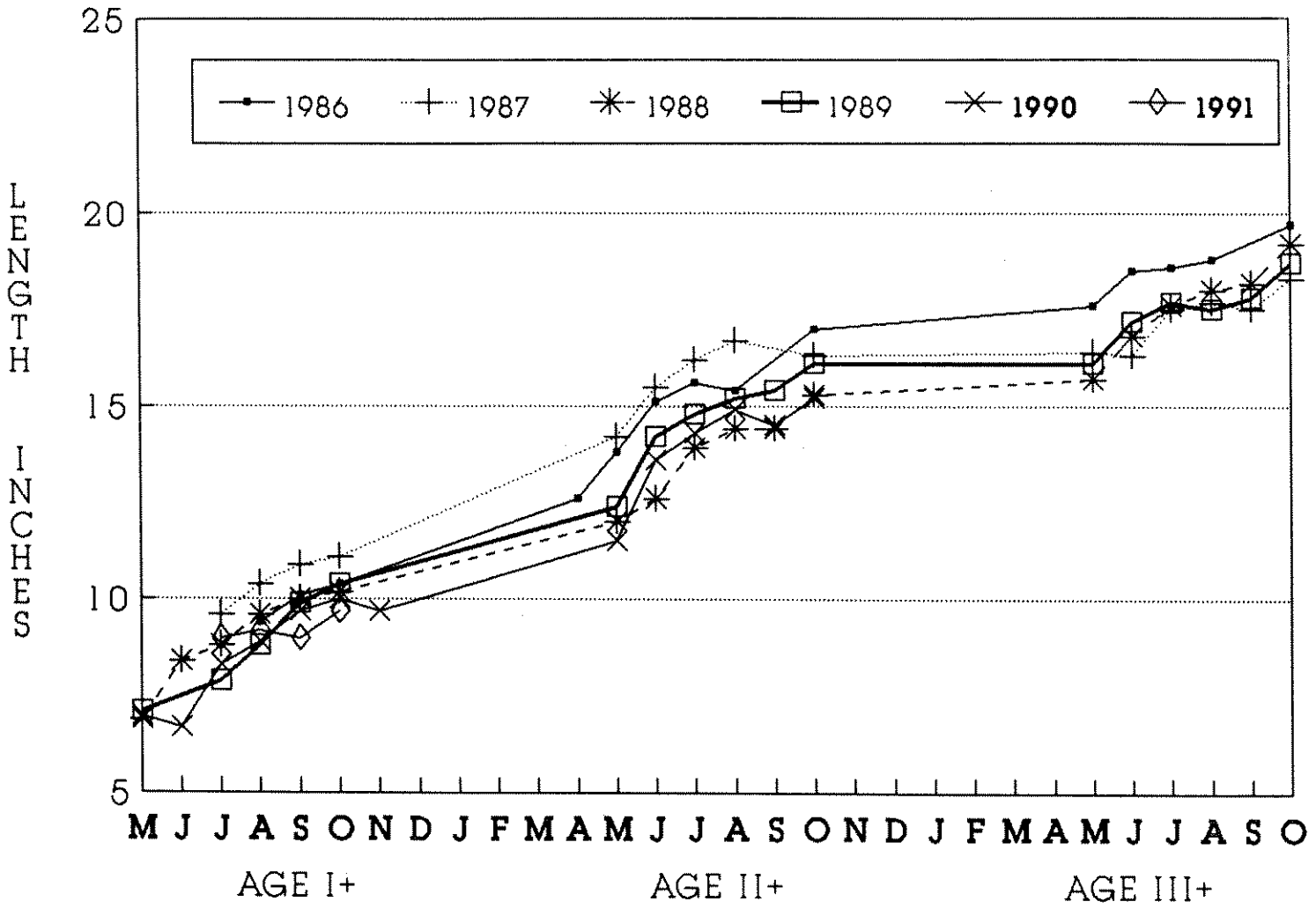

Figure 6. A comparison of empirical growth curves for six year classes of kokanee in Hauser Reservoir.

Beach seining

Table 20 presents results of beach seining efforts on Hauser Reservoir. Data obtained in 1987 and 1990 are included in Table 20 although permanent sampling stations were not established until 1991. The number of young of the year perch collected from seine hauls in 1991 was less than for the previous two years. In addition, the abundance of young of the year perch in Hauser was substantially less than in Canyon Ferry Reservoir.
Flushing losses probably account for the limited number of young of the year perch found in the reservoir. Flushing losses of yellow perch fry from Hauser Reservoir are thought to be substantial due to the reservoirs very short retention time (every 6 to 9 days). In addition, the greater number of juvenile perch collected in the Causeway Arm in 1991 is likely due, in part, to a longer retention time occurring in this isolated arm of the reservoir. Young of the year perch collected in the Causeway Arm were larger than those collected in the main body of the reservoir. Growth rates would be expected to be greater in the Causeway Arm because of the warmer water temperatures and more abundant zooplankton populations found there.

Table 20. Catch per haul of young of the year and yearling yellow perch utilizing a beach seine (4 X 100 foot, 0.25 inch mesh) towed along the shoreline of Hauser Reservoir during August.

YEAR	LOCATION	# OF HAULS		MEAN # PERCH/HAUL		MEAN SIZE AGE 0+ (inches)
		WITH YP	EMPTY	AGE 0+	AGE I+	
1987	TOTAL	4	4	116.0	0	2.49
1990	TOTAL	6	3	265.6	29.9	1.68
1991	Main Body	6	4	10.0	0.8	1.92
	Causeway	9	1	61.1	7.5	2.10
	TOTAL	15	5	35.6	4.2	2.07

Summer Creel Census

Interview distribution, party size and angler day

A total of 3,341 anglers were interviewed on Hauser Reservoir during the summer period (April through November) in 1991. Distribution of interviews, mean hours per fishing trip and mean number of anglers per fishing party are presented in Table 21.

Table 21. Distribution of interviews by day of week and by method of fishing with mean hours per completed fishing trip and mean party size obtained on Hauser Reservoir during the summers of 1986 through 1991.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
	WEEKDAY	WEEKEND	SHORE	BOAT		
1986	38	62	58	42	3.96	2.98
1987	49	51	60	40	3.93	1.87
1988	48	52	48	52	4.18	1.93
1989	61	39	54	46	4.07	1.90
1990	48	52	55	45	4.03	1.85
1991	37	63	25	75	4.63	2.07
OVERALL	47	53	50	50	4.13	2.10

Composition of the catch and catch rates

Table 22 presents the composition of the catch made by anglers during the summer fishery in 1991. Kokanee dominated the catch by anglers in 1991, reflecting their popularity among anglers and their great abundance in the reservoir. The number of rainbow trout in the creel, in contrast, was the fewest recorded over the six year period of survey. A few largemouth bass and one walleye were also observed in the creel in 1991. Again, recent plants of these two species are beginning to provide some new fishing opportunities in the reservoir.

Table 22. Composition of the catch by anglers on Hauser Reservoir during the summers of 1986 through 1991.

