MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA TITLE: STATEWIDE FISHERIES INVESTIGATIONS
PROJECT NO: F-46-R-3 TITLE: SURVEY AND INVENTORY OF COLDWATER LAKES
JOB NO: II-f TITLE: MID-MISSOURI RESERVOIRS STUDY

PROJECT PERIOD: JULY 1, 1989 THROUGH JUNE 30, 1990

ABSTRACT

Baseline limnological and fisheries data were gathered on Canyon Ferry, Hauser and Holter reservoirs during 1986, 1987, 1988 and 1989 to obtain a better understanding of fish population dynamics in the reservoirs and to evaluate impacts of existing reservoir operations on the sport fisheries. Surface water temperatures (to 15 feet) on Canyon Ferry Reservoir averaged 58.4, 59.8 and 61.0 F. during 1987, 1988 and 1989, respectively. Euphotic zone depths tended to be greatest in the lower reservoir and least in the upper reservoir during the survey period. Approximately 92% of all rainbow trout collected in Canyon Ferry Reservoir from gill nets were of known hatchery origin. Mean catch rates (fish per net night) for rainbow trout declined between 1986 and 1989, reflecting a decline in population abundance. These declines appeared to be due to relatively unsuccessful hatchery plants made in 1987 and 1988. A total of 8,332 anglers were interviewed during the four summers on Canyon Ferry Reservoir. Angler catch rates for rainbow trout averaged 0.28, 0.20, 0.23 and 0.16 fish/hour during the four respective years. Rainbow catch rates appeared to be closely related to the stocking success of the previous year as measured by the number of yearling trout captured per horizontal net set during the spring. A total of 3,961 anglers were interviewed during the winter ice fishery on Canyon Ferry Reservoir. Angler catch rates for yellow perch declined steadily through the period of survey, ranging from 3.68 fish/hour in 1985/86 to 0.92 fish/hour in 1989/90. Increases in the average length of yellow perch harvested during the winter ice fishery, combined with decreasing angler catch rates, indicated a decline in the population level. Winter catch rates for rainbow trout averaged 0.20 fish/hour. Surface water temperatures (to 15 feet) on Hauser Reservoir averaged 56.6, 59.0 and 58.8 F. during 1987, 1988 and 1989, respectively. Euphotic zone depths were similar among sampling stations, ranging from 5 to 14 feet. About 95% of all rainbow trout collected from gill nets set in Hauser Reservoir were of known hatchery origin. Mean catch rates (fish per net night) for kokanee more than doubled between 1986 and 1989, reflecting an expansion of the population. Growth rates for kokanee appeared to decline in response to expanding population levels. Kokanee appeared to prefer water temperatures cooler than 62 F. and tended to be distributed in

water deeper than 10 feet during July, August and September. A total of 7,532 anglers were interviewed during the four summers on Hauser Reservoir. Angler catch rates for rainbow trout averaged 0.25, 0.24, 0.24 and 0.12 fish per hour during the four respective years. Catch rates for kokanee averaged 0.10, 0.13, 0.24 and 0.42 fish per hour, respectively. A total of 873 anglers were interviewed during the winter ice fishery on Hauser Reservoir. Angler catch rates averaged 0.16, 0.21 and 0.20 fish per hour for rainbow trout, kokanee and yellow perch, respectively. Surface water temperatures (to 15 feet) on Holter Reservoir averaged 57.6, 59.2 and 60.4 F. during 1987, 1988 and 1989, respectively. Euphotic zone depths were shallower in mid-reservoir than in the lower reservoir. Up to 46% of the rainbow trout collected in gill nets in Holter Reservoir evidently originated from the wild. Mean catch rates (fish per net night) for kokanee increased annually through the survey period, indicating possible expansion of the population. The number of walleye captured in sinking gill nets remained relatively constant through the survey period. A total of 5,612 anglers were interviewed during the four summers on Holter Reservoir. Angler catch rates for rainbow trout averaged 0.34, 0.37, 0.32 and 0.27 fish per hour during the four respective years. A total of 927 anglers were interviewed during the winter ice fishery on Holter Reservoir. Angler catch rates for rainbow trout and yellow perch averaged 0.26 and 2.77 fish per hour, respectively. Growth rates for the Arlee, Desmet and Eagle Lake strains of rainbow trout averaged 0.48, 0.43 and 0.53 inches per month in Canyon Ferry Reservoir. Condition factors were greatest for the Arlee strain, intermediate for the Eagle Lake strain and least for the Desmet strain. Daphnia was the most important food item for all three strains of rainbow trout. Desmet and Eagle Lake strains appeared to survive better in Canyon Ferry Reservoir than the Arlee strain. The Arlee strain appeared to be substantially easier for anglers to catch than the two 'wild' strains of rainbow. Fall estimates of rainbow trout densities in the Hauser section of Missouri River ranged from 1,770 to 5,974 fish per mile. Rainbow densities in the Hauser section were greatly influenced by hatchery fish, either by introductions into the river or by flushing of hatchery fish over or through Hauser Dam. Fall estimates of brown trout densities in the Hauser section declined from a high of 492 fish per mile in 1986 to a low of 194 fish per mile in 1989. The decline in the brown trout population appeared to be associated with the expansion of kokanee populations in Hauser and Holter reservoirs. However, this population decline also may have been due to over-harvest by anglers or to the effects of a series of low flow years. An estimated 5,848 rainbow trout, 741 brown trout and 1,263 kokanee were harvested by anglers in the Hauser section of the Missouri River during 1983. The rainbow trout harvest represented about 77% of the fall population. Hatchery fish flushing over Hauser Dam appeared to supplement the rainbow population in the river. The brown trout harvest represented about 58% of the fall population. Harvest was greater for the younger age classes of brown trout than for the older "trophy size" age groups.

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JOB OBJECTIVES AND DEGREES OF ATTAINMENT

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.

PROCEDURES

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

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. At stations of adequate depth, tows measured 45 feet in length. At shallower stations, the length of tow covered the entire water column. Procedures used to process zooplankton samples followed those described by Leathe and Graham (1982).

Fish for food habits analyses were collected by gill netting. Stomach contents were removed in the field and placed in plastic vials with 10% formalin as preservative. Insects were identified to order and zooplankton were identified to genus. The number and volume of each identified food item was recorded. Subsamples of zooplankton were taken when large quantities were present in the diet. An index of relative importance was calculated by incorporating the number, volume and frequency of occurrence of a specific food item (George and Hadley 1979).

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 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

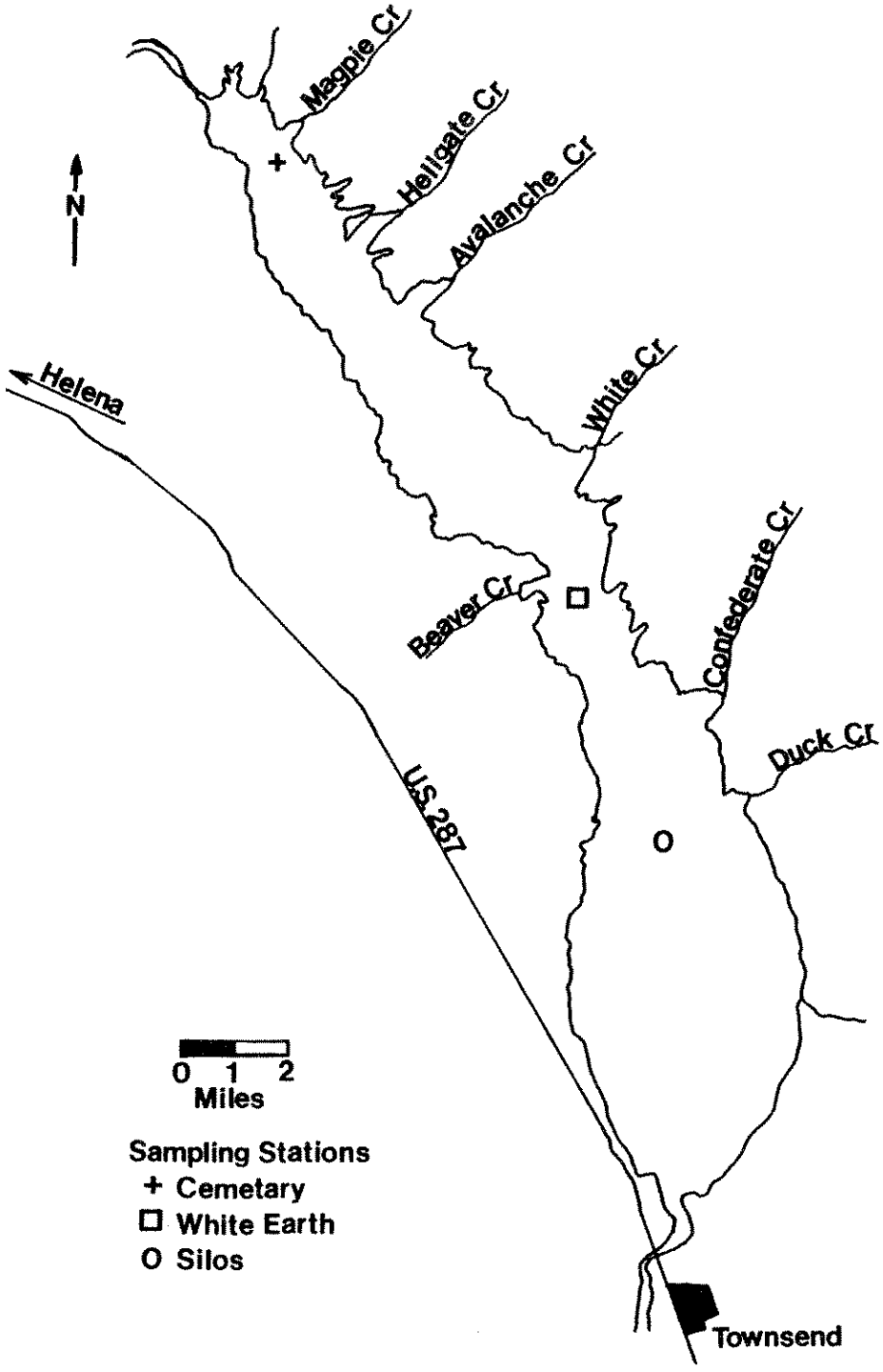

Figure 1. Map of Canyon Ferry Reservoir showing locations of permanent sampling stations.

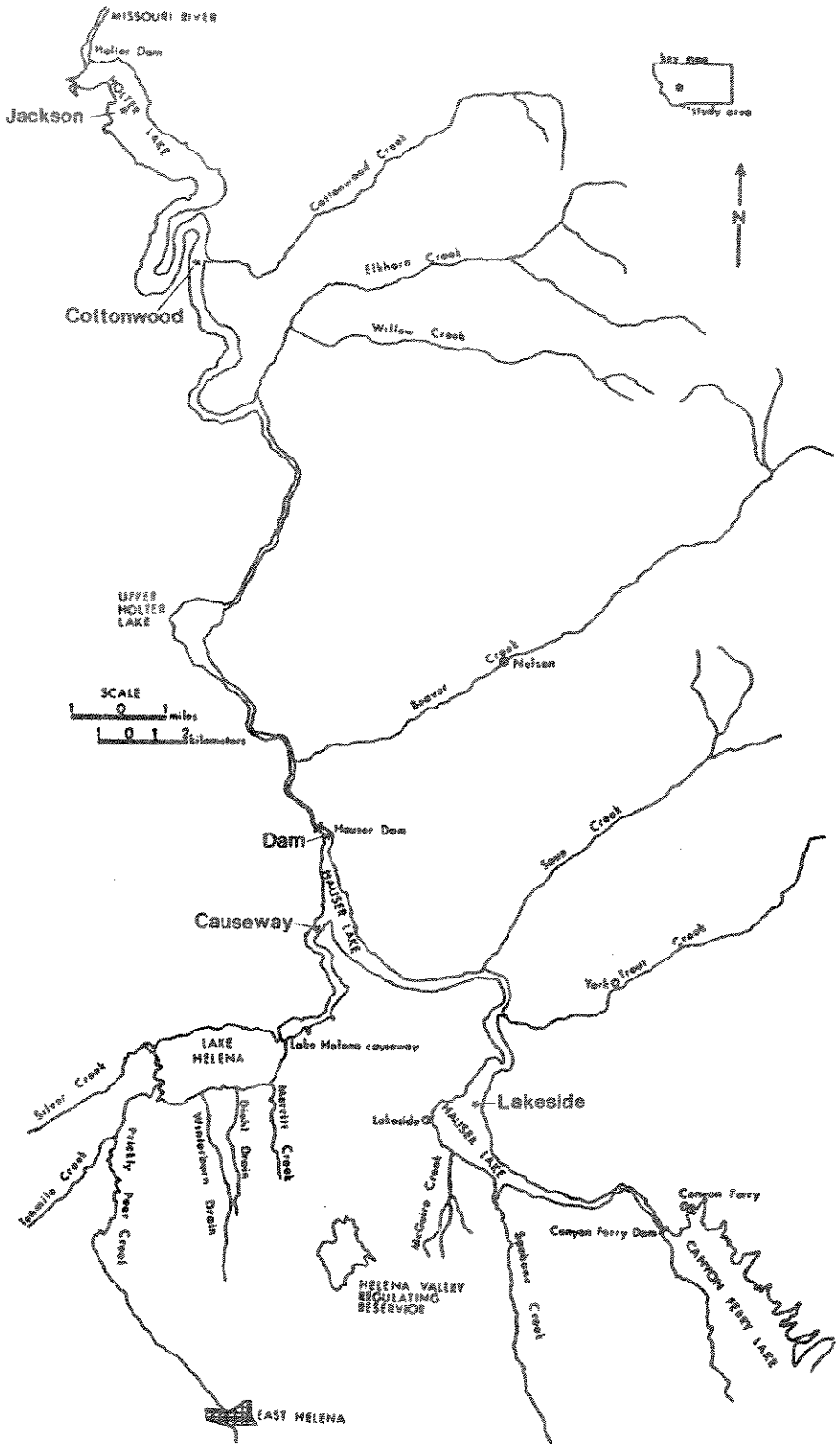

Figure 2. Map of Hauser and Holter reservoirs showing locations of permanent sampling stations.

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.

A boom suspended electrofishing system was used to sample fish populations in the Hauser section of the Missouri River. The electrofishing system was adapted from Novotny and Priegel (1974). Population estimates were made using Chapman's modification of Peterson's mark and recapture formula (Ricker 1975).

A partial creel census was conducted each year on Canyon Ferry, Hauser and Holter reservoirs from mid April through late November. Procedures for this partial creel census is 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 Hauser section of the Missouri River during 1982, 1983 and 1985 to obtain estimates of fishing pressure and harvest. Sampling design and supervision of field work were conducted by A. Wipperman. Surveys were structured within two week strata for purpose of analyses. In general, 6 to 7 days were sampled within each 2 week stratum. Sampling days were selected in a somewhat random fashion, but weekends and holidays were sampled more frequently than weekdays. As a result, computations were made separately for weekends/holidays and weekdays. Five counts were made each sampling day. Counting times were spaced at 3.0 hour intervals when day length was sufficient. When day length became too short, counting times were spaced at 2.0 hour intervals. During each count, all boat and shore anglers observed between Hauser Dam and Cochran gulch were tabulated. Creel clerks used a small boat and motor to travel up and down the river section to make angler counts. Procedures and formulae for this creel were adapted from those described by Neuhold and Lu (1957).

RESULTS

CANYON FERRY RESERVOIR

Physical Limnology and Zooplankton

Water temperatures measured at the surface and reservoir bottom at three sampling stations during 1987, 1988 and 1989 are shown in Appendix Figure 1. Surface waters (to 15 feet) for the spring through fall period of survey averaged 58.4, 59.8 and 61.0 F. during 1987, 1988 and 1989, respectively. Water in the upper reservoir (Silos station) remained mixed during the sampling period due to shallow depths and exposure to wind action. In mid-reservoir (White Earth station), water tended to form a weak thermal structure beginning in May and ending in August. Water in the lower reservoir (Cemetery station) tended to form a weak thermal structure from May through October. Water temperatures on the surface peaked at 70.0, 71.0 and 76.0 F. during the three respective years.

Euphotic zone depths measured during 1987, 1988 and 1989 are presented in Appendix Figure 2. Euphotic zone depths tended to be greatest in the lower reservoir and least in the upper reservoir. For 1987 and 1988, euphotic zones were generally deepest during June and shallowest during August or September. For 1989, euphotic zones tended to be shallower in the spring and deeper in the fall. Euphotic zone depths for the period of survey averaged 9.8, 10.3 and 11.4 feet over the three respective years.

Zooplankton collections are continuing to be analyzed and results will be presented in a future report.

Fish Abundance and Distribution

Horizontal gill nets

Relative abundances of fish captured in floating gill nets since 1986 are presented in Appendix Table 1. Rainbow trout dominated the composition of the catch in all years, although their contribution to the catch declined annually. With the exception of rainbow trout and the Utah chub, other fish species collected in floating nets did not exhibit any obvious changes in population abundance. The abundance of Utah chubs, although relatively low, appeared to increase in Canyon Ferry Reservoir. One walleye, 19.2 inches in length, was captured in a floating gill net in the fall of 1989.

Mean catch rates (fish per net night) for rainbow trout from seasonal gill nets set in Canyon Ferry Reservoir are shown in Figure 3. The number of rainbow trout collected in floating gill nets increased annually from 1983 through 1986. Since 1986, however, mean catch rates for rainbow trout decreased each year, reflecting a declining trend in population abundance. The rainbow trout fishery in Canyon Ferry Reservoir has undergone similar fluctuations in past years (Rehwinkel 1986). Past declines in the fishery were thought to be closely associated with losses of hatchery fish over the dam when surplus water was spilled through the radial gates. Historically, water has spilled over Canyon Ferry Dam about 7 out of every 10 years. However, the decline in the rainbow fishery since 1986 occurred during a period of drought, with water passing through the radial gates only once in the past four years (1986). Apparently, recent declines in the rainbow fishery were not correlated with spills over Canyon Ferry Dam.

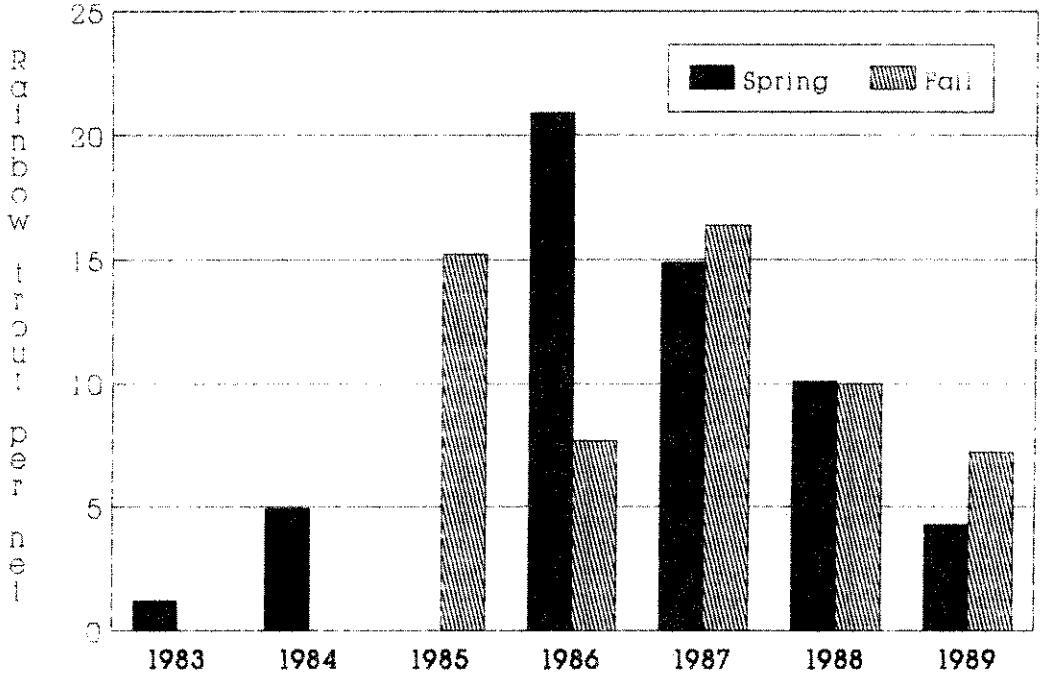

Figure 3. Average catch of rainbow trout per net night by season in floating gill nets set in Canyon Ferry Reservoir from 1983 through 1989. Data from 1983 through 1985 are from Rehwinkel (1986).

