

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Project Number: F-46-R-3  
Job Number: II-d

Project Title: Statewide Fisheries Investigations  
Study Title: Survey and Inventory of Cold Water Lakes  
Job Title: Southwest Montana Major Reservoirs Investigations  
Period Covered: July 1, 1989 through June 30, 1990.

JOB OBJECTIVES

Clark Canyon Reservoir

1. Maintain shoreline in a state of minimal development to satisfy access needs of recreationists and maintain shoreline integrity and water quality.

Discussed waste disposal and weed control programs with the U.S. Bureau of Reclamation.

2. Maintain wild brown trout populations at densities reflected by an average sample of  $\geq 2.0$  adult brown trout per surface 125 ft. gill net set.

Spring gill net sets were made to determine the relative densities of wild brown trout. Gill net data has yet to be analyzed.

3. Maintain successful stocking program of Arlee rainbow trout to attain densities reflected by an average spring sample of 4.0 per 125 ft. surface gill net set. Maintain growth rates that produce 15 inch rainbow trout at age I+.

Data has been collected, but will be included in a future report.

4. Establish the wild, spring spawning DeSmet strain of rainbow trout to augment the planting program of Arlee rainbow and provide a longer lived, reproducing segment to the rainbow fishery.

Data has been collected, but will be included in a later report.

5. Evaluate the comparative success of the DeSmet and Arlee strains of rainbow regarding catchability, longevity, survival, growth and recruitment to the Clark Canyon fishery.

Data has been collected, but will be included in a future report.

6. Maintain fishery for large (20-25 inch) wild burbot sustaining

a catch rate of 0.25 fish/hr.

No activity was scheduled for this objective until 1991.

#### Hebgen Reservoir

1. Maintain shoreline in a state of minimal development while providing sufficient access for anglers. Protect spawning streams from impacts of development.

Reviewed U.S. Forest Service timber management and grazing allotments plans in areas where there may be impacts on the lake shore and/or the spawning tributaries fisheries habitat and water quality.

2. Establish wild, self-sustaining rainbow populations at densities reflected in a sample of  $\geq 10$  adults per 125 foot surface gill net set in spring of year.

Data included in this report.

3. Maintain wild brown trout populations at densities reflected in a sample of  $\geq 18$  adults per 125 ft. bottom gill net set in spring of year. Maintain averages of 16 inches in creel with opportunity of catching large, trophy brown trout ( $\geq 3$  pounds).

Data included in this report.

4. Collect the information necessary to accurately assess fishing pressure, catch rates and harvest (State Project).

Data will be included in this report.

5. Provide rainbow to anglers without jeopardizing the establishment of self-sustaining populations.

Creel limits for the 1988-89 fishing season reduced the daily possession limits from 10 trout or 10 lbs. and one trout to a 5 trout limit. In addition an extended fishing closure was placed on all the spawning tributaries to protect the spawning rainbow trout.

#### Willow Creek Reservoir

1. Attempt to reduce magnitude of reservoir drawdown in fall of year.

Numerous visits with the dam operator were made to try to minimize fall drawdown.

2. Determine time of out-migration of rainbow trout fry from spawning streams (State Project).

A total of 2200 young rainbow trout were electrofished in Willow Creek during the fall of 1989 to determine quantity and timing of

fry movement out of the stream. Data has not been fully analyzed.

3. Maintain a spawning run of at least 2500 adult wild rainbow trout in Willow Creek as the state brood stock of DeSmet rainbow.

The 1990 spawning run of approximately 4200 DeSmet rainbow trout was observed with a total egg take of 1,300,000 for the state hatcheries.

#### Canyon Ferry Reservoir

1. Maintain densities of rainbow trout reflected in average samples of  $\geq 15$  yearling and older rainbow per 125 ft. surface gill net set in the spring.

Spring 1989 surface gill net sets were made with data to be reported in job IIf.

2. Identify spawning areas successfully used by trout in reservoir system tributaries (State Project).

Spring electrofishing was done in various spawning tributaries. Data to be reported at a later date.

3. Provide a consistent rainbow fishery with an annual average catch rate of  $\geq 0.3$  fish/hour.

Monthly creel census was conducted on the reservoir with results to be reported in job IIf.

4. Provide an average winter catch rate of at least 2.0 yellow perch per hour with an average size of 8.5 inches and an annual harvest of 300,000.

Data to be included in this report.

5. Minimize incidence, magnitude and duration of reservoir spill through radial gates at dam to minimize escapement of trout.

All rainbow trout stocked were either marked through fin clips or fluorescent dyed to determine the extent movement through reservoir spill.

#### PROCEDURES

Clark Canyon, Hebgen and Canyon Ferry Reservoirs were sampled with 125 foot surface and bottom set experimental gill nets to determine fish population trends. Spawning tributaries of the three reservoirs will be electrofished to determine use and year class strength of the wild trout strains. Recruitment will be monitored using fry traps.

Willow Creek Reservoir will be sampled via a spawning trap which will be maintained annually enabling the magnitude of the run to be determined. Eggs necessary to meet state requirements will be taken at this trap.

