Ref ID 87927

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA
PROJECT NO: F-46-R-1
JOB NO: II-f

TITLE: STATEWIDE FISHERIES INVESTIGATIONS
TITLE: SURVEY AND INVENTORY OF COLDWATER LAKES
TITLE: MID-MISSOURI RESERVOIRS STUDY

PROJECT PERIOD: JULY 1, 1987 THROUGH JUNE 30, 1988

ABSTRACT

Baseline limnological and fisheries data were gathered on Canyon Ferry, Hauser and Holter reservoirs 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) were warmest in Canyon Ferry Reservoir and coolest in Hauser Reservoir. Weak thermocline development was observed in all three reservoirs during the summer. The zooplankton community in the reservoir complex was dominated by Daphnia, Diaptomus and Cyclops. Copepods were the most abundant zooplankters in Canyon Ferry and Hauser reservoirs while cladocerans were the most abundant zooplankters in Holter Reservoir. Densities of Daphnia were greatest in Holter Reservoir and least in Hauser Reservoir. Salmonids dominated the catch in floating gill nets in all three reservoirs. Suckers and yellow perch dominated the catch in sinking gill nets. Yellow perch dominated vertical gill net catches in Canyon Ferry Reservoir. Kokanee and suckers dominated the respective vertical net catches in Hauser and Holter reservoirs. Kokanee were found distributed in water cooler than 62 F. Migrant spawners of both rainbow trout and brown trout were collected in Confederate, Trout and Silver creeks. Spawning rainbow migrants of known hatchery origin (Desmet and Arlee strain) were collected in Confederate and Trout creeks. Instream flow recommendations were completed on 14 streams in the Missouri Basin for submission as part of an application to the Montana Department of Natural Resources and Conservation. Estimates of trout populations were successfully completed during the fall on two tailwater sections of the Missouri River. Creel census surveys indicated rainbow trout, yellow perch and kokanee dominated the catch in the three reservoirs during the summer. Catch rates for rainbow trout averaged 0.20, 0.24 and 0.37 fish per hour in Canyon Ferry, Hauser and Holter reservoirs, respectively. Catch rates for rainbow trout were greatest during the spring and fall. Yellow perch dominated the catch during the 1987-88 ice fishery on Canyon Ferry Reservoir. The overall winter catch rate for yellow perch was 1.74 fish per hour. A comprehensive creel census conducted on the Canyon Ferry tailrace from August through late November revealed that 19,765 hours were

expended to harvest 3,349 kokanee and 2,312 rainbow trout. A majority of harvested rainbow trout from the reservoir complex were of known hatchery origin. The 1986 Arlee plant (Age I+ fish) dominated the harvest in all three reservoirs. Harvested rainbow trout averaged 16.4, 14.2 and 13.8 inches in length in the three respective reservoirs. Retention of tetracycline and fluorescent pigment marks was determined to be high 1.5 years following marking. Marking hatchery rainbow trout with fluorescent pigment and tetracycline has proven to be valuable for purposes of this study. The rate of return to the creel of the 1986 rainbow plant was estimated at 4.6, 18.4, and 26.0 %, respectively, for Canyon Ferry, Hauser and Holter reservoirs. Differences in the rate of return among reservoirs may have been correlated to differences in fishing pressure per surface acre found among reservoirs. Desmet rainbow trout were returned to the creel at a slightly higher rate than Arlee rainbow trout in Canyon Ferry Reservoir (4.4 vs. 7.1 %). The 1986 Desmet plant displayed greater survival than the 1986 Arlee plant. However, the 1986 Arlee plant displayed greater catchability than the 1986 Desmet plant. Growth curves of hatchery rainbow trout are compared among reservoirs and between strains. Downstream escapement of marked hatchery rainbow trout from the three reservoirs during 1987 was almost nonexistent. Radial gates at Canyon Ferry Dam did not spill excess water during 1987. A high water year is needed to fully evaluate the correlation between radial gate spills and rainbow trout escapement.

OBJECTIVES AND DEGREE OF ATTAINMENT

Job Objectives

1. To 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. To quantify downstream escapement of hatchery reared rainbow trout from the three reservoirs.

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

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

5. To 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. To 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. To determine status of walleye populations in Hauser and Holter reservoirs.

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

Degree of Attainment

Progress was accomplished on all objectives and findings are presented in appropriate sections of this report.

PROCEDURES

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

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

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

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

Reservoir fish were sampled with floating and sinking 6 X 125 foot experimental gill nets (3/4 to 2 inch mesh) set during the spring and fall. Nets were set in locations and at times of the year to match previous years sampling efforts. 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 gas powered backpack electrofishing system was used to sample fish populations in the tributaries. Sex and spawning condition were recorded for adult fish captured during their spawning season. Trout larger than 10.0 inches in length were marked with individually numbered anchor tags to evaluate movement, growth

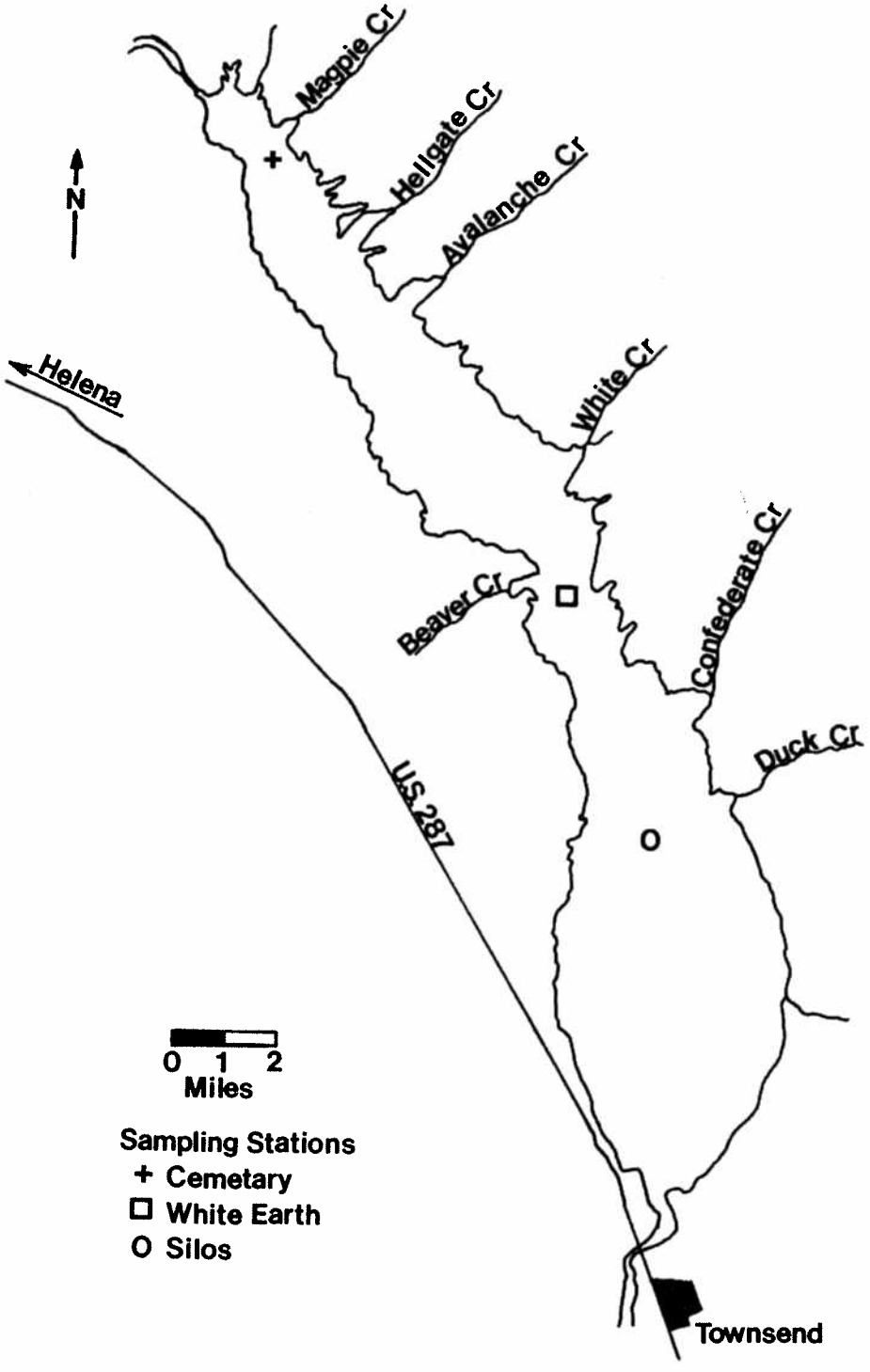


Figure 1 Map of Canyon Ferry Reservoir showing locations of permanent sampling stations.

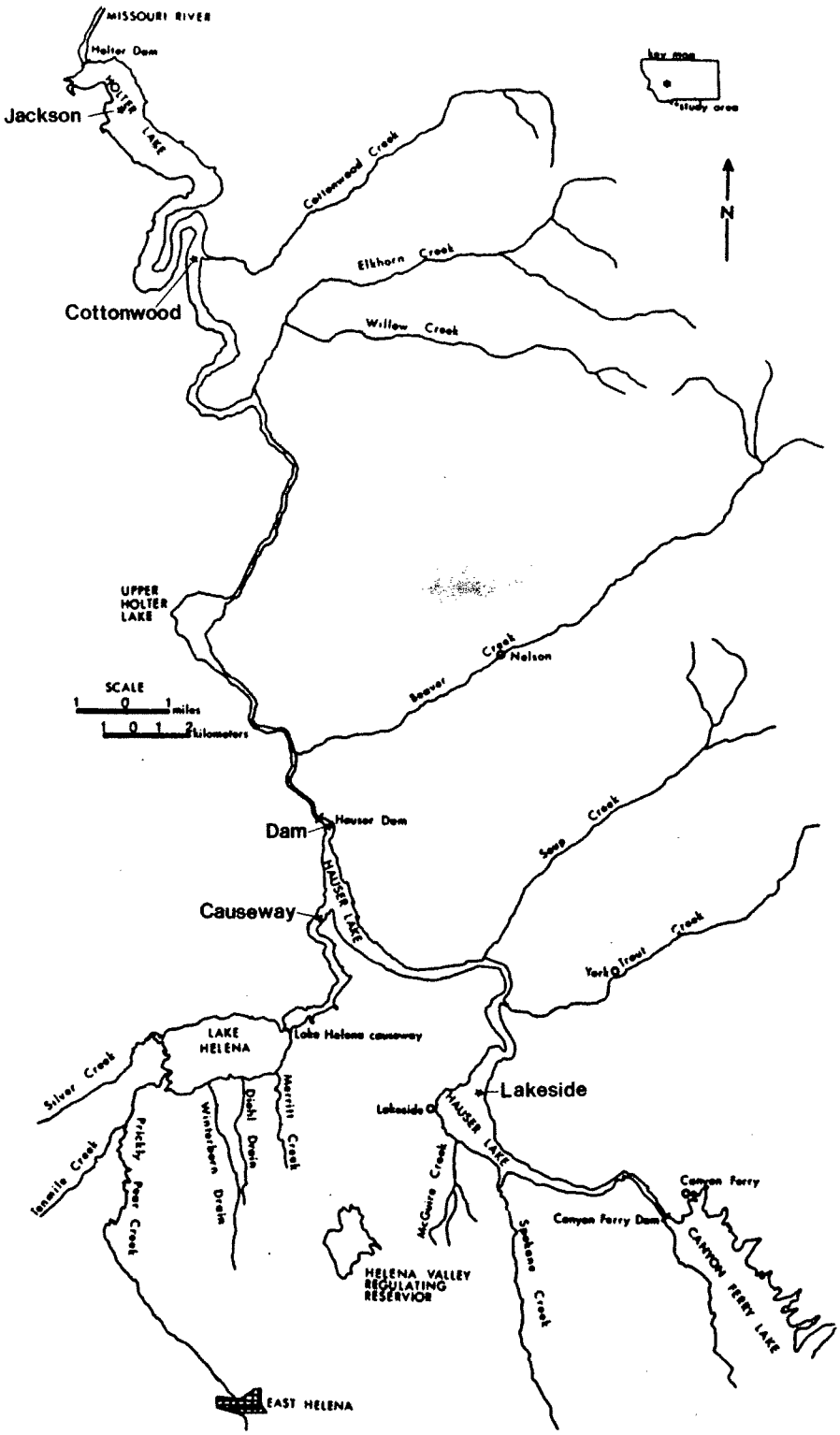


Figure 2 Map of Hauser and Holter reservoirs showing locations of permanent sampling stations.

and harvest.

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

A partial creel census was conducted 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 Canyon Ferry Reservoir from December 30 through March 19. This survey was conducted two days a week and included one weekend day and one weekday.

A more comprehensive creel census was conducted on the Canyon Ferry tailrace from August 1 through November 20 to obtain estimates of fishing pressure and harvest. Surveys were conducted on three randomly selected days during the week. Sampling days were selected weekly without replacement and were structured within 2 week strata. Angler counts were made three times a day and starting times were selected randomly without replacement within the 2 week strata. Counting times were spaced at 3.5 hour intervals. Procedures for this creel were adapted from those described by Malvestuto (1983).

RESULTS AND DISCUSSION

Physical Limnology

Canyon Ferry Reservoir

Temperatures of surface waters (to 15 feet) in Canyon Ferry Reservoir averaged 58.4 F from mid April through early December and were similar among the three sampling stations. A maximum average temperature of 68.0 F was reached on August 4 at the White Earth station (mid-reservoir). For comparable sampling periods, surface water temperatures measured in Canyon Ferry Reservoir during 1987 were similar to measurements obtained in 1986.

Waters at the Silos station (upper reservoir) remained mixed during the sampling period due to shallow depth and exposure to wind action. At the White Earth station, a thermocline was found to occur from mid May through mid July at a depth ranging from 40 to 45 feet. A weak thermocline also developed at the Cemetery station (lower reservoir) from mid July through mid August at depths that ranged from 65 to 75 feet. Temperature profiles obtained in Canyon Ferry Reservoir during 1987 are shown in Appendix Figures 1 - 3.

Euphotic zone depths measured from mid April through early

December averaged 5.0, 9.8 and 14.6 feet, respectively, at the Silos, White Earth and Cemetery stations. Euphotic zone depths were reflective of turbidity regimes in the reservoir. Suspended sediments and/or plankton blooms are the major causes of turbidity in the reservoir (Rada 1974). Turbidity was greatest in the upper reservoir and least in the lower reservoir.

Hauser Reservoir

Surface water temperatures in Hauser Reservoir were cooler than in Canyon Ferry Reservoir as a result of deep water releases from the penstocks of Canyon Ferry Dam. Surface water temperatures averaged 56.6 F during the April 15 through December 7 sampling period. A maximum average temperature of 65.5 F was reached on August 4 at the Causeway station (Lake Helena arm). Surface water temperatures, for a comparable period of sampling, averaged about 3.0 F warmer during 1987 than 1986. Due to heating effect of shallow Lake Helena, water temperatures measured at the Causeway station tended to be warmer than at the other two stations. Thermal stratification was evident at all three sampling stations from mid June through early August. Depth of the thermocline ranged from 12 to 18 feet. Temperature profiles obtained in Hauser Reservoir during 1987 are shown in Appendix Figures 4 and 5.

Euphotic zone depths measured during the sampling period averaged 9.0, 7.8 and 9.1 feet at the Lakeside (upper reservoir), Causeway and Dam (lower reservoir) stations, respectively. The depth of the euphotic zone at the Causeway station was least as a result of the eutrophic effects of Lake Helena.

Holter Reservoir

Surface water temperatures were slightly warmer in Holter Reservoir than in Hauser Reservoir for the April 16 through December 8 sampling period. Surface water temperatures averaged 57.6 F and were about 3.0 F warmer than temperatures obtained in 1986 for a comparable period of sampling. A maximum average temperature of 66.8 F was reached on August 5 at the Jackson station (lower reservoir). The Jackson station averaged approximately 1.0 F warmer than the Cottonwood station (mid reservoir). Weak thermal stratification was evident at the Jackson station from mid June through early October. Depth of the thermocline, although not always readily evident, ranged from 60 to 70 feet. Temperature profiles obtained in Holter Reservoir during 1987 are shown in Appendix Figures 6 - 8.

Euphotic zone depths measured during the sampling period averaged 9.4 feet at the Cottonwood station and 13.1 feet at the Jackson station. Differences in euphotic zone depth between stations appeared to be reflective of phytoplankton densities found in the reservoir.

Zooplankton

Canyon Ferry Reservoir

The zooplankton community in Canyon Ferry Reservoir was dominated by Daphnia, Diaptomus and Cyclops spp. during the mid April through early December sampling period (Figure 3). Bosmina, Leptodora and a member of Sididae comprised the remainder of the community. In general, the composition of the zooplankton community appeared similar among the three sampling stations. Copepods were the most numerous zooplankters, comprising an average of 57.6% of the zooplankton density. Cyclops was the dominant copepod through most of the sampling period. However, Diaptomus became the dominant copepod from late June through mid August. Daphnia, a major food item for trout and yellow perch, comprised an average of 39.1% of the zooplankton density. Daphnia was most prominent in the community during June and August.

Zooplankton densities in Canyon Ferry Reservoir ranged from a high of 54.5 organisms per liter in mid August to a low of 3.1 organisms per liter in early December (Figure 4). Generally, zooplankton densities exhibited a primary peak during May and a secondary peak during September. Daphnia numbers peaked in mid June and exhibited a secondary peak in late September (Figure 4). Densities of Daphnia averaged 9.59, 7.67 and 8.10 organisms per liter at the Silos, White Earth and Cemetery stations, respectively. The pattern of abundance for Daphnia was similar among the three sampling stations with the exception of the Silos station where Daphnia numbers exhibited a much greater peak during the fall than at the other two stations.

Hauser Reservoir

The zooplankton community in Hauser Reservoir was dominated by Daphnia, Bosmina and Cyclops spp. during the mid April through early December sampling period (Figure 5). Copepods were the most numerous zooplankters, comprising an average of 48.9% of the zooplankton density. Cyclops was by far the dominant copepod through most of the sampling period. Diaptomus made a small contribution to the community and was most prominent during early August. Daphnia and Bosmina comprised and average of 36.0 and 15.0%, respectively, of the zooplankton community. Bosmina contributed substantially to the community during August and September. Composition of the zooplankton community was generally similar among the three sampling stations.

