MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA
PROJECT NO: F-46-R-4
JOB NO: II-f

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

PROJECT PERIOD: JULY 1, 1990 THROUGH JUNE 30, 1991

ABSTRACT

Baseline limnological and fisheries data were gathered on Canyon Ferry, Hauser and Holter reservoirs during 1986, 1987, 1988, 1989 and 1990 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) in Canyon Ferry Reservoir have exhibited a slight warming trend since 1987. Average temperature of surface waters were warmer in Canyon Ferry Reservoir than in Hauser and Holter reservoirs. Average depth of the euphotic zone was deeper in Canyon Ferry Reservoir than in Hauser Reservoir but was slightly shallower than in Holter Reservoir. Total zooplankton densities in Canyon Ferry averaged 22.1, 23.5, 25.7 and 21.3 organisms per liter in 1987, 1988, 1989 and 1990, respectively. Cyclops was the most numerous genera in Canyon Ferry Reservoir. Mean catch rates for rainbow trout in horizontal gill nets declined annually. The decline in catch rates appeared to be associated with poor survival of hatchery plants. Desmet and Eagle Lake strains were exclusively selected for stocking into Canyon Ferry Reservoir beginning in 1990 in attempt to provide more stability to the fishery. Recruitment and rearing of trout in tributaries to Canyon Ferry Reservoir were monitored. A total of 2,809 anglers were interviewed on Canyon Ferry during the summer of 1990. Catch rates by anglers averaged 0.14 and 0.03 fish/hour for rainbow trout and yellow perch, respectively. About 99% of all rainbow trout harvested were of known hatchery origin. A total of 884 anglers were interviewed on Canyon Ferry during the winter ice fishery. Catch rates by anglers in the winter averaged 0.08 and 0.95 fish/hour for rainbow trout and yellow perch, respectively. Temperatures of surface waters in Hauser Reservoir have displayed similar seasonal trends from 1987-1990. The euphotic zone was shallower in Hauser Reservoir than in Canyon Ferry or Holter reservoirs. Total zooplankton densities in Hauser Reservoir averaged 17.6, 22.8, 29.2 and 17.3 organisms per liter during the four respective years of sampling. Cyclops was the most numerous genera in Hauser Reservoir. Average densities of Daphnia were less in Hauser Reservoir than in the other two reservoirs. The length of Daphnia in Hauser Reservoir has remained constant since 1988, averaging 1.15 mm. The contribution of kokanee to the catch in horizontal gill nets increased in 1990,

while the contribution of rainbow trout has continued to decline. Growth rates for kokanee in Hauser Reservoir have remained constant since 1986. A total of 2,881 anglers were interviewed on Hauser Reservoir during the summer of 1990. Catch rates by anglers averaged 0.10 and 0.22 fish/hour for rainbow trout and kokanee, respectively. About 98% of all rainbow trout harvested in 1990 were of known hatchery origin. A total of 451 anglers were interviewed on Hauser Reservoir during the 1990/91 ice fishery. Catch rates for rainbow trout, kokanee and yellow perch averaged 0.08, 0.18 and 0.60 fish/hour, respectively. Temperature of surface waters for Holter Reservoir have displayed similar seasonal trends during the four years of sampling. Surface water temperatures in Holter Reservoir were intermediate to temperatures in the other two reservoirs. Secchi readings were slightly deeper in Holter Reservoir than in Canyon Ferry and Hauser reservoirs. Total zooplankton densities in Holter Reservoir averaged 17.3, 24.0, 31.5 and 20.6 organisms per liter in 1987, 1988, 1989 and 1990, respectively. Daphnia and Cyclops were the two most numerous genera. Average densities of Daphnia in Holter Reservoir were similar to densities found in Canyon Ferry Reservoir. Daphnia in Holter Reservoir were larger than those found in Hauser Reservoir. Reflecting a recent expansion of the population in Holter Reservoir, 1990 was the first year in five years of sampling that more kokanee were collected in gill nets than rainbow trout. 'Wild' rainbow trout comprised about 27% of the gill net catch in 1990. The number of walleye collected per sinking gill net has remained constant through the period of survey. Walleye up to 16 years of age were collected. A total of 1,633 anglers were interviewed on Holter Reservoir during the summer of 1990. Catch rates by anglers averaged 0.26 and 0.53 fish/hour for rainbow trout and yellow perch, respectively. About 89% of all rainbow trout harvested were of known hatchery origin. A total of 547 anglers were interviewed during the 1990/91 winter ice fishery on Holter Reservoir. Catch rates for rainbow trout and yellow perch averaged 0.27 and 3.57 fish/hour, respectively. Desmet and pre-1989 Eagle Lake strains of rainbow trout appeared to survive better in Canyon Ferry Reservoir than the Arlee strain. The Arlee strain, however, appeared to be easier for anglers to catch. Desmet strain rainbow appeared to be less catchable than the Eagle Lake strain. 'Wild' rainbow trout in Holter Reservoir appeared to be less catchable than the hatchery rainbow (Arlee strain) that were stocked. Eagle Lake strain rainbow stocked into Canyon Ferry after 1988 appeared to exhibit very poor survival. The densities of rainbow trout and brown trout in the Hauser section of the Missouri River were estimated at 13,449 and 630 fish per section, respectively, in the fall of 1990. Food habits for walleye and brown trout are presented.

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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. Duplicate vertical tows were made at each station. Carapace lengths of 50 Daphnia selected randomly on a monthly basis were measured with an optical micrometer. 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 with a dissecting microscope under black light in the lab to examine for tetracycline marks.

Reservoir fish were sampled with floating and sinking 6 X 125 foot experimental gill nets (3/4 to 2 inch mesh) set during the spring and fall. Nets were set in each reservoir in similar locations and at similar times of the year through the period of survey.

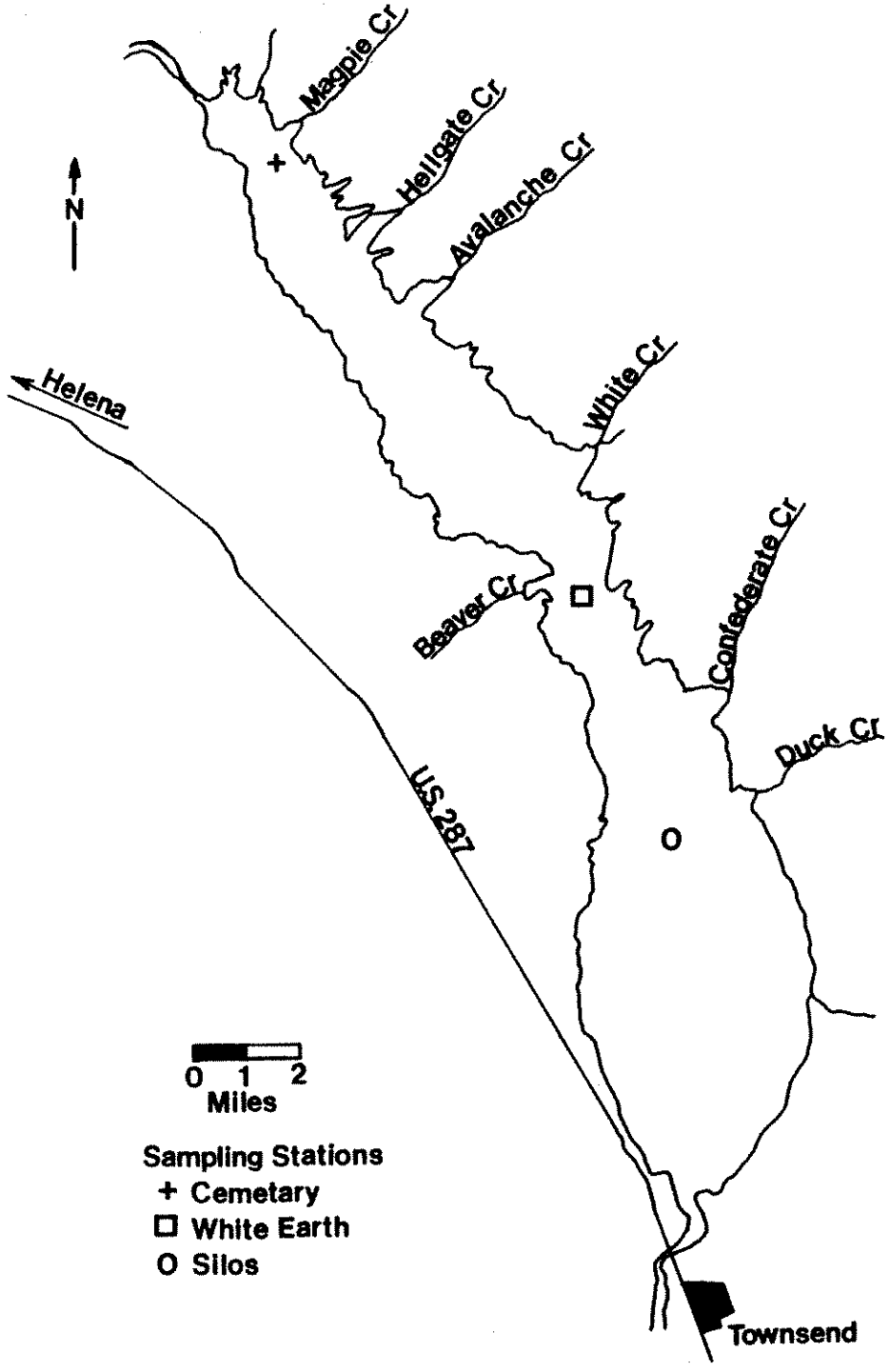

Figure 1. Map of Canyon Ferry Reservoir showing locations of permanent sampling stations.

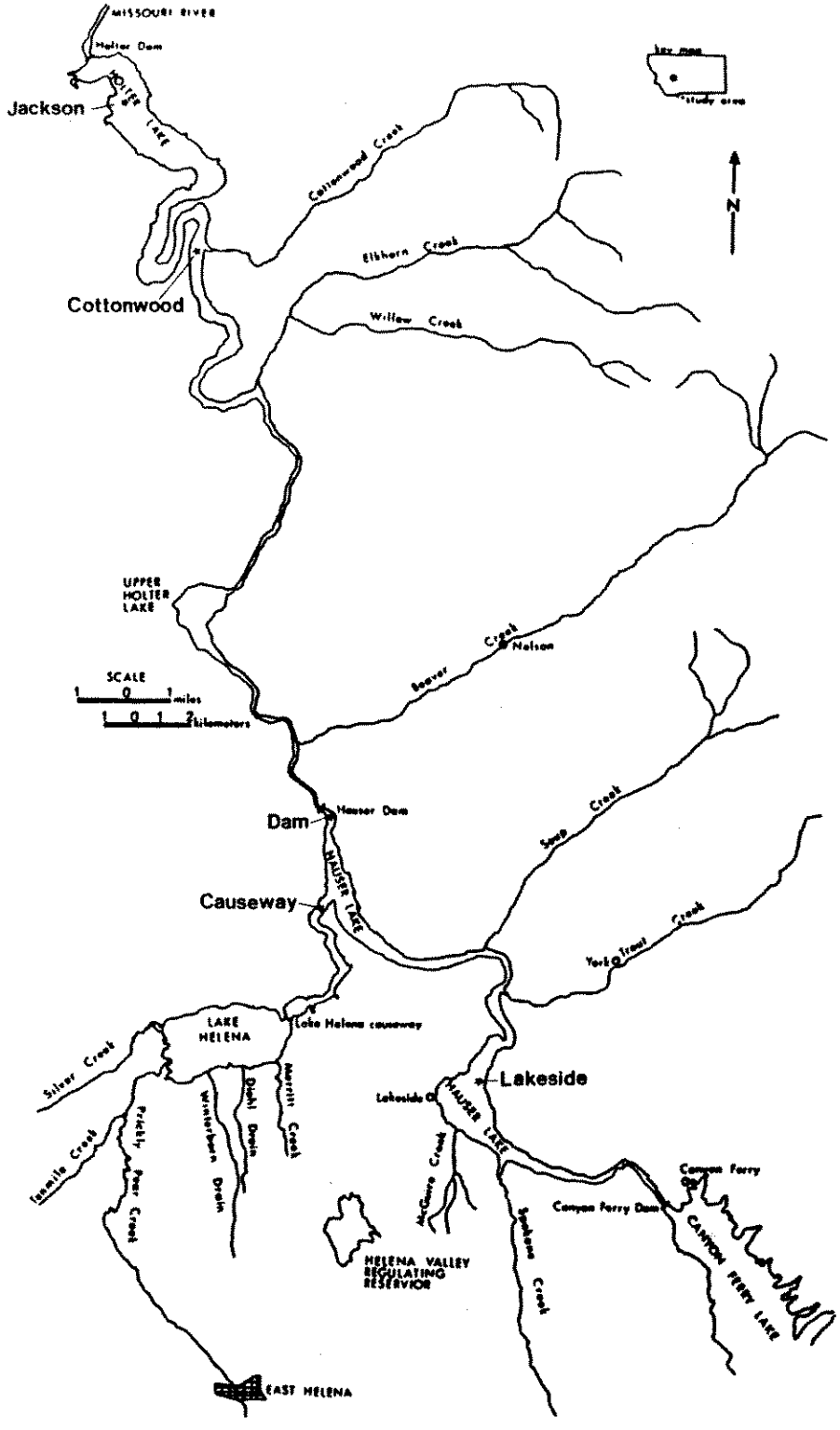

Figure 2. Map of Hauser and Holter reservoirs showing locations of permanent sampling stations.

Distribution of fish species by depth was determined by using a bank of four vertical gill nets that were 150 feet deep and 12 feet wide (3/4, 1, 1.25, and 1.5 inch mesh). Vertical nets were set monthly from July through October at permanent sampling stations located in the lower end of each reservoir. Vertical nets were set to fish the entire water column.

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). Tributaries and shoreline areas of the Missouri River were sampled with a back-pack shocker. Population estimates were made using Chapman's modification of Peterson's mark and recapture formula (Ricker 1975).

Emigration of juvenile trout was monitored with traps constructed with 1/16 inch nylon netting sewn to a rectangular metal rebar frame. The net necked down to a baffled fry holding box. Traps were set in the evening and removed the next morning.

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.

RESULTS

CANYON FERRY RESERVOIR

Physical Limnology

Surface water temperature (to 15 feet) during the spring through fall period of survey in 1990 averaged 60.8, 62.7 and 60.8 F, respectively, in upper (Silos), middle (White Earth) and lower (Cemetery) stations of the reservoir (Table 1). A maximum average water temperature of 72.7 F was obtained during early August. Temperatures of surface waters have displayed similar seasonal trends during the four year period of sampling (Figure 3). However, surface temperatures have exhibited a slight annual warming trend since 1987. During the period of survey, average temperature of surface waters were warmer in Canyon Ferry than in Hauser and Holter reservoirs.

Table 1. Average water temperatures for surface waters (to 15 feet) at upper (Silos), mid (White Earth) and lower (Cemetery) sampling stations on Canyon Ferry Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN WATER TEMPERATURE (F)			
	SAMPLING STATION			
YEAR	UPPER	MID	LOWER	MAXIMUM AVERAGE
1987	58.3	58.8	58.2	66.6
1988	59.6	59.9	59.9	69.0
1989	60.3	61.3	61.3	71.8
1990	60.8	62.7	60.8	72.7

Seasonal water temperatures measured on the surface and reservoir bottom at the three sampling stations during 1987, 1988, 1989 and 1990 are shown in Appendix Figures 1 - 3. Water in the upper reservoir (Silos station) tended to remain 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. Thermoclines in mid-reservoir usually occurred at depths ranging from 35 to 50 feet. Water in the lower reservoir (Cemetery station) tended to form a very weak thermal structure from July through August at depths ranging from 50 to 60 feet.

Secchi disk readings approximate the region of transmission of 5% sunlight and provide an estimate of the zone of photosynthesis (euphotic zone). Secchi depth readings during the spring through fall sampling period in 1990 averaged 7.0, 10.5, and 16.1 feet,

respectively, in upper, mid and lower stations of the reservoir (Table 2). Secchi readings in 1990 were similar to the three previous years of survey. Average depth of the euphotic zone in Canyon Ferry was deeper than in Hauser Reservoir but slightly shallower than in Holter Reservoir.

Table 2. Average Secchi depth readings (feet) at upper (Silos), mid (White Earth) and lower (Cemetery) sampling stations on Canyon Ferry Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN SECCHI DEPTH (FT)			
	SAMPLING STATION			
YEAR	UPPER	MID	LOWER	OVERALL
1987	5.0	9.8	14.6	9.8
1988	5.5	9.7	15.7	10.3
1989	5.2	9.1	15.1	9.8
1990	7.0	10.5	16.1	11.2

Seasonal Secchi depths measured during 1987, 1988, 1989 and 1990 are presented in Appendix Figure 4. In general, euphotic zones at all stations were deepest during June. In the upper station, the euphotic zone tended to be shallowest during April or May due to turbid inflows from the Missouri River. In contrast, the euphotic zone in the mid and lower stations tended to be shallowest during October and November.

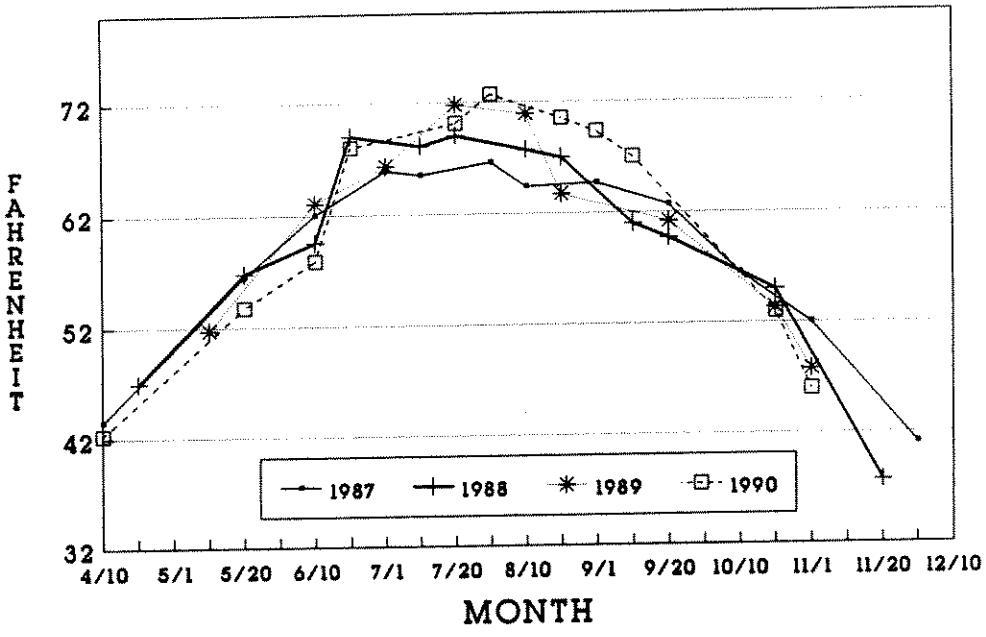

Figure 3. Seasonal trends of mean temperature for surface waters (to 15 feet) in Canyon Ferry Reservoir during 1987, 1988, 1989 and 1990.

Zooplankton

Total zooplankton densities in Canyon Ferry Reservoir averaged 22.1, 23.5, 25.7 and 21.3 organisms per liter, respectively, in 1987, 1988, 1989 and 1990. Seasonal patterns for total zooplankton densities are shown in Figure 4. Zooplankton densities have displayed similar seasonal trends during the four year period of sampling. Zooplankton densities tended to peak in mid-May and then decline to relatively stable levels by late July.

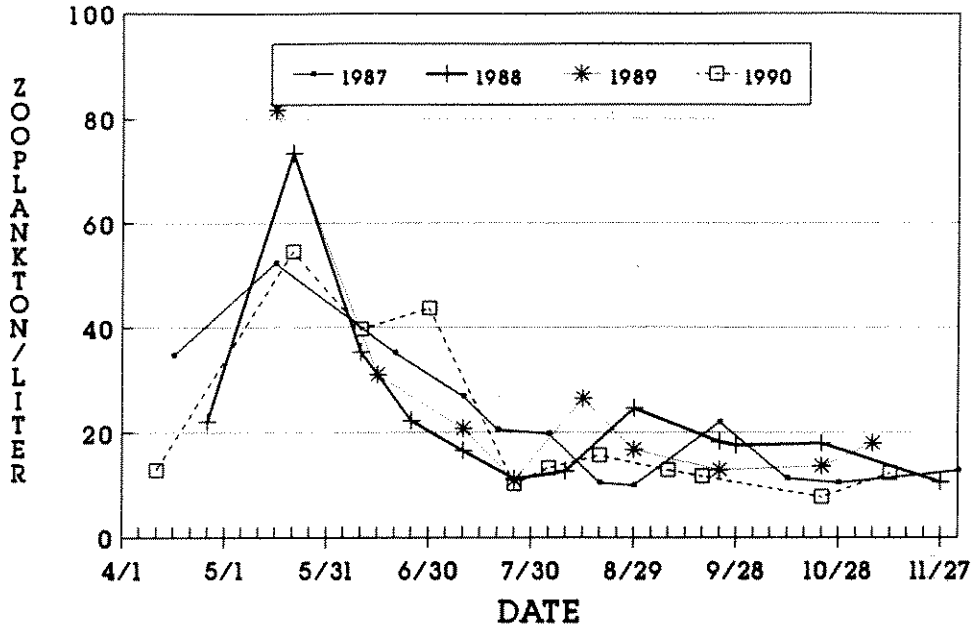

Figure 4. Seasonal trends of mean zooplankton densities for Canyon Ferry Reservoir during 1987, 1988, 1989 and 1990.