## FINDINGS

### HEBGEN LAKE

#### Rainbow Spawning Runs

Efforts were made during 1989 to document the timing, intensity and duration of rainbow trout spawning runs and fry recruitment from Hebgen Lake tributaries. There are ten tributaries to Hebgen Lake that have spawning potential (Figure 1). The Madison River and South Fork of the Madison are the largest, both entering from the south. Along the west shore, Cherry, Rumbaugh, Watkins and Trapper Creeks are smaller high gradient streams emerging from cold mountain snowmelt. Red Canyon Creek is the only north shore tributary, a small heavily sedimented stream subject to dewatering from irrigation in the lower reaches. Grayling Creek, Duck Creek and Cougar Creek are all intermediate-size streams entering from Yellowstone National Park on the east side of the lake. Additionally, Black Sand Spring Creek is an intermediate-size spring-fed stream which joins the South Fork of the Madison in its lower reaches.

Observation and electrofishing of all these streams has been conducted intermittently since 1982. Rainbow trout spawning runs have been documented in all but Cherry, Cougar and the mainstem Madison during that period. Cherry Creek has a large beaver dam blocking the mouth and probably does not sustain a spawning run. Cougar Creek and the mainstem Madison both sustained spawning runs of rainbow historically, and probably still do, but were not sampled extensively during this period. The other streams are summarized individually in order of their occurrence around the lake shore.

**Trapper Creek.** Over 30 fresh redds were observed there on May 15, 1987 and approximately 100 ripe rainbow spawners were electrofished from the creek on May 19, 1988. A fish trap was installed in 1989 and monitored intensively from June 1 - 9 but captured only 23 rainbow spawners and 10 cutthroat spawners. Apparently the peak of the run was missed but numbers of spawners were not observed to be large during 1989. It is suspected that cutthroat prefer this tributary, possibly because of its cold water temperatures.

**Watkins Creek.** Adult rainbow spawners were observed in Watkins Creek on June 19, 1986 (2 fish) and sampled on May 18, 1988 (40 fish). The latter sample contained both gravid females and ripe female spawners. On May 31, 1989 at least 30 pairs of lake spawners were observed working redds in the lower  $1\frac{1}{2}$  miles of Watkins Creek (below the road). Fish had negotiated a large beaver dam but may not have passed above the road culvert. The fish were not sampled.

**Rumbaugh Creek.** Fish were not observed spawning in Rumbaugh Creek prior to 1989. On May 23, 1989 about one dozen adult rainbow and 15-20 fresh redds were observed in the lower  $\frac{1}{4}$  mile of Rumbaugh Creek. Most of the

spawning activity took place in the stream channel that traversed the dewatered lake bed. Consequently, as lake levels rose, the redds were inundated and the eggs probably did not hatch. This may be a common problem in certain tributaries. Rumbaugh Creek is too small to support a significant spawning run.

**South Fork of the Madison.** Historically, the South Fork of the Madison River was the source for millions of rainbow and brown trout eggs collected from a spawning trap near the mouth between 1935 and 1964. Observations and electrofishing from 1985-89 failed to disclose any significant numbers of spawning rainbow. It is a cold, clear-flowing tributary with excellent spawning gravels and must be more thoroughly investigated as a potential spawning stream for rainbow trout.

**Black Sand Spring Creek.** This stream is a short (approx. 3/4 mile) natural free-flowing spring creek that enters as a tributary to the South Fork of the Madison about 6 miles upstream from Hebgen Lake. It has a stable base flow of about 20 cfs and high water quality. Beaver dams on the lower end of the stream where it enters the South Fork may act as occasional barriers to upstream migration. On May 26, 1982 the stream was electrofished and 46 rainbow spawners from Hebgen Lake were captured. Since that sample, only occasional observations of spawning fish have been made, generally between mid-May and mid-June. This stream, like the South Fork itself, needs further study.

**Duck Creek.** This stream was also trapped as an egg source for both brown and rainbow trout over a 30 year period between 1935 and 1964. The stream is only a few miles long from the confluence of its several tributaries in Yellowstone Park to its union with Cougar Creek at the edge of Hebgen Lake. An on-stream dam about 1 1/2 miles upstream from its mouth has been a partial fish barrier in recent years but a fish ladder was reconstructed there in the summer of 1989. The dam impounds about 1/4 mile of the stream.

On June 5, 1989 we observed 10-15 adult rainbow and over 20 redds in the creek channel upstream from the pond. Other rainbow were spawning below the dam. This stream appears to support a substantial spawning run.

**Grayling Creek.** Rainbow and cutthroat spawning runs have been observed in Grayling Creek annually since 1985. Observations from electrofishing in 1986 found rainbow were mostly ripe on May 23 and spawned out by June 18. This is in line with observations in other years.

There is a major canyon in Grayling Creek about 3 miles upstream from the mouth that may be impassible to upstream migrants at certain flows. However, on June 5, 1989 at least ten Hebgen Lake rainbow spawners were observed on redds upstream from that point, as far upstream as the Yellowstone Park boundary 5 miles above the mouth. Grayling Creek may be a major spawning stream for rainbow trout.

**Red Canyon Creek.** Spawning fish from Hebgen Lake were observed in this stream in 1986, 1987 and 1988. The stream was favored by McBride cutthroat trout which spawned later than the rainbow, generally in late June.

A sample of 25 juvenile cutthroat electrofished from this stream on August 11, 1989 at a site in the upper drainage (4 miles above the mouth) were examined electrophoretically. Results found they were hybrids containing genes from westslope cutthroat, Yellowstone cutthroat and rainbow trout, in that order. The lower end of this stream is dewatered in most years during the summer and migrant spawners from the lake may be trapped before they can emigrate.