Zooplankton densities in Hauser Reservoir ranged from a high of 131.4 organisms per liter on December 7 at the Causeway station to a low of 1.29 organisms per liter on December 7 at the Lakeside station (Figure 6). The differences between the two stations reflect the different sources of water entering Hauser Reservoir. Water passing the Causeway station comes from Prickly Pear Creek and eutrophic Lake Helena. In contrast, water passing

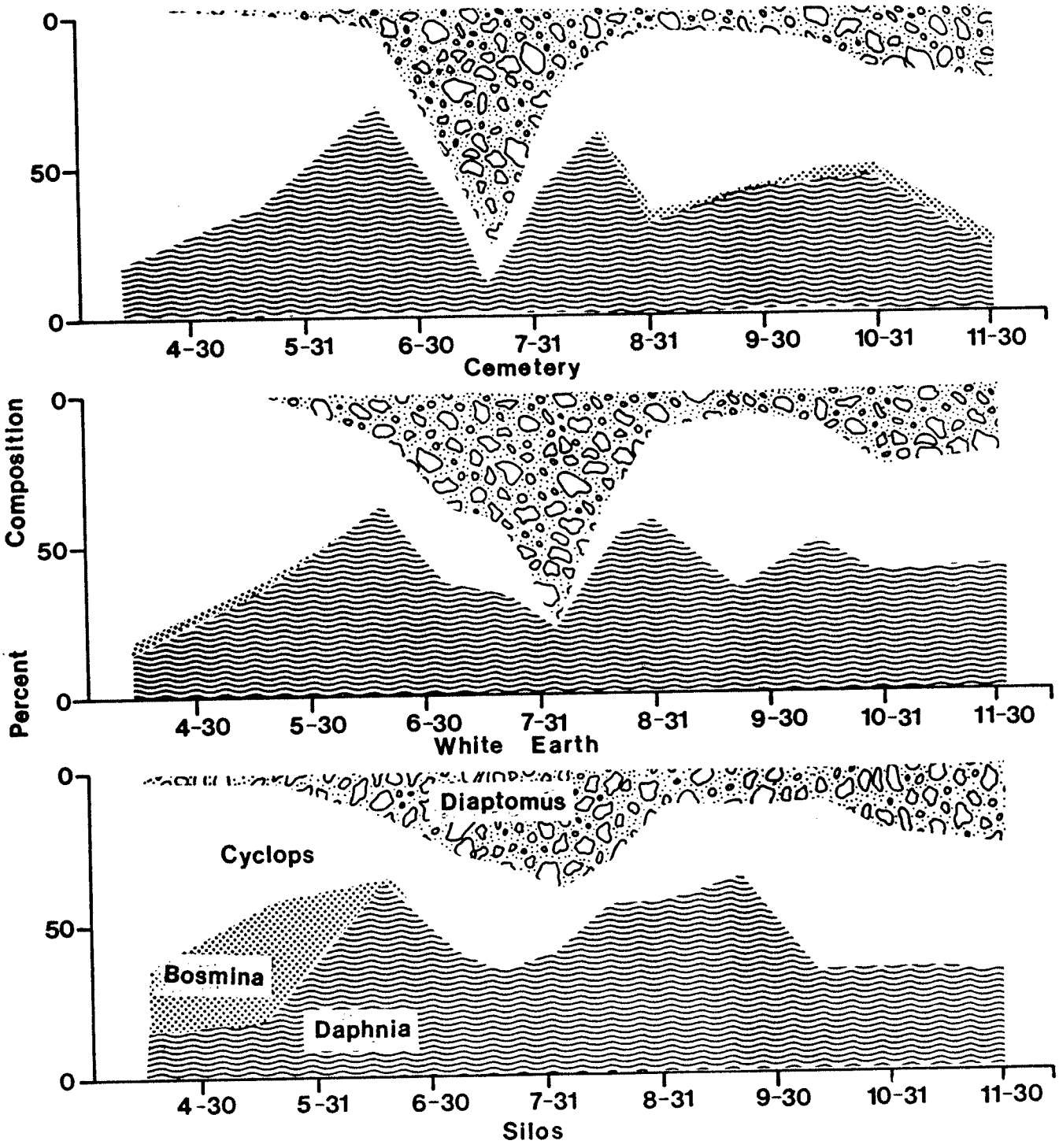


Figure 3. Species composition of the principal zooplankton in upper (Silos), mid (White Earth) and lower (Cemetery) stations on Canyon Ferry Reservoir from April 15 to December 7, 1987.

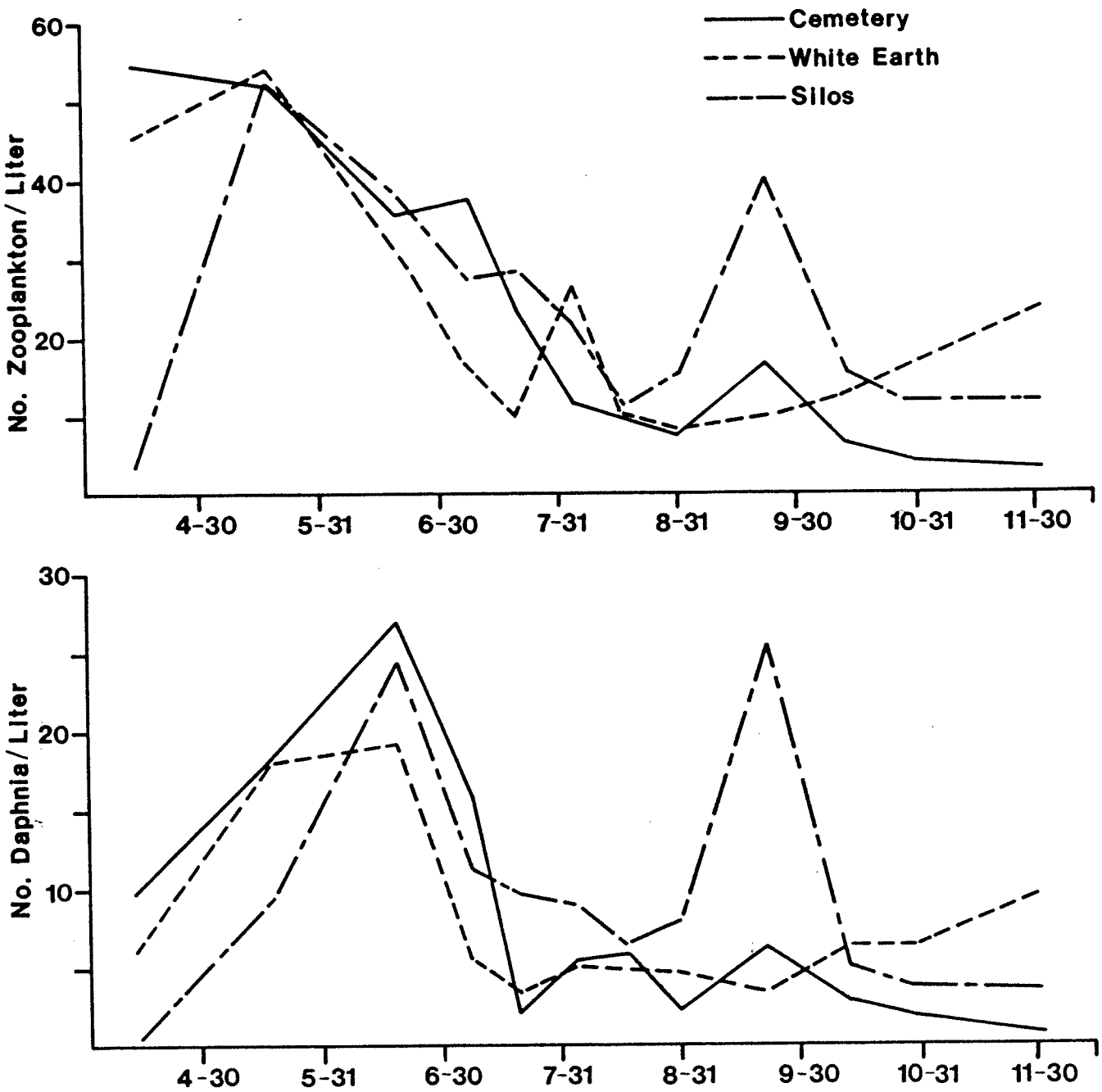


Figure 4. Densities (number per liter) of principal zooplankton (upper figure) and of Daphnia (lower figure) in three areas of Canyon Ferry Reservoir from April 15 to December 7, 1987.

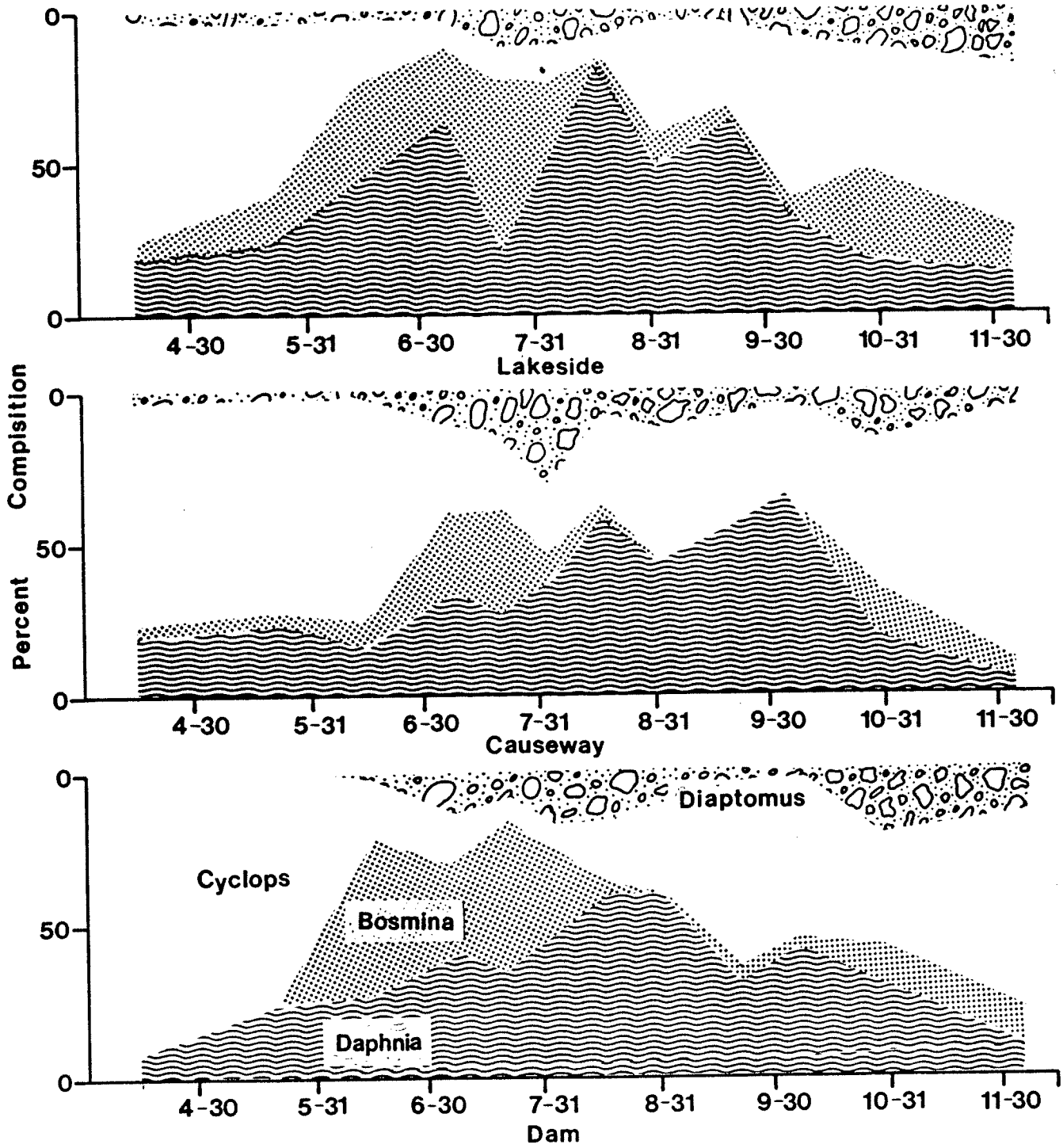


Figure 5. Species composition of the principal zooplankton in upper (Lakeside), mid (Causeway) and lower (Dam) stations on Hauser Reservoir from April 15 to December 7, 1987.

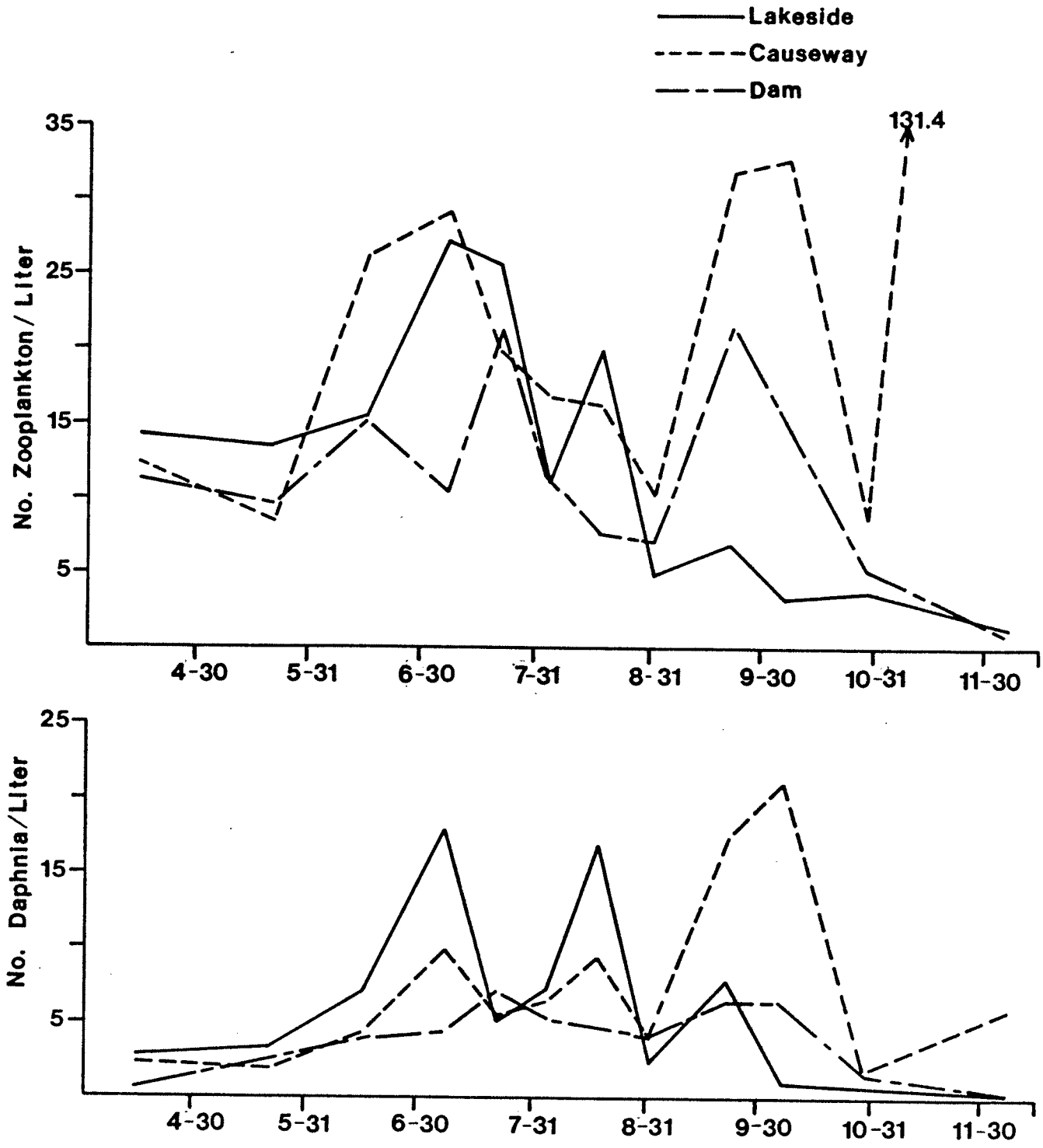


Figure 6. Densities (number per liter) of principal zooplankton (upper figure) and of Daphnia (lower figure) in three areas of Hauser Reservoir from April 15 to December 7, 1987.

the Lakeside station comes from deep releases through the penstocks at Canyon Ferry Dam. Generally, zooplankton densities in Hauser Reservoir peaked in early July and then exhibited two secondary peaks in August and September. The Causeway station was the exception where a major peak in zooplankton densities (primarily Cyclops) occured during November.

Daphnia displayed a pattern of abundance similar to the pattern exhibited by the entire zooplankton community (Figure 6). Densities of Daphnia averaged 5.97, 7.43 and 3.89 organisms per liter at the Lakeside, Causeway and Dam stations, respectively. Densities of Daphnia were greatest at the Lakeside station from mid April through late August. After August, however, Daphnia numbers were greatest at the Causeway station.

Holter Reservoir

The zooplankton community in Holter Reservoir was dominated by Daphnia, Diaptomus and Cyclops spp. during the mid April through early December sampling period (Figure 7). Although Bosmina was present in the community for the entire sampling period, its contribution to zooplankton density was minor until late fall. Daphnia were the most abundant zooplankters in Holter Reservoir, comprising an average of 46.8% of the zooplankton community. Copepods were nearly as abundant (45.8%) with Cyclops dominating for most of the sampling period. Diaptomus became an important community member during July and August. Composition of the zooplankton community was generally similar between the two sampling stations.

Zooplankton densities ranged from a high of 59.03 organisms per liter on May 22 at the Jackson station to a low of 1.76 organisms per liter on December 8 at the Cottonwood station (Figure 8). At the Jackson station, zooplankton densities peaked in late May and then exhibited a secondary peak in late September. In contrast, the zooplankton community at the Cottonwood station did not bloom during the spring but exhibited peaks in mid August and late September. Daphnia displayed a pattern of abundance similar to the pattern exhibited by the entire zooplankton community (Figure 8). Densities of Daphnia averaged 7.35 and 10.24 organisms per liter at the Cottonwood and Jackson stations, respectively. Densities of Daphnia were greater at the Jackson station than at the Cottonwood station for a majority of the sampling period.