In all years, the zooplankton community in Canyon Ferry Reservoir was dominated by Daphnia, Cyclops, and Diaptomus spp. during the spring through fall sampling period (Table 3). Bosmina and Leptodora spp. comprised the remainder of the zooplankton community. Cyclops was the most numerous genera, followed by Daphnia, Diaptomus, Bosmina and Leptodora. With the exception of Leptodora, average densities of the primary zooplankters remained similar among the four years of study. Densities of Leptodora, however, were less in 1989 and 1990 than in the two previous years. Interestingly, Wright (1959) and Martin (1975) reported much higher average densities of Daphnia and Cyclops in Canyon Ferry. In 1958, densities of Daphnia and Cyclops averaged 14.5 and 43.6 organisms per liter, respectively. In 1972, densities of Daphnia and Cyclops averaged 14.6 and 38.5 organisms per liter, respectively. Lower zooplankton densities since the late 1950's and early 1970's may be a reflection of declining productivity in the reservoir. However, Wright sampled only in the euphotic zone for zooplankton. As a result, differences observed in 1958 may be simply a reflection of varying sampling efficiencies between studies. Martin's techniques, however, would tend to be less efficient than present

sampling techniques since Martin sampled the entire water column for zooplankton.

Table 3. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in bimonthly vertical tows from three stations in Canyon Ferry Reservoir during the spring through fall sampling period in 1987, 1988, 1989 and 1990.

	NUMBER PER LITER				#/M³
YEAR	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
1987	8.45 (0.5-26.8)	3.99 (0.1-19.9)	8.80 (0.7-43.5)	0.77 (0-20.7)	13.88 (0-99.9)
1988	8.18 (0.9-45.1)	2.94 (0.2-14.6)	11.56 (1.1-97.9)	0.79 (0-7.5)	19.79 (0-104.4)
1989	9.57 (2.2-41.6)	2.08 (0.1-6.8)	13.91 (1.4-130.1)	0.51 (0-4.7)	6.10 (0-20.5)
1990	8.45 (0.3-39.8)	3.70 (0.1-8.4)	8.81 (0.5-48.2)	0.59 (0-5.2)	6.48 (0-33.0)

Seasonal changes in the zooplankton community in Canyon Ferry are shown in Figure 5. In general, Cyclops dominated the community during the spring and the fall. During the summer, Diaptomus and Daphnia were the dominant members of the community. Although varying among years, Bosmina densities were greatest either during the spring or the fall. Although relative abundance was very low, Leptodora densities tended to peak in mid-summer.

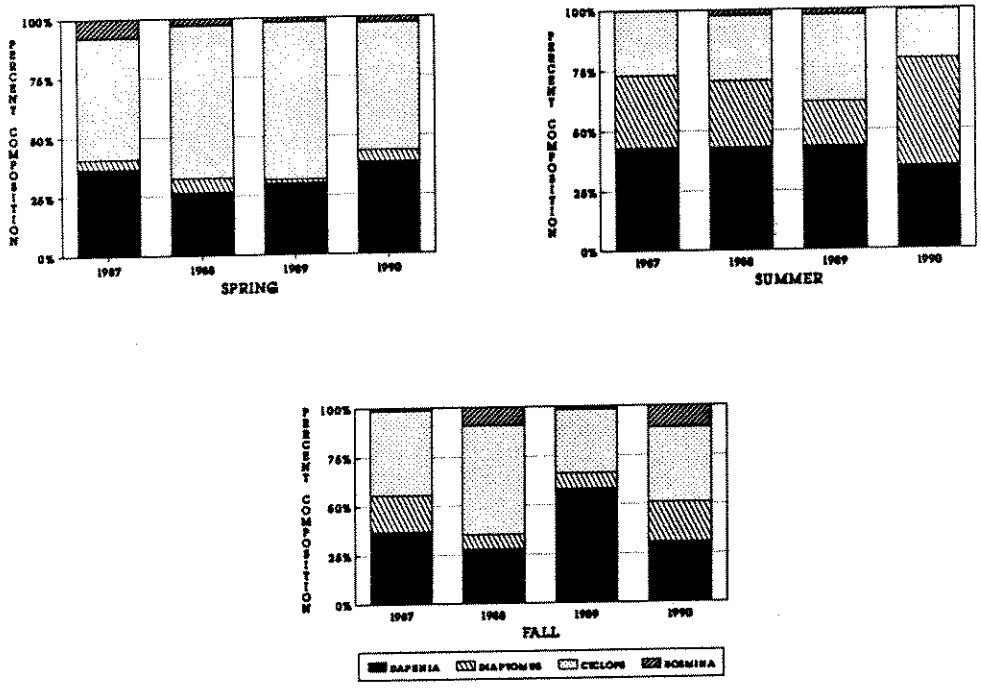

Figure 5. Seasonal composition of primary zooplankters residing in Canyon Ferry Reservoir during 1987, 1988, 1989 and 1990.

Daphnia is the most important food item in the diet of rainbow trout and yellow perch residing in Canyon Ferry. Although overall densities of Daphnia were similar among sampling locations, the seasonal progression of abundance varied among upper, mid and lower stations (Appendix Figures 5, 6 and 7). In the upper station (Silos), Daphnia densities tended to peak in June and then again in August or September. Densities of Daphnia in the middle station (White Earth) also peaked in June, but no secondary peak was observed in the fall. In the lower station (Cemetery), Daphnia densities tended to peak earlier (in May) and at substantially higher levels than in the other two stations. A secondary peak in Daphnia numbers was not observed in the lower station.

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 catch per unit effort has declined annually since 1986. The abundance of Utah chubs, although relatively low, appeared to increase in Canyon Ferry Reservoir over the five year sampling period. 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.

Mean catch rates (fish per net night) for rainbow trout from floating gill nets set seasonally in Canyon Ferry Reservoir are shown in Figure 6. Since 1986, mean catch rates for rainbow trout have decreased each year, reflecting a continuous decline in population abundance. Although specific reasons remain unknown, this decline appears to be associated with poor survival of the Department's hatchery plants.

MDFWP has adjusted the stocking program numerous times in past years in attempt to improve survival of stocked trout. Past adjustments included changing the number and size of stocked fish, the type of strain stocked, as well as the season of the year when the fish were stocked. Although MDFWP began experimenting with different strains of rainbow trout beginning in 1983, the Arlee rainbow trout has been the primary strain of trout stocked into the reservoir prior to 1990 (Appendix Table 2). Because of the Arlee's short lived nature (about 2.5 years), a less than successful plant in any one year could significantly reduce the population level the following year.

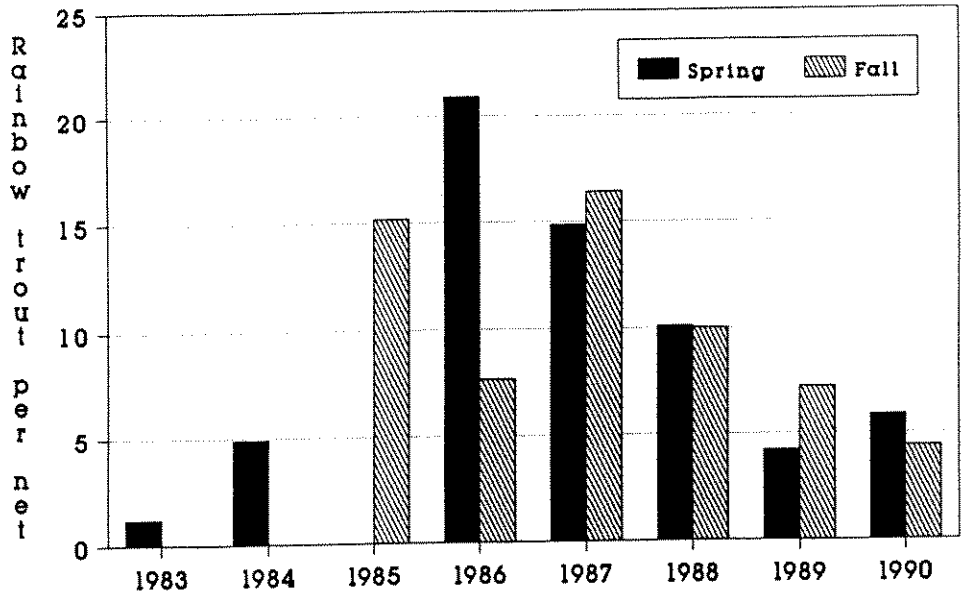

Figure 6. Average catch of rainbow trout per net night by season in floating gill nets set in Canyon Ferry Reservoir from 1983 through 1990. Data from 1983 through 1985 are from Rehwinkel (1986).

In attempt to provide for a more stable fishery, the Arlee strain was dropped from the stocking program in 1990 and two 'wild' strains (Desmet and Eagle Lake) were exclusively selected for stocking. These two strains were selected because they tend to live longer than the Arlee and are capable of reproducing in the wild. These longer lived strains should provide more stability to the population because five or six age classes will potentially be present in the reservoir instead of just two.

Stocking rates for Canyon Ferry Reservoir between 1986 and 1989 averaged 28.6 trout (1.24 pounds) per surface acre (Table 4). With the exception of Hebgen Reservoir, this stocking rate is substantially lower than for most of the other Montana reservoirs located east of the continental divide. In part, this lower rate is due to the large size of Canyon Ferry and the limited capacity of the hatchery system. However, to accelerate the recovery of the rainbow trout population in Canyon Ferry, the stocking rate should be increased to approximately 50 trout (2.5 pounds) per acre until age classes are sufficiently filled in the system. Once the age structure of the population is filled, the stocking rate could then be reduced to a lower level to meet catch rate or harvest objectives.

Table 4. A summary of the number of trout stocked in selected Montana reservoirs from 1986 through 1989. Number of pounds stocked per surface acre is in parentheses.

RESERVOIR	SURFACE ACRES (Full Pool)	TROUT PER SURFACE ACRE 1986	1987	1988	1989	Mean
Canyon Ferry	35,180	29.8 (1.6)	27.7 (1.0)	29.1 (1.1)	27.9 (1.3)	28.6 (1.2)
Clark Canyon	4,888	68.9 (4.6)	66.3 (2.0)	41.2 (1.9)	32.1 (1.1)	52.1 (2.4)
Cooney	815	160.9 (13.6)	154.8 (13.2)	125.0 (11.6)	132.2 (14.1)	143.2 (13.2)
Hebgen	12,670	26.7 (1.7)	45.4 (1.8)	44.3 (0.7)	21.8 (0.1)	34.6 (1.1)
Holter	4,800	67.7 (3.8)	67.3 (2.9)	67.3 (3.0)	76.4 (4.4)	69.7 (3.5)
Martinsdale	985	100.7 (3.9)	107.8 (6.2)	108.3 (5.7)	125.5 (8.6)	110.6 (6.1)

The average length, weight and condition factors for rainbow trout collected in floating gill nets from 1986 through 1990 are presented in Appendix Table 3. In 1990, captured rainbow trout averaged 16.6 inches in length and 1.95 pounds in weight. Approximately 93% of all rainbow trout collected in gill nets in 1990 were of known hatchery origin. Arlee strain dominated the composition of the catch (40.7%), followed by Desmet (34.1%), Eagle Lake (15.6%) and wild fish (3.0%). The remainder of the catch was comprised of hatchery fish of unknown origin (2.4%) and fish that could not be identified as either hatchery fish or wild fish (4.2%). A more thorough discussion of strain evaluation is discussed later in this report.

Age distribution for rainbow trout collected in floating gill nets is presented in Table 5. The number of older aged trout collected per net (fish that had been in the reservoir for more than 3 years) tended to be greater in 1989 and 1990 than in previous years. This increase appeared to be due to better survival of 'wild' strains of rainbow trout to an older age. Specifically, yearling Desmet stocked in 1986 and young of the year Eagle Lake stocked in 1987 contributed a substantial 15 and 14 percent, respectively, to the gill net catch obtained in the spring of 1990. Apparently, these 'wild' strains of trout are beginning to fill in new (older) age classes into the population age structure.

The number of second year rainbow trout (time spent in reservoir) collected in floating gill nets during the spring has been closely related (correlation coefficient=0.85) to summer catch rates obtained by anglers for the years 1983 and 1986 through 1990 (Figure 7). If the age structure of the rainbow trout population continues to change in the future as a result of increasing numbers

of older aged fish then gill net catches of second year trout will likely become less related to summer catch rates by anglers. Gill net catches obtained in the spring of 1991 indicate anglers will catch an average of 0.15 rainbow trout per hour during the 1991 spring through fall fishing season.

Table 5. Distribution by year 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						
SEASON	YEAR	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	OTHER	TOTAL
SPRING	1986	0	16.23	2.54	1.54	0.15	0.54	21.00
	1987	0	9.08	3.85	0.38	0	1.54	14.85
	1988	0	4.62	4.38	0.69	0	0.38	10.08
	1989	0.77	0.92	1.46	0.77	0.08	0.23	4.23
	1990	0.40	2.07	0.80	1.33	0.87	0.46	5.93
FALL	1986	5.00	2.17	0.39	0	0	0.06	7.61
	1987	5.78	9.11	1.28	0.06	0	0.17	16.39
	1988	2.06	3.39	4.00	0.11	0.06	0.38	10.00
	1989	2.78	1.06	2.17	0.67	0	0.56	7.22
	1990	1.00	0.83	1.22	0.78	0.17	0.39	4.39

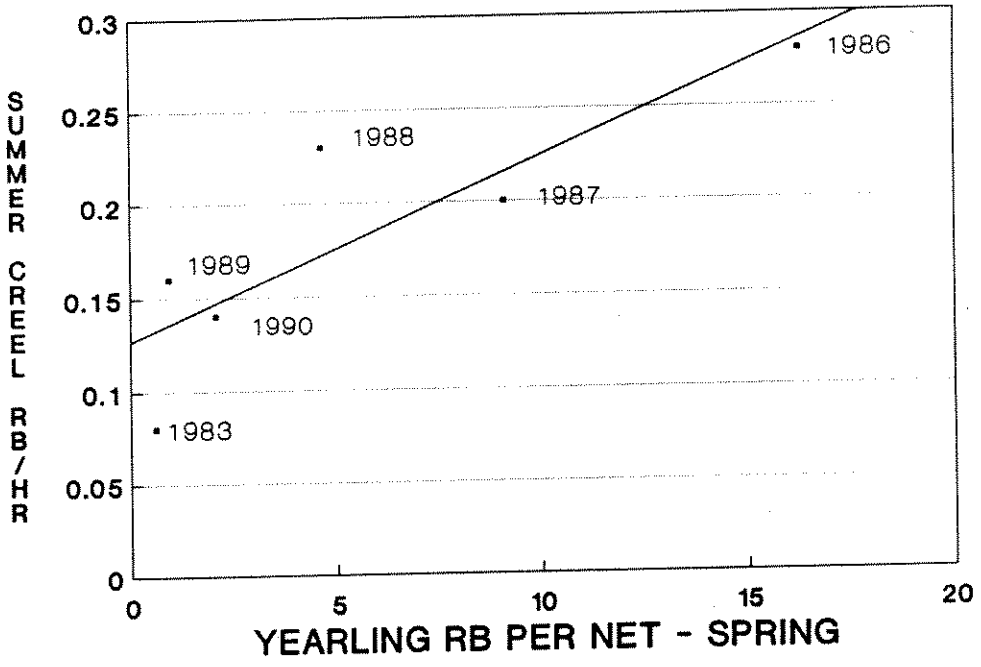

Figure 7. The relationship between the average summer catch rate (fish/angler hour) for rainbow trout and the number of second year rainbow trout collected in horizontal gill nets set in the spring for Canyon Ferry Reservoir.

Relative abundances of fish captured in sinking gill nets set during the fall are presented in Appendix Table 4. In 1990, white suckers dominated the composition of the catch (58.5%), followed by yellow perch (32.1%). The number of yellow perch collected in sinking gill nets approximately doubled between 1989 and 1990. This increase may indicate the beginning of a rebound for the yellow perch population in Canyon Ferry Reservoir. Yellow perch collected in sinking gill nets averaged 8.1, 7.3, 8.5, 8.5 and 7.1 inches in length for the five respective years of sampling.

Recruitment and Rearing

Emigration of young of the year (YOY) rainbow trout from four tributaries to Canyon Ferry Reservoir was monitored by trapping during June and July in 1988 through 1990 (Table 6). Only Confederate Creek was trapped each of the three years of sampling. Because traps were not 100 percent effective, data can be used only as an index for tributary recruitment to the reservoir, not an estimate of actual numbers. Of the four tributaries sampled, Confederate Creek produced the greatest number of emigrating rainbow trout. Emigration from Confederate Creek appeared to be positively related to total discharge from the tributary. For all four tributaries, the number of YOY rainbow trout captured was relatively low. Although rainbow spawners have been observed to spawn in all four tributaries, spawning habitat appears to be limited by dewatering and a lack of clean spawning gravel. Recruitment to the reservoir will likely remain limited until spawning habitat can be enhanced in one or all of the tributaries.

Confederate Creek was electrofished during the fall of 1986, 1987, 1988 and 1990 to evaluate it's importance as a rearing area for juvenile rainbow trout and brown trout. The number of juvenile rainbow trout and brown trout collected per unit effort (10 yds. shoreline electrofished) averaged 4.42 and 0.76 fish, respectively (Table 7). Individual fish of both species averaged about 4.0 inches in total length. Interestingly, approximately two thirds of all juvenile rainbow trout collected were of known hatchery origin. Apparently, recently planted rainbow trout tend to migrate into the tributaries almost immediately following stocking.

Table 6. Number of emigrating rainbow trout captured in four tributaries to Canyon Ferry Reservoir during mid-summer in 1988 through 1989.

STREAM NAME	YEAR	TRAP PERIOD	# OF TRAP NIGHTS	# OF RAINBOW TROUT		DISCHARGE (Cu.ft./sec.)		% FLOW SAMPLED
				YOY	YEARLING	MEAN	RANGE	
Beaver Cr.	1988	6/28-8/4	6	3	5	1.6	2.5-0.5	80
	1990	6/21-7/9	6	2	0	--	--	--
Confed. Cr.	1988	6/23-8/1	6	6	0	3.7	7.0-1.3	47
	1989	6/12-7/19	6	71	0	20.0	41.0-4.0	25
	1990	6/21-7/9	6	118	0	30.0	--	25
Duck Cr.	1988	6/23-8/1	6	2	0	8.0	19.0-1.0	50
Magpie Cr.	1988	6/23-8/1	6	0	0	--	--	100

Table 7. Number and average length (inches) of juvenile rainbow trout and brown trout collected in Confederate Creek during the fall of 1986, 1987, 1988 and 1990. Earlier dates for each year were spent specifically searching for juvenile trout. CPUE=number of trout collected per 10 yards of shoreline electrofished.

DATE SAMPLED	SECTION LENGTH (FT)	RAINBOW TROUT				BROWN TROUT		
		NUMBER	AVE LENGTH	CPUE	% HATCHERY ORIGIN	NUMBER	AVE LENGTH	CPUE
10-1-86	600	80	5.5	4.00	75	42	4.4	2.10
10-30-86	600	10	5.6	0.50	70	9	3.9	0.45
9-28-87	600	342	3.0	17.10	18	56	3.8	2.80
11-6-87	600	5	7.0	0.25	80	0	--	0
10-3-88	600	190	3.6	9.50	82	11	3.9	0.55
11-7-88	1300	132	4.3	3.05	88	5	3.5	0.12
9-27-90	1300	214	4.7	4.94	64	47	4.0	1.08
10-30-90	1300	43	5.0	0.99	49	5	4.6	0.12
OVERALL	6900	1016	4.0	4.42	66	175	4.0	0.76

The shoreline of the Missouri River located upstream from Canyon Ferry Reservoir was electrofished during July, 1990 to monitor rearing habitat utilized by juvenile trout. The number of YOY rainbow trout and brown trout collected per unit of effort (10 yds. shoreline electrofished) averaged 0.12 and 0.77 fish, respectively (Table 8). These densities are substantially less than peak densities reported by Carty (1985) for both rainbow trout and brown trout in the section of Missouri River located downstream of Hauser Dam. A lack of good quality spawning habitat is probably limiting recruitment of trout in the section of river located upstream from Canyon Ferry Reservoir. Densities of YOY trout appeared to remain the same from the river delta to Deepdale. As observed in the smaller tributaries, approximately 23% of the YOY rainbow trout collected were of known hatchery origin. All of these hatchery fish were captured downstream from Townsend. Burbot also appear to be using the river for rearing habitat. In the course of searching for YOY trout, a total of 11 juvenile burbot were collected.

Table 8. The number of young of the year (YOY) rainbow trout and brown trout collected from shoreline electrofishing on the section of Missouri River located upstream from Canyon Ferry Reservoir during July, 1990.

RIVER SECTION	MILES ABOVE RESERVOIR	TOTAL YARDS ELECTROFISHED	NUMBER OF YOY TROUT/ 10 YDS. ELECTROFISHED	
			RAINBOW	BROWN
Delta	0-1.0	435	0.11	0.94
Sawmill	1.0- 2.0	490	0.12	0.59
Deepdale	8.0	175	0.11	0.86

Summer Creel Census

Interview distribution, party size and angler day

A total of 2,809 anglers were interviewed on Canyon Ferry Reservoir during the summer period (April through November) in 1990 (Appendix Table 5). Approximately 39% of the interviews were conducted on weekdays and 61% were conducted on weekends or holidays (Table 9). More shore anglers were interviewed during the summer than boat anglers (63% vs. 37%). 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 2.00 people, with parties of up to 9 anglers encountered. The length of an angler day averaged 3.45 hours during the 1990 summer census.

Table 9. 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, 1989 and 1990.

	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
1990	39	61	63	37	3.45	2.00
OVERALL	45	55	68	32	3.58	2.16

Composition of catch and catch rates

Rainbow trout dominated the composition of the catch during the summer fishery in 1990 (Table 10). Reflecting an apparent decline in the yellow perch population, perch only comprised 17% of the catch, the lowest contribution to the fishery over the five year period of sampling. As in the previous four years, brown trout and mountain whitefish contributed very little to the fishery. Surprisingly, one kokanee was caught by an angler in Canyon Ferry during the 1990 summer creel census.

Annual summer catch rates for rainbow trout and yellow perch (fish per angler hour) are presented in Table 11. Catch rates for both rainbow trout and yellow perch continued to decline in 1990. Catch rates by anglers averaged 0.14 and 0.03 fish per hour for rainbow trout and yellow perch, respectively. Although specific reasons remain unknown, declining angler catch rates for rainbow trout

appear to be due to relatively poor survival of hatchery plants since 1988.

Table 10. Composition of the catch made by anglers on Canyon Ferry Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990.

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

Table 11. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986, 1987, 1988, 1989 and 1990 on Canyon Ferry Reservoir.

