R. Graham
for your files

FISHERIES EVALUATION PROGRAM FOR THE FLATHEAD LAKE/RIVER SYSTEM AND HUNGRY HORSE AND LIBBY RESERVOIRS

prepared by

John Fraley, Project Manager
Bruce May, Pat Clancey, Will Beattie; Project Biologists

Montana Department of Fish, Wildlife and Parks
P.O. Box 67
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Prepared, January 1986
Revised, August 1986, March 1987

Montana Department of Fish, Wildlife & Parks

1420 East Sixth Avenue
Helena, MT 59620
April 10, 1987

Rick Applegate
Director, Fish and Wildlife Division
Northwest Power Planning Council
Suite 1100, 850 S.W. Broadway
Portland, OR 97205

Dear Rick:

The Montana Department of Fish, Wildlife and Parks proposes to test, evaluate and refine recommendations implemented as a result of our resident fish studies pursuant to measures 804(a)(1,2,4,9) and 804(b)(1,3,4,5) of the Northwest Power Planning Council's Fish and Wildlife program. We would use a systematic, adaptive management approach over a five-year validation period (April 1, 1988 - March 31, 1993). We have designed this evaluation program to validate the recommendations by measuring the biological response over one complete life cycle of important fish species. Major advantages of the approach include the following:

1) Some of the recommendations from our present studies will be based on new methods (e.g., quantitative reservoir fishery models). It will be necessary to confirm the recommendations for operation of Libby and Hungry Horse reservoirs to ensure they are benefiting the fishery, and to avoid unnecessary restraints on the power system.

2) The five-year evaluation program will result in more responsible decisions on how to balance the operation of the power system and management of the fishery. Lasting solutions are much more likely because they will be based on a more complete database, longer period of record, actual biological responses and model simulation responses to proposed changes in operations.

3) Much of what we learn from our present studies and from the five-year evaluation program should be applicable to other waters in the Columbia system.

4) Multi-agency funding would divide the responsibility for the evaluation program among all concerned entities, protecting everyone's investment in the Fish and Wildlife program.

We have consulted with concerned agencies (list attached) on two earlier versions of the evaluation plan. On February 13, 1987, we met with the Montana members of the Northwest Power Planning Council. This revision (enclosed) includes their comments and further information from our ongoing investigations. We have received encouraging responses on the evaluation plan from representatives of the Bonneville Power Administration and U.S. Forest Service. The Montana Department of Fish, Wildlife and Park's contribution is before our state legislature, and indications are that it will be approved.

In submitting our proposal now, we hope to influence the federal budget cycle, and input the evaluation plan into the Northwest Power Planning Council's amendment process for the Fish and Wildlife Program. It would have been premature to submit an evaluation plan to the Council before we had consulted with all concerned agencies. For example, we recently consulted again (March 31) with Bonneville Power Administration on the evaluation plan.

Please examine the enclosed plan and consider inputting it into your Fish and Wildlife program amendment process. If you have any questions, please contact me.

Sincerely,

James W. Flynn
Director

JWF:jf:fs

Attachment
Enclosure

c: Gerald Mueller
Morris Brusett

Distribution List

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Director, Fish and Wildlife Division
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CONTENTS

SUMMARY PROPOSAL

Introduction

We propose to evaluate and refine recommendations implemented as a result of Montana's resident fish studies pursuant to measures 804(a)(1,2,4,9) and 804(b)(1,3,4,5) of the Northwest Power Planning Council's (NPPC) Fish and Wildlife program. We would use a systematic, adaptive management approach over a five-year validation period (April 1, 1988 - March 31, 1993). Our present studies regarding these program measures are scheduled to be completed by March 31, 1988. Recommendations from these studies could include changes in dam operation or non-operational steps to enhance fisheries in waters affected by hydro development. We have designed this evaluation program to test and validate our recommendations by measuring the biological response over one complete life cycle of important fish species. Major advantages of the approach include the following:

1) Some of our recommendations will be based on new methods (e.g., quantitative reservoir fishery models). It will be necessary to confirm the recommendations for reservoir operations to ensure they are benefiting the fishery, and to avoid unnecessary restraints on the power system.

2) The major fisheries of the upper Columbia system in Montana are in a state of change (e.g., Mysis and kokanee competition in Flathead Lake, kokanee population increase in Libby Reservoir). The five-year evaluation program will allow us to make adjustments to our recommendations in light of changes in the fishery.

3) The five-year evaluation program will result in more responsible decisions on how to balance the operation of the power system and management of the fishery. Lasting solutions are much more likely because they will be based on a more complete data base, longer period of record, actual biological responses and model simulation responses to proposed changes in operations.

4) Much of what we learn from our present studies and from the five-year evaluation program should be applicable to other waters in the Columbia system. For example, the reservoir fishery model we develop and refine could be applied to Dworshak; relationships between Mysis and kokanee populations in Flathead Lake could have bearing on management decisions for other lakes and reservoirs in the Columbia system where these species coexist.

5) We propose a multi-agency approach to divide the responsibility of the funding for the evaluation program among all concerned entities, and to protect everyone's investment in

the Fish and Wildlife program. A synthesis of the wide range of past fisheries studies in the system would be a powerful tool in directing management and mitigation policy.

The evaluation program will incorporate the findings of previous investigations on (1) fisheries in the Flathead River below Hungry Horse Dam funded by the Bureau of Reclamation (BOR), (2) Kootenai River and Libby Reservoir fisheries funded by the U.S. Army Corps of Engineers (ACOE), and (3) Flathead River Basin Fisheries, funded by the U.S. Environmental Protection Agency (EPA), U.S. Forest Service (USFS), and related to the International Joint Commission (IJC) investigation of the proposed Cabin Creek coal mine in the North Fork Flathead drainage in Canada. We have designed the evaluation program to include all important fisheries concerns and to provide an integrated management plan for resident fish in the Upper Columbia System in Montana. This revision of our proposal includes the comments of concerned agencies and further information from our ongoing investigations.

If the evaluation program is not conducted, management of these resources will be based on a more limited data base, and it will not be possible to adequately evaluate the effectiveness of fisheries mitigation or management actions. The project is timely and cost-effective because methods and procedures are in place, personnel and equipment are available, and there is a continuous record of information spanning five years or more.

Description of the Evaluation Plan

Specific objectives and methods for the proposed program are presented in detail in the attached work plans for each segment: Hungry Horse/Libby Reservoirs (HHLRS), Flathead Lake/River Kokanee (FLRK), and Flathead River Basin fisheries (FRB). A summary of the major objectives of each segment is presented below.

Segment	Major objectives
ANNEX A Libby/ Hungry Horse Reservoirs	Validate and refine quantitative models of fisheries and operations; evaluate the response of phytoplankton, zooplankton, benthic macroinvertebrates, insects on surface film, and fish species to change in operations of the reservoirs; input results into the Region One fisheries management program; evaluate effectiveness of mitigation measures in cooperation with other agencies as an integral part of the Council's Fish and Wildlife Program.

ANNEX B Flathead Lake/ River kokanee	Implement and evaluate mitigation measures for kokanee and other resident fish in the Flathead system; evaluate Mysis/zooplankton/ fry interactions in Flathead Lake; monitor kokanee harvest escapement, spawning, incubation, and fry production in the river and lake system; input results into the Region One fisheries management program; evaluate effectiveness of mitigation measures in cooperation with other agencies as an integral part of the NPPC Fish and Wildlife Program.
ANNEX C Flathead River Basin fisheries bull trout/ westslope cutthroat	Evaluate bull trout spawning escapement; test suspected limiting factors on the bull trout population in the system; monitor abundance of bull trout and westslope cutthroat juveniles in selected rearing streams; evaluate stream habitat conditions; cooperate with regional staff in monitoring important Flathead Lake fisheries; input results into the Region One fisheries management program; evaluate results in light of the proposed Cabin Creek coal mine.

Proposed Funding

We propose that the cost of the evaluation program be shared by the Montana Department of Fish, Wildlife and Parks (MDFWP), federal agencies and other entities which have been involved with Northwest Power Act projects, Flathead River Basin studies, and other fisheries investigations in the Upper Columbia system in Montana. Shared agency funding will ensure the protection of everyone's investment in the NPPC Fish and Wildlife Program. The evaluation program is designed for participation by the following agencies.