Declines in the rainbow fishery since 1986 appeared to be due to a series of hatchery plants that were relatively unsuccessful. The reasons for this poor stocking success are unknown at this time. For example, there appeared to be no correlation between the number of yearling rainbow trout collected in gill nets during the spring and the number of rainbow trout stocked into the reservoir the previous year (Figure 4). Other factors, such as the time of the year when hatchery fish were stocked or the strain of rainbow trout planted, also appeared to be unrelated to the number of yearlings collected in spring gill nets (Appendix Table 2).

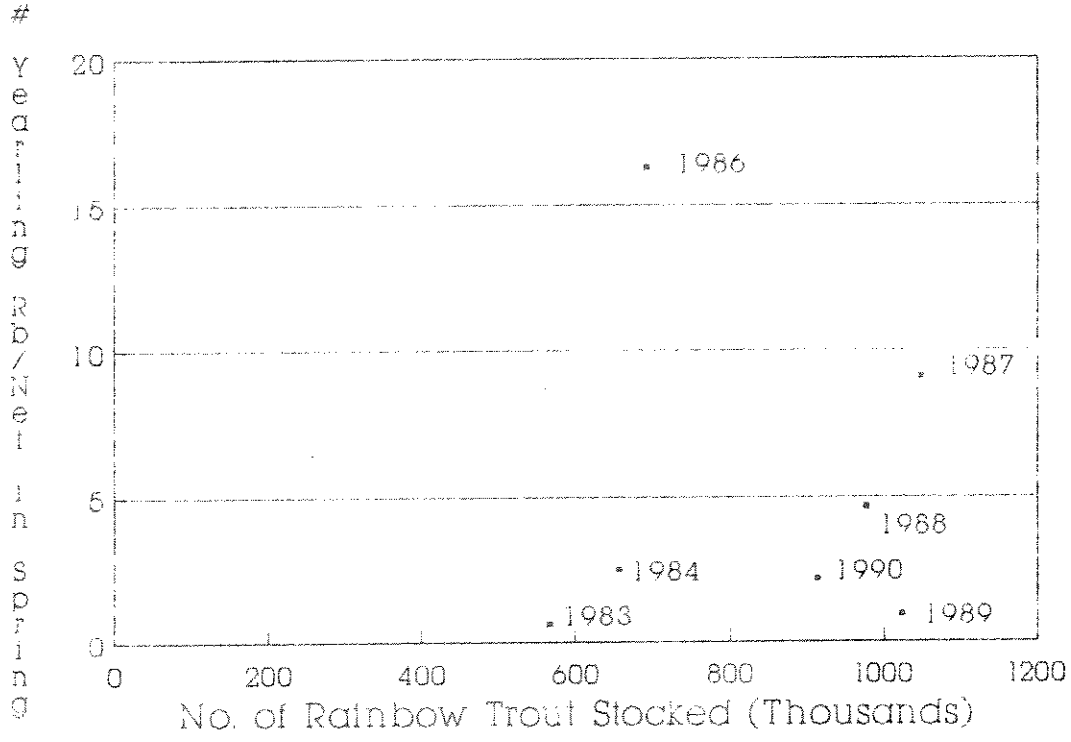

Figure 4. A comparison between the number of rainbow trout stocked into Canyon Ferry Reservoir each year to the number of yearling rainbow trout collected in horizontal gill nets set in the spring of the following year for the period 1983 through 1990.

The Arlee strain of rainbow trout has been the principal hatchery fish stocked into Canyon Ferry Reservoir in past years. Because of the short life span of the Arlee strain (1-3 years), unsuccessful plants during any one year have resulted in a poor

year class that dominated the population the following year. Based on the number of yearling rainbow trout collected in spring gill nets, survival of hatchery rainbow trout stocked during 1985 and 1986 appeared to be good, while survival from plants made in 1987 and 1988 was relatively poor (Figure 4).

The average length, weight and condition factors for rainbow trout collected in floating gill nets from 1986 through 1989 are presented in Table 1. In general, the average size of rainbow trout captured in gill nets increased annually. Condition factors for rainbow trout were similar among years, however, ranging from 38.18 to 43.35. Increases in the size of rainbow trout appeared to be correlated with changes in the age composition of the population. Because of the recent series of relatively unsuccessful hatchery plants, an increasing proportion of the population was comprised of older aged and, as a result, larger fish. The age distribution for rainbow trout collected in floating gill nets is presented in Appendix Table 3.

Table 1. Mean length, weight and condition factors for rainbow trout collected in floating gill nets set in Canyon Ferry Reservoir since 1986. Ranges are in parentheses.

YEAR	SEASON	# OF FISH	MEAN LENGTH INCHES	MEAN WEIGHT POUNDS	MEAN CONDITION FACTOR
1986	SPRING	273	13.8 (9.9-20.7)	1.16 (0.38-3.16)	42.02
	FALL	137	13.4 (9.4-18.2)	1.03 (0.37-2.43)	40.34
1987	SPRING	193	15.2 (11.9-18.7)	1.48 (0.78-2.58)	41.34
	FALL	295	15.5 (8.4-20.2)	1.71 (0.22-3.04)	42.53
1988	SPRING	131	16.2 (10.6-20.5)	1.89 (0.46-3.11)	43.35
	FALL	180	16.3 (8.6-20.2)	1.83 (0.22-3.51)	40.17
1989	SPRING	55	15.1 (5.9-20.4)	1.60 (0.07-3.16)	38.18
	FALL	130	16.0 (10.9-22.4)	1.70 (0.47-3.25)	38.86

Approximately 92% of all rainbow trout collected in floating gill nets since 1986 were of known hatchery origin (Table 2). The Arlee strain of rainbow trout, reflecting their dominant stocking rate, was the most abundant rainbow strain collected in floating gill nets in all years. A more thorough discussion of strain evaluation is discussed later in this report.

Table 2. Percent composition by strain for rainbow trout collected in floating gill nets set in Canyon Ferry Reservoir from 1986 through 1989.

		RAINBOW STRAIN					
YEAR	SEASON	ARLEE	DESMET	EAGLE LAKE	UNKNOWN HATCHERY	TOTAL HATCHERY	WILD
1986	SPRING	Data not available					
	FALL	56.9	9.5	0	25.6	92.0	8.0
1987	SPRING	54.4	17.6	0	14.5	86.5	13.5
	FALL	78.6	14.2	4.4	1.4	98.6	1.4
1988	SPRING	61.1	18.3	10.7	3.1	93.2	6.8
	FALL	55.6	18.0	15.3	1.7	90.6	9.4
1989	SPRING	45.5	9.1	29.1	7.3	91.0	9.0
	FALL	63.1	6.4	22.1	0.8	92.4	7.6
					OVERALL	92.0	8.0

Relative abundances of fish captured in sinking gill nets set during the fall are presented in Appendix Table 4. Yellow perch dominated the composition of the catch in 1986, 1987 and 1988. In 1989, white suckers dominated the composition of the catch, reflecting a decline in the relative abundance of yellow perch. However, it is doubtful that limited sampling with sinking gill nets provides a true index of abundance for yellow perch. However, winter creel data discussed later in this report also indicates a decline in the perch population in Canyon Ferry Reservoir. Yellow perch collected in sinking gill nets averaged 8.1, 7.3, 8.5, and 8.5 inches in length for the four respective years.

Summer Creel Census

Interview distribution, party size and angler day

A total of 8,332 anglers were interviewed on Canyon Ferry Reservoir during the summer period (April through November) from 1986 through 1989 (Appendix Table 5). Approximately 46% of the interviews were conducted on weekdays and 54% were conducted on weekends or holidays (Table 3). More shore anglers were interviewed during the summer than boat anglers (69% vs. 31%). However, differences in the number of interviews between the two groups probably did not represent actual differences in fishing pressure since shore anglers generally were more accessible to creel clerks than boat anglers. The number of anglers per party averaged 2.20 people, with parties of up to 9 anglers

encountered. The length of an angler day averaged 3.62 hours, remaining relatively constant among years. On the average, boat anglers fished about 0.7 hours longer per angler day than shore anglers. Bait was the most popular method of fishing over the survey period, comprising 69% of all interviews, followed by lures (23%) and a combination of tackle (8%). Very few anglers were found using flies as a fishing method (0.3%).

Table 3. 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, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS	MEAN # OF
YEAR	WEEKDAY	WEEKEND	SHORE	BOAT	FISHED/TRIP	ANGLERS/PARTY
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
OVERALL	46	54	69	31	3.62	2.20

Characteristics of anglers

Approximately 43% of all anglers interviewed on Canyon Ferry Reservoir were from either Lewis and Clark or Gallatin counties, followed by residents from Silver Bow (10%) and Broadwater (7%) counties (Table 4). Residents from the remaining Montana counties comprised about 30% of the interviews. Eight percent of all anglers surveyed were from out of state.

Table 4. Residency of anglers fishing on Canyon Ferry Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS							
						OTHER MT		
YEAR	LEWIS& CLARK	GALLATIN	SILVER BOW	BROAD-WATER	CASCADE	(EAST)	(WEST)	OUT OF STATE
1986	23.1	27.9	6.7	8.2	2.5	19.0	7.5	5.2
1987	18.7	20.7	10.4	6.5	2.1	21.4	9.4	10.8
1988	17.3	20.3	11.4	7.0	1.7	25.4	8.3	8.5
1989	16.7	26.0	11.8	6.8	2.3	19.0	8.4	9.0
MEAN	19.0	23.7	10.1	7.1	2.2	21.2	8.4	8.4

Trout was by far the most fished for species on Canyon Ferry Reservoir (73% of all interviews), followed by yellow perch and

then any available fish (Table 5). Anglers tended not to discern rainbow trout from brown trout, although most anglers were probably fishing specifically for rainbow trout. Anglers preference in fishing for rainbow trout was consistent over the four year period of survey.

Table 5. Species targeted by anglers fishing on Canyon Ferry Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS					
YEAR	TROUT	TROUT OR KOKANEE	KOKANEE	YELLOW PERCH	TROUT OR PERCH	ANY FISH
1986	81.9	0.3	0	12.7	1.9	3.3
1987	61.1	0.3	0	15.8	5.6	17.2
1988	72.7	0	0	9.8	5.5	12.0
1989	76.6	1.5	0.4	7.6	6.8	7.1

Composition of catch and catch rates

Yellow perch dominated the composition of the catch during the summer fishery except in 1989, when rainbow trout became the most readily caught species in the reservoir (Table 6). In all years, brown trout and mountain whitefish contributed very little to the fishery. Other gamefish species observed in the creel, although rarely seen, included largemouth bass, chinook salmon, brook trout and burbot.

Table 6. Composition of the catch made by anglers on Canyon Ferry Reservoir during the summers of 1986, 1987, 1988 and 1989.

		% COMPOSITION OF CATCH			
YEAR	NUMBER CAUGHT	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

Catch rates (fish per angler hour) for rainbow trout exhibited a common seasonal pattern (Figure 5). In general, this pattern was one of relatively good rainbow trout fishing during April and May followed by a decline in the fishery through July. Once a low point in the fishery was reached during July, catch rates for rainbow trout tended to increase steadily through the fall. In all years, the highest monthly catch rates for rainbow trout occurred during November.

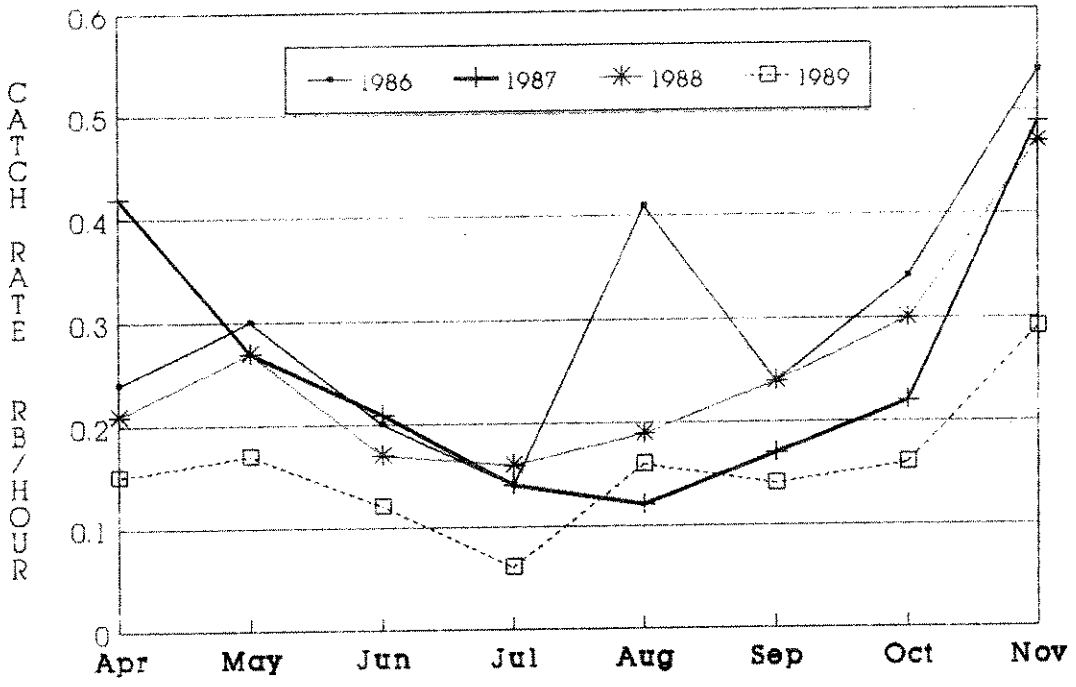

Figure 5. Average monthly catch rates (fish per angler hour) for rainbow trout in Canyon Ferry Reservoir obtained from 1986 through 1989.

Annual summer catch rates for rainbow trout and yellow perch are presented in Table 7. Overall, anglers kept approximately 91% of all rainbow trout and 80% of all yellow perch caught. Boat anglers were more successful at catching rainbow trout than shore anglers, averaging about 0.10 fish more per hour. Shore anglers, in contrast, were more successful at catching yellow perch (0.32 fish more per hour).

Table 7. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986, 1987, 1988 and 1989 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
OVERALL	0.18	0.28	0.22	90.7	0.52	0.20	0.40	80.2

Catch rates for rainbow trout declined from a high of 0.28 fish per hour in 1986 to a low of 0.16 fish per hour in 1989. Summer catch rates for rainbow trout appear to be closely related to the level of stocking success from the previous year as measured by the number of yearling trout captured per net during the spring. (Figure 6). The decline in angler catch rates between years was likely due to poor survival of hatchery fish, especially for trout stocked in 1988.

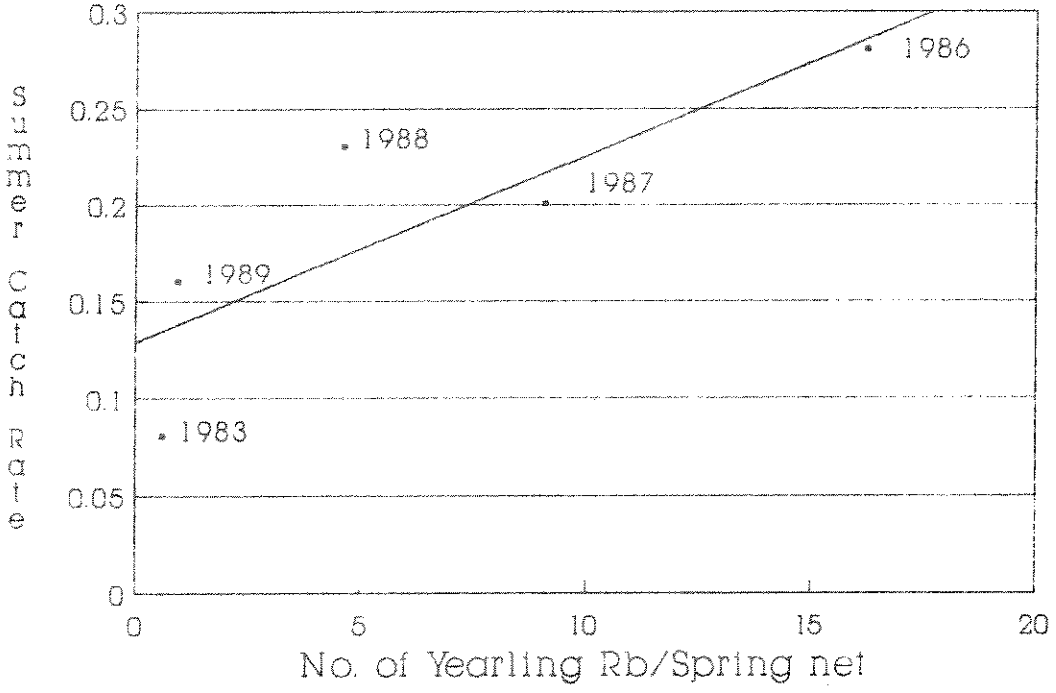

Figure 6. The relationship between the average summer catch rate (fish/angler hour) for rainbow trout and the number of yearling rainbow trout collected in horizontal gill nets set in the spring for Canyon Ferry Reservoir.

A summary of catch rates for rainbow trout from fisherman log data is shown in Figure 7. Although inflated in comparison to creel census data obtained since 1986, fisherman log data appear to reflect comparable trends in the rainbow fishery. Pre-1982 catch rates are substantially higher than post-1982 catch rates. The reasons for these differences, however, remain unclear. For example, catch rates for rainbow trout obtained from fisherman log data do not appear to be related to historic changes in the stocking program or to changes in reservoir operations.

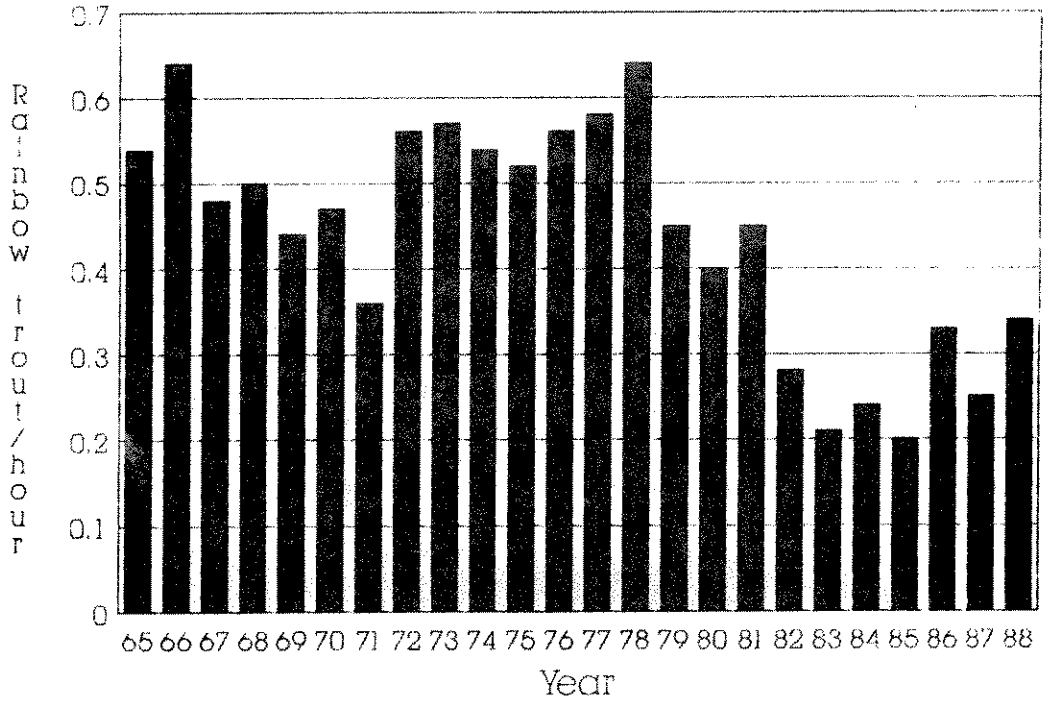

Figure 7. Angler catch rates for rainbow trout (fish/hour) as determined from fishermen log data for Canyon Ferry Reservoir from 1965 through 1988.

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the summers of 1986 through 1989 are presented in Table 8. Similar to the results obtained from gill netting, rainbow trout harvested by anglers increased in average size each year. Again, increases in the average size of these fish were probably due to changes in the age composition of the rainbow trout population. Age I+ fish dominated the rainbow trout harvest in 1986, 1987 and 1988. In 1989, the harvest was dominated by age II+ fish. Again, these data indicate that survival of hatchery fish stocked during 1988 was relatively poor. Very few rainbow trout older than three years of age were harvested from Canyon Ferry Reservoir, reflecting the short lived nature of the Arlee strain.

Table 8. Mean length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the summers of 1986, 1987, 1988 and 1989. 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

Approximately 99% of all rainbow trout harvested from Canyon Ferry Reservoir and examined for marks were of known hatchery origin (Table 9). The Arlee strain of rainbow trout dominated the harvest in all years except 1986 when a majority of the harvest was comprised of hatchery fish that could not be differentiate by strain. Although not identified by a mark, a majority of these fish were also likely Arlee strain rainbow. A more thorough discussion of strain evaluation is discussed later in this report.