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

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the summer census are presented in Table 12. In the summer of 1990, harvested rainbow trout averaged 18.5 inches in total length and 2.57 pounds in weight. Approximately 99% of all rainbow trout harvested from Canyon Ferry Reservoir in 1990 and examined for marks were of known hatchery origin. The Arlee strain continued to dominate the harvest (60.5%), followed by Eagle Lake (22.2%) and Desmet (7.5%). The remainder of the harvest was comprised of hatchery fish of unknown origin, fish that could not be identified as either hatchery or wild fish (5.2%) and wild fish (0.6%). A more thorough discussion of strain evaluation is discussed later in this report.

Table 12. Mean length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990. Ranges are in parentheses.

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

The distribution by year of stocking for rainbow trout (hatchery origin) harvested during the summer creel census since 1986 is presented in Table 13. Reflecting results from the 1990 gill net collections, the percent composition of older aged rainbow trout harvested by anglers (fish that had been in the reservoir for more than 3 years) tended to be greater in 1989 and 1990 than in previous years. Again, these increases appear to be due to the greater longevity of the 'wild' strains of rainbow stocked into the reservoir (Desmet and Eagle Lake). These longer lived 'wild' strains appear to be filling in older age classes within the population age structure.

Table 13. Distribution by year of stocking for rainbow trout harvested by anglers from Canyon Ferry Reservoir during the April through November sampling period from 1987 through 1990.

	PERCENT COMPOSITION OF HARVEST				
YEAR	1ST YEAR	2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR
1987	8.9	66.8	21.9	2.4	0
1988	3.2	56.6	39.6	0.3	0.3
1989	11.9	12.8	60.9	14.4	0
1990	4.7	29.8	34.2	29.3	2.0

Winter Creel Census

Interview distribution, party size and angler day

A total of 884 anglers were interviewed on Canyon Ferry Reservoir during the winter ice fishery in 1990/91 (Appendix Table 6). Approximately 48% of the interviews were conducted on weekdays and 52% were conducted on weekends or holidays (Table 14). The number of anglers per party averaged 2.10 people, with parties of up to 8 anglers encountered. The length of an angler day averaged 3.8 hours.

Table 14. 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 - 1990/91.

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
1990/91	48.0	52.0	3.8	2.10
OVERALL	45.8	54.2	4.1	2.16

Composition of catch and catch rates

Yellow perch was the most readily caught species during the winter ice fishery in 1990/91, comprising about 91% of the catch (Table 15). Rainbow trout contributed about 7.5% to the catch. Other gamefish observed in the winter creel included mountain whitefish and burbot. The number of burbot caught by anglers was substantially greater during the 1990/91 winter ice fishery than in previous years. This increase in the burbot fishery may be an indication that the population is expanding in the reservoir.

Annual winter catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 16. During the 1990/91 winter ice fishery, catch rates for rainbow trout and yellow perch averaged 0.08 and 0.95 fish per angler hour, respectively. As in the summer creel census, catch rates for rainbow trout continued to decline during the 1990/91 winter ice fishery. The catch rate for yellow perch remained similar to the 1989/90 catch rate.

Table 15. Composition of the catch made by anglers on Canyon Ferry Reservoir during the winter ice fishery from 1986/87 through 1990/1991.

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

Table 16. Average catch rates (fish per angler hour) and percent harvested for rainbow trout and yellow perch obtained during the winters of 1985/86 - 1990/91 on Canyon Ferry Reservoir.

YEAR	RAINBOW TROUT/HOUR	%KEPT	YELLOW PERCH/HOUR	%KEPT
1985/86	0.11	95.5	3.68	92.6
1986/87	0.25	98.0	2.29	98.3
1987/88	0.26	96.6	1.74	90.3
1988/89	0.19	99.0	1.94	92.5
1989/90	0.12	95.1	0.92	99.8
1990/91	0.08	100.0	0.95	97.7
OVERALL	0.17	97.4	1.92	95.2

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested during the winter ice fishery in Canyon Ferry Reservoir are presented in Table 17. In the winter of 1990/91, harvested rainbow trout averaged 18.3 inches in total length and 2.32 pounds in weight. Although a greater percentage of the fish harvested during the winter ice fishery are of unknown origin, 74% of the rainbow trout harvested during the winter of 1990/91 were of known hatchery origin. Fewer rainbow trout can be identified by strain during the winter because vertebrae are not collected for examination of tetracycline marks. Even though MDFWP discontinued stocking Arlee rainbow in 1990, the Arlee strain continued to dominate the harvest during the winter of 1990/91 (40%).

The composition of first year fish in the winter creel, shown in Figure 8, appears to be correlated with survival of hatchery fish that were stocked into the reservoir the previous year. As a result, an examination of the age composition for rainbow trout in the winter creel provides an index to what can be expected for

rainbow catch rates the following summer (correlation coefficient=0.83). Based on the composition of first year fish harvested in the winter of 1990/91, the summer catch rate for 1991 should be approximately 0.15 fish per hour. This estimate is the same as the estimate obtained from gill net data (0.15 fish per hour).

Table 17. Mean length, weight and condition factors for rainbow trout harvested from Canyon Ferry Reservoir during the winter ice fishery from 1985/86 through 1990/91. 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
1990/91	18.3 (12.1-23.0)	2.32 (0.68-3.86)	36.96

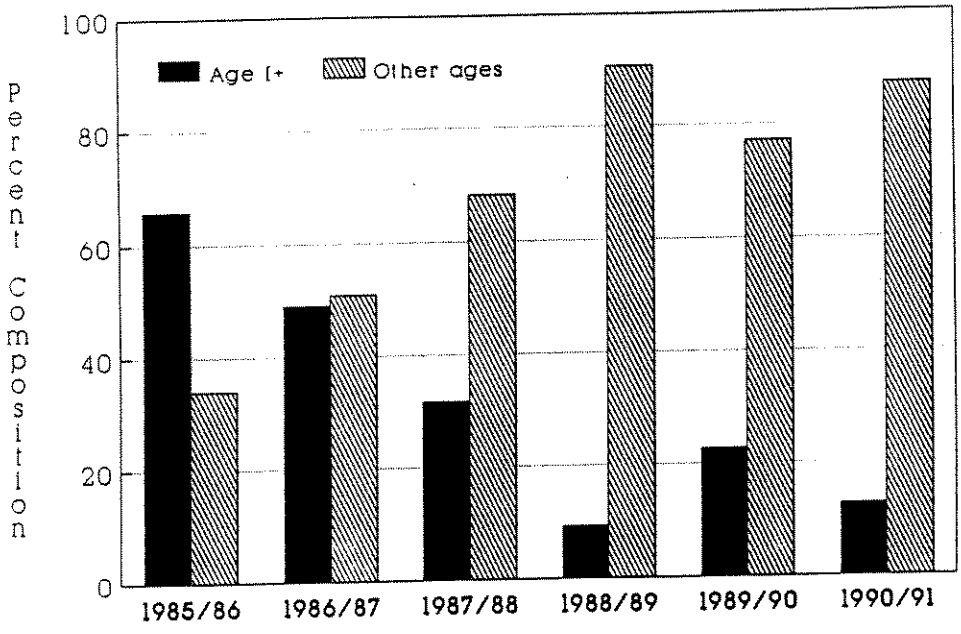

Figure 8. Age composition of rainbow trout harvested during the winter ice fishery in Canyon Ferry Reservoir from 1985/86 through 1990/91.

The average length of yellow perch harvested during the winter ice fishery averaged 8.2, 8.6, 8.9, 9.1, 9.6 and 10.2 inches in total length during the six respective years that a winter creel census was conducted. Apparently, fewer perch are being recruited into the population and, as a result, the structure is shifting toward older age groups. Although data are not available for Canyon Ferry, recruitment of yellow perch may be limited by the lower reservoir levels in recent years or by adverse spring weather patterns. There is a need to obtain additional age and growth data from yellow perch in Canyon Ferry Reservoir to determine if growth rates have changed as a result of changing population densities.

HAUSER RESERVOIR

Physical Limnology

Surface water temperature (to 15 feet) during the spring through fall period of survey in 1990 averaged 56.0, 58.9, and 58.1 F, respectively, in upper (Lakeside), middle (Causeway) and lower (Dam) stations of the reservoir (Table 18). A maximum average water temperature of 66.5 F was obtained during late July. Due to the warming effects of shallow Lake Helena, surface water temperatures were consistently warmer at the middle station (Causeway) than at the other two stations. Temperatures of the surface waters have displayed similar seasonal trends during the four year period of sampling (Figure 9). During the period of survey, temperature of the surface waters were cooler in Hauser Reservoir than in Canyon Ferry and Holter reservoirs. Water temperatures in Hauser Reservoir are cooled by deep water releases from Canyon Ferry Reservoir. Releases from Canyon Ferry apparently dampen the seasonal temperature fluctuations in Hauser Reservoir.

Table 18. Average water temperatures for surface waters (to 15 feet) at upper (Lakeside), mid (Causeway) and lower (Dam) sampling stations on Hauser Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN WATER TEMPERATURE (F)			
	SAMPLING STATION			
YEAR	UPPER	MID	LOWER	MAXIMUM AVERAGE
1987	55.7	57.3	56.7	65.2
1988	57.6	60.8	58.6	65.1
1989	58.2	59.6	59.0	66.5
1990	56.0	58.9	58.1	66.5

Seasonal water temperatures measured at the surface and reservoir bottom at the three sampling stations during 1987, 1988, 1989 and 1990 are shown in Appendix Figures 8, 9 and 10. Waters at all three sampling stations (Lakeside, Causeway and Dam) tended to form weak thermal structure. In upper and mid reservoir, thermoclines began to form in mid to late May. A thermocline tended to form later in the lower reservoir, beginning in early to mid June. At all three stations, waters began to recirculate in mid August. Thermoclines were located at depths ranging from 5 to 15 feet. In general, the thermocline in the lower reservoir was located deeper in the water column than at the other two stations.

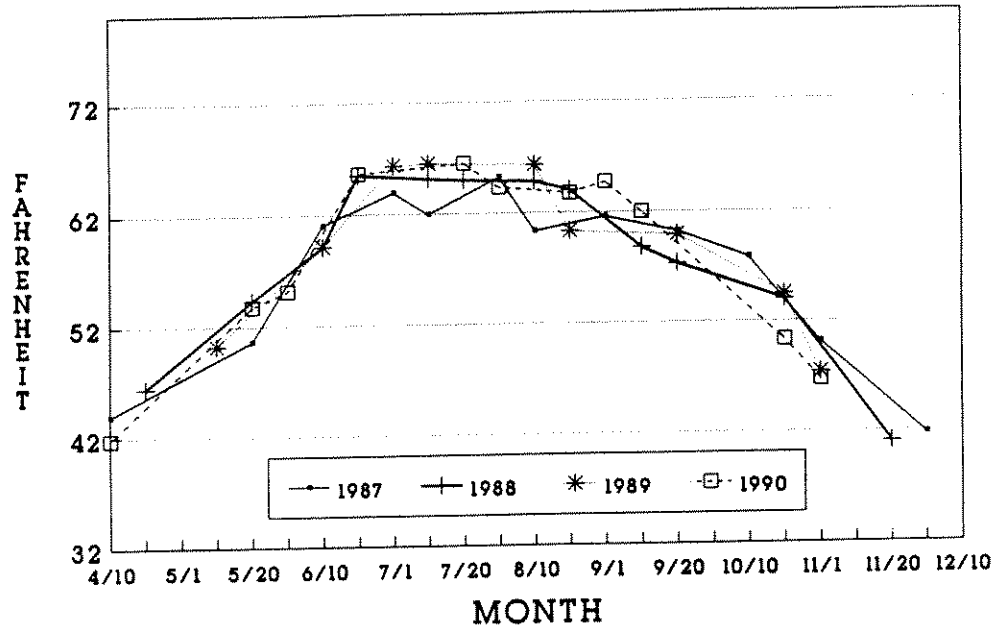

Figure 9. Seasonal trends of mean temperature for surface waters (to 15 feet) in Hauser Reservoir during 1987, 1988, 1989 and 1990.

Secchi depth readings during the spring through fall sampling period in 1990 averaged 9.1, 7.3 and 9.2 feet, respectively in upper, mid and lower stations of the reservoir (Table 19). Secchi readings were shallowest at the Causeway station. The Causeway Arm is warmer and more productive than the rest of the reservoir and, as a result, the density of plankton is greater. Greater plankton densities undoubtedly reduce light transmittance in the Causeway Arm. Overall, the euphotic zone was shallower in Hauser Reservoir than in Canyon Ferry or Holter reservoirs.

Seasonal Secchi depths measured during 1987, 1988, 1989, and 1990 are presented in Appendix Figure 11. Seasonal patterns for euphotic zones varied among the three stations as well as among the four years. Variations in seasonal trends appeared to be greatest at the upper station. These variations may have been due to turbidity created by wind and wave action in this shallow portion of the reservoir. In very general terms, euphotic zones tended to be deepest in the fall and shallowest in the spring.

Table 19. Average Secchi depth readings (feet) at upper (Lakeside), mid (Causeway) and lower (Dam) sampling stations on Hauser Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN SECCHI DEPTH (FT)			
	SAMPLING STATION			
YEAR	UPPER	MID	LOWER	OVERALL
1987	9.0	7.8	9.1	8.6
1988	9.0	7.4	8.2	8.2
1989	8.1	8.5	8.9	8.5
1990	9.1	7.3	9.2	8.5

Zooplankton

Total zooplankton densities in Hauser Reservoir averaged 17.6, 22.8, 29.2 and 17.3 organisms per liter, respectively in 1987, 1988, 1989 and 1990. Seasonal patterns for total zooplankton densities are shown in Figure 10. Seasonal trends were similar among the four year period of sampling. Zooplankton densities tended to peak in late June, followed by a secondary peak in late September. Overall, averages for total zooplankton densities in Hauser Reservoir were similar to those for Canyon Ferry and Holter reservoirs.

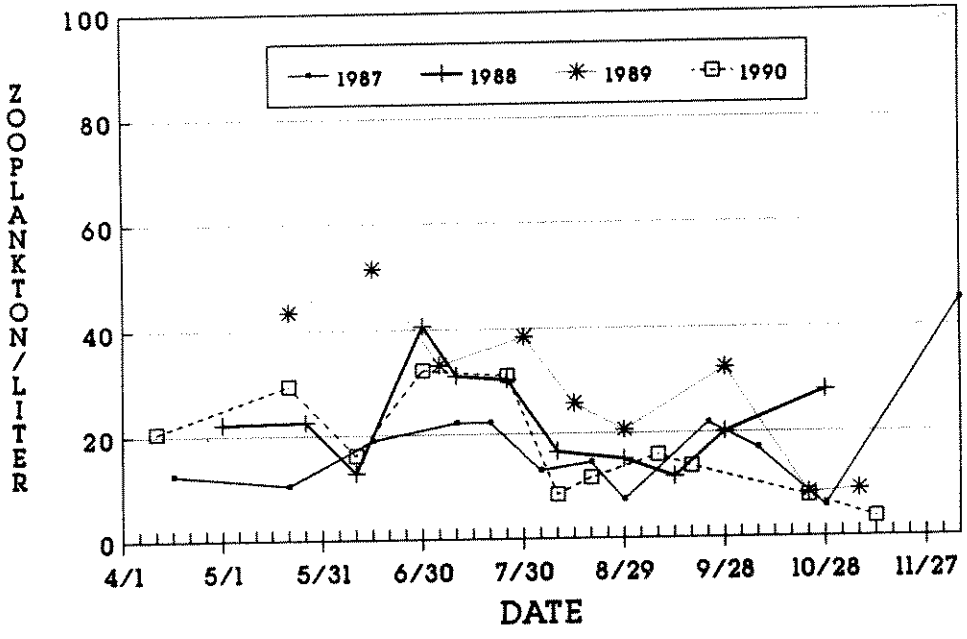

Figure 10. Seasonal trends of mean zooplankton densities for Hauser Reservoir during 1987, 1988, 1989 and 1990.

In all years, the zooplankton community in Hauser Reservoir was dominated by Daphnia, Cyclops, and Bosmina spp. during the spring through fall sampling period (Table 20). Diaptomus and Leptodora

spp. comprised the remainder of the zooplankton community. Cyclops was the most numerous genera, followed by Daphnia, Bosmina, Diaptomus, and Leptodora. In general, average densities of the primary zooplankters were greater in 1988 and 1989 than in 1987 and 1990.

Table 20. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in bimonthly vertical tows from three stations in Hauser Reservoir during the spring through fall sampling period in 1987, 1988, 1989 and 1990.

	NUMBER PER LITER				#/M³
YEAR	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
1987	5.76 (0.2-21.0)	1.18 (<0.1-5.2)	8.11 (0.7-115.8)	2.50 (<0.1-15.3)	6.47 (0-45.0)
1988	5.86 (0.2-16.1)	0.72 (<0.1-2.9)	10.90 (1.7-58.8)	4.80 (<0.1-29.7)	22.80 (0-349.7)
1989	8.26 (0.2-45.3)	0.59 (<0.1-3.6)	14.00 (0.6-63.3)	4.73 (<0.1-33.0)	14.50 (0-174.8)
1990	4.32 (0.1-14.9)	0.94 (<0.1-3.8)	9.32 (0.4-45.4)	2.73 (<0.1-22.1)	7.28 (0-57.1)

Densities of Daphnia were intermediate in the upper station Lakeside), greatest in the middle station (Causeway) and least in the lower station (Dam). Over the four year sampling period, densities of Daphnia averaged 5.96, 7.98, and 4.25 organisms per liter in the upper, middle and lower stations, respectively. Average densities of Daphnia were less in Hauser Reservoir than in Canyon Ferry Reservoir. The seasonal progression of abundance also varied among the three sampling stations (Appendix Figures 12, 13 and 14). At the upper station, Daphnia densities tended to peak in early July and then again in late August. Densities of Daphnia at the middle station, in contrast, peaked in late September or early October. At the lower station, Daphnia did not exhibit any discernable peak in densities, but tended to gradually increase from spring though the fall.

Due to the expansion of the kokanee population in Hauser Reservoir, the average size of Daphnia has been expected to decline as a result of selective cropping by feeding fish. However, the average size of Daphnia in Hauser Reservoir has remained the same since at least 1988 (Table 21). Overall, Daphnia have averaged 1.15 mm in length. In general, Daphnia size tended to be greatest in the spring and least in the fall.

Table 21. Monthly mean lengths (mm) of Daphnia spp. in Hauser Reservoir from 1986 through 1990.

YEAR	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	OVERALL
1986			Data not available						
1987			Data not available						
1988	1.36	1.32	1.12	0.99	1.28	1.09	1.02	1.10	1.16
1989	--	1.26	1.37	1.16	1.07	1.09	1.02	1.18	1.16
1990	1.14	1.24	1.18	1.16	1.32	1.04	1.10	0.96	1.14

Fish Abundance and Distribution

Horizontal gill nets

Relative abundances of fish captured in floating gill nets since 1986 are presented in Appendix Table 7. The gill net data indicate that the kokanee population in Hauser Reservoir has continued to expand. The contribution of kokanee to the catch in horizontal gill nets increased again in 1990, averaging 84% of all fish collected. In contrast, gill net data indicate that the rainbow trout population has continued to decline. Rainbow trout contributed an average of only 11% of the catch in 1990. Apparently, kokanee are suppressing the rainbow trout population in Hauser Reservoir through possible competition for food and space. 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 spring and fall gill net sampling in Hauser Reservoir are shown in Figures 11 and 12, respectively. The number of rainbow trout collected in floating gill nets during the spring has declined annually through the survey period. Again, the lower catch rates for rainbow trout may be associated with an expanding kokanee population. The number of kokanee collected in floating gill nets set in the spring has steadily increased since 1988, indicating a continued expansion of the population. Spring gill net data probably represent a more true picture of population trends in Hauser Reservoir than fall data. In the fall, recently stocked rainbow trout and the onset of secondary sexual characteristics in kokanee (development of an easily entangled kype) greatly influence the catch in gill nets. Fall catch rates for rainbow trout have fluctuated annually over the five year period of survey. Catch rates for kokanee in the fall have steadily increased since 1987.

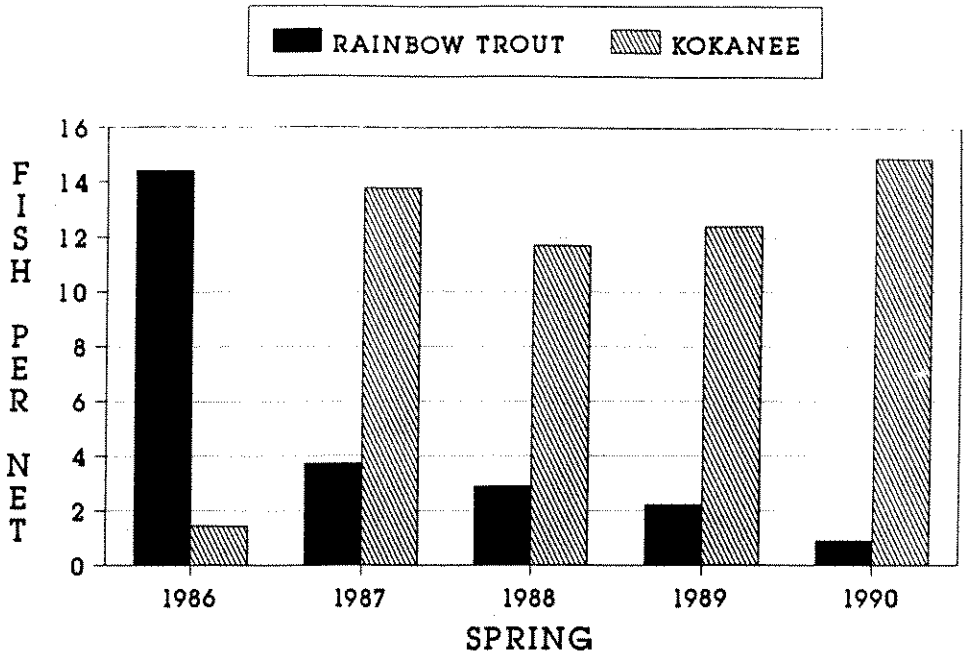

Figure 11. Average catch of rainbow trout and kokanee in floating gill nets set in Hauser Reservoir in the spring from 1986 through 1990.