YEAR	NUMBER CAUGHT	% COMPOSITION OF CATCH					
		RAINBOW TROUT	BROWN TROUT	KOKANEE	YELLOW PERCH	MOUNTAIN WHITEFISH	S.MOUTH BASS
1986	2,728	49.9	1.4	26.7	21.6	0.3	0.2
1987	3,912	47.6	0.4	30.4	20.3	1.2	0.1
1988	3,882	45.3	0.3	43.6	10.6	0.2	0
1989	3,247	18.1	0.3	65.8	15.5	0.4	0
1990	3,870	21.2	0.5	44.2	33.8	0.2	0
1991	6,935	4.3	0.2	81.5	13.7	0.3	<0.1

Summer catch rates (fish per angler hour) for rainbow trout and kokanee are presented in Table 23. Catch rates for rainbow trout continued to decrease in 1991, reflecting a further decline in population abundance. In response to the continued expansion of the kokanee population in the reservoir, the Department reduced the annual stocking rate for rainbow trout from 200,000 to 125,000 fingerlings in 1990 and to 100,000 fingerlings in 1991. It is

assumed that kokanee are out competing rainbow trout for food and space in the reservoir. Angler catch rates for kokanee in 1991 were the highest recorded over the six year period of survey.

Table 23. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and kokanee during the summers of 1986 through 1991 on Hauser Reservoir.

	RAINBOW TROUT				KOKANEE			
	FISH/HOUR			%	FISH/HOUR			%
YEAR	SHORE	BOAT	TOTAL	KEPT	SHORE	BOAT	TOTAL	KEPT
1986	0.25	0.26	0.25	88.7	0.01	0.18	0.10	98.6
1987	0.31	0.18	0.24	80.4	0.02	0.24	0.13	92.6
1988	0.38	0.09	0.24	74.8	<0.01	0.38	0.24	93.3
1989	0.21	0.06	0.12	66.2	0.08	0.63	0.42	89.0
1990	0.19	0.05	0.10	89.8	0.02	0.35	0.22	94.0
1991	0.12	0.01	0.02	84.5	0.07	0.53	0.46	94.6
OVERALL	0.24	0.11	0.16	80.7	0.03	0.39	0.26	93.7

Characteristics of harvested gamefish

The average length, weight and condition factor for rainbow trout and kokanee harvested from Hauser Reservoir during 1991 are presented in Table 24. Approximately 91% of all rainbow trout harvested in 1991 and examined for marks were of known hatchery origin.

Table 24. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the summers of 1986 through 1991. Length is in inches and weight in pounds. Ranges are in parentheses.

	RAINBOW TROUT			KOKANEE		
YEAR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR
1986	13.5 (7.0-20.1)	1.06 (0.14-4.06)	40.1	16.6 (8.5-22.2)	1.87 (0.20-3.94)	39.0
1987	14.2 (7.6-23.0)	1.26 (0.15-4.07)	41.2	15.6 (8.6-21.4)	1.52 (0.32-3.31)	38.2
1988	15.8 (7.9-23.9)	1.73 (0.22-6.00)	40.9	16.3 (8.2-21.8)	1.71 (0.28-3.24)	37.9
1989	13.7 (8.3-22.4)	1.17 (0.22-4.90)	39.1	14.6 (9.2-21.1)	1.13 (0.28-3.10)	35.4
1990	14.9 (7.0-23.5)	1.60 (0.30-4.95)	41.4	15.7 (8.6-23.4)	1.57 (0.26-3.97)	38.5
1991	15.3 (7.4-23.4)	1.74 (0.18-4.90)	41.0	14.7 (8.7-21.2)	1.25 (0.28-3.44)	38.3

The age distribution for kokanee harvested from Hauser Reservoir during 1991 is presented in Table 25. As in previous years, Age II+ kokanee dominated the harvest in 1991. Similar to horizontal gill net data, the summer creel data indicate that strong year classes of kokanee were produced in 1987 and 1989. Based on the large number of Age II+ fish harvested in 1991, there is a good probability that this age class will carry over to 1992, providing for more Age III+ fish to the 1992 harvest. Data gathered in 1992 will be used to test this hypothesis.

Table 25. Age distribution of kokanee harvested from Hauser Reservoir during the summers of 1986 through 1991.

YEAR	# OF FISH	PERCENT COMPOSITION			
		AGE I+	AGE II+	AGE III+	AGE IV+
1986	367	1.6	95.4	3.0	0
1987	582	2.9	88.3	8.8	0
1988	1,184	1.1	81.8	16.8	0.3
1989	1,106	0.5	92.2	7.2	0.1
1990	1,156	0.8	58.7	40.3	0.2
1991	3,556	0.1	86.9	12.7	0.2

Winter Creel Census

Composition of catch and catch rates

Yellow perch dominated the composition of the catch during the 1991/92 winter ice fishery on Hauser Reservoir (Table 26). The number of rainbow trout harvested during the winter declined to the lowest level recorded over the four year period of survey. In contrast, the composition of kokanee observed in the creel was greater than the four previous survey years. Catch rates (fish per angler hour) for rainbow trout, kokanee and yellow perch averaged 0.02, 0.30, and 0.45 fish per hour, respectively, during the 1991/92 ice fishery.

Table 26. Composition of the catch made by anglers on Hauser Reservoir during the winter ice fishery from 1988/89 through 1991/1992.

YEAR	NUMBER CAUGHT	% COMPOSITION OF CATCH				
		RAINBOW TROUT	BROWN TROUT	KOKANEE	YELLOW PERCH	MOUNTAIN WHITEFISH
1988/89	882	29.1	1.8	37.1	31.9	0.1
1989/90	337	27.2	1.4	37.0	34.3	0.1
1990/91	723	9.4	0.7	20.7	69.2	0
1991/92	1177	2.4	0.2	39.0	58.4	0

Characteristics of harvested gamefish

Rainbow trout harvested during the 1991/92 ice fishery averaged 15.7 inches in total length and 1.85 pounds in weight. Approximately 86% of the rainbow trout examined in the winter creel were of known hatchery origin. Harvested kokanee averaged 12.9 inches in total length and 0.83 pounds in weight. Yellow perch averaged 8.0 inches in total length and 0.26 pounds in weight.

HOLTER RESERVOIR

Physical Limnology and Zooplankton

Water temperature, water transparency and zooplankton densities were monitored at permanent sampling stations on a monthly or a biweekly basis during the ice free period from mid-March through mid-November in 1991. Collected data have been analyzed and summaries will be presented in a future report. Additionally, limnological parameters and zooplankton densities were monitored during the ice cover period in January of 1991. During January, surface water temperature (to 15 feet) averaged 33.0 F at the upper (Cottonwood) sampling station and 34 F at the lower (Jackson) station. Water temperatures were isothermal at the upper station. At the lower station, water temperatures warmed to 37 F as measurements descended deeper in the water column.

Secchi disk readings during January measured 11.5 and 12.5 feet at middle and lower stations, respectively. Secchi depths obtained during January were greater than average depth readings obtained during the summer at mid-reservoir, but similar to those obtained during the summer in the lower reservoir.

Zooplankton densities measured during January totaled 1.94 and 1.73 organisms per liter, respectively, in mid and lower stations of the reservoir. Zooplankters were much less abundant during the winter than during the ice free period (17 to 32 organisms per liter). During January, Cyclops was the most numerous genera, followed by Bosmina, Diaptomus, and Daphnia (Table 27).