Agency/Entity	Responsibility
Montana Department of Fish, Wildlife and Parks (MDFWP)	State fisheries management agency.
Bonneville Power Administration (BPA)	Investment in Fish and Wildlife program, federal power marketing agency.
U.S. Army Corps of Engineers (ACOE)	Operator of Libby Dam, investment in the Fish and Wildlife program, cooperation in previous fisheries projects in the system.
U.S. Bureau of Reclamation (BOR)	Operator of Hungry Horse Dam, investment in the Fish and Wildlife program, cooperation in previous fisheries projects in the system.
Montana Power Company (MPC)	Operator of Kerr Dam, interest in fisheries mitigation in Flathead Lake.
U.S. Forest Service (USFS)	Federal land management agency, cooperation in present and previous studies in the system.
International Joint Commission Investigative Board (IJC)	Investigating potential impacts of Cabin Creek coal mine in Canada on Flathead fisheries.
U.S. Environmental Protection Agency (EPA)	Interest in the Cabin Creek issue, past investment in Flathead River Basin studies.

We have proposed funding levels for the agencies based on previous investments and responsibilities (BPA, BOR, ACOE, MDFWP, EPA), or presumed level of responsibility (USFS, MPC, IJC) based on the rationale given in the above table. These are our best

estimates of agency responsibility, recognizing the difficulty of developing an agreeable quantitative method for assigning funding levels.

Budgets in this document are based on 1987 dollars. Grand totals may vary by a few dollars because of rounding.

PROPOSED AGENCY FUNDING FOR ONE YEAR

April 1, 1988 - March 31, 1989

(Proposed evaluation/monitoring period: 1988-1993)

Segment	Funding	Agency	Funded	Cost	Overhead +15.5%	Total Cost
Hungry Horse/ Libby Reservoir Segment	163,439	MDFWP	10%	16,344	--	16,344
		BPA	40%	65,376	10,133	75,509
		BOR	15%	24,516	3,800	28,316
		ACOE	35%	57,204	8,867	66,071
Total Hungry Horse Libby Reservoir Study						186,240
Flathead Lake/River Kokanee Segment	124,068	MDFWP	10%	12,407	--	12,407
		BPA	40%	49,627	7,692	57,319
		BOR	20%	24,814	3,846	28,660
		MPC	20%	24,814	3,846	28,660
		IJC	5%	6,203	962	7,165
		EPA	5%	6,203	962	7,165
Total Flathead Lake/ River Kokanee						141,376
Flathead River Basin/ Westslope cutthroat and Bull trout	32,748	MDFWP	45%	14,737	--	14,737
		USFS	40%	13,099	2,030	15,129
		EPA	10%	3,275	508	3,783
		IJC	5%	1,637	254	1,891
Total Flathead River Basin						35,540
TOTALS		MDFWP		43,488		
		BPA		132,828		
		BOR		56,976		
		MPC		28,660		
		ACOE		66,071		
		USFS		15,129		
		EPA		10,948		
		IJC		9,056		
				363,154		

EVALUATION BUDGET ESTIMATE -- ONE YEAR

(proposed monitoring/evaluation period: 1988-1993)

A. SALARIES

Title	Grade/ Step	FTE	Salaries and Benefits	Total
Program Manager/Biologist	15/10	1.00	35,145.53	
Project Biologist	14/6	1.00	29,940.10	
Project Biologist	14/6	1.00	29,940.10	
Fisheries Fieldworker III	11/8	1.00	24,843.70	
Fisheries Fieldworker II	10/8	1.00	23,185.47	
Fisheries Fieldworker II	10/8	1.00	23,185.47	
Fisheries Fieldworker I	8/6	1.00	19,552.07	
Fisheries Fieldworker I	8/6	1.00	19,552.07	
Secretary/Word Processor	8/6	1.00	18,457.11	
Work Study	01/01	0.50	4,883.41	
TOTAL SALARIES				228,686
B. CONTRACTED SERVICES				13,800
C. SUPPLIES AND MATERIALS				21,924
D. COMMUNICATIONS				6,000
E. TRAVEL AND TRANSPORTATION				30,345
F. RENT				6,000
G. UTILITIES				1,500
H. MAINTENANCE/REPAIR				12,000
I. EQUIPMENT				--
SUBTOTAL				320,255
Less MDFWP Share				43,488
Subtotal				276,767
Overhead 15.5%				42,899
Subtotal				319,666
Plus MDFWP Share				43,488
GRAND TOTAL				363,154

ANNEX A

EVALUATING EFFECTS OF RESERVOIR OPERATION ON GAME FISH POPULATIONS IN HUNGRY HORSE AND LIBBY RESERVOIRS

Proposed Work Plan

Prepared By:
Bruce May, Project Biologist
Montana Department of Fish, Wildlife and Parks
P.O. Box 67
Kalispell, Montana 59903

INTRODUCTION

The Hungry Horse Reservoir (HHR) and Libby Reservoir (LR) Fisheries projects resulted from the Pacific Northwest Electric Power Planning and Conservation Act passed by Congress in 1980. The Act created the Northwest Power Planning Council (NPPC) which developed a comprehensive plan to protect and enhance fish and wildlife populations impacted by hydroelectric development in the Columbia River Basin. The maximum drawdown recommendations (Graham et al. 1982) of 90-110 ft. for Libby and 85 ft. for Hungry Horse Reservoirs were adopted by NPPC as part of the plan, except in years of extreme runoff. Timing of the drawdown and refill was not addressed, but may play an important role in determining the effects of operation upon reservoir fisheries. The plan is being implemented by BPA.

The HHR and LR studies began in May 1983 with a goal of quantifying seasonal water levels needed to maintain or enhance principal game fish species in the two reservoirs. Annual drawdown of reservoirs for flood control and power production causes reductions in surface area, volume, shoreline length, area in littoral zone, volume in euphotic zone and volumes in preferred temperature strata for trout. In addition, large outflow volumes reduce hydraulic residence times and weaken thermal structure. These changes in reservoir morphometrics and thermal stability translate into a reduction of habitat for fish food organisms and game fish populations. The loss of productive littoral zones in the upstream part of a reservoir may be especially detrimental to fish populations.

One of the end products of the studies will be a quantitative model which estimates the effect of reservoir operation on primary production, secondary production, fish habitat and game fish populations. The project will result in a plan outlining the most desirable reservoir operations scenarios for fisheries. The information will be used to make future adjustments in operations as needed and will be applicable to other reservoir systems in the northwest.

The objectives of the proposed evaluation program are: 1) to provide the long-term data base needed to refine and verify the quantitative fishery models, 2) evaluate the effects of any modification in reservoir operation on game fish populations, and 3) evaluate impacts of the kokanee population in Libby Reservoir on food resources and other fish species.

DESCRIPTION OF THE STUDY AREAS

LIBBY RESERVOIR

Physical Environment

Libby Reservoir (Lake Koocanusa) located in northwest Montana (Figure 1) was created in 1972 when Libby Dam impounded the Kootenai River. Operation of Libby Dam for flood control and generation of hydroelectric power results in an annual drawdown and refill of the reservoir. The morphometry of the reservoir changes dramatically with changes in annual vertical water level fluctuations (Figure 2) of up to 172 ft. (52.4 m).

Reservoir Biota

Primary productivity in Libby Reservoir was estimated by Woods and Falter (1982). Irving and Falter (1981) described the species composition, biomass, and spatial and temporal distribution of both the phytoplankton and zooplankton communities within Libby Reservoir during 1977. The phytoplankton community was dominated by Daphnia sp. in the upper part of the reservoir within the United States, and Cyclops and Diaptomus were most abundant in the lower reservoir. Phytoplankton and zooplankton densities peaked in early to mid-summer and were lowest in the winter. Shepard (1985) found a similar seasonal progression of zooplankton in 1983-84.

The fish community in Libby Reservoir has been monitored from impoundment through 1982 under a contract with the U.S. Army Corps of Engineers. A final report summarizing the work was completed in 1984 (Huston et al. 1984). The relative abundance of each species in the reservoir and trend of abundance from gill net and creel census sampling suggests the reservoir's fish community is still in a state of flux (Table 1).