Table 9. Percent composition by strain for rainbow trout harvested from Canyon Ferry Reservoir during the summers of 1986, 1987, 1988 and 1989.

	RAINBOW STRAIN					
YEAR	ARLEE	DESMET	EAGLE LAKE	UNKNOWN HATCHERY	TOTAL HATCHERY	WILD
1986	34.3	2.1	0	63.3	99.7	0.3
1987	85.7	5.8	0.3	7.6	99.4	0.6
1988	75.9	8.8	8.4	5.9	99.0	1.0
1989	71.2	5.1	16.5	5.1	97.9	2.1
				OVERALL	99.0	1.0

Winter Creel Census

Interview distribution, party size and angler day

A total of 3,961 anglers were interviewed on Canyon Ferry Reservoir during the winter ice fishery from 1986 through 1990 (Appendix Table 6). Approximately 40% of the interviews were

conducted on weekdays and 60% were conducted on weekends or holidays (Table 10). The number of anglers per party averaged 2.17 people, with parties of up to 11 anglers encountered. The length of an angler day averaged 4.2 hours.

Table 10. Distribution of interviews by day of week with mean hours per completed fishing trip and mean party size obtained on Canyon Ferry Reservoir during the winters of 1985/86 - 1989/90.

YEAR	% OF INTERVIEWS WEEKDAY	% OF INTERVIEWS WEEKEND	MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
1985/86	38.1	61.9	4.4	2.06
1986/87	32.7	67.3	3.9	2.23
1987/88	36.1	63.9	3.9	2.30
1988/89	72.5	27.5	5.1	2.02
1989/90	47.1	52.9	3.7	2.23
OVERALL	40.3	59.7	4.2	2.17

Characteristics of anglers

A majority of the anglers interviewed during the winter ice fishery were from either Lewis and Clark (30.0%), Gallatin (23.2%) or Broadwater counties (13.8%). Only 1.2% of the anglers surveyed were non-residents. Seventy four percent of all anglers surveyed were fishing in the Silos Campground area, followed by White Earth Campground (15.3%) and Confederate Creek (2.3%). Yellow perch were substantially more important to anglers during the ice fishery than during the summer. Forty percent of all anglers interviewed were seeking to catch either trout or yellow perch, followed by anglers specifically fishing for perch (31%) and then those specifically fishing for trout (25%). Four percent of the anglers indicated that they were fishing for any kind of available fish.

Composition of catch and catch rates

Yellow perch was by far the most readily caught species during the winter ice fishery in all years, averaging about 95% of the catch. Rainbow trout and brown trout contributed about 9 and 0.2% to the catch, respectively. Other gamefish observed in the winter creel included mountain whitefish and burbot.

Annual winter catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 11. Overall, anglers kept approximately 94% of all yellow perch and 97% of all rainbow trout caught. Catch rates for rainbow trout were greater during the winters of 1986/87 and 1987/88 than during the other winters. Apparently, excellent survival of the 1986 plant

produced improved fishing that carried over for the next two winters.

Table 11. Average catch rates (fish per angler hour) and percent harvested for rainbow trout and yellow perch obtained during the winters of 1985/86 - 1989/90 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
OVERALL	0.20	97.0	2.02	94.4

In general, catch rates for yellow perch declined steadily during the five year period of survey. These data, coupled with poorer catches in sinking gill nets, indicate that the population level of yellow perch has declined in Canyon Ferry Reservoir. However, it is not unusual for yellow perch populations to experience large fluctuations in year class strength (Griswold and Bjornn 1989). Future efforts for monitoring the yellow perch population in Canyon Ferry Reservoir should be directed at developing an index of abundance for young of the year fish. Griswold and Bjornn (1989) determined that beach seining was an effective technique for monitoring the abundance of young of the year perch in Cascade Reservoir, Idaho. This technique may also be applicable to Canyon Ferry Reservoir. Although data are not available for Canyon Ferry Reservoir, spring weather patterns in other waters have been shown to be correlated with fluctuations of perch populations (Forney 1971). Fisherman log data indicate catch rates for yellow perch, in general, have steadily increased over the period of record (Figure 8). These increases likely reflect expanding interest in fishing for perch rather than actual population trends.

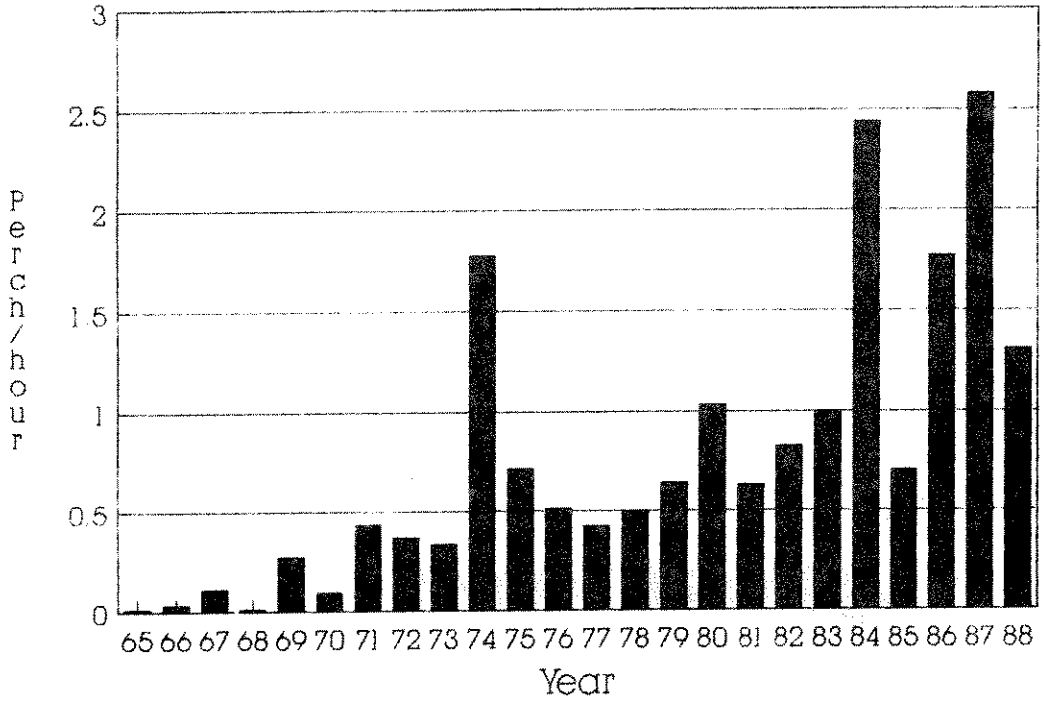

Figure 8. Angler catch rates for yellow perch (fish/hour) as determined from fishermen log data for Canyon Ferry Reservoir from 1965 through 1988.

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested during the winter ice fishery from 1985/86 through 1989/90 are presented in Table 12. As during the summer creel, harvested rainbow trout increased in average size each year, reflecting a change in the age composition of the population. The contribution of age I+ fish to the harvest declined annually between the winters of 1985/86 and 1988/89, then increased slightly during the winter of 1989/90 (Figure 9). These data appeared to be correlated with the survival of hatchery fish that were planted the previous year. The survival of rainbow trout planted in Canyon Ferry Reservoir apparently decline annually between 1985/86 and 1988/89. Comparable with gill net and summer creel data, the survival of the 1988 plant appeared to be very poor. The greater contribution of age I+ fish to the harvest during the winter of 1989/90 indicated improved survival of the 1989 plant. Although a greater percentage of fish in the harvest were of unknown origin during the winter surveys, the Arlee strain of rainbow trout dominated the catch during all years. Fewer rainbow trout could be identified by strain during the winter because vertebrae were not collected for examination.

Table 12. Mean length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the winters of 1986, 1987, 1988 and 1989. Ranges are in parentheses.

YEAR	MEAN LENGTH (INCHES)	MEAN WEIGHT (POUNDS)	MEAN CONDITION FACTOR
1985/86	14.1 (9.3-21.0)	1.27 (0.38-3.30)	40.55
1986/87	15.1 (10.2-23.3)	1.38 (0.48-6.00)	39.10
1987/88	16.6 (9.2-21.8)	1.88 (0.37-4.22)	40.34
1988/89	17.8 (12.7-21.6)	2.32 (1.00-3.46)	39.86
1989/90	18.0 (11.9-23.0)	2.25 (0.68-3.84)	37.81

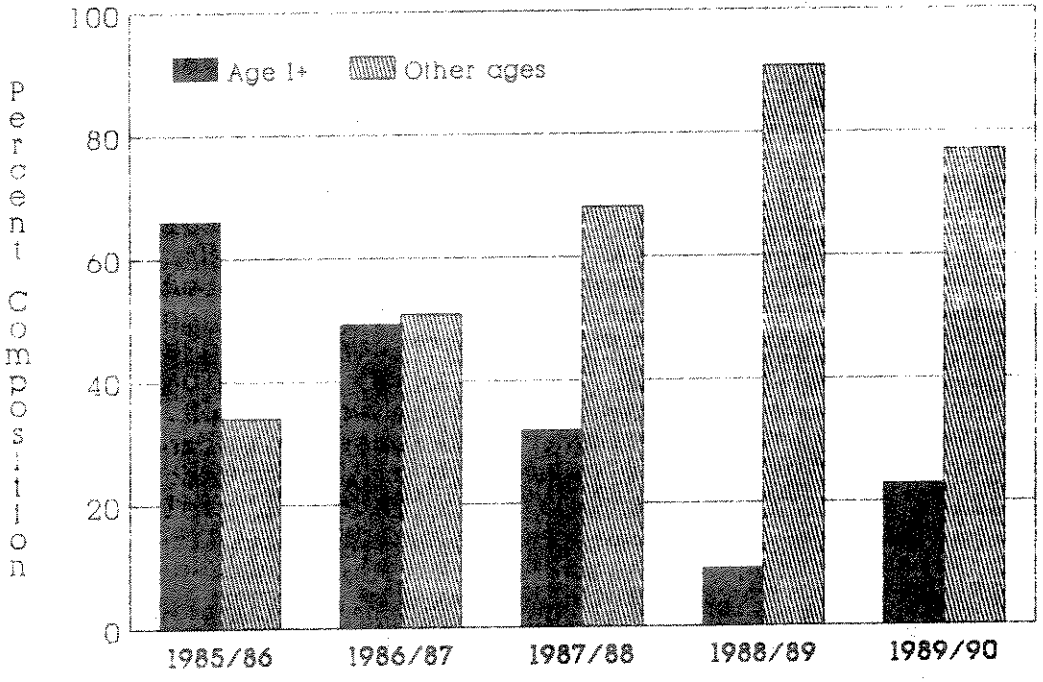

Figure 9. Age composition of rainbow trout harvested during the winter ice fishery in Canyon Ferry Reservoir from 1985/86 through 1989/1990.

The average length of yellow perch harvested during the winter ice fishery increased annually through the five year survey period, ranging from 8.2 inches in 1985/86 to 9.6 inches in 1989/90. During the same period of time, gill net and catch rate data indicated a decline in the population level. Although difficult to demonstrate due to the lack of age data, the growth rate of yellow perch in Canyon Ferry Reservoir may be dependent on the density of the population. However, increases in the average size of harvested perch in Canyon Ferry Reservoir may simply be related to changes in the age composition of the population.

HAUSER RESERVOIR

Physical Limnology and Zooplankton

Water temperatures measured at the surface and reservoir bottom for three sampling stations during 1987, 1988 and 1989 are shown in Appendix Figure 3. Surface water temperatures (to 15 feet) for the spring through fall period of survey averaged 56.6, 59.0 and 58.9 F. during 1987, 1988 and 1989, respectively. Waters at all three sampling stations (Lakeside, Causeway and Dam) tended to form a weak thermal structure beginning in May and ending in mid-September. Water temperatures at the surface peaked at 68.0, 74.0 and 78.0 F. during the three respective years.

Euphotic zone depths measured during 1987, 1988 and 1989 are presented in Appendix Figure 2. Euphotic zone depths tended to be similar at all three sampling stations. In general, euphotic zones ranged in depth from 5 to 14 feet. Euphotic zone depths for the period of survey averaged 8.6, 8.2 and 8.5 feet over the three respective years.

Zooplankton collections are continuing to be analyzed and results will be presented in a future report.

Fish Abundance and Distribution

Horizontal gill nets

Relative abundances of fish captured in floating gill nets since 1986 are presented in Appendix Table 7. Changes in the composition of gill net catches reflected a dramatic expansion in the level of the kokanee population during the survey period. Rainbow trout and kokanee contributed about 30% to the catch in 1986 and 1987. However, kokanee began to dominate the gill net catch in 1988 and their contribution to the catch continued to

increase in 1989. Kokanee comprised approximately 75% of the entire catch from floating gill nets during 1989. For rainbow trout, relative abundance appeared to remain fairly steady from 1986 through 1988, but then declined in 1989. Other species collected in floating gill nets during the survey period did not exhibit any obvious changes in population abundance.

Mean catch rates (fish per net night) for rainbow trout and kokanee from annual gill net sampling in Hauser Reservoir are shown in Figure 10. The number of rainbow trout collected in floating gill nets fluctuated annually through the survey period, ranging from 4.6 to 10.9 fish per net. The lower catch rates for rainbow trout obtained in 1989 may be associated with the expanding kokanee population, with kokanee potentially out-competing rainbow trout for food and space in the reservoir. The number of kokanee collected in floating gill nets more than doubled between 1986 and 1989, reflecting the rapid expansion of the population.

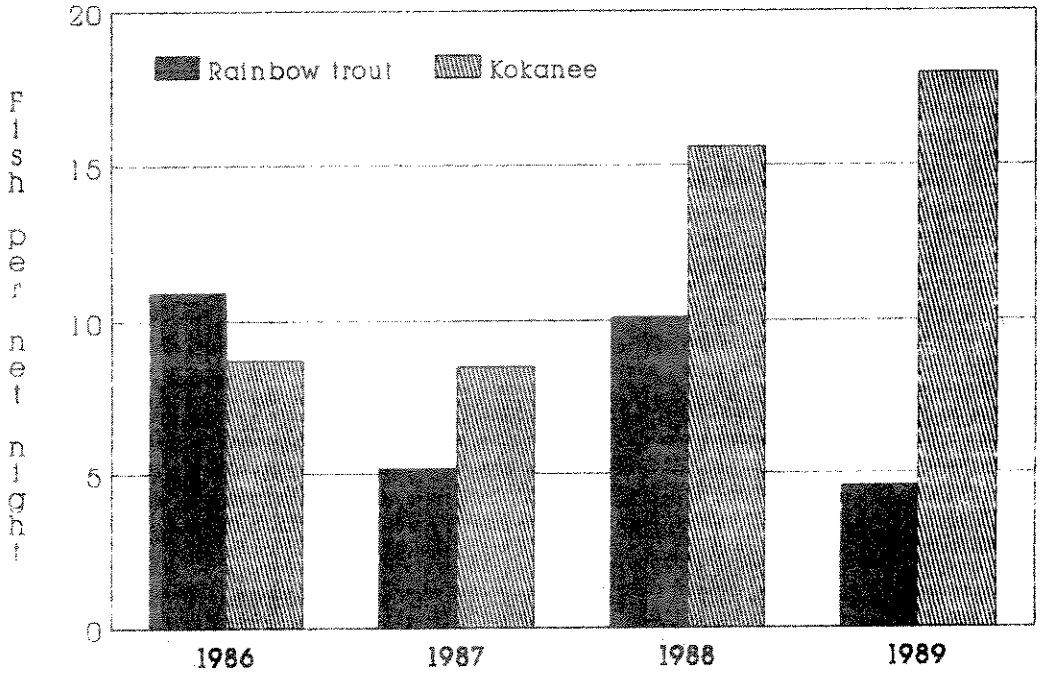

Figure 10. Average catch of rainbow trout and kokanee in floating gill nets set in Hauser Reservoir from 1986 through 1989.

Approximately 95% of all rainbow trout collected in floating gill nets during the period of survey were of known hatchery origin (Table 13). Almost all of these hatchery trout were Arlee strain

fish, reflecting the management practice of stocking about 200,000 Arlee rainbow into the reservoir each year. Only five rainbow trout collected from gill nets were fish originally from Canyon Ferry Reservoir that had passed over or through the dam. Age I+ rainbow trout dominated the catch during the spring, while age 0+ fish dominated the gill net catch during the fall. Few rainbow trout older than 2 years of age were collected in gill nets. Age I+ fish comprised about 75% of gill net catch during the spring, but their contribution declined to about 17% during the fall. The reasons for this decline may be simply due to both harvest by anglers and to entry of young of the year hatchery fish into the population.

Age II+ fish dominated the composition of captured kokanee during the spring survey period, contributing an average of about 86% to the catch. Age III+ fish comprised about 12% of the netted kokanee during the spring. Very few yearling fish were collected in spring nets. During the fall, the age composition of netted kokanee varied from year to year. Age II+ fish comprised a majority of the catch in 1987 (54%) and 1989 (89%), while age III+ kokanee dominated the catch in 1986 (50%) and 1988 (48%).

Table 13. Percent composition by strain and age for rainbow trout collected in floating gill nets set in Hauser Reservoir from 1986 through 1989.

		ARLEE RAINBOW				OTHER	TOTAL	
YEAR	SEASON	AGE 0+	AGE I+	AGE II+	AGE III+	HATCH.	HATCHERY	WILD
1986	SPRING	Data not available						
	FALL	70.5	23.9	3.4	0	0.2	100.0	0
1987	SPRING	0	64.9	18.9	2.7	5.4	91.9	8.1
	FALL	77.8	13.9	4.2	0	1.4	97.3	2.7
1988	SPRING	0	82.8	10.3	0	3.4	96.5	3.5
	FALL	82.1	12.5	1.6	0.5	1.1	97.8	2.2
1989	SPRING	0	80.0	5.0	0	0	85.0	15.0
	FALL	83.3	8.3	1.4	0	2.8	95.8	4.2
						OVERALL	94.9	5.1

The average length, weight and condition factors for rainbow trout and kokanee collected in floating gill nets during the survey period are presented in Table 14. The average length of rainbow trout remained relatively constant through the survey period, ranging from 12.9 to 13.6 inches during the spring and 10.1 to 11.7 inches during the fall. The largest rainbow trout collected was 20.1 inches in length and 3.08 pounds in weight. The average length of kokanee varied from 12.1 to 15.1 inches

during the spring and 15.4 to 17.3 inches during the fall. The largest kokanee collected was 22.6 inches in length and 3.50 pounds in weight.

Table 14. Mean length, weight and condition factors for rainbow trout and kokanee collected in floating gill nets set in Hauser Reservoir since 1986. Length is in inches and weight in pounds.

		RAINBOW TROUT				KOKANEE			
YEAR	SEASON	# OF FISH	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR	# OF FISH	MEAN LENGTH	MEAN WEIGHT	COND. FACTOR
1986	SPRING	130	13.6	1.02	39.74	13	15.1	1.31	37.55
	FALL	88	11.4	0.68	38.96	160	16.1	1.62	34.96
1987	SPRING	37	13.6	1.15	43.67	138	13.1	0.98	39.94
	FALL	72	11.7	0.77	42.75	41	15.4	1.54	39.31
1988	SPRING	29	13.6	1.15	44.83	117	14.2	1.28	42.25
	FALL	184	10.1	0.47	38.06	210	17.3	1.88	33.61
1989	SPRING	20	12.9	0.89	39.36	112	12.1	0.66	35.67
	FALL	71	11.3	0.65	39.15	248	15.9	1.36	33.74

Relative abundances of fish captured in sinking gill nets are presented in Appendix Table 4. Suckers dominated the composition of the catch in all years, averaging 84% of the total catch. In general, the number of kokanee collected in sinking gill nets increased annually, reflecting the continued expansion of the population. Other fish species collected in sinking nets did not exhibit any obvious changes in population abundance.

Vertical gill nets

Vertical gill nets were used to monitor distribution and abundance of juvenile kokanee in Hauser Reservoir. With the exception of 1986 when suckers were the most numerous, kokanee dominated the vertical gill nets catches through the survey period. Mean catch rates (fish per net night) by age class for kokanee are presented in Table 15. The number of kokanee collected in vertical nets increased substantially between 1986 and 1989, again revealing the dramatic expansion of the kokanee population in Hauser Reservoir.

Table 15. Mean catch rates (fish per net night) by age class for kokanee collected in vertical nets set at the Dam Station in Hauser Reservoir during 1986, 1987, 1988 and 1989.

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

Age I+ kokanee dominated the catch from 1986 through 1988. In 1989, however, age II+ kokanee dominated the catch in vertical nets. This change in age composition appeared to be due to two factors. First, the 1987 year class of kokanee appeared to be exceptionally strong, resulting in greater numbers of age II+ fish in 1989. Secondly, growth rates for kokanee declined during the period of survey in apparent response to the expanding population level (Figure 11). Age II+ kokanee may have become more vulnerable to gill netting in 1989 because of the their smaller average size.