Marking Scheme for Hatchery Fish

Table 1 presents the marking scheme for hatchery rainbow trout planted into the reservoir complex for 1986 and 1987. This scheme allows for identification of hatchery fish following planting. The scheme enables fish to be identified by the reservoir in which they were planted and by strain type. Prior to 1986, several other marking programs were initiated in the reservoir complex. From 1983 to 1985, all rainbow trout planted into Canyon Ferry Reservoir received a single tetracycline mark.

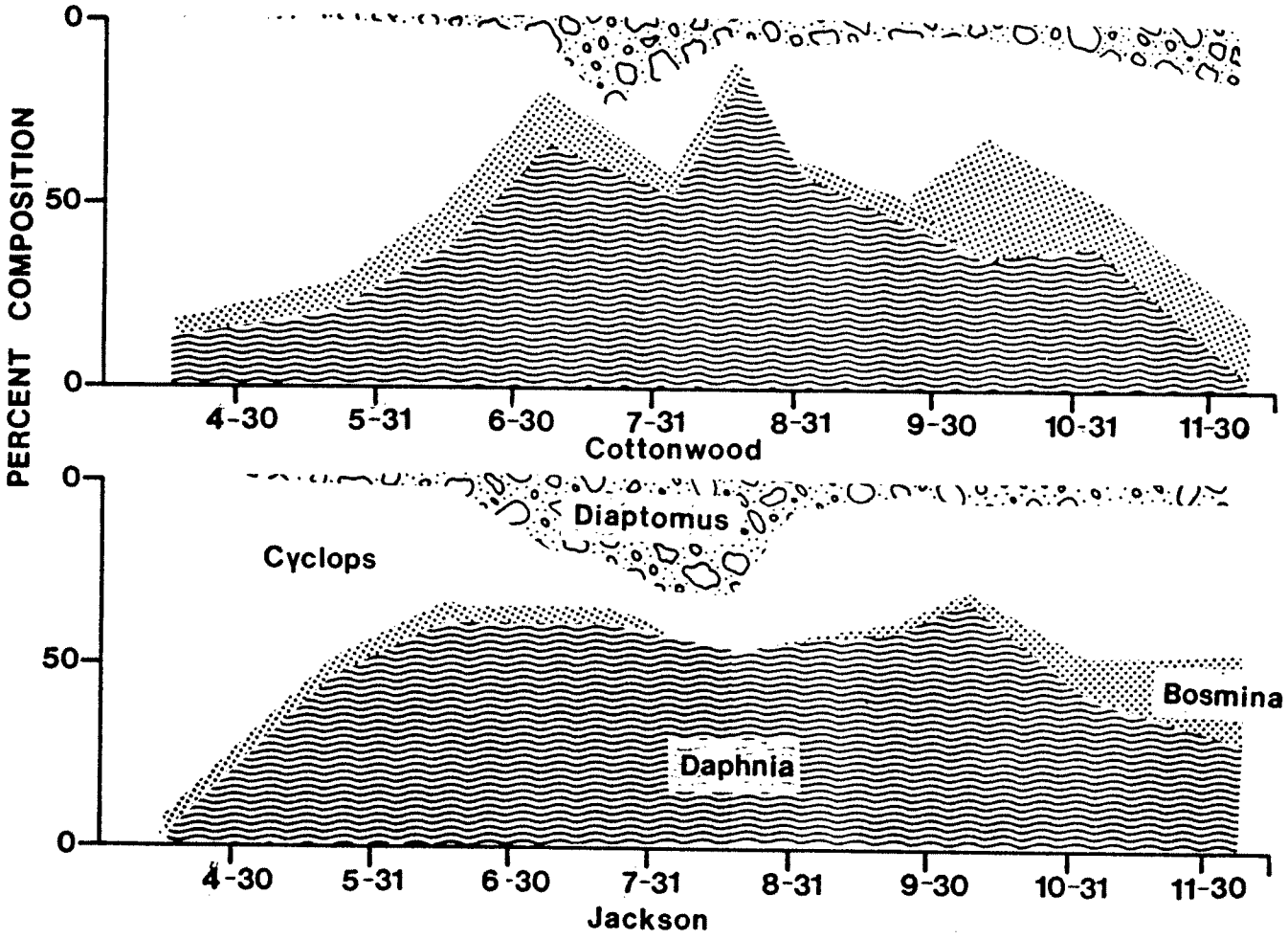


Figure 7. Species composition of the principal zooplankton in mid (Cottonwood) and lower (Jackson) stations on Holter Reservoir from April 16 to December 8, 1987.

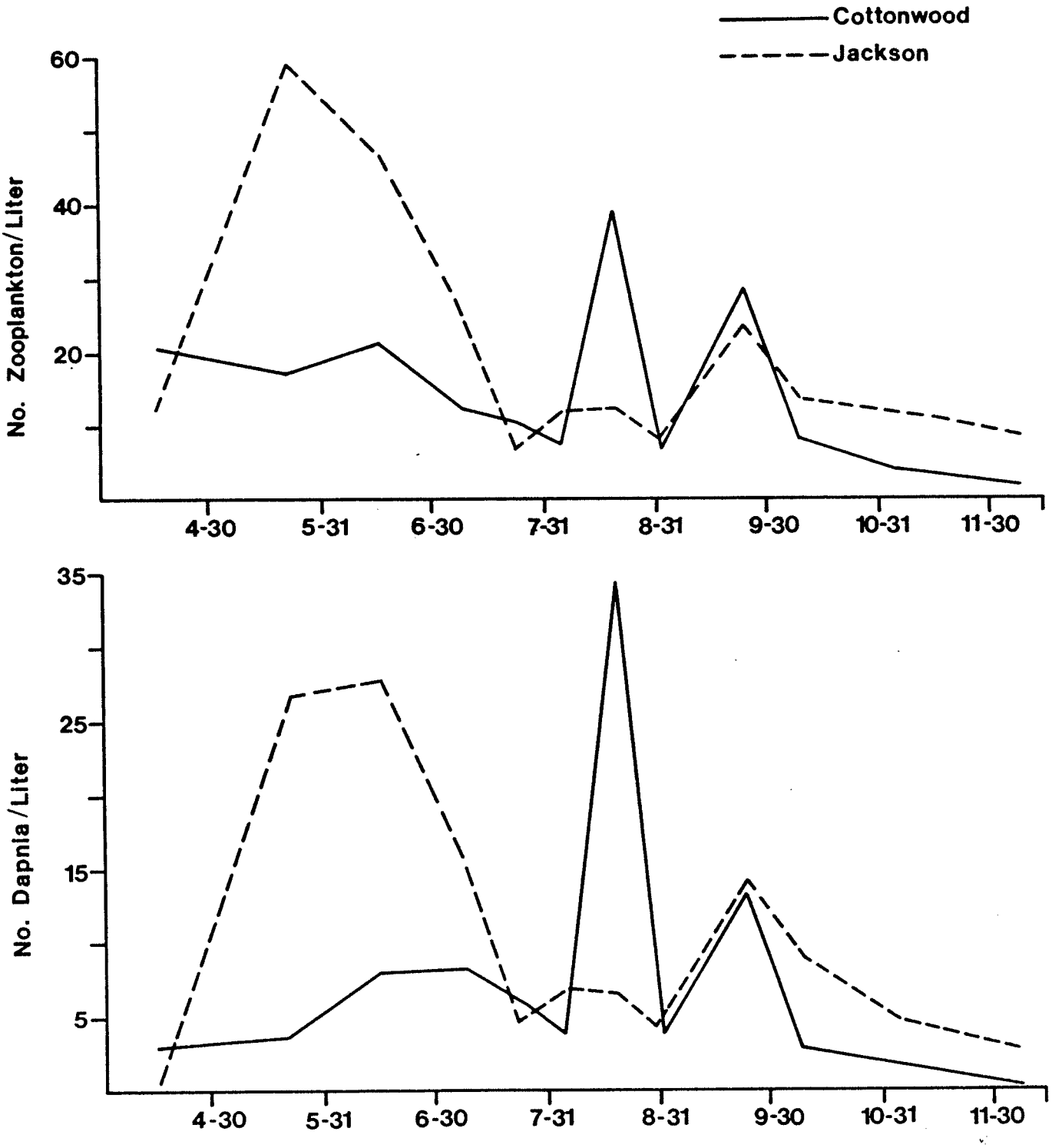


Figure 8. Densities (number per liter) of principal zooplankton (upper figure) and of Daphnia (lower figure) in two areas on Holter Reservoir from April 16 to December 8, 1987.

In addition, 10% of the annual plant received a fin clip. Arlee rainbow trout were marked with a pelvic clip (left in 1983 and 1985; right in 1984) while Desmet rainbow were marked with an adipose clip. The stocking records for rainbow trout planted into Canyon Ferry Reservoir from 1983 through 1985 have been presented previously by Rehwinkel (1986).

From 1984 to 1986, all of the McConaughy strain of rainbow trout planted into the free flowing section of the Missouri River located upstream from Holter Reservoir were marked with a fin clip. These fish received adipose clips in 1984 and left pelvic clips in 1985 and 1986.

Table 1. Marking scheme for rainbow trout planted in the reservoir complex during 1986.

Year	Reservoir	Rainbow Strain	Number Planted	Pigment Color	TM	Fin Clip
1986	C. Ferry	Arlee	1,035,639	Red	Single	
		Desmet	62,100	Green	Double	
	Hauser	Arlee	212,596			Adipose
	Holter	Arlee	325,089	Orange	Single	
		McConaughy	32,195			Left Pelvic
1987	C. Ferry	Arlee	724,686	Red	Single	
		E. Lake	251,303	Green	Double	
	Hauser	Arlee	212,840			Adipose
	Holter	Arlee	323,002	Orange	Single	

Fish Abundance and Distribution

Canyon Ferry Reservoir

Horizontal Gill Nets

A total of 602 fish were collected in 31 floating gill nets set in Canyon Ferry Reservoir during 1987. Rainbow trout was the most abundant species collected (81.1% of the catch), followed by carp, suckers and brown trout (Table 2). For comparison, rainbow trout comprised a similar majority of the catch during 1986.

Mean catch rates (fish per net) for rainbow trout during 1987 were similar between spring and fall but varied among areas of the reservoir (Table 3). Catch rates for rainbow trout were greatest in the upper reservoir and least in the lower reservoir. Rainbow trout collected in floating gill nets during the spring

Table 2. Percent composition by species and net type for gill net catches in Canyon Ferry, Hauser and Holter reservoirs during 1987.

	CANYON FERRY		HAUSER		HOLTER	
Species[1]	Floating Nets	Sinking Nets	Floating Nets	Sinking Nets	Floating Nets	Sinking Nets
Rb	81.1	0.2	20.0	1.0	61.8	1.6
LL	2.8	0.9	1.3	0.8	1.9	0.6
KOK			32.8	3.0	3.7	0.1
MWF		0.2		2.8	0.8	1.9
YP	0.2	59.4		7.6	10.1	45.3
WE					4.0	2.2
LnSu	0.5	1.2	28.9	18.6	8.5	18.6
Wsu	3.2	34.0	16.3	65.9	8.5	29.7
CP	11.3	2.1			0.8	0.1
UC	1.0	1.2	0.7	0.2		
BB		0.7				
SB				0.1		
TOTAL CAUGHT	602	429	546	1,312	377	1,439
NUMBER OF NETS	31	3	21	11	16	11

[1]Rb=rainbow trout; LL=brown trout; KOK=kokanee; MWF=mountain whitefish; YP=yellow perch; WE=walleye; LnSu=longnose sucker; Wsu=white sucker; CP=carp; UC=utah chub; BB=burbot; SB=smallmouth buffalo.

averaged 15.2 inches in length and 1.48 pounds in weight. Approximately 87% of the rainbow trout collected during the spring were of hatchery origin (tetracycline marked or fin clipped). The 1986 Arlee plant dominated the catch, followed by hatchery rainbow trout of unknown age (pre 1986 plants), the 1986 Desmet plant and unmarked fish (Figure 9). The remainder of the catch was comprised of fin clipped hatchery fish from the 1985 plant.

Rainbow trout collected in floating gill nets during the fall averaged 15.5 inches in length and 1.17 pounds in weight. Approximately 98% of the rainbow trout collected during the fall were of hatchery origin. The 1986 Arlee plant dominated the catch, followed by the 1987 Arlee plant and the 1986 Desmet plant (Figure 9). The remainder of the catch was comprised of the 1987 Eagle Lake plant, unknown age hatchery fish (pre 1986 plants), unmarked fish and fin clipped fish planted in 1985.

Mean catch rates for rainbow trout were slightly greater during 1987 than during 1986. In addition, the average size of rainbow trout collected in 1987 were larger than collections made in

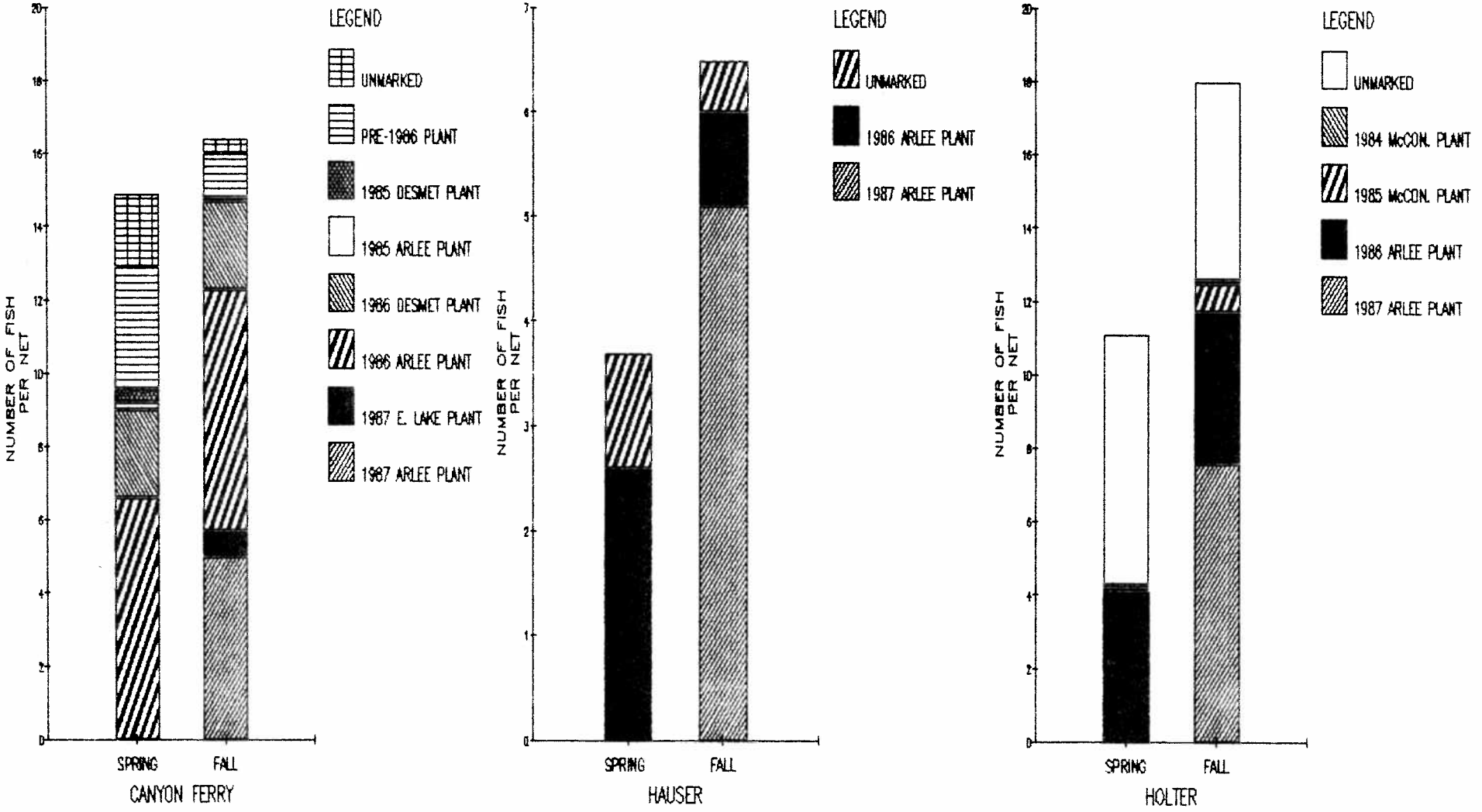


Figure 9. Distribution by strain and year of plant for rainbow trout collected from floating horizontal gill nets in Canyon Ferry, Hauser and Holter reservoirs during 1987.

Table 3. Average catch of gamefish per net night by season and area in floating gill nets set in Canyon Ferry, Hauser and Holter reservoirs during 1987.

Reservoir	Season	Location of Nets	Number of Nets	CATCH PER NET[1] RB	LL	KOK	WE
Canyon Ferry	Spring	Upper	5	17.0	1.2		
		Mid	5	17.0	1.2		
		Lower	3	7.7			
		Total	13	14.8	0.9		
	Fall	Upper	6	23.8	0.7		
		Mid	6	12.8	0.2		
		Lower	6	12.5			
		Total	18	16.4	0.3		
Hauser	Spring	Upper	2	2.5		0.5	
		Mid	5	3.0	0.6	23.2	
		Lower	3	5.7	0.7	7.0	
		Total	10	3.7	0.5	13.8	
	Fall	Upper	4	7.0		2.8	
		Mid	4	6.0	0.5	3.3	
		Lower	3	6.7		5.7	
		Total	11	6.6	0.2	3.7	
Holter	Spring	Upper	3	8.7	0.7	0.3	1.0
		Mid	3	9.3	0.3	1.3	1.7
		Lower	2	17.5			3.0
		Total	8	11.1	0.4	0.6	1.8
	Fall	Upper	3	3.7	0.7		
		Mid	3	21.0	0.3	0.7	
		Lower	2	35.0	0.5	3.5	0.5
		Total	8	18.0	0.5	1.1	0.1

[1]Rb=rainbow trout; LL=brown trout; KOK=kokanee; WE=walleye.

1986. These differences may be due to consecutive low water years and resultant negligible radial gate spills that have occurred since 1985. Population levels and growth may be negetively correlated with the duration and magnitude of these spills from Canyon Ferry Dam.

A total of 429 fish were collected from three sinking gill nets set during 1987, with yellow perch (59.4%) and white sucker (34.0%) being the two most dominant species in the catch (Table 2). These data were similar to results obtained in 1983, 1984 and 1986 (Rehwinkel 1986, Lere 1987). Average catch per net night in sinking gill nets is given in Appendix Table 1.