Kokanee salmon abundance increased dramatically during recent years and a large spawning run was observed in 1982. The origin of this large year-class was probably an unauthorized release of kokanee fry from the Kootenay Trout Hatchery, upstream from the reservoir in British Columbia (Huston et al. 1984). Age information indicated the 1982 spawning run was dominated by the 1980 year class. The 1982 year class was also extremely strong, with an estimated 200,000 fish in the 1985 spawning run. In spring 1986, Gerrard strain rainbow trout were introduced into the Canadian portion of the reservoir. Currently, MDFWP is initiating a Gerrard strain rainbow stocking program to provide a trophy fishery and help stabilize kokanee population levels. Mountain whitefish and redside shiner abundance has declined in recent years, while peamouth abundance has steadily increased.

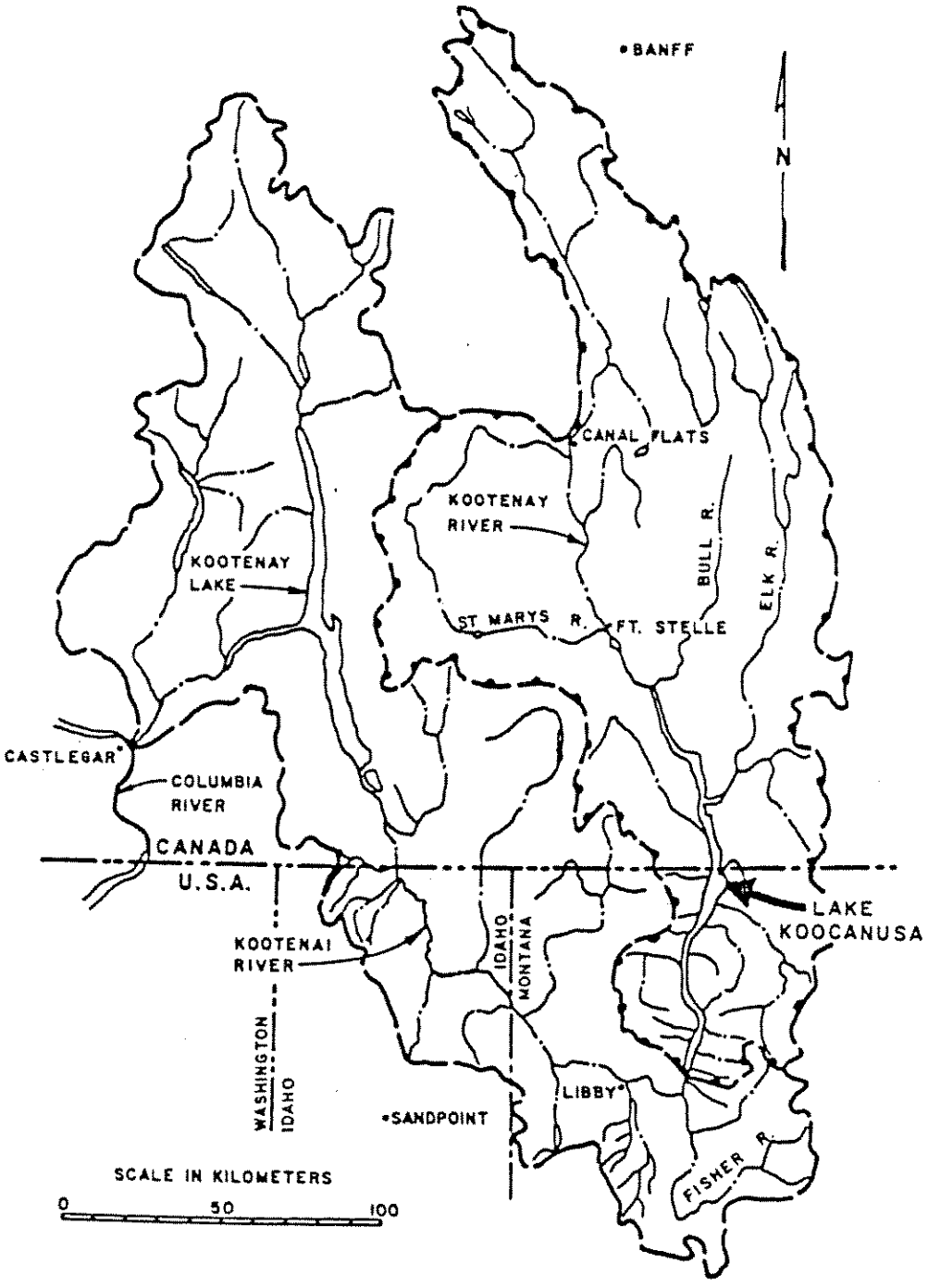

Figure 1. Map of the Kootenai River Basin showing the location of Libby Reservoir (Lake Koocanusa)(from Woods and Falter 1982).

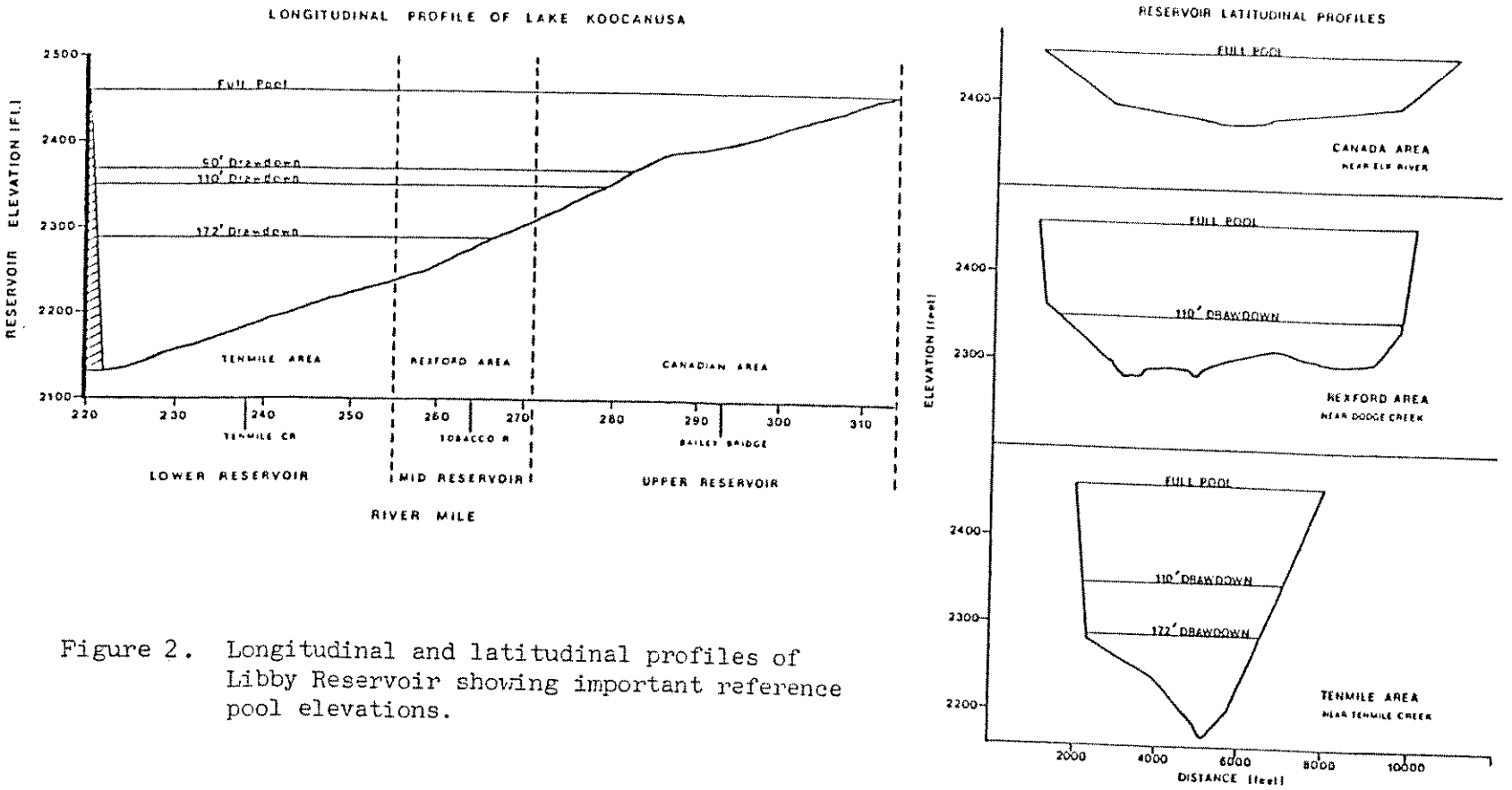

Figure 2. Longitudinal and latitudinal profiles of Libby Reservoir showing important reference pool elevations.