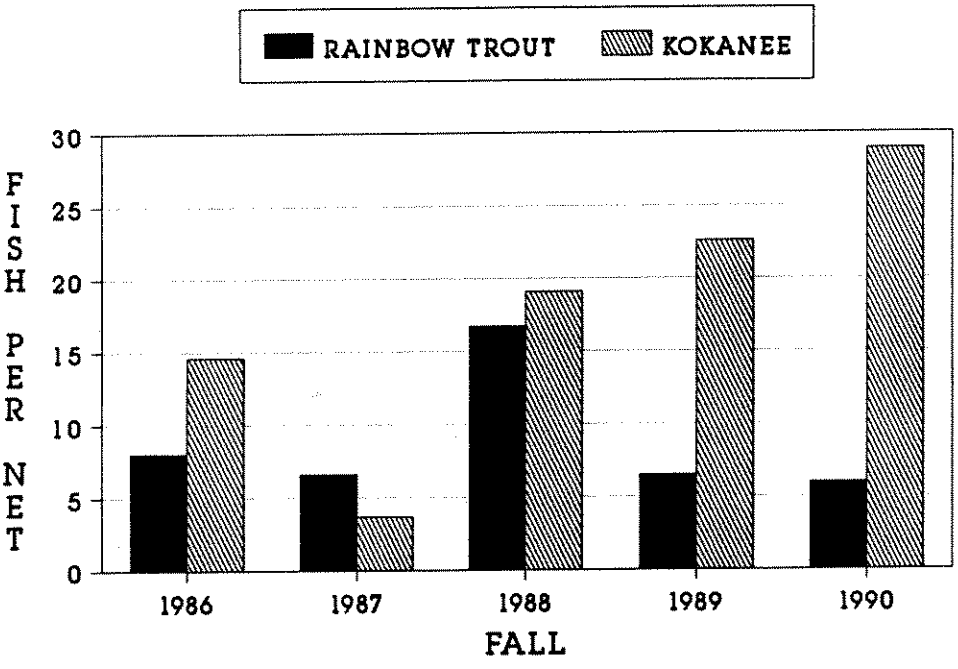

Figure 12. Average catch of rainbow trout and kokanee in floating gill nets set in Hauser Reservoir in the fall from 1986 through 1990.

In 1990, approximately 98% of all rainbow trout collected in floating gill nets were of known hatchery origin (Arlee strain)(Table 22). Age I+ rainbow trout dominated the catch during the spring, while age 0+ fish dominated the gill net catch during the fall. No hatchery rainbow trout older than 2 years of age were collected in gill nets.

For kokanee, age II+ fish dominated the age composition during the spring survey period in 1990, contributing 70% to the catch. Age III+ fish comprised about 29% of the netted kokanee during the spring. During the fall, age III+ fish comprised a majority of the catch (48%), followed by age II+ fish (35%) and age I+ fish (17%).

Table 22. Percent composition by strain and age for rainbow trout collected in floating gill nets set in Hauser Reservoir from 1986 through 1990.

YEAR	SEASON	ARLEE RAINBOW AGE 0+	ARLEE RAINBOW AGE I+	ARLEE RAINBOW AGE II+	ARLEE RAINBOW AGE III+	OTHER HATCH.	TOTAL HATCHERY	WILD
1986	SPRING	Data not available						
1987		0	64.9	18.9	2.7	5.4	91.9	8.1
1988		0	82.8	10.3	0	3.4	96.5	3.5
1989		0	80.0	5.0	0	0	85.0	15.0
1990		0	100.0	0	0	0	100.0	0
1986	FALL	70.5	23.9	3.4	0	0.2	100.0	0
1987		77.8	13.9	4.2	0	1.4	97.3	2.7
1988		82.1	12.5	1.6	0.5	1.1	97.8	2.2
1989		83.3	8.3	1.4	0	2.8	95.8	4.2
1990		77.3	19.7	0	0	0	97.0	3.0
						OVERALL	95.7	4.3

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 23. Rainbow trout collected during the spring and fall of 1990 averaged 12.9 and 11.6 inches in total length, respectively. The average size of rainbow trout collected in gill nets has remained similar through the period of survey. The average length of kokanee collected during the spring and fall averaged 12.9 and 17.0 inches, respectively, in total length. The average size of kokanee collected in gill nets has surprisingly remained similar through the period of survey. It was expected that the average size of kokanee would decline with continued expansion of the population.

Table 23. 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
1987		37	13.6	1.15	43.67	138	13.1	0.98	39.94
1988		29	13.6	1.15	44.83	117	14.2	1.28	42.25
1989		20	12.9	0.89	39.36	112	12.1	0.66	35.67
1990		10	12.9	0.93	43.44	164	12.9	0.88	39.06
1986	FALL	88	11.4	0.68	38.96	160	16.1	1.62	34.96
1987		72	11.7	0.77	42.75	41	15.4	1.54	39.31
1988		184	10.1	0.47	38.06	210	17.3	1.88	33.61
1989		71	11.3	0.65	39.15	248	15.9	1.36	33.74
1990		66	11.6	0.69	36.75	318	17.0	1.68	32.15

Relative abundances of fish captured in sinking gill nets are presented in Appendix Table 8. As in previous years, suckers dominated the composition of the catch in 1990, averaging 80% of the total catch. The number of Utah chubs collected in sinking gill nets, although remaining relatively low, has tended to increase each year. 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. In 1990, the catch rate for kokanee in vertical nets (number of kokanee collected per set) averaged 61.7 fish per set (Table 24). Average catch rates for kokanee have steadily declined in vertical nets since 1988. It is unlikely this decline represent a decline in population abundance for kokanee, however, since all other indices of abundance indicate a continued expansion of the population. For unknown reasons, the vulnerability of kokanee to being caught in vertical gill nets has apparently changed. Although average lengths for individual age classes have declined slightly over the survey period, this slight decline in size does not appear to be great enough to affect gill net vulnerability.

Age I+ kokanee dominated the catch in vertical gill nets in 1990. In 1989, however, age II+ kokanee dominated the catch in vertical nets. Changes in age composition during the period of survey appear to be due primarily to an exceptionally strong year class that developed in 1987. This year class appeared to influence composition of the age structure in consecutive years following their hatching and emergence in 1987.

Table 24. 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. Average total lengths by age class are in parentheses.

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
		(-)	(9.6)	(14.7)	(-)	
1987	4	0	32.3	7.5	0.2	40.0
		(-)	(10.5)	(14.1)	(-)	
1988	5	0.4	100.6	4.8	3.0	108.8
		(-)	(9.6)	(14.2)	(19.5)	
1989	6	0	36.7	44.0	0.6	81.3
		(-)	(9.1)	(12.8)	(17.6)	
1990	7	0.1	35.7	22.5	3.4	61.7
		(-)	(8.9)	(13.3)	(16.2)	

A comparison of growth rates among five consecutive year classes of kokanee is shown in Figure 13. Surprisingly, growth rates for kokanee in Hauser Reservoir have changes very little since 1986. In general, kokanee tend to become smaller as the population increases in density. Apparently, the food supply in Hauser Reservoir (primarily Daphnia) has been great enough to maintain growth rates in a rapidly expanding population.

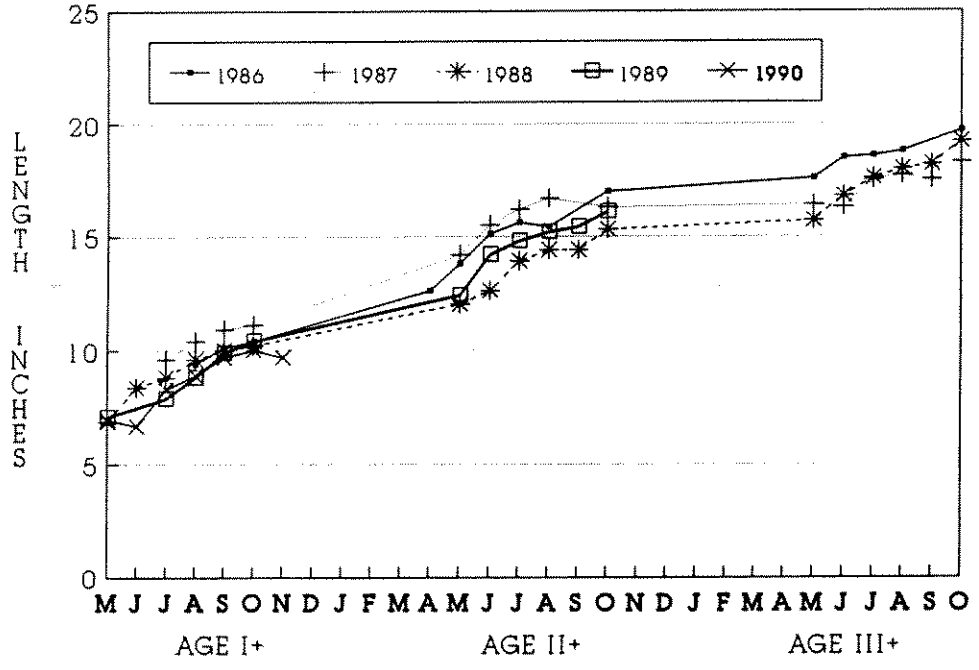

Figure 13. A comparison of empirical growth curves for five year classes of kokanee in Hauser Reservoir.

Summer Creel Census

Interview distribution, party size and angler day

A total of 2,881 anglers were interviewed on Hauser Reservoir during the summer period (April through November) in 1990 (Appendix Table 5). Approximately 48% of the interviews were conducted on weekdays and 52% were conducted on weekends or holidays (Table 25). 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 1.85 people, although parties up 7 anglers were encountered. The length of an angler day averaged 4.03 hours.

Table 25. 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, 1989 and 1990.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS FISHED/TRIP	MEAN # OF ANGLERS/PARTY
	WEEKDAY	WEEKEND	SHORE	BOAT		
1986	38	62	58	42	3.96	2.98
1987	49	51	60	40	3.93	1.87
1988	48	52	48	52	4.18	1.93
1989	61	39	54	46	4.07	1.90
1990	48	52	55	45	4.03	1.85
OVERALL	49	51	55	45	4.03	2.11

Composition of the catch and catch rates

Kokanee continued to dominate the composition of the catch during the summer fishery in 1990, although the contribution to the fishery in 1990 was lower than in 1989 (Table 26). As observed in the gill net data, the outstanding 1989 kokanee fishery was likely influenced by an exceptionally strong 1987 year class. Reflecting an apparent increase in the yellow perch population, perch contributed more to the fishery in 1990 than during any of the four previous years. The contribution of brown trout to the summer fishery has remained relatively steady over the period of survey. Several small walleye and one largemouth bass were caught in the Causeway Arm in 1990, indicating recent plants of the two species are beginning to provide new fishing opportunities in the reservoir.

Table 26. Composition of the catch by anglers on Hauser Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990.

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
1990	3,870	21.2	0.5	44.2	33.8	0.2	0

Annual summer catch rates (fish per angler hour) for rainbow trout and kokanee are presented in Table 27. In 1990, catch rates by anglers averaged 0.10 and 0.22 fish per hour for rainbow trout and kokanee, respectively. Catch rates for rainbow trout declined through the survey period, reflecting an apparent decline in the population. For kokanee, catch rates were lower during the summer creel in 1990 than in 1989. Again, the outstanding catch rates observed in 1989 may be a result of an exceptionally strong 1987 year class entering the fishery. The angler catch rate for yellow perch was greater in 1990 than during any other previous year, averaging 0.17 fish per hour.

Table 27. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and kokanee during the summers of 1986, 1987, 1988, 1989 and 1990 on Hauser Reservoir.

	RAINBOW TROUT				KOKANEE			
	FISH/HOUR			%	FISH/HOUR			%
YEAR	SHORE	BOAT	TOTAL	KEPT	SHORE	BOAT	TOTAL	KEPT
1986	0.25	0.26	0.25	88.7	0.01	0.18	0.10	98.6
1987	0.31	0.18	0.24	80.4	0.02	0.24	0.13	92.6
1988	0.38	0.09	0.24	74.8	<0.01	0.38	0.24	93.3
1989	0.21	0.06	0.12	66.2	0.08	0.63	0.42	89.0
1990	0.19	0.05	0.10	89.8	0.02	0.35	0.22	94.0
OVERALL	0.27	0.13	0.19	80.0	0.03	0.36	0.22	93.5

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the summer census are presented in Table 28. In the summer of 1990, harvested rainbow trout averaged 14.9 inches in total length and 1.60 pounds in weight. Harvested kokanee averaged 15.7 inches in length and 1.57 pounds in weight. Approximately 98% of all rainbow trout

harvested from Hauser Reservoir in 1990 were of known hatchery origin. Only 2 trout taken by anglers were fish that were originally stocked into Canyon Ferry Reservoir.

Table 28. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the summers of 1986, 1987, 1988, 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
1986	13.5 (7.0-20.1)	1.06 (0.14-4.06)	40.1	16.6 (8.5-22.2)	1.87 (0.20-3.94)	39.0
1987	14.2 (7.6-23.0)	1.26 (0.15-4.07)	41.2	15.6 (8.6-21.4)	1.52 (0.32-3.31)	38.2
1988	15.8 (7.9-23.9)	1.73 (0.22-6.00)	40.9	16.3 (8.2-21.8)	1.71 (0.28-3.24)	37.9
1989	13.7 (8.3-22.4)	1.17 (0.22-4.90)	39.1	14.6 (9.2-21.1)	1.13 (0.28-3.10)	35.4
1990	14.9 (7.0-23.5)	1.60 (0.30-4.95)	41.4	15.7 (8.6-23.4)	1.57 (0.26-3.97)	38.5

The distribution by age for rainbow trout harvested during the summer creel census is shown in Figure 14. With the exception of 1989, age I+ fish dominated the composition of the rainbow trout harvest in all years of the survey. A lower harvest of yearling trout in 1989 appeared to be a result of poor over-winter survival of the 1988 plant.

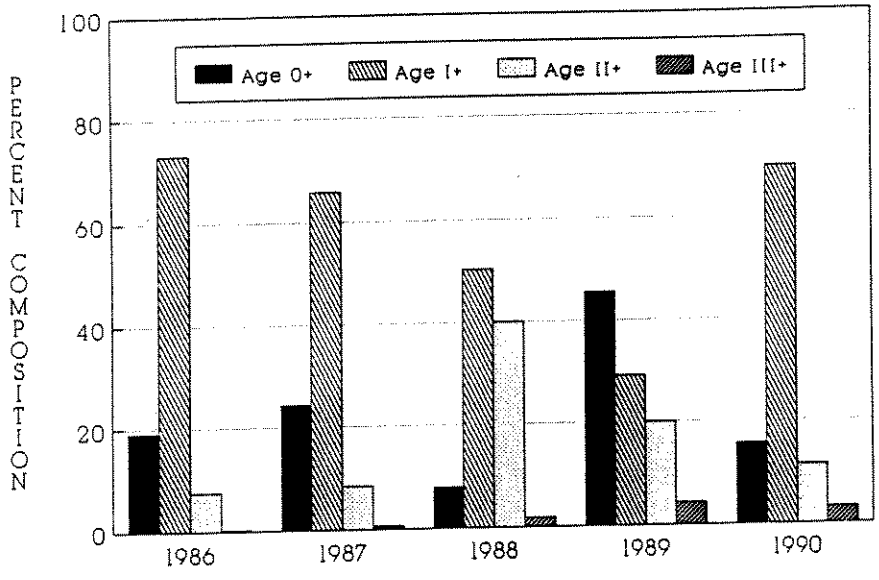

Figure 14. Age composition of rainbow trout harvested from Hauser Reservoir during the summers of 1986, 1987, 1988, 1989, and 1990.

The age distribution for kokanee harvested from Hauser Reservoir since 1986 is presented in Table 29. Age II+ kokanee dominated the harvest in all years. However, with the exception of 1989, the contribution of age III+ fish to the harvest has tended to increase annually. Apparently, more and more kokanee in Hauser Reservoir are living to an older age before they reach sexual maturity and spawn. Age distribution in 1989 (age II+ fish) and 1990 (age III+ fish) appeared to be influenced by the exceptionally strong 1987 year class.

Table 29. Age distribution of kokanee harvested from Hauser Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990.

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

Winter Creel Census

Interview distribution, party size and angler day

A total of 451 anglers were interviewed on Hauser Reservoir during the winter ice fishery in 1991 (Appendix Table 6). Approximately 40% of the interviews were conducted on weekdays and 60% were conducted on weekends or holidays. The number of anglers per party averaged 1.83 people, with parties of up to 7 anglers encountered. The length of an angler day averaged 3.1 hours.

Composition of catch and catch rates

Yellow perch was the most readily caught species during the winter ice fishery in 1991 (69% of the catch), followed by kokanee (21%), rainbow trout (9%) and brown trout (1%). As in the summer creel, yellow perch contributed more to the fishery in 1991 than in the previous two years, indicating a possible increase in population density.

Annual winter catch rates (fish per angler hour) for rainbow trout, kokanee and yellow perch are presented in Table 30. During the 1990/91 ice fishery, catch rates for rainbow trout, kokanee and yellow perch averaged 0.08, 0.18, and 0.60 fish per hour, respectively. As in the summer creel, angler catch rates for rainbow trout have annually declined. For kokanee, catch rates have tended to remain relatively steady over the three year period of survey.

Table 30. Average catch rates (fish per angler hour) and percent harvested for rainbow trout, kokanee and yellow perch obtained during the winters of 1988/89, 1989/90 and 1990/91 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
1990	0.11	88.0	0.18	90.3	0.20	98.5
1991	0.08	82.4	0.18	98.0	0.60	92.0
OVERALL	0.12	79.8	0.20	92.0	0.33	92.1

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 31. The average size of harvested rainbow trout and kokanee have remained similar among the three years of sampling. Approximately 99% of all rainbow trout harvested in 1991 were of known hatchery origin (Arlee strain). Age 0+ fish comprised about 24% of the rainbow harvest. For kokanee, yearling fish comprised a majority (58%) of the harvest. Yellow perch harvested during the winter of 1991 averaged 8.1 inches in length.

Table 31. Mean length, weight and condition factors for rainbow trout and kokanee harvested from Hauser Reservoir during the winters of 1988/89, 1989/90 and 1990/91. 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
1991	17.1 (9.9-22.0)	2.22 (0.39-4.82)	41.4	12.2 (9.3-15.8)	0.65 (0.29-1.46)	34.9

HOLTER RESERVOIR

Physical Limnology

Surface water temperature (to 15 feet) during the spring through fall period of survey in 1990 averaged 58.4 and 59.6 F, respectively, in the middle (Cottonwood) and lower (Jackson) stations of the reservoir (Table 32). A maximum average water temperature of 70.8 F was obtained in early August. Temperatures of surface waters have displayed similar seasonal trends during the four year period of sampling (Figure 15). Surface water temperature tended to be slightly cooler at the middle station than at the lower station. Average temperature of surface waters in Holter Reservoir were intermediate to temperatures in Canyon Ferry and Hauser reservoirs.

Table 32. Average water temperatures for surface waters (to 15 feet) at mid (Cottonwood) and lower (Jackson) sampling stations on Holter Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN WATER TEMPERATURE (F)		
	SAMPLING STATION		
YEAR	MID	LOWER	MAXIMUM AVERAGE
1987	57.1	58.0	66.1
1988	59.0	59.4	70.0
1989	60.0	60.8	71.2
1990	58.4	59.6	70.8

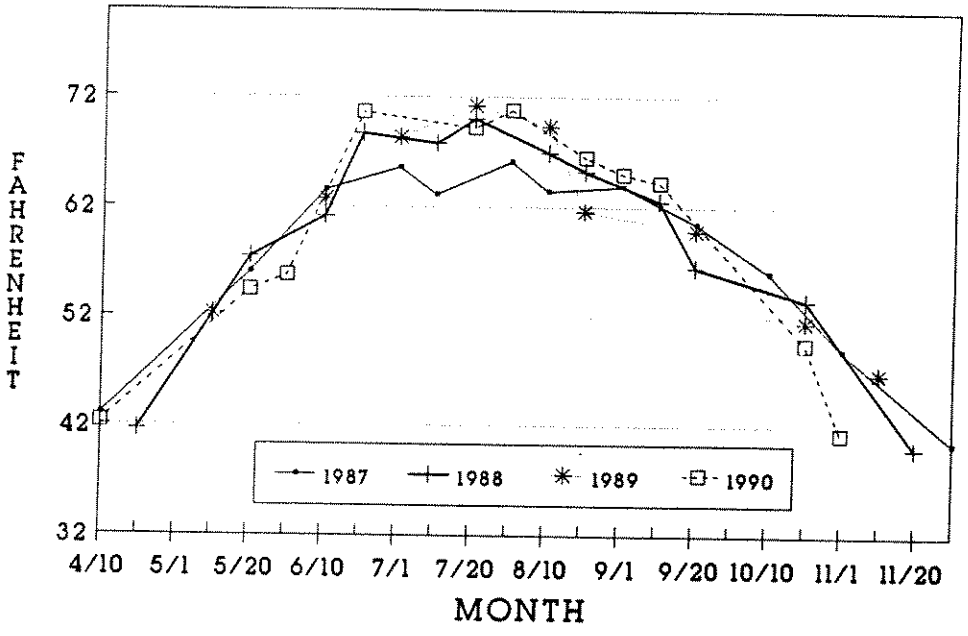

Figure 15. Seasonal trends of mean temperature for surface waters (to 15 feet) in Holter Reservoir during 1987, 1988, 1989 and 1990.

Seasonal water temperatures measured on the surface and reservoir bottom at the two stations during the four year period of survey are shown in Appendix Figures 15 and 16. With the exception of 1988, the formation of thermal structure at both stations tended to be very weak and of short duration. In general, a weak thermocline formed in late May and ended in mid-July at both stations. Thermal layering was located at depths ranging from 20 to 30 feet. In 1988, thermal structure appeared to be stronger and of longer duration than the other years of sampling. Thermal structure tended to form in late May and end in late July in 1988.