Table 27. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in vertical tows from two stations in Holter Reservoir during January, 1991 (ice cover).

	NUMBER PER LITER				#/M³
MONTH	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
JAN.	0.15	0.24	0.97	0.49	0

Fish Abundance and Distribution

Horizontal gill nets

Relative abundance of fish captured in floating gill nets set in Holter Reservoir since 1986 are presented in Appendix Table 5. In the spring, kokanee dominated the composition of the catch, followed by rainbow trout. In the fall, the reverse relationship was true. Mean catch rates (fish per net night) for rainbow trout and kokanee collected in floating gill nets during the spring and fall are shown in Figures 7 and 8. Based on the number of rainbow trout collected from spring gill nets in 1991, hatchery rainbow stocked into Holter Reservoir in 1990 appeared to exhibit good survival into the spring of 1991. Rainbow trout collected in floating gill nets during 1991 averaged 12.2 inches in total length and 0.92 pounds in weight. Approximately 58% of all rainbow trout collected in gill nets in 1991 were of known hatchery origin. As in past years, the contribution of naturally reproduced fish to the rainbow trout population in Holter Reservoir was substantial (42%).

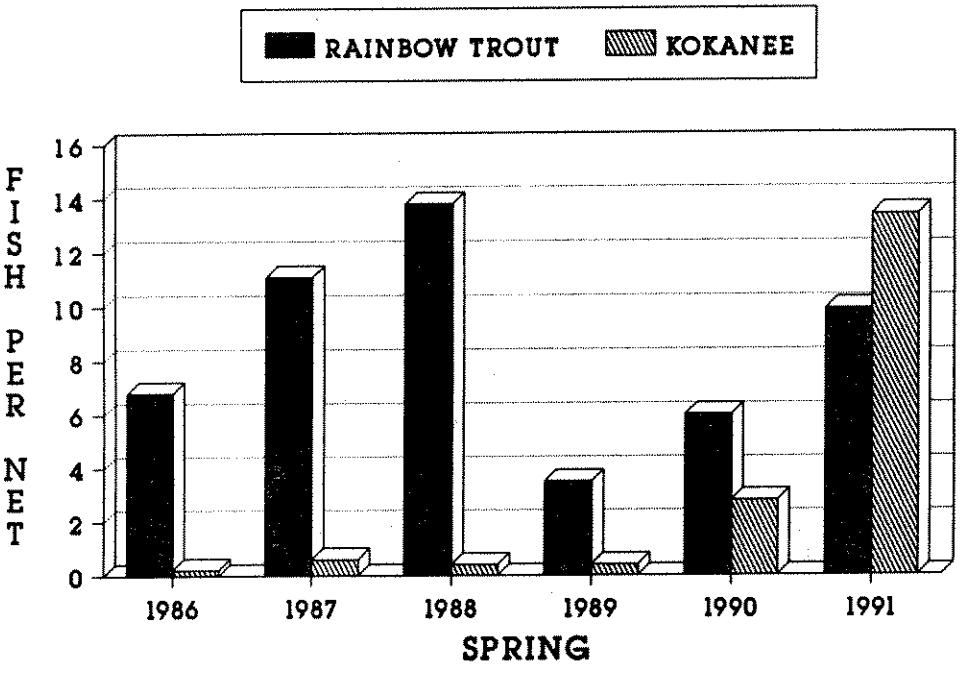

Figure 7. Average catch of rainbow trout and kokanee in floating gill nets set in Holter Reservoir in the spring from 1986 through 1991. Catch reported in fish per net night.

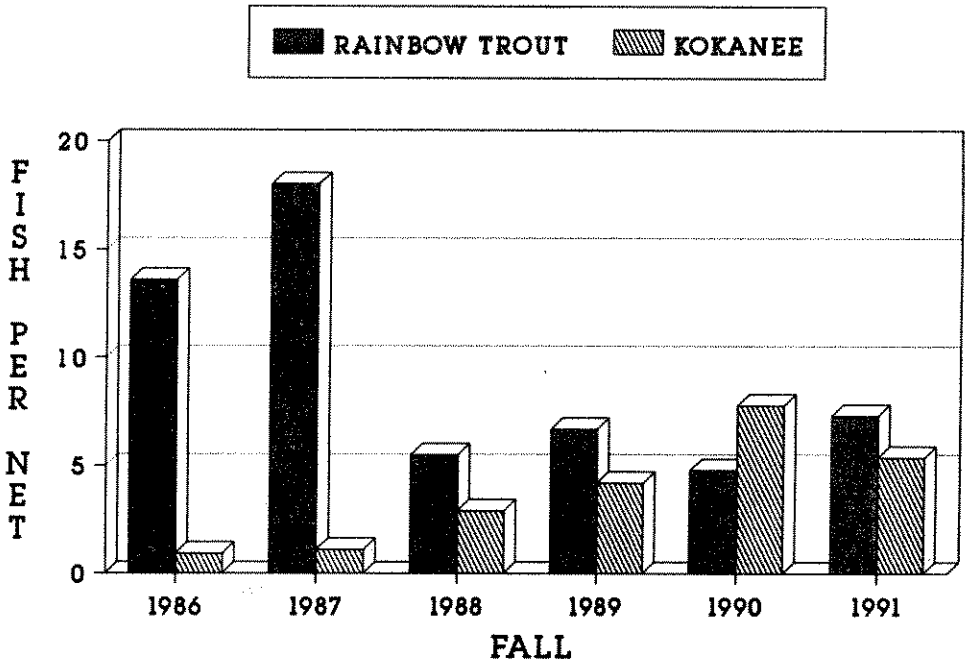

Figure 8. Average catch of rainbow trout and kokanee in floating gill nets set in Holter Reservoir in the fall from 1986 through 1991. Catch reported in fish per net night.

The number of kokanee collected in floating gill nets has tended to steadily increase since 1989, indicating that the kokanee population is continuing to expand in Holter Reservoir. The average number of kokanee collected in floating gill nets during the spring of 1991 averaged 13.44 fish per net, the highest on record since 1986. In the fall of 1991, the number of kokanee collected per net was less than the number collected in the fall of 1990.

Relative abundance of fish captured in sinking gill nets since 1986 are presented in Appendix Table 6. Yellow perch, followed by suckers, dominated the composition of the catch in the spring. In the fall, suckers dominated the catch, followed by yellow perch.

The number of walleye collected per sinking gill net continued to remain relatively constant in 1991 (Table 28). Apparently, the walleye population in Holter Reservoir is remaining relatively stable although fishing pressure for this species appears to be increasing. In spring nets, average length of collected walleye was substantially less than in the three previous years. However, the average length from fall collections was similar to past sampling.

Table 28. Number of fish per net night and mean length, weight and condition factors for walleye collected in sinking gill nets set in Holter Reservoir from 1986 through 1991. Ranges are in parentheses.