Table 1. Present relative abundance (A=abundant, C=common, R=rare) and abundance trend from 1975 to 1987 (I=increasing, S=stable, D=decreasing) of fish species present in Libby Reservoir.

Common Name	Scientific Name	Relative Abundance	Abundance Trend
Game fish species			
Westslope cutthroat trout	Salmo clarki lewisi	A	S
Rainbow trout	Salmo gairdneri	A	I
Bull trout	Salvelinus confluentus	C	S
Brook trout	Salvelinus fontinalis	R	S
Lake trout	Salvelinus namaycush	R	S
Kokanee salmon	Oncorhynchus nerka	C	I
Mountain whitefish	Prosopium williamsoni	C	D
Burbot	Lota lota	C	S
Largemouth bass	Micropterus salmoides	R	S
White sturgeon	Acipenser transmontanus	R	D[a/]
Nongame fish species			
Pumpkinseed	Lepomis gibbosus	R	S
Yellow perch	Perca flavescens	R	I
Redside shiner	Richardsonius balteatus	C	D
Peamouth	Mylocheilus caurinus	A	I
Northern squawfish	Ptychocheilus oregonensis	A	S
Largescale sucker	Catostomus macrocheilus	A	S
Longnose sucker	Catostomus catostomus	C	D
Longnose dace	Rhinichthys cataractae	R	S
Slimy sculpin	Cottus cognatus	R	S
Torrent sculpin	Cottus rhotheus	R	S

a/ Five white sturgeon were relocated from below Libby Dam to the reservoir. At least one of these fish moved up-river out of the reservoir and two were reported caught by anglers.

HUNGRY HORSE RESERVOIR

Physical Environment

Hungry Horse Dam was completed in 1952 and the reservoir reached full pool elevation of 3,560 feet msl in July 1953. The dam impounded the South Fork of the Flathead River eight km upstream from its confluence with the Flathead River (Figure 3). Hungry Horse is a large storage reservoir, operated by the Bureau of Reclamation, whose primary benefits are flood control and power production. At full pool the reservoir is 56 km in length with a surface area of 23,800 acres and a volume of 3,468,000 acre-feet. Fluctuations in pool elevation have large impacts upon the morphometrics of the reservoir (Figure 4).

Reservoir Biota

Phytoplankton and zooplankton communities were not studied prior to the present reservoir study. Zooplankton data collected in 1984 indicated that Daphnia comprised about 49 percent of the biomass followed by Cyclops with 24 percent and Diaptomus approximately 20 percent. The remainder was comprised of Bosmina, Epischura and Leptodora. Zooplankton peaks of abundance occurred in August and November. A primary productivity study was conducted in 1986.

Prior to construction of Hungry Horse Dam in 1952, the South Fork of the Flathead River drainage was considered the major spawning area for adfluvial fish stocks from Flathead Lake. Substantial numbers of bull trout and westslope cutthroat trout spawned in the South Fork drainage along with smaller numbers of mountain whitefish and kokanee salmon. Native fish species in the South Fork drainage prior to dam construction included westslope cutthroat, bull trout, mountain whitefish, northern squawfish, largescale sucker, longnose sucker, pygmy whitefish and sculpins.

Today, the native species comprise almost the entire fish population in the reservoir. They are considered abundant except for pygmy whitefish which is rated as rare (Table 2). Populations in the reservoir appeared to have stabilized and changes in relative abundance since 1970 appear to be comparatively small.

EVALUATION WORK PLAN

The sampling program for the two reservoirs includes: 1) water quality profiles; 2) quantifying benthos, macroinvertebrates, zooplankton, and surface macroinvertebrates, and; 3) assessing the abundance of fish populations by the use of horizontal and vertical gill nets, and fish traps, acoustical gear and trawling (Tables 3 and 4). All reservoir areas will be sampled, but with a reduced frequency. An outline of sampling frequency and methodology is given below. Methodology is detailed in previous reports (May and Zubik 1985, and Shepard 1985).

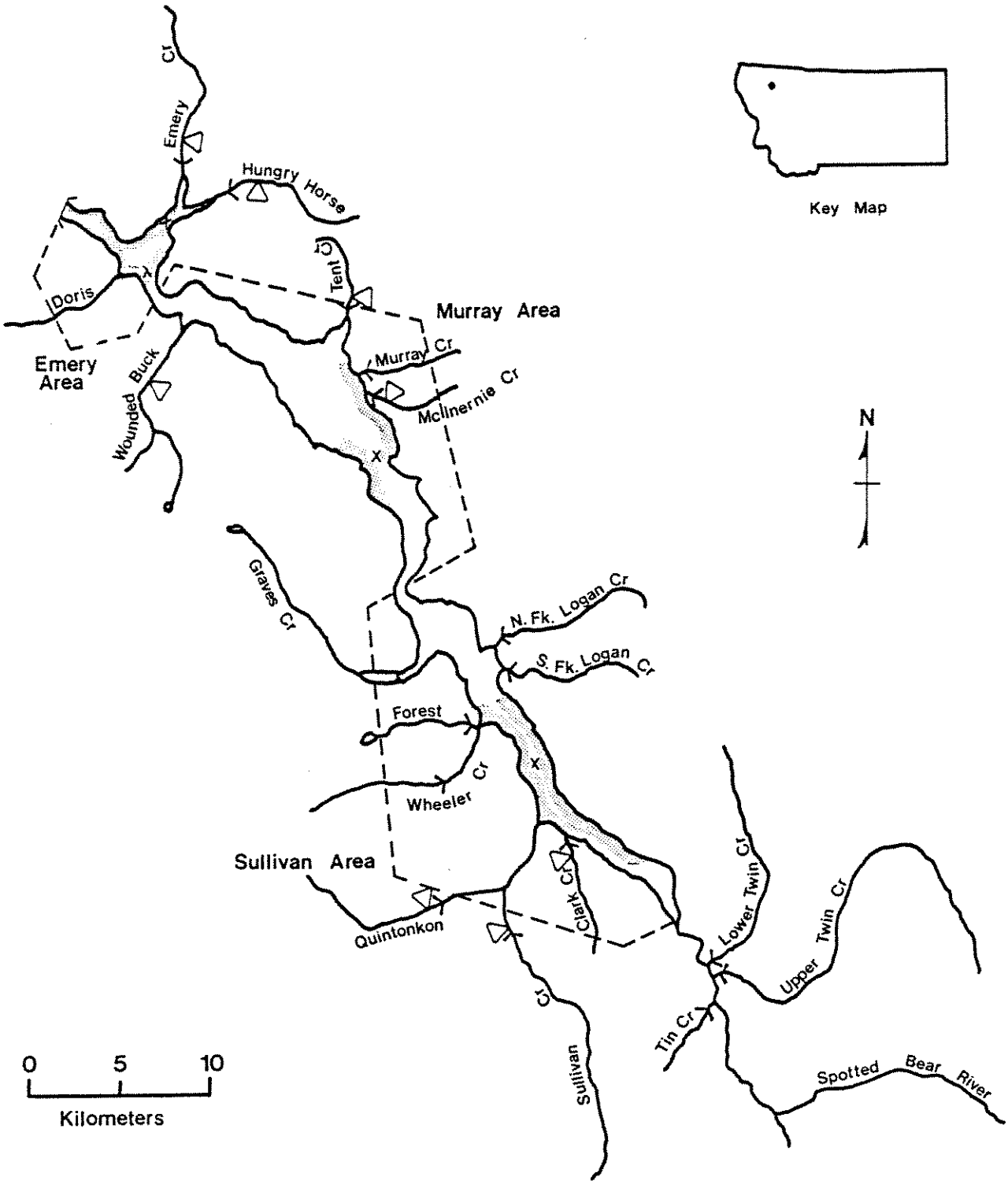

Figure 3. Map of Hungry Horse Reservoir showing study areas, netting areas (▒), water quality, vertical net and zooplankton stations (X), fish trap location (>), and electrofishing sections (Δ).