Secchi depth readings during the spring through fall sampling period in 1990 averaged 9.2 and 12.2 feet, respectively, in middle and lower stations of the reservoir (Table 33). Secchi readings in 1990 were similar to the three previous years of survey. Average readings were 3 to 4 feet shallower at the middle station than at the lower station. Overall, Secchi readings were slightly deeper in Holter Reservoir than in Canyon Ferry or Hauser reservoirs.

Table 33. Average Secchi depth readings (feet) at mid (Cottonwood) and lower (Jackson) sampling stations on Holter Reservoir during the spring through fall period of survey in 1987, 1988, 1989, and 1990.

	MEAN SECCHI DEPTH (FT)		
	SAMPLING STATION		
YEAR	UPPER	MID	OVERALL
1987	9.4	13.1	11.3
1988	9.1	13.2	11.2
1989	9.9	12.9	11.4
1990	9.2	12.2	10.7

Seasonal Secchi depths measured during 1987, 1988, 1989 and 1990 are presented in Appendix Figure 17. Seasonal trends were similar between the two sampling stations. In general, euphotic zones at both stations were shallowest in the spring and the fall and were deepest in July.

Zooplankton

Total zooplankton densities in Holter Reservoir averaged 17.3, 24.0, 31.5, and 20.6 organisms per liter, respectively, in 1987, 1988, 1989 and 1990. Seasonal patterns for total zooplankton densities are shown in Figure 16. Seasonal trends were similar among the four year period of sampling. Zooplankton densities tended to peak in late May, followed by a smaller secondary peak in September. Overall, averages for total zooplankton densities in Holter Reservoir were similar to those in Canyon Ferry and Hauser reservoirs.

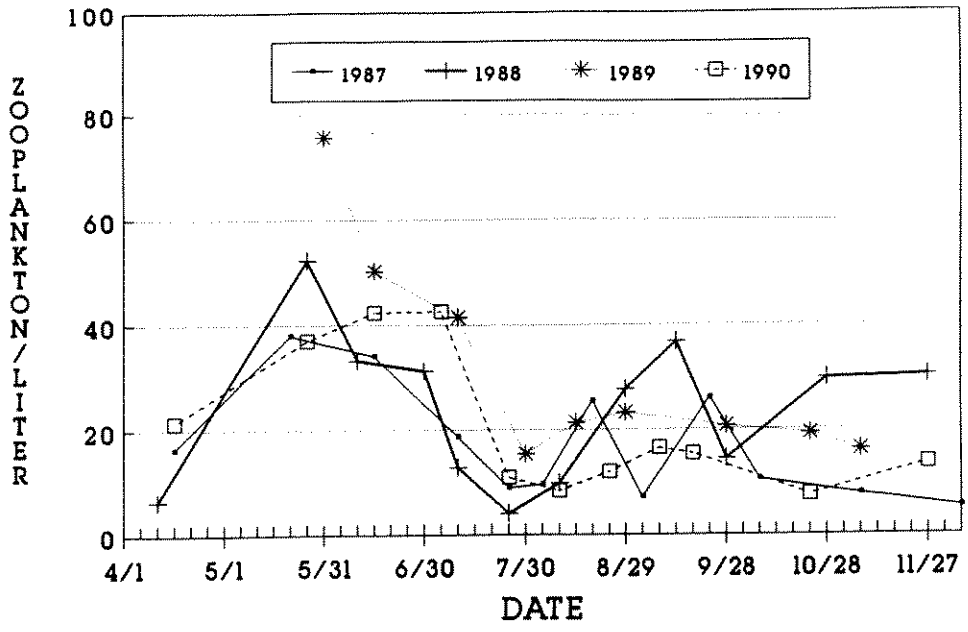

Figure 16. Seasonal trends of mean zooplankton densities for Holter Reservoir during 1987, 1988, 1989 and 1990.

In all years, the zooplankton community in Holter Reservoir was dominated by Daphnia, Cyclops, and, to a lesser extent, Bosmina spp. during the spring through fall sampling period (Table 34). Diaptomus and Leptodora spp. comprised the remainder of the primary zooplankton community. Daphnia and Cyclops, similar in average densities, were the two most numerous genera. Bosmina was the third most numerous genera, followed by Diaptomus and Leptodora. As in Hauser Reservoir, average densities of the primary zooplankters were generally greater in 1988 and 1989 than in 1987 and 1990.

Table 34. Mean density (No./L) and range of density (in parentheses) of the principal zooplankters collected in bimonthly vertical tows from two stations in Holter Reservoir during the spring through fall sampling period in 1987, 1988, 1989 and 1990.

	NUMBER PER LITER				#/M³
YEAR	DAPHNIA	DIAPTOMUS	CYCLOPS	BOSMINA	LEPTODORA
1987	8.80 (<0.1-34.1)	0.99 (<0.1-4.6)	6.48 (1.0-28.9)	0.99 (<0.1-3.5)	10.14 (0-83.9)
1988	9.34 (<0.1-39.8)	0.95 (<0.1-4.0)	9.24 (0.5-43.9)	4.49 (<0.1-35.1)	13.99 (0-47.0)
1989	12.65 (1.9-41.5)	0.75 (<0.1-2.1)	14.81 (1.2-91.7)	3.55 (0.1-15.3)	17.62 (0-53.5)
1990	6.57 (<0.1-18.1)	0.96 (<0.1-2.5)	10.12 (1.0-34.0)	2.99 (0-16.6)	15.92 (0-135.9)

Densities of Daphnia were less in the middle station than the lower station. Over the four year sampling period, densities of Daphnia averaged 7.42 and 11.25 organisms per liter, respectively, at the middle and lower stations. Average densities of Daphnia in Holter Reservoir tended to be similar to densities found in Canyon Ferry Reservoir and greater than those found in Hauser Reservoir. The seasonal progression of abundance also varied between the two sampling stations (Appendix Figures 18 and 19). At the middle station (Cottonwood), Daphnia densities tended to peak in August or September. A smaller secondary peak was exhibited in early July. Densities of Daphnia at the lower station, in contrast, tended to peak May or June, and was followed by a smaller secondary peak in the fall.

Although the kokanee population appears to be expanding in Holter, the average size of Daphnia (mean length) in the reservoir remained similar between 1988 and 1990. However, Daphnia collected in Holter Reservoir were larger than those collected in Hauser Reservoir by approximately 0.15 mm. The smaller size of Daphnia found in Hauser Reservoir may be a result of selective cropping by the very abundant kokanee population residing there.

Table 35. Monthly mean lengths (mm) of Daphnia spp. in Holter Reservoir from 1988 through 1990.

YEAR	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	OVERALL
1988	1.49	1.30	1.36	1.36	1.50	1.31	1.28	0.96	1.32
1989	Data not available								
1990	1.48	1.26	1.24	1.64	1.41	1.02	1.15	1.04	1.28

Fish Abundance and Distribution

Horizontal gill nets

Relative abundances of fish captured in floating gill nets since 1986 are presented in Appendix Table 9. During 1990, rainbow trout dominated the catch in the spring (61.5%), while kokanee dominated the catch in the fall (56.5%). Reflecting a recent expansion of the population, 1990 was the first year during the five year sampling period that more kokanee were captured in horizontal gill nets than rainbow trout. For rainbow trout, relative abundance tended to vary between seasons and among years. Other species of fish collected in floating nets did not exhibit any obvious changes in population abundance over the five year sampling period.

Mean catch rates (fish per net night) for rainbow trout and kokanee from spring and fall gill net sampling in Holter Reservoir are shown in Figures 17 and 18, respectively. For unknown reasons, gill net catches for rainbow trout do not exhibit any consistent

trend in population abundance. The number of rainbow trout collected in floating nets in the spring, 1990 was greater than collections in 1989. During the fall, however, catch rates for rainbow trout were slightly lower in 1990 than in 1989. For kokanee, the number of fish collected per gill net has increased annually over the 5 year period of survey. Again, these data indicate that the kokanee population is continuing to expand in Holter Reservoir.

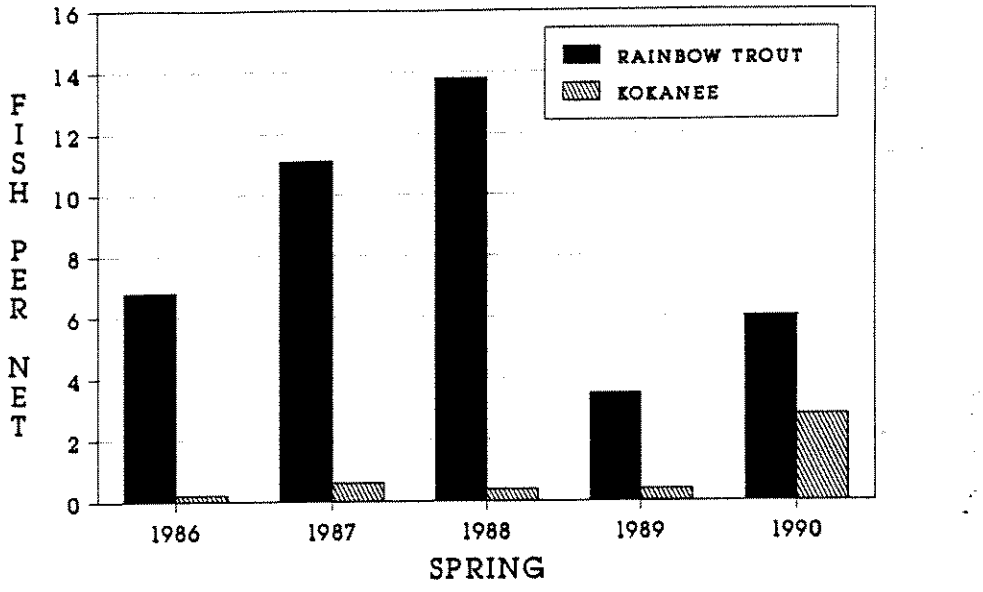

Figure 17. Average catch of rainbow trout and kokanee per net night set in Holter Reservoir in the spring from 1986 through 1989.

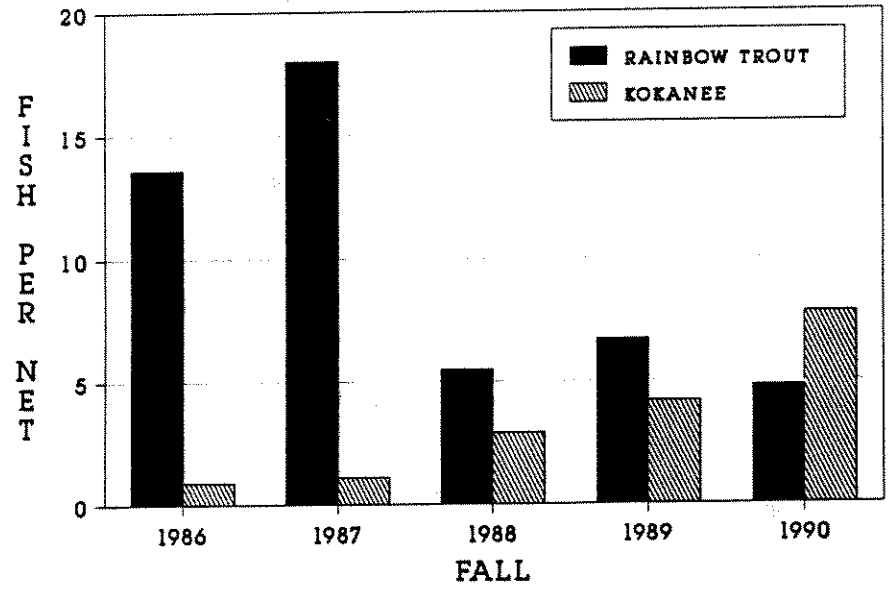

Figure 18. Average catch of rainbow trout and kokanee per net night set in Holter Reservoir in the fall from 1986 through 1990.

In 1990, approximately 73% of all rainbow trout collected in floating gill nets were of known hatchery origin (Arlee strain)(Table 36). Age I+ rainbow trout dominated the gill net catch of hatchery fish during the spring, while age 0+ Arlee dominated the catch of hatchery fish in the fall. Only one hatchery rainbow trout older than 2 years of age was collected in gill nets. In contrast to Canyon Ferry and Hauser reservoirs, the contribution of wild fish to the catch in Holter Reservoir is substantial (about 27% in 1990). Apparently, there is adequate spawning habitat in the 3.5 mile segment of free flowing river located upstream of Holter to maintain a viable 'wild' rainbow population. The contribution of wild fish to the gill net catch could not be ascertained in 1986, 1987 and somewhat in 1988 because a substantial number of rainbow trout collected in gill nets at the time remained unmarked. The marking program for hatchery rainbow trout was begun in 1986. Some of these unmarked fish likely originated from natural reproduction. In 1990, there were no hatchery rainbow trout originating from the upstream reservoirs captured in floating gill nets.

Table 36. Percent composition by strain and age for rainbow trout collected in floating gill nets set in Holter Reservoir from 1986 through 1990.

		ARLEE RAINBOW				OTHER	TOTAL	
YEAR	SEASON	AGE 0+	AGE I+	AGE II+	AGE III+	HATCH.	HATCHERY	WILD
1986	SPRING		Data not available					
1987			Data not available					
1988		0	40.8	16.3	0	4.1	61.2	38.8
1989		0	35.7	10.7	0	7.1	53.5	46.4
1990		0	68.8	8.3	2.1	0	79.2	20.8
1986	FALL		Data not available					
1987			Data not available					
1988		58.3	11.1	5.6	0	0	75.0	25.0
1989		56.3	6.3	1.5	1.5	1.6	67.4	32.8
1990		55.8	9.3	0	0	0	65.1	34.9

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 37. Rainbow trout collected during the spring and fall of 1990 averaged 14.1 and 12.4 inches in total length, respectively. The average length of kokanee collected during the spring and fall, respectively, averaged 13.8 and 17.8 inches in total length. The average length of rainbow trout and kokanee remained relatively constant through the period of survey.

Table 37. Mean length, weight and condition factors for rainbow trout and kokanee collected in floating gill nets set in Holter 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	41	15.1	1.31	37.7	1	15.1	1.50	43.6
1987		97	13.9	1.13	39.9	5	13.7	1.07	41.6
1988		110	14.8	1.30	39.0	3	17.2	2.30	44.6
1989		28	15.4	1.39	37.4	3	14.4	1.39	44.8
1990		48	14.1	1.13	39.4	22	13.8	1.12	40.7
1986	FALL	96	13.0	1.02	42.0	6	16.4	1.77	37.4
1987		152	13.8	1.19	43.2	9	17.4	2.17	40.4
1988		44	13.9	1.14	39.0	23	19.3	2.72	36.0
1989		64	13.5	1.11	41.0	40	17.8	2.24	38.2
1990		43	12.4	0.78	35.0	70	17.8	2.03	33.9

Relative abundances of fish captured in sinking gill nets set during the period of survey are presented in Appendix Table 10. As in previous years, suckers dominated the composition of the catch in 1990, averaging 62% of the catch. Yellow perch was the next most abundant species collected in 1990, averaging 28% of the catch. The relative abundance of all the fish species collected in sinking gill nets did not appear to change during the period of survey.

The number of walleye collected per sinking net has generally remained constant through the period of survey, indicating that the population has been relatively stable. In the spring and fall of 1990, the number of walleye captured in sinking gill nets averaged 2.4 and 2.3 fish per net, respectively (Table 38). With the exception of fish collected during 1987, the average size of walleye also remained constant, ranging from 19.1 to 21.2 inches in length and from 2.70 to 3.97 pounds in weight. In 1990, walleye averaged 19.1 inches in length in spring gill nets and 21.2 inches in length in fall gill nets. Age V+ walleye dominated the catch in sinking gill nets in 1990 (37% of all walleye collected), followed by age III+ fish (20%), and age VI+ fish (17%). Walleye up to 16 years of age were collected in 1990.

Table 38. 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
1987	SPRING	2.60	12.2 (9.5-16.6)	0.70 (0.22-1.69)	31.3
1988		2.17	19.1 (11.0-27.9)	3.00 (0.40-8.00)	33.8
1989		2.50	19.6 (17.2-27.0)	2.70 (1.55-7.50)	33.1
1990		2.40	19.1 (12.3-24.6)	3.22 (0.55-6.25)	38.6
1986	FALL	2.33	20.0 (15.0-30.0)	3.31 (1.12-10.0)	35.8
1987		3.17	16.7 (9.7-26.2)	2.05 (0.26-8.00)	36.7
1988		1.33	19.6 (15.6-25.4)	2.87 (1.52-5.00)	36.7
1989		4.33	20.5 (13.3-29.1)	3.60 (0.78-8.60)	37.9
1990		2.33	21.2 (13.5-27.2)	3.97 (0.84-9.00)	37.5

Vertical gill nets

In 1990, yellow perch dominated the catch in vertical gill nets set into Holter Reservoir (36%), followed by kokanee (30%), rainbow trout (15%) and suckers (13%). Walleye (2%) and mountain whitefish (4%) made up the remainder of the catch. The number of kokanee collected in vertical nets in 1990 was similar to the catch in 1989. Catch rates for kokanee in vertical nets (number of kokanee collected per set) averaged 13.7 fish per net in 1990. (Table 39). Age II+ kokanee dominated the catch in 1990, possibly reflecting a strong year class that had hatched and emerged in 1988.

Table 39. Mean catch rates (fish per net night) by age class for kokanee collected in vertical nets set at the Dam Station in Holter Reservoir during 1986, 1987, 1988 and 1990.

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

Summer Creel Census

Interview distribution, party size and angler day

A total of 1,633 anglers were interviewed on Holter Reservoir during the summer period (April through November) in 1990 (Appendix Table 5). Approximately 35% of the interviews were conducted on weekdays and 65% were conducted on weekends or holidays (Table 40). A greater number of interviews were conducted with boat anglers than with shore anglers (60% vs. 40%). 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 2.21 people. Parties of up to 7 anglers were encountered. The length of an angler day averaged 4.08 hours in 1990.

Table 40. 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, 1989 and 1990.

YEAR	PERCENT OF TOTAL INTERVIEWS				MEAN HOURS	MEAN # OF
	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
1990	35	65	40	60	4.08	2.21
OVERALL	35	65	39	61	4.13	2.23

Composition of the catch and catch rates

Yellow perch continued to dominate the composition of the angler catch in 1990 (Table 41). Reflecting a substantial expansion in the kokanee population, kokanee contributed more to the fishery in 1990 than during any of the four previous years. The sudden increase in the kokanee fishery may be due to an exceptionally strong 1988 year class. Brown trout and mountain whitefish contributed little to the fishery in 1990.

Annual summer catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 42. In 1990, catch rates by anglers averaged 0.26 and 0.53 fish per hour for rainbow trout and yellow perch, respectively. The angler catch rate for rainbow trout was similar between 1990 and 1989. For yellow perch, angler catch rates were lower in 1990 than in 1989. Angler catch rates for kokanee were substantially greater in 1990 than the four

previous years of survey, averaging 0.11 fish per hour. Again, these data indicate an expansion of the kokanee population in Holter Reservoir. Catch rates for walleye by anglers specifically seeking to catch the fish were slightly lower in 1990 than the four previous years of survey, averaging 0.04 fish per hour.

Table 41. Composition of the catch by anglers on Holter Reservoir during the summers of 1986 through 1990.

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

Table 42. Catch rates (fish per angler hour) and the percent harvested for rainbow trout and yellow perch during the summers of 1986, 1987, 1988, 1989 and 1990 on Holter Reservoir.

	RAINBOW TROUT				YELLOW PERCH			
	FISH/HOUR			%	FISH/HOUR			%
YEAR	SHORE	BOAT	TOTAL	KEPT	SHORE	BOAT	TOTAL	KEPT
1986	0.27	0.37	0.34	81.8	0.30	0.10	0.16	91.3
1987	0.24	0.41	0.37	85.9	0.61	0.31	0.39	72.7
1988	0.19	0.38	0.32	81.8	0.70	0.22	0.37	76.2
1989	0.22	0.29	0.27	70.8	0.40	1.06	0.85	83.1
1990	0.27	0.25	0.26	67.8	0.48	0.55	0.53	65.7
OVERALL	0.24	0.34	0.31	77.6	0.50	0.45	0.46	77.8

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested from Holter Reservoir during the summer census are presented in Table 43. In the summer of 1990, harvested rainbow trout averaged 14.2 inches in total length and 1.17 pounds in weight. Harvested kokanee averaged 16.1 inches in total length and 1.79 pounds in weight. Approximately 89% of all rainbow trout harvested in 1990 were of known hatchery origin. Rainbow trout originating from the wild comprised about 11% of the harvest. In contrast, 1990 gill net data indicated rainbow trout from natural reproduction comprised about 28% of the population. Apparently, the Arlee strain of rainbow trout stocked into Holter Reservoir is substantially easier to catch for anglers than rainbow trout originating from the wild.

Table 43. Mean length, weight and condition factors for rainbow trout harvested from Holter Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990. 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
1990	14.2 (8.0-20.1)	1.17 (0.22-3.72)	39.1

The distribution by age for rainbow trout harvested during the summer creel census is shown in Figure 19. With the exception of 1988, age I+ fish dominated the composition of the harvest in all years. In 1990, age I+ rainbow trout comprised about 63% of the total harvest. Apparently, over-winter survival of the 1989 plant was very good. For kokanee, age II+ fish dominated the 1990 fishery, comprising approximately 94% of the total harvest. Again, these data indicate the kokanee fishery was supported by a strong 1988 year class.