YEAR	SEASON	NUMBER PER NET	MEAN LENGTH (IN)	MEAN WEIGHT (LBS)	MEAN CONDITION FACTOR
1986	SPRING	--	--	--	--
1987		2.60	12.2 (9.5-16.6)	0.70 (0.22-1.69)	31.3
1988		2.17	19.1 (11.0-27.9)	3.00 (0.40-8.00)	33.8
1989		2.50	19.6 (17.2-27.0)	2.70 (1.55-7.50)	33.1
1990		2.40	19.1 (12.3-24.6)	3.22 (0.55-6.25)	38.6
1991		2.17	15.7 (11.7-26.3)	1.75 (0.51-7.00)	34.5
1986	FALL	2.33	20.0 (15.0-30.0)	3.31 (1.12-10.0)	35.8
1987		3.17	16.7 (9.7-26.2)	2.05 (0.26-8.00)	36.7
1988		1.33	19.6 (15.6-25.4)	2.87 (1.52-5.00)	36.7
1989		4.33	20.5 (13.3-29.1)	3.60 (0.78-8.60)	37.9
1990		2.33	21.2 (13.5-27.2)	3.97 (0.84-9.00)	37.5
1991		2.83	20.4 (11.5-26.0)	4.08 (0.44-9.10)	40.7

Vertical gill nets

Yellow perch dominated the composition of the catch in vertical nets in 1991 (54%), followed by kokanee (24%) and rainbow trout (15%). Mountain whitefish (2%), walleye (1%) and suckers (4%) made up the remainder of the catch. The number of kokanee collected in vertical gill nets in 1991 was greater than in the five previous years of survey, likely reflecting a continuing expansion of the population Table 29. As in 1990, age II+ fish dominated the catch in 1991. Interestingly, the number of age I+ kokanee collected in 1991 was the fewest on record for Holter Reservoir. Very few yearlings were also collected in Hauser Reservoir in 1991. Apparently, for reasons that remain unknown, the 1990 year class of kokanee was very weak in both reservoirs.

Table 29. Mean catch rates (fish per net night) by age class for kokanee collected in vertical nets set at the Dam Station in Holter Reservoir from 1986 through 1991.

YEAR	NUMBER OF SETS	NUMBER OF KOKANEE PER SET				
		AGE 0+	AGE I+	AGE II+	AGE III+	TOTAL
1986	3	0	4.0	2.3	1.0	7.3
1987	4	0	3.0	3.0	0.5	6.5
1988	6	0	2.8	1.7	0.7	5.2
1989	5	0	9.2	4.2	0.4	13.8
1990	6	0	4.0	9.0	0.7	13.7
1991	5	0	2.2	11.2	2.0	15.5

Beach seining

Table 30 presents results of beach seining efforts on Holter Reservoir. Data obtained in 1987 and 1990 are included in Table 30 although permanent sampling stations were not established until 1991. The number of young of the year perch collected from seine hauls in 1991 was similar to 1990 data. The number of perch per seine haul in Holter Reservoir was less than in Canyon Ferry but greater than in Hauser Reservoir. There may be a correlation between the intermediate abundance of young of the year yellow perch in Holter Reservoir and the reservoir's intermediate flushing rate.

Table 30. Catch per haul of young of the year and yearling yellow perch utilizing a beach seine (4 X 100 foot, 0.25 inch mesh) towed along the shoreline of Holter Reservoir during August.

YEAR	LOCATION	# OF HAULS		MEAN # PERCH/HAUL		MEAN SIZE AGE 0+ (inches)
		WITH YP	EMPTY	AGE 0+	AGE I+	
1987	TOTAL	4	0	62.5	0	--
1990	Mid-res.	8	1	48.6	40.3	1.70
	Lower res.	8	0	571.4	79.6	--
	TOTAL	16	1	294.6	58.8	--
1991	Mid-res.	10	0	191.9	16.7	1.90
	Lower res.	10	0	338.1	1.7	1.91
	TOTAL	20	0	265.0	9.2	1.91

Age and growth of walleye

Age and growth data from walleye collected in Holter Reservoir during the spring of 1990 and 1991 are presented in Table 31. Growth rates for walleye in Holter appear to be greater than in comparable waters in the state or in adjacent states. Growth rates for Holter walleye appear to be most similar to those found in the Tongue River Reservoir. Substantial overlap of length at age occurred for walleye that were Age V+ and older. Overlap of length at age, however, began as early as with age III+ walleye. Although males and females were not separated in age and growth analysis, female walleye appeared to grow substantially faster than their male counterparts. Age data from Holter may be more accurate, especially for older age classes, when compared to age data from other bodies of water because analysis was conducted using cross-sections of dorsal spines.

Table 31. Average length at age and growth increments (inches) for walleye collected from Holter Reservoir during the spring of 1990 and 1991. Spring samples were retreated to the last annulus to correspond with other samples. Sample size is in parentheses. Bighorn data from Fredenberg (1985). Tongue data from Riggs (1978). Seminoe data from citation in McMillan (1984). Oahe data from Riis et. al. (1988).

	AGE									
Water	1	2	3	4	5	6	7	8	9	10
Holter 1990/91	-- (0)	12.5 (8)	16.8 (16)	19.2 (35)	21.4 (55)	22.7 (107)	23.7 (46)	24.1 (15)	25.8 (11)	25.7 (12)
Bighorn 1983/84	--	11.7	14.3	15.9	17.6	18.6	19.4	20.5	--	--
Tongue 1975/77	9.7	13.7	16.8	18.8	20.1	21.1	21.7	22.4	23.0	23.7
Seminoe 1977	4.8	7.8	11.8	14.3	16.9	19.1	21.1	23.1	24.9	26.1
Oahe 1988	6.4	9.9	13.3	15.7	18.0	20.3	21.7	23.1	25.1	--

Summer Creel Census

Interview distribution, party size and angler day

A total of 1,851 anglers were interviewed on Holter Reservoir during the summer period (April through November) in 1991.

Distribution of interviews, mean hours per fishing trip and mean number of anglers per fishing party are presented in Table 32.

Table 32. Distribution of interviews by day of week and by method of fishing with mean hours per completed fishing trip and mean party size obtained on Holter Reservoir during the summers of 1986 through 1991.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
	WEEKDAY	WEEKEND	SHORE	BOAT		
1986	25	75	34	66	3.88	2.43
1987	34	66	41	59	4.02	2.23
1988	44	56	40	60	4.54	2.17
1989	38	62	41	59	4.13	2.10
1990	35	65	40	60	4.08	2.21
1991	42	58	48	52	4.02	2.17
OVERALL	36	64	41	59	4.11	2.22

Composition of the catch and catch rates

The composition of the catch made by anglers during the summer fishery in 1991 is presented in Table 33. Yellow perch dominated the catch made by anglers, followed by rainbow trout and kokanee. The composition of the catch in 1991 appeared similar to the catch obtained in 1990.

Table 33. Composition of the catch by anglers on Holter Reservoir during the summers of 1986 through 1991.