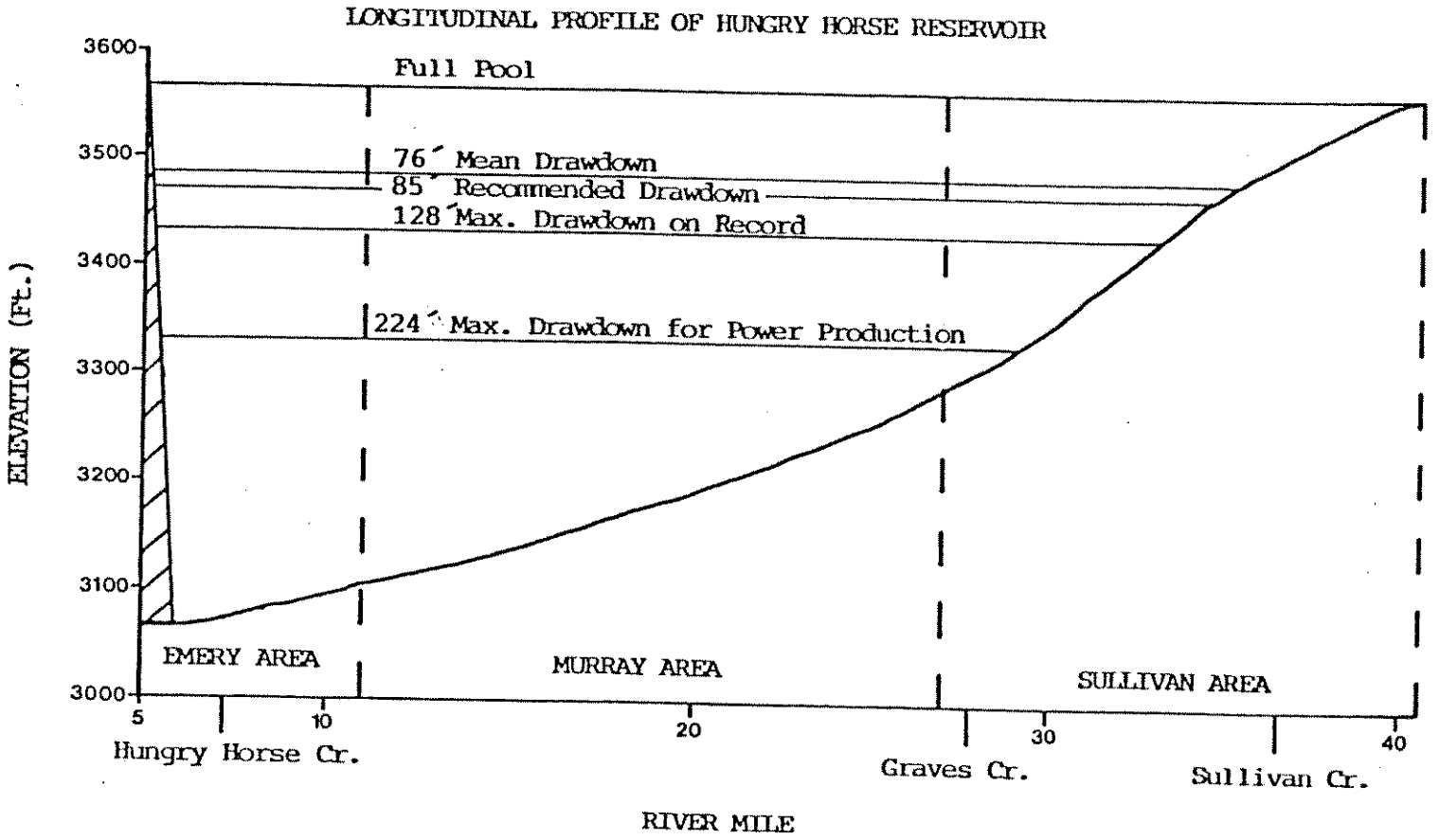

Figure 4. Longitudinal cross-sectional profile of Hungry Horse Reservoir at water surface elevations of 3,560 (full pool); 3,484; 3,475; 3,432;and 3,336.

Table 2. The relative abundance of fish species in Hungry Horse Reservoir as determined by gill net catches and creel surveys from 1958 to 1983. Abbreviations are given in parentheses.

Species	Scientific Name	Relative Abundance[a/]
	Native Species	
Westslope cutthroat trout (WCT)	Salmo clarki lewisi	A
Bull trout (DV)	Salvelinus confluentus	A
Mountain whitefish (MWF)	Prosopium williamsoni	A
Pygmy whitefish (PWF)	Prosopium coulteri	R[b/]
Northern Squawfish (NSQ)	Ptychocheilus oregonensis	A
Longnose sucker (LNSU)	Catostomus catostomus	A
Largescale sucker (CSU)	Catostomus macrocheilus	A
Sculpin species	Cottus sp.	R
	Exotic Species	
Rainbow trout (RB)	Salmo gairdneri	R
Yellowstone cutthroat trout (YCT)	Salmo lewisi bouvieri	R
Arctic grayling (GR)	Thymallus arcticus	R

a/ Relative abundance: A=abundant, C=common, R=rare.

b/ Pygmy whitefish may be more abundant than net catches indicated because they inhabit deep offshore waters and are not vulnerable to shoreline net sets.

Table 3. Project year 1988-89 Activities Matrix for Hungry Horse Reservoir.

	Worker Days												
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
Data Collection:													
Water quality	--	1	1	1	1	1	1	1	--	--	--	--	7
Surface insects	--	1	1	1	1	1	1	1	--	--	--	--	7
Zooplankton tows	--	1	1	1	1	1	1	1	--	--	--	--	7
Emergence traps	--	2	2	2	2	2	2	2	--	--	--	--	14
Benthos	--	2	--	--	2	--	2	--	--	--	--	--	6
Gill netting	--	25	--	--	--	--	--	--	--	--	--	--	25
Fish trapping	--	5	30	25	10	--	--	--	--	--	--	--	70
Equipment maintenance	5	4	4	4	4	4	4	4	--	--	--	--	33
													169
Laboratory:													
Surface insects	*											*	23
Zooplankton	*											*	30
Benthos	*											*	15
Emergence traps	*											*	15
Mount scales	*											*	15
Read scales	*											*	22
													120
Data Analysis:													
Data entry	*											*	30
Statistical analysis	*											*	16
Data summary (graphs and figures)	*											*	20
													66
Report Preparation:													
Literature review	*											*	10
Report preparation	*											*	30
Word processing	*											*	15
													55
Administrative and Clerical:													
Word processing	*											*	30
Clerical	*											*	30
Project manager	*											*	30
													90
TOTAL													500

Table 4. Project year 1988-89 Activities Matrix for Libby Reservoir.

	Worker Days												
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
Data Collection:													
Water quality	1	1	1	1	1	1	1	1	1	--	--	--	9
Surface insects	1	1	1	1	1	1	1	1	1	--	--	--	9
Zooplankton tows	1	1	1	1	1	1	1	1	1	--	1	--	10
Schindler trap samples	1	1	1	1	1	1	1	1	1	--	1	--	10
Benthos	2	2	2	2	2	2	2	2	2	--	--	--	18
Emergence traps	--	2	2	2	2	2	2	2	--	--	--	--	14
Vertical netting	--	8	--	--	8	--	8	--	--	--	--	--	24
Gill netting	--	20	--	--	--	--	20	--	--	--	--	--	40
Sonar kokanee estimates	--	--	--	--	30	--	--	--	--	--	--	--	30
Kokanee juvenile sampling	--	--	--	--	40	20	--	--	--	--	--	--	60
Kokanee spawning run monitoring	--	--	--	--	--	--	10	--	--	--	--	--	10
Fish trapping	10	20	30	20	10	--	--	--	--	--	--	--	90
Equipment maintenance	6	6	6	6	6	6	6	6	6	6	--	--	60
													384
Laboratory:													
Surface insects	*----------											----------*	25
Zooplankton	*----------											----------*	70
Benthos	*----------											----------*	20
Mount scales/otoliths	*----------											----------*	15
Read scales/otoliths	*----------											----------*	20
													150
Data Analysis:													
Data entry	*----------											----------*	60
Statistical analysis	*----------											----------*	40
Data summary (graphs and figures)	*----------											----------*	20
													120
Report Preparation:													
Literature review	*----------											----------*	10
Report preparation	*----------											----------*	40
Word processing	*----------											----------*	15
													65
Administrative and Clerical:													
Word processing	*----------											----------*	30
Clerical	*----------											----------*	30
Project manager	*----------											----------*	35
													95

TOTAL													814

WATER QUALITY

Temperature and pH will be measured with a Martek V meter, and euphotic zone depth with a Protomatic photometer. Both light penetration and water quality profiles will be measured at the permanent stations monthly from April through December in Libby and May through November in Hungry Horse. These data will be entered into the U.S. Geological Survey WATSTORE system and summarized in isopleth diagrams. Libby Reservoir hydraulic influences will be quantified at depth using current velocity measurement techniques. A comparison with selective withdrawal and variations in dam discharge will elucidate the hydraulic effects of dam operation.