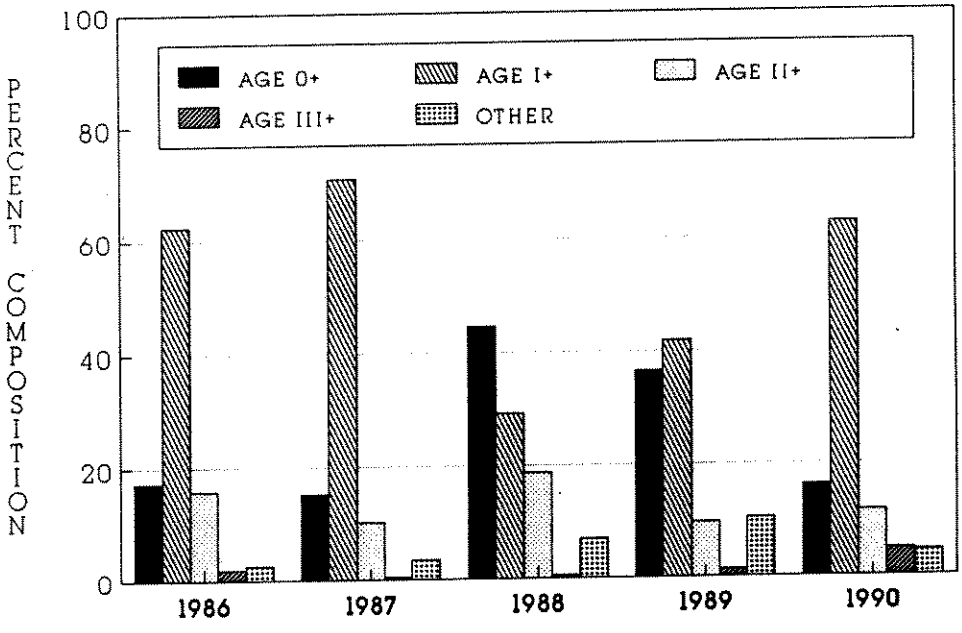

Figure 19. Age composition of rainbow trout harvested from Holter Reservoir during the summers of 1986, 1987, 1988, 1989 and 1990.

Winter Creel Census

Interview distribution, party size and angler day

A total of 547 anglers were interviewed on Holter Reservoir during the winter ice fishery in 1990/91 (Appendix Table 6). Approximately 39% of the interviews were conducted on weekdays and 61% on weekends. The number of anglers per party averaged 2.16 people, with parties of up to 8 people encountered. The length of an angler day averaged 3.8 hours.

Composition of the catch and catch rates

Yellow perch was by far the most readily caught species during the 1990/91 winter ice fishery, comprising about 92% of the catch. Rainbow trout comprised about 6.9% of the catch. Other gamefish observed in the creel included mountain whitefish, kokanee and walleye.

Annual winter catch rates (fish per angler hour) for rainbow trout and yellow perch are presented in Table 44. During the 1990/91 ice fishery, catch rates for rainbow trout and yellow perch averaged 0.27 and 3.57 fish per hour, respectively. Catch rates for rainbow trout were similar to the winters of 1989 and 1990. For yellow perch, angler catch rates were greater in 1990/91 than during the three previous years of survey. The winter of 1991 was the first year catch rates for kokanee during the winter fishery were measurable (0.02 fish per hour), reflecting the expansion of the population.

Table 44. Average catch rates (fish per angler hour) and percent harvested for rainbow trout and yellow perch obtained during the winters of 1987, 1989, 1990 and 1991 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
1991	0.27	97.2	3.57	88.3
OVERALL	0.31	94.2	2.54	94.6

Characteristics of harvested gamefish

The average length, weight and condition factors for rainbow trout harvested during the winter ice fishery are presented in Table 45. The average length of harvested rainbow trout was slightly less during 1990/1991 than during the three previous years of survey. About 94% of all rainbow trout harvested during the winter of

1990/91 were of known hatchery origin (Arlee strain). A majority of these harvested rainbow trout were age 0+ hatchery fish (85%). Yellow perch harvested in the winter of 1990/91 averaged 8.3 inches in total length.

Table 45. Mean length, weight and condition factors for rainbow trout harvested from Holter Reservoir during the winters of 1987, 1989, 1990 and 1991. 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
1991	12.0 (9.6-18.8)	0.70 (0.28-2.14)	37.4

STRAIN EVALUATION

Survival and Catchability

Overall, the Desmet strain (both age 0+ and I+ planters) and Eagle Lake strain (stocked prior to 1989) appeared to survive longer in Canyon Ferry Reservoir than the Arlee strain. Based on gill net collections, both the Desmet and the pre-1989 Eagle Lake strains of rainbow trout appeared to survive better in the reservoir than the Arlee strain (Table 46). 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 yearling Desmet planted in 1986 comprised about 6% of the total number of fish stocked into the reservoir, but comprised about 29% of the 1986 plant collected in gill nets over a five year period of survey. For another example, the Eagle Lake strain comprised about 26% of the 1987 plant, but comprised about 34% of the 1987 plant collected in gill nets over a four year period of survey.

At the same time, however, the Arlee strain of rainbow trout appeared to be easier to catch than the two 'wild' strains. For example, yearling Desmet stocked in 1986 comprised about 29% of the catch in the gill nets, but only 16% of the angler harvest. For another example, Eagle Lake stocked in 1987 comprised 34% of the catch in gill nets, but only 22% of the angler harvest. In general, differences in catchability between 'wild' and 'domestic' fish appear to be greater with the Desmet than with the Eagle Lake strain (differences between gill net and creel composition was greater for the Desmet). Gill net and harvest data indicate similar differences in the catchability between 'wild' versus 'domestic' rainbow trout in Holter Reservoir.

The Eagle Lake strain stocked after 1988 appeared to exhibit very poor survival immediately following stocking. This poor survival may be related to their condition upon stocking and/or to a later stocking date. Plants of Eagle Lake rainbow in 1989 and 1990 originated from the Creston National Hatchery and were stocked in the fall. In contrast, a majority of the Eagle Lake rainbow stocked in 1987 and 1988 originated from Bluewater State Hatchery and were stocked in mid-summer.

In general, the composition of the Arlee rainbow collected in gill nets declined annually from their original composition in the plant (Appendix Table 11). 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 for the 1989 and 1990 plant of age 0+ Eagle Lake). 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. Without actual population estimates for the reservoir, separating natural mortality from angler caused mortality is not possible.

Table 46. Distribution (percent composition) of rainbow trout by strain and date of stocking from gill net and angler harvest data collected on Canyon Ferry Reservoir since 1986. Percent composition is based solely on individual year classes (year fish were stocked).

PLANT DATE	FISH PLANTED	PERCENT COMPOSITION NUMBER PLANTED	GILL NETS	CREEL
1986	0+ ARLEE	94.1	70.8	84.2
	I+ DESMET	5.9	29.2	15.8
1987	0+ ARLEE	74.3	65.9	78.4
	0+ E. LAKE	25.7	34.1	21.6
1988	0+ ARLEE	74.9	67.0	83.9
	0+ E. LAKE	11.9	14.0	13.0
	0+ DESMET	13.2	19.0	3.1
1989	0+ ARLEE	86.8	98.1	100.0
	0+ E. LAKE	13.2	1.9	0
1990	0+ E. LAKE	70.7	12.5	0
	I+ DESMET	29.3	87.5	100.0

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 47. Population estimates presented for 1982 and 1983 were obtained by White et. al. (1984). In 1990, the estimated density for rainbow trout in the Hauser section was 13,449 fish (age I+ or older). The 1990 fall estimate was the second highest estimate in the seven year period of survey. Of the rainbow trout handled and checked for marks, only 1.4% were found to be adipose clipped (hatchery fish originally from Hauser Reservoir) and 1.8% were spray marked orange (hatchery fish originally stocked into Holter Reservoir). 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).

Inconsistencies in the rainbow population estimates are found if one follows age classes through the consecutive years. For example, there are an estimated greater number of age III+ fish in 1990 than there were age II+ fish in 1989. The reason for this inconsistency remains unclear, but may be a reflection in the quality of the estimates.

Table 47. 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, 1989 and 1990. Eighty percent confidence intervals are in parentheses.

AGE GROUP	1982	1983	1985	1986	1987	1989	1990
I	2,213	4,119	4,716	12,441	5,981	5,282	9,704
II	2,483	1,224	1,168	2,566	1,873	1,192	1,038
III	365	701	1,851	1,767	1,035	1,416	1,961
IV & older	2		479	312	363	985	746
TOTAL	5,061	6,044	8,214	17,087	9,252	8,875	13,449
	(864)	(1,422)	(1,597)	(4,618)	(786)	(917)	(1,424)
# per MILE	1,770	2,113	2,872	5,974	3,235	3,103	4,702

Brown trout

Fall population estimates for brown trout in the Hauser section of the Missouri River are presented in Table 48. 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. In 1990, the estimated density of brown trout in the Hauser section was 630 fish (age I+ or older). The fall brown trout population has remained relatively stable since 1987. Estimated densities of brown trout in the Hauser section were not significantly different in 1987, 1989 and 1990.

Table 48. 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, 1989 and 1990. Eighty percent confidence intervals are in parentheses.

AGE GROUP	1982	1983	1985	1986	1987	1989	1990
I	257	199	256	194	114	159	270
II	702	576	214	510	151	148	110
III	293	369	542	456	187	140	88
IV & older	135	202	394	100	299	108	161
TOTAL	1,387	1,346	1,406	1,260	750	555	630
	(181)	(212)	(304)	(468)	(112)	(124)	(146)
NO. > 20.0"	386	432	292	91	288	110	134
NUMBER/MILE	485	471	492	441	262	194	220

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 49. The level of infection for spawners was higher in 1990 than in the four previous years of survey. Males had a very high incidence of infection in 1990, with approximately 44% of all males showing some form of the disease. Fungus infection on spawning brown trout may be a contributing factor to their population decline since 1986. However, further work needs to be conducted to determine what are the effects of this disease on spawning brown trout. A graduate student project is currently conducting research in the Hauser Section to determine how spawning brown trout and kokanee interact and if Saprolegnia or other possible disease is harming the brown trout population.

Table 49. Incidence of fungus (Saprolegnia) on brown trout collected in the Hauser section of Missouri River during the fall of 1985, 1986, 1987, 1989 and 1990. Percent incidence in parentheses.

YEAR	NO. OF FISH EXAMINED TOTAL	SPAWNERS	MALES	FEMALES	NO. OF FISH WITH FUNGUS 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)
1989	201	93	16	77	13 (6.5)	13 (14.0)	3 (18.8)	10 (13.0)
1990	220	92	18	74	22 (10.0)	21 (22.8)	8 (44.4)	13 (17.6)
TOTAL	1131	640	170	470	66 (5.8)	63 (9.8)	28 (16.5)	35 (7.4)

FOOD HABITS

Walleye

Food habits for walleye in Holter Reservoir continued to be monitored in 1990. All stomachs were collected from fish captured in gill nets. Indices of relative importance (IRI) for food items consumed by walleye residing in Holter Reservoir for spring and fall are presented in Tables 50 and 51, respectively. In the spring, fish made up 99.5% of the dietary volume for walleye. Species of fish consumed by walleye during the spring, in order of importance, included yellow perch, mottled sculpin, and walleye. Unidentified fish comprised a substantial portion of the total dietary volume for walleye in the spring (28%). Undoubtedly, a majority of this volume was comprised of the more easily digested species of fish, including rainbow trout, mountain whitefish, suckers and kokanee. Approximately 30% of all stomachs examined in the spring were empty.

In the fall, fish comprised about 99% of the dietary volume for walleye. Yellow perch was again the most important food item found in the walleye diet, followed by salmonids, suckers and mottled sculpins. Again, unidentified fish made up a substantial portion of the dietary volume (44%). The fall diet for walleye appeared to be somewhat more varied than the diet in the spring. Approximately 35% of all stomachs examined during the fall were empty.

Table 50. Indices of relative importance (IRI) for food items in the diet of walleye collected from Holter Reservoir during the spring from 1986 through 1990. Total number of stomachs=66.

FOOD ITEMS	% OCCURRENCE	% ABUNDANCE	% VOLUME	IRI
Y. PERCH	12.1	16.1	42.8	25.1
SCULPIN	12.1	19.5	28.4	21.2
SUCKERS	0	0	0	0
SALMONIDS	0	0	0	0
WALLEYE	1.5	1.2	0.3	1.0
UNKNOWN FISH	47.0	37.9	28.0	39.9
DAPHNIA	0	0	0	0
LEPTODORA	0	0	0	0
HIRUNIDAE	3.0	3.5	0.4	2.5
DIPTERA	7.1	21.8	0.1	10.3
OTHER	0	0	0	0

Table 51. Indices of relative importance (IRI) for food items in the diet of walleye collected from Holter Reservoir during the fall from 1986 through 1990. Total number of stomachs=85.

FOOD ITEMS	% OCCURRENCE	% ABUNDANCE	% VOLUME	IRI
Y. PERCH	15.3	20.3	28.7	22.9
SCULPIN	1.2	5.1	3.2	3.4
SUCKERS	2.4	1.7	9.1	4.7
SALMONIDS	3.5	5.9	14.9	8.7
WALLEYE	0	0	0	0
UNKNOWN FISH	43.5	34.8	44.0	43.5
DAPHNIA	10.6	25.4	<0.1	12.8
LEPTODORA	2.4	5.1	<0.1	2.7
HIRUDINAE	0	0	0	0
DIPTERA	0	0	0	0
DECAPOD	1.2	0.9	0.1	0.8
OTHER	1.2	0.9	<0.1	0.7

Brown Trout

Food habits for brown trout have been monitored in all three reservoirs since 1986. All brown trout stomachs were collected from fish captured in gill nets. Indices of relative importance for food items consumed by brown trout residing in the three mid-Missouri reservoirs are presented in Table 52. Fish comprised 88, 93 and 96 percent of the total dietary volume for brown trout, respectively, in Canyon Ferry, Hauser and Holter reservoirs. Rainbow trout and yellow perch were the most important fish species in the diet of brown trout residing in Canyon Ferry and Holter

reservoirs. A majority of the rainbow consumed by brown trout were recently stocked hatchery fish. For Hauser Reservoir, sculpins and rainbow trout were the most important food items for brown trout. Apparently, the availability of yellow perch as a food item in Hauser Reservoir was less than in the other two reservoirs. Unidentified fish comprised a substantial portion of the total dietary volume in brown trout diets for all three reservoirs. Daphnia was the second most important food item for brown trout in all three reservoirs. IRI values for Daphnia ranged from 39.1 to 46.5. However, IRI values tended to over-estimate the importance of zooplankton in the diet of brown trout. Although Daphnia were very abundant in brown trout diets, they comprised very little of the dietary volume. Approximately 27% of all brown trout stomachs examined were empty.

Table 51. Indices of relative importance (IRI) for food items in the diet of brown trout collected from Canyon Ferry, Hauser and Holter reservoirs from 1986 through 1990. Total number of stomachs from Canyon Ferry=159. Total number of stomachs from Hauser=100. Total number of stomachs from Holter=29

RESERVOIR	FOOD ITEMS	% OCCURRENCE	% ABUNDANCE	% VOLUME	IRI
C. FERRY	Y. PERCH	16.4	0.4	31.7	13.4
	SCULPIN	0.7	<0.1	0.6	2.1
	SALMONIDS	6.9	0.1	45.6	14.5
	SUCKERS	0	0	0	0
	UNKNOWN FISH	37.1	0.2	9.9	13.1
	DAPHNIA	60.4	97.2	10.5	46.5
	LEPTODORA	16.4	1.9	0.8	5.3
	DIPTERA	8.8	0.1	<0.1	2.5
	DECOPODS	0.6	<0.1	0.2	0.1
	OTHER	6.9	0.1	0.6	2.5
HAUSER	Y. PERCH	3.0	0.1	3.7	2.2
	SCULPINS	9.0	0.3	13.8	7.4
	SALMONIDS	4.0	0.2	26.2	9.7
	SUCKERS	3.0	0.1	16.0	6.1
	UNKNOWN FISH	32.0	0.9	33.0	21.0
	DAPHNIA	30.0	95.7	3.5	41.3
	LEPTODORA	7.0	1.4	0.2	2.7
	DIPTERA	17.0	1.0	0.2	5.8
	DECOPODS	5.0	0.1	3.3	2.7
	OTHER	3.0	0.2	0.2	1.1

Table 51. cont.

RESERVOIR	FOOD ITEMS	% OCCURRENCE	% ABUNDANCE	% VOLUME	IRI
HOLTER	Y. PERCH	13.8	0.2	17.7	9.9
	SCULPINS	0	0	0	0
	SALMONIDS	3.5	<0.1	23.5	8.4
	SUCKERS	0	0	0	0
	UNKNOWN FISH	37.9	0.6	54.4	29.0
	DAPHNIA	24.1	97.5	3.8	39.1
	LEPTODORA	3.5	0.1	<0.1	1.1
	DIPTERA	28.0	1.5	0.3	9.1
	DECOPODS	0	0	0	0
	OTHER	10.4	0.2	0.3	3.4

ACKNOWLEDGEMENTS

The author thankfully acknowledges the assistance and support of numerous individuals in completing field, laboratory and office work on this project. Dave Yerk assisted in all aspects of this project, contributing valuable ideas and energy toward data collection, analysis and summary. Andrew Lawrence, Lee Bergstedt, Eric Jeanes and Russ Pelo gathered thousands of interviews from anglers fishing on the mid-Missouri reservoirs. Eric Jeanes spent countless hours analyzing food habits and zooplankton collections. All the the individuals mentioned above participated in marking the approximately 1.5 million rainbow trout stocked into the three reservoirs in 1990. Volunteers from Region 4 aided in clipping the hatchery rainbow trout for Hauser Reservoir. Hatchery managers from Great Falls, Bluewater, and Lewistown provided assistance and cooperation in the marking and distribution of hatchery rainbow trout into the three reservoirs.

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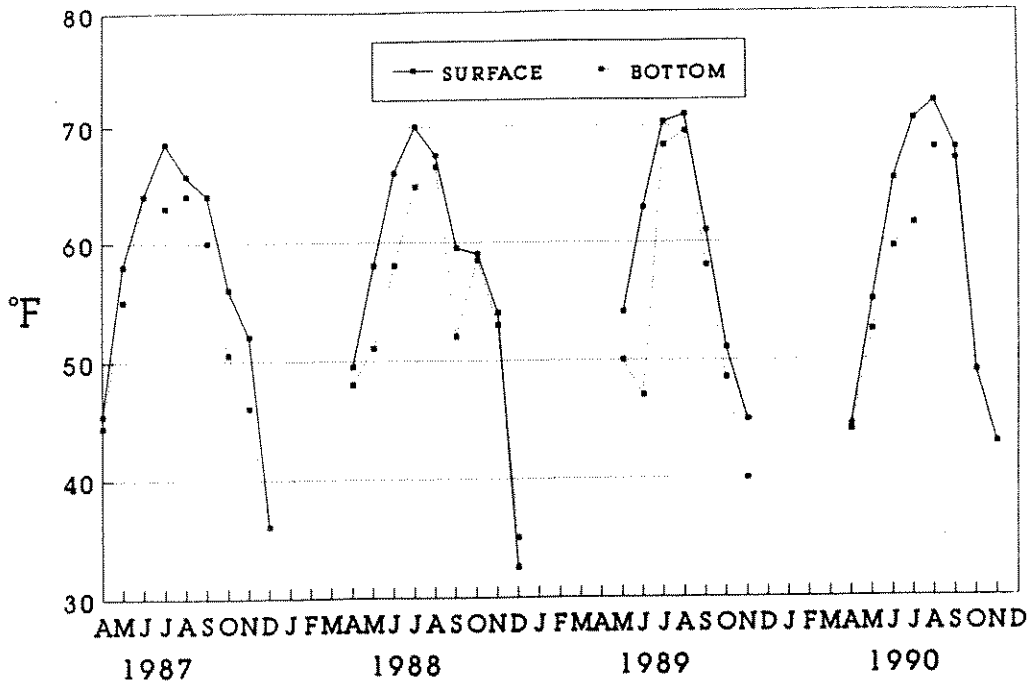
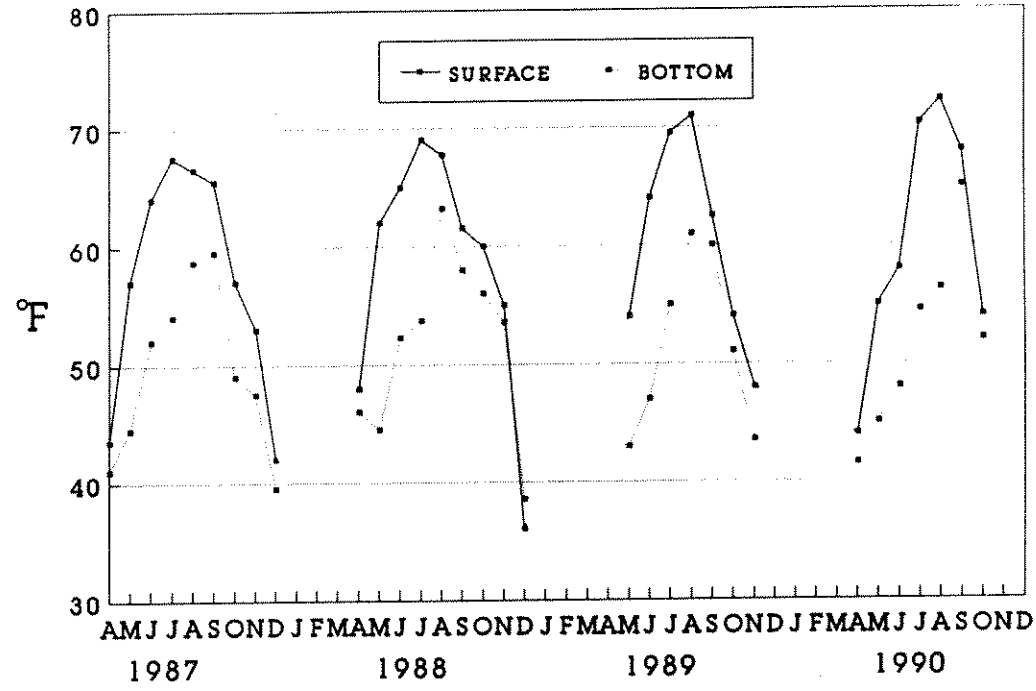
Prepared by: Mark E. Lere
Date: August 31, 1991
Waters referred to:

Canyon Ferry Reservoir	17-8832
Hauser Reservoir	17-9056
Holter Reservoir	17-9136
Missouri River Sec 10A	17-4913
Sec 11	17-4928
Beaver Creek	17-0480
Confederate Creek	17-1664
Duck Creek	17-2432
Magpie Creek	17-4448