YEAR	NUMBER CAUGHT	RAINBOW TROUT	BROWN TROUT	KOKANEE	YELLOW PERCH	MOUNTAIN WHITEFISH	WALLEYE
1986	1,893	67.5	0.3	1.0	30.9	<0.1	0.3
1987	4,339	46.3	0.1	1.8	49.6	<0.1	2.2
1988	2,968	45.0	0.2	1.8	52.2	0	0.8
1989	4,848	23.7	<0.1	0.7	75.2	0	0.4
1990	5,109	28.5	0	12.5	58.5	0	0.5
1991	4,223	34.9	<0.01	12.5	52.0	0.2	0.4

Annual summer catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 34. The angler catch rate for rainbow trout in 1991 was similar to the rate obtained in 1990. For yellow perch, angler catch rates were slightly lower in 1991 than in 1990. The angler catch rates for kokanee in 1991 was 0.10 fish per hour, similar to the catch rate obtained in 1990 (0.11 fish/hr.). About 93% of the kokanee caught in Holter Reservoir were by boat anglers and anglers kept 93.4% of all the kokanee they had landed. Catch rates for walleye by anglers specifically

seeking to catch the fish was 0.02 fish per hour, the lowest rate recorded over the six year period of survey.

Table 34. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986 through 1991 on Holter Reservoir.

	RAINBOW TROUT				YELLOW PERCH			
	FISH/HOUR			%	FISH/HOUR			%
YEAR	SHORE	BOAT	TOTAL	KEPT	SHORE	BOAT	TOTAL	KEPT
1986	0.27	0.37	0.34	81.8	0.30	0.10	0.16	91.3
1987	0.24	0.41	0.37	85.9	0.61	0.31	0.39	72.7
1988	0.19	0.38	0.32	81.8	0.70	0.22	0.37	76.2
1989	0.22	0.29	0.27	70.8	0.40	1.06	0.85	83.1
1990	0.27	0.25	0.26	67.8	0.48	0.55	0.53	65.7
1991	0.36	0.19	0.27	78.1	0.31	0.47	0.40	76.3
OVERALL	0.26	0.32	0.31	77.7	0.47	0.45	0.45	77.6

A total of 575 walleye have been tagged in Holter Reservoir since 1988 (Table 35). A majority of these fish were tagged in the Oxbow area (47.8%) or the Split Rock area (17.2%). Approximately 6.4% of the walleye tagged in the reservoir were caught by anglers, but only 3.7% of the total number of fish tagged were harvested. Anglers are releasing about half of the walleye they are catching in Holter. Based on the assumption that there is about a 50% compliance by anglers returning tags to the Department, an estimated 7.4% of all walleye tagged in Holter Reservoir has been harvested by anglers. Tag return data will be updated in a future progress report.

Table 35. Preliminary estimate of angler harvest of walleye in Holter Reservoir as indicated by tags returned through January 1, 1992. Number of tags are in parentheses.

		% RECAPTURE			% ANGLER
YEAR	# TAGGED	ANGLERS	OTHER	TOTAL	HARVEST
1988	98	13.3 (13)	4.1 (4)	17.3 (17)	7.1 (7)
1989	31	12.9 (4)	9.7 (3)	22.6 (7)	9.7 (3)
1990	217	8.3 (18)	5.5 (12)	13.8 (30)	3.7 (8)
1991	229	0.9 (2)	1.8 (4)	2.6 (6)	1.3 (3)
TOTAL	575	6.4 (37)	4.0 (23)	10.4 (60)	3.7 (21)

Characteristics of harvested gamefish

The average length, weight and condition factor for rainbow trout and kokanee harvested from Holter Reservoir during 1991 are presented in Table 36. Approximately 87% of all rainbow trout harvested in 1991 and examined for marks were of known hatchery origin. These data are in contrast to gill netting data which indicated 58% of the rainbow population in Holter Reservoir was of hatchery origin. As in previous years, there is a strong indication that Arlee rainbow trout stocked into Holter Reservoir are more susceptible to being caught by anglers than naturally reproduced rainbow trout.

As in 1990, age II+ fish dominated the kokanee fishery during the summer creel census, comprising about 73% of the total harvest. However, the number of age III+ kokanee harvested by anglers increased between 1990 and 1991 (6% in 1990 vs. 27% in 1991). An increase in the harvest of three year old kokanee was apparently a carry-over from a very strong year class that was produced in 1988.

Table 36. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Holter Reservoir during the summers of 1986 through 1991. Length is in inches and weight in pounds. Ranges are in parentheses.

	RAINBOW TROUT			KOKANEE		
YEAR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR
1986	13.9 (8.1-20.8)	1.17 (0.2-4.4)	40.8	16.9 (14.3-20.1)	2.17 (1.4-3.0)	43.4
1987	13.8 (7.5-22.2)	1.11 (0.2-3.7)	41.0	16.7 (10.1-21.0)	2.01 (0.4-3.8)	41.9
1988	13.7 (7.5-20.8)	1.17 (0.2-3.3)	41.6	16.8 (13.0-23.2)	1.96 (0.9-4.0)	42.2
1989	14.5 (8.9-21.3)	1.26 (0.3-2.9)	39.7	16.1 (14.1-19.5)	1.99 (1.3-3.6)	43.8
1990	14.2 (8.0-20.1)	1.17 (0.2-3.7)	39.1	16.1 (11.7-21.0)	1.79 (0.6-3.9)	42.1
1991	12.6 (8.1-24.5)	0.83 (0.3-5.0)	37.9	15.2 (9.7-20.2)	1.63 (0.4-3.1)	44.1

Comprehensive Night Creel Census

In the summers of 1989, 1990 and 1991, a comprehensive creel census was conducted on Holter Reservoir to estimate fishing pressure and angler harvest during daylight and night-time fishing hours. This special creel census was conducted due to an ongoing controversy over night fishing on Holter Reservoir. Although this controversy seems to continue to exist today, the Fish, Wildlife and Parks Commission in 1991 ruled to remove the night fishing closure on

Holter Reservoir to make the regulation uniform with the other bodies of water in the state.

Results of the comprehensive creel census for day versus night anglers on Holter Reservoir are presented in Table 37. About 80% of the fishing pressure occurred during daylight hours and 20% occurred at night. During the survey period, night fishing was restricted between the hours of Midnight and 5:00 AM. Obviously, there was less fishing pressure at night because there were substantially fewer hours of darkness than hours of light available to anglers. Harvest rates for rainbow trout were substantially greater for night anglers than for day anglers. In contrast, harvest rates for yellow perch were similar between day and night during August, 1989 and were less at night than the day during July and August, 1991. Also in 1991, kokanee were harvested almost exclusively by daytime anglers.

Because catch rates for rainbow trout were substantially greater at night than during the day, a disproportionate number of rainbow trout were harvested at night. In 1991, 63% of all the trout harvested were taken at night. Regardless of the fact that a greater number of trout were harvested at night in 1991, it appears night fishing has no more impact on the rainbow population than fishing during daylight hours. Intuitively, if night fishing adversely impacted the rainbow population in the reservoir, night anglers would be unable to continue to harvest fish on a continual basis. The night fishing controversy on Holter Reservoir appears to be more of a social issue than a biological issue. In development of a fisheries management plan for Holter, the Department should make special effort to explain the implications of night fishing (or lack thereof) to the angling public.

Table 37. Summary of the comprehensive creel census for day versus night anglers on Holter Reservoir conducted during the summers of 1989, 1990, and 1991.