FISH FOOD ORGANISMS

Zooplankton

Three 30 m vertical tows will be made monthly with a Wisconsin plankton net from April through December. Three tows will be from the permanent station and six will be randomly selected. Forebay Schindler sampling in Libby Reservoir may be performed in conjunction with tail water sampling to calibrate zooplankton loss due to annual changes in selective withdrawal depth. Cladocerans and copepods will be identified to genus.

Surface Insects

Surface insects will be sampled at three randomly selected transects weekly from April through November using a net attached to a one meter by 0.3 meter frame. Two tows will be made at each transect, one within 100 meters of the shoreline and the other farther than 100 meters from the shore. The tows will be made in a zigzag pattern at a speed of about one meter per second until a distance of 600 meters has been sampled. The insects will be identified to order and the weight of each order determined.

Benthos

We will collect benthos monthly with a Peterson dredge in the reservoir study area. A total of nine samples will be taken at a permanent transect in each area and from each of the following depth zones: 1) full pool elevation to recommended drawdown, 2) recommended to maximum drawdown on record, and 3) below maximum on record. The macroinvertebrates will be identified to order and the wet weights of each insect order determined.

FISH POPULATIONS

Abundance

Seasonal and annual changes in fish abundance in near-shore zones will be assessed using floating and sinking gill nets.

These nets are 38.1 m long and 1.8 m deep and consist of five equal panels of 19, 25, 32, 38 and 51 mm mesh. A floating gill net set consists of two nets tied end-to-end creating a 76.2 m long net. Sinking net sets will be individual. All nets will be set perpendicular from shore and catches reported as the number of fish per single net.

Libby will be netted when water temperatures are approximately $10^{o}C$ in the spring and $15^{o}C$ in the fall, while the gill net sampling in Hungry Horse will take place in the spring when temperatures are in the 8^{o}-$10^{o}C$ range. Approximately 40 sinking and 10 floating sets will be made in Libby in the spring, whereas 30 sinking and 42 floating sets will be in Hungry Horse. The fall net series in Libby will consist of 20 floating sets.

Fish traps will be used to capture spawning runs of trout from Libby and Hungry Horse reservoirs into selected tributaries. An upstream box trap in the bypass channel collects spawning adults and a Wolfe type downstream trap captures spent adults and smolting juveniles. All fish collected in the traps will be anesthesized, measured, weighed, sampled for scales, marked and released.

Additional sampling to determine abundance and growth of kokanee will be done in Libby Reservoir. Vertical gill nets will be set seasonally to evaluate kokanee year class strength and determine empirical seasonal growth increments. Four vertical nets will be set in the evening and retrieved the next morning. The nets are 3.7 m wide, 45.6 m deep and depths are marked in 1.0 m increments. Each set includes four nets of square mesh size 19, 25, 32 and 38 mm. The number of adult kokanee will be estimated using hydroacoustical sampling during moonless nights in August and September. Vertical gill net data will be used to assign a proportion of the targets as kokanee. Approximately 40 transects covering 78 km will be surveyed throughout the reservoir. A trawl will be used to estimate abundance of Age 0 and Age I kokanee. This is a new technique and the details of the sampling design are in the process of being developed. Aerial flights will be used to count spawning densities of kokanee in tributary streams during September and October.

DATA PROCESSING AND REPORTING

Data collected during the evaluation program will be integrated into the data base management system currently being used for the HHR and LR studies. Summaries and analysis of data will be accomplished by methods developed during the present studies. The processed data will be used to validate and refine the models relating reservoir operation to the production of fish and fish food organisms and to evaluate the impacts of changes in reservoir operation upon the reservoir fishery.

A brief narrative summary describing each month's activities and the next month's work plan will be prepared. A detailed annual report will also be written each year. This report will include results, discussion, summary, conclusions, and appendices that contain summaries of all data collected. We will continue to evaluate additional information as it applies to reservoir operations and management of the fisheries.

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HUNGRY HORSE AND LIBBY RESERVOIRS
EVALUATION BUDGET ESTIMATE

April 1, 1988 - March 31, 1989

Proposed evaluation period: 1988-1993

A. SALARIES

Title	Grade/ Step	FTE	Salaries and Benefits	Total
Program Manager/Biologist	15/10	.25	8,786.39	
Fisheries Biologist III	14/6	1.00	29,940.19	
Fisheries Fieldworker II	10/8	1.00	23,185.47	
Fisheries Fieldworker III	11/8	1.00	24,843.70	
Fisheries Fieldworker I	08/6	1.00	19,552.07	
Work Study Students	1/1	.50	4,883.41	
Secretary/Word Processor	08/6	.58	10,706.60	
TOTAL SALARIES				$121,898

B. CONTRACTED SERVICES

Airplane rental for kokanee spawning counts	1,000	
U.S.G.S. water quality data base isopleth generation	1,000	
Statistical model consulting	5,000	
TOTAL CONTRACTED SERVICES		7,000

C. SUPPLIES AND MATERIALS

Propane for Anna Creek	300	
Gasoline for boats (3,000 gal @ 1.20/gal)	3,600	
10 gill nets (replacement of damaged nets)	1,500	
Laboratory reagents and supplies	500	
Field supplies (minor tools and instruments, field monitoring supplies, photographic supplies, fish trap materials, etc.)	3,000	
Office supplies and materials	2,000	
TOTAL SUPPLIES AND MATERIALS		10,900

D. COMMUNICATIONS

Telephone and postage	1,800	
TOTAL COMMUNICATIONS		1,800

E.	TRAVEL (Includes per diem)		
	Two 3/4 ton 4x4 pickups (1 with propane conversion) 1,200 mi/mo x 8 mo = 19,200 mi @ .28	5,376	
	One compact pickup 1,000 mi/mo x 8 mo = 8,000 mi @ .22	1,760	
	One subcompact sedan 300 mi/mo x 10 mo = 3,000 mi @ .19	570	
	Per diem 4 people in field @ 14.50 per day x 10 days/mo x 10 mo =	5,800	
	One trip to Portland airfare-$300.00, lodging -$35.00, meals-$50.00, car rental-$50.00	435	
	Kootenai/Flathead Coordination Meeting mileage-$150.00, meals-$150.00, lodging-$100.00	400	
	TOTAL TRAVEL		14,341
F.	RENT		2,000
G.	UTILITIES		500
H.	MAINTENANCE/REPAIR		
	Boats, trailers, field equipment		5,000
I.	EQUIPMENT		--
	SUBTOTAL		163,439
	Less MDFWP Share		16,344
	Subtotal		147,095
	Overhead 15.5%		22,800
	Subtotal		
	Plus MDFWP Share		16,344
	TOTAL CONTRACT		186,239

ANNEX B

EVALUATION OF METHODS TO MITIGATE THE EFFECTS OF HYDROELECTRIC DAM OPERATION ON KOKANEE REPRODUCTIVE SUCCESS IN THE FLATHEAD SYSTEM

Proposed Work Plan

Prepared by:
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PREFACE

Studies of the effects of hydroelectric dam operations on the kokanee salmon fisheries of the Flathead system began in 1979 and are scheduled to conclude in 1988 under funding from the Bonneville Power Administration. The results of these studies will include recommendation of methods to mitigate the effects of hydropower operations. This proposal outlines a plan to evaluate the effectiveness of the controlled flows in the Flathead River and mitigation strategies in Flathead Lake.

