MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA

PROJECT TITLE: STATEWIDE FISHERIES INVESTIGATIONS

PROJECT NO.: F-46-R-4

STUDY TITLE: SURVEY AND INVENTORY OF COLDWATER AND WARMWATER ECOSYSTEMS

JOB NO.: V-a

JOB TITLE: FLATHEAD LAKE-RIVER SYSTEM STUDY

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

ABSTRACT

The fisheries of the Upper Flathead River and Lake System is being guided and implemented by a five-year co-management plan agreed upon by the Department and the Confederated Salish and Kootenai Tribe. Mitigation plans for losses in fish populations affected by the construction and operation of Hungry Horse and Kerr dams are presently being negotiated. Project reviews, on-site inspections, and recommendations were made on 4 lakeshore and 97 river or stream habitat alteration projects to minimize impacts upon aquatic habitat in Flathead Lake and River system. Summer anglers prefer to fish for lake trout and lake whitefish. Ninety percent of interviewed anglers supported the use of hatchery fish and 66 percent were willing to pay more on their monthly electric bill to assist recovery of fish losses caused by hydropower projects. A total of 278 fish tagged by anglers have been recaptured including 149 lake trout (13.1 percent return rate), 90 cutthroat trout (13.5 percent), 23 bull trout (14.1 percent) and 3 rainbow trout (10.0 percent). The catch rate for lake trout was 1.2 fish/hour for guided and non-guided anglers. Sales of commercial lake whitefish totalled 495 fish or 918 pounds. Lake trout in the Flathead River drainage have recently increased their range both above and below the lake. A fall acoustic survey conducted during August, 1990 estimated 18.53 million fish (185.34 fish/acre). The 1990 estimate was 2.3 million fish less than that estimated in 1989. Highest densities occurred in the open mid lake area. The predominant fish in the open water areas were lake whitefish (73.1 percent) and lake trout (15.3 percent). Of the 2.25 million kokanee fingerlings released in the lake in 1991, 0.4 million were reared in pens, the rest reared at state hatcheries. Fingerling kokanee were released offshore at four southern locations. Low densities

of kokanee did not provide a summer sport fishery and we could not make an acoustic estimate.The September, 1990 lakewide average Mysis density was 37 /m^2. The 1990 index count of 305 bull trout redds was lower than the norm because of below average counts in the Middle Fork drainage. Low stream flows and barriers were partial explanations for lower redd counts. Fine sediment (< 6.35 mm)decreased in several spawning streams, potentially increasing trout embryo survival.

BACKGROUND

The Flathead Lake/River system located in northwest Montana consists of Flathead Lake, the main Flathead River above Kerr Dam, that portion of the South Fork Flathead River below Hungry Horse Dam, the Swan River below Bigfork Dam, the Whitefish River below Whitefish Lake, and the North and Middle Forks of the Flathead River and their major tributaries as used for spawning and rearing. The system needs to be managed as one ecosystem due to the adfluvial nature of several of the major gamefish species in the system. These adfluvial fish also interact with lake and river resident stocks, further underscoring the interdependency of the lake and river fisheries.

The major sportfish species in the lake include westslope cutthroat trout (Oncorhynchus clarki), bull trout (Salvelinus confluentus), lake trout (Salvelinus namaycush), lake whitefish (Coregonus clupeaformis) and yellow perch (Perca flavescens). The major sportfish in the river are westslope cutthroat trout, bull trout, and mountain whitefish (Prosopium williamsoni). Scattered populations of largemouth bass (Micropterus salmoides) and northern pike (Esox lucius) occur in old oxbows of the river.

Flathead Lake

Flathead Lake, measuring 125,000 surface acres, is currently one of the most heavily fished water in Montana. The lake supports about 75,000 angler-days per year for trout and perch.

Kokanee (Oncorhynchus nerka) were once the predominant gamefish in the lake and abundant seasonally in the river but have declined dramatically in numbers in recent years due to a combination of hydropower impacts, predation, angling harvest and impacts from Mysis.

Flathead River

Flathead River and its forks support one of the most extensive adfluvial fishery in Montana. Westslope cutthroat and bull trout migrate as much as 140 miles to spawn in their natal stream.

10. Provide public access to popular use areas and develop more low water boat ramps. The review and implementation of development projects at existing sites and identification of sites needed for future acquisition. Objective accomplished with state funding.

River Objectives

1. Maintain, within legal limits, instream flows sufficient to maintain or enhance existing fish populations. Objective accomplished as described in the mitigation plan for operation of Hungry Horse is being considered by the Northwest Power Planning Council. Accomplished with state funds.

2. Maintain spawning and incubations flow discharges from Hungry Horse Dam as calculated by Special Projects studies. Objective accomplished.

3. Maintain streambanks and channels in present or improved condition. Objective accomplished through the annual monitoring of streams and through the cooperative participation and review with appropriate agencies to enforce stream bed protection laws. Utilized state funds.

4. Maintain water quality at or above present levels as measure by WQB and U. S. Geological Survey (USGS). Objective accomplished.

5. Maintain fish habitat at or above present levels. Objective accomplished through the annual monitoring of spawning habitat in the main Flathead, North and Middle Fork Flathead Rivers.

6. Maintain fish populations that will provide use and harvest at present levels. Objective accomplished through the monitoring of cutthroat and bull trout populations in the North and Middle Fork tributaries.

7. Provide river access sites 4-6 hours (floating time) apart. Secure public access on currently used private ground. Objective accomplished through review of access plans in coordination with the USFS. State funded.

8. Increase public awareness of the unique nature and problems of the adfluvial fisheries. Objective accomplished through public meetings and in review of the Upper Flathead System Fisheries Management Plan.

9. Increase compliance with existing angling regulations. Objective accomplished using state funds through education at public meetings and through coordinated effort of the enforcement division.

PROCEDURES

Flathead Lake Seasonal Fishery Monitoring

Flathead Lake seasonal fishing patterns were monitored by conducting periodic angler interviews. Volunteer information was also obtained from interested anglers, professional guides and from anglers returning fish tags. Information obtained included angler effort, success and methods by season.

In keeping with the Upper Flathead System Fisheries Management Plan, 1989-1994, the CS&KT provided assistance with personnel and equipment to collect, record and analyze fisheries information on the South half of the lake. Portions of the data presented here was provided by CS&KT biologists.

Flathead Lake Bioeconomic and Angler Creel Survey

We cooperated with the State Department of Justice, Attorney General's Office, to collect angler interview information to identify the extent and value of the recreational fishery of Flathead Lake. Data gathered were to be used in the suit between the Confederated Salish and Kootenai Tribe (CS&KT) and the State of Montana over management jurisdiction of fisheries within the southern portion of the lake within the exterior boundaries of the reservation.

Data was collected from individual anglers from July 31 to September 3, 1991 by a survey clerk and one volunteer. The interview questionnaire was developed by ECO Northwest (Eugene, OR) and included 37 questions on demographics, fishing success, and expenditures related to fishing.

The study design was similar to that developed by Hanzel (1985). The lake was divided into 5 areas with sampling stratified relative to fishing pressure. The lake was periodically surveyed aerially to determine shifts in angling pressure patterns. Most information was gathered by a clerk using a boat to conduct on-the-water interviews. The 24 sampling days were randomly selected as were was the daily sample area. The effort was equally split between weekends and weekdays with starting time varying from 0700 hours and 1300 hours.

Raw data were entered into computer memory by data processing technicians located at the MDFWP, Bozeman. The data set was then sent to ECO Northwest for analysis.

Volunteer Angler Tagging Program

The cooperative tagging program was continued again this season with 6 volunteer anglers; however we are slowly phasing out the program. The taggers are now asked to mark fish in new areas where we have not previously had data. One individual continued to concentrated his efforts in the river system tagging cutthroat trout. Five lake anglers troll and jig to catch lake and bull trout. This volunteer tagging program has been active since January, 1985.

Taggers were issued kits which included a tagging gun, numbered Floy tags, scale sample envelopes, measuring tape, hanging spring-scale and data sheets.