### **Rainbow Trout - Fry Emergence & Emigration**

Observations and/or fry trapping were conducted on a weekly basis beginning July 13, 1989. Fry were either observed or suspected to be present in Black Sand Spring, South Fork of the Madison, mainstem Madison, Cougar and Duck creeks on July 13 (Figure 2). Fry were first sampled in Watkins and Grayling creeks two weeks later (July 27) and in Trapper Creek not until three weeks later (August 4). These later emergence times coincide with colder temperature regimes in those streams.

Fry were first observed when they were about 21 mm. in length and at that size carried large yolk sacs indicating emergence from the gravel had only recently occurred. As fry grew, the yolk sacs were absorbed and were generally absent by the time the fry reached about 23 mm. total length; usually within one week. Growth rates of fry could be observed from consecutive weekly samples (Figure 2).

Number of fry captured in traps ranged from 0 to 679. Traps sampled from 10-80% of the streams volume of flow depending on placement and stream size. Generally, largest numbers of fry were captured when they were 23-26 mm. long with yolk sacs fully absorbed. These fish were probably about two weeks post-emergence, and in Trapper, Duck and Grayling Creeks appeared to be emigrating downstream in large numbers. An example is the July 20 trap catch on Duck Creek where 276 fry were captured in a single night in a trap set that only sampled about 10% of the streamflow.

Backpack electrofishing surveys of major tributary streams were conducted October 16-17, 1989. By this time, rainbow fry were highly mobile and difficult to capture by dipnet or trapping. All streams sampled (with the exception of Cherry Creek) contained some rainbow fry. Average length ranged from 1.4 inches in Trapper Creek, the coldest tributary, to 2.6 inches in Duck Creek (Figure 2). Rainbow were several times as abundant as brown trout in Grayling, Duck, South Fork, Rumbaugh and Watkins Creeks. Trapper Creek did not contain any brown trout. In Black Sand Spring, we captured 42 brown trout and only 10 rainbow.

It appears that while significant downstream emigration of rainbow fry occurs shortly after hatching there are at least some fish which rear in the stream through the summer. Whether or not these fish eventually migrate to the lake is not known.

### **Tributary Monitoring Summary**

In summary, nearly all tributaries to Hebgen Lake appear to be supporting

some spawning activity from rainbow trout out of Hebgen Lake. The tributaries that have potential to support major runs and which should be closely evaluated are the mainstem Madison River, South Fork of the Madison River, Black Sand Spring Creek, Grayling Creek and Duck Creek.

Water temperatures may play a key role in determining which tributaries support spawning runs and the timing of such runs. Generally, the west shore tributaries all drain snowmelt and emerge from deeply shaded canyons resulting in very cold water temperatures (Figure 1). The Madison River is at the opposite end of the spectrum with the thermal inflow from its tributaries in the park ( e.g. Firehole River) resulting in very warm temperatures. Duck and Cougar Creeks are also warmer than average due to the open floodplain they flow across. Grayling Creek and Red Canyon Creek are relatively cold.

An example of this extreme variation is shown by a series of water temperatures taken off the main road crossings on June 9, 1989. The water temperatures were taken between 6:10 and 7:20 p.m. on an overcast day when the maximum air temperatures were around 71°F. Instantaneous water temperatures at each site in ascending order were Trapper Creek 44°F, Watkins Creek 46°F, Cherry Creek 46.5°F, Rumbaugh Creek 47°F, Red Canyon 48°F, Grayling Creek 52°F, South Fork Madison 53 °F, Cougar Creek 55°F, Duck Creek 62°F and mainstem Madison 66°F. This 22°F range between the warmest and coldest tributaries is probably typical and would account for a tremendous variability in fry hatching dates, growth rates, and fry survival in these streams. Improved thermal monitoring is crucial to understanding the importance of thermal conditions as they relate to fry development, emergence, and emigration to the lake.

Fry trapping will prove effective in estimating the total contribution of recruitment to Hebgen Lake from its tributary streams. Rainbow trout eggs hatch after accumulating about 624 temperature units in 45°F water. Thus direct observations of spawning runs coupled with emergence dates and daily temperature information will allow us to accurately assess the relative importance of the Hebgen Lake tributaries to the recruitment of fish into the reservoir.

#### Hebgen Lake Gillnet and Electrofishing

Standardized gill net surveys in the spring and fall of 1989 were supplemented with fish samples collected by night electrofishing. Electrofishing was relatively unsuccessful in June but proved highly effective in October. Electrofishing results complemented the net surveys very well, resulting in a much more complete length frequency for both brown and rainbow trout (Figures 3 & 4). Electrofishing results were especially invaluable in providing samples of fish under twelve inches.

Fish planted in 1989 (approximately 300,000 2.5 inch DeSmet rainbow) were all marked with tetracycline in order to facilitate recognition of hatchery fish in the samples. The combination of stocking of marked fish and the recapture of small fish by electrofishing allowed evaluation of the hatchery contribution to the juvenile population.

The complete sample of 301 rainbow trout were aged and classified as

either hatchery or wild based on scale characteristics. Hatchery fish showed a strong "stocking check" on the scales, generally about 8 circuli out from the focus. On wild fish, there were usually about 15 circuli out from the focus to the first annulus and a clearly defined zone of compaction was located in the area of the first annulus. The degree of confidence in the judgement of hatchery vs. wild characteristics became lower as the fish became larger.