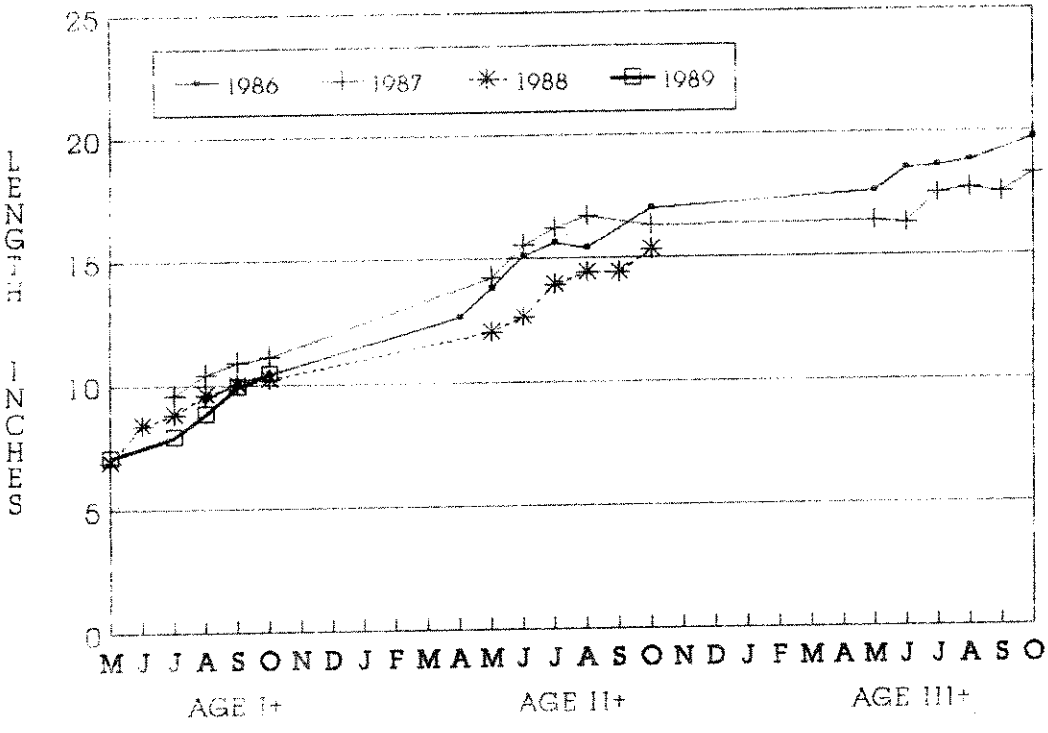

Figure 11. A comparison of empirical growth curves for four year classes of kokanee in Hauser Reservoir.

In all years, kokanee tended to be distributed in water deeper than 10 feet during July, August and September. During other sampling months, kokanee tended to be distributed throughout the water column. In general, kokanee appeared to prefer water temperatures cooler than 62 F. Shepard (1984) found a similar temperature preference for kokanee in Lake Koocanusa. During the mid-summer months, rainbow trout remained separated from kokanee by distributing themselves in water shallower than 10 feet and warmer than 62 F. During the other sampling months, rainbow trout mixed freely with kokanee.

Summer Creel Census

Interview distribution, party size and angler day

A total of 7,532 anglers were interviewed on Hauser Reservoir during the summer period (April through November) from 1986 through 1989 (Appendix Table 5). Approximately 49% of the interviews were conducted on weekdays and 51% were conducted on weekends or holidays (Table 16). More shore anglers were interviewed than boat anglers (55% vs. 45%), but this discrepancy probably does not represent actual differences in fishing pressure between the two groups. The number of anglers per party averaged 2.17 people, although parties up 8 anglers were encountered. The length of an angler day averaged 4.04 hours. Boat anglers, on average, fished about 1.2 hours longer than shore anglers. Bait was the most popular method of fishing during the survey period, comprising 54% of all interviews, followed by a combination of tackle (33%) and lures (13%). Few anglers used flies as a fishing method.

Table 16. 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, 1987,1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS	MEAN # OF
YEAR	WEEKDAY	WEEKEND	SHORE	BOAT	FISHED/TRIP	ANGLERS/PARTY
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
OVERALL	49	51	55	45	4.04	2.17

Characteristics of anglers

Approximately 48% of all anglers interviewed on Hauser Reservoir

during the survey period were from Lewis and Clark County, followed by residents from Montana counties located of west of the continental divide (23%) (Table 17). Anglers from out of state comprised about 10% of all interviews. The origin of anglers fishing Hauser Reservoir remained relatively constant during the period of survey.

Table 17. Residency of anglers fishing on Hauser Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS						
					OTHER MT		
YEAR	LEWIS& CLARK	GALLATIN	SILVER BOW	CASCADE	(EAST)	(WEST)	OUT OF STATE
1986	50.5	3.1	3.1	3.7	9.9	17.3	12.4
1987	53.7	1.0	5.0	4.8	10.3	18.3	6.9
1988	47.5	3.2	4.1	4.5	12.0	20.5	8.2
1989	38.3	4.9	7.9	7.2	14.5	14.7	12.6
MEAN	47.5	3.1	5.0	5.0	11.7	17.7	10.0

The species of fish anglers sought to catch in Hauser Reservoir gradually changed between 1986 and 1989 (Table 18). In 1986, 75% of all anglers interviewed were fishing specifically for trout. In contrast, only 29% of the anglers were specifically seeking to catch trout in 1989. Anglers apparently were changing their fishing preference towards kokanee as the kokanee population expanded. In 1989, approximately 47% of all anglers were fishing specifically for either kokanee or a combination of trout and kokanee.

Table 18. Species targeted by anglers fishing on Hauser Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS						
YEAR	TROUT	TROUT OR KOKANEE	KOKANEE	YELLOW PERCH	TROUT/ PERCH	WALLEYE/ BASS	ANY FISH
1986	75.3	0.8	11.5	3.1	1.3	0.6	7.4
1987	36.2	10.3	14.6	4.9	3.2	0.2	30.6
1988	33.5	32.1	11.9	2.6	0.4	0.1	19.4
1989	28.8	11.3	35.8	5.6	4.8	0.4	13.3

Composition of the catch and catch rates

The composition of the anglers catch changed during the survey period, reflecting the expansion of the kokanee population (Table 19). Rainbow trout dominated the catch during the summers of 1986 and 1987. However, the composition of the catch changed

during the summer of 1988, when rainbow trout and kokanee contributed about equally to the creel. In 1989, kokanee became the most readily caught species in Hauser Reservoir, comprising about 66% of the catch. The importance of yellow perch to the creel remained relatively steady during the survey period, comprising about from 10 to 20% of the catch. Brown trout, walleye and smallmouth bass contributed little to the summer fishery.

Table 19. Composition of the catch by anglers on Hauser Reservoir during the summers of 1986, 1987, 1988 and 1989.

YEAR	NUMBER CAUGHT	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

Summer catch rates (fish per angler hour) for rainbow trout and kokanee are presented in Table 20. Overall, anglers kept about 79% of all rainbow trout and 92% of all kokanee caught. Boat anglers were much more successful at catching kokanee than shore anglers. Shore anglers, in contrast, were more successful at catching rainbow trout, although it is likely boat anglers were targeting kokanee and, as a result, would be less apt to catch rainbow trout. Catch rates for rainbow trout declined through the survey period, while catch rates for kokanee increased. In contrast to Canyon Ferry Reservoir, catch rates for rainbow trout did not appear to be correlated to the level of stocking success from the previous year as measured by the number of yearling rainbow trout captured in gill nets set during the spring.

Table 20. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and kokanee during the summers of 1986, 1987, 1988 and 1989 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
OVERALL	0.29	0.15	0.21	79.2	0.03	0.36	0.22	91.8

Angler catch rates for rainbow trout exhibited a seasonal pattern similar to the pattern observed on Canyon Ferry Reservoir. Rainbow catch rates were moderate in the spring, low in mid-summer and then high during the fall (Figure 12). Catch rates for kokanee, in contrast, exhibited a pattern of relatively low rates in the spring and the fall, with high rates occurring during mid-summer (Figure 13). Seasonal patterns by these two species seem to complement each other, providing a good fishery in Hauser Reservoir throughout the summer.

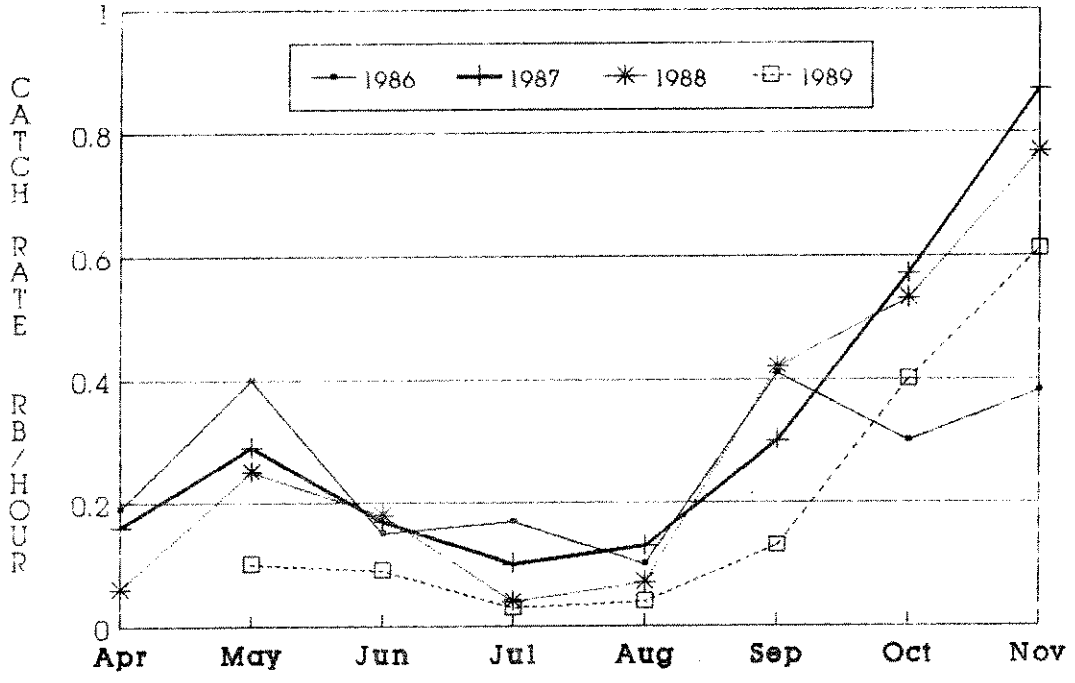

Figure 12. Average monthly catch rates (fish per angler hour) for rainbow trout in Hauser Reservoir obtained from 1986 through 1989.

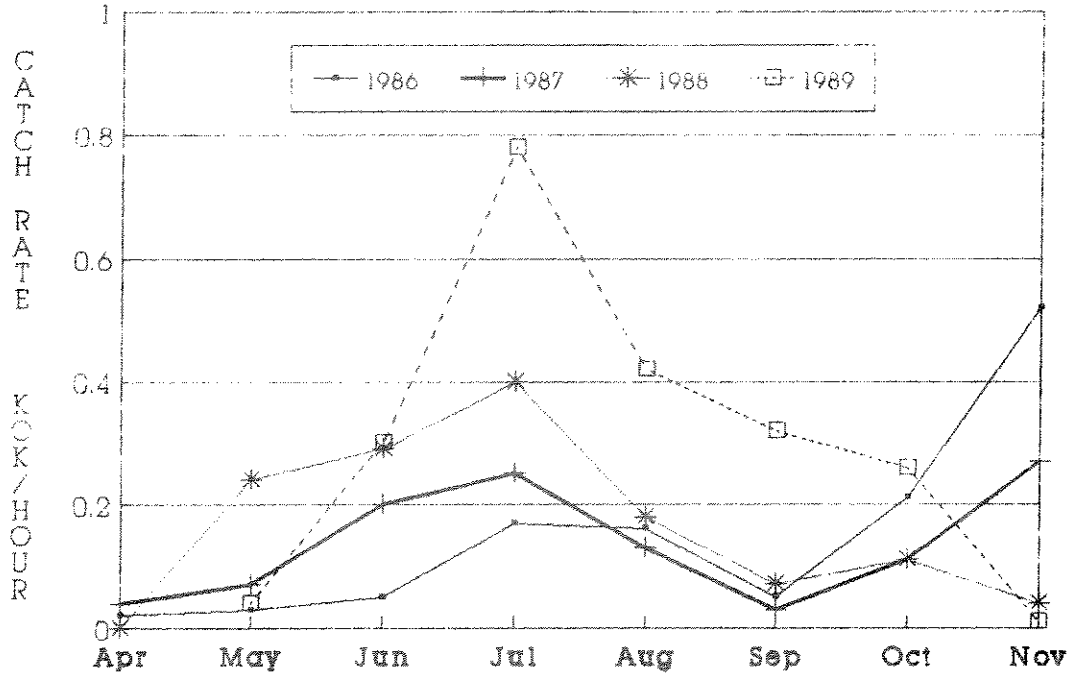

Figure 13. Average monthly catch rates (fish per angler hour) for kokanee in Hauser Reservoir obtained from 1986 through 1989.

Characteristics of harvested gamefish

Approximately 93% of all rainbow trout harvested during the survey period were of known hatchery origin (Arlee strain). Only 9 rainbow trout taken out of Hauser Reservoir were fish that were originally stocked into Canyon Ferry Reservoir. Apparently, few fish have flushed from Canyon Ferry Reservoir because of the near lack of spill through the radial gates at Canyon Ferry Dam.

The average length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the summer survey period are presented in Table 21. Age 0+ hatchery fish comprised between 19 and 46% of the harvest in 1986, 1987 and 1989 (Figure 14). In 1988, however, young of the year trout comprised only 8% of the harvest, indicating poor survival of the 1988 plant. For kokanee, age II+ fish dominated the harvest in all years, averaging about 89% of the total number caught. The smaller average size of the kokanee harvested during 1989 appeared to be a result of a declining growth rate in response to the continued expansion of the population.

Table 21. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the summers of 1986, 1987, 1988 and 1989. 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

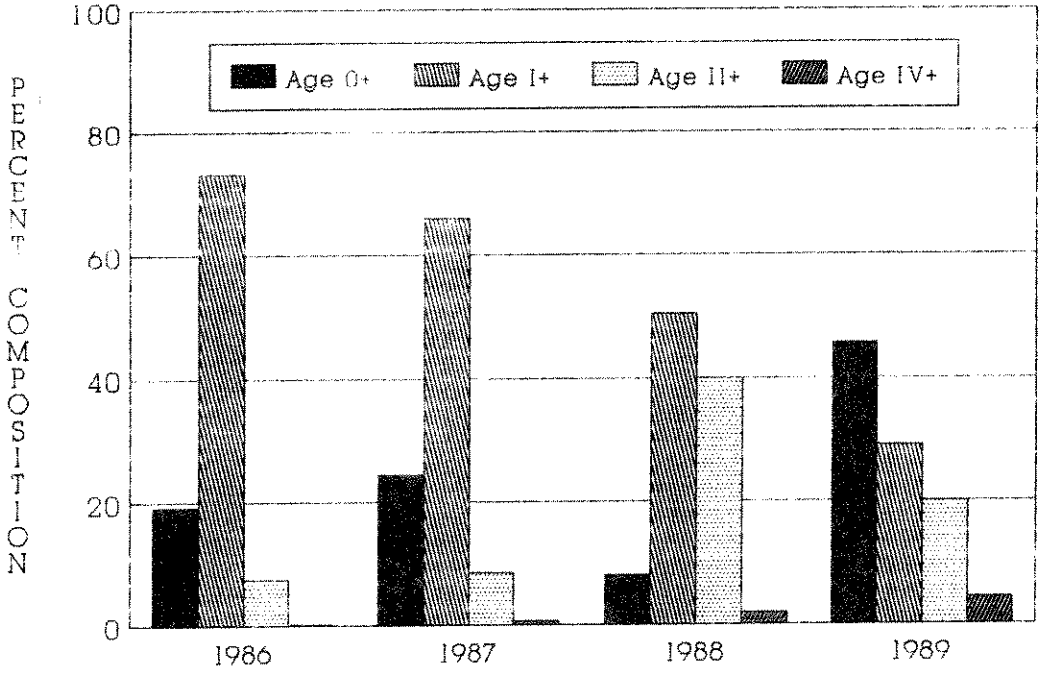

Figure 14. Age composition of rainbow trout harvested from Hauser Reservoir during the summers of 1986, 1987, 1988, 1989.

Winter Creel Census

Interview distribution, party size and angler day

A total of 873 anglers were interviewed on Hauser Reservoir during the winter ice fishery in 1989 and 1990 (Appendix Table 6). Approximately 43% of the interviews were conducted on weekdays and 57% were conducted on weekends or holidays. The number of anglers per party averaged 1.88 people, with parties of up to 8 anglers encountered. The length of an angler day averaged 3.7 hours.

Characteristics of anglers

A majority of anglers interviewed during the winter ice fishery were from Lewis and Clark County (54.6%), followed by Silver Bow County (13.6%). Residents from other Montana counties west of the continental divide comprised almost 18% of the interviews. Only 1.1% of the interviews were from out of state. Most of the anglers interviewed were fishing either the Black Sandy (54%) or Causeway area (39%). Thirty two percent of all anglers interviewed were specifically seeking to catch rainbow trout, followed by anglers specifically fishing for kokanee (27%). Twenty three percent of the anglers indicated that they were fishing for any kind of available fish. Only 7% of the anglers were seeking to catch yellow perch.

Composition of catch and catch rates

Kokanee was the most readily caught species during the winter ice fishery in both years, averaging about 37% of the catch. Yellow perch and rainbow trout contributed about 34 and 27% to the catch, respectively. Other gamefish observed in the creel included brown trout and mountain whitefish.

Annual winter catch rates (fish per angler hour) for rainbow trout, kokanee and yellow perch are presented in Table 22. Overall, anglers kept approximately 73% of the rainbow trout, 89% of the kokanee and 90% of the yellow perch caught during the winter. Catch rates for rainbow trout and kokanee tended to be lower during the winter than during the summer, while the catch rate for yellow perch tended to be higher.

Table 22. Average catch rates (fish per angler hour) and percent harvested for rainbow trout, kokanee and yellow perch obtained during the winters of 1989 and 1990 on Hauser Reservoir.

YEAR	RAINBOW PER HOUR	% KEPT	KOKANEE PER HOUR	% KEPT	Y. PERCH PER HOUR	% KEPT
1989	0.18	68.9	0.23	87.8	0.20	85.8

Table 22. continued.

YEAR	RAINBOW PER HOUR	% KEPT	KOKANEE PER HOUR	% KEPT	Y. PERCH PER HOUR	% KEPT
1990	0.11	88.0	0.18	90.3	0.20	98.5
OVERALL	0.16	73.2	0.21	88.5	0.20	90.0

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout and kokanee harvested during the winter ice fishery are presented in Table 23. Approximately 94% of all rainbow trout harvested were of known hatchery origin (Arlee strain). Age 0+ fish comprised about 26% of the harvest in 1989 and 40% of the harvest in 1990. For kokanee, yearling fish comprised a majority (82%) of the harvest in 1989. In 1990, about 41% of the harvest was comprised of yearling fish and 59% was comprised of age II+ fish. Yellow perch harvested during the winter averaged 9.0 and 7.7 inches in length during 1989 and 1990, respectively.

Table 23. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the winters of 1989 and 1990. 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
1989	16.5 (9.4-23.8)	2.17 (0.32-5.50)	42.9	11.6 (9.5-21.5)	0.63 (0.29-2.86)	36.6
1990	16.4 (11.2-22.2)	2.03 (0.53-4.41)	40.4	12.9 (10.2-15.7)	0.77 (0.37-1.37)	34.2

HOLTER RESERVOIR

Physical Limnology and Zooplankton

Water temperatures measured at the surface and reservoir bottom for two sampling stations during 1987, 1988 and 1989 are shown in Appendix Figure 4. Surface water temperatures (to 15 feet) for the spring through fall period of survey averaged 57.6, 59.2 and 60.4 F. during 1987, 1988 and 1989, respectively. Water in mid-

reservoir (Cottonwood station) tended to form a weak thermal structure beginning in mid-May and ending in mid-September. In the lower reservoir (Jackson station), water tended to form a weak thermal structure beginning the first of May and ending in late October. Water temperatures at the surface peaked at 67.0, 72.0, and 74.0 F. during the three respective years.