PROJECT STATUS

Studies of kokanee salmon in the Flathead River system were conducted by the Montana Department of Fish, Wildlife and Parks (MDFWP) from 1979-1982 with funding provided by the Bureau of Reclamation (Graham et al. 1980, McMullin and Graham 1981, Fraley and Graham 1982). These studies recommended that a flow range of 3,500 to 4,500 cfs be maintained in the mainstem river (measured at Columbia Falls) during the kokanee spawning period (October 15-December 15). A minimum flow of 3,500 cfs was recommended during the incubation period (December 15-April 30). These flows were intended to reduce redd dewatering, and the resulting high egg mortality, caused by the fluctuating discharge from Hungry Horse Dam. This flow regime was endorsed by the Northwest Power Planning Council (NPPC 1982) and subsequently provided by the Bureau of Reclamation beginning in the fall of 1982. Preliminary study flows were provided by the Bureau of Reclamation during 1980-81 and 1981-82. Research has focused on enumerating escapement and measuring egg-to-fry survival in spawning areas influenced by these flows and in tributaries that are not affected by releases from Hungry Horse Dam.

Study of the effects of lake level fluctuation on kokanee spawning success in Flathead Lake began in 1981. Winter hydropower operations at Kerr Dam lower the elevation of Flathead Lake ten feet. The lake has been drafted to minimum pool between February 15 and March 15 for the last five years. Kokanee eggs, deposited in shallow water in October and November, are exposed to freezing and desiccation. For the past five years, 50-90 percent of lakeshore spawning has occurred in sites above minimum pool (2,883 ft. m.s.l.). In most of these areas egg mortality is complete after two months exposure. Kokanee spawning persists at some shallow sites because groundwater seeps improve egg survival and facilitate fry emergence. Lakeshore escapement now comprises 2-4 percent of spawning in the entire drainage. Returns to the west shore, which were abundant in the 1940's and 1950's, have been eliminated except at one site in Rollins Bay. The persistence of strong lakeshore spawning returns into the 1960's, twenty-five years after Kerr Dam was built, was in part due to large-scale hatchery fry plants at several east shore areas.

Proposed evaluation/monitoring activities on the Flathead River are essential to develop a clear understanding of kokanee escapement and population trends, and to evaluate the effectiveness of the recommended flows in the Flathead River. Continued monitoring of escapement will allow generation of a stock-recruitment curve. Studies of the alevin survival and fry production are also necessary to evaluate the effectiveness of the controlled flows in the Flathead River.

Several strategies could be used to mitigate the effects of dam operations on Flathead Lake kokanee. Enhancement of lakeshore and tributary spawning runs would add diversity to the reproductive potential of the population, and stability to the fishery. Lakeshore reproductive success could be enhanced by minimizing the time that the lake is held at minimum pool, or by artificial means such as hatchery production or spawning channels. Fry production in the Swan River could be improved by constructing a spawning channel, and by improving upstream and downstream fish passage over Bigfork Dam. Whatever mitigation strategy is implemented, considerable effort is warranted to monitor its effectiveness in enhancing and stabilizing the Flathead kokanee population.

Understanding the survival and growth of young-of-the-year (YOY) fish is becoming more critical as the abundance of Mysis relicta, the oppossum shrimp, has increased exponentially in Flathead Lake over the past four years. Mysid shrimp compete with kokanee for cladoceran zooplankton. Changes in zooplankton community structure and reduced YOY kokanee survival have been observed following the establishment of mysid shrimp populations in other lakes (Rieman and Falter 1981).

If the survival of wild kokanee fry is significantly reduced by competition with mysid shrimp, mitigation strategies that stabilize fry production from the Flathead River would not maintain the fishery. Hatchery produced kokanee fry could be used to supplement wild production. These fry would be reared at the hatchery until July when zooplankton abundance peaks in Flathead Lake, and the conditions for survival are optimum. Survival of both wild and hatchery produced fry should be assessed in the lake before a long-term mitigation plan is implemented. The evaluation plan proposed here addresses the need for this information.

EVALUATION WORK PLAN

A. Escapement Counts

The number of kokanee redds are an indicator of the numbers of successful spawners in a particular area. Escapement can be estimated from redd counts by applying a ratio of the number of spawners associated with a completed redd. The number of spawners per completed redd averages 2.4 in the Flathead River system (Fraley 1984).

Redd counts to monitor kokanee population trends are proposed for major spawning sites in the main stem Flathead River, South Fork of the Flathead River, two tributaries of the Middle Fork of the Flathead River, the Whitefish River, and at ten areas on the shore of Flathead Lake. All redd counts are high priority, i.e., are considered essential to monitor kokanee population trends. We will collect kokanee at major spawning areas for analysis of age, sex and length.

Snorkel counts of kokanee spawners in lower McDonald Creek should be conducted biweekly from early September through mid November to determine timing and strength of the spawning run and to assess natural fluctuations in the population. The counts are conducted on the 4 km of stream from McDonald Lake to the Middle Fork of the Flathead River.

Spawner surveys on Flathead Lake, using boat and SCUBA, would cover only the principal east shore areas. Four surveys will be done -- in November and early December. Two aerial surveys of the west shore would supplement boat surveys. The Swan River run will be monitored with biweekly snorkel counts at Bigfork Dam, from mid October to early December.

The harvest of kokanee spawners in the Flathead River, especially in the Salmon Hole area where fish stage before proceeding upstream, will be closely monitored and regulated to ensure that anglers do not over-harvest a particular year class. Aerial surveys will be used to index the migration timing and number of river spawners. During years of weak cohorts, kokanee fishing may be closed in the river to ensure adequate escapement.

B. Preemergent Survival

Sampling kokanee eggs and alevins in spawning gravels provides data on survival and development that can be compared between years at a particular site. We recommend that egg and alevin sampling be conducted during late January in McDonald Creek (natural) and the main stem of the Flathead River (regulated) to monitor development and survival.

C. Fry Survival

Estimating the abundance and timing of fry emigrating from the river system will be coordinated with studies of YOY kokanee on Flathead Lake. The timing of emigrating fry will be monitored by drift-netting the lower Flathead River throughout the cross-sectional area of the water column. Several lower river sloughs and backwater areas will be netted or electrofished to determine if fry are rearing in them.

Fry will be sampled in Flathead Lake by trawling during late spring and early summer. Early summer zooplankton abundance may be reduced by the rapidly increasing grazing pressure of oppossum

shrimp (Mysis relicta). Growth rate and survival of YOY kokanee may be affected.

We propose to measure and compare the growth rates of 0+ and 1+ kokanee over a five year period, as the competitive interaction with mysid shrimp develops. Growth rates over specific time intervals of 15-30 days can be accurately measured on otoliths (Campana and Neilsen 1985). The age structure of successive samples of YOY fish taken in any one year will provide an estimate of survival rate (Essig and Cole 1986). Direct estimation of 0+ and 1+ year class strength is difficult at the present low fish densities in Flathead Lake. The catch per effort statistics derived from trawl and gill net sampling of areas in the lake where these ages of fish aggregate will yield an index of abundance. The assessment of 1+ year class strength is particularly useful as an estimate of recruitment, and as a predictor of adult year class strength two years later.

Characterization of kokanee diet will detect changes in food habits, if they occur, as the zooplankton community changes in response to mysid grazing pressure. It is important to determine if YOY kokanee use alternate prey as cladoceran zooplankton becomes less available. We will compare food habits data with those collected before mysids became established (Leathe and Graham 1982).

D. Adult and Sub-adult Year Class Strength

We will estimate the abundance of II+ and III+ kokanee in Flathead Lake using hydroacoustic gear, and with trawls and gill nets. Transects representative of all limnetic habitats in Flathead Lake will be sampled before mature fish begin the spawning run upriver. Species composition and age of acoustic targets will be verified in concurrent trawl and gill net samples. We will develop estimates of abundance for each year class, and measure growth rates by reading otoliths. Baseline growth rate data has been collected by MDFWP for the past ten years, which will allow comparison of growth parameters before and after the impact of mysid shrimp. The assumptions of density dependent growth in the lake will be tested. This yearly sampling of the kokanee population will provide accurate estimates of year class strength for all ages of fish, and will allow us to monitor the effectiveness of mitigation efforts that improve reproductive success. Abundance estimates will provide a sound basis for management of the kokanee fishery.

E. Zooplankton Community Dynamics

Zooplankton abundance will be sampled seasonally at six index stations through the year. Spring/early summer community composition and species density will be sampled at six stations biweekly from May to August. We will also sample zooplankton at stations where we sample fish. This sampling regime is designed

to detect changes in the zooplankton community, as mysid grazing pressure increases, especially during the growing season of kokanee.