Overall, 209 of the 301 rainbow sampled (69%) were believed to be hatchery fish (Figure 5). Age classes from 0 to 5 were represented with the average length for each shown below (Table 1). The remaining 92 fish (31% of the sample) were judged to be wild rainbow (Figure 6). Growth rates of the wild fish are slower initially but they appear to catch up to their hatchery counterparts over time (Table 1).

TABLE 1: Average length (inches) at age for wild and hatchery rainbow trout taken from Hebgen Lake in October 1989.

	AGE					
	0	1	2	3	4	5
Hatchery	3.8	9.2	14.8	16.9	17.5	18.6
Wild	No Sample	6.4	13.0	15.8	17.7	19.0

The development of a wild rainbow trout fishery in Hebgen Lake appears to be progressing well. The number of age 1 wild fish in the sample was 37 as compared to 60 hatchery fish the same age. As the number of adult spawners stabilizes over the next few years consistent wild year classes should be produced. The number of wild fish should soon exceed the number of hatchery fish and when that point is reached stocking of the reservoir may be reduced or eliminated.

It is apparent that stocked age 0 DeSmet rainbow have an initial size advantage over wild fish. During mid-October, the DeSmet fish averaged 3.8 inches long whereas their wild counterparts sampled from the stream system (and not yet detected in the lake) averaged only about 2.0 inches. It remains to be determined whether or not size confers a survival advantage in the lake.

The 1989 fall gill net series consisting of 16 floating net sets at standardized sites captured 134 rainbow, 60 brown trout, 3 cutthroat, 10 mountain whitefish and 317 Utah chubs. Numbers of game fish were very similar to 1988 samples but chub populations have decreased markedly from an average of 109 per net in 1988 to 20 per net in 1989. A large die-off of adult chubs occurred in early summer 1989 and may be responsible for the observed decrease. The indirect cause of the die-off was believed



to be spawning-related stress but no direct cause was determined. Juvenile chubs too small to be gill netted were abundant during fall 1989 electrofishing, so numbers are expected to rebound.

Brown Trout. Brown trout numbers during 1989 remained stable. Electrofishing samples during the fall were used to complement the gill net catch, resulting in a more comprehensive analysis of age and growth. Average length at age from October 1989 samples was 7.6, 12.7, 15.3, 16.8, and 18.9 inches for ages one through 5 and older, respectively. These values are slightly lower than for wild rainbow which averaged 17.7 inches at age 4. Some very large brown trout still exist in Hebgen Lake. One captured by electrofishing was 31.5 inches long with an estimated weight of 15 pounds.

Brown trout appear to have more variable growth patterns than rainbow, probably as a result of a tendency to spend anywhere from 0-2 years in a tributary stream prior to emigrating out into the lake. A large concentration of juvenile brown trout was found in the South Fork Arm of the lake during electrofishing surveys. Brown trout juveniles there outnumbered rainbow juveniles by 7:1, whereas in other areas of the lake rainbow predominated. The South Fork was used extensively as an egg taking station for brown trout in the middle of this century. Brown trout juveniles are abundant throughout the South Fork and Black Sand Spring. All of these factors point toward the South Fork as the primary recruitment source of Hebgen Lake brown trout.

On November 1 & 14, 1989 a visual survey of brown trout spawning activity was conducted on the South Fork and Black Sand Spring. On November 1, there were about 45 redds and approximately 60 adult brown trout from 14-20 inches long observed spawning in Black Sand Spring. Additionally, as many as 500 adult brown trout spawners were observed in  $\frac{1}{2}$  mile of the South Fork directly upstream from the mouth of Black Sand. These fish were congregated in holes and appeared to be in a pre-spawn condition. Only a few redds were evident.

On November 14, 1989 it was apparent that the run had intensified and spawning was in full progress. Well over 100 adult fish were observed in Black Sand Spring and the number of redds was several times higher than the previous count. In the South Fork, brown trout were more dispersed than previously with most fish paired up on redds rather than gathered in holes as before. Spawning appeared to be near the peak. Two large beaver dams were identified just upstream from Mosquito Gulch, which appeared to block progress for migrant spawners. About 50 fish were gathered and spawning immediately below that point and only one adult brown trout was observed upstream. Steps should be taken to remove these barriers seasonally in future years to allow passage.

Prepared by: Dick Oswald, Wade Fredenberg and Dick Vincent.