CREEL PERIOD	TIME OF DAY	AVERAGE ANGLERS/ COUNT	TOTAL HOURS FISHED	HARVEST RATE			ESTIMATED NO. HARVESTED		
				RB	KOK	YP	RB	KOK	YP
8/13-8/20/89	Day	29.0	3,476 (76)	0.10	0	0.74	361 (60)	0	2,572 (74)
	Night	45.6	1,094 (24)	0.22	0	0.83	237 (40)	0	906 (26)
	TOTAL	34.5	4,570	0.16	0	0.79	598	0	3,474
9/1-9/30/90	NIGHT ONLY	11.3	1,749	0.42	0.01	0.62	735	17	1,084
7/8-8/18/91	Day	56.3	36,663 (85)	0.04	0.16	0.79	1,533 (37)	5,683 (98)	27,961 (94)
	Night	44.8	6,534 (15)	0.40	0.01	0.26	2,613 (63)	99 (2)	1,741 (6)
	TOTAL	50.6	43,197	0.22	0.09	0.53	4,146	5,782	29,702

Winter Creel Census

Composition of catch and catch rates

As in previous years, yellow perch dominated the composition of the catch during the 1991/92 winter ice fishery on Holter Reservoir (Table 38). Catch rates (fish per angler hour) for rainbow trout and yellow perch averaged 0.23 and 5.60 fish per hour, respectively, during the 1991/92 ice fishery. The catch rate for rainbow trout in 1991/92 was similar to the previous three years of survey. For yellow perch, the angler catch rate during the winter of 1991/92 was the highest recorded since the survey was begun in 1988.

Table 38. Composition of the catch made by anglers on Holter Reservoir during the winter ice fishery from 1988/89 through 1991/1992.

		% COMPOSITION OF CATCH				
YEAR	NUMBER CAUGHT	RAINBOW TROUT	BROWN TROUT	KOKANEE	YELLOW PERCH	MOUNTAIN WHITEFISH
1988/89	4704	7.3	<0.1	0	92.3	0.4
1989/90	3597	7.2	0	<0.1	92.6	0.2
1990/91	6162	6.9	0	0.4	92.4	0.3
1991/92	2930	3.9	0	<0.1	96.0	0

Characteristics of harvested gamefish

Rainbow trout harvested during the 1991/92 ice fishery averaged 11.8 inches in total length and 0.64 pounds in weight. Approximately 95% of the rainbow trout examined in the winter creel were of known hatchery origin (Arlee strain). Yellow perch averaged 8.6 inches in total length and 0.34 pounds in weight.

STRAIN EVALUATION

Canyon Ferry Reservoir

Table 39 presents the estimated number of rainbow trout, partitioned by strain and year of stocking, harvested from Canyon Ferry Reservoir from 1986 through 1991. Harvest estimates were obtained by multiplying estimated annual fishing pressure from the Department's mail surveys by the average summer harvest rate determined through the annual creel census. The harvest estimate was then partitioned by strain and year of stocking based on the annual composition of marked fish observed in the summer creel census program. An average annual fishing pressure of 86,000 angler days (309,600 angler hours) was used for all calculations. This figure was obtained by averaging the 1982, 1983, 1984, 1985 and 1989 mail survey data. All calculations were made under the assumption that the angler harvest rates and the composition of the harvest (strain and stocking date) obtained during the summer creel (mid-April through mid-November) were similar to rates for the remainder of the year.

With the exception of the 0+ Desmet stocked in 1988 and the 0+ Eagle Lake stocked in 1989 and 1990, wild strains of rainbow trout (Desmet and Eagle Lake) provided a greater return to the angler's creel than did the Arlee. The greater rate of return by wild strains was accentuated by the number of harvested fish that had been residing in the reservoir for more than two years. This is likely due to the greater longevity exhibited by the wild strains of rainbow trout. Age I+ Desmet stocked in 1986 provided the greatest return to the angler's creel, with 22.09% of the plant harvested by anglers.

Poor returns exhibited by the 1988 0+ Desmet and 1989/1990 0+ Eagle Lake plants appeared to be a result of the late date that these fish were stocked into the reservoir. All of these plants were made after mid-August. Apparently, stocking success tends to be very poor for plants made into Canyon Ferry Reservoir after mid-August. This conclusion is not the first time that biologists have observed poor success of late plants made into Canyon Ferry. Holton (1966) reported that, based on a marking study conducted in 1963 and 1964, the earlier that hatchery rainbow can be stocked into the reservoir the better the return to the angler.

The number of hatchery rainbow trout returned to the creel averaged 8.29, 9.05, 3.47 and 2.55 percent of the total number of trout stocked, respectively, for 1986, 1987, 1988 and 1989. Data obtained from the 1990 and 1991 plants are too preliminary to determine the success or failure of year classes. Success of hatchery plants were substantially lower in 1988 and 1989 than in the previous two years. Although reasons remain unknown for poor stocking success for the Arlee rainbow trout in 1988 and 1989,

drought and associated low reservoir levels may have been contributing factors.

The distribution (percent composition) of rainbow trout by strain and date of stocking from gill net and angler harvest data collected in Canyon Ferry Reservoir since 1986 is presented in Appendix Table 7.

Holter Reservoir

The estimated number of hatchery rainbow trout, partitioned by year of stocking, harvested from Holter Reservoir since 1986 is presented in Table 40. Calculation procedures followed those used for Canyon Ferry Reservoir. An average annual fishing pressure of 75,000 angler days (307,500 angler hours) was used for all calculations. This figure was obtained by averaging the 1982, 1983, 1984, 1985 and 1989 mail survey data. The number of rainbow trout returned to the anglers creel was 28.25, 13.10, 20.76, and 17.29 percent of the hatchery plant made for 1986, 1987, 1988 and 1989, respectively. Data obtained from the 1990 and 1991 plants are too preliminary to make an estimate of harvest. The rate of return to the creel for Arlee rainbow trout was substantially higher in Holter Reservoir than in Canyon Ferry Reservoir. Holter Reservoir receives greater fishing pressure per surface acre than does Canyon Ferry (15.62 angler days/surface acre versus 2.45 angler days/surface acre). Consequently, the higher rate of return for hatchery fish in Holter Reservoir may simply due to more fishing pressure.

Table 39. Estimated number of rainbow trout, partitioned by strain and year stocked, harvested by anglers in Canyon Ferry Reservoir from 1986 through 1991. The cumulative percent of the hatchery plant is based on the time (year) the rainbow trout had spent in the reservoir.