Members of the Montana Charterboat Association that operate on Flathead Lake volunteered to record information on their summer catch. A fish kill-release booklet was provided to each guide. Information requested included: date, area, species, length, weight, whether the fish was kept or released and description of stomach content of fish killed.

Fish Sampling

A 420 Khz, portable echo sounder (BioSonics, Inc. - Model 105 sounder) with a through the hull mounted single 15° beam transducer was used to search for areas of fish concentrations. Survey transect data were collected while moving at 3.0 meters/sec and were preserved on a standard magnetic tape, two channel, cassette recorder. Recording threshold levels on the echogram strip chart recorder were adjusted to allow detection of fish as small as 50 mm, with the lesser scattering layer echoes being excluded. Once concentrations of fish were located with the sounder, a 2-meter fixed frame trawl was deployed to verify fish species and size.

The fall 1990 hydroacoustic fish survey and population estimate was contracted to BioSonics, Inc. of Seattle, WA. They used a dual-beam (5°-15°) echosounder that integrates fish sizes from acoustic data collected and preserved on VCR recording tape. Measurements of fish density and target strength in 5m depth intervals were made with a BioSonics Model 281 Echo Signal Processor. Fish targets to within one meter of the bottom were distinguished and counted by the computer analysis. Fish density (fish/m^3) in each depth stratum for each transect were calculated by BioSonics data processing software. The survey did not include South Bay, or nearshore areas where depth was less than 12.2 meters.

Average fish density for the lake was derived by summing the average densities for the all transects. Total fish were then estimated by multiplying the average density by area of the lake surveyed.

Species composition was determined from gill-net sampling and midwater trawling preceding and following the acoustic survey, September and October, 1990. Two experimental gill-nets, each 6 x 125 feet, were generally set for 12 to 18 hours on the bottom and at mid depth at the sample sites. Each net was constructed of equal length panels of 3/4, 1, 1 1/4, 1 1/2 and 2 inch nylon mesh. Monofilament gill nets, 15 x 100 feet, constructed with 3/4 and 1 inch mesh were also set at some midwater sites. The 2-meter fixed frame midwater trawl was constructed of side panels of 1-1/2 and 1-1/4 inch mesh, with a 1/4 inch mesh cod end. The trawl was held open with a 6 x 6 foot frame of 1-inch iron tubing. A 200-foot 1/4 inch wire bridle connected to the single or main 3/8 inch towing wire. We were able to trawl to depths of 110 feet. Attachment and angle control points were made on an adjustment bar. This bar was an 18-inch piece of 1 1/4 inch angle iron with holes drilled every 1 1/2 inches. This bar was welded mid-way on the vertical frame. Weights, varying from 3 to 10 pounds, were attached to the bottom corners of the frame to weight the net to fish deeper with less line. The trawl was towed at 1.9 to 2.2 knots (1.0 - 1.2 m/sec). Net depth was measured with a Benthos time/depth recorder, while speeds and distances were monitored by a knot log.

Total length and weight were recorded, and scales, otoliths, and stomach contents taken from lake trout, bull trout, lake whitefish and kokanee. Stomach contents were preserved in ethyl alcohol. Zooplankton in these samples were subsequently identified to species and counted, while other invertebrates were classified by order.

Fish otoliths were stored dry with the scale samples in small coin envelopes with corresponding data.

Age and Growth

Age was determined from scale impressions on heated acetate strips projected with a microfiche reader at 65X magnification. Backcalculations were based on the nomograph method or upon proportional increases of scales and fish body length (assumed constant proportion at all ages). Scale formation was set at 43 mm. Age interpretation from scales were verified using otoliths. Otoliths interpretations were made by the direct light technique using a 10X binocular microscope which does not require preparation of the bones before examination.

Pen Rearing of Kokanee

Kokanee were reared in net pens attached to a floating dock which was anchored off shore near the Flathead Lake Salmon Hatchery. Pen rearing was initiated in 1988, to evaluate a method of providing larger fish for release in the lake. During 1991, three floating pens of 1/16" delta nylon mesh and supported on 1 1/2" aluminum tubing frames, 10 x 12 feet and 10 feet deep, were used to rear the salmon in lake water. The top of each net was suspended 18 inches above the water surface by four corner floats made of styrene-filled tires. Fry were fed a ration based on 4 percent live body weight which was distributed during twelve hourly feedings starting at 0600 hrs. Surface water temperatures were monitored daily.

Stream Habitat Quality and Populations Monitoring of Bull Trout and Westslope Cutthroat

Since 1982, FWP has gathered data annually from upper basin tributaries (Shepard and Graham, 1983). Much of this work has been contract funded and conducted in cooperation with the USDA - Forest Service, Flathead National Forest (FNF). FWP completed the 1990 data collection efforts using a combination of state and contract funds. Two contracts covered various aspects of the work:

1. Coal Creek Fisheries Monitoring Study No. IX and Forest-wide Fisheries Monitoring Study (Weaver, 1991). This study has been annually funded since 1983 by FNF and is ongoing in 1990-91; and

2. Study Module 8 - Flathead Basin Commission Cooperative Forest Practice, Water Quality, and Fisheries Study. This Module was part of a larger effort to determine if forest management in the Flathead Basin has affected water quality or fisheries. Funding provided by the various cooperative members was administered by a cooperative board. In addition to a final report (Weaver & Fraley, 1991) generated several manuscripts for submittal to professional journals.

Substrate Coring

We selected the original study areas based on annual observations of natural spawning. We only core sample in spawning habitat used by the fish. Coring sites are selected using a stratified random selection process. We use a standard 15.2cm (6.0 inch) hollow core sampler (McNeil and Ahwell, 1964) to collect four samples across each of three transects at each study area. In some sites we deviate from this procedure due to limited areas of spawning habitat.

Sampling involves working the corer into the streambed to a depth of 15.2cm. We remove all material inside the sampler and place it in a heavy duty plastic bag. We label the bags and transport them to the FNF Soils Lab in Kalispell, Montana, for gravimetric analysis. We sample the material in suspension in the water inside the corer using an Imhoff settling cone (Shepard and Graham, 1982). We allow the cone to settle for 20 minutes before recording the amount of sediment per liter of water. After taking the Imhoff cone sample, we determine total volume of the turbid water inside the cone by measuring the depth and referencing a depth to volume conversion table (Shepard and Graham, 1982).

The product of the cone reading (mg of sediment per liter) and the total volume of turbid water inside the corer (liters) yields an approximation of the amount of fine sediment suspended inside the corer after sample removal. We then apply a wet to dry conversion factor developed for Flathead tributaries by Shepard and Graham (1982), yielding an estimated dry weight (g) for the suspended material.

We oven dry the bagged samples and sieve separate them into 13 size classes ranging from 76.1mm (3.0 inches) to less than 0.063mm (0.002 inches). We weigh the material retained on each sieve and calculate the percent dry weight in each size class. We sum these percentages, obtaining a cumulative particle size distribution for each sample (Tappel and Bjornn, 1983). We add the estimated dry weight of the suspended fine material (Imhoff cone results) to the weight observed in the pan to determine the total weight of material smaller than 0.063mm.

We reference each set of samples by using the median percentage smaller than 6.35mm (0.25inches). This size class is commonly used to describe spawning gravel quality and it includes the size range of material typically generated by land management activities. We test for annual changes in this size class using two-tailed Mann-Whitney tests. A portion of the Cooperative Forest Practice, Water Quality and Fisheries Study involved work on models allowing prediction of westslope cutthroat and bull trout embryo survival to emergence based on the percentage of material smaller than 6.35mm (0.25 inches) in the incubation environment (Weaver & Fraley, 1991).

Spawning areas where we have collected samples annually include three in the Coal Creek drainage and one area each in Whale, Big, Trail, Granite, and Challenge creeks.

Substrate Scoring

Substrate scoring is a visual classification system for surface streambed materials developed by Crouse, et al. (1981), and modified by Leathe and Enk (1985). This method results in an index of particle size and embeddedness which has been shown to be indicative of rearing habitat quality, particularly for juvenile bull trout because of their close association with the substrate. We annually compute substrate scores for Big, Coal, North Coal, South Fork Coal, and Morrison creeks. We collected eight additional substrate scores as part of the 1989 contract work.