Vertical Gill Nets

Only 27 fish were collected in four monthly sets of vertical gill nets at the Cemetery station (lower reservoir) during 1987. Yellow perch dominated the catch (40.7%), followed by rainbow trout (29.6%), suckers (25.9%) and brown trout (3.7%). Rainbow trout, excluding one fish collected in August, were found in the upper 25 feet of the water column where conditions tended to be homothermal (Figure 10).

Hauser Reservoir

Horizontal Gill Nets

A total of 546 fish were collected in 21 floating gill nets set in Hauser Reservoir during 1987. Longnose and white suckers were the most abundant fish captured in floating nets (45.2% of the catch), followed by kokanee (32.8%) and rainbow trout (20.0%) (Table 2). For comparison, the catch made during 1986 was comprised of fewer kokanee and more rainbow trout than in 1987.

Mean catch rates (fish per net) for rainbow trout and kokanee varied seasonally and by area (Table 3). In general, catch rates for rainbow trout were greatest in the fall while catch rates for kokanee were greatest in the spring. Catch rates for rainbow trout tended to be greatest in the lower reservoir. Kokanee catch rates were greatest in mid reservoir during the spring and greatest in the lower reservoir during the fall.

Rainbow trout collected in floating gill nets during the spring averaged 13.6 inches in length and 1.15 pounds in weight. Approximately 70% of the rainbow trout collected were of known hatchery origin (1986 Arlee plant) (Figure 9). No rainbow trout originally planted into Canyon Ferry Reservoir were collected in Hauser Reservoir during 1987. Kokanee collected during the spring averaged 13.1 inches in length and 0.98 pounds in weight.

During the fall, rainbow trout collected in floating gill nets averaged 11.7 inches in length and 0.77 pounds in weight. About 93% of the rainbow trout collected during the fall were of known hatchery origin (Figure 9). The 1987 Arlee plant dominated the catch, followed by the 1986 Arlee plant and unmarked fish. Only one rainbow trout originally planted into Canyon Ferry Reservoir was collected in Hauser Reservoir. Kokanee collected during the fall averaged 15.4 inches in length and 1.54 pounds in weight.

In general, the mean catch rates for rainbow trout obtained in 1987 were substantially less than those obtained in 1986. For kokanee, mean catch rates tended to be similar between years. The size of rainbow trout collected in floating nets was similar between years while kokanee collected in 1987 were smaller than fish collected during 1986.

A total of 1,312 fish were collected in 11 sinking gill nets set

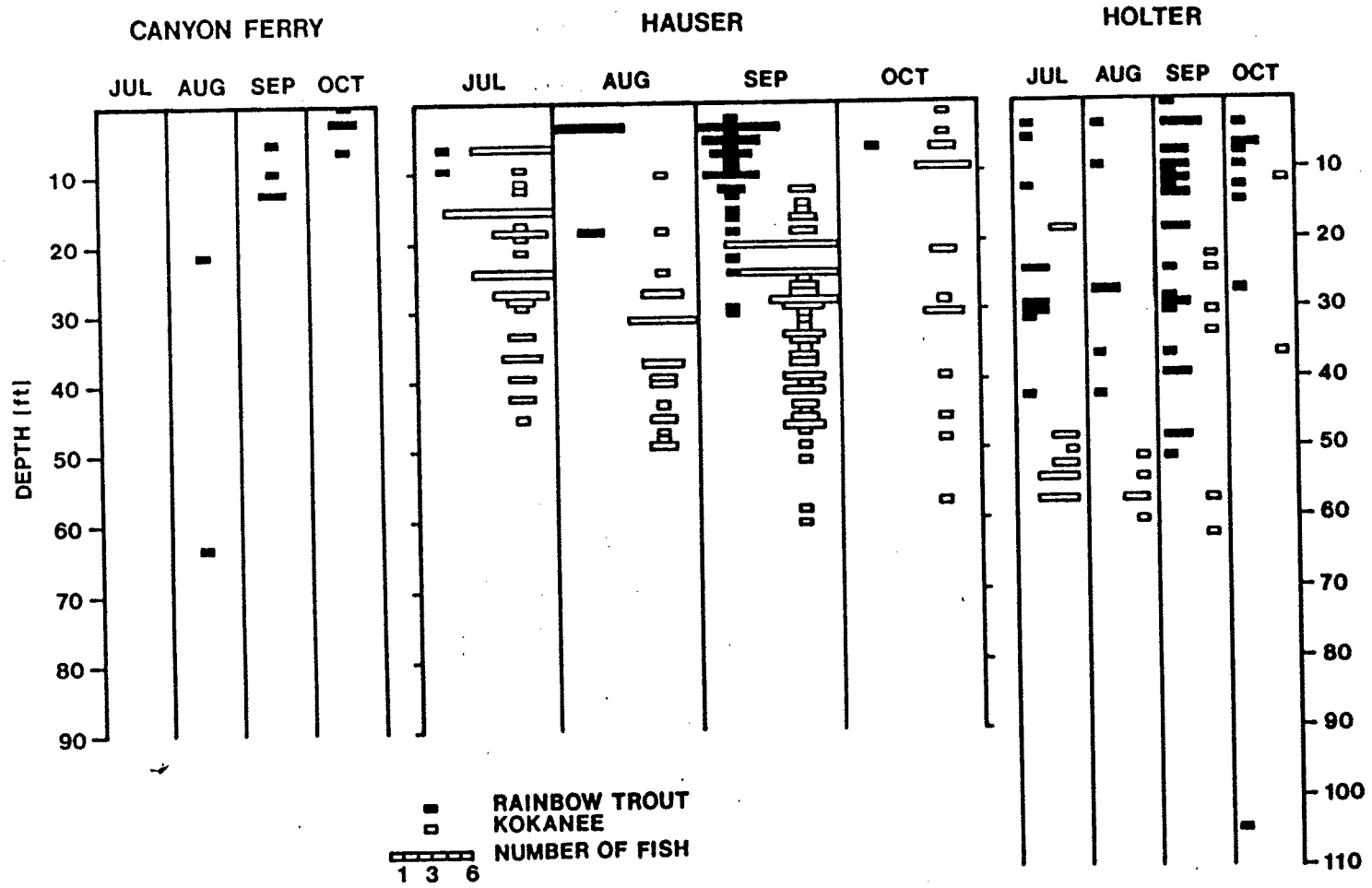


Figure 10. Vertical distribution of salmonids in Canyon Ferry, Hauser and Holter reservoirs as determined from vertical gill nets set monthly from June-October, 1987.

during 1987, with white and longnose suckers being the two most dominant species in the catch (84.5%) (Table 2). The composition of fish species collected in sinking nets during 1987 was similar to 1986 collections. Average catch per net night in sinking gill nets is given in Appendix Table 1.

Vertical Nets

A total of 250 fish were collected in four monthly sets of vertical gill nets at the Dam station (lower reservoir) during 1987. Kokanee dominated the vertical gill net catch, comprising 64.0% of the sample, followed by rainbow trout (16.8%), suckers (13.6%) and brown trout (2.8%). Rainbow trout were distributed in the upper 30 feet of the water column and were generally located above the thermocline during all sampling months (Figure 10). Rainbow trout were found to reside in water temperatures that ranged from 60 to 66 F during the sampling period.

Kokanee tended to be distributed beneath the thermocline during the sampling period. During July, August and September, kokanee were generally found in water deeper than 10 feet and at temperatures that were cooler than 62 F. Kokanee were distributed throughout the water column during October. The development and location of a thermocline apparently were major factors in determining the distribution of rainbow trout and kokanee within the water column in Hauser Reservoir.

Holter Reservoir

Horizontal Gill Nets

A total of 377 fish were collected from 16 floating gill nets set in Holter Reservoir during 1987. Rainbow trout dominated the catch, comprising 61.8% of the sample, followed by suckers (17.0%), yellow perch (10.1%), walleye (4.0%) and kokanee (3.7%) (Table 2). These results were similar to data obtained during 1986.

Mean catch rates (fish per net) for rainbow trout varied seasonally and by area (Table 3). Catch rates tended to be greater during the fall and were greatest in nets set in the lower reservoir. Mean catch rates for walleye also varied seasonally and by area, with catch rates being greatest in nets set in the lower reservoir during the spring.

Rainbow trout collected in floating gill nets during the spring averaged 13.9 inches in length and 1.13 pounds in weight. About 39% of the rainbow trout collected during the spring were of known hatchery origin (Figure 9). The 1986 Arlee plant comprised almost all of the known hatchery fish captured. No known rainbow trout originally planted in Hauser Reservoir were collected in Holter Reservoir during the spring. Only two McConaughy strain were collected during the spring.

Rainbow trout collected during the fall averaged 13.7 inches in length and 1.06 pounds in weight. Approximately 70% of the rainbow trout collected during the fall were of known hatchery origin (Figure 9). The 1987 Arlee plant dominated the catch, followed by unmarked fish, the 1986 Arlee plant and the 1984-1985 McConaughy plant. No known rainbow trout from Hauser Reservoir were collected during the fall. In general, mean catch rates for rainbow trout obtained in 1987 were greater than those obtained in 1986. The size of rainbow trout collected in floating gill nets was similar between 1987 and 1986.

A total of 1,439 fish were collected in 11 sinking gill nets set during 1987, with white and longnose suckers dominating the catch (48.3%), followed by yellow perch (45.3%) and walleye (2.2%) (Table 2). The composition of the catch made in sinking gill nets during 1987 was similar to 1986 collections. Average catch per net night in sinking gill nets is given in Appendix Table 1.

Vertical Gill Nets

A total of 154 fish were collected in four monthly sets of vertical gill nets at the Jackson station (lower reservoir) during 1987. Suckers dominated the catch (46.1%), followed by rainbow trout (34.4%) and kokanee (16.9%). Generally, rainbow trout were distributed in the upper 50 feet of the water column and were located above the thermocline during all sampling months (Figure 10). Rainbow trout were found in temperatures that ranged from 56 to 67 F. Kokanee were generally distributed below 50 feet during July and August but were located higher in the water column during September and October. Kokanee appeared to prefer water temperatures cooler than 62 F. Kokanee moved into the upper water column when water temperatures cooled to less than 62 F.

Salmonid Spawning in Tributaries

Confederate, Trout and Silver creeks were surveyed during the spring and the fall to document the possible presence of spawning runs and identify barriers to migration. In addition, these surveys were conducted to evaluate the contribution of hatchery strains to the spawning population. Rainbow trout and brown trout spawners were collected in each of the three tributaries. Rainbow spawners of known hatchery origin were collected in both Confederate and Trout creeks. In Confederate Creek, Desmet rainbow (1985 and 1986 plant) comprised 26% of the collected spawning migrants. In addition, one Arlee rainbow was found in spawning condition. In Trout Creek, Arlee rainbow (1986 plant) comprised 20% of the collected spawning migrants.

To protect both resident and spawning habitat in basin tributaries, instream flow recommendations were compiled on 14 creeks. These recommendations will be part of an application to be submitted to the Montana Department of Natural Resources and Conservation covering the lower Missouri River basin.

Tailwater Population Estimates

Estimates of trout populations were successfully completed in a 2.8 mile section of the Missouri River located immediately downstream of Hauser Dam. All data have been compiled and age analyses have been completed. Final estimates for 1985, 1986 and 1987 will be presented in the next progress report. Estimates of trout populations also were completed in a 2.5 mile section of the Missouri River located immediately downstream of Holter Dam. Results are published in progress reports from project F-46-R, Job I-g.

1987 Summer Creel Census

Interview Distribution, Party Size and Angler Day

The number of anglers interviewed on the mid-Missouri Reservoir complex during the summer, 1987 totalled 6,467. Interviews on Canyon Ferry, Hauser and Holter reservoirs numbered 2,362; 2,229 and 1,876, respectively (Table 4). Forty-five percent of the interviews were conducted on weekdays and 55% were conducted on weekends or holidays. Anglers per party averaged 2.12, 1.87 and 2.23 on Canyon Ferry, Hauser and Holter reservoirs, respectively. Parties of up to 9 anglers were encountered, although most parties were comprised of two people. The length of an angler day averaged 3.40, 3.93, and 4.02 hours on the three respective reservoirs. Anglers in boats fished about 1.5 hours longer per angler day than shore anglers.

Table 4. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during 1987 and their distribution by month.

Reservoir	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
C. Ferry	80	172	439	413	421	463	230	144	2362
Hauser	80	188	434	568	433	258	194	74	2229
Holter	56	115	375	462	479	274	115	0	1876

Characteristics of Anglers

Approximately 40% of all anglers interviewed on Canyon Ferry Reservoir during 1987 were from either Lewis and Clark or Gallatin counties, followed by residents from Silver Bow (10%) and Broadwater (7%) counties (Table 5). Eleven percent of the anglers surveyed were from outside of Montana. On Hauser Reservoir, a majority of the anglers interviewed were residents of Lewis and Clark County (54%), followed by anglers residing in counties located west of the Continental Divide (23%). Seven

percent of the anglers surveyed on Hauser Reservoir were from outside of Montana. A majority if the anglers interviewed on Holter Reservoir were from Cascade County (59%). Only 6% of the anglers surveyed were residents of Lewis and Clark County. Non-residents of the state comprised 7% of all interviews on Holter Reservoir.

Table 5. Residency of anglers fishing the mid-Missouri Reservoir complex during 1987.

	PERCENT OF TOTAL						
Reservoir	Lewis & Clark	Cascade	Gallatin	Silver Bow	Other MT (East)	Other MT (West)	Non-Resident
C. Ferry	19	2	21	10	21	9	11
Hauser	54	5	1	5	10	18	7
Holter	6	59	1	1	12	13	7

A majority of the anglers interviewed on Canyon Ferry and Hauser reservoirs were fishing from shore, comprising 78 and 61% of the interviews, respectively. On Holter Reservoir, a majority of the anglers surveyed were fishing from a boat (59%). Bait was the most popular method of fishing on all three reservoirs, comprising 76, 61 and 47% of the interviews on Canyon Ferry, Hauser and Holter reservoirs, respectively. Lures or a combination of lures or bait was the second most popular fishing method.

Trout was the most fished for species on all three reservoirs (Table 6). Secondly, anglers indicated they were seeking to catch any available fish. On Canyon Ferry and Holter reservoirs, the third most sought after species was yellow perch. On Hauser Reservoir, kokanee was the third most sought after species. Fishing for walleye on Holter Reservoir increased substantially between 1986 and 1987.

Table 6. Species targeted by anglers fishing the mid-Missouri Reservoir complex during the summer, 1987.

	PERCENT OF TOTAL						
Reservoir	Trout	Trout/ Kokanee	Kokanee	Yellow Perch	Trout/ Perch	Walleye/ Bass	Any Fish
C. Ferry	61	<1	0	16	6	0	17
Hauser	36	10	15	5	3	<1	31
Holter	52	3	1	12	3	5	24

Composition of Catch and Catch Rates for Canyon Ferry Reservoir

Yellow perch and rainbow trout were the most readily caught species in Canyon Ferry Reservoir, comprising 76.7 and 22.9%, respectively, of the catch (Table 6). Catch rates for rainbow trout were greatest in the early spring and late fall while catch rates for yellow perch were greatest in mid summer (Table 7). The overall catch rate for rainbow trout was 0.20 fish per hour and anglers kept 93% of the catch. The catch rate for rainbow trout was lower during 1987 than during 1986. The overall catch rate for yellow perch during 1987 was 0.68 fish per hour and was greater than the catch rate obtained during 1986. Anglers kept about 73% of all yellow perch caught.

Table 7. Composition of the catch on the mid-Missouri Reservoir complex during the summer of 1987.

		% COMPOSITION OF CATCH					
Reservoir	Number Caught	Rainbow Trout	Brown Trout	Kokanee	Walleye	S.mouth Bass	Yellow Perch
C. Ferry	5,814	22.9	0.4				76.7
Hauser	3,206	48.6	0.3	26.6	<0.01	0.1	24.2
Holter	4,337	46.3	0.1	1.8	2.2		49.6

Table 8. Monthly catch rates (fish per hour) on Canyon Ferry Reservoir during the summer, 1987 with comparisons to 1986 data.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Yellow Perch Caught
April	80	210.4	0.43	0.01	0
May	172	488.7	0.28	0.01	0.17
June	439	1165.2	0.21	0.01	0.56
July	413	1004.5	0.14	<0.01	0.55
August	421	1226.9	0.12	<0.01	1.51
September	463	1303.5	0.17	<0.01	0.87
October	230	797.4	0.22	<0.01	0.12
November	144	403.4	0.49	<0.01	0.30
Total	2362	6600.0	0.20	<0.01	0.68
1986 Total	1532	4778.3	0.28	0.01	0.37

Boat anglers were more successful at catching rainbow trout than

shore anglers. Shore anglers, however, were more successful at catching yellow perch. For shore anglers, overall catch rates for rainbow trout were greatest at access areas located on the lower end of the reservoir.

Monthly averages for the length of rainbow trout harvested from Canyon Ferry Reservoir during 1987 are given in Table 9. Rainbow trout averaged 16.4 inches in length and 1.92 pounds in weight. Length ranged from 6.5 to 23.0 inches and weight ranged from 0.12 to 5.75 pounds. Condition factors for harvested rainbow trout were generally excellent and averaged 40.9 (SD=4.7). Rainbow trout harvested in 1987 were substantially larger than fish harvested in 1986. Growth of rainbow trout may be related to the magnitude and duration of radial gate spills from Canyon Ferry Dam.

Table 9. Mean length (inches) by month for rainbow trout harvested in Canyon Ferry, Hauser and Holter reservoirs during the summer, 1987 with comparisons to 1986 data.

	CANYON FERRY		HAUSER		HOLTER	
Month	Number of Fish	$\bar{X}$ Length (Inches)	Number of Fish	$\bar{X}$ Length (Inches)	Number of Fish	$\bar{X}$ Length (Inches)
April	73	15.6	31	12.6	64	12.9
May	97	15.9	120	13.6	119	13.5
June	182	16.2	184	14.5	399	14.2
July	100	16.6	113	15.4	252	14.3
Aug.	82	15.8	114	13.7	210	14.1
Sept.	159	16.8	172	14.4	195	12.9
Oct.	129	17.1	210	14.4	191	13.3
Nov.	140	16.8	116	13.5		
Total	963	16.4	1060	14.2	1430	13.8
1986 Data	877	14.9	826	13.5	864	13.9

The age composition of harvested rainbow trout is shown in Figure 11. Age I+ fish comprised a majority of the catch, followed by age II+ fish and age 0+ fish. Very few rainbow trout older than three years of age were harvested. Hatchery rainbow planted into Canyon Ferry Reservoir during May first entered the creel in late June.