Date: August 22, 1990

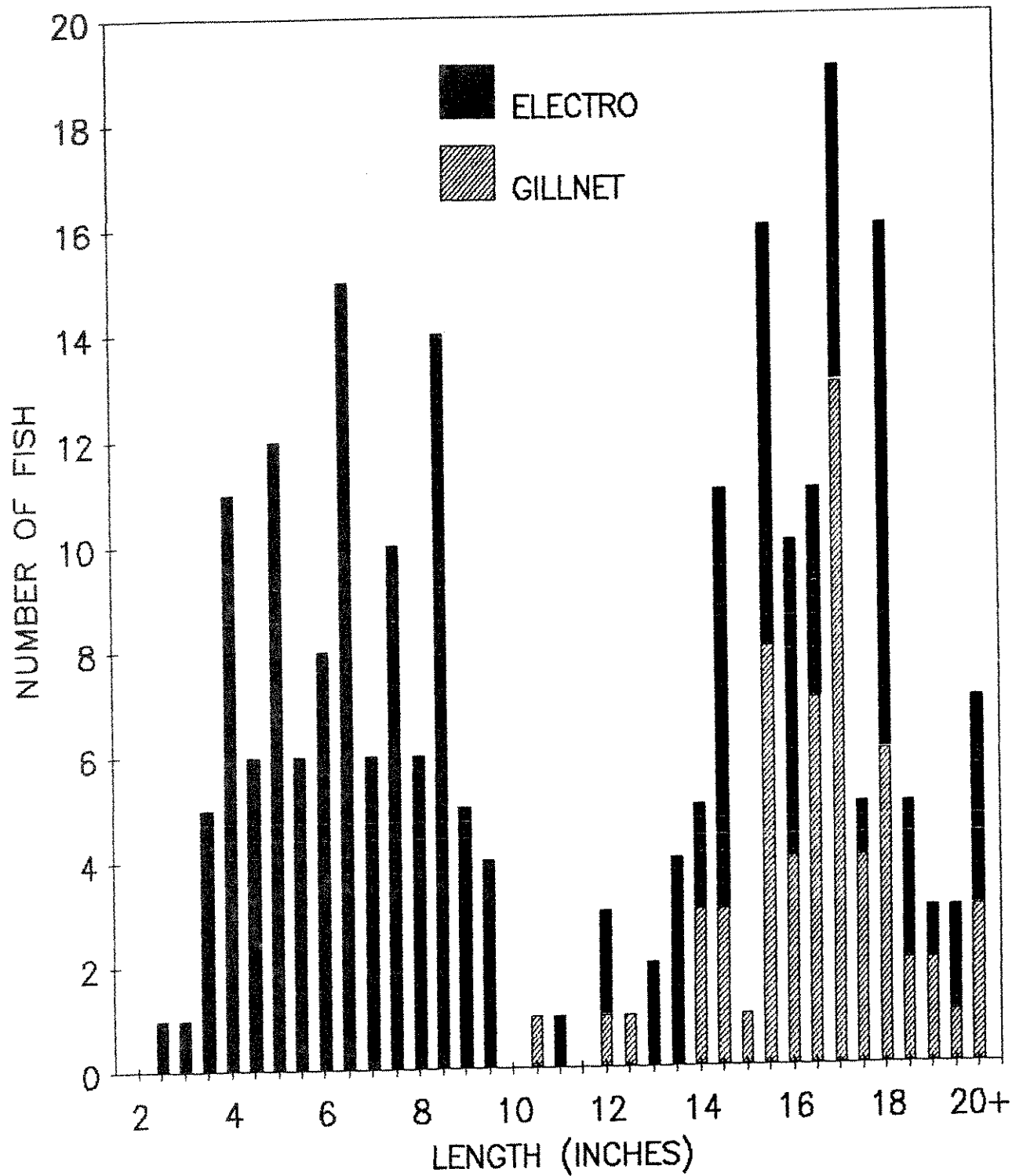


Figure 3. Combined October 1989 brown trout length frequency from Hebgen Lake, including electrofishing (solid) and gillnet (barred) samples.