Redd Counts

We annually conduct bull trout redd counts in standardized sections in four major North Fork Flathead Rive index streams (Big, Coal, Whale, and Trail) and four major Middle Fork Flathead River index streams (Morrison, Lodgepole, Granite, and Ole). Surveys are conducted by crews of one or two persons, walking down the channel and classifying redds as definite (Class I) or probable (Class II). Shepard and Graham (1983) outlined the survey procedure used. We include both classes of redds in final totals, which are compared to counts made during previous years in the same stream sections. We use total counts as an annual index of spawner escapement from Flathead Lake.

Electrofishing Estimates

We make estimates of juvenile bull trout populations by electrofishing 150m (467 foot) sections in important rearing areas in the North Fork Flathead River (three reaches of Coal, South Fork Coal, Big, Red Meadow, and Whale creeks) and Middle Fork Flathead River drainages (Ole and Morrison creeks). We estimate cutthroat trout abundance in North (two reaches of Coal, South Fork Coal, and Red Meadow creeks) and Middle Fork Flathead River tributaries (Challenge Creek) also. Estimates of Age I and older fish are made by either the mark-recapture method (Vincent, 1971), two-pass method (Seber and LeCren, 1967), or the removal method (Zippin, 1958). We use block nets on all sections and follow procedures described by Shepard and Graham (1983). Final estimates are compared over time by section to assess abundance trends and to obtain an idea of the range of annual fluctuation in population statistics.

RESULTS AND DISCUSSION

Participation in Administration of Stream and Lake Bed Laws

Department personnel reviewed 12 projects under the Stream Protection Act, 4 under the Lakeshore Protection Act, 2 under the U. S. Army Corps of Engineers Section 404 dredge and fill permit program and 85 stream modification projects on private property. Projects were approved, denied, or modified as appropriate and mitigation requested when necessary. Project review was coordinated with CS&KT Lakeshore Protection, Corps of Engineers, State Department of Highways, Flathead and Lake County Commissions and the Flathead and Lake County Soil and Water Conservation Districts Board of Supervisors.

Mitigation for Fish Affected by Hydro-Development

Construction and operation of Hungry Horse, Kerr and Bigfork Dams have negatively affected important fisheries in the basin. Operation of Hungry Horse Dam on the South Fork Flathead River caused an estimated annual loss of 96,300 river spawning kokanee and caused large changes in water temperature in the Flathead River. Operation of the dam also negatively affects the fishery in Hungry Horse Reservoir. The construction of Hungry Horse Dam in the resulted in annual estimated losses of 65,500 migratory westslope cutthroat juveniles and 1,965 migratory bull trout adults downstream to Flathead Lake. Operation of Kerr Dam on Flathead Lake caused a loss of an estimated 131,000 lakeshore spawning kokanee and unquantified losses of other fish species (Fraley, et al. 1989; Zubik and Fraley, 1988; Beattie, et al. 1990). Construction of Bigfork Dam blocked the Swan River for an unquantified number of migratory fish from Flathead Lake.

Mitigation for these losses is being pursued through three related processes. Mitigation for Hungry Horse Dam is being negotiated through the Northwest Power Planning Council (NWPPC) under the Northwest Power Planning Act (NWPPA). The Department and the Confederated Salish and Kootenai Tribes presented the mitigation plan to the NPPC in March, 1991. A mitigation plan for fisheries and wildlife affected by Kerr Dam was presented to the Federal Energy Regulatory Commission (FERC) by Montana Power Company in July, 1990. The plan was jointly developed with the Department, Confederated Salish and Kootenai Tribes and the U.S. Fish and Wildlife Service. The Department is working closely with the Pacific Power and Light Company to address fisheries concerns relating to Bigfork Dam. Mitigation measures proposed through these three processes included: (1) stream habitat improvement and imprint planting; (2) direct introduction of hatchery juveniles into Flathead Lake and/or Hungry Horse Reservoir; (3) improved fish passage; (4) stream flow recommendations; (5) recommendations of water levels to protect reservoir fisheries; (6) installation of a selective withdrawal system in Hungry Horse Dam; (7) a fish ladder and fish screen at Bigfork Dam, and; (8) evaluation and monitoring.

Flathead Lake Seasonal Fisheries Monitoring

Bioeconomic Fisheries Survey.

A total of 279 anglers interviews were conducted between July 31 and September 3, 1990. ECO Northwest, an Oregon consulting firm was to perform the analysis. However, during December 1990, the State and the CS&KT signed a joint cooperative agreement by mutual consent, with neither conceding any jurisdictional issues. Both agreed to notify the public of applicable fishing and hunting requirements on the Reservation. With this agreement, the need for analysis of our information was postponed. We retained a copy of the data and cursorily reviewed half (14) of questions which pertained specifically to the fishery. The following statistics were noted.

Thirty percent of the anglers interviewed said they owned or rented a home on Flathead Lake, with 19 percent of these homes occurring on the Indian Reservation. Over half (58 percent) of the interviews came from the popular fishing area off Woods Bay. Anglers said that they were primarily out to seek lake trout (48 percent) and then secondarily for lake whitefish (30 percent). Fish species and numbers caught by the interviewed anglers, in decreasing order, were: 235 lake whitefish, 200 lake trout, 52 others unidentified, 9 bull trout, 4 cutthroat trout and 4 perch. A total of 245 (90.1 percent) of interviewed anglers said they were willing to support the use of hatchery fish in Flathead Lake if we were unable to restore wild fish populations damaged by hydropower projects. Sixty percent (161 respondents) said they would also be willing to pay an average amount of $1.71 more on their monthly electric bill to help restore the fisheries in Flathead Lake damaged by hydropower projects. These latter two points reflect public support of two points presented in both the Kerr Dam and Hungry Horse Dam mitigation plans.

Two flights (8/19/90 and 9/2/90) were made over the lake to count boats, to identify use areas and to establish a figure to monitor future boat use. The total boat count on September 2, Sunday during Labor Day week end, was 297 boats. Past boat counts (Hanzel, 1985) have shown this weekend to be one of the most active boat periods on the lake. Fishing boats on September 2 represented 43.5 percent (129 boats) of the total. Total boat count on August 19 was 148 (about half of the Labor Day count) with fishing boats accounting for 45.3 percent. The percentage of fishing boats to total boats was nearly the same on both aerial counts. Both flights were made between the hours of 1130 hours and 1300 hours. We are requesting that the economic analysis be completed to establish a base for comparing future angler use, preferences and expenditures.

Volunteer Angler Tagging Program

Volunteers tagged 210 fish this report period. To date 2,092 fish have been tagged; 1,241 in the lake and 851 in the river. Lake fish tagged included 1,137 lake trout, 103 bull trout and 1 westslope cutthroat trout. Fish tagged in the river included 731 westslope cutthroat trout, 89 bull trout, 30 rainbow trout (Oncorhynchus mykiss) and 1 lake trout.

The average length of 132 lake trout tagged since July 1, 1990 was 23.7 inches compared to 29.3 inches (5.6 inches smaller) for those measured in 1989. Lake trout were tagged in every month of the period except November. Over a third of the fish were tagged during January, 1991. The average size of 19 bull trout, 24.1 inches, tagged in the lake was larger than the 3 tagged in the river, 17.7 inches. The average size of 56 tagged cutthroat trout, 16.4 inches, was 0.2 inches less than those tagged in 1989.

Fifty-eight tagged fish were recaptured during the period, raising the total recaptures from this program to 278. Total recaptures now include 149 lake trout (13.1 percent return); 90 cutthroat trout (13.5 percent return); 23 bull trout (14.1 percent return) and 3 rainbow trout (10.0 percent return).