The distribution of harvested rainbow trout by strain and year of plant is shown in Figure 12. Approximately 98% of all rainbow trout harvested and examined for marks were of known hatchery origin. The 1986 Arlee plant dominated the harvest throughout the survey period, followed by hatchery fish planted prior to 1986. Only 10% of the 1983-85 plant was marked to enable strain identification (fin clip). As a result, few of these harvested

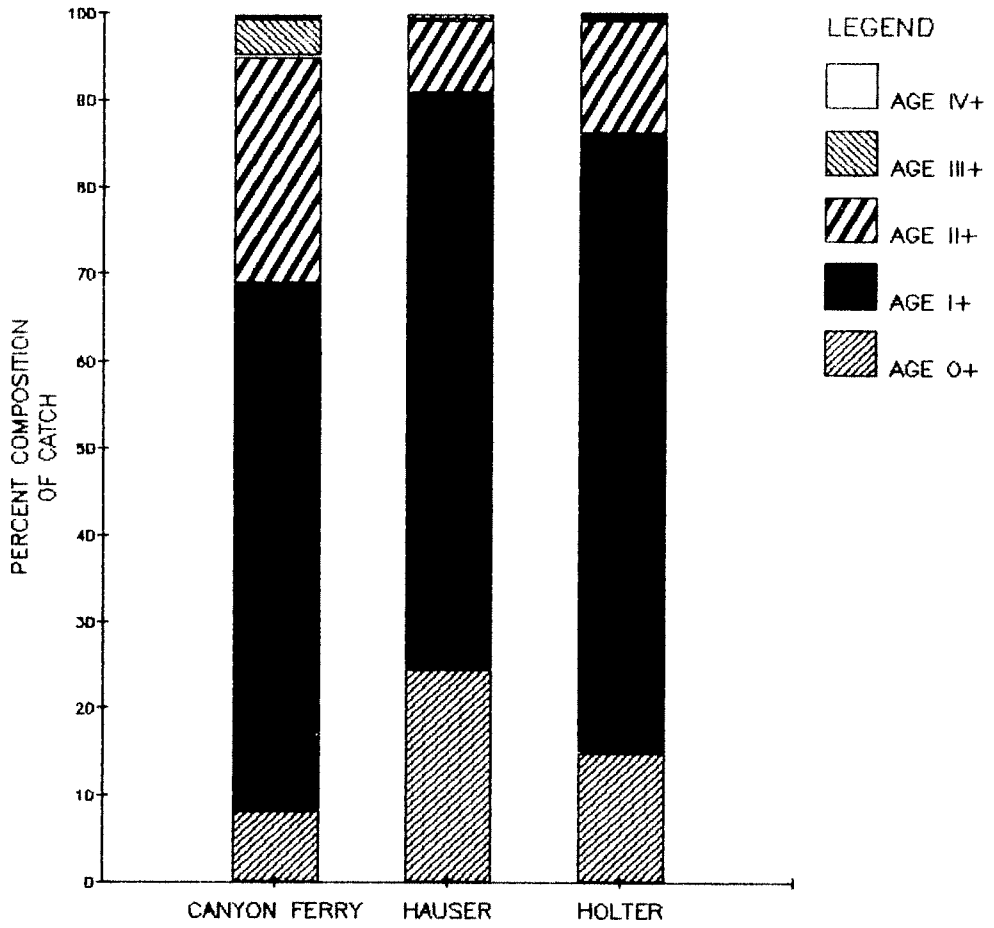


Figure 11. Distribution by age for rainbow trout harvested in mid-Missouri reservoirs during the summer, 1987.

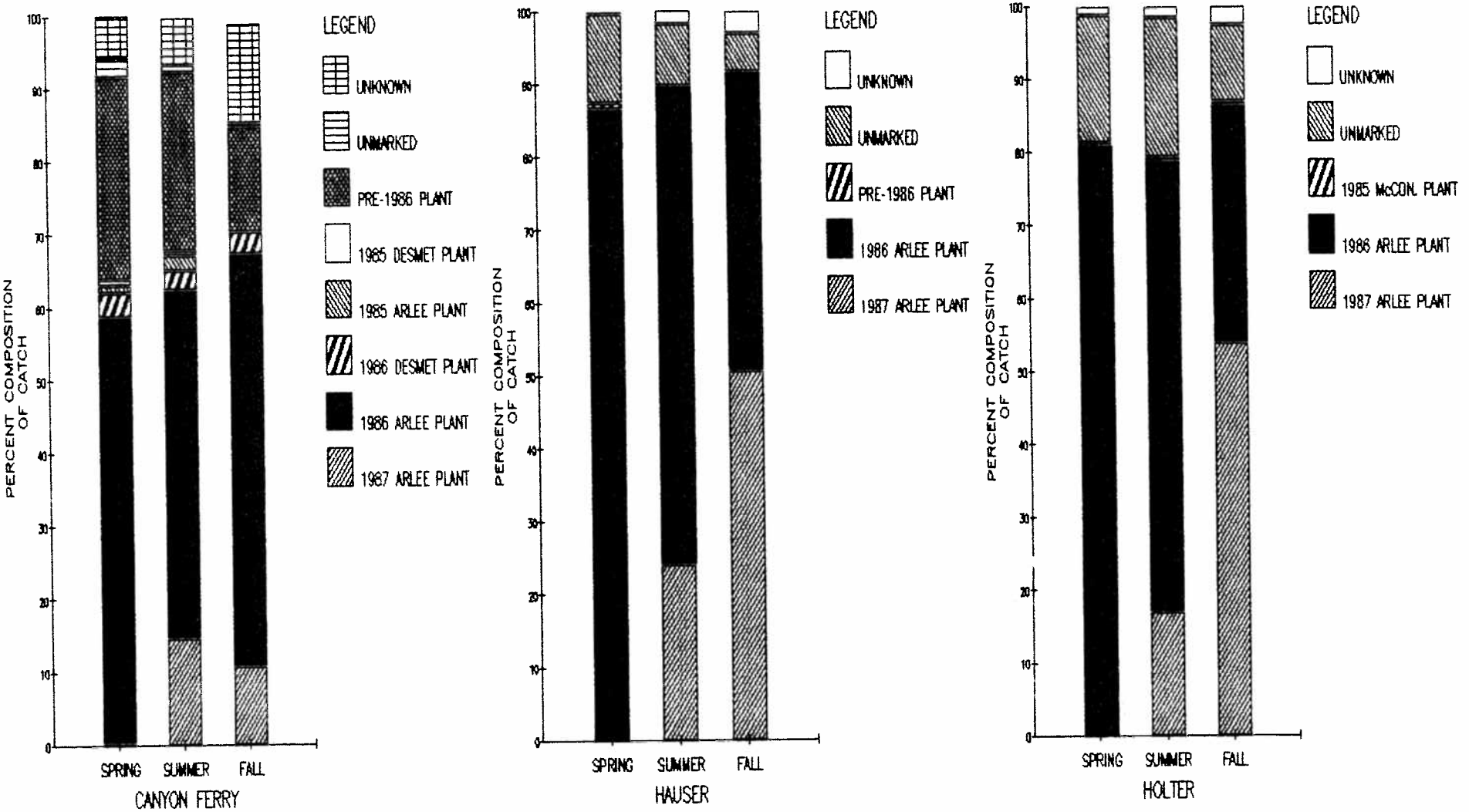


Figure 12. Distribution by strain and year of plant for rainbow trout havested in mid-Missouri reservoirs during the summer, 1987.

fish could be separated by strain, although it is likely a majority of this group was comprised of the 1985 Arlee plant. The 1987 Arlee plant, stocked during May, comprised about 10% of the harvest starting in July.

Composition of Catch and Catch Rates for Hauser Reservoir

Rainbow trout, kokanee and yellow perch were the most readily caught species in Hauser Reservoir during 1987, comprising 48.6, 26.6 and 24.2% of the catch, respectively (Table 7). Kokanee contributed about 7% more to the fishery in 1987 than in 1986.

Catch rates for rainbow trout were greatest during the spring and fall with an overall rate of 0.24 fish per hour (Table 10). Anglers kept about 80% of all rainbow trout landed. The overall catch rate for kokanee was 0.13 fish per hour. Excluding the fall fishery in the Canyon Ferry tailrace, kokanee catch rates were greatest in July. Anglers kept 92.6% of all kokanee landed. For yellow perch, catch rates were greatest during July. The overall catch rate for yellow perch was 0.12 fish per hour and anglers kept 68% of all fish landed. Catch rates for all species in Hauser Reservoir were similar between 1987 and 1986.

Table 10. Monthly catch rates (fish per hour) on Hauser Reservoir[1] during the summer, 1987 with comparisons to 1986 data.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Kokanee Caught	Yellow Perch Caught
April	63	201.1	0.16	0	0.04	0.01
May	188	590.7	0.29	0.01	0.07	0.17
June	434	1303.3	0.17	<0.01	0.20	0.13
July	568	1695.0	0.10	<0.01	0.25	0.09
August	433	1232.0	0.18	0	0.09	0.23
September	258	752.4	0.40	0	0.02	0.08
October	194	465.9	0.59	0	<0.01	0.01
November	74	170.8	1.10	0	0.01	0.04
Total	2229	6411.2	0.24	<0.01	0.13	0.12
1986 Data	1404	4554.9	0.26	<0.01	0.10	0.13

[1]Excludes the Canyon Ferry tailrace from August-November.

Boat anglers were more successful at catching kokanee than shore anglers. However, shore anglers were more successful at catching rainbow trout and yellow perch. For shore anglers, overall catch rates for rainbow trout were greatest at the Causeway and York bridge access sites.

Characteristics of Game Fish Harvested in Hauser Reservoir

Monthly averages for the length of rainbow trout harvested from Hauser Reservoir during 1987 are given in Table 9. Rainbow trout averaged 14.2 inches in length and 1.26 pounds in weight. Length ranged from 7.6 to 23.0 inches and weight ranged from 0.15 to 4.07 pounds. Condition factors for harvested rainbow trout averaged 41.2 (SD=4.2). The size of harvested rainbow trout was similar between 1987 and 1986.

The age composition of harvested rainbow trout is shown in Figure 11. Age I+ fish comprised almost 70% of the catch. Less than 10% of the harvested rainbow trout from Hauser Reservoir were older than age I+. Hatchery rainbow trout that were planted during June first entered the creel in August.

Approximately 91% of all harvested rainbow trout that were examined for marks were of known hatchery origin (Figure 12). During the survey period, nearly 90% of all harvested rainbow trout were from either the 1986 or 1987 Arlee plant. The 1986 plant dominated the harvest during the spring but the contribution of the 1987 plant became increasingly significant to the harvest beginning in August and became dominant by the fall. Only four rainbow trout originally stocked in Canyon Ferry Reservoir were harvested in Hauser Reservoir.

Harvested kokanee from Hauser Reservoir averaged 15.6 inches in length and 1.52 pounds in weight. Length ranged from 8.6 to 21.4 inches and weight ranged from 0.32 to 3.31 pounds. Age II+ kokanee comprised about 88% of the harvest, followed by age III+ fish (9%).

Composition of Catch and Catch Rates for Holter Reservoir

Yellow perch and rainbow trout were the most readily caught species in Holter Reservoir during 1987, comprising 49.6 and 46.3% of the catch, respectively (Table 7). Walleye, comprising about 2% of the catch, contibuted substantailly more to the fishery during 1987 than 1986. More walleye were caught during 1987 due to the increasing interest in fishing for the species and also to improving angling techniques.

The overall catch rate for rainbow trout was 0.37 fish per hour with anglers keeping 86% of all fish landed (Table 11). Catch rates for rainbow trout were greatest in the spring and fall. For kokanee, the overall catch rate was 0.01 fish per hour. Catch rates for rainbow trout and kokanee were similar between 1987 and 1986. Catch rates for yellow perch, however, were substantially greater in 1987 than 1986. The overall catch rate for yellow perch was 0.39 fish per hour and anglers kept 73% of all fish landed.

Boat anglers were more successful at catching rainbow trout and

shore anglers were more successful at catching yellow perch. For shore anglers, overall catch rates for rainbow trout were highest at the Black Beach access site. The catch rate for walleye by anglers specifically seeking to catch the fish was 0.27 fish per hour. This catch rate is similar to rates reported for reservoirs known for their walleye fishery (Fredenberg 1985).

Table 11. Monthly catch rates (fish per hour) on Holter Reservoir during the summer, 1987 with comparisons to 1986 data.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Kokanee Caught	Yellow Perch Caught
April	56	188.3	0.37	0	0.01	0.09
May	115	374.3	0.44	0	<0.01	0.24
June	375	1202.6	0.45	0	0.02	0.36
July	462	1246.4	0.23	<0.01	0.02	0.79
August	479	1365.9	0.23	<0.01	0.01	0.41
September	274	730.5	0.46	<0.01	0.01	0.08
October	115	404.7	0.74	0	<0.01	0.02
Total	1876	5512.7	0.37	<0.01	0.01	0.39
1986 Data	1063	3759.9	0.34	<0.01	0.01	0.16

Characteristics of Game Fish Harvested in Holter Reservoir

Monthly averages for the length of rainbow trout harvested from Holter Reservoir during 1987 are given in Table 9. Rainbow trout averaged 13.8 inches in length and 1.11 pounds in weight. Length ranged from 7.5 to 22.2 inches and weight ranged from 0.19 to 3.71 pounds. The size of rainbow trout harvested from Holter Reservoir was similar between 1987 and 1986. Condition factors for rainbow trout averaged 41.0 (SD=4.7).

The age composition for harvested rainbow trout is shown in Figure 11. Age I+ fish dominated the harvest in Holter Reservoir, comprising 71% of the total harvest. Age 0+ and II+ fish were the other prominent age classes in the harvest. Rainbow trout that were 3 years or older comprised less than 1% of the harvest. Hatchery rainbow planted during early July first entered the creel in late July.

Approximately 83% of all harvested rainbow trout that were examined for marks were of known hatchery origin (Figure 12). Apparently, there is a greater percentage of wild fish in the Holter rainbow population than there are in the other two reservoirs. Nearly 80% of all harvested rainbow trout were from either the 1986 or 1987 Arlee plant. The 1986 plant dominated the harvest during the spring and summer but the 1987 plant

dominated the harvest during the fall.

Size data also were gathered from 52 walleye that were harvested from Holter Reservoir during 1987. These fish averaged 16.1 inches in length and 1.64 pounds in weight. Sixty-four kokanee harvested during 1987 averaged 16.7 inches in length and 2.01 pounds in weight. Age composition data will be presented in a future report when aging of scales is completed.

Canyon Ferry Winter Creel Census (1987-88)

Distribution of Interviews and Angler Characteristics

A total of 1,411 anglers were interviewed on Canyon Ferry Reservoir during the 1987-88 ice fishery. Interviews conducted during December, January, February and March numbered 27, 742, 482 and 160, respectively. About 64% of the interviews were conducted on weekends and 36% were conducted on weekdays. A majority of the anglers interviewed were from Lewis and Clark, Gallatin and Broadwater counties, comprising 30, 21 and 14% of the interviews, respectively. Sixty-nine percent of all anglers were found fishing from Kohn's Cove to the dust abatement ponds, followed by 17% of all anglers fishing at the White Earth access site. Thirty-two percent of all anglers interviewed were seeking to catch either trout or yellow perch, while 30% were fishing specifically for perch and 30% were fishing for trout.

Composition of Catch and Catch Rates

Yellow perch and rainbow trout were the most readily caught species during the winter, comprising 87.7 and 12.9% of the catch, respectively. Catch rates for both yellow perch and rainbow trout were greatest during December (Table 12). The overall catch rate for yellow perch was 1.74 fish per hour and anglers kept 90% of all fish landed. Catch rates for yellow perch were lower during 1987-88 than during the previous two winters. For rainbow trout, the overall catch rate was 0.26 fish per hour and was similar to the catch rate obtained in 1986-87. Anglers kept 97% of all rainbow trout landed.

Table 12. Monthly catch rates (fish per hour) on Canyon Ferry Reservoir during the winter, 1987-88 with comparisons to 1986-87 data.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Yellow Perch Caught
December	27	27.9	0.40	2.91
January	742	2110.2	0.22	1.93
February	482	1287.6	0.28	1.64
March	160	472.1	0.38	1.13
Total	1411	3897.8	0.26	1.74
1987-88 data	951	3406.6	0.25	2.29

Characteristics of Harvested Fish

Harvested rainbow trout averaged 16.6 inches in length and 1.88 pounds in weight. Approximately 83% of all harvested rainbow trout that were examined for marks were of known hatchery origin. The 1986 Arlee plant dominated the harvest (40.8%), followed by the 1987 Arlee plant (28.9%), unknown fish (17.2%) and the 1986 Desmet plant (9.7%). The 1986 Desmet plant contributed substantially more to the harvest during the winter than during the summer. Apparently, the Desmet plants became more catchable during the winter. The 1987 Eagle Lake plant comprised only 2.2% of the winter harvest. These fish were planted in late July and apparently did not reach a sufficient size by winter to contribute significantly to the harvest. There were a greater percentage of unknown fish in the winter harvest than in the summer harvest because vertebrae were not collected for tetracycline examination during the winter survey. Harvested yellow perch averaged 8.9 inches in length and 0.38 pounds in weight. Age classes were not distinguishable in the yellow perch harvest. Distribution of lengths from harvested yellow perch was bell-shaped.

Canyon Ferry Tailrace Creel Census (1987)

Distribution of Interviews and Angler Characteristics

A total of 654 anglers were interviewed on the Canyon Ferry tailrace from August 1 through November 20, 1987. Interviews numbered 317, 153, 101 and 83 during the four respective months. Sixty-six percent of the interviews were conducted on weekdays and 44% were conducted on weekends. Seventy-four percent of the anglers surveyed were fishing from shore and 26% were fishing from a boat. Residents from Lewis and Clark County dominated the survey (45%), followed by out of state anglers (11%), Silver Bow residents (9.8%) and people from other counties located west of the Continental Divide (9.6%). Thirty-four percent of the anglers were seeking to catch any fish, while 33% were fishing specifically for kokanee and 16% were seeking trout. Bait was the most popular fishing method, comprising 64% of all interviews.