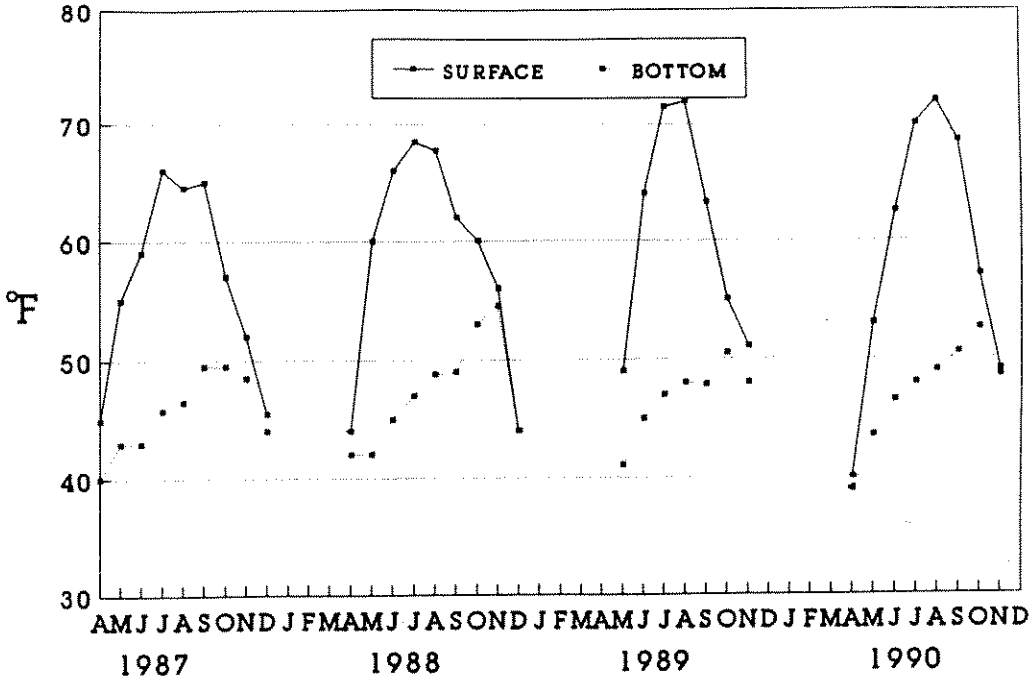
APPENDIX FIGURES



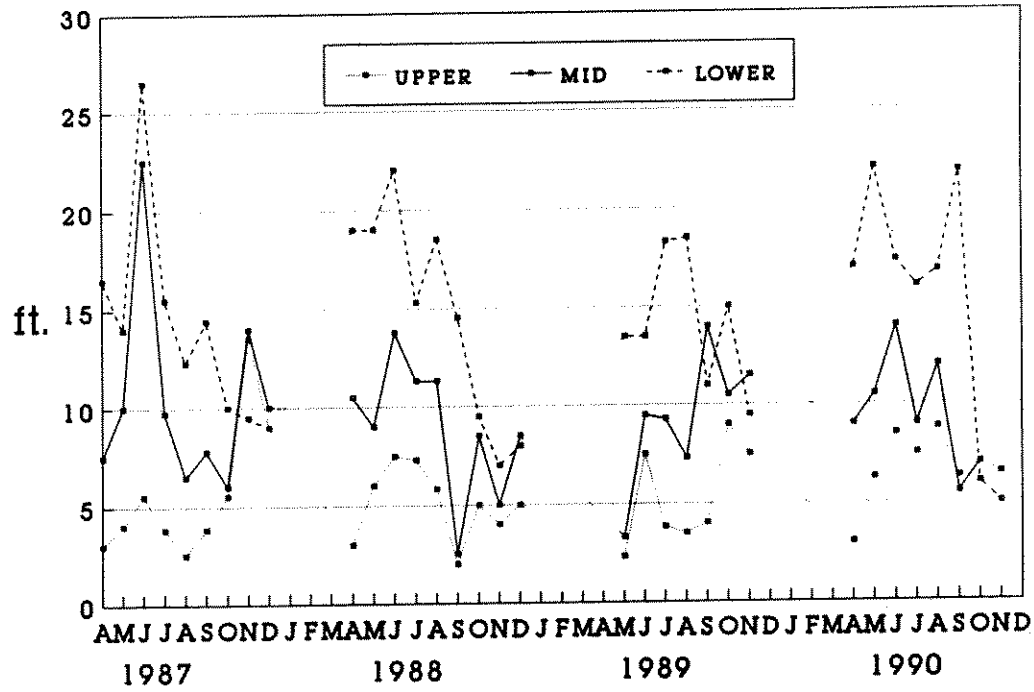
Appendix Figure 1. Water temperatures at surface and bottom in upper (Silos) station on Canyon Ferry Reservoir from April, 1987 through November, 1990.



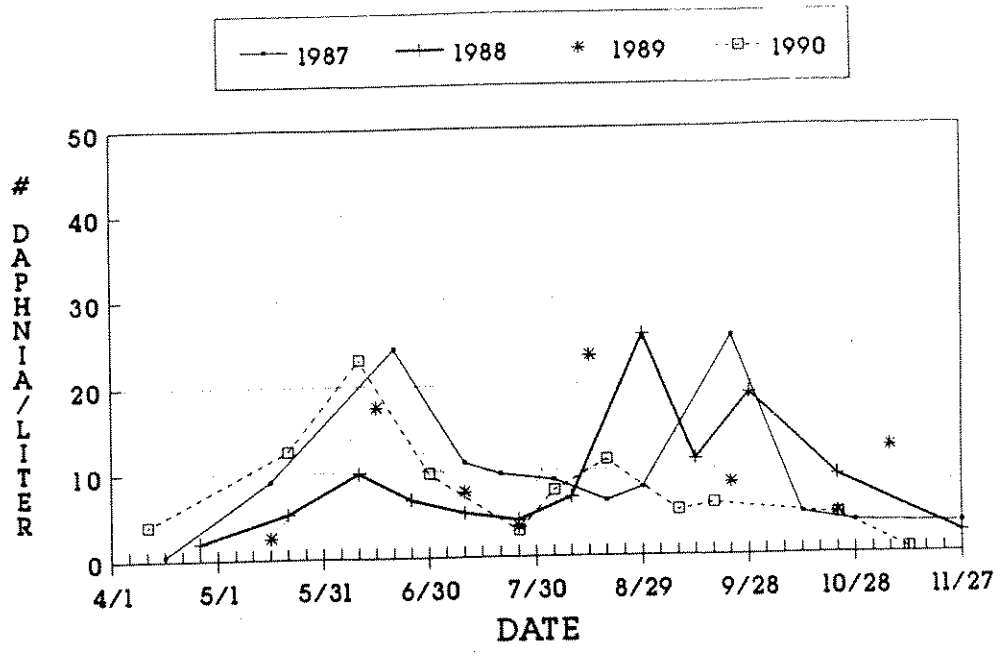
Appendix Figure 2. Water temperatures at surface and bottom in middle (White Earth) station on Canyon Ferry Reservoir from April, 1987 through November, 1990.



Appendix Figure 3. Water temperatures at surface and bottom in lower (Cemetery) station on Canyon Ferry Reservoir from April, 1987 through November, 1990.

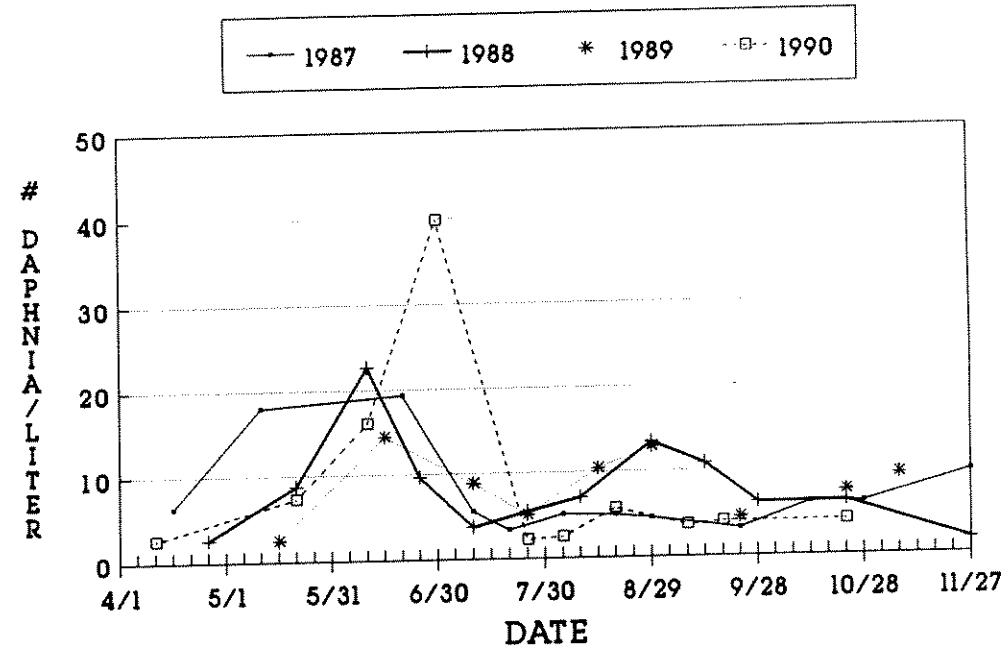


Appendix Figure 4. Euphotic zone depths measured in upper (Silos), middle (White Earth), and lower (Cemetery) stations on Canyon Ferry Reservoir from April, 1987 through November, 1990.



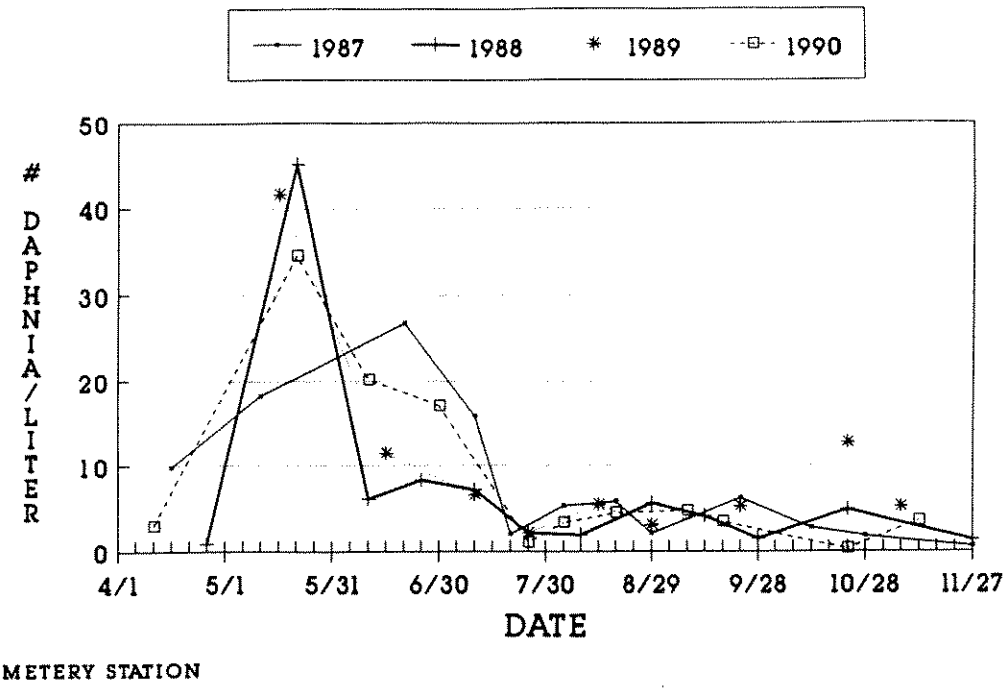
SILOS STATION

Appendix Figure 5. Seasonal trends of mean Daphnia spp. densities for upper station (Silos) on Canyon Ferry during 1987, 1988, 1989 and 1990.

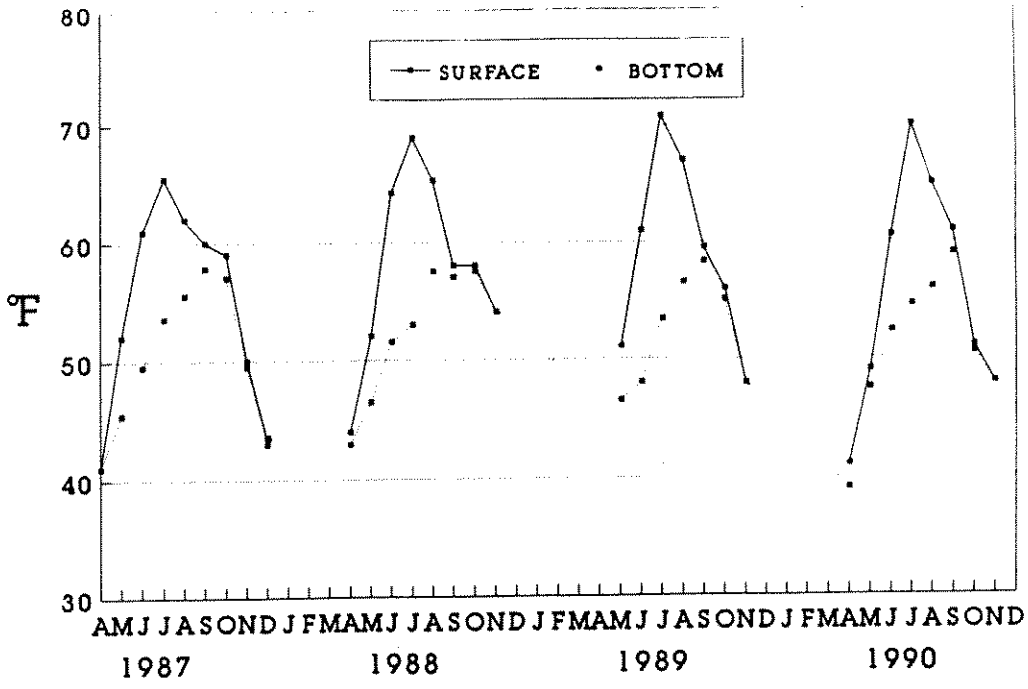


WHITE EARTH STATION

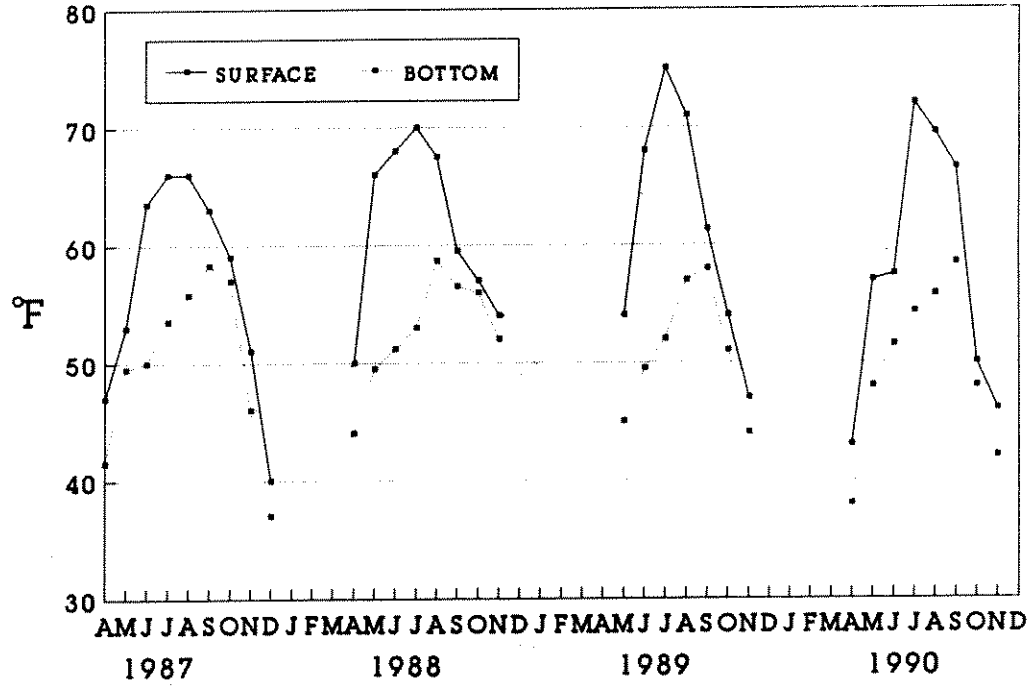
Appendix Figure 6. Seasonal trends of mean Daphnia spp. densities for middle station (White Earth) on Canyon Ferry during 1987, 1988, 1989 and 1990.



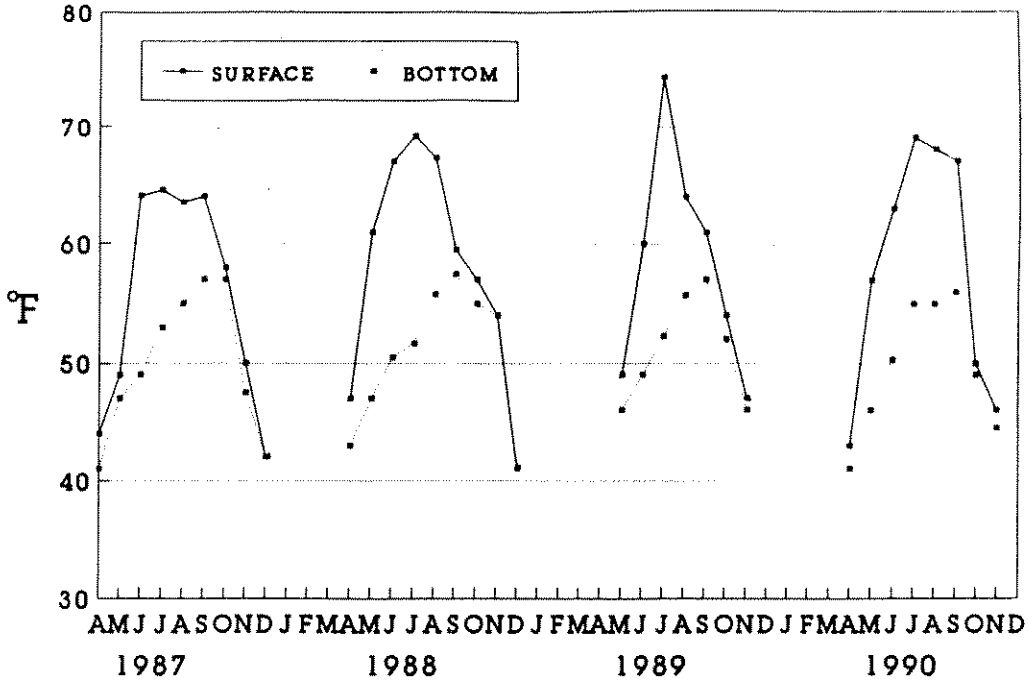
Appendix Figure 7. Seasonal trends of mean Daphnia spp. densities for lower station (Cemetery) on Canyon Ferry during 1987, 1988, 1989 and 1990.



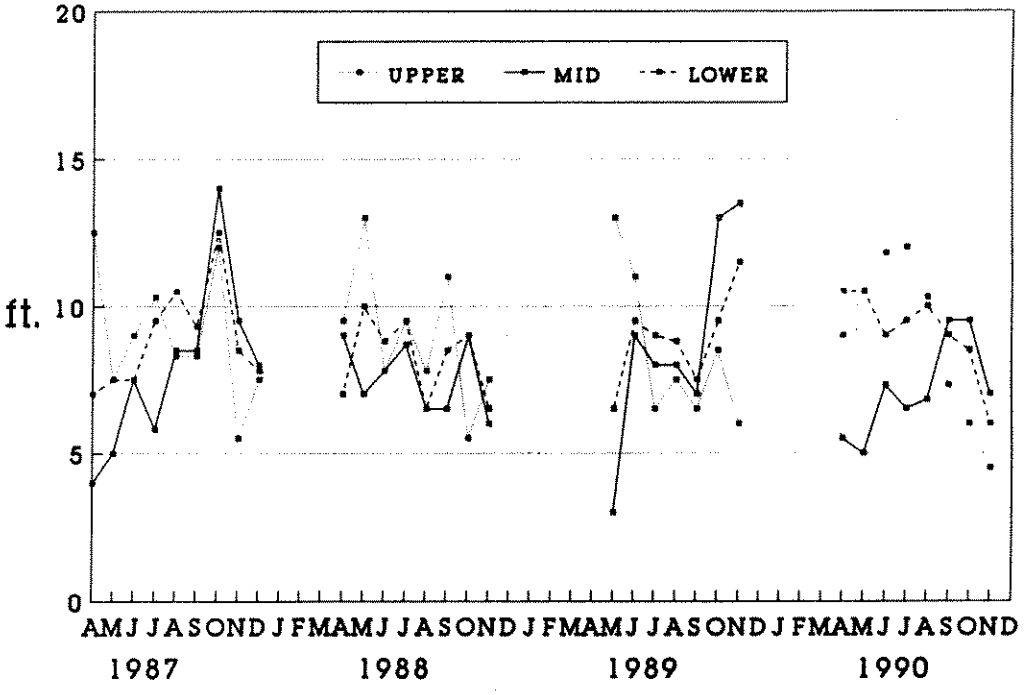
Appendix Figure 8. Water temperatures at surface and bottom in upper (Lakeside) station on Hauser Reservoir from April, 1987 through November, 1990.