Length of time between recaptures of tagged lake trout (average 597 days) continues to increase as this tagging program progresses. This longevity and high return percentage does show that these angler-caught fish can survive catch and release and tagging. Fourteen of the recent recaptures had time spans that exceeded 1,000 days. The longest was 1,763 days. During this same report period a total of 3, 8, 9, 12, 10 and 4 recaptures were reported from fish previously tagged in the years 1986 through 1991, respectively.

Over half of the 44 lake trout recaptures this period were from fish tagged on the mid-lake bar near Painted Rocks. These fish showed a wide dispersal pattern from the tagging area spreading to most areas of the lake, except for Polson and Lakeside Bays. Ten other lake trout recaptures were from fish tagged off Yenney Point, near Woods Bay. Their information shows a general dispersal along the entire east shoreline, extending from Polson Bay on the south and then north into the mainstem Flathead River above the lake. The river return was a 20.5 inch lake trout recaptured in Church Slough 15 miles upstream from the lake on June 8, 1991, one year after it was tagged off Woods Bay. Other lake trout tagged off the east shoreline near Blue and Yellow Bays also showed similar dispersal patterns along the east shoreline however several fish did reflect some westward movement toward Wildhorse Island. One lake trout tagged off the mouth of the Flathead River was recaptured in the Swan River at Bigfork, 5 miles east of the tagging location.

Forty-six (30.8 percent) of all recaptured lake trout have been released back to the water after tag number and color was noted. We have encouraged anglers, through the news media, to release their tagged fish. During the last three angling seasons, anglers have supported our request of returning tagged fish to the water with the number of released recaptures remaining quite constant.

Since July 1, 1990, 9 cutthroat recaptures have been reported. Average time span between tagging and recapture was 383 days with a range from 6 to 1,764 days. Five of these recaptures occurred in the same area as tagging, within a time span varying from 6 to 784 days. An upstream movement of over 60 miles during the spring was shown on a 14.3 inch fish which was tagged in the main stem Flathead River near Pressentine Bar and was recaptured 134 days later in the North Fork of the Flathead River in British Columbia, Canada near the mouth of Pollock Creek. A fall downstream movement of over 1 mile per day (62 miles in 52 days) was shown by a 12-inch cutthroat tagged in the North Fork of the Flathead River near Ford Ranger Station and recaptured at Foys Bend, an area on the main stem Flathead River near Kalispell. Another downstream migration was shown by a cutthroat trout which traveled 35 miles down into Flathead Lake and was recaptured after 1,757 days in an area along the east shore near Bigfork. An interesting aging fact was documented by the recapture of a 14 inch cutthroat trout tagged on March 15, 1986. This fish was recaptured 1,764 days (4.8 years) later on January 12, 1991. An assigned age for a 14-inch cutthroat from the Flathead River, would be either 4 or 5 years old. This 18-inch fish at recapture would then have been either 9 or 10 years old, some 2 or 3 years older than any cutthroat trout had previously been aged by scale examination. This known aged fish would then suggest that further verification of age be conducted, possibly by otoliths, when assigning ages on fish larger than 18 inches. To date, 6 of 99 cutthroat trout returns have shown recapture time spans longer than 1,000 days (2.74 years).

Three of the four bull trout recaptures were from fish tagged at the mouth of the Flathead River and then recaptured near the tagging area after time spans ranging from 86 to 274 days. The remaining bull trout recapture showed a northward movement of 15 miles from the Rollins Bay area into Lakeside Bay in 86 days.

No rainbow trout tag recaptures were reported during the period.

Volunteer Catch and Kill Records

A member of the Montana Charter Boat Association that operates on Flathead Lake and three dedicated lake trout anglers volunteered to keep records of their daily catch from July, 1990 through June, 1991. Their records showed 97 days on the lake totalling 1,038 hours to catch 1,241 fish. The predominant species caught was lake trout, a total of 1,126 fish. Other species taken included 6 bull trout, 108 lake whitefish and 1 westslope cutthroat trout. The combined average summer angling success was 1.2 fish/hr; however, daily success rates often exceeded 2 fish/hr. The highest success experienced was 15.3 fish/hour on February 23, 1991, when 61 fish were caught in 4 hours of fishing. Exceptional angling success (3.6 fish/hour) continued into March when on 4 trips in one week anglers handled 411 lake trout and 3 bull trout while expending 114.5 hours on the water. On one exceptional day two anglers caught 97 lake trout (52 of which weighed more than 8 pounds with the largest estimated at 30 pounds) and 2 bull trout. The estimated total weight of their catch was an astounding 800 pounds. When handling so many fish, our anglers have preferred to switch their terminal tackle to barbless hooks. They reported that use of barbless hooks did reduce the release time and handling of fish without a reduction in success. This undoubtedly reduced the possibility of injury to many fish. Our reporting anglers experienced little trouble with the fish they released, for most fish descended to the depths immediately regardless of water temperature or season. However, an occasional fish failed to swim off and appeared bloated. Subsequent examination showed these fish had distended air bladders. Examination of the stomachs of these bloated fish showed they were full. This suggests that a fish with food in its stomach has more difficulty than fish with empty stomachs to equalize the change in pressures as they are raised from the depths. We are experimenting with methods to successfully release fish with this condition.

All of the fishing trips during the season could have been termed successful for at least one fish was caught on each outing. Poorest success was experienced during late August with the best success occurring in January. The experience of the guides should increase angling success but seldom was it higher than that of experienced non-commercial anglers. Availability of guided angling trips on the lake has more than tripled the last two years and provides more opportunities to many new anglers to the lake. However this year, guided trips were restricted to areas north of the Flathead Reservation Line. The CS&KT do not support commercial utilization of fish. This restriction could double the angling pressure on off reservations waters. Assessment of this increased use on the lake trout population should be monitored to avoid over exploitation.

The average lake trout landed was 24.7 inches long (527 fish) and weighed 5.6 pounds. Two percent of the lake trout landed weighed more than 20 pounds. Nearly half (40 percent) of the fish were larger than 26 inches (Figure 1.). (Note--current fishing regulations allow seven lake trout of which only one can be longer than 26 inches.) More large lake trout were taken by guided anglers in early spring, April through mid-June. Size of catch during the rest of the summer did not favor any size group. Area and methods of fishing can influence the size of the fish caught. The technique of deep troll fishing yielded a greater number of larger fish, with 70 percent (204 fish) longer than 26 inches and averaging 28.9 inches and 8.3 pounds. Winter jig fishing, particularity fishing in the southern areas of the lake, can occasionally yield large trout, however, our volunteers generally caught smaller fish. Their fish averaged 19.3 inches and 2.3 pounds. Since our report anglers are experienced in fishing Flathead Lake their success was higher than what is experienced by the occasional angler. The average angler can expect a catch rate of 1.0 fish/hour with about half the catch longer than 26 inches. During the 1990 season the number of reported 30+ pound lake trout increased from reports the previous three years. The largest reported lake trout caught during the period was a 36 pound, 44 inch fish taken on April 4, 1991 in the vicinity of "the Narrows".