Composition of Catch, Catch Rates and Harvest

Kokanee and rainbow trout were the most readily caught species in the Canyon Ferry tailrace, comprising 49 and 45% of the catch, respectively. The overall catch rate for kokanee was 0.22 fish per hour and anglers kept 81% of all fish landed. For rainbow trout, the overall catch rate was 0.20 fish per hour and anglers kept 62% of all fish landed. Catch rates for both species were highest during November.

Estimated fishing pressure and harvest of kokanee and rainbow trout from the Canyon Ferry tailrace are presented in Table 13. About 19,800 hours were expended to harvest 3,349 kokanee and

2,312 rainbow trout. Kokanee harvested during July, however, likely surpassed the harvest obtained during the entire fall survey period. The kokanee harvest in the Canyon Ferry tailrace has appeared to peak successively earlier each year since 1985. The kokanee harvest in 1985 was observed to peak during September, while in 1986 the harvest peaked during August and, in 1987, the harvest peaked during July. The reasons for this successively earlier harvest are unknown.

Table 13. Estimated fishing pressure and harvest obtained in the Canyon Ferry tailrace from August 1 through November 20, 1987.

Strata	Hours Fished	HARVEST	
		Kokanee	Rainbow
8/1-8/14	5590	1364	140
8/15-8/28	3583	509	150
8/29-9/11	2536	205	89
9/12-9/25	2907	125	201
9/26-10/9	1270	103	133
10/10-10/23	1319	210	385
10/24-11/6	1220	435	740
11/7-11/20	1340	398	474
Total	19765	3349	2312

Fishing pressure on the Canyon Ferry tailrace has progressively increased since 1985 (Table 14). Despite increasing fishing pressure, however, the number of kokanee harvested in the tailrace during the fall survey period has progressively decreased. This apparent decrease in kokanee harvest is somewhat misleading, however, since large numbers of fish were harvested prior to the survey period during 1986 and 1987. If the timing of the kokanee harvest is considered, the number of kokanee creeled in the tailrace has undoubtedly increased substantially since 1985. The average length of harvested kokanee has remained similar among the three years of survey.

Table 14. A comparison of fishing pressure, size of fish, and harvest in the Canyon Ferry tailrace during the mid September-late November survey period for 1985-87.

Year	Hours Fished	ESTIMATED HARVEST			
		Kokanee	X Length (Inches)	Rainbow Trout	X Length (Inches)
1987	6953	1418	18.2	2075	13.4
1986	6383	1695	19.0	1006	14.7
1985	3999	2280	19.2	2108	12.2

Characteristics of Harvested Fish

Harvested kokanee ranged from 10.5 to 22.6 inches in length and 0.40 to 3.42 pounds in weight. Age data will presented in a future report when aging of scales or otoliths is completed. Rainbow trout harvested in the tailrace ranged from 6.8 to 21.2 inches in length and 0.10 to 3.70 pounds in weight. About 85% of all harvested rainbow trout that were examined for marks were of known hatchery origin. These fish were evenly distributed among the 1986 and 1987 Arlee plant. Only one rainbow trout originally planted in Canyon Ferry Reservoir was harvested in the Canyon Ferry tailrace.

Mark Retention

Rainbow trout sampled from creel census activities and gill netting in Canyon Ferry and Holter reservoirs during 1986 and 1987 were used to evaluate the retention of tetracycline and fluorescent pigment marks in fish. To provide mark retention results spanning the longest period of time possible, only rainbow trout that were planted into the reservoir complex during 1986 were evaluated in this report.

Retention of fluorescent pigment marks on rainbow trout planted into Canyon Ferry and Holter reservoirs during 1986 is shown in Table 15. In general, rainbow trout were planted into the two reservoirs one to three weeks following marking in 1986. At the time rainbow trout were planted, retention of both tetracycline and pigment marks approached 100%. Retention of tetracycline marks has remained near 100% throughout the duration of the study, although identifying multiple marks has been less precise. Approximately 83% of the Arlee rainbow stocked into Canyon Ferry Reservoir during 1986 had retained their pigment mark 1.5 years following planting. Retention of green pigment marks on Desmet rainbow was somewhat less, with 66.7% of the fish retaining their marks. Apparently, fluorescent green pigment is more difficult to detect than fluorescent red pigment.

Table 15. Retention of fluorescent pigment marks on 1986 plants of rainbow trout made into Canyon Ferry and Holter reservoirs.

				PERCENT RETENTION OF PIGMENT				
		Collec.	Mark	Fall	Winter	Spring	Summer	Fall
Reservoir	Strain	Method	Color	1986	1986-87	1987	1987	1987
C. Ferry	Arlee	G. Net	Red	95.9		84.7		82.1
		Creel	Red	97.6	78.5	68.8	70.1	84.7
	Desmet	G. Net	Green	84.6		67.6		66.7
Holter	Arlee	G. Net	Oran.	99.2		94.3		92.0
		Creel	Oran.	97.8		98.1	95.1	96.8

In Holter Reservoir, retention of orange pigment marks on Arlee rainbow approached 95% 1.25 years following planting. In comparison to pigment marked rainbow trout in Canyon Ferry Reservoir, the greater retention of pigment found in Holter rainbow was likely due to a change in marking techniques. Rainbow trout from Holter Reservoir were sprayed at a slightly greater air pressure (110 vs. 100 psi). In addition, the method of drawing pigment into the sandblasting gun was greatly improved. Overall, retention of tetracycline and pigment marks has been high and, as a result, these techniques have proven valuable for purposes of this study.

Strain Evaluation

Estimates of the harvest and the percent return to the creel of 1986 plants of rainbow trout from the three reservoirs are given in Table 16. Although harvest estimates were calculated from questionable estimates of fishing pressure (1985 mail survey estimates were used in calculations), the relationships among the three reservoirs and between rainbow strains are likely to be correct. The rate of return to the creel of the 1986 rainbow plant from Canyon Ferry, Hauser and Holter reservoirs through February, 1988 was estimated to be 4.6, 18.4 and 26.0%, respectively. Differences in the rate of hatchery returns among the three reservoirs may be due to the differences of fishing pressure that occur on the reservoir complex. An average of 2.16, 10.28 and 15.84 angler days per surface acre of fishing pressure occurred on Canyon Ferry, Hauser and Holter reservoirs, respectively during 1985 (determined from mail survey). Apparently, greater fishing pressure per surface acre resulted in a greater rate of return to the creel for hatchery rainbow trout. For Canyon Ferry Reservoir, the 1986 Desmet plant exhibited a slightly greater rate of return than the 1986 Arlee plant. However, it is unclear if this difference between strains is significant.

Table 16. Estimated harvest and percent return to the creel of 1986 rainbow trout plants from Canyon Ferry, Hauser and Holter reservoirs through February, 1988.

Reservoir	Strain	# Planted in 1986	Est. Hours Fished[1]	Estimated harvest of 1986 rainbow plant 1986	1987	Total	Est. % Return
C. Ferry	Arlee	1,035,639	279,500	13281	32656	45937	4.44
	Desmet	62,100	same	1133	3251	4384	7.06
Hauser	Arlee	212,596	154,625	13464	25562	39026	18.36
Holter	Arlee	325,089	294,691	22804	99160	61744	26.01

[1]Based on 1985-86 mail survey estimate and used for both 1986 and 1987 harvest estimates.

Based on gill net catches made in 1987, the 1986 Desmet plant appeared to survive better than the 1986 Arlee plant (Figure 13). Desmet rainbow comprised about 6% of the total number of fish stocked into Canyon Ferry Reservoir compared to 26% of the rainbow trout collected in gill nets. However, this conclusion assumes that Desmet and Arlee have equal susceptability to capture in gill nets. Data is unavailable at this time to determine if this assumption is correct. Differences in survivability between strains may have been more a function of age and size at time of planting since the 1986 Desmet plant was comprised of Age I+ holdovers at 7.0 inches in length while the 1986 Arlee plant was comprised of Age 0+ fish at 4.5 inches in length.

If the 1986 Desmet plant displayed greater survivability, then catchability appeared to be poorer when compared to the 1986 Arlee plant (Figure 13). The Arlee strain comprised about 89% of the catch while the Desmet strain comprised only 11% of the catch. Despite the apparent poorer catchability by the 1986 Desmet plant, a greater percentage of Desmet were found in the creel than were found in the original composition of the plant.

Growth curves for 1986 rainbow planters from the three reservoirs are shown in Figure 14. Arlee rainbow from Canyon Ferry Reservoir were planted about two months earlier than in Hauser and Holter reservoirs and, as a result, maintained a size advantage over fish in the other two reservoirs into the second growing season. However, 1986 Arlee plants in Hauser Reservoir reached a similar average length as Arlee in Canyon Ferry Reservoir by the end of the second growing season. There appears to be a plateau in growth for Arlee rainbow trout in the reservoir complex at about 17.5 inches in length.

Desmet rainbow were planted into Canyon Ferry Reservoir in 1986 at about 7.0 inches in length while the Arlee rainbow were planted at 4.0 inches in length. The 1986 Desmet plant maintained their size advantage over the Arlee plant for most of the first growing season but the Arlee rainbow reached a similar average length by the end of the first year (Figure 14). Growth rates appeared similar between the two strains during their second growing season.

The McConaughy strain, planted in the section of free flowing Missouri River located below Hauser Dam, was not evaluated for this report because too few were collected for meaningful analyses. A majority of the McConaughy strain apparently have remained in the river section where they were planted or they may have simply not survived.

Rainbow Trout Escapement

Downstream escapement of marked hatchery rainbow trout from the three reservoirs was almost nonexistent during 1987 (Table 17). This lack of escapement was likely correlated with the lack of

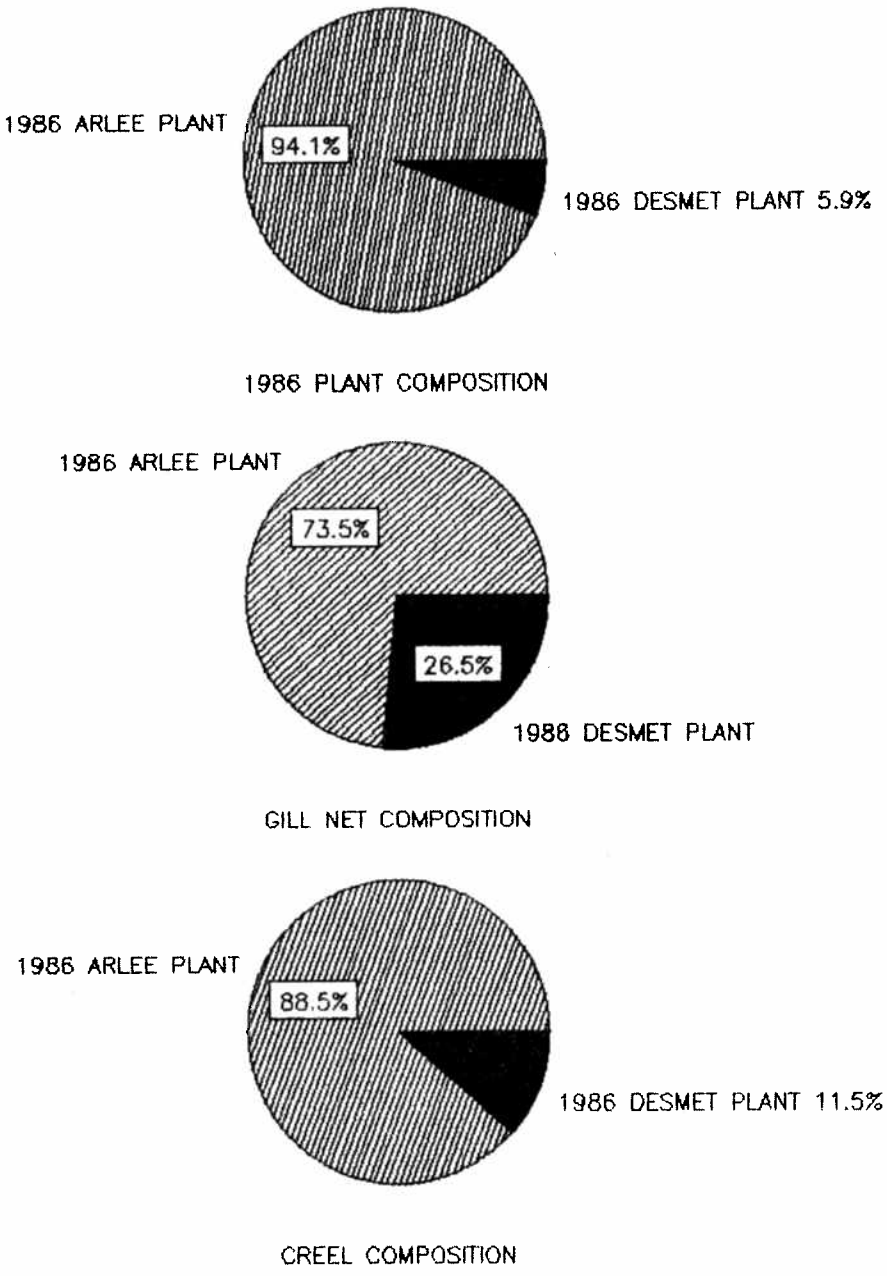


Figure 13. Distribution of the 1986 rainbow trout plant in Canyon Ferry Reservoir from harvest and gill net collections made in 1987.

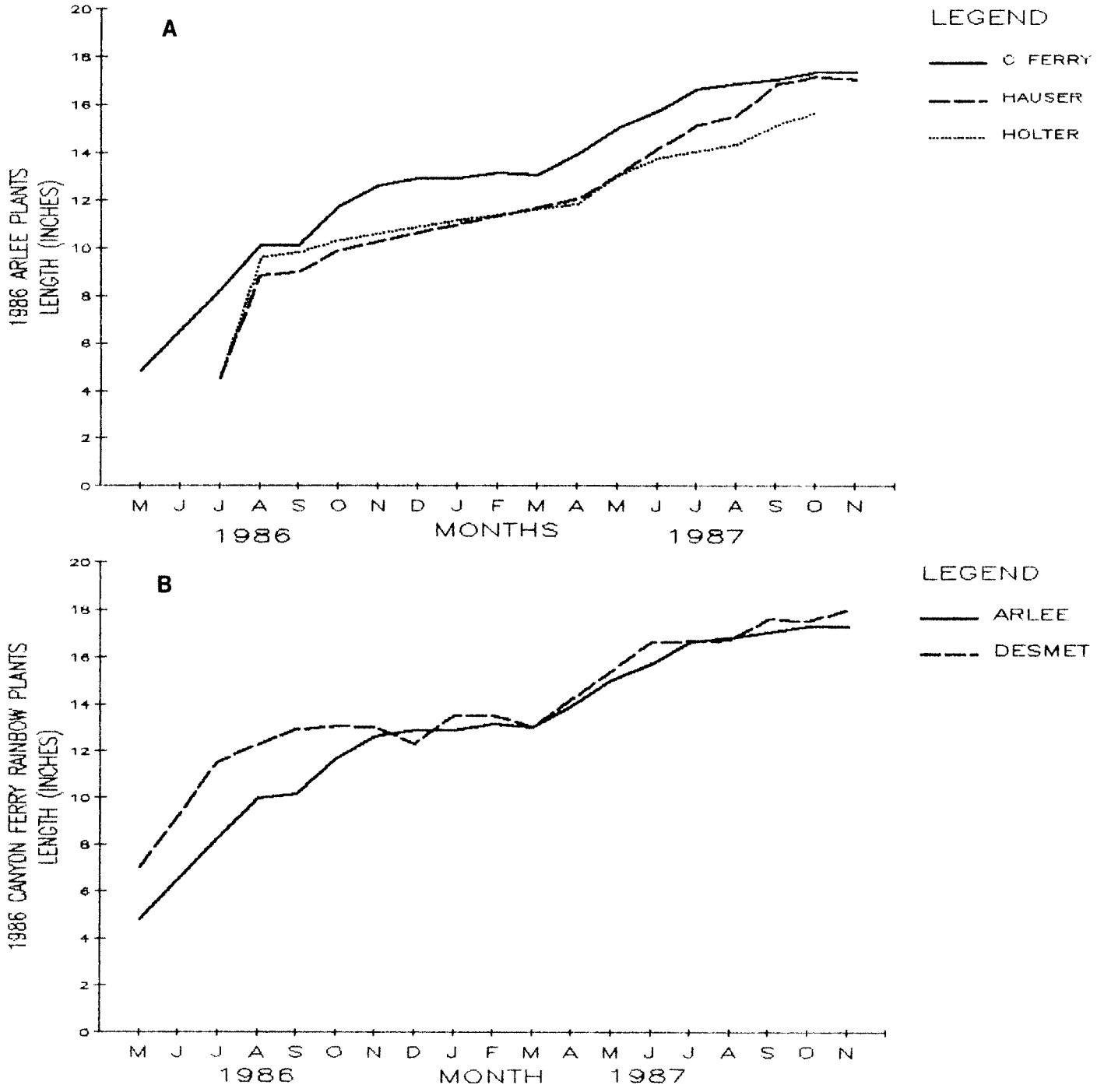


Figure 14. Comparisons of growth curves of Arlee rainbow trout from the three mid-Missouri reservoirs (A) and between Arlee and Desmet strains of rainbow trout planted in Canyon Ferry Reservoir (B).

water spills through the radial gates of Canyon Ferry Dam during 1987. Also, since Canyon Ferry Reservoir controls flow patterns in the entire complex, the impacts to the fishery resources on the two downstream reservoirs are likely to follow those of Canyon Ferry Reservoir. Historically, the average duration of radial gate spills has been about 50 days with a mean discharge through the gates of 7,300 cfs (Rehwinkel 1986). Since 1985, however, almost no spill has passed through the radial gates at Canyon Ferry Dam. A high water year is needed to fully evaluate the correlation between radial gate spills and rainbow trout escapement.

Table 17. Numbers of marked hatchery rainbow trout observed to have escaped from Canyon Ferry, Hauser and Holter reservoirs during 1987 with comparable data from 1986.

	RADIAL GATE		CANYON FERRY ESCAPEMENT		HAUSER ESCAPEMENT		HOLTER ESCAP.
Year	Duration (Days)	Magnitude (CFS)	C. Ferry Tailrace	Hauser Reservoir	Hauser Tailrace	Holter Reservoir	Holter Tailrace
1987	0	0	5	2	17	1	40
1986	13	4600	58	21	122	0	330

Rainbow trout that escaped from Canyon Ferry and Holter reservoirs during 1987 must have survived passage through the turbines because spill over the dams didn't occur. In Hauser Reservoir, rainbow trout may have either passed through the turbines or over the dam. Fish that escaped from the reservoirs apparently remained in the tailwater areas since few displaced rainbow were found in downstream reservoirs. In addition, very few fish displaced during 1986 were found during sampling in 1987. Very few of these fish appeared to survive to their second year.