Euphotic zone depths measured during 1987, 1988 and 1989 are presented in Appendix Figure 5. Euphotic zone depths were shallower in mid-reservoir than in the lower reservoir. In general, euphotic zones were shallowest during the spring and deepest during July. Euphotic zone depths for the period of survey averaged 11.3, 11.2 and 11.4 feet over the three respective years.

Zooplankton collections are continuing to be analyzed and results will be presented in a future report.

Fish Abundance and Distribution

Horizontal gill nets

Relative abundances of fish captured in floating gill nets from 1986 through 1989 are presented in Appendix Table 8. With the exception of 1986 and 1989 when suckers dominated the catch during spring sampling, rainbow trout was the most abundant species of fish collected in floating gill nets. The relative abundance of kokanee, at least during fall sampling, increased substantially between 1987 and 1988 and continued to increase in 1989 (comprising about 33% of the catch). Increases in the relative abundance of kokanee may be indicative of an expanding population similar to the expansion that occurred in Hauser Reservoir. The relative abundance of walleye was fairly consistent, comprising up to 10% of the catch. Other species of fish collected in floating nets did not exhibit any obvious changes in population abundance.

Mean catch rates (fish per net night) for rainbow trout and kokanee from annual gill net sampling in Holter Reservoir are shown in Figure 15. The number of rainbow trout collected in floating nets fluctuated annually, ranging from a high of 14.6 fish per net in 1987 to a low of 5.2 fish per net in 1989. For kokanee, mean catch rates increased annually through the survey period. Again, the kokanee population in Holter Reservoir may be beginning to expand as it did in Hauser Reservoir.

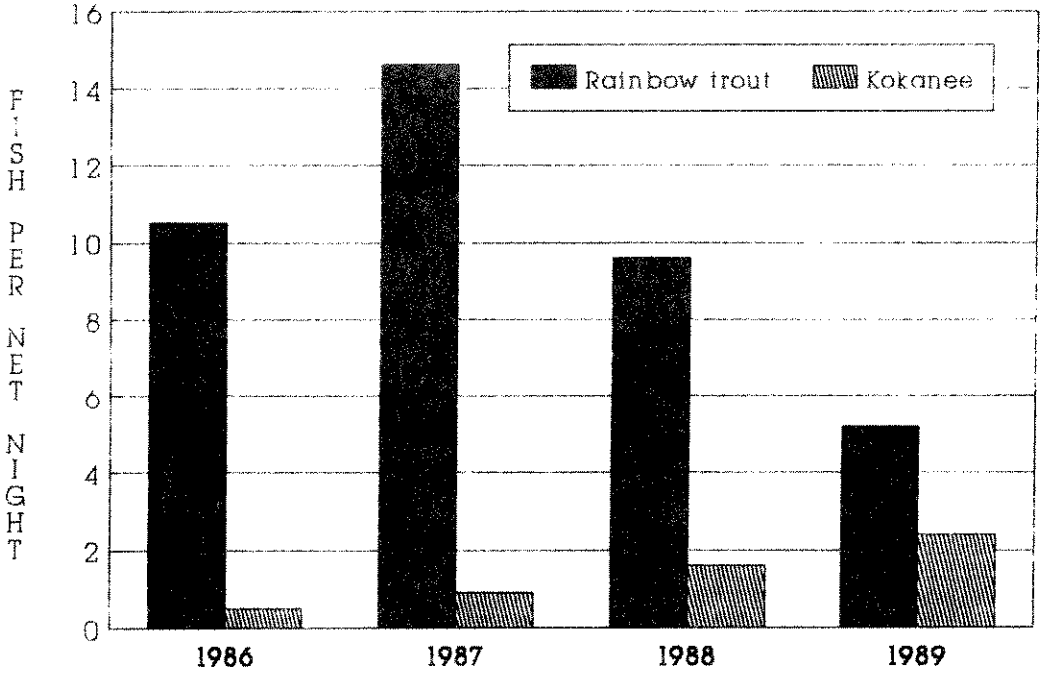

Figure 15. Average catch of rainbow trout and kokanee per net night set in Holter Reservoir from 1986 through 1989.

Most of the rainbow trout collected in floating gill nets since 1986 were of known hatchery origin (Arlee strain) (Table 24). However, a substantial portion of the catch was comprised of rainbow trout that had apparently originated from the wild. The contribution of wild fish to the gill net catch may have been even greater if it had been possible to discern the origin of unmarked trout. Because the marking program for hatchery rainbow trout was initiated in 1986, a substantial number of rainbow trout collected in gill nets during 1986 and 1987 remained unmarked. Many of these unmarked fish may also have originated from natural reproduction.

Almost all of the hatchery trout collected in gill nets were Arlee strain fish, reflecting the management practice of stocking about 325,000 Arlee rainbow into the reservoir each year. Age I+ Arlee dominated the gill net catch of hatchery fish during the spring, while age 0+ Arlee dominated the catch of hatchery fish in the fall. Few hatchery rainbow trout older than 2 years of age were collected in gill nets. Very few McConaughy strain rainbow were collected during the sampling period. Apparently, the 130,000 McConaughy rainbow stocked into the Hauser section of the Missouri River and Beaver Creek over a 3 year period (1984-

1986) failed to significantly contribute to the fishery in the reservoir. Only 2 rainbow trout (Arlee) originally from Hauser Reservoir and 1 rainbow trout (Eagle Lake) originally from Canyon Ferry Reservoir were collected in gill nets during the four year period of survey.

Table 24. Percent composition by strain for rainbow trout collected in floating gill nets set in Holter Reservoir from 1986 through 1989.

		RAINBOW STRAIN					
YEAR	SEASON	ARLEE	McCONAUGHY	UNKNOWN HATCHERY	TOTAL HATCHERY	WILD	UNKNOWN
1986	SPRING	Data not available					
	FALL	50.0	5.2	4.2	59.4	5.2	35.4
1987	SPRING	36.1	2.1	0	38.2	17.5	44.3
	FALL	63.2	3.9	0.7	67.8	3.9	28.3
1988	SPRING	50.9	3.6	0	54.5	34.5	10.9
	FALL	61.4	0	0	61.4	20.5	18.2
1989	SPRING	46.4	7.1	0	53.5	46.4	0
	FALL	65.6	0	0	65.6	32.8	0

The average length, weight and condition factors for rainbow trout collected in floating gill nets during the survey period are presented in Table 25. The average length of rainbow trout remained relatively consistent through the survey period, ranging from 13.0 to 15.4 inches in length. The largest rainbow trout collected was 20.6 inches in length. Kokanee averaged 14.2 inches in length during spring sampling and 18.1 inches in length during fall sampling. The largest kokanee collected was 22.1 inches in length and 3.91 pounds in weight.

Table 25. Mean length, weight and condition factors for rainbow trout collected in floating gill nets set in Holter Reservoir from 1986 through 1989. Ranges are in parentheses.

YEAR	SEASON	# OF FISH	MEAN LENGTH INCHES	MEAN WEIGHT POUNDS	MEAN CONDITION FACTOR
1986	SPRING	41	15.1 (12.7-20.1)	1.31 (0.73-2.25)	37.7
	FALL	96	13.0 (9.5-18.8)	1.02 (0.30-2.30)	42.0
1987	SPRING	97	13.9 (10.0-20.6)	1.13 (0.33-2.55)	39.9

Table 25. continued.

YEAR	SEASON	# OF FISH	MEAN LENGTH INCHES	MEAN WEIGHT POUNDS	MEAN CONDITION FACTOR
	FALL	152	13.8 (10.2-19.6)	1.19 (0.54-2.74)	43.2
1988	SPRING	110	14.8 (6.6-19.5)	1.30 (0.10-2.28)	39.0
	FALL	44	13.9 (10.5-19.7)	1.14 (0.51-2.76)	39.0
1989	SPRING	28	15.4 (11.7-18.1)	1.39 (0.56-2.15)	37.4
	FALL	64	13.5 (9.3-19.8)	1.11 90.31-2.58)	41.0

Relative abundances of fish captured in sinking gill nets set during the period of survey are presented in Appendix Table 4. Suckers dominated the composition of the catch in all years, averaging 63% of the catch. Yellow perch was the next most abundant species collected during the survey period, averaging 29% of the catch.

The number of walleye captured in sinking gill nets remained relatively constant through the sampling period, ranging from 1.33 to 4.33 fish per sinking net (Table 26). With the exception of fish collected during 1987, the average size of walleye also remained constant, ranging from 19.1 to 20.5 inches in length and from 2.70 to 3.60 pounds in weight. Condition factors for walleye were lower in the spring than the fall, averaging 32.7 and 36.8, respectively. Low spring condition factors for walleye were likely associated with spawning stress. Overall, age IV+ walleye comprised almost 30% of the catch, followed by age V+ fish (16%), age III+ fish (15%) and age II+ fish (12%). Walleye up to 10 years in age were collected. However, age analyses should be considered preliminary because of the difficulty in reading scales. Confirmation of aging will be made by comparing scale readings with length frequency data and analysis of spine sections.

Table 26. 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 1989. Ranges are in parentheses.

YEAR	SEASON	NUMBER PER NET	MEAN LENGTH (IN)	MEAN WEIGHT (LBS)	MEAN CONDITION FACTOR
1986	SPRING	--	--	--	--
	FALL	2.33	20.0 (15.0-30.0)	3.31 (1.12-10.0)	35.8

Table 26. continued.

YEAR	SEASON	NUMBER PER NET	MEAN LENGTH (IN)	MEAN WEIGHT (LBS)	MEAN CONDITION FACTOR
1987	SPRING	2.60	12.2 (9.5-16.6)	0.70 (0.22-1.69)	31.3
	FALL	3.17	16.7 (9.7-26.2)	2.05 (0.26-8.00)	36.7
1988	SPRING	2.17	19.1 (11.0-27.9)	3.00 (0.40-8.00)	33.8
	FALL	1.33	19.6 (15.6-25.4)	2.87 (1.52-5.00)	36.7
1989	SPRING	2.50	19.6 (17.2-27.0)	2.70 (1.55-7.50)	33.1
	FALL	4.33	20.5 (13.3-29.1)	3.60 (0.78-8.60)	37.9

A total of 130 stomachs were collected from walleye in Holter Reservoir from 1986 through 1989 for food habits analyses. All stomachs were collected from fish captured in gill nets. Approximately 35% of the stomachs were empty. Fish was the principal component in the diet of walleye comprising 99.5% of the total dietary volume. Species of fish consumed by walleye, in order of importance, included yellow perch, sculpins, suckers, rainbow trout, mountain whitefish and walleye. However, most of the fish consumed by walleye could not be identified. Indices of relative importance (IRI) for food items consumed by walleye are given in Table 27. IRI values tended to overestimate the importance of zooplankton and insects in the diet of walleye.

Table 27. Indices of relative importance (IRI) for food items in the diet of walleye collected from Holter Reservoir from 1986 through 1989. Total number of stomachs=130.

FOOD ITEM	% OCCURRENCE	% NUMBERS	% VOLUME	IRI
YELLOW PERCH	12.3	15.3	32.0	21.1
SCULPIN	5.4	12.0	20.0	13.2
SUCKER	0.8	0.6	7.1	3.0
RAINBOW TROUT	1.5	2.7	1.7	2.1
M. WHITEFISH	0.8	0.6	0.3	0.6
WALLEYE	0.8	0.6	0.1	0.5
UNKNOWN FISH	46.2	36.6	38.3	42.8
DAPHNIA	6.9	16.4	<0.1	8.2
LEPTODORA	1.5	3.3	<0.1	1.7
DIPTERA	3.9	9.3	<0.1	4.7
LEACH	1.5	1.6	0.2	1.2
OTHER	18.4	1.0	0.2	0.9

Vertical gill nets

The composition of the catch in vertical gill nets set into Holter Reservoir varied annually through the period of survey (Table 28). Rainbow trout was the most abundant species collected in vertical nets during 1986 and longnose sucker was the most abundant species collected in 1987. In 1988 and 1989, yellow perch was the most abundant species collected. With the exception of kokanee, the various fish species collected did not exhibit any obvious changes in population abundance during the four year period of survey. For kokanee, mean catch rates (fish per net night) remained relatively constant from 1986 through 1988, ranging from 5.6 to 7.3 fish per net night. However, the mean catch rate for kokanee increased substantially in 1989, averaging 17.3 fish per net night. As with floating gill nets, this increase may be indicative of an expanding kokanee population in Holter Reservoir.

During July, August and September, kokanee in Holter Reservoir tended to reside in water deeper than 45 feet. During other sampling months, kokanee appeared to be distributed throughout the water column. Similar to the fish in Hauser Reservoir, kokanee in Holter Reservoir appeared to prefer water temperatures cooler than 62 F. Rainbow trout tended to be separated from kokanee during the mid-summer months, distributing themselves in water shallower than 45 feet. Rainbow trout appeared to mix freely with kokanee during the remainder of the survey period.

Table 28. Percent composition by species for fish collected in vertical nets set into Holter Reservoir since 1986.

SPECIES	1986	1987	1988	1989
RB	44.8	34.5	7.3	19.8
LL	0	0.6	0	0.3
KOK	16.4	16.9	5.3	21.3
Y. PERCH	21.6	0.6	64.8	47.5
WE	1.5	0.6	0.7	0
LNSU	11.2	40.9	17.7	8.0
WSU	3.7	5.3	4.1	2.5
MWF	0.8	0.6	<0.1	0.6

Summer Creel Census

Interview distribution, party size and angler day

A total of 5,612 anglers were interviewed on Holter Reservoir during the summer period (April through November) from 1986 through 1989 (Appendix Table 5). Approximately 36% of the

interviews were conducted on weekdays and 64% were conducted on weekends or holidays (Table 29). A greater number of interviews were conducted with boat anglers than with shore anglers (59% vs. 41%). Actual differences in fishing pressure between boat and shore anglers are probably greater than observed during the survey period because shore anglers tended to be more accessible to creel clerks. The number of anglers per party averaged 2.23 people. Parties of up to 8 anglers were encountered. The length of an angler day was slightly longer than fishing trips on Canyon Ferry and Hauser reservoirs, averaging 4.14 hours. Boat anglers, on average, fished about 1.3 hours longer than shore anglers.

Table 29. 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, 1987,1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS	MEAN # OF
YEAR	WEEKDAY	WEEKEND	SHORE	BOAT	FISHED/TRIP	ANGLERS/PARTY
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
OVERALL	36	64	41	59	4.14	2.23

Characteristics of anglers

Approximately 61% of all anglers interviewed on Holter Reservoir were from Cascade County, followed by other Montana counties located east of the continental divide (23%) (Table 30). Lewis and Clark County residents comprised only 6% of the interviews. Residents from out of state comprised about 8% of all interviews.

Table 30. Residency of anglers fishing on Holter Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS						
	LEWIS&		SILVER		OTHER MT		OUT OF
YEAR	CLARK	GALLATIN	BOW	CASCADE	(EAST)	(WEST)	STATE
1986	3.0	1.0	0.4	62.7	12.9	14.8	5.2
1987	6.2	0.8	1.5	58.8	12.1	13.5	7.0
1988	7.3	1.5	1.3	61.9	12.7	8.3	7.0
1989	7.6	1.4	0.8	59.2	14.2	8.5	8.3
MEAN	6.0	1.2	1.0	60.6	13.0	11.3	6.9

Trout was the most fished for species on Holter Reservoir (58% of all interviews), followed by any available fish (18%) (Table 31). Interest in fishing for yellow perch appeared to increase through the survey period, ranging from 6% to 17% of the interviews. Surprisingly, the number of anglers seeking to catch walleye remained relatively constant through the survey period, averaging about 3% of the interviews. The substantial increase in the number of anglers willing to catch any species of fish between 1986 and the remainder of the survey period was probably due to a bias introduced by creel clerks conducting the survey. Bait was the most popular method of fishing during the survey period (48%), followed by lures (26%) and a combination of tackle (25%). Few anglers used flies as a fishing method.

Table 31. Species targeted by anglers fishing on Holter Reservoir during the summers of 1986, 1987, 1988 and 1989.

	PERCENT OF TOTAL INTERVIEWS						
YEAR	TROUT	TROUT OR KOKANEE	KOKANEE	YELLOW PERCH	TROUT/ PERCH	WALLEYE	ANY FISH
1986	84.9	0.3	0.1	5.8	3.0	1.3	4.5
1987	52.4	2.6	1.2	12.3	3.1	4.9	23.5
1988	41.6	10.2	0.3	13.2	1.7	3.5	29.5
1989	53.5	7.3	0.7	17.1	4.8	1.8	14.9
MEAN	58.1	5.1	0.6	12.1	3.2	2.9	18.1

Composition of the catch and catch rates

The composition of the catch by anglers gradually changed over the period of survey (Table 32). Rainbow trout contributed less to the catch each year while yellow perch contributed more each year. Kokanee, walleye, brown trout and mountain whitefish contributed little to the total catch of fish from Holter Reservoir. The contribution to the catch by kokanee appeared to remain relatively constant despite data from gill nets indicating that the kokanee population was gradually expanding.

Table 32. Composition of the catch by anglers on Holter Reservoir during the summers of 1986 through 1989.

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

Annual summer catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 33. Holter Reservoir appeared to provide the best and most consistent rainbow trout fishery among the three reservoirs. Overall, anglers kept about 80% of all rainbow trout and 81% of all yellow perch caught. Catch rates for rainbow trout remained relatively constant through the survey period, ranging from 0.29 to 0.37 fish per hour. Boat anglers were more successful at catching rainbow trout than shore anglers. As in Hauser Reservoir, catch rates for rainbow trout did not appear to be correlated to the level of stocking success from the previous year as measured by the number of yearling rainbow trout captured in gill nets during the spring. In general, catch rates for yellow perch tended to increase through the survey period. Shore anglers were more successful at catching yellow perch than boat anglers during 1986, 1987 and 1988. In 1989, however, boat anglers were about 2.5 times more successful at catching perch than shore anglers. Catch rates for walleye by anglers specifically seeking to catch the fish varied annually through the survey period, averaging 0.03, 0.27, 0.12 and 0.08 fish per hour over the four respective years.

Table 33. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986, 1987, 1988 and 1989 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
OVERALL	0.23	0.36	0.33	80.1	0.50	0.42	0.44	80.8

Angler catch rates for rainbow trout exhibited a seasonal pattern similar to the pattern observed on Canyon Ferry and Hauser reservoirs. Rainbow catch rates were moderate in the spring, low in mid-summer and then highest during the fall (Figure 16). Catch rates for yellow perch, in contrast, exhibited a pattern of relatively low rates in the spring and fall, with high rates occurring during mid-summer.

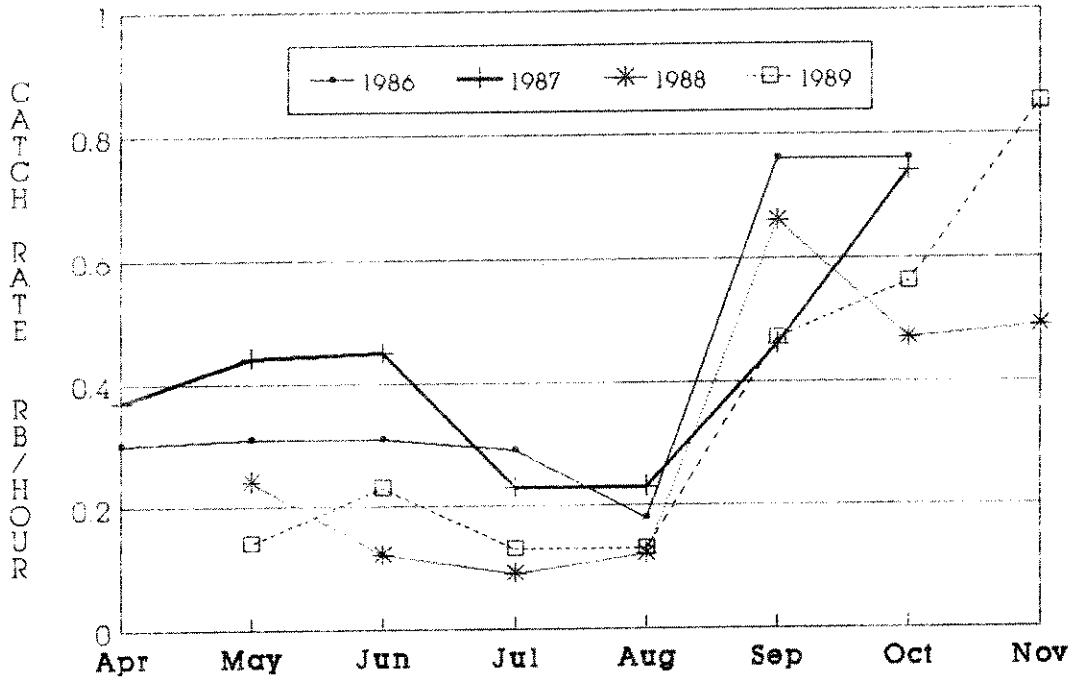

Figure 15. Average monthly catch rates (fish per angler hour) for rainbow trout in Holter Reservoir obtained from 1986 through 1989.