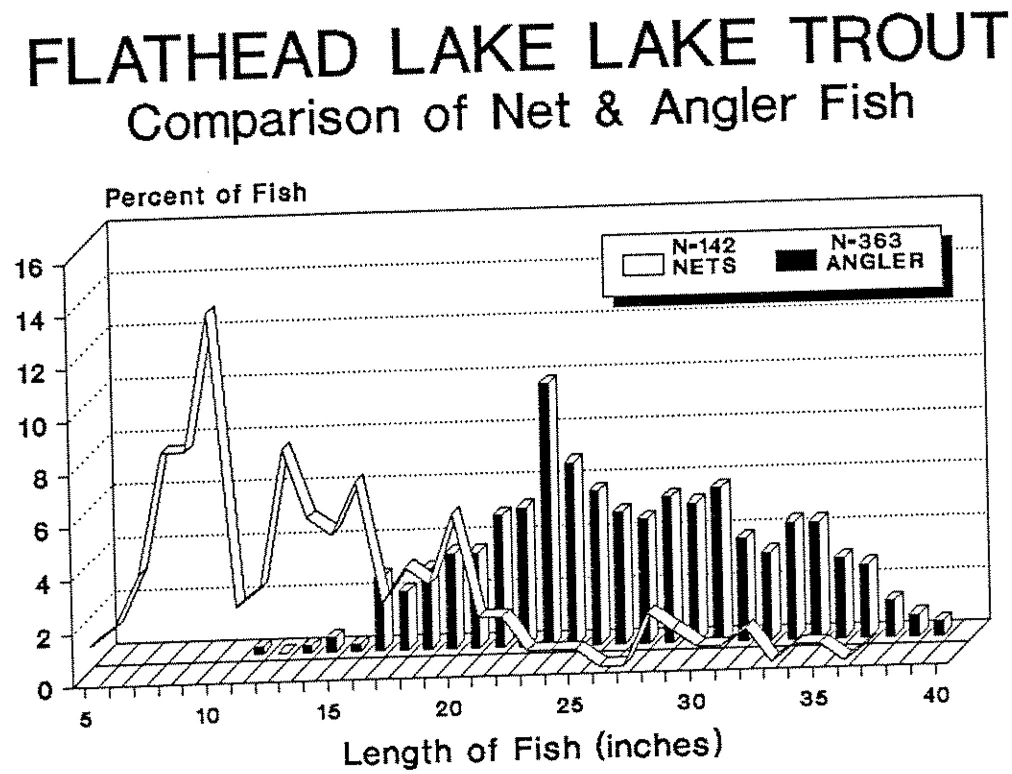

Figure 1. Length frequency histogram of lake trout caught by nets and anglers in Flathead Lake, 1990.

Stomach contents on 299 lake trout were documented by our volunteer anglers. Fifty-nine percent or 178 stomachs were empty. Of the remaining stomachs checked, 117 (96.3 percent) contained fish remains while 4 (3.2 percent) contained only mysids. Identified prey species and numbers of stomachs were as follows : yellow perch in 70 (57.8 percent); lake whitefish in 25 (20.0 percent); kokanee in 4 (3.3 percent), sculpin spp. in 1 and 4 stomachs with small unidentifiable fish (3.3 percent). Lake trout feeding on yellow perch ate predominately perch from 1 to 3 inches long and were caught in most popular fishing areas. Kokanee were found in lake trout caught in both the northern and southern parts of the lake. Three age groups of kokanee, ages 0, 2, and 4, were found in the lake trout stomachs. They ranged in size from 3 to 12 inches. Only adult sized mysids were observed being eaten by the lake trout. These fish were all caught in the southern deeper mid-lake zones.

Lake Trout Age Analysis

Age analysis of 99 lake trout scales was summarized from fish collected during 1990 (Table 1.). Assigned ages ranged from 1 to 6 years on fish 60 to 569 mm in length. Backcalculated lengths showed similar growth patterns as experienced from 1987-1989. Although age determination from lake trout scales becomes more difficult after 6 years of age, the 1990 age assignments were made with confidence since all fish were six years and younger.

Table 1. Backcalculated total lengths at annulus formation for lake trout, Flathead Lake, 1987-1990.

		Fish Length (mm) at Annulus Formation										
Year	No.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
1987	35	98	160	175	370	382	465	543	532	624	630	
1988	58	(94)	149	285	332	458	531	679	680	823	735	728
1989	76	(113)	177	269	391	432	443	605	648	766	839	872
1990	99	125	188	269	364	433	489	---	---	---	---	---
Combined 1987-90	268	103	180	256	373	428	479	628	650	789	735	824

() = First year lengths backcalculated from II+ fish.

Lake Trout Range Expansion

Lake trout have increased dramatically in Flathead Lake in recent years since the appearance of Mysis shrimp has enhanced juvenile lake trout survival. In the past, lake trout were rarely reported in the river but they are now pioneering throughout the drainage and have been reported in the North Fork of the Flathead River above Polebridge, Middle Fork near Essex, Stillwater River up to and including Upper Stillwater Lake, Swan River below Bigfork Dam, the Flathead River below Kerr Dam, Jocko River, and Noxon Rapids Reservoir on the Clark Fork River.

With increasing numbers of lake trout in the river system there is obvious concerns for their predation on schools of juvenile cutthroat and bull trout emigrating to the lake during the fall. Little is known about the incidence of these **species of special concern** as a food item for lake trout. Under existing regulations, anglers are limited to harvesting essentially one lake trout in streams above Flathead Lake and have to release all lake trout in the catch and release section of river below Kerr Dam. Efforts during the fall of 1990 failed to document the food habits of these stream dwelling lake trout. This effort should be continued next spring. If the stream dwelling lake trout are found to be feeding on the juvenile cutthroat and bull trout we would propose a liberalized river limit for lake trout.

Commercial Lake Whitefish Fishery

Anglers are allowed to capture whitefish by hook and line and commercially sell the fish if they obtain a free validation on their fishing license. Seven commercial lake whitefish anglers reported a total of 918 pounds of lake whitefish caught and sold during 1990. Their combined effort of 32 angling days yielded them 495 fish that averaged 1.8 pounds. Their average catch per day was 15.5 fish. The highest number of fish caught in one day during this report this was 51 fish, which occurred on August 27, 1990. Angler interest in the lake whitefish fishery has grown constantly the last three years. It was common to observe groups of 30 or more boats grouped in the more popular fishing areas, particularly near Woods Bay. Most fish to date have been either sold at the docks or to local grocery stores. Several individuals are investigating the possibility of establishing a brokerage business which would collect and process the fish purchased from licensed anglers. Areas within the exterior boundaries of the Flathead Indian Reservation Boundary are closed to commercial fishing for whitefish.

Hydroacoustic Estimate of Fish Abundance

A hydroacoustic survey was conducted on the lake during the nights of August 27 - 30, 1990. We estimated 18.53 million fish in Flathead Lake in August, 1990 This figure translates to an overall fish density of 185.34 fish/acre (457.6 fish/hectare). This compares to a slightly higher average density in 1989 of 222.8 fish/acre (550.5 fish/hectare). The 1990 number estimate was 2.6 million fish less than estimated in 1989. Because of sampling design, these estimates primarily include species that inhabit deeper limnetic zones in the lake, i.e. bull trout, lake trout, kokanee, lake whitefish and pygmy whitefish (Prosopium coulteri). This estimate excludes those species living primarily in the littoral zone, i.e. cutthroat trout, yellow perch, squawfish (Ptychocheilus oregonensis), peamouth (Mylocheilus caurinus) and suckers (Catostomus and C. macrocheilus).

Fish density varied from 0.785 to 10.95 fish/surface acre (1.94 to 27.04 fish/hectare) among the 36 transects (totalling 80 miles). The highest density occurred in the NW Lakeside Bay area. Other areas showing high densities (greater than 8.1 fish/surface acre or 20.0 fish/hectare) included most of the mid-lake area extending from a north line from between Angel Point and Woods Bay south to the "Narrows". These higher densities occurred along both shorelines.

A new computer analysis program, developed at BioSonics, Inc. which tracks bottom and utilizes a minimum detection filter to eliminate noise and small targets, i.e. Mysis, to allow fish detection to within 1 meter of the bottom was used to calculate fish densities from the 1990 recorded data. Since this program differs from the ones used the previous two years, we could not make comparisons of previous years data. Because of the differences in summary techniques we could not distinguish between changes in technique from changes in the population. In order to establish a basis from which to compare fish density changes, data from the last two years data will be re-analyzed. At the same time, data from the most recent acoustic survey, that of

August, 1991 will also be analyzed. This combined analysis will be completed by March, 1992. A more reliable review and comparisons between years will be available and will be presented in the next progress report.

The high fish concentration found in the mid-lake areas during the 1989 survey was not present in 1990; however, fish densities in the open pelagic area were higher with a more uniform distribution in 1990. A preliminary review shows a increase in the percentage of large fish targets (lengths >19.7" or 500mm) from 3.0 percent in 1989 to 11.7 percent in 1990. If the percentages hold true after the re-analysis, they could reflect a 10 fold increase in the numbers of large fish targets. Although not enumerated in the analysis, the relative numbers of the fish and their sizes in 1990 resemble more closely the proportionate sizes of fish collected during the verification netting series.