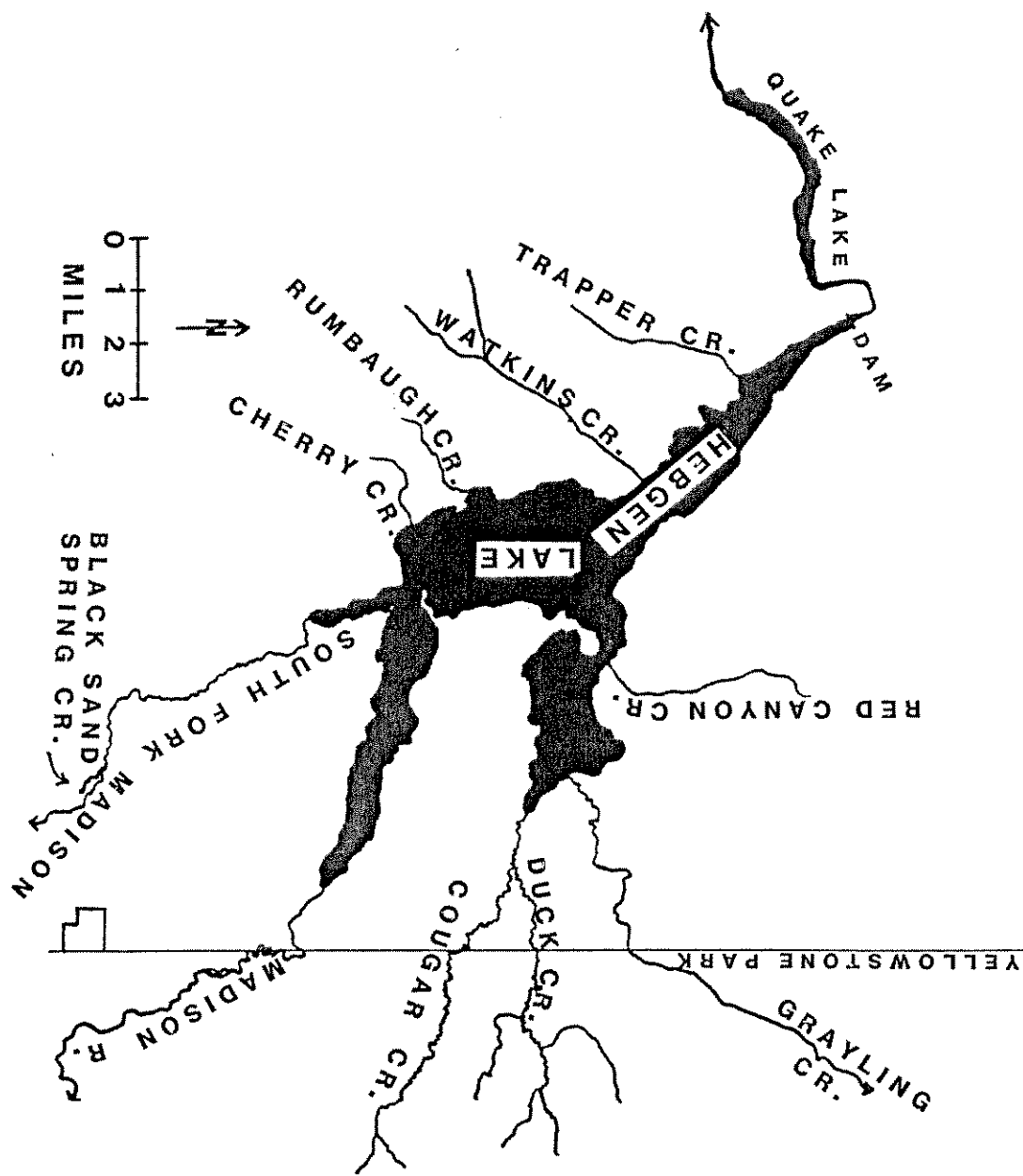


Figure 1. Map of Hebgen Lake and its main tributaries.



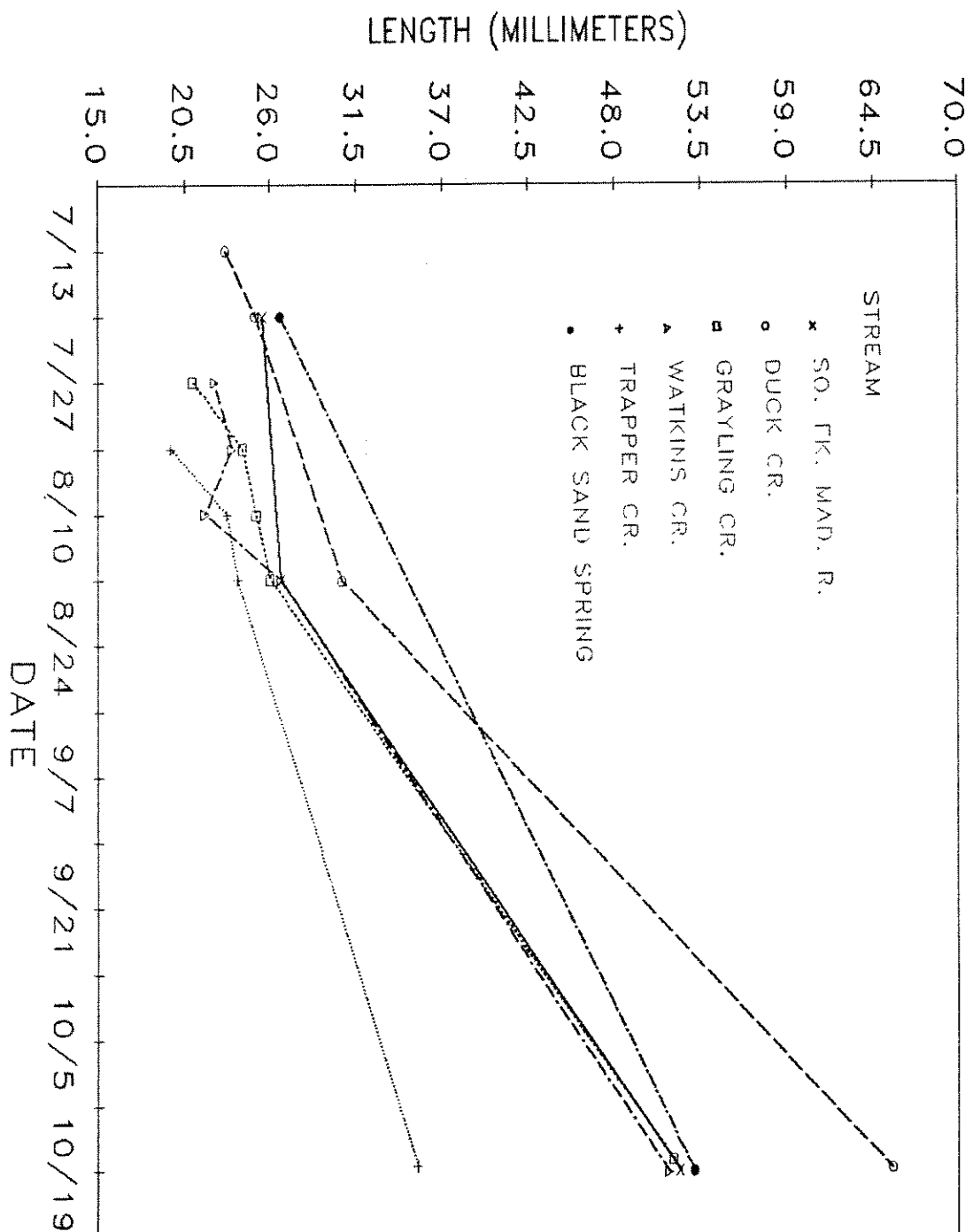


Figure 2. Growth parameters of rainbow trout fry collected from selected Heben Lake tributaries during summer and fall 1989.