YEAR	STRAIN	NUMBER STOCKED	ESTIMATED HARVEST CUMULATIVE PERCENT OF PLANT 1ST	2ND	3RD	4TH	5TH	6TH	TOTAL # HARVESTED	TOTAL % RETURNED TO CREEL
1986	0+ Arlee	985,449	1.54	4.99	6.95	7.42	7.42	7.42	73,159	7.42
	I+ Desmet	61,200	2.00	7.13	17.38	20.75	22.09	22.09	13,717	22.09
	OVERALL	1,047,549	1.57	5.12	7.57	8.21	8.29	8.29	86,876	8.29
1987	0+ Arlee	724,686	0.66	4.72	7.83	8.39	8.41	--	60,912	8.41
	0+ E. Lake	251,303	0.08	2.51	4.90	8.19	10.91	--	27,425	10.91
	OVERALL	975,989	0.51	4.15	7.08	8.34	9.05	--	88,337	9.05
1988	0+ Arlee	766,045	0.26	0.90	2.42	3.49	--	--	26,755	3.49
	0+ E. Lake	121,587	0	1.00	2.80	6.09	--	--	7,399	6.09
	0+ Desmet	135,513	0	0	0.50	0.99	--	--	1,344	0.99
	OVERALL	1,023,045	0.19	0.80	2.21	3.47	--	--	35,498	3.47
1989	0+ Arlee	852,158	0.64	2.08	2.90	--	--	--	24,731	2.90
	0+ E. Lake	130,000	0	0	0.23	--	--	--	297	0.23
	OVERALL	982,158	0.56	1.81	2.55	--	--	--	25,028	2.55
1990	0+ E. Lake	474,623	0	0.04	--	--	--	--	188	0.04
	I+ Desmet	196,431	0.98	3.03	--	--	--	--	5,950	3.03
	OVERALL	671,054	0.29	0.91	--	--	--	--	6,138	0.91
1991	I+ Desmet	442,234	0.25	--	--	--	--	--	1,123	0.25

Table 40. Estimated number of rainbow trout, partitioned by year of stocking, harvested by anglers Holter Reservoir from 1986 through 1991. The cumulative percent of the hatchery plant is based on the time (year) the rainbow trout had spent in the reservoir.

YEAR	NUMBER STOCKED	ESTIMATED HARVEST CUMULATIVE % OF PLANT 1ST	2ND	3RD	4TH	5TH	TOTAL # HARVESTED	TOTAL % RETURN TO CREEL
1986	325,089	4.33	23.62	27.99	28.25	28.25	91,837	28.25
1987	323,002	4.21	11.15	13.10	13.10	13.10	42,309	13.10
1988	322,887	10.58	18.98	20.47	20.76	---	67,037	20.76
1989	366,785	6.47	15.07	17.29	---	---	63,412	17.29
1990	347,257	2.37	11.65	---	---	---	40,446	11.65
1991	420,067	3.67	---	---	---	---	15,419	3.67

Poor stocking success in Holter Reservoir appeared to occur in 1987 and possibly 1990, although 1990 data are somewhat preliminary. In contrast, poor stocking success in Canyon Ferry Reservoir occurred in 1988 and 1989. Apparently, seasonal weather patterns have less influence on stocking success than other factors, such as the timing of the plants.

Interestingly, the contribution of wild rainbow trout to the fishery in Holter Reservoir has steadily increased since 1986, ranging from 1.6% of the harvest in 1986 to 12.4% in 1991. The increase in the number of wild rainbow trout in the population may be a result of the recovery of trout populations in Beaver Creek following the 1984 fire/flood event. Beaver Creek and the Missouri River downstream of Hauser Dam are the major spawning areas for rainbow trout residing in Holter Reservoir.

Holter Reservoir has been managed by the Department in a very consistent manner since the late 1970's, annually receiving about 325,000 Arlee fingerlings following spring run-off in June or early July. Despite this consistent management, the rate of return to the angler's creel appears to be quite variable. As a result of this annual variability, it appears any meaningful evaluation on rainbow trout strains should be conducted within the same year of stocking or year class and not between year classes.

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Waters referred to:

Canyon Ferry Reservoir	17-8832
Hauser Reservoir	17-9056
Holter Reservoir	17-9136
Missouri River Sec 10A	17-4913
Sec 11	17-4928
Beaver Creek	17-0496

APPENDIX TABLES

Appendix Table 1. Percent composition by species and season for floating gill net catches in Canyon Ferry Reservoir from 1986 through 1991.

	1986		1987		1988		1989		1990		1991	
SPECIES	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL
RB	91.3	90.8	70.2	90.2	59.0	76.3	51.4	73.9	63.8	82.3	64.3	62.0
LL	7.7	3.9	4.4	1.5	7.2	2.1	15.9	7.4	13.1	8.3	1.4	2.6
MWF	0	0	0	0	1.8	1.3	2.8	0	0	0	5.7	1.0
YP	1.0	0	0.4	0	14.0	0	0.9	0	0	0	5.7	0
LNSU	0	0.7	1.1	0	0.9	0	0	1.1	0.7	0	0	0
WSU	0	0	2.5	3.7	6.8	3.4	3.7	6.3	3.6	1.0	14.3	4.6
CARP	0	2.6	20.0	4.0	5.4	13.5	17.8	4.5	6.5	3.1	5.7	11.3
U.CHUB	0	2.0	1.4	0.6	4.9	3.4	7.5	6.8	12.3	5.2	2.9	18.5
TOTAL # CAUGHT	298	152	275	327	222	236	107	176	138	96	70	195
NUMBER OF NETS	13	18	13	18	13	18	13	18	15	18	15	18

Appendix Table 2. Percent composition by species for sinking gill net catches in Canyon Ferry reservoir from 1986 through 1991.

RESERVOIR	SPECIES	1986 SPRING	1986 FALL	1987 SPRING	1987 FALL	1988 SPRING	1988 FALL	1989 SPRING	1989 FALL	1990 SPRING	1990 FALL	1991 SPRING	1991 FALL
C. FERRY	RB		0.4		0.2		0.5		0.5		0.9		0.4
	LL		0.6		0.9		1.6		4.4		1.3		2.4
	MWF		0.2		0.2		0.8		1.1		0.9		0.8
	YP		59.7		59.5		52.6		20.8		32.1		43.8
	LNSU		2.7		1.2		0		0.5		0.9		0.4
	WSU		34.6		34.0		42.8		65.1		58.5		43.0
	CARP		0.8		2.1		1.1		7.1		1.3		2.0
	U. CHUB		1.0		1.2		0.3		0.5		2.7		1.6
	BURBOT		0		0.7		0.3		0		1.3		5.2
	# CAUGHT	0	489	0	429	0	367	0	183		224		251
	# OF NETS	0	3	0	3	0	3	0	3		3		3

Appendix Table 3. Percent composition by species and season for floating gill net catches in Hauser Reservoir from 1986 through 1991.

	1986		1987		1988		1989		1990		1991	
SPECIES	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL
RB	29.0	31.3	9.7	44.2	17.7	42.0	13.2	20.9	5.4	16.5	7.8	8.1
LL	0.2	2.5	1.3	1.2	0.6	1.4	2.0	0.9	1.6	0.5	0.7	0.7
KOK	2.9	57.3	36.0	25.1	71.3	47.9	74.2	73.2	88.6	79.3	85.6	70.0
MWF	0.2	4.3	0	0	1.2	0.9	0	0.3	0	0.7	0.4	0.5
WE	0	0	0	0	0	0	0	0	0	0	0	0.5
YP	0	0.7	0	0	0	0	0	0	0	0	0	0
LNSU	52.9	1.4	35.8	12.9	6.1	2.5	5.3	0.9	1.6	0.2	1.8	0
WSU	13.8	1.1	16.4	16.0	3.1	0.5	5.3	0.3	2.7	0.2	1.5	0
CARP	0.5	0	0	0	0	0	0	0	0	0	0	0
U.CHUB	0.5	1.4	0.8	0.6	0	4.8	0	3.5	0	2.5	2.2	20.2
TOTAL # CAUGHT	448	281	383	163	164	438	151	339	185	401	271	420
NUMBER OF NETS	9	11	10	11	10	11	9	11	11	11	11	11

Appendix Table 4. Percent composition by species for sinking gill net catches in Hauser Reservoir from 1986 through 1991.