Characteristics of harvested gamefish

During the years when nearly all age classes of hatchery fish were marked (1988 and 1989), approximately 90% of all rainbow trout harvested from Holter Reservoir were of known hatchery origin. In contrast, 'wild' rainbow trout comprised up to 46% of the catch in gill nets. These data indicate that the Arlee strain of rainbow trout was much easier for anglers to catch than the fish originating from the wild. The Arlee strain comprised by far the majority of the rainbow harvest. Only six McConaughy strain rainbow were harvested during the survey period. In addition, two rainbow trout taken from Holter Reservoir were fish that had been originally stocked into Canyon Ferry Reservoir (Desmet strain).

The average length, weight and condition factors for rainbow trout harvested from Holter Reservoir are presented in Table 34. The average length of harvested rainbow trout remained relatively constant through the survey period, ranging from 13.7 to 14.5 inches. Age I+ trout strongly dominated the catch during 1986

and 1987 (Figure 17). In 1988 and 1989, however, age 0+ fish contributed substantially to the harvest. Apparently, over-winter survival of young of the year hatchery fish was poorer in 1987 and 1988 than during the two previous years. Few fish older than 2 years of age were harvested, reflecting the short lived nature of the Arlee strain.

Table 34. Mean length, weight and condition factors for rainbow trout harvested from Holter Reservoir during the summers of 1986, 1987, 1988 and 1989. Ranges are in parentheses.

YEAR	MEAN LENGTH (INCHES)	MEAN WEIGHT (POUNDS)	MEAN CONDITION FACTOR
1986	13.9 (8.1-20.8)	1.17 (0.22-4.44)	40.8
1987	13.8 (7.5-22.2)	1.11 (0.19-3.71)	41.0
1988	13.7 (7.5-20.8)	1.17 (0.24-3.26)	41.6
1989	14.5 (8.9-21.3)	1.26 (0.33-2.88)	39.7

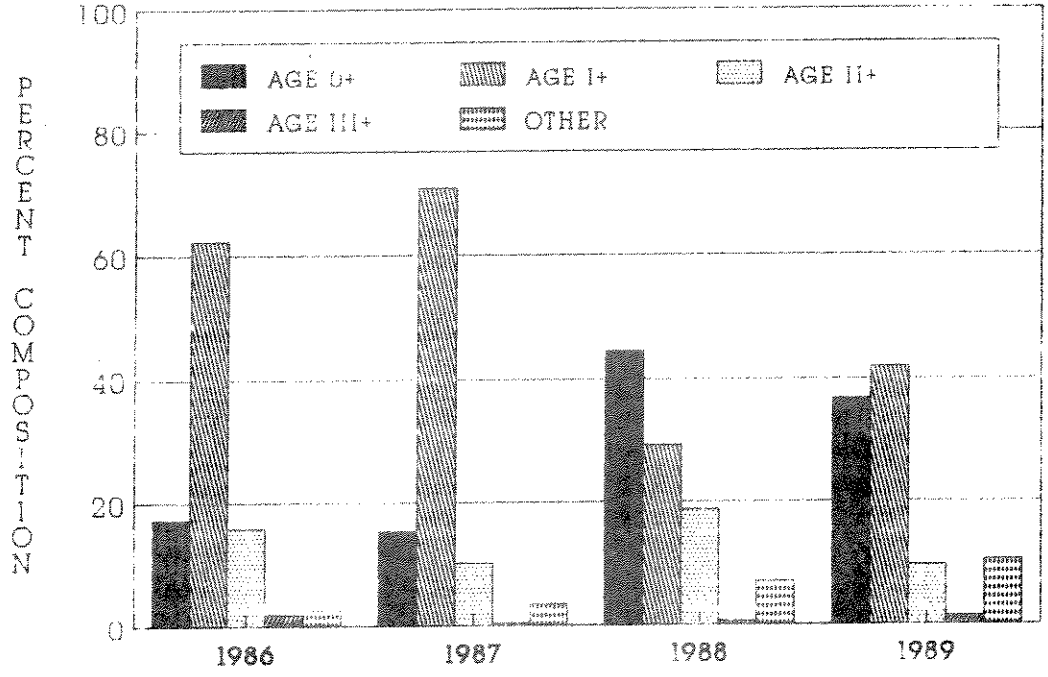

Figure 17. Age composition of rainbow trout harvested from Holter Reservoir during the summers of 1986, 1987, 1988 and 1989.

Winter Creel Census

Interview distribution, party size and angler day

A total of 927 anglers were interviewed on Holter Reservoir during the winter ice fishery in 1987, 1989 and 1990 (Appendix Table 6). Approximately 26% of the interviews were conducted on weekdays and 74% on weekends. The number of anglers per party averaged 2.29 people, with parties of up to 8 people encountered. The length of an angler day averaged 3.6 hours.

Characteristics of anglers

A majority of anglers interviewed during the winter ice fishery were from Cascade County (85%), followed by Lewis and Clark County (7%). Less than 1% of the anglers interviewed were from out of state. Most of the anglers were fishing either at Departure Point (31%), Black Beach (19%) or Log Gulch (15%). Ice fishermen also utilized the Lake Lodge and the BLM campground areas to some extent. Approximately 40% of the anglers interviewed were seeking to specifically catch yellow perch, followed by a combination of yellow perch and trout (36%) and then specifically trout (15%).

Composition of the catch and catch rates

Yellow perch was by far the most readily caught species during the winter ice fishery, comprising about 91% of the catch. Rainbow trout comprised about 8.5% of the catch. Other gamefish observed in the creel, although rare, included brown trout, mountain whitefish and walleye.

Winter catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 35. Overall, anglers kept about 96% of all yellow perch and rainbow trout caught. Winter catch rates for both rainbow trout and yellow perch were higher on Holter Reservoir than either Canyon Ferry or Hauser reservoirs.

Table 35. Average catch rates (fish per angler hour) and percent harvested for rainbow trout and yellow perch obtained during the winters of 1987, 1989 and 1990 on Holter Reservoir.

YEAR	RAINBOW TROUT/HOUR	%KEPT	YELLOW PERCH/HOUR	%KEPT
1987	0.49	83.3	0.60	97.5
1989	0.23	98.0	2.95	96.6
1990	0.24	98.4	3.05	96.0
OVERALL	0.26	95.6	2.77	96.4

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested during the winter ice fishery are presented in Table 36. About 92% of all rainbow trout harvested during the winter were of known hatchery origin (Arlee strain). Age 0+ trout comprised about 80% of the harvest in both 1989 and 1990. Yellow perch harvested in the winter averaged 8.7, 8.4 and 9.0 inches in length during the three respective years.

Table 36. Mean length, weight and condition factors for rainbow trout harvested from Holter Reservoir during the winters of 1987, 1989 and 1990. Ranges are in parentheses.

YEAR	MEAN LENGTH (INCHES)	MEAN WEIGHT (POUNDS)	MEAN CONDITION FACTOR
1987	12.3 (8.5-20.0)	Data not available	
1989	13.4 (10.9-19.2)	1.02 (0.52-2.70)	40.9
1990	13.4 (10.1-21.3)	0.92 (0.44-2.30)	37.2

STRAIN EVALUATION

Growth Rates and Condition Factors

Empirical growth curves for the Arlee, Desmet and Eagle Lake strains of rainbow trout stocked into Canyon Ferry Reservoir are presented in Figure 18. These curves represent the growth of the 1987 Arlee and Eagle Lake plant and the 1986 Desmet plant. Monthly growth rates for the Arlee, Desmet and Eagle Lake strains averaged 0.48, 0.43 and 0.53 inches per month, respectively. Differences in monthly growth rates among the three strains probably were due more to differences in the time of year and average size when the fish were stocked than to strain type. The Arlee and Desmet rainbow were planted during May, while the Eagle Lake rainbow were planted during July and August. In addition, the 1986 Desmet rainbow were planted as hold-over yearlings at an average length of about 6.5 inches. The Arlee and Eagle Lake fish were planted as young of the year fish, averaging about 4.0 and 3.5 inches in length, respectively. In spite of these differences, all three strains reached a similar length by the end of their second growing season (18.0 inches) and all three strains appeared to reach a plateau in growth of about 20.0 inches by the end of their third growing season. Too few McConaughy rainbow trout have been collected in Holter Reservoir to make a valid evaluation of their performance.

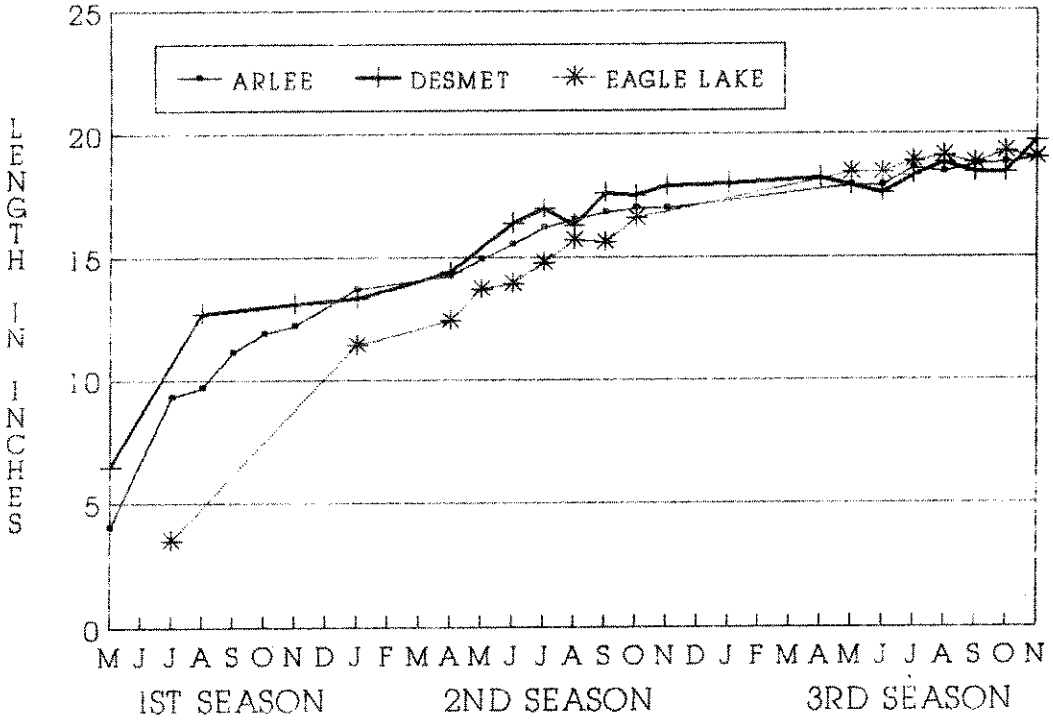

Figure 18. A comparison of empirical growth curves among Arlee, Desmet and Eagle Lake strains of rainbow trout in Canyon Ferry Reservoir.

A comparison of average condition factors among the three strains of rainbow trout is presented in Table 37. Overall, condition factors were greatest for the Arlee strain, intermediate for the Eagle Lake strain and least for the Desmet strain. Because the Desmet strain rainbow were planted as yearlings, condition factors among strains were compared by the year of stocking, not by age class. For all three strains, condition factors declined as the fish grew older. In all years, condition factors were greatest for fish during their second growing season in the reservoir.

Table 37. Mean condition factors for the Arlee, Desmet and Eagle Lake strains of rainbow trout in Canyon Ferry Reservoir. Number of fish are in parentheses.

	TIME SPENT IN THE RESERVOIR			
STRAIN	FIRST SEASON	SECOND SEASON	THIRD SEASON	FOURTH SEASON
ARLEE	42.11 (575)	43.51 (1480)	39.02 (853)	35.63 (37)

Table 37. continued.

STRAIN	TIME SPENT IN THE RESERVOIR FIRST SEASON	SECOND SEASON	THIRD SEASON	FOURTH SEASON
DESMET	37.61 (26)	39.29 (122)	36.28 (173)	32.75 (27)
EAGLE LAKE	38.05 (20)	42.46 (157)	36.12 (88)	--

Food Habits

Food habits appeared to be similar among the three strains of rainbow trout (Table 38). All stomachs examined were obtained from spring and fall gill netting. For all strains, analyses included stomachs collected during both the spring and the fall of the year. Daphnia was the most important food item consumed by all three strains of rainbow trout, with indices of relative importance (IRI) values ranging from 61.55 for the Arlee strain to 69.92 for the Eagle Lake strain. Leptodora was the next most important food item for the Arlee strain rainbow, followed by dipterans. Fish was the second most important food item in the diet for both the Desmet and Eagle Lake strain rainbow trout, followed by Leptodora and dipterans. It was surprising to find fish in the diet of the Desmet strain rainbow since it is known for its habit of feeding almost exclusively on zooplankton.

Table 38. Indices of relative importance (IRI) for food items in the diet of Arlee, Desmet and Eagle Lake rainbow trout collected from Canyon Ferry Reservoir during 1988.

PARAMETER	ARLEE	DESMET	EAGLE LAKE
NUMBER OF STOMACHS	28	16	19
FOOD ITEM:			
DAPHNIA	61.55	66.48	69.92
LEPTODORA	11.12	5.48	3.83
DIPTERA	9.64	4.61	4.96
COLEOPTERA	0.80	4.70	3.81
HEMIPTERA	0	3.09	2.48
HYMENOPTERA	0.80	1.53	2.48
EPHEMEROPTERA	2.64	1.53	0
FISH	7.86	6.42	5.08
OTHER	5.59	6.16	7.44

Survival and Catchability

Overall, the two 'wild' strains of rainbow trout (Desmet and Eagle Lake) appeared to survive longer in the reservoir than the Arlee strain. However, the Arlee strain appeared to be easier for anglers to catch. Based on gill net collections, both the Desmet (yearling plants) and the Eagle Lake strains of rainbow trout appeared to survive better in the reservoir than the Arlee strain (Table 39). This conclusion assumes that the Arlee, Desmet and Eagle Lake strains of rainbow trout have equal susceptibility to capture in gill nets. For example, the Desmet strain planted in 1986 comprised about 6% of the total number of fish stocked into the reservoir, but comprised about 27% of the 1986 plant collected in gill nets over a four year period of survey. For another example, the Eagle Lake strain comprised about 26% of the 1987 plant, but comprised about 30% of the 1987 plant collected in gill nets over a three year period of survey.

Table 39. 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.

			PERCENT COMPOSITION							
		TOTAL	1986		1987		1988		1989	
YEAR	STRAIN	STOCKED	NET	CREEL	NET	CREEL	NET	CREEL	NET	CREEL
1986	ARLEE	94.1	86.0	94.5	74.5	86.6	66.3	74.2	31.6	67.2
	DESMET	5.9	14.0	5.5	25.5	13.4	33.7	25.8	68.4	32.8
1987	ARLEE	74.3	--	--	87.5	93.6	68.4	82.7	40.0	79.0
	E. LAKE	25.7	--	--	12.5	6.4	31.6	17.3	60.0	21.0
1988	ARLEE	74.9	--	--	--	--	89.2	100.0	70.0	80.7
	E. LAKE	11.9	--	--	--	--	10.8	0.0	30.0	19.3
	DESMET	13.2	--	--	--	--	0.0	0.0	0.0	0.0
1989	ARLEE	85.7	--	--	--	--	--	--	96.7	100.0
	E. LAKE	14.3	--	--	--	--	--	--	3.3	0.0

Desmet rainbow stocked as yearlings in the spring (1986) appeared to survive better than either the Eagle Lake or Arlee strains (stocked as young of the year fish). However, it is impossible to determine if apparent differences in survival are due to strain type or due to the differences in the size of fish at the time of stocking or the time of year when the fish were planted. Desmet strain rainbow stocked as young of the year fish in the fall (1988) , for example, apparently did not survive long enough to be captured in gill nets or by anglers.

In general, the composition of the Arlee rainbow collected in gill nets declined annually from their original composition in the plant. In contrast, the composition of the 'wild' rainbow strains (Desmet and Eagle Lake) collected in gill nets annually increased in comparison to their original composition in the plant (except the 1988 plant of age 0+ Desmet).

Survival of hatchery rainbow trout is a function of hardiness, longevity and vulnerability to harvest by anglers. Poorer survival of the Arlee strain may be simply due to a combination of a short life span (about 2 years) and a greater susceptibility to harvest by anglers. A comparison of the composition of rainbow strains in gill nets to the composition of rainbow strains in the creel indicates that the Arlee strain was substantially easier for anglers to catch than the two 'wild' strains of rainbow. In all years, the composition of Arlee rainbow made up a greater percentage in the creel than in gill net collections. In contrast, the composition of 'wild' rainbow strains made up a lesser percentage in the creel than in gill net collections.

HAUSER SECTION OF THE MISSOURI RIVER

Population Estimates

Rainbow trout

Fall population estimates for rainbow trout in the Hauser section of the Missouri River are presented in Table 40. Population estimates presented for 1982 and 1983 were obtained by White et. al. (1984). Densities of rainbow trout ranged from a low of 5,061 fish per section in 1982 to a high of 17,087 fish per section in 1986. In general, population levels in the Hauser section appeared to be intermediate compared to levels found in the Craig and Cascade sections located below Holter Dam (Leathe and Hill 1987).

Table 40. Estimated numbers of rainbow trout obtained in the Hauser section of the Missouri River (2.86 miles) during the fall of 1982, 1983, 1985, 1986, 1987, and 1989. Eighty percent confidence intervals are in parentheses.

AGE GROUP	1982	1983	1985	1986	1987	1989
I	2,213	4,119	4,716	12,441	5,981	5,282
II	2,483	1,224	1,168	2,566	1,873	1,192
III	365	701	1,851	1,767	1,035	1,416
IV & older	2		479	312	363	985
TOTAL	5,061	6,044	8,214	17,087	9,252	8,875
	(864)	(1,422)	(1,597)	(4,618)	(786)	(917)
# per MILE	1,770	2,113	2,872	5,974	3,235	3,103

Rainbow densities in the Hauser section were greatly influenced by hatchery fish, either by introductions into the river or by flushing of hatchery fish over or through Hauser Dam. In addition, low numbers of Arlee rainbow stocked into Holter Reservoir were found to move into the river section. McConaughy strain rainbow trout were stocked into the Hauser section of the river and into Beaver Creek during the summers of 1984, 1985 and 1986 (approximately 50,000 each year). These hatchery introductions were undoubtedly responsible for the substantial increase in the number of rainbow trout estimated to be in the river section after 1983. Introduced McConaughy rainbow comprised approximately 9.4, 13.6 and 0.4% of the fall rainbow population during 1986, 1987, and 1989, respectively. Interestingly, McConaughy introductions did not appear to substantially increase estimated numbers of age II+ fish. Apparently, few McConaughy rainbow survived more than one year after they were stocked.

Arlee rainbow trout that had flushed over or through Hauser Dam into the Hauser section comprised approximately 10.6, 0.8 and 5.4% of the fall rainbow population in 1986, 1987, and 1989, respectively. These losses apparently were associated with the magnitude and duration of spring spill. Although relatively minor when compared to the historical record, 1986 was the only year of the three in which water was spilled through the radial gates at Canyon Ferry Dam. This also was the year in which the greatest numbers of reservoir fish were found in the river section.

Estimated densities of older age rainbow trout (age III+ and older) were substantially greater in 1985, 1986, 1987 and 1989 than in 1982 or 1983. Increased densities of older aged fish may have been a result of a change in fishing regulations initiated

in 1983. The former limit of 10 pounds plus one fish or 10 fish was restricted to a limit of 5 fish including only one fish longer than 18 inches.

Brown trout

Fall population estimates for brown trout in the Hauser section of the Missouri River are presented in Table 41. Population estimates presented for 1982 and 1983 were obtained by White et. al. (1984). Fall estimates of brown trout must be considered merely as indices of abundance since a number of assumptions required for accurate estimation were violated, including movements by spawning fish. Estimated densities of brown trout ranged from a high of 1,406 fish per section in 1985 to a low of 555 fish per section in 1989. Brown trout densities in the Hauser section were somewhat greater than fall estimates obtained by Berg (1983) in sections of the Missouri River located below Holter Dam. However, the fall population of brown trout in the Hauser section is substantially influenced by spawners moving into the river section from Holter Reservoir. White et. al. (1986) estimated that about 70% of the fall population was comprised of migrant spawners from Holter Reservoir.

Table 41. Estimated numbers of brown trout obtained in the Hauser section of the Missouri River (2.86 miles) during the fall of 1982, 1983, 1985, 1986, 1987, and 1989. Eighty percent confidence intervals are in parentheses.