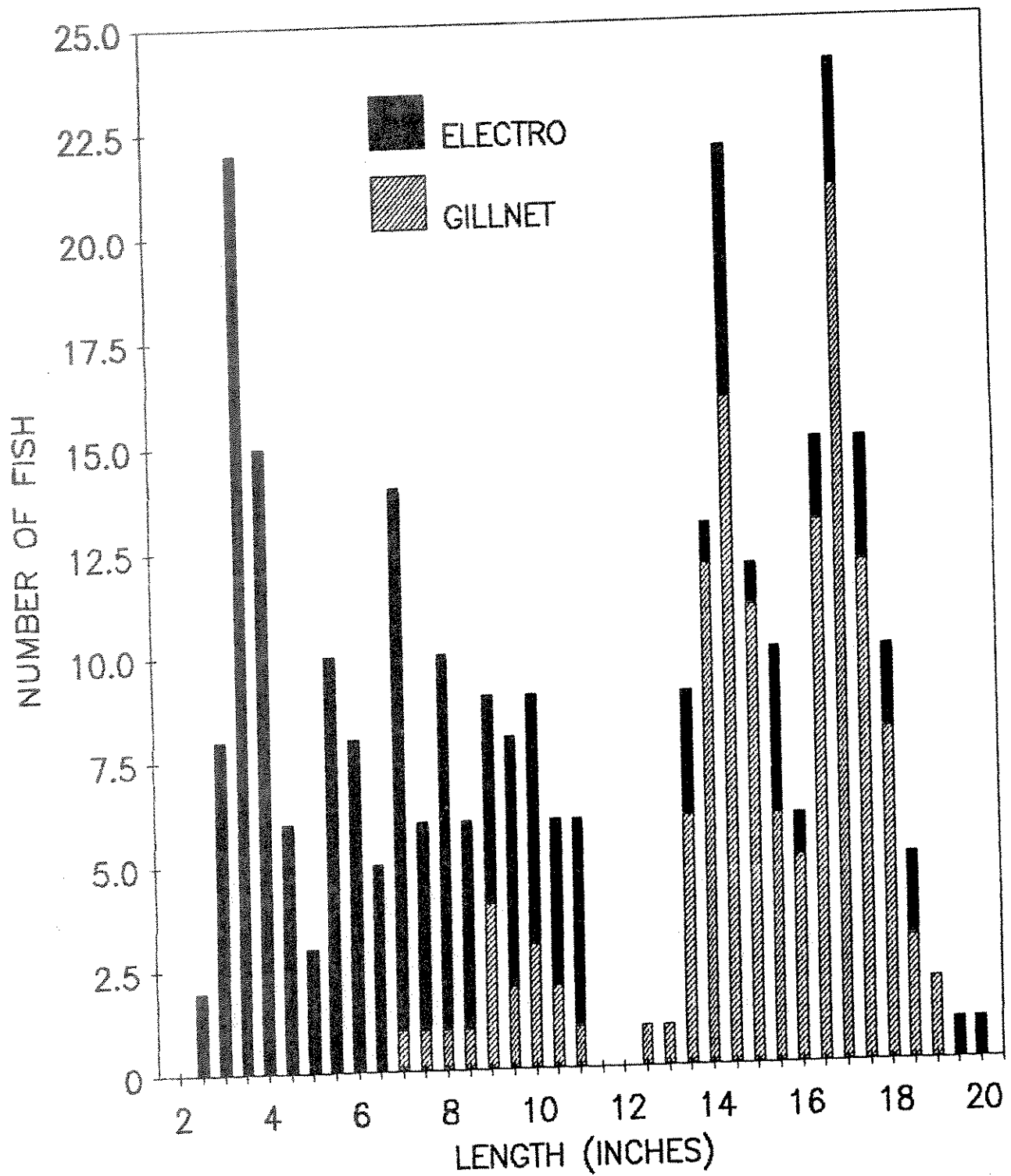


Figure 4. Combined October 1989 rainbow trout length frequency from Hebgen Lake; including electrofishing (solid) and gillnet (barred) samples.