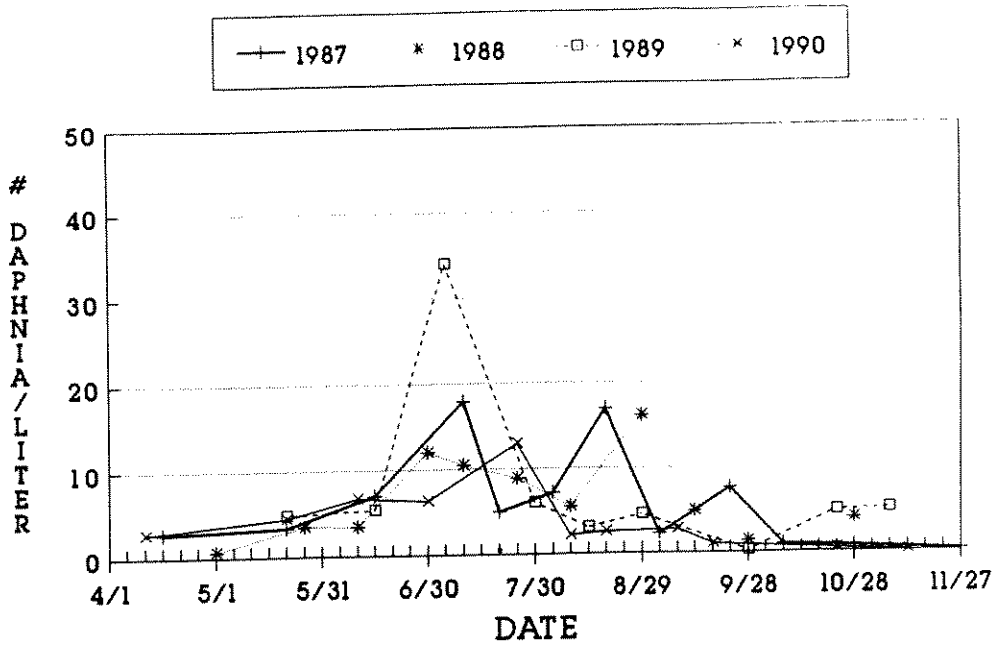
Appendix Figure 9. Water temperatures at surface and bottom in middle (Causeway) station on Hauser Reservoir from April, 1987 through November, 1990.



Appendix Figure 10. Water temperatures at surface and bottom in lower (Dam) station on Hauser Reservoir from April, 1987 through November, 1990.

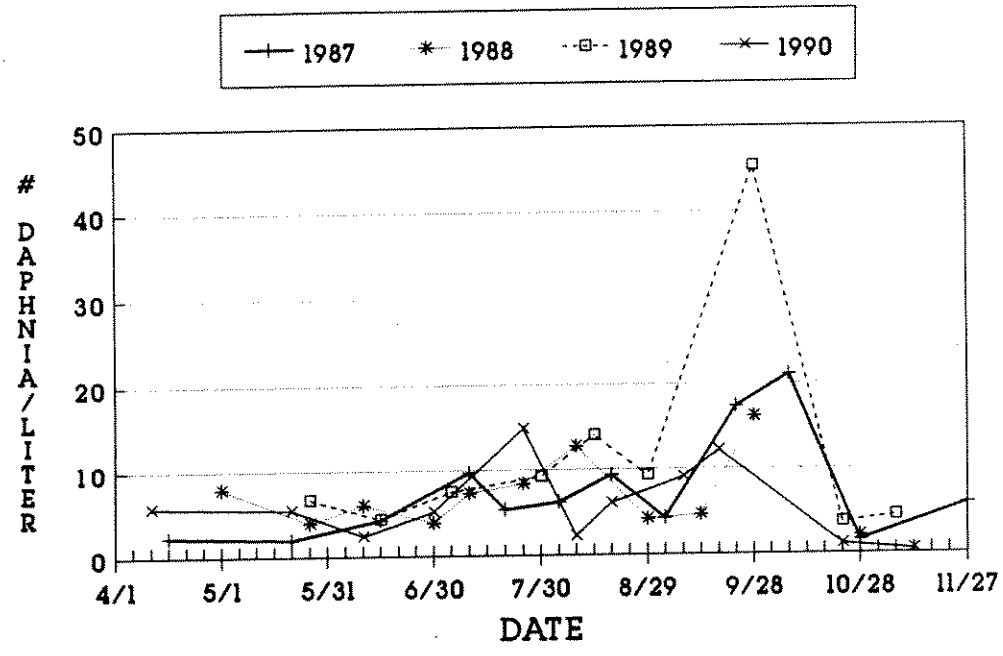


Appendix Figure 11. Euphotic zone depths measured in upper (Lakeside), middle (Causeway), and lower (Dam) stations on Hauser Reservoir from April, 1987 through November, 1990.



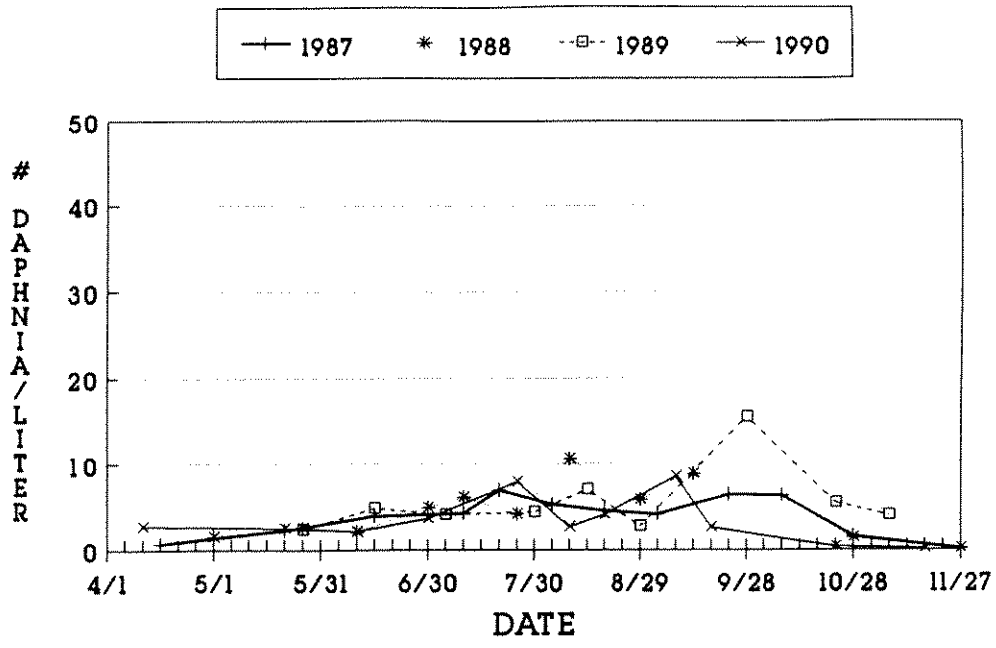
LAKESIDE STATION

Appendix Figure 12. Seasonal trends of mean Daphnia spp. densities for upper station (Lakeside) on Hauser during 1987, 1988, 1989 and 1990.



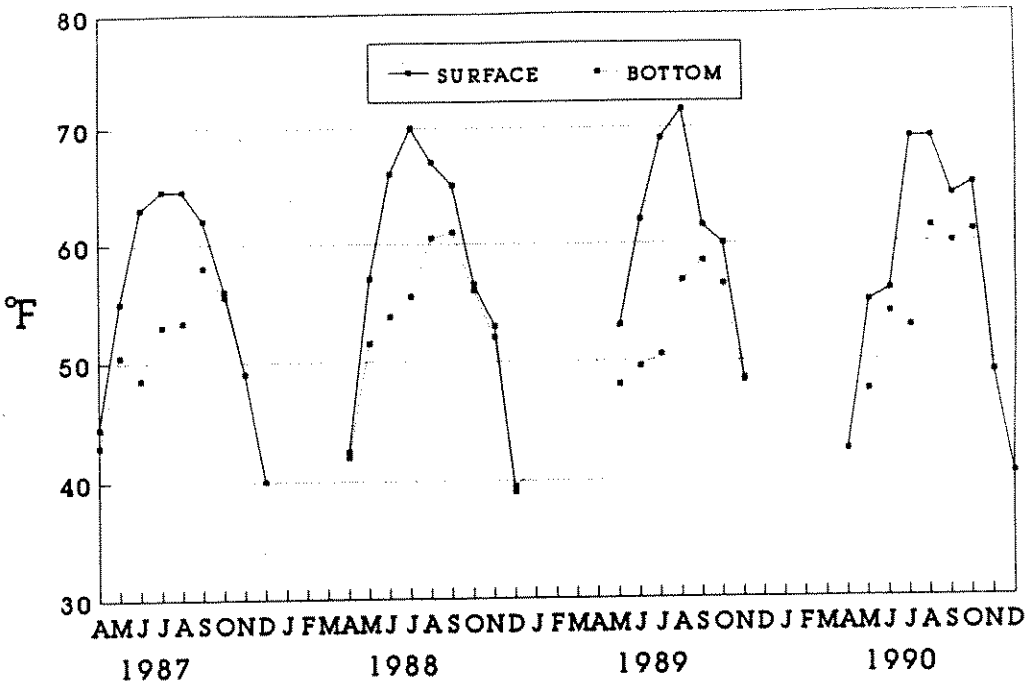
CAUSEWAY STATION

Appendix Figure 13. Seasonal trends of mean Daphnia spp. densities for middle station (Causeway) on Hauser during 1987, 1988, 1989 and 1990.

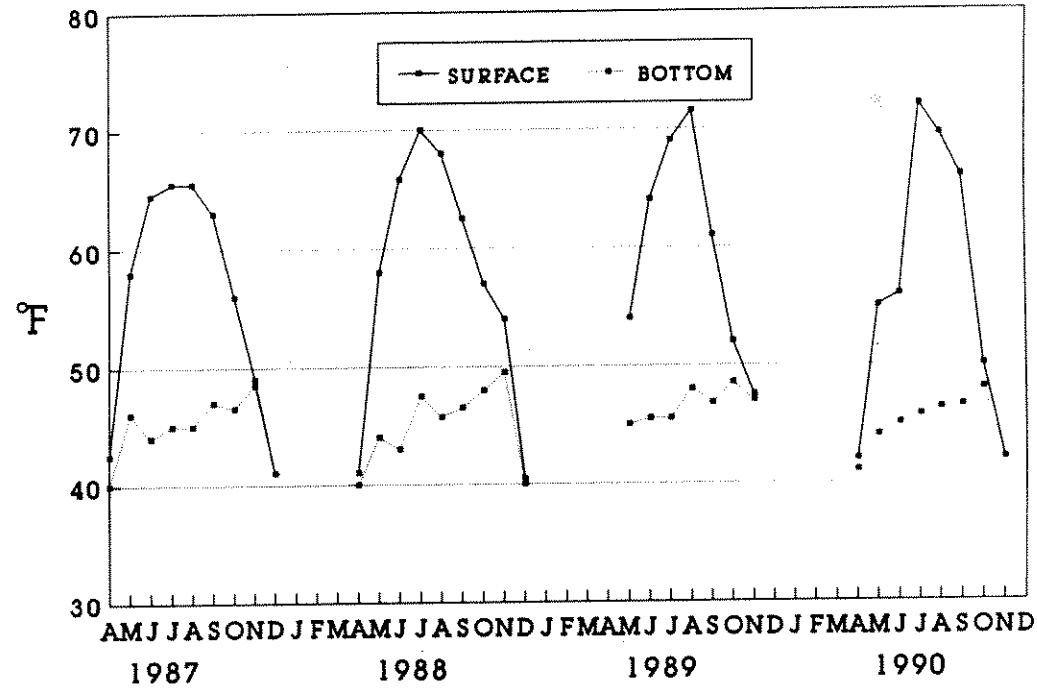


HAUSER DAM STATION

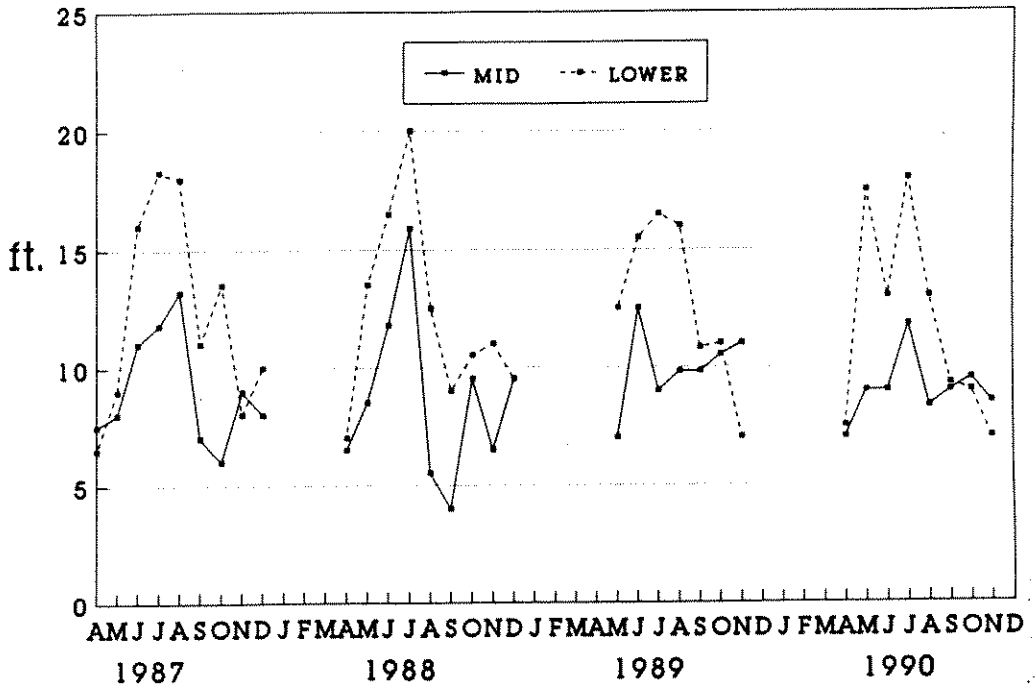
Appendix Figure 14. Seasonal trends of mean Daphnia spp. densities for lower station (Dam) on Hauser during 1987, 1988, 1989 and 1990.



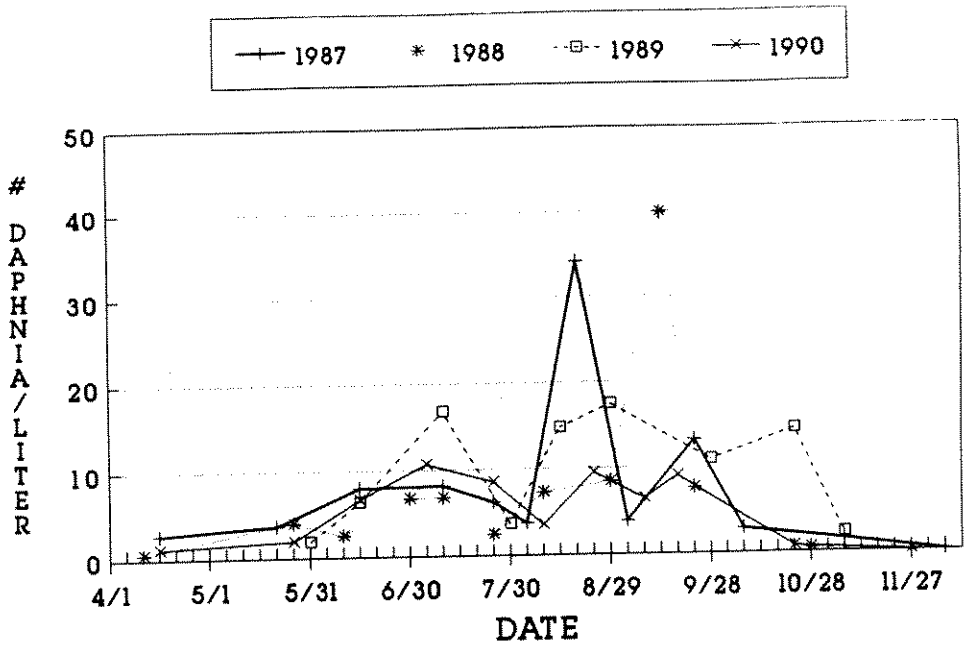
Appendix Figure 15. Water temperatures at surface and bottom in middle (Cottonwood) station on Holter Reservoir from April, 1987 through November, 1990.



Appendix Figure 16. Water temperatures at surface and bottom in lower (Jackson) station on Holter Reservoir from April, 1987 through November, 1990.

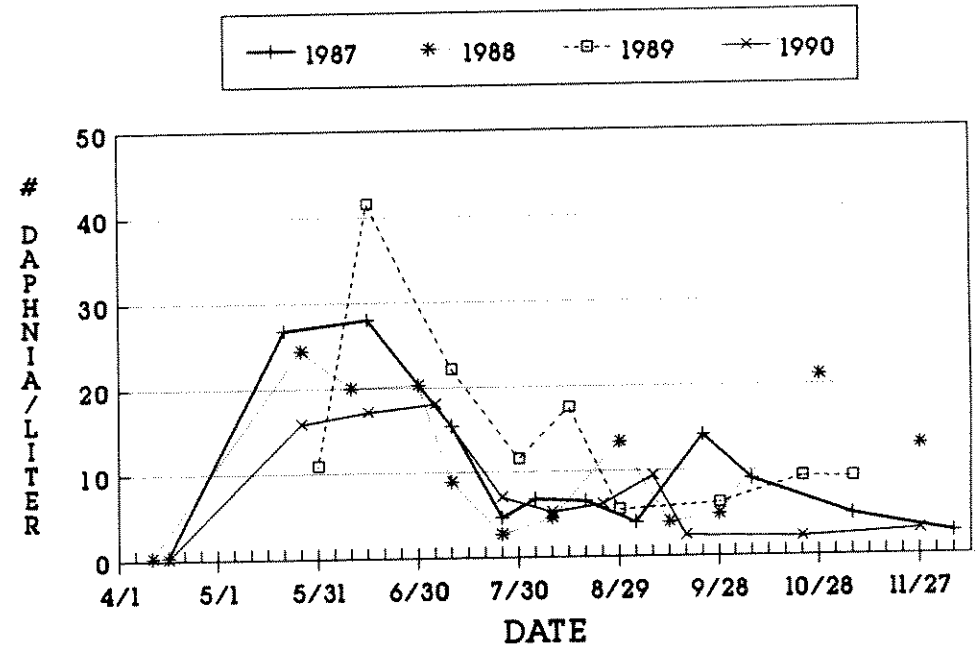


Appendix Figure 17. Euphotic zone depths measured in middle (Cottonwood) and lower (Jackson) sampling stations on Holter Reservoir from April, 1987 through November, 1990.



COTTONWOOD STATION

Appendix Figure 18. Seasonal trends of mean Daphnia spp. densities for middle station (Cottonwood) on Holter during 1987, 1988, 1989 and 1990.



JACKSON STATION

Appendix Figure 19. Seasonal trends of mean Daphnia spp. densities for lower station (Jackson) on Holter during 1987, 1988, 1989 and 1990.

APPENDIX TABLES

Appendix Table 1. Percent composition by species and season for floating gill net catches in Canyon Ferry Reservoir from 1986 through 1990.

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

Appendix Table 2. Rainbow trout stocking records for Canyon Ferry Reservoir from 1980 through 1990.

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	852,158	(87)	982,158	87	13
	E. Lake	130,000	(13)			
1990	Desmet I+	196,431	(29)	671,054	48	52
	E. Lake	474,623	(71)			

Appendix Table 3. 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
1990	SPRING	88	16.7 (6.3-21.2)	2.04 (0.10-3.52)	41.51
	FALL	79	16.4 (9.0-20.7)	1.86 (0.26-3.42)	39.18

Appendix Table 4. Percent composition by species for sinking gill net catches in Canyon Ferry reservoir from 1986 through 1990.

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

Appendix Table 5. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during the summer period from 1986 through 1990.

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
	1990	7.4	16.2	17.9	20.6	10.6	12.5	9.0	5.8	2809
	OVERALL	4.7	11.8	17.5	17.1	14.3	15.9	12.8	5.8	11141
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
	1990	3.6	14.7	21.6	19.1	20.2	10.0	7.8	3.0	2881
	OVERALL	2.4	12.5	16.1	23.8	19.6	12.4	9.7	3.4	10413
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
	1990	3.5	17.3	17.9	21.4	17.5	13.1	6.9	2.4	1633
	OVERALL	3.0	13.4	16.8	17.2	23.9	14.2	9.1	2.3	7245

Appendix Table 6. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during winter period (ice) from 1986 through 1991.

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
	1991	2.1	63.3	29.8	4.8	884
	OVERALL	3.4	55.3	31.8	9.5	4845
HAUSER	1989	0	22.2	43.6	34.2	573
	1990	0	49.7	49.7	0.6	300
	1991	2.0	37.5	36.6	23.9	451
	OVERALL	0.7	36.5	43.3	19.6	1324
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
	1991	4.4	64.4	23.4	7.9	547
	OVERALL	1.1	54.8	35.6	8.6	1474

Appendix Table 7. Percent composition by species and season for floating gill net catches in Hauser Reservoir from 1986 through 1990.

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

Appendix Table 8. Percent composition by species for sinking gill net catches in Hauser Reservoir from 1986 through 1990.

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

Appendix Table 9. Percent composition by species and season for floating gill net catches in Holter Reservoir from 1986 through 1990.

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

Appendix Table 10. Percent composition by species for sinking gill net catches in Holter Reservoir from 1986 through 1990.

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

Appendix Table 11. Distribution (percent composition) of rainbow trout by strain and age class from gill net and harvest data collected on Canyon Ferry Reservoir. Percent composition is based on individual year classes.

YEAR	STRAIN	TOTAL STOCKED	PERCENT COMPOSITION 1986 NET	1986 CREEL	1987 NET	1987 CREEL	1988 NET	1988 CREEL	1989 NET	1989 CREEL	1990 NET	1990 CREEL
1986	AGE 0+ ARLEE	94.1	86.0	94.5	74.5	86.6	66.3	74.2	31.6	67.2	0	0
	AGE I+ DESMET	5.9	14.0	5.5	25.5	13.4	33.7	25.8	68.4	32.8	100	100
1987	AGE 0+ ARLEE	74.3	--	--	87.5	93.6	68.4	82.7	40.0	79.0	31.3	33.0
	AGE 0+ E. LAKE	25.7	--	--	12.5	6.4	31.6	17.3	60.0	21.0	68.8	67.0
1988	AGE 0+ ARLEE	74.9	--	--	--	--	89.2	100.0	70.0	80.7	39.4	80.8
	AGE 0+ E. LAKE	11.9	--	--	--	--	10.8	0.0	30.0	19.3	3.0	14.6
	AGE 0+ DESMET	13.2	--	--	--	--	0.0	0.0	0.0	0.0	57.6	4.6
1989	AGE 0+ ARLEE	85.7	--	--	--	--	--	--	96.7	100.0	100	100
	AGE 0+ E. LAKE	14.3	--	--	--	--	--	--	3.3	0.0	0	0
1990	AGE I+ DESMET	29.3	--	--	--	--	--	--	--	--	87.5	100
	AGE 0+ E. LAKE	70.7	--	--	--	--	--	--	--	--	12.5	0