AGE GROUP	1982	1983	1985	1986	1987	1989
I	257	199	256	194	114	159
II	702	576	214	510	151	148
III	293	369	542	456	187	140
IV & older	135	202	394	100	299	108
TOTAL	1,387	1,346	1,406	1,260	750	555
	(181)	(212)	(304)	(468)	(112)	(124)
NO. > 20.0"	386	432	292	91	288	110
NUMBER/MILE	485	471	492	441	262	194

Since 1985, the population level of brown trout declined annually through the period of survey. This decline appeared to be associated with the expansion of kokanee populations in Hauser and Holter reservoirs. Brown trout and kokanee spawn in the same areas at the same time and, as a result, may be competing with each other for spawning sites. However, there are other possible reasons, or combination of reasons, for the decline in the brown

trout population. Disease transfer from kokanee to brown trout, over-harvest by anglers and limited reproduction due to a series of low flow years may be other possible factors that have contributed to this decline.

The conclusion that fall population levels have declined in recent years is supported by a decline in the number of brown trout redds counted in the river. On November 30, 1989 a total of 48 brown trout redds were observed from Hauser Dam to Cochran Gulch. In contrast, 156 brown trout redds were observed in the same river section during the fall of 1982 (Spoon 1985).

Reports of fungus infections on brown trout by anglers fishing the Hauser section of the river began to surface in about 1985. Anglers were observing dead or dying kokanee covered with fungus and were also observing what they felt was an increasing incidence of infection on brown trout. Although fungus infections in spawning populations are quite common, angler reports lead to the monitoring of fungus infections on brown trout while conducting fall electrofishing work on the Hauser section of river. The incidence of infection on brown trout collected by electrofishing is presented in Table 42. The level of infection on spawning brown trout appeared to be within the norm (pers. comm. with Jim Peterson). Approximately 5% of all brown trout examined had the infection. Males in spawning condition had the greatest incidence of infection, averaging about 13% of those examined. Males would be expected to have a greater incidence of infection because of the greater number of injuries sustained while competing with other males during spawning. The incidence of fungus appeared to remain relatively constant through the period of survey, indicating the disease was not spreading throughout the population. Fungus infections on spawning brown trout did not appear to be a significant factor in the annual decline of the population.

Table 42. Incidence of fungus (Saprolegnia) on brown trout collected in the Hauser section of Missouri River during the fall of 1985, 1986, 1987 and 1989. Percent incidence in parentheses.

	NO. OF FISH EXAMINED				NO. OF FISH WITH FUNGUS			
YEAR	TOTAL	SPAWNERS	MALES	FEMALES	TOTAL	SPAWNERS	MALES	FEMALES
1985	378	235	73	162	14 (3.7)	14 (6.0)	13 (17.8)	1 (0.6)
1986	95	44	2	42	10 (10.5)	8 (18.2)	1 (50.0)	7 (16.7)
1987	237	176	61	115	7 (3.0)	7 (4.0)	3 (4.9)	4 (3.5)

Table 42. continued.

YEAR	NO. OF FISH EXAMINED TOTAL	SPAWNERS	MALES	FEMALES	NO. OF FISH WITH FUNGUS TOTAL	SPAWNERS	MALES	FEMALES
1989	201	93	16	77	13 (6.5)	13 (14.0)	3 (18.8)	10 (13.0)
TOTAL	911	548	152	396	44 (4.8)	42 (7.7)	20 (13.2)	22 (5.6)

Creel Census

A fishing pressure and harvest survey was conducted on the Hauser section of the Missouri River during the periods September 4 through November 30, 1982; March 16 through November 20, 1983; and October 12 through November 17, 1985. All field work was supervised by A. Wipperman, but data collected were never formally summarized or included in a report. These data are presented in this report because of the growing interest in the interaction of fish populations (especially brown trout and kokanee) within this section of river.

Distribution of interviews

A total of 570, 2,728 and 364 angler interviews were conducted on the Hauser section during 1982, 1983 and 1985, respectively (Appendix Table 9). In all years, approximately 40% of the interviews were conducted on weekdays and 60% were conducted on weekends. In 1982 and 1983, most interviews were conducted either in the upper 0.2 miles of the river section or a 1.0 mile section located immediately above Beaver Creek. In 1985, most interviews were conducted in a 1.5 mile section located immediately above Beaver Creek.

Characteristics of anglers

Approximately 77% of all anglers interviewed on the Hauser section were from the Helena area. Residents from out of state comprised about 10% of the interviews. Seventy seven percent of the anglers interviewed were male and 8% were unlicensed juveniles. Approximately 95% of all anglers interviewed were fishing from shore. The type of tackle used by anglers appeared to remain relatively constant through the three years of survey (Table 43). Bait was the most popular method of fishing during all three years, followed by flies in 1982 and 1983 and lures in 1985.

Table 43. Type of tackle used by anglers fishing the Hauser section of the Missouri River during 1982, 1983 and 1985.

YEAR	TOTAL INTERVIEWS	PERCENT OF TOTAL BAIT	LURES	FLIES	COMBINATION
1982	570	51.9	10.0	23.9	14.2
1983	2728	64.8	10.7	12.4	12.2
1985	364	47.0	24.2	17.9	11.0

Fishing pressure

Monthly summaries of fishing pressure (angler hours) obtained during the three years of survey are presented in Table 44. Shore anglers comprised about 95% of the total fishing pressure on the river through the survey period. A conversion factor of 3.0 hours per completed fishing trip (estimated) was used to compute the number of angler days expended. During 1983, an estimated total of 8,719 angler days were expended on the river. Total fishing pressure estimated for the Hauser section was similar to pressure estimates obtained on the Holter section by Leathe and Hill (1987). Annual fishing pressure on the Hauser section estimated by the statewide mail survey totaled about 16,500 angler days during 1983. Obviously, the mail survey estimate was greatly inflated when compared to the creel survey.

Table 44. Monthly summaries of fishing pressure estimates (angler-hours) for the Hauser section of the Missouri River obtained during 1982, 1983 and 1985. Eighty percent confidence intervals are in parentheses.

MONTH	1982 SHORE	1982 BOAT	1982 TOTAL	1983 SHORE	1983 BOAT	1983 TOTAL	1985 SHORE	1985 BOAT	1985 TOTAL
MAR.				1133	62	1195			
APR.				2709	253	2962			
MAY				2498	95	2593			
JUNE				3846	107	3953			
JULY				5073	263	5336			
AUG.				2801	134	2935			
SEPT.	2139	223	2362	2039	148	2187			
OCT.	2556	174	2730	3010	137	3147	2378	53	2431
NOV.	1493	75	1568	1830	21	1851	878	69	947
TOTAL	6188	472	6660 (265)	24939	1220	26159 (581)	3256	122	3378 (192)

Catch rates and harvest

Catch rates for rainbow trout, brown trout and kokanee are presented in Table 45. Consistent with population estimates, catch rates were much higher for rainbow trout than for brown trout or kokanee. For all species, catch rates peaked during November. For the season-long survey in 1983, mean catch rates for rainbow trout and brown trout were somewhat lower than what were observed in the river below Holter Dam by Leathe and Hill (1987). Mean catch rates for rainbow trout and brown trout appeared to be similar among the three years for the comparable months of October and November. Catch rates for kokanee appeared to increase over the three year period, possibly reflecting an expansion in the spawning population. Overall, anglers kept 67% of all rainbow trout, 60% of all brown trout and 88% of all kokanee caught. Mountain whitefish also provided a decent fishery in the river, with catch rates averaging 0.06, 0.10, and 0.07 during the three respective years.

Table 45. Monthly summary of catch rates (fish per angler hour) for rainbow trout, brown trout and kokanee obtained on the Hauser section of the Missouri River during 1982, 1983 and 1985.

	CATCH RATES (FISH PER HOUR)								
	RAINBOW TROUT			BROWN TROUT			KOKANEE		
MONTH	1982	1983	1985	1982	1983	1985	1982	1983	1985
MAR.	--	0.10	--	--	0.04	--	--	0.0	--
APR.	--	0.26	--	--	0.03	--	--	<0.01	--
MAY	--	0.15	--	--	0.04	--	--	0.0	--
JUNE	--	0.15	--	--	0.04	--	--	0.02	--
JULY	--	0.25	--	--	0.05	--	--	0.07	--
AUG.	--	0.18	--	--	0.03	--	--	0.07	--
SEPT.	0.49	0.38	--	0.05	0.03	--	0.01	0.05	--
OCT.	0.48	0.52	0.26	0.10	0.05	0.07	0.01	0.12	0.09
NOV.	0.49	1.25	0.70	0.11	0.11	0.06	0.12	0.19	0.34
TOTAL	0.49	0.35	0.37	0.08	0.04	0.07	0.03	0.06	0.15

Monthly harvest estimates for rainbow trout, brown trout and kokanee are presented in Table 46. During the season long survey in 1983, a total of 5,848 rainbow trout, 741 brown trout and 1,263 kokanee were harvested by anglers. Peak harvest for all three species of fish occurred during July. Leathe and Hill (1987) estimated 9,219 rainbow trout and 228 brown trout were harvested in the river section immediately below Holter Dam during 1986. For brown trout, harvest estimates in the Hauser section appeared to be considerably higher than harvest in the Holter section. In contrast, harvest estimates for rainbow trout were lower in the Hauser section. Based on estimates obtained in

October and November, harvest of rainbow trout was higher in 1982 and 1983 than in 1985. For brown trout, harvest was similar between 1983 and 1985, but was lower than in 1982.

Table 46. Monthly summary of estimated harvest for rainbow trout, brown trout and kokanee obtained on the Hauser section of the Missouri River during 1982, 1983 and 1985. Eighty percent confidence intervals are in parentheses.

	ESTIMATED HARVEST								
	RAINBOW TROUT			BROWN TROUT			KOKANEE		
MONTH	1982	1983	1985	1982	1983	1985	1982	1983	1985
MAR.	--	92	--	--	36	--	--	0	--
APR.	--	583	--	--	81	--	--	4	--
MAY	--	316	--	--	65	--	--	0	--
JUNE	--	562	--	--	115	--	--	70	--
JULY	--	1263	--	--	220	--	--	385	--
AUG.	--	433	--	--	62	--	--	164	--
SEPT.	890	564	--	73	35	--	10	101	--
OCT.	1045	1141	393	143	66	59	29	326	212
NOV.	455	894	374	104	61	17	111	213	289
TOTAL	2390	5848	767	320	741	76	150	1263	501
	(241)	(307)	(100)	(66)	(77)	(22)	(82)	(141)	(147)

A comparison of harvest to fall population estimates for brown trout obtained during 1983 is presented in Table 47. These data indicate that the harvest level for brown trout was relatively high (58.3% of the population harvested). Harvest levels for brown trout less than 15 inches in length appeared to be extremely high. Harvest may be affecting the younger age classes of brown trout more than the older "trophy size" age groups. However, it is important to keep in mind that fall population estimates for brown trout are relatively inaccurate because of spawning movements. Problems with fall population estimates probably provide an explanation for the absurdly high harvest levels for fish in the 10.0 to 15.0 inch length group (113.5%).

Table 47. Brown trout harvest during 1983 compared to fall populations estimates (1983) in the Hauser section of the Missouri River.

LENGTH GROUP (INCHES)	ESTIMATED HARVEST	ESTIMATED POPULATION	PERCENT HARVESTED
5.0-10.0	9	--	--
10.0-15.0	388	342	113.5
15.0-20.0	255	498	51.2
>20.0	89	432	20.6
TOTAL	741	1272	58.3

A comparison of harvest to fall population estimates for rainbow trout obtained in 1983 revealed a harvest rate of 77.5%. This harvest rate appears to be extremely high, but is probably valid. Undoubtedly, rainbow trout steadily flushing over Hauser Dam comprise a substantial (?) portion of the harvest. Fall population estimates for rainbow trout in 1986 indicated at least 10.6% of the population was comprised of fish originally stocked into Hauser Reservoir. This percentage would probably be greater during a high water year. Leathe and Hill (1987) felt this phenomenon also occurred below Holter Dam.

Average lengths and weights of rainbow trout, brown trout and kokanee harvested in the Hauser section of the Missouri River are presented in Table 48. Rainbow trout harvested in the section ranged from 6.5 to 24.5 inches in length and 0.10 to 5.70 pounds in weight. Brown trout ranged from 9.4 to 28.0 inches in length and 0.34 to 11.0 pounds in weight. For kokanee, lengths ranged from 12.2 to 21.7 inches and weight ranged from 0.89 to 3.70 pounds.

Table 48. Mean length (inches) and weight (lbs) for gamefish harvested from the Hauser section of the Missouri River during 1982, 1983 and 1985.

	RAINBOW TROUT		BROWN TROUT		KOKANEE	
YEAR	LENGTH	WEIGHT	LENGTH	WEIGHT	LENGTH	WEIGHT
1982	13.5	1.10	17.5	2.47	16.9	1.90
1983	13.2	1.06	15.3	1.48	16.6	1.73
1985	15.5	1.48	19.3	3.15	19.0	2.34

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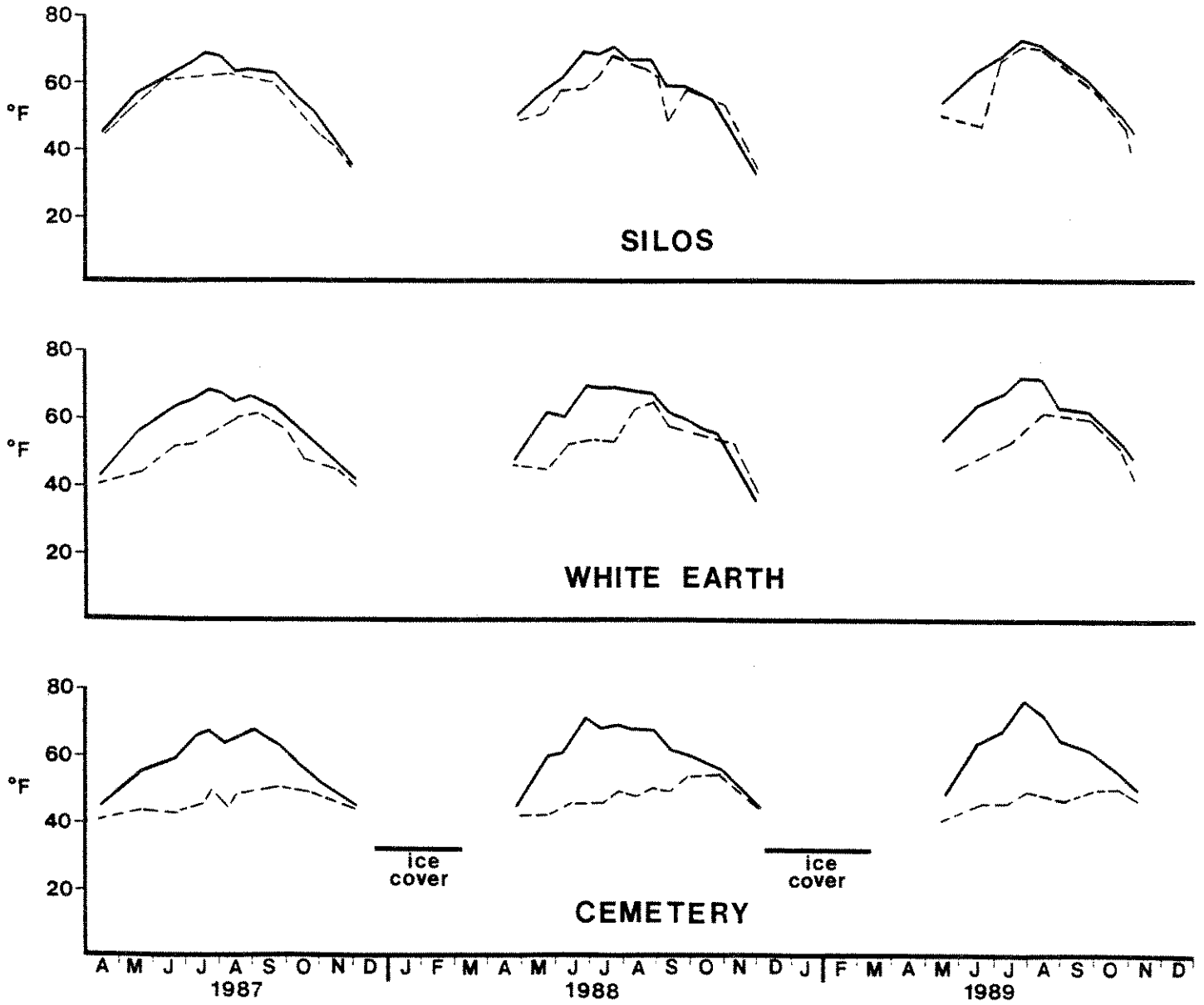
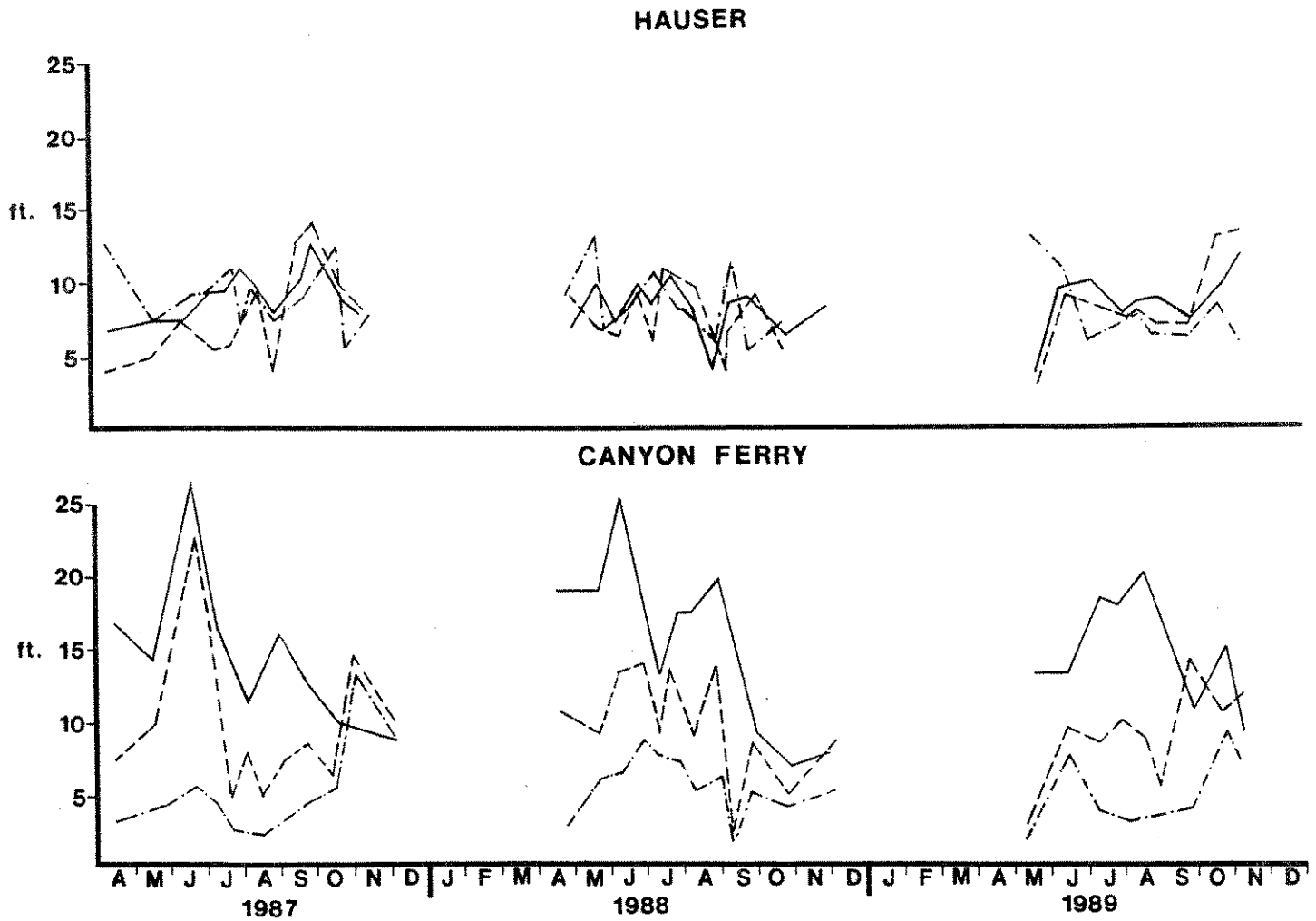
Date: August 31, 1990
Waters referred to:

Canyon Ferry Reservoir	17-8832
Hauser Reservoir	17-9056
Holter Reservoir	17-9136
Missouri River Sec 9	17-4896
Sec 10A	17-4913