MANAGEMENT RECOMMENDATIONS

1. Continue mass marking all rainbow trout planted in the reservoir complex to more fully evaluate the correlation between radial gate spills and rainbow trout escapement.

2. Continue evaluation of rainbow trout strains in terms of survival, growth and catchability.

3. Continue creel census activities on the reservoir complex.

4. Continue walleye tagging program on Holter Reservoir. Attempt to identify walleye spawning areas by electrofishing the shoreline in the spring and by using trap nets.

5. Monitor success of largemouth bass plants made into Lake Helena during 1987.

6. Estimate recruitment of rainbow trout, brown trout, and kokanee fry from all tributaries to reservoir complex.

7. Develop a comprehensive five year management plan for the mid-Missouri Reservoir complex by holding pubic scoping meetings to identify fisheries management issues and potential management goals. A draft plan should be developed addressing issues identified at public scoping meetings. A final plan should be derived addressing public comments received from the draft plan.

LITERATURE CITED

Berg, R. K. and M. Lere. 1983. Fish populations of Hauser and Holter Reservoirs, Montana with emphasis on tributary recruitment. Job Progress Report. Funded, in part, by U.S. Bureau of Reclamation, Purchase Order 2-01-60-02720. 40 pp.

Fredenberg, W. A. 1984. South Central Montana Fisheries Investigations. Fed. Aid to Fish and Wild. Rest. Proj. No. F-20-R-29, Job IV-a. 80 pp.

Leathe, S. A. and P. J. Graham. 1982. Flathead Lake fish food habits study. Final report to the E.P.A., Region VIII, Water Division, Denver, Colorado. Contract no. ROO 8224-01-4. 137 pp.

Lere, M. 1987. Statewide Fisheries Inverstigations. Mid-Missouri Reservoirs Study. Fed. Aid to Fish and Wild. Rest. Proj. No. F-36-R-2, Job II-f. 66 pp.

Malvestuto, S. P. 1983. Sampling the recreational fishery. In Fisheries Techniques, L.A. Nielson and D.J. Johnson, editors. Amer. Fish Soc. Bethedsa, Maryland. 397-419.

Montana Department of Fish, Wildlife and Parks. 1985. Upper Missouri River reservoir operating guidelines for fish, wildlife and recreation. 38 pp.

Novotny, D. W. and G. R. Priegel. 1974. Electrofishing boats: improved designs and operational guidelines to increase the effectiveness of boom shockers. Dept. of Nat. Res., Madison, WI. Technical Bulletin No. 73. 48 pp.

Phinney, D. E. and S. B. Mathews. 1973. Retention of fluorescent pigment by Coho salmon after two years. The Prog. Fish Cult. 35(2) 161-163.

Pribble, J. 1976. Pressure spray marking of fish with granular dyes. Info. report series, fisheries. Oregon Dept. of Fish and Wildlife. Number 76-1. 12 pp.

Rada, R. G. 1974 An investigation into the trophic status of Canyon Ferry Reservoir, Montana. Phd Thesis. Montana State University, Bozeman, MT. 126 pp.

Rehwinkel, B. J. 1986. Southwest Montana Fisheries Investigations. Fed. Aid to Fish and Wild. Rest. Proj. No. F-9-R-34, Job I-d. 56 pp.

Ricker, W. E. 1975. Computation and interperatation of biological statistics of fish populations. Bulletin 191, Dept. of the Environment, Fisheries and Marine Service. Ottowa, Canada. 382 pp.

Prepared by: Mark E. Lere
Date: July, 1988
Waters referred to:

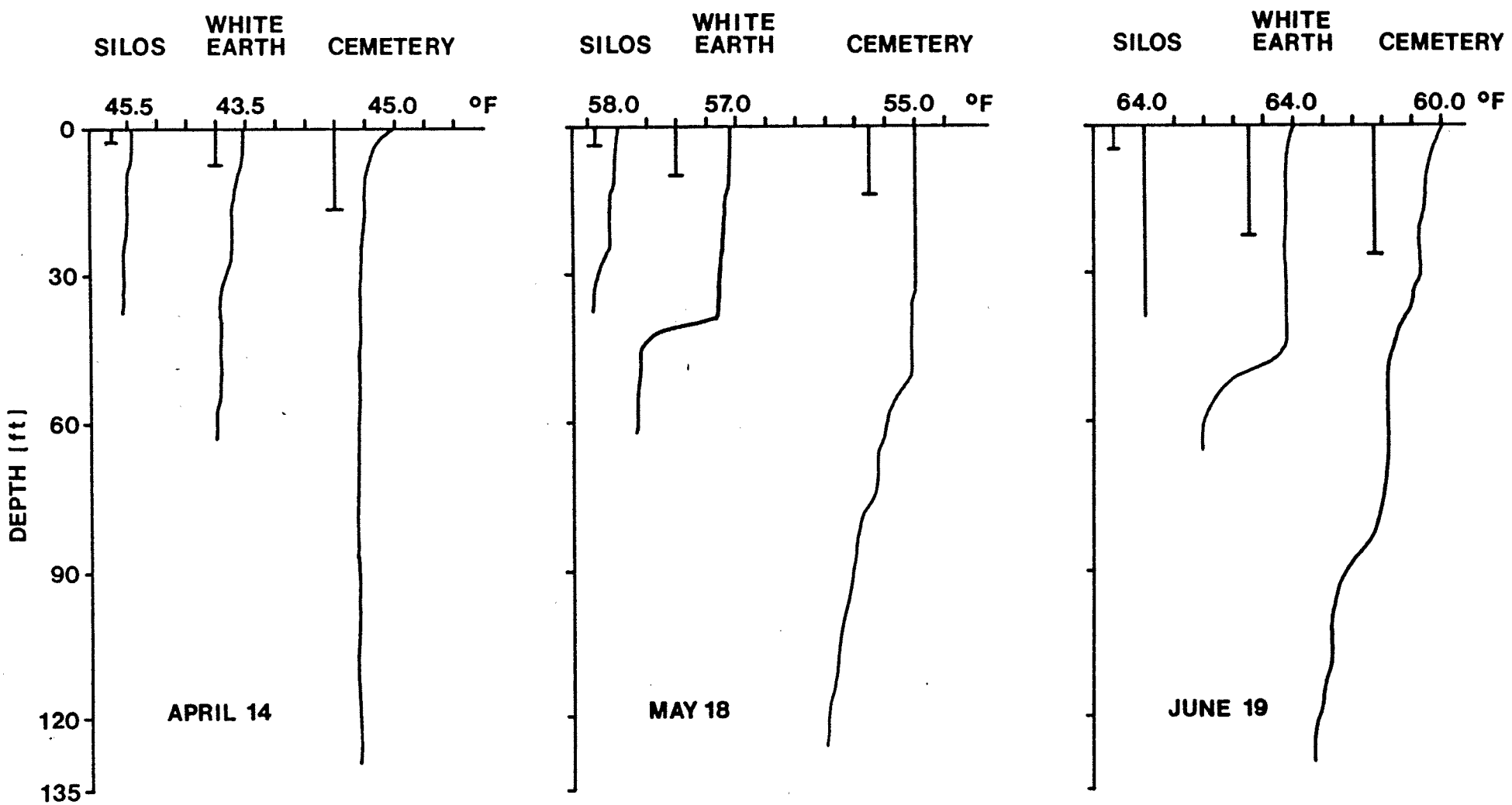
Canyon Ferry Reservoir		17-8832
Hauser Reservoir		17-9056
Holter Reservoir		17-9136
Missouri River	Sec 9	17-4896
	Sec 10A	17-4913
	Sec 10B	17-4914
Confederate Gulch		17-1664
Silver Creek		17-6704
Trout Creek		17-7888

APPENDIX

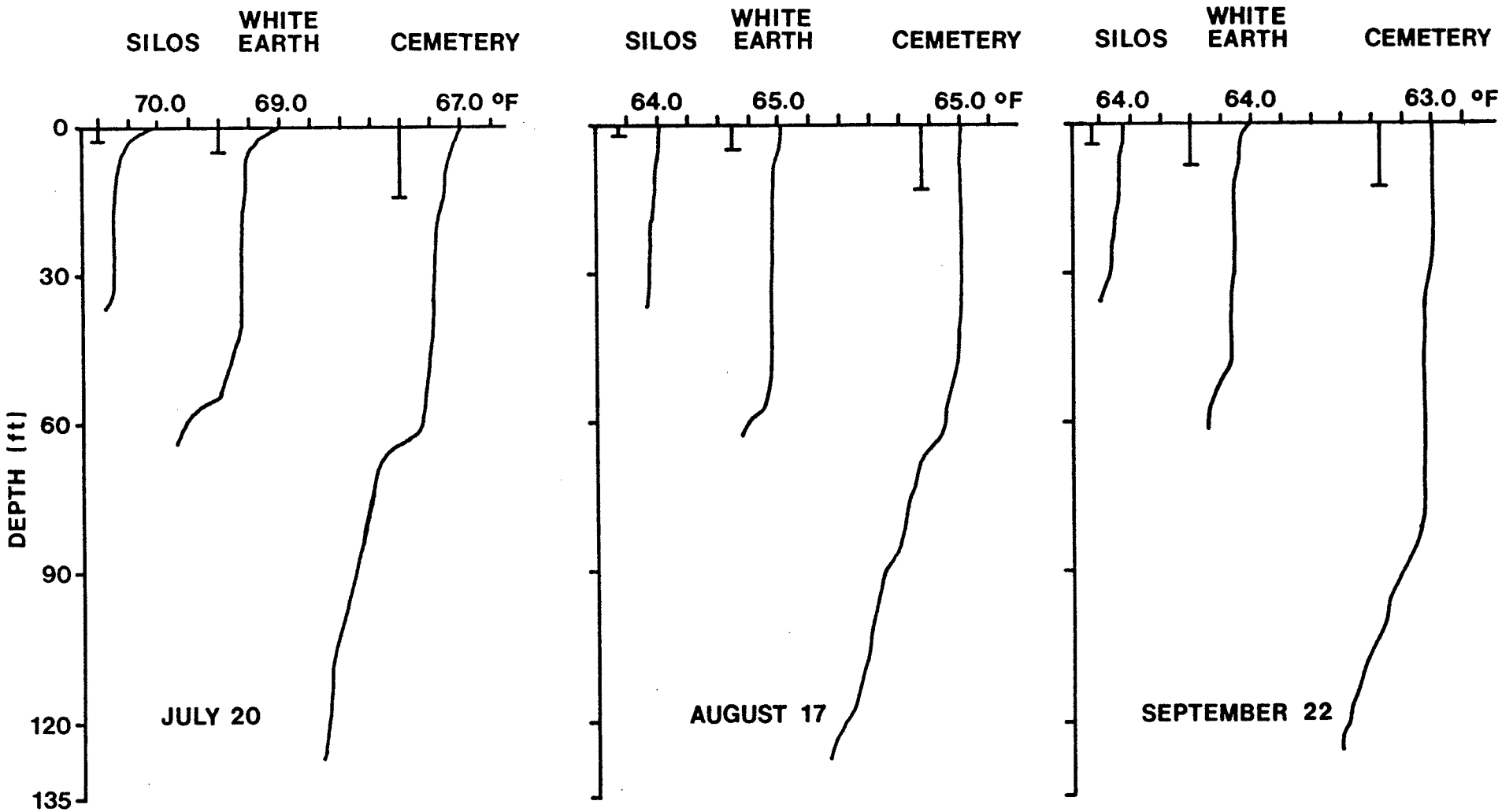
Appendix Table 1. Average catch per net night in sinking gill nets set in Canyon Ferry, Hauser and Holter reservoirs during 1987.

Parameter	Canyon Ferry		Hauser		Holter	
	Spring	Fall	Spring	Fall	Spring	Fall
Number of nets	0	3	5	6	5	6
Ave. catch of:[1]						
RB		0.3	0.2	2.0	1.6	2.5
LL		1.3	1.4	0.5	1.4	0.3
Kok			1.0	5.8		0.2
MWF		0.3	3.6	3.2	3.0	2.0
YP		85.0	4.4	13.0	95.8	28.8
WE					2.6	3.2
LnSu		1.7	21.8	22.5	27.6	21.5
Wsu		48.7	62.0	92.3	35.4	41.7
CP		3.0			0.2	
UC		1.7	0.2	0.2		
BB		1.0				
SB				0.3		

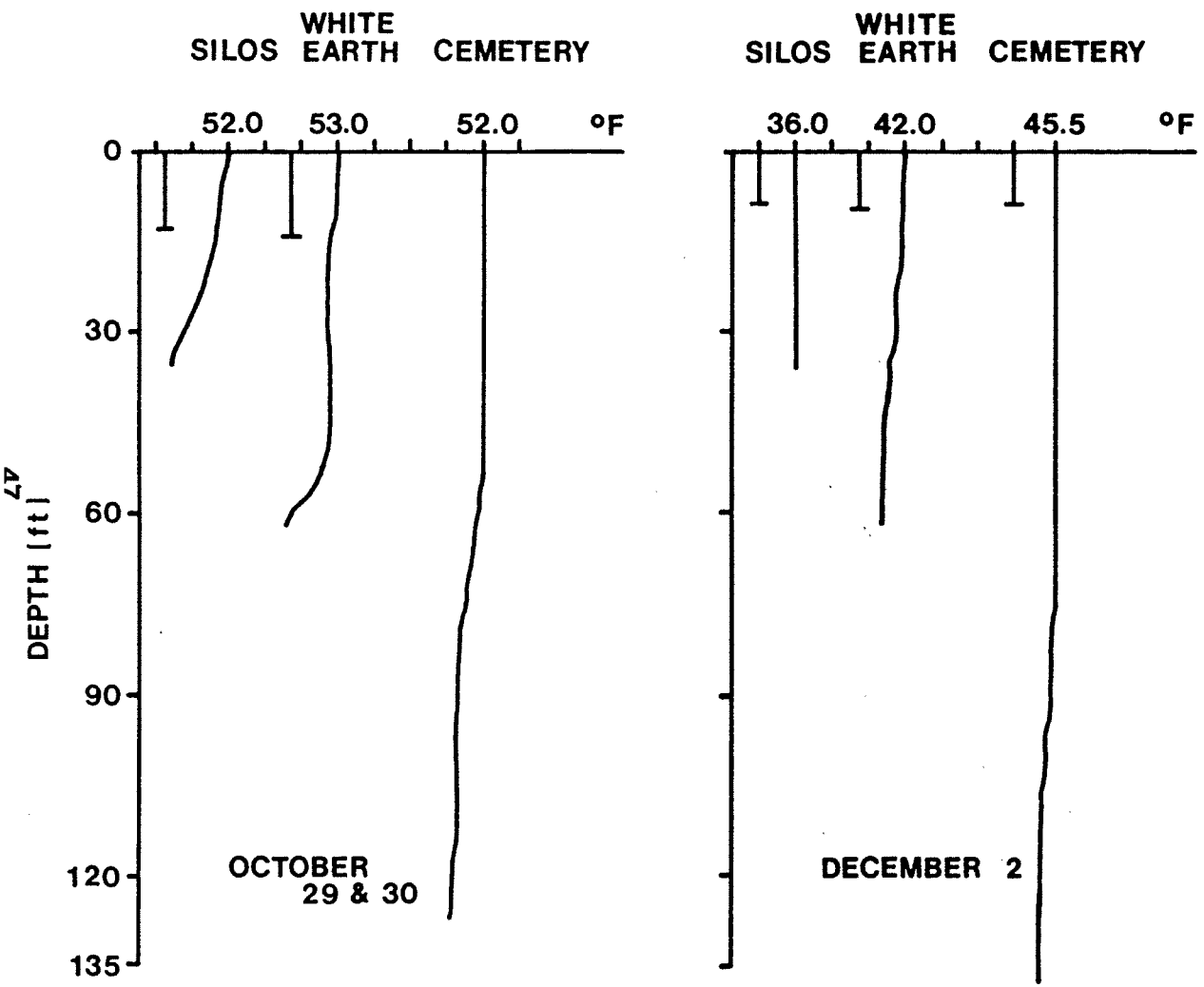
[1]RB=rainbow trout, LL=brown trout, KOK=kokanee, MWF=mountain whitefish, YP=yellow perch, WE=walleye, LnSu=longnose sucker, Wsu=white sucker, CP=carp, UC=utah chub, BB=burbot, SB=smallmouth buffalo.