Fall Species Verification Series

The need to verify fish species in 16 areas was established by reviewing fish target concentrations on echograms made during the acoustic survey. Specific depths and areas were selected to represent changes in fish distributions with nets set to identify fish seen at specific depths.

A total of 992 fish were collected during the verification netting series, September 27 through October 30, 1990. Lake whitefish was the predominant gamefish (73.1 %) caught at these selected sites and depths. Other species collected included: lake trout, (15.3%); pygmy whitefish, (4.5%); bull trout, (1.9%); and kokanee, (0.3%). Nongame species found at these deep offshore sites were minor, representing 4.8 percent of the total fish collected. Nongame species, in decreasing order of abundance, were squawfish, peamouth and longnosed suckers.

The length frequency of the catch of lake trout during the verification series (Figure 1) does illustrate the predominance of young lake trout in the population. We have never experienced such a predominance of small fish in any fall netting series. In 1990, 41.6 percent of the lake trout collected were less than 10 inches long, with 75.4 percent of the sample less than 17 inches. When comparing the size of the fish caught by anglers to what is represented in this fall series, one might visualize the potential impact that anglers could have on the larger sized fish (Figure 1). A liberalized regulation emphasize harvest of small lake trout will be recommend to reduce the number of small lake trout.

Since we could not follow kokanee fingerlings after the mass release of 2.25 million fish during June we concluded that these fish either experienced very high mortality during the summer or dispersed into a low overall density. Either result would preclude an estimation of their abundance. Although the kokanee population is low, evidence of a higher numbers of salmon in the lake has progressively increased the past three years, suggesting and increase in densities. The incidence of salmon being taken by casual anglers and the more frequent occurrence of kokanee found in stomachs of the larger piscivorous fish also suggests that more salmon are surviving each year.

Mysis

Mysid shrimp were introduced into Flathead Lake by natural downstream drift from Swan Lake or Whitefish Lake (Rumsey, 1987). Mysid shrimp were first collected in Flathead Lake in 1981. Yearly monitoring documented the exponential increase in their abundance through 1985 (Figure 2) to a peak of 132/m^2 in 1986. Mysis numbers have steadily decreased since 1986. The lakewide average density in 1990 was 37/m^2, a point below the sudden rise in the 1985 density. Mysids were again most abundant in water deeper than 30 m, but their abundance varied widely in any depth range. Acoustic surveys on Flathead Lake indicate mysid distribution is patchy in all areas of the lake. Adult mysids do not migrate into the epilimnion after summer water temperature exceeds 14° C. in the surface layer.

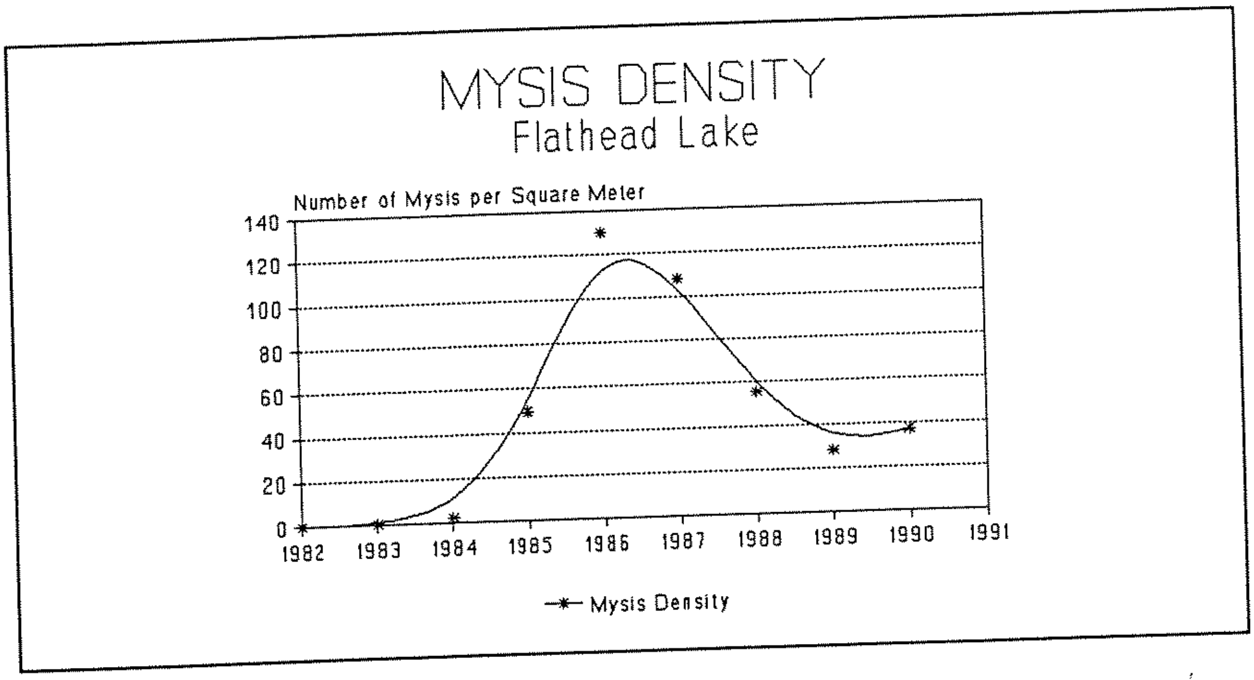

Figure 2. Average density of Mysis in Flathead Lake, 1982-1990. Line depicts trend curve of Mysis densities.

Densities and age distribution of Mysis have continued to fluctuated. The youngest age class has made an increasing contribution to the overall population density each year.

Artificial Kokanee Enhancement

A total of 2.25 million kokanee fingerlings were released into Flathead Lake during early June, 1991. These fish are a part of a four year experimental recovery program to plant from 3 to 5 million fish annually. Plants over the last 5 years have been 1.25 million in 1987, 2.0 million in 1987, 2.5 million in 1988, 4.0 million in 1989 and 3.0 million in 1990. The planting strategy is to hold the fish in the hatcheries until mid June. Half of the fish planted in 1991 averaged 3.5 inches in length, with the remainder split nearly equal with average lengths of 1.5 and 2.3 inches. The smaller fish were reared for a shorter period in the pens at the Flathead Lake Salmon Hatchery.

A release date during the first week in June was scheduled for all salmon reared in hatchery waters. This timing coincides with increasing macrozooplankton populations at planting sites. Since plankton were more numerous in the southern areas of the lake the same four release sites used in 1990 were used in 1991. These sites included Table Bay and Rollins Bay along the west shore and Yellow Bay and Blue Bay along the westshore. Fish at the release sites were transferred from the hatchery truck into 33 gallon plastic garbage cans and transported approximately 1/4 miles to the off-shore release sites. Interested sportsmen volunteered the use of their boats and time to aid us in distributing salmon. After being released, most of the salmon moved directly to the deeper offshore waters. Surface water temperatures ranged from 53 to 56° F. on planting day.

Pen Rearing of Kokanee

A total of 0.47 million kokanee were reared in three pens at the Flathead Lake Salmon Hatchery. Fish to be pen reared were in excess of available state hatchery capacity. Fry were "feed trained" in the hatchery for two weeks prior to being stocked in the pens. Fish were stocked at a density of 125,000 per net and at a size of 2,200/pound. Fish were placed in the pens on early May and were released at the pen site after dark on May 24 and May 26, when surface water temperatures were approaching mid 50° F. It is at this temperature that past pen reared kokanee fry have exhibited stress from crowding and mortality from bacterial infections started to increase.

Stream Habitat Quality

Substrate Coring

The median percentage of substrate material smaller than 6.35 mm ranged from 32.8 percent in the North Coal sampling site to 51.8 percent in the Big Creek area (Table 2.). Several of our monitoring sites showed significant decreases in the amount of fine material. The 1990 samples from North Coal Creek contained significantly less ($p < 0.10$) fine material than in 1989. Samples from Granite and Challenge Creeks also had significantly less ($p < 0.05$) material smaller than 6.35 mm than in past years.