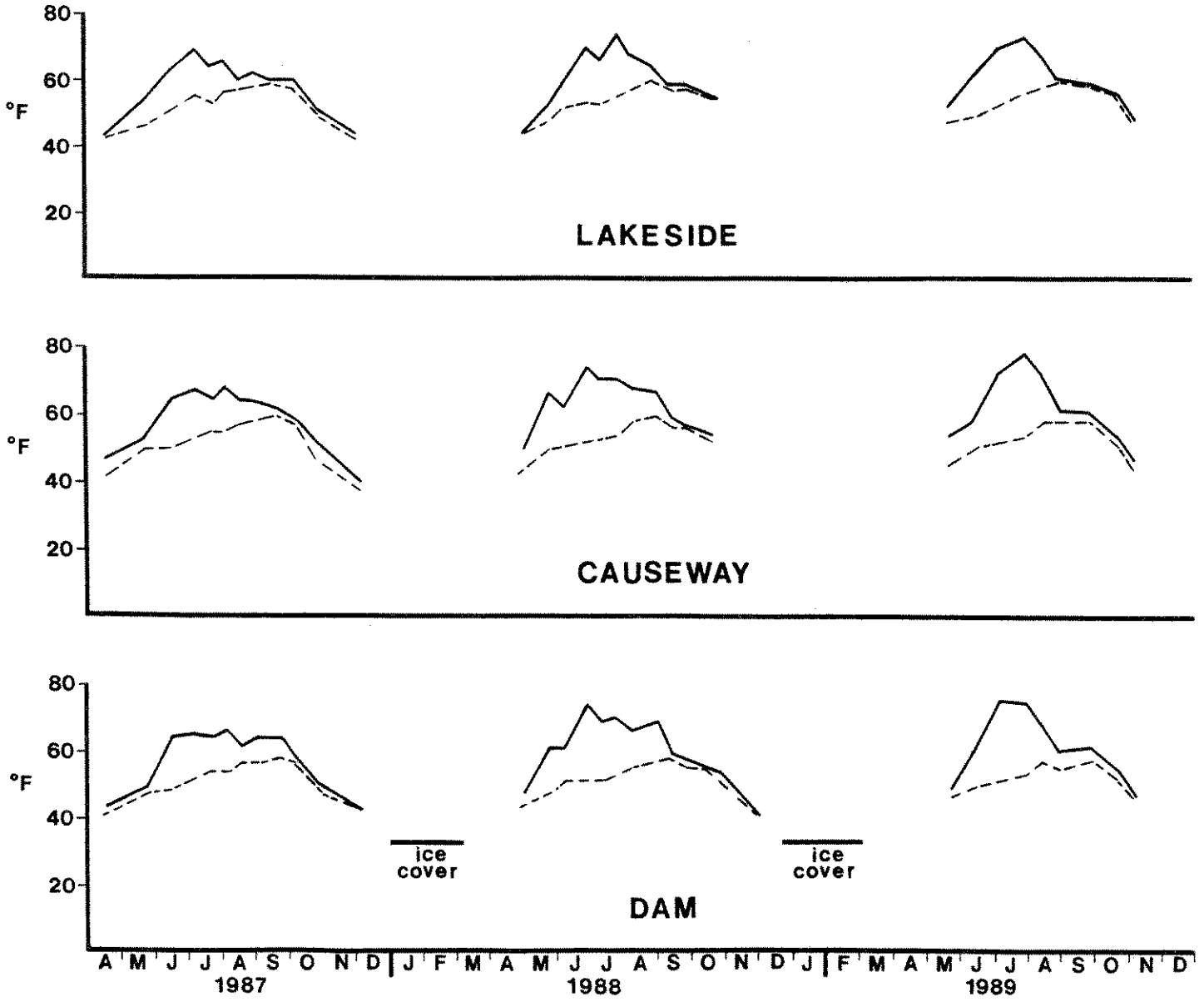
APPENDIX FIGURES



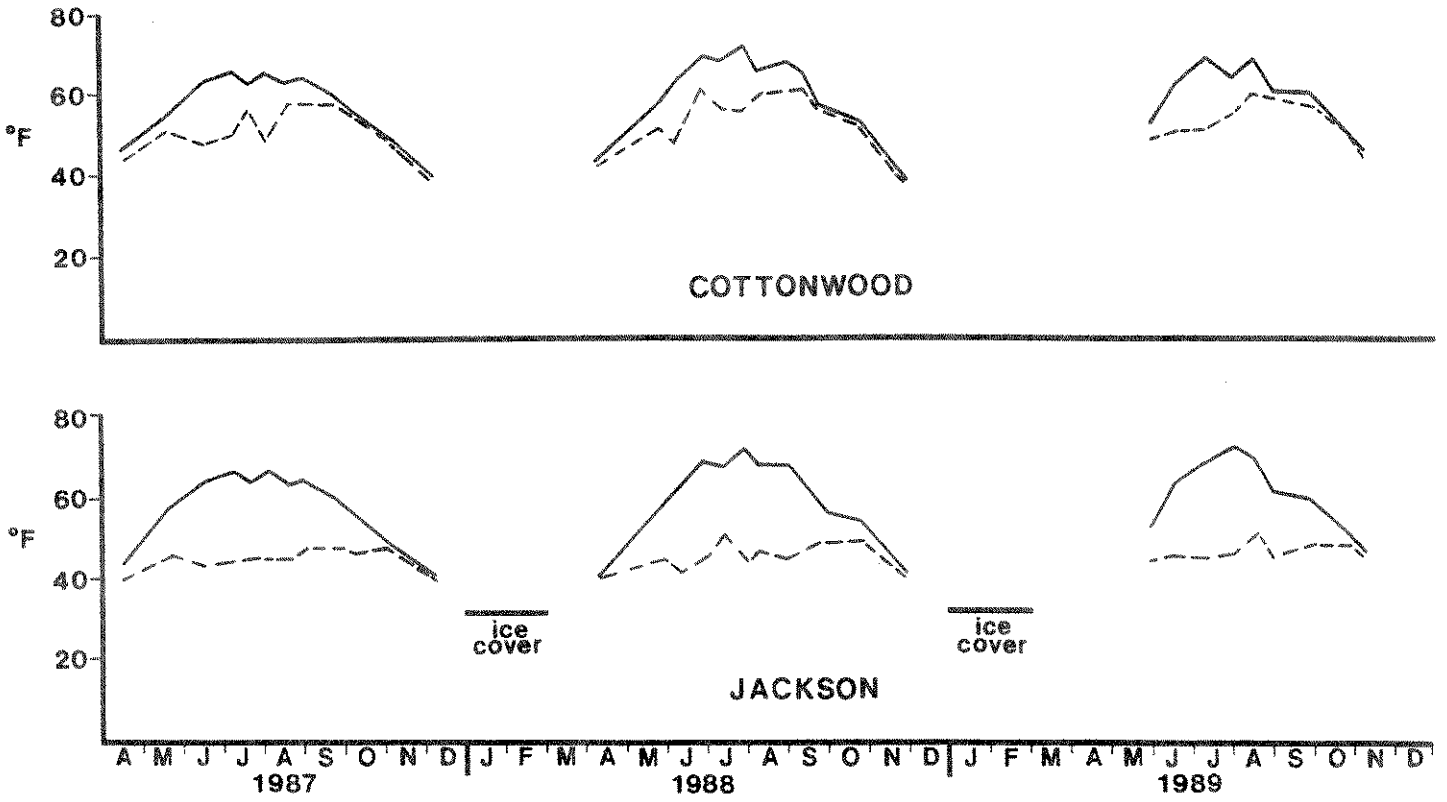
Appendix Figure 1. Water temperatures at surface and bottom in upper (Silos), middle (White Earth), and lower (Cemetery) stations on Canyon Ferry Reservoir from April, 1987 through November, 1989.



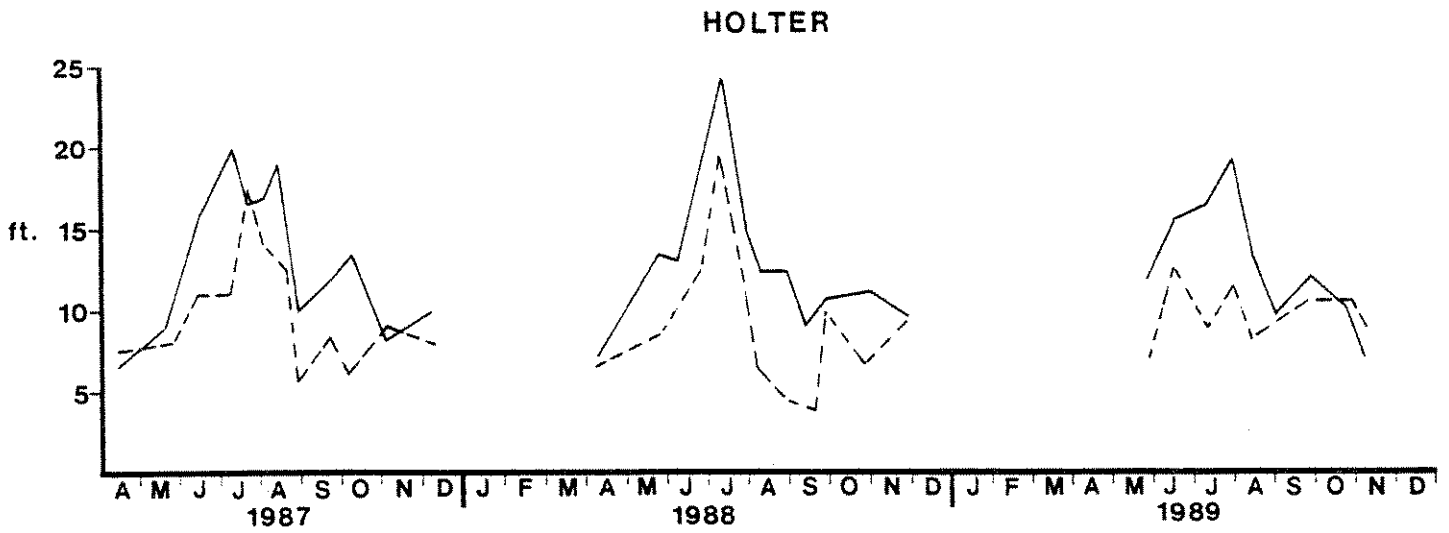
Appendix Figure 2. Euphotic zone depths measured in upper (dot/dashed line), middle (dashed line) and lower (solid line) sampling stations on Canyon Ferry and Hauser reservoirs from April, 1987 through November, 1989.



Appendix Figure 3. Water temperatures at surface and bottom in upper (Lakeside), middle (Causeway) and lower (Dam) stations on Hauser Reservoir from April, 1987 through November 1989.



Appendix Figure 4. Water temperatures at surface and bottom in middle (Cottonwood) and lower (Jackson) stations on Holter Reservoir from April, 1987 through November, 1989.



Appendix Figure 5. Euphotic zone depths measured in middle (dashed line) and lower (solid line) sampling stations on Holter Reservoir from April, 1987 through November, 1989.

APPENDIX TABLES

Appendix Table 1. Percent composition by species and season for floating gill net catches in Canyon Ferry Reservoir from 1986 through 1989.

	1986		1987		1988		1989	
SPECIES	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
LL	7.7	3.9	4.4	1.5	7.2	2.1	15.9	7.4
MWF	0	0	0	0	1.8	1.3	2.8	0
YP	1.0	0	0.4	0	14.0	0	0.9	0
LNSU	0	0.7	1.1	0	0.9	0	0	1.1
WSU	0	0	2.5	3.7	6.8	3.4	3.7	6.3
CARP	0	2.6	20.0	4.0	5.4	13.5	17.8	4.5
U.CHUB	0	2.0	1.4	0.6	4.9	3.4	7.5	6.8
TOTAL # CAUGHT	298	152	275	327	222	236	107	176
NUMBER OF NETS	13	18	13	18	13	18	13	18

Appendix Table 2. Rainbow trout stocking records for Canyon Ferry Reservoir from 1980 through 1989.

YEAR	STRAIN	NUMBER PLANTED	PERCENT PLANTED	TOTAL PLANTED	PERCENT SPRING PLANTS	PERCENT SUMM./FALL PLANTS
1980	Arlee	994,890	(47)	2,101,607	38	62
	Hatch	1,080,685	(51)			
	Misc.	26,032	(2)			
1981	Arlee	444,456	(96)	463,583	75	25
	Misc.	19,127	(4)			
1982	Arlee	557,487	(97)	573,474	30	70
	Misc.	15,987	(3)			
1983	Arlee	415,622	(63)	659,056	20	80
	Desmet 0+	240,558	(36)			
	Misc.	2,876	(1)			
1984	Arlee	312,198	(31)	1,015,124	0	100
	Desmet 0+	702,926	(69)			
1985	Arlee	434,237	(63)	691,966	46	54
	Desmet 0+	194,111	(28)			
	Desmet I+	63,618	(9)			
1986	Arlee	985,449	(94)	1,047,549	97	3
	Desmet I+	62,100	(6)			
1987	Arlee	724,686	(74)	975,989	74	26
	E. Lake	251,303	(26)			
1988	Arlee	766,045	(75)	1,023,145	75	25
	E. Lake	121,587	(12)			
	Desmet 0+	135,513	(13)			
1989	Arlee	782,000	(86)	912,000	85	15
	E. Lake	130,000	(14)			

Appendix Table 3. Distribution by age of stocking for rainbow trout collected in floating gill nets set in Canyon Ferry Reservoir during the spring and fall since 1986.

		NUMBER OF RAINBOW TROUT PER NET					
YEAR	SEASON	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	OTHER	TOTAL
1986	SPRING	0	16.23	2.54	1.54	0.69	21.00
	FALL	5.00	2.17	0.39	0	0.06	7.61
1987	SPRING	0	9.08	3.85	0.38	1.54	14.85
	FALL	5.78	9.11	1.28	0.06	0.17	16.39
1988	SPRING	0	4.62	4.38	0.69	0.38	10.08
	FALL	2.06	3.39	4.00	0.11	0.44	10.00
1989	SPRING	0.77	0.92	1.46	0.77	0.31	4.23
	FALL	2.78	1.06	2.17	0.67	0.56	7.22

Appendix Table 4. Percent composition by species for sinking gill net catches in the mid-Missouri reservoirs from 1986 through 1989.

RESERVOIR	SPECIES	1986 SPRING	1986 FALL	1987 SPRING	1987 FALL	1988 SPRING	1988 FALL	1989 SPRING	1989 FALL
C. FERRY	RB		0.4		0.2		0.5		0.5
	LL		0.6		0.9		1.6		4.4
	MWF		0.2		0.2		0.8		1.1
	YP		59.7		59.5		52.6		20.8
	LNSU		2.7		1.2		0		0.5
	WSU		34.6		34.0		42.8		65.1
	CARP		0.8		2.1		1.1		7.1
	U. CHUB		1.0		1.2		0.3		0.5
	BURBOT		0		0.7		0.3		0
	# CAUGHT	0	489	0	429	0	367	0	183
	# OF NETS	0	3	0	3	0	3	0	3
HAUSER	RB		0.7	0.2	1.4	0	0.5	0	1.8
	LL		1.0	1.5	0.4	1.2	0.5	0.9	0
	KOK		0.4	1.1	4.2	4.2	9.1	1.7	18.3
	MWF		3.6	3.8	2.3	5.4	2.6	2.4	0.5
	WE		0	0	0	0	0	0.2	0
	YP		4.9	4.7	9.3	10.6	4.3	5.8	3.5
	LNSU		28.9	23.0	16.1	17.9	24.1	22.3	14.7
	WSU		60.5	65.5	66.0	60.0	58.3	66.0	59.4
	CARP		0	0	0	0	0	0	0.2
	U. CHUB		0	0.2	0.1	0.5	0.1	0.3	1.3
	BURBOT		0	0	0.2	0	0.5	0.2	0
	S. BUFF.		0	0	0.2	0	0.5	0.2	0
	# CAUGHT	0	700	473	839	407	648	574	600
	# OF NETS	0	5	5	6	6	6	6	6
HOLTER	RB		4.3	0.9	2.5	1.4	2.6	1.1	1.8
	LL		0.2	0.8	0.3	0.2	0	0.2	0
	KOK		0.4	0	0.2	0.3	0.5	0	0.6
	MWF		1.8	1.7	2.0	3.6	0.5	5.1	1.8
	WE		2.5	1.6	3.1	2.0	1.3	2.8	5.2
	YP		24.0	57.2	28.8	34.0	21.8	29.5	10.6
	LNSU		24.0	16.5	21.5	17.6	21.9	11.2	20.4
	WSU		42.8	21.2	41.6	40.7	51.2	49.7	59.6
	CARP		0	0.1	0	0	0.2	0.4	0
	U. CHUB		0	0	0	0.2	0	0	0
	# CAUGHT	0	551	838	601	658	611	545	500
	# OF NETS	0	6	5	6	6	6	6	6

Appendix Table 5. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during the summer period from 1986 through 1989.

RESERVOIR	YEAR	PERCENT OF TOTAL								TOTAL
		APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	
C. FERRY	1986	7.3	15.7	13.3	15.5	13.1	13.5	16.1	5.5	1532
	1987	3.4	7.3	18.6	17.5	17.8	19.6	9.7	6.1	2362
	1988	2.1	11.1	19.2	18.9	12.8	15.4	16.7	3.5	2978
	1989	4.7	7.7	15.8	7.2	20.3	20.3	13.9	10.3	1460
	OVERALL	3.9	10.3	17.4	15.9	15.6	17.1	14.1	5.7	8332
HAUSER	1986	3.8	20.5	16.1	23.0	20.9	10.4	5.3	0	1404
	1987	3.6	8.4	19.5	25.5	19.4	11.6	8.7	3.3	2229
	1988	0.4	15.0	8.6	31.2	14.4	9.1	15.3	6.1	2146
	1989	0	4.5	11.9	21.1	24.3	23.3	11.0	3.7	1753
	OVERALL	1.9	11.6	14.0	25.6	19.4	13.4	10.5	3.6	7532
HOLTER	1986	8.3	21.5	24.6	13.2	21.6	8.2	2.4	0	1063
	1987	3.0	6.1	20.0	24.6	25.5	14.6	6.1	0	1876
	1988	0	20.6	9.6	14.7	15.5	14.9	18.9	5.8	1280
	1989	0	1.5	12.0	12.3	39.6	20.2	11.1	3.3	1393
	OVERALL	2.6	11.2	16.5	17.1	26.0	14.9	9.6	2.1	5612

Appendix Table 6. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during the winter period from 1986 through 1989.

RESERVOIR	YEAR	PERCENT OF TOTAL DEC.	JAN.	FEB.	MAR.	TOTAL
C. FERRY	1986	8.6	48.6	34.9	7.9	556
	1987	5.6	57.8	29.1	7.5	951
	1988	1.9	52.6	34.3	11.2	1411
	1989	0	21.6	38.3	40.1	287
	1990	0	68.4	28.2	3.4	756
	OVERALL	3.2	54.1	32.3	10.5	3961
HAUSER	1989	0	22.2	43.6	34.2	573
	1990	0	49.7	49.7	0.6	300
	OVERALL	0	31.6	45.7	22.7	873
HOLTER	1987	0	100.0	0	0	88
	1989	0	32.7	43.8	23.5	493
	1990	0	22.0	75.1	2.9	346
	OVERALL	0	35.1	51.3	13.6	927

Appendix Table 7. Percent composition by species and season for floating gill net catches in Hauser Reservoir from 1986 through 1989.

	1986		1987		1988		1989	
SPECIES	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
LL	0.2	2.5	1.3	1.2	0.6	1.4	2.0	0.9
KOK	2.9	57.3	36.0	25.1	71.3	47.9	74.2	73.2
MWF	0.2	4.3	0	0	1.2	0.9	0	0.3
YP	0	0.7	0	0	0	0	0	0
LNSU	52.9	1.4	35.8	12.9	6.1	2.5	5.3	0.9
WSU	13.8	1.1	16.4	16.0	3.1	0.5	5.3	0.3
CARP	0.5	0	0	0	0	0	0	0
U.CHUB	0.5	1.4	0.8	0.6	0	4.8	0	3.5
TOTAL # CAUGHT	448	281	383	163	164	438	151	339
NUMBER OF NETS	9	11	10	11	10	11	9	11

Appendix Table 8. Percent composition by species and season for floating gill net catches in Holter Reservoir from 1986 through 1989.

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

Appendix Table 9. Total number of angler interviews conducted on the Hauser section of the Missouri River during 1982, 1983 and 1985.

MONTH	1982	1983	1985
MARCH	--	77	--
APRIL	--	301	--
MAY	--	312	--
JUNE	--	389	--
JULY	--	504	--
AUGUST	--	272	--
SEPT.	218	337	--
OCT.	210	275	275
NOV.	142	261	89
TOTAL	570	2,728	364