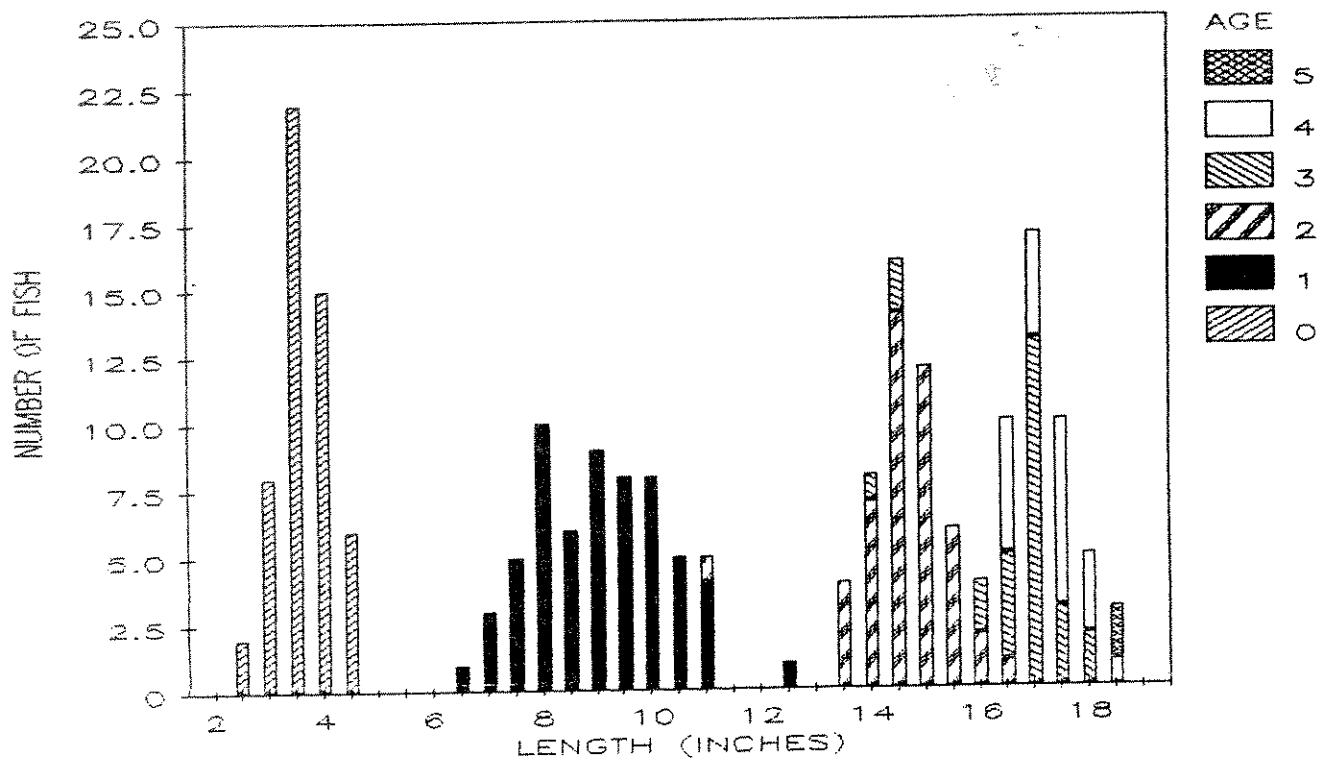


Figure 5. Length frequency of hatchery rainbow trout (by age group) sampled from Hebgen Lake during October, 1989.

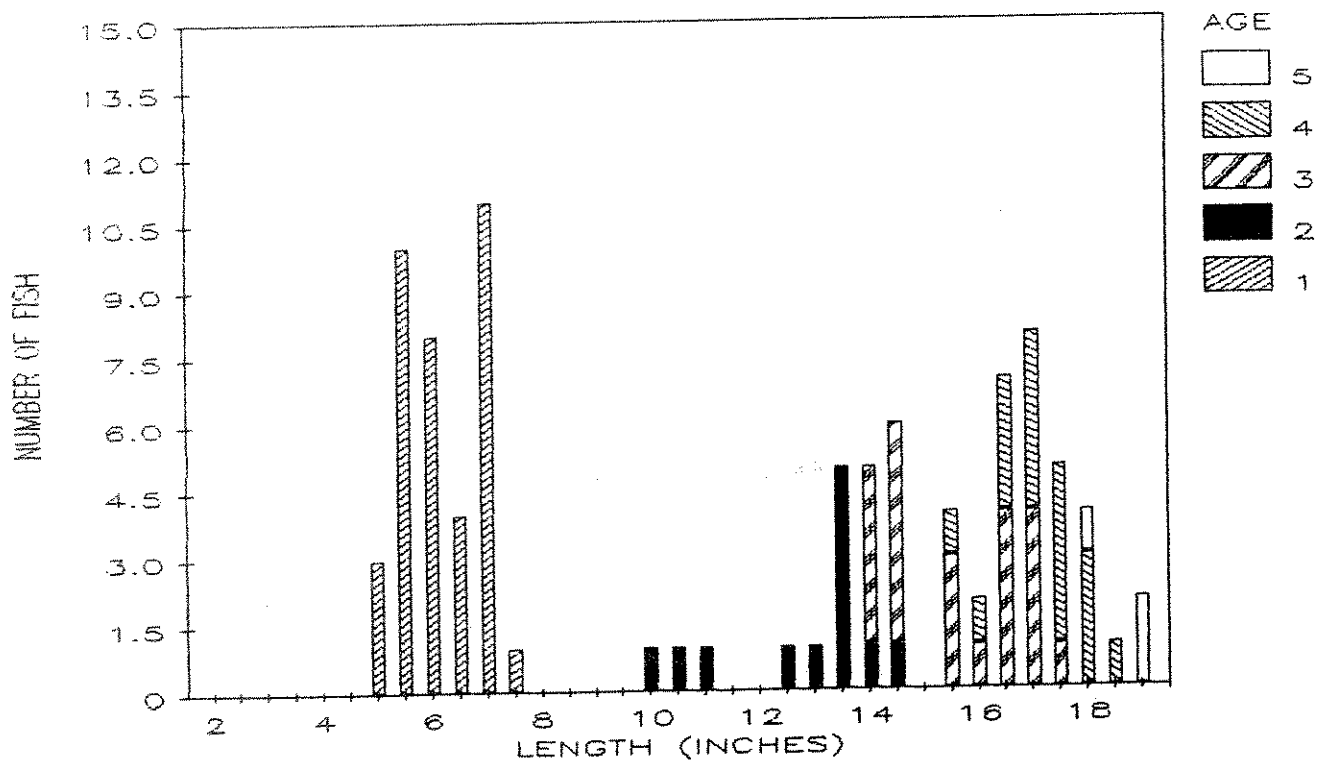


Figure 6. Length frequency of wild rainbow trout (by age group) sampled from Hebgen Lake during October, 1989.