Table 2. Summary of median cumulative percentages of substrate material smaller than 6.35 mm (0.25 inches) in diameter from annual McNeil core samplings in known cutthroat and bull trout spawning areas.

Stream	Species	Year	Sample Size	Median % Sediments <6.35mm
	North Fork Drainage			
Whale Creek	bull trout	1981	13	26.7
		1982	11	31.2
		1983	12	32.6
		1984	12	28.9
		1985	11	19.3
		1986	12	27.6
		1987	12	27.9
		1988	12	36.9
		1989	12	35.4
		1990	--	----
Coal Creek--Dead Horse Bridge	bull trout	1981	20	34.0
		1982	20	39.2
		1983	20	39.3
		1984	20	31.7
		1985	20	36.2
		1986	20	34.8
		1987	20	41.1
		1988	20	39.0
		1989	20	39.8
		1990	8	42.1
North Coal Creek	bull trout	1985	12	34.8
		1986	12	29.3
		1987	12	30.2
		1988	12	39.4
		1989	12	37.8
		1990	12	32.8
South Fork Coal Creek	bull trout	1985	12	35.8
		1986	12	31.1
		1987	12	31.4
		1988	12	31.4
		1989	12	36.1
		1990	12	33.5

continued

Table 2 continued

Stream	Species	Year	Sample Size	Median % Sediments <6.35mm
	North Fork Drainage - continued			
Big Creek	bull trout	1981	12	21.6
		1982	10	31.3
		1983	12	28.2
		1984	12	27.1
		1985	12	28.6
		1986	12	21.6
		1987	12	29.0
		1988	12	39.8
		1989	12	48.0
		1990	12	51.8
Trail Creek	bull trout	1981	19	23.3
		1982	19	22.0
		1983	12	27.2
		1984	12	27.4
		1985	12	26.5
		1986	12	29.2
		1987	12	27.4
		1988	12	30.0
		1989	12	30.8
		1990	12	34.6
	Middle Fork Drainage			
Granite Creek--Trail Crossing	bull trout	1982	12	44.6
		1986	6	50.6
		1987	6	47.6
		1988	6	44.6
		1989	6	39.0
		1990	6	26.2
Other Sites		1982	--	---
		1986	8	32.6
		1987	6	39.8
		1988	6	44.0
		1989	6	44.4
		1990	6	34.7
Challenge Creek	cutthroat trout	1986	12	---
		1987	12	33.4
		1988	12	41.0
		1989	12	43.5
		1990	12	33.0

Samples collected from Big Creek have shown significant increases ($p < 0.05$) in fine material annually from 1987 to 1989 (Table 2.). The 1990 sampling showed the increasing trend continued, although the change from 1989 to 1990 was not statistically significant. Information on embryo survival to emergence indicates that both westslope cutthroat and bull trout embryos experience about 75 percent mortality when 40 percent of the gravel in the incubation environment is less than 6.35 mm (Weaver & Fraley, 1991). Mortality increased to over 95 percent at 50 percent gravels less than 6.35 mm. The dominant cause of mortality in our testing resulted from entombment of alevins by high levels of fine material.

We collected fewer samples from Coal Creek at Dead Horse Bridge and did not sample the spawning area in Whale Creek during 1990 due to time constraints. These sites will again become part of our annual data collection efforts in 1991.

Substrate Scoring

All substrate scores calculated for 1990 were above the critical standard for juvenile bull trout rearing habitat (9.0) developed by Leathe and Enk (1985) (Table 3.). Scores above 11.0 indicate good rearing habitat quality. Substrate conditions in Coal Creek at Dead Horse Bridge began to decline in 1987; juvenile bull trout population estimates also have declined in the section. The decrease in substrate score we observed in Morrison Creek also corresponded to a major decline in juvenile bull trout numbers this year (Table 3.). Weaver and Fraley (1991) reported a significant positive relationship between substrate scores and juvenile bull trout densities for 15 Flathead Basin tributary streams.

Fish Population Monitoring

Redd Counts

We completed the 1990 bull trout redd counts between September 25 and October 16. Based on the number of redds observed, the 1990 spawning run appeared about average in the North Fork and Swan River Drainages and considerably below average in the Middle Fork Drainage (Table 4.)

North Fork tributary monitoring areas have averaged 229 redds during 11 years of annual counts (1979-1989). This year's total of 228 suggests an average run in the North Fork Drainage. Although Coal Creek contained approximately one-third fewer redds than normal this year, above average runs in Big and Trail Creeks made up this difference (Table 4.).

Counts in Middle Fork tributary monitoring areas have averaged 144 redds annually during the same 11-year period. The 1990 total of 77 redds is 46 percent below this average figure. We recorded the lowest totals on record in Morrison and Lodgepole Creeks this year. We also observed lower than normal redd numbers in the two other Middle Fork monitoring streams (Table 4.).

Table 3. Summary of annual substrate scoring in important westslope cutthroat and juvenile bull trout rearing areas in the Flathead drainage.

Streams	Rearing Area	Year	Substrate Score
	North Fork Drainage		
Big Creek	Skookoleel Bridge	1986	12.2
		1987	11.5
		1988	11.2
		1989	11.8
		1990	11.3
Coal Creek	Dead Horse Bridge	1983	10.3
		1984	10.2
		1985	11.6
		1986	12.3
		1987	10.0
		1988	9.8
		1989	9.6
		1990	10.4
North Coal Creek		1983	14.0
		1984	12.2
		1985	13.5
		1986	14.2
		1987	13.7
		1988	13.0
		1989	12.3
		1990	13.2
South Fork Coal Creek		1985	12.8
		1986	12.0
		1987	12.2
		1988	12.0
		1989	11.8
		1990	11.5
	Middle Fork Drainage		
Morrison Creek	Reach IV	1986	12.3
		1987	12.8
		1988	12.8
		1989	13.0
		1990	11.1

Table 4. Bull trout redd counts for sections of tributaries chosen for monitoring in the Flathead drainage.

Stream	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
				North Fork Drainage								
Big	10	20	18	41	88	9	9	12	22	19	24	25
Coal	38	34	23	60	61	53	40	13	48	52	50	29
Whale	35	45	98	211	141	133	94	90	143	136	119	109
Trail	34[a]	31[a]	78	94	56	32	25	69	64	62	51	65
TOTAL	117	130	217	406	280	227	168[b]	184	277	269	244	228
				Middle Fork Drainage								
Morrison	25[a]	75	32[a]	86	67	38	99	52	49	50	63	24
Granite	14	34	14[a]	34	31	47	24	37	34	32	31	21
Lodgepole	32	14	18	23	23	23	20	42	21	19	43	12
Ole		19	19	51	35	26	30	36	45	59	21	20
TOTAL	71	142	83	194	156	134	173[b]	167	149	160	158	77
GRAND TOTAL	188	272	300	600	436	361	341	351	426	429	402	305

[a]Counts may be underestimated due to incomplete survey.
[b]High flows may have obliterated some of the redds.

Combining redd numbers from the North and Middle Fork monitoring areas gives an index of total bull trout spawning escapement from Flathead Lake. This total has averaged 373 redds over the last 11 years. The 1990 count of 305 is 18 percent less than average. There are unmonitored sections in several of these streams, as well as other streams which are utilized by spawning bull trout. Our numbers do not represent the total annual spawning run. We estimate our annual counts represent around 35 percent of the annual Flathead Lake spawning escapement.

Electrofishing Estimates

The 1990 juvenile bull trout population estimates generally appeared within the range observed during past years, with the exceptions of Coal Creek at Dead Horse Bridge and Morrison Creek (Table 5.). These two sections contained lower numbers of juvenile bull trout than observed in past years. Streambed substrate conditions in the Dead Horse section of Coal Creek are less than optimal for bull trout rearing. Based on substrate scores (Table 3.), a period of declining habitat quality began in 1987 and extended through last year. The substrate score for the electrofishing section in Morrison Creek was also lower than usual this year (Table 3.). This portion of Morrison Creek was not accessible to spawners in 1987 and 1988 due to low flows and an upstream migration barrier 5.5 km above the Middle Fork.