RESERVOIR	SPECIES	1986 SPRING	1986 FALL	1987 SPRING	1987 FALL	1988 SPRING	1988 FALL	1989 SPRING	1989 FALL	1990 SPRING	1990 FALL	1991 SPRING	1991 FALL
HAUSER	RB		0.7	0.2	1.4	0	0.5	0	1.8	0	0.3	0	0.7
	LL		1.0	1.5	0.4	1.2	0.5	0.9	0	0.7	0.7	1.2	0.4
	KOK		0.4	1.1	4.2	4.2	9.1	1.7	18.3	2.7	11.1	3.1	20.6
	MWF		3.6	3.8	2.3	5.4	2.6	2.4	0.5	2.0	2.1	3.0	1.7
	WE		0	0	0	0	0	0.2	0	0	0	0	0.6
	YP		4.9	4.7	9.3	10.6	4.3	5.8	3.5	13.5	3.8	13.7	11.2
	LNSU		28.9	23.0	16.1	17.9	24.1	22.3	14.7	19.5	16.1	20.9	16.6
	WSU		60.5	65.5	66.0	60.0	58.3	66.0	59.4	58.4	63.4	55.7	45.0
	CARP		0	0	0	0	0	0	0.2	0	0	0	0
	U. CHUB		0	0.2	0.1	0.5	0.1	0.3	1.3	3.1	2.3	1.9	1.7
	BURBOT		0	0	0.2	0	0.5	0.2	0	0	0.2	0.2	0.4
	S. BUFF.		0	0	0.2	0	0.5	0.2	0	0	0	0.3	1.1
	# CAUGHT	0	700	473	839	407	648	574	600	548	577	635	705
	# OF NETS	0	5	5	6	6	6	6	6	6	6	6	7

Appendix Table 5. Percent composition by species and season for floating gill net catches in Holter Reservoir from 1986 through 1991.

	1986		1987		1988		1989		1990		1991	
SPECIES	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL
RB	25.5	77.2	47.1	76.6	64.3	41.5	25.0	52.1	61.5	34.7	34.5	53.7
LL	0	0.8	1.6	2.2	1.2	1.9	0	0.9	1.3	0	0	1.9
KOK	0.6	4.9	2.6	4.8	1.7	21.7	2.7	33.0	28.2	56.5	46.9	39.8
MWF	2.5	3.3	1.6	0	1.2	2.8	0.9	0.9	0	1.6	1.2	2.8
WE	5.0	9.7	7.4	0.5	4.1	0	1.8	2.6	5.1	0	13.9	0
YP	0	0	20.1	0	18.7	0	8.9	0	0	0	0	0
LNSU	40.4	3.3	10.1	6.9	4.1	12.3	38.4	7.0	1.3	6.5	0.4	0.9
WSU	24.8	0.8	7.9	9.0	3.5	19.8	22.3	2.6	2.6	0.8	2.7	0.9
CARP	1.2	0	1.6	0	1.2	0	0	0	0	0	0.4	0
U. CHUB	0	0	0	0	0	0	0	0.9	0	0	0	0
TOTAL # CAUGHT	161	123	189	188	171	106	112	115	78	124	258	108
NUMBER OF NETS	6	7	8	8	8	8	8	9	8	9	9	8

Appendix Table 6. Percent composition by species for sinking gill net catches in Holter Reservoir from 1986 through 1991.

RESERVOIR	SPECIES	1986 SPRING	1986 FALL	1987 SPRING	1987 FALL	1988 SPRING	1988 FALL	1989 SPRING	1989 FALL	1990 SPRING	1990 FALL	1991 SPRING	1991 FALL
HOLTER	RB	4.3	0.9	2.5	1.4	2.6	1.1	1.8	1.0	3.1	0.7	4.4	
	LL	0.2	0.8	0.3	0.2	0	0.2	0	0.7	0	0.1	0	
	KOK	0.4	0	0.2	0.3	0.5	0	0.6	0	1.9	0.6	1.6	
	MWF	1.8	1.7	2.0	3.6	0.5	5.1	1.8	4.0	4.3	5.8	1.3	
	WE	2.5	1.6	3.1	2.0	1.3	2.8	5.2	2.0	2.9	1.4	3.0	
	YP	24.0	57.2	28.8	34.0	21.8	29.5	10.6	39.2	16.0	50.4	11.3	
	LNSU	24.0	16.5	21.5	17.6	21.9	11.2	20.4	11.4	15.4	11.9	20.3	
	WSU	42.8	21.2	41.6	40.7	51.2	49.7	59.6	41.4	56.2	29.1	58.1	
	CARP	0	0.1	0	0	0.2	0.4	0	0	0.2	0	0	
	U. CHUB	0	0	0	0.2	0	0	0	0.3	0	0	0	
		551	838	601	658	611	545	500	597	486	894	566	
# OF NETS		6	5	6	6	6	6	6	5	6	6	6	

Appendix Table 7. Distribution (percent composition) of rainbow trout by strain and age class from gill net and harvest data collected on Canyon Ferry Reservoir. Percent composition is based on individual year classes.

YEAR	STRAIN	TOTAL STOCKED	PERCENT COMPOSITION 1986 NET	1986 CREEL	1987 NET	1987 CREEL	1988 NET	1988 CREEL	1989 NET	1989 CREEL	1990 NET	1990 CREEL	1991 NET	1991 CREEL
1986	0+ ARLEE	94.1	86.0	94.5	74.5	86.6	66.3	74.2	31.6	67.2	0	0	0	--
	I+ DESMET	5.9	14.0	5.5	25.5	13.4	33.7	25.8	68.4	32.8	100	100	100	--
1987	0+ ARLEE	74.3	--	--	87.5	93.6	68.4	82.7	40.0	79.0	31.3	33.0	0	1.4
	0+ E. LAKE	25.7	--	--	12.5	6.4	31.6	17.3	60.0	21.0	68.8	67.0	100	98.6
1988	0+ ARLEE	74.9	--	--	--	--	89.2	100	70.0	80.7	39.4	80.8	41.2	63.7
	0+ E. LAKE	11.9	--	--	--	--	10.8	0	30.0	19.3	3.0	14.6	47.0	31.1
	0+ DESMET	13.2	--	--	--	--	0	0	0	0	57.6	4.6	11.8	5.2
1989	0+ ARLEE	85.7	--	--	--	--	--	--	96.7	100	100	100	83.3	96.0
	0+ E. LAKE	14.3	--	--	--	--	--	--	3.3	0	0	0	16.7	4.0
1990	I+ DESMET	29.3	--	--	--	--	--	--	--	--	87.5	100	83.3	95.6
	0+ E. LAKE	70.7	--	--	--	--	--	--	--	--	12.5	0	16.7	4.4
1991	I+ DESMET	100	--	--	--	--	--	--	--	--	--	--	100	100