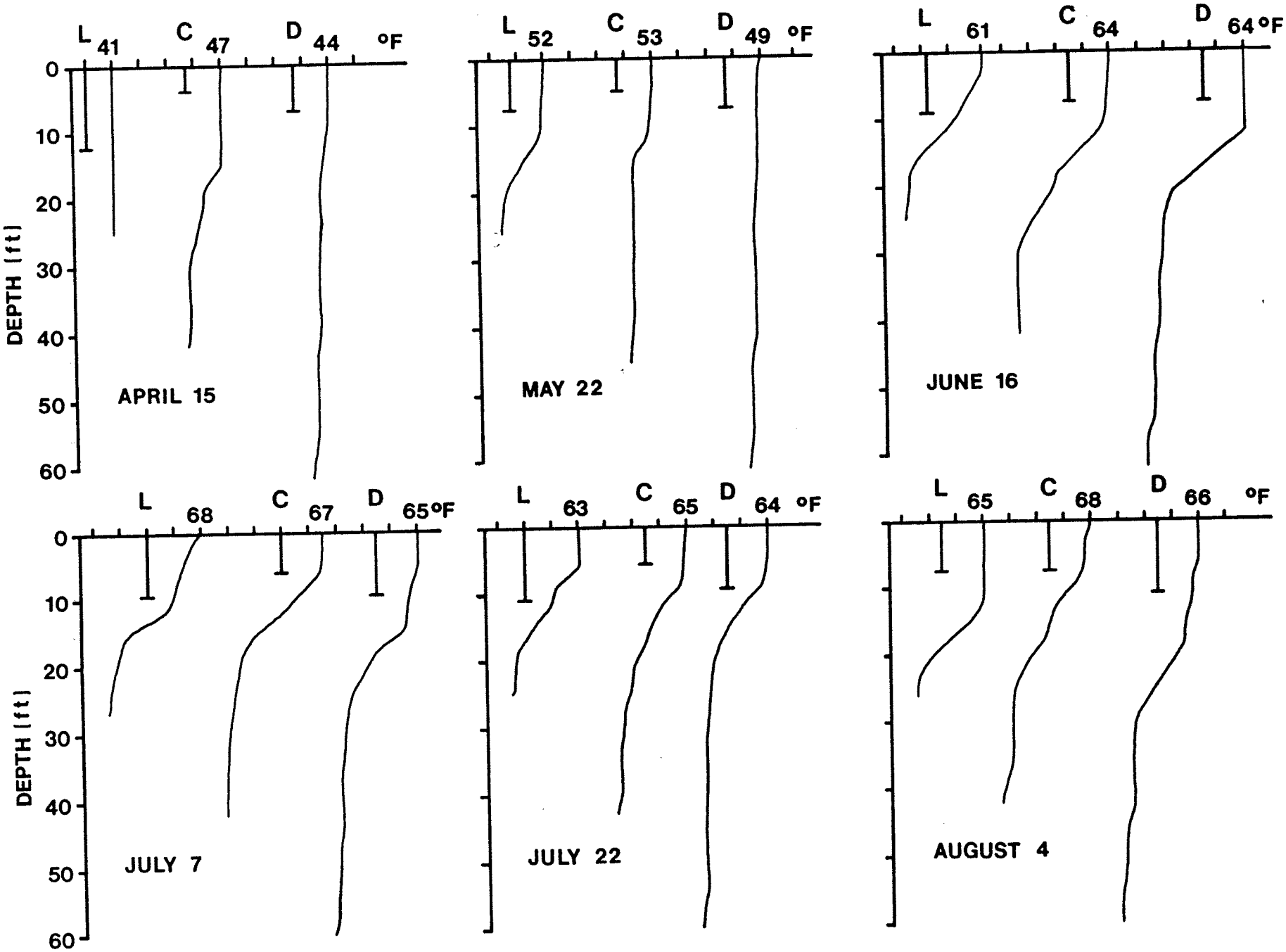
Appendix Figure 1. Profiles of water temperature monitored in Canyon Ferry Reservoir during 1987. (4 F demarcation on X axis).



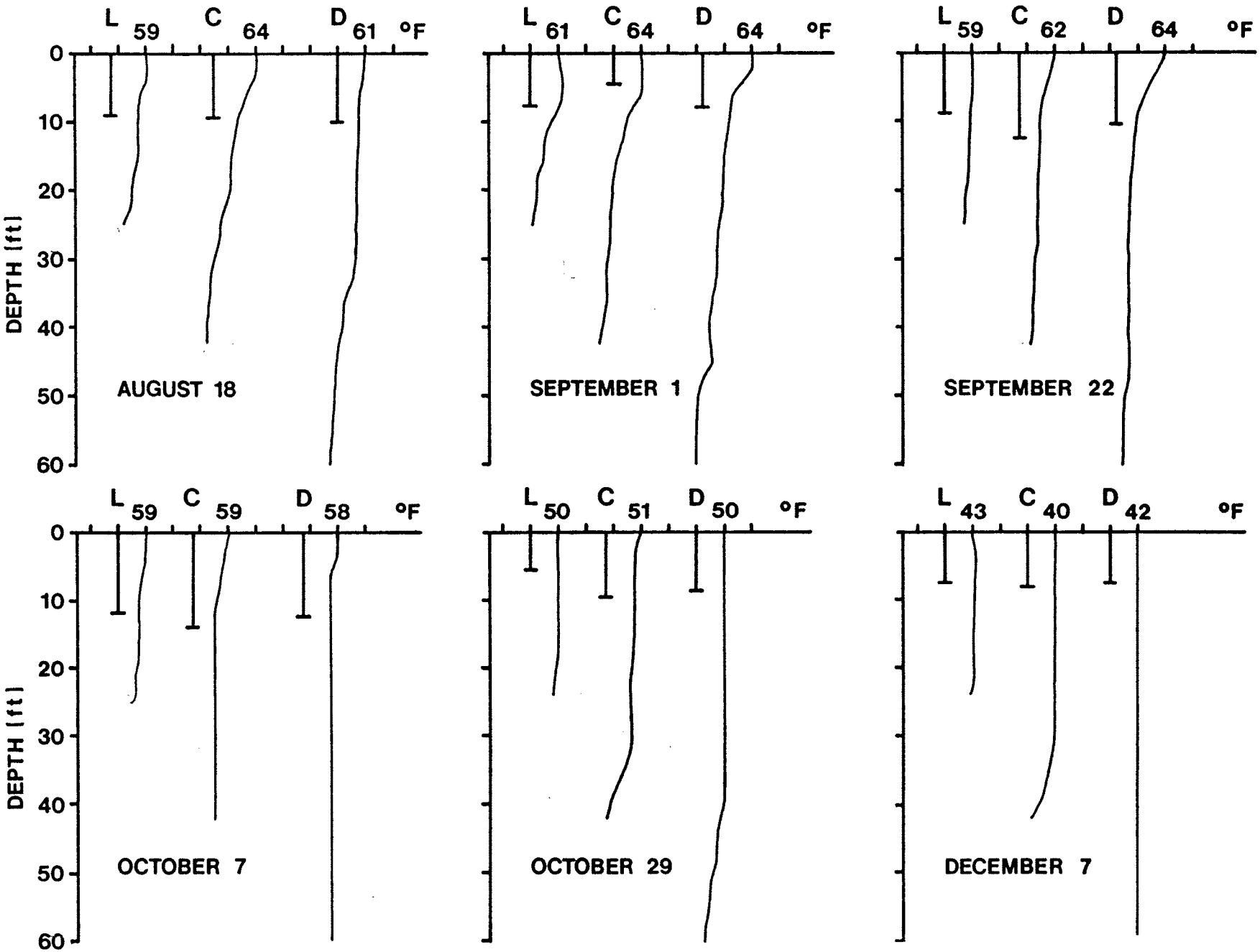
Appendix Figure 2. Profiles of water temperature monitored in Canyon Ferry Reservoir during 1987. (4 F demarcation on X axis).



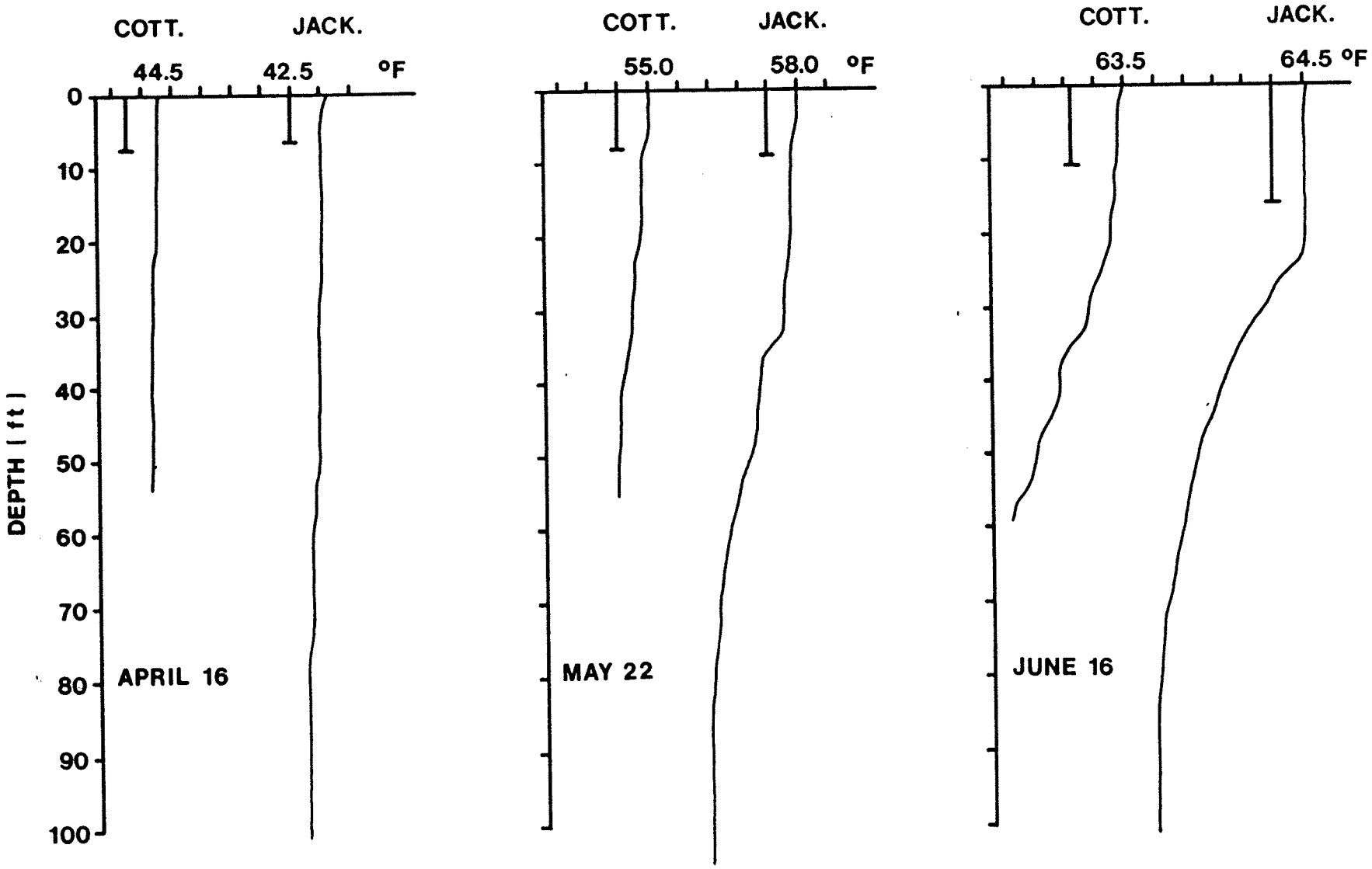
Appendix Figure 3. Profiles of water temperature monitored in Canyon Ferry Reservoir during 1987. (4 F demarcation on X axis).



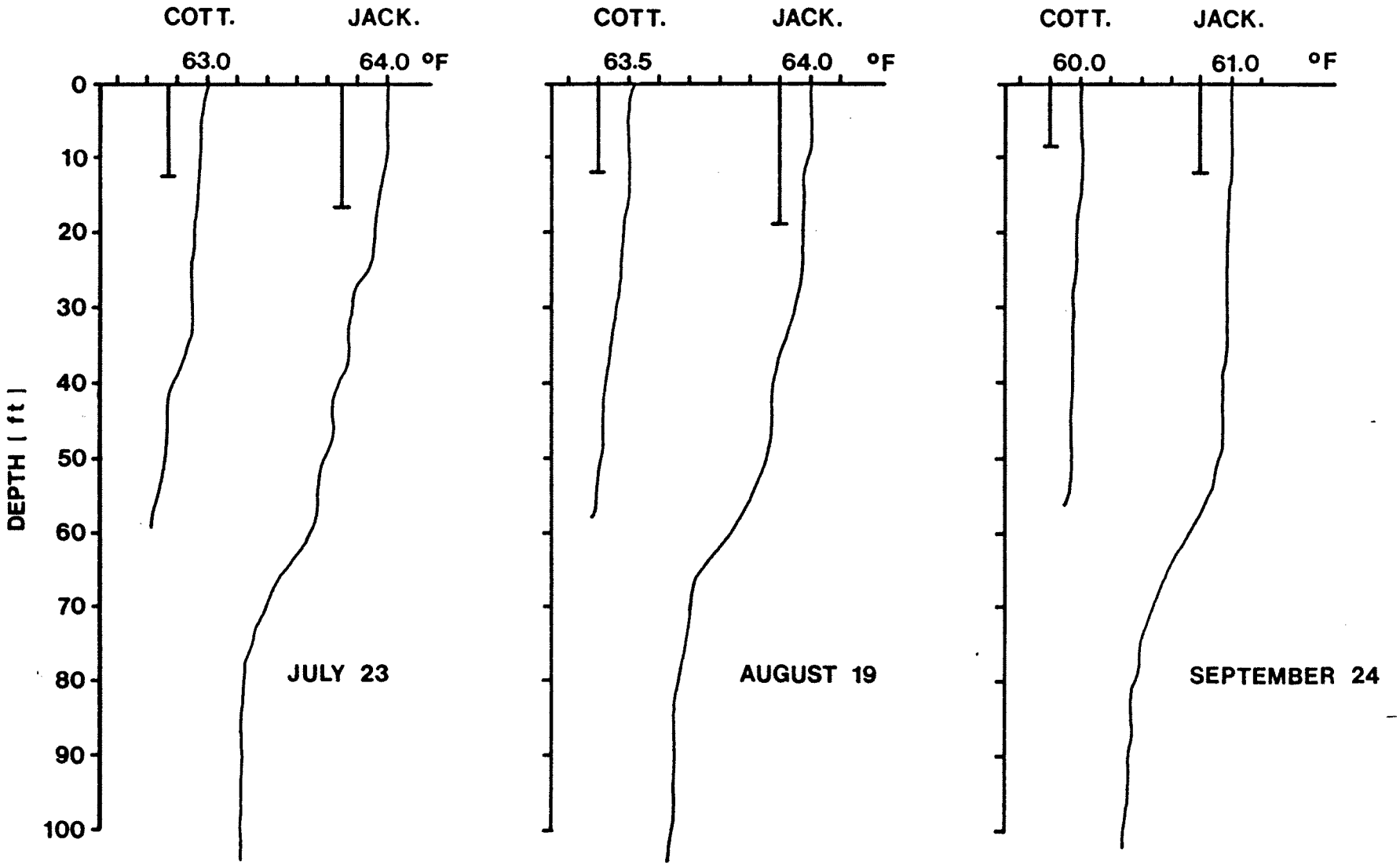
Appendix Figure 4. Profiles of water temperature monitored in Hauser Reservoir during 1987. L=Lakeside, C=Causeway, D=Dam. (4 F demarcation on X axis).



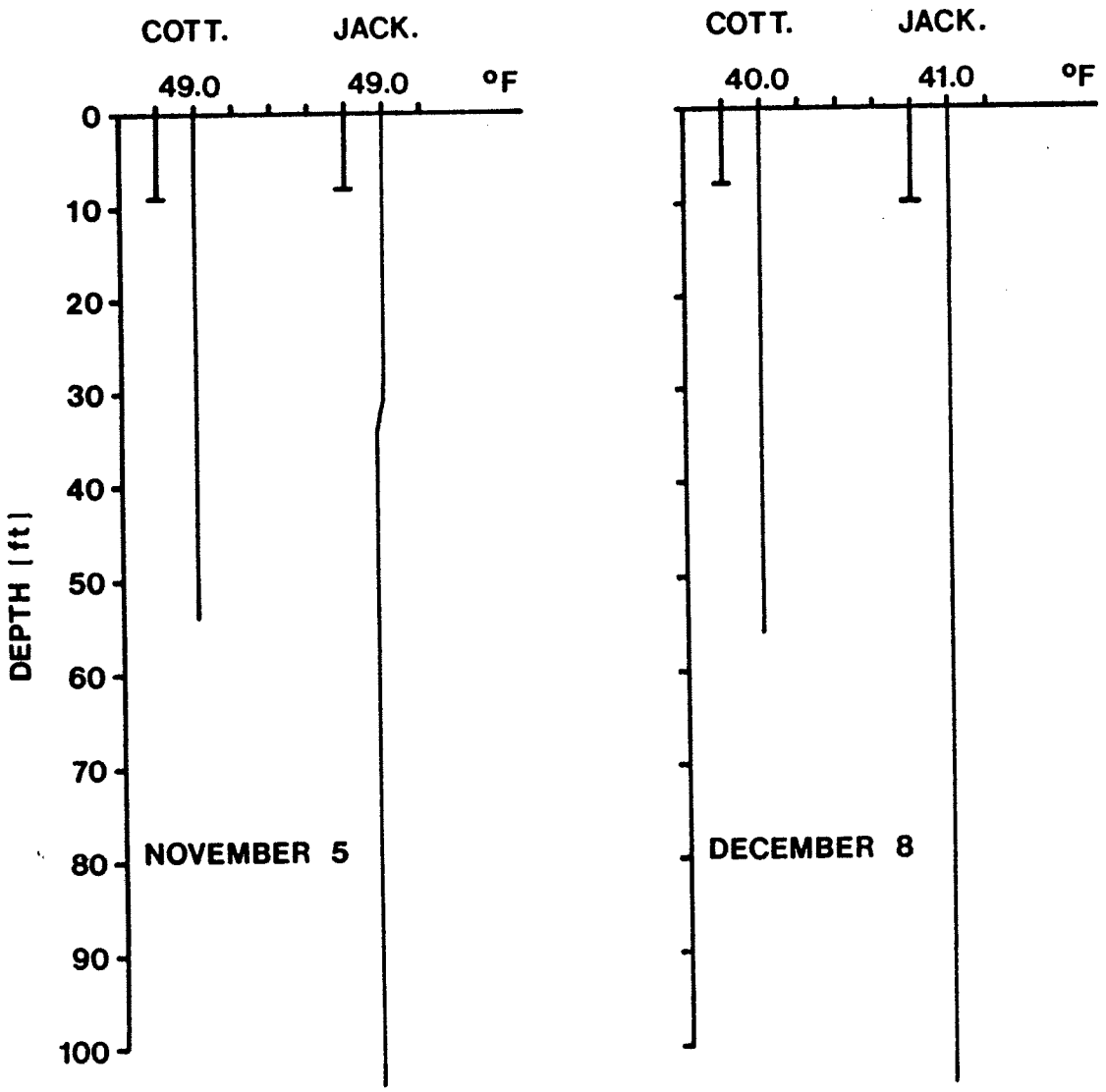
Appendix Figure 5. Profiles of water temperature monitored in Hauser Reservoir during 1987. L=Lakeside, C=Causeway, D=Dam. (4 F demarcation on X axis).



Appendix Figure 6 . Profiles of water temperature monitored in Holter Reservoir during 1987. Cottonwood and Jackson stations. (4 F demarcation on X axis).



Appendix Figure 7. Profiles of water temperature monitored in Holter Reservoir during 1987. Cottonwood and Jackson stations. (4 F demarcation on X axis).



Appendix Figure 8. Profiles of water temperature monitored in Holter Reservoir during 1987. Cottonwood and Jackson stations. (4 F demarcation on X axis).