The probability of first pass capture (p) during this year's electrofishing in several sections was slightly lower than the recommended level of 0.60 (Shepard and Graham, 1983b). Generally, when we handle a substantial number of fish during an effort, we will make a third electrofishing run if this level of p is not substantial number of fish during an effort, we will make a third electrofishing run if this level of p is not obtained. Since we had adequate values of p for cutthroat trout and a considerable period of record exists for comparison, the information to be gained by a third pass did not seem to justify the additional electrofishing effort.

Westslope cutthroat trout population estimates for the Coal Creek drainage in 1990 appeared quite similar to past years (Table 5.). These sections contain substantial populations. We observed several young-of-the-year westslope cutthroat trout in the North Coal section. Spawning and incubation probably takes place in the general vicinity of the 317 Bridge, although high spring flows prevent us from detecting where.

Estimates of westslope cutthroat populations in Red Meadow and Challenge Creeks were within the range observed in past years. Challenge Creek, a low summer flow stream, may be showing some effects of the drought in 1987 and 1988 (Table 6.)

RECOMMENDATIONS

1. Negotiate Flathead Lake level management or mitigation with Montana Power Company to maintain levels that are sufficient to maintain or enhance fish populations at existing levels.

2. Negotiate river flows with NWPPC to maintain levels that are sufficient to maintain or enhance fish populations at existing levels.

3. Proceed with the implementation of the strategies of five-year Flathead River and Lake Fisheries Management Plan with the cooperation of the CS&KT.

4. Evaluate the feasibility of using hatching reared late-summer O+ or spring I+ kokanee releases in the lake in an effort to restore and increase kokanee numbers to meet angler demands. Assess and identify the impact of the Mysis population in the lake on kokanee and other fish species.

5. Monitor trout species in the lake and river to evaluate the effectiveness of present regulations in regulating harvest and to monitor present growth conditions. Acoustical data should be summarized by depth intervals oriented to both the surface and to the bottom.

6. Annually monitor the bull trout spawning escapement by enumerating redds on selected streams in the North and Middle Fork River drainage as part of a system population evaluation.

7. Monitor bull, cutthroat and lake trout populations through netting surveys and a cooperative angler tagging program to establish annual population status levels and catch rates to aid in the maintenance of fish populations that can sustain acceptable use and harvest levels.

8. Annually monitor stream bottom substrate composition and population estimates of juvenile bull trout and cutthroat trout on selected streams in the North and Middle Fork River drainage to assess fish embryo survival as stream environments change resulting from man's activities.

Table 5. Summary of electrofishing population estimates for Age I+ bull trout in 150m sections selected for annual monitoring between 1982 and 1990.

Creek	Section	Date	Pop. Est.	95% C.I.	P Value
		North Fork Drainage			
Coal	Cyclone Bridge	08/10/82	50	±43	.40
		08/24/83	34	± 7	.71
		08/30/84	52	±13	.63
		08/10/87	18	± 3	.78
		08/16/88	18	± 3	.78
		1989	---	---	---
		1990	---	---	---
	Dead Horse Bridge	08/05/82	97	±23	---
		08/23/83	99	±33	---
		08/28/84	85	± 7	---
		08/26/85	159	±61	---
		09/05/86	152	±45	---
		09/01/87	179	±55	---
		09/06/88	131	---	---
		09/15/89	65	±50	---
		08/28/90	35	±7	---
	North Coal Bridge	08/04/82	17	± 9	.60
		08/25/83	18	± 3	.78
		08/29/84	48	±12	.63
		08/27/85	41	± 5	.77
		09/03/86	29	±12	.59
		09/05/87	47	±17	.56
		08/16/88	39	± 5	.67
		09/08/89	44	±18	.54
		08/27/90	33	± 4	.65
South Fork Coal	Section 26	08/28/85	62	± 8	.74
		08/06/87	12	± 2	.48
		08/08/88	24	± 2	.85
		09/29/89	14	± 2	.83
		08/24/90	49	±16	.57
Big	Skookoleel Bridge	09/15/86	47	± 5	.78
		08/19/87	48	± 6	.75
		08/18/88	67	± 6	.56
		09/22/89	83	±11	.54
		09/17/90	65	±14	.48

continued

Table 5 continued

Creek	Section	Date	Pop. Est.	95% C.I.	P Value
Red Meadow	1st Bridge RMC Rd	08/15/83	75	±11	.69
		09/16/86	69	± 8	.74
		08/18/87	47	± 4	.82
		10/28/88	44	±19	.54
		09/09/89	20	±15	.50
		09/18/90	50	±42	.40
Whale	Shorty Creek	08/22/83	38	± 8	.69
		09/04/86	32	---	.74
		08/13/87	63	±17	.60
		1988	---	---	---
		09/25/89	33	±11	.60
		09/26/90	36	± 6	.57
	Middle Fork Drainage				
Ole	Fielding Trail	09/13/82	25	±12	.57
		09/12/86	39	± 5	.76
		08/27/87	42	±14	.60
		1988	---	---	---
		10/12/89	45	± 2	.90
		1990	---	---	---
Morrison	Reach IV	09/01/82	95	± 6	.82
		08/19/83	70	±11	.69
		09/25/85	93	±27	.54
		08/27/86	114	±15	.67
		08/25/87	138	±10	.76
		08/30/88	126	±15	.69
		08/23/89	130	±31	.56
		09/07/90	28	±13	.56

Table 6. Summary of electrofishing population estimates for Age I+ westslope cutthroat trout in areas for monitoring between 1982 and 1990.

Creek	Section	Date	Pop. Est.	95% C.I.	p Value
		North Fork Drainage			
Coal	Cyclone Bridge	08/10/82	41	±18	.55
		08/24/83	17	± 7	.64
		08/30/84	25	±11	.56
		08/10/87	23	± 2	.66
		08/16/88	25	± 6	.70
		1989	---	---	---
		1990	---	---	---
	North Coal Bridge	08/04/82	32	± 6	.74
		08/25/83	27	± 4	.82
		08/29/84	31	± 9	.65
		08/27/85	36	±12	.33
		09/03/86	40	±11	.64
		08/05/87	63	± 2	.91
		08/16/88	51	± 9	.69
		09/08/89	51	± 9	.69
		08/27/90	39	± 8	.53
South Fork Coal	Section 26	08/28/85	63	±35	.33
		08/06/87	43	± 4	.47
		08/08/88	43	± 3	.83
		09/29/89	59	±10	.67
		08/24/90	41	± 4	.82
Red Meadow	1st Bridge RMC Rd.	08/15/83	121	± 5	.46
		09/16/86	69	±12	.63
		08/18/87	58	± 4	.88
		10/28/88	75	±18	.60
		09/09/89	64	±55	.38
		09/18/90	76	± 8	.73
		Middle Fork Drainage			
Challenge	Skyland Rd. Bridge	09/23/80	90	±33	---
		07/18/81	183	±50	---
		07/15/82	78	± 5	.82
		07/22/83	66	± 7	.76
		08/28/86	112	± 9	.76
		08/24/87	209	± 9	.80
		08/31/88	152	±18	.66
		08/24/89	137	±18	.66
		09/05/90	77	±12	.67

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Waters Referred to:

Akokola Creek 08-0110
Big Creek 08-0680
Challenge Creek 08-1420
Coal Creek 08-1620
Flathead Lake 07-6400
Flathead River 07-1560
Granite Creek 08-3080
Lodgepole Creek 08-4240
Middle Fork Flathead River 08-4740
Morrison Creek 08-4940
North Fork Coal Creek (no code)
North Fork Flathead River 08-5100
Ole Creek 08-5150
Quartz Creek 08-5650
Red Meadow Creek 08-5760
South Fork Coal Creek 08-6620
Trail Creek 08-7330
Whale Creek 08-77

Key Words: Flathead Lake, Flathead River, Co-Management Plan, kokanee, bull trout, lake trout, westslope cutthroat trout, pen-rearing, Mysis, substrate sediments.