Mysid abundance will be measured at 15 stations on Flathead Lake, in June and September of each year. The spring sample will assess mysid year class strength at the time of peak abundance. The fall sample will be compared with data from five previous years, taken in September, and allow assessment of the impact of predation on the mysid population during the summer.

F. Evaluation of Artificial Enhancement

Releasing hatchery produced kokanee fry in Flathead Lake would be a feasible mitigation strategy for loss of lakeshore spawning if survival of wild fry is limited by competition with mysid shrimp. Limited hatchery facilities require that late-release fry be reared in pens in the lake. We will determine the optimum time of fry release by assessing the survival of groups of 400,000 to 500,000 fry released between May 15 and July 15. Hatchery fry will be marked, either by tetracycline feeding, fluorescent dye, or temperature changes read on the otoliths, to identify them upon recapture. Intensive trawl sampling, described in Section C, will provide sufficient samples for measuring the relative survival rates of groups of hatchery fry.

We will study the feasibility of building a spawning channel at Bigfork Dam or improving upstream passage at the dam to enhance the productivity of the Swan River kokanee run. Enhancement of any wild "stock" is contingent on proof that wild fry will be recruited to the fishery. Reproduction in Swan River presently is limited by the lack of spawning habitat. The recent level of annual escapement of 1,000 to 1,500 fish could be in increased to 5,000 if a spawning channel were built. Improved passage through Bigfork Dam could contribute significantly to the production of juvenile kokanee for Flathead Lake. Enhancement of tributary runs is aimed at increasing the diversity of kokanee stocks that contribute to the Flathead Lake fishery.

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FLATHEAD RIVER KOKANEE EVALUATION AND MONITORING
ACTIVITY SCHEDULE

April 1988 - March 1989 (Proposed evaluation period: April 1988 - March 1993)

Activity	Worker Days												
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	MAN-DAYS
Redd counts	--	--	--	--	--	--	4	12	--	--	--	--	16
Snorkel counts	--	--	--	--	--	7	9	3	--	--	--	--	19
Fish samples	--	--	--	--	--	--	2	3	1	--	--	--	6
Fry sampling	8	13	13	--	--	--	--	--	--	--	--	2	36
Creel survey	--	--	--	--	--	15	--	--	--	--	--	--	15
Egg & alevin sampling	--	--	--	--	--	--	--	--	--	4	2	--	6
Clerical	11	11	11	10	10	11	11	11	11	11	11	11	130
TOTAL MAN-DAYS	19	24	24	10	10	33	26	29	12	15	13	13	228

Summary of activities and man-day requirements outlined in the Flathead River system kokanee evaluation/ monitoring report.

FLATHEAD LAKE KOKANEE EVALUATION AND MONITORING
ACTIVITY SCHEDULE

April 1988 - March 1989 (Proposed evaluation period: April 1988 - March 1993)

Activity	Worker Days												
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	MAN-DAYS
Spawner surveys and preemergent survival	--	--	--	--	--	--	8	16	8	--	--	--	32
YOY survival and abundance	--	16	16	16	16	16	16	30	30	--	--	--	156
Adult population dynamics	--	--	25	25	20	20	--	--	--	25	25	--	140
Zooplankton monitoring	8	16	16	16	16	8	8	8	8	8	8	8	128
Expt'l fry plants	--	20	20	20	20	--	--	--	--	--	--	--	80
Clerical	11	11	11	11	11	11	11	11	11	11	10	10	130
TOTAL MAN-DAYS	19	63	88	87	82	55	43	65	57	44	44	19	666

NOTE: Activity schedule includes laboratory analysis time for each phase of study.

FLATHEAD SYSTEM KOKANEE
EVALUATION BUDGET ESTIMATE

April 1, 1988 - March 31, 1989[1/]

A. SALARIES

Title	Grade/ Step	FTE	Salaries and Benefits	Total
Project Manager	15/10	.35	12,300.93	
Fisheries Biologist II	14/06	1.00	29,940.10	
Fisheries Fieldworker II	10/08	1.00	23,185.47	
Fisheries Fieldworker I	08/06	.55	10,753.64	
Secretary/Word Processor	08/06	.38	7,013.54	
TOTAL SALARIES				83,194

B. CONTRACTED SERVICES

Aircraft rental (kokanee migration, angler counts redds surveys) 30 hr @ $60/hr	1,800	
Hydroacoustic assessment consulting	5,000	
TOTAL CONTRACTED SERVICES		6,800

C. SUPPLIES AND MATERIALS

Thermometer and probe	800	
Gasoline for boats (900 gal @ 1.36/gal)	1,224	
Field supplies (minor tools and instruments, photographic supplies, field monitoring supplies, etc.)	1,000	
Office supplies (photocopying, photography, etc.)	3,500	
Computer materials/supplies	3,000	
TOTAL SUPPLIES AND MATERIALS		9,524

D. COMMUNICATIONS

Telephone	2,500	
Postage	1,000	
TOTAL COMMUNICATIONS		3,500

1/ Proposed evaluation period: April 1988 - March 1993.

E.	TRAVEL AND TRANSPORTATION		
	One 1/2 ton 4X4 pickup 1,000 mi/mo x 12 mos = 12,000 mi @ .24	2,880	
	One 1 ton 4x4 pickup 600 mi/mo x 12 mos = 7,200 mi @ .50	3,600	
	Per diem 4 people in field @ 14.50 per day x 120 days	5,220	
	Three trips to Portland airfare-$300.00, per diem/bus-$150.00 = $450/trip total	1,350	
	TOTAL TRAVEL AND TRANSPORTATION		13,050
F.	RENT		2,000
G.	UTILITIES		500
H.	MAINTENANCE/REPAIR		
	Boats, trailers, diving gear, thermograph pumps, freight, etc.	3,000	
	Computer/office equipment	2,500	
	TOTAL MAINTENANCE/REPAIR		5,500
I.	EQUIPMENT		--
	SUBTOTAL		124,068
	Less MDFWP Share		12,407
	Subtotal		111,661
	Overhead 15.5%		17,307
	Subtotal		128,968
	Plus MDFWP Share		12,407
	GRAND TOTAL		141,375

ANNEX C

A PROGRAM FOR EVALUATING AND MONITORING WESTSLOPE CUTTHROAT AND BULL TROUT POPULATIONS AND STREAM HABITAT IN THE FLATHEAD RIVER SYSTEM

Proposed Work Plan

Prepared by:
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INTRODUCTION

Monitoring and evaluation of fishery resources in the Flathead Basin is essential for the responsive management of fish populations in the drainage. In addition, a comprehensive evaluation/monitoring program is required to detect changes in fish populations and habitat caused either naturally or by various forms of resource development. The evaluation/monitoring program outlined in this report is a revision and update of a previous fishery resource monitoring strategy (Shepard and Graham 1983). The program involves fish abundance monitoring, bull trout spawning site inventories, and streambed composition in the Flathead River Basin. The areas proposed for monitoring include selected tributaries of the North and Middle Forks of the Flathead River, the North Fork of the Flathead River and selected tributaries of the Swan River.

The Flathead River Basin Studies (FRBS), which were conducted from 1978-1983, provided an extensive fishery resource data base for comparisons of fish population and habitat trends (Montana Department of Fish, Wildlife and Parks 1979, Graham et al. 1980, Fraley et al. 1981, Shepard et al. 1982, Graham et al. 1982, Fraley and Graham 1982, Shepard and Graham 1983, 1983a, Shepard et al. 1984). These studies also evaluated methods for measuring fish abundance and habitat. The monitoring program recommended in this report is based on results and recommendations from the FRBS, as well as on information generated from other studies conducted since the FRBS were completed.

Major objectives for this project are listed below:

1) Evaluate the population status of bull trout in the Flathead Lake and River system through redd counts and estimates of juvenile abundance in tributaries.

2) Evaluate the population status of juvenile westslope cutthroat in selected tributaries.

3) Determine the impact of land use practices on stream habitat of the above species through monitoring of various habitat conditions in selected tributaries.

4) Test suspected limiting factors on populations of bull trout and cutthroat through continued monitoring of tributary populations and habitat. If time allows (or if additional funding is available), employ migrant trapping techniques to help identify limiting factors.

AREA DESCRIPTION AND MONITORING SITES

The Flathead Lake-River system is the northeastern-most drainage in the Columbia River Basin. Flathead Lake is a large oligomesotrophic lake with a surface area of 476 km^2 and a mean

depth of 32.5 m. The upper 3 m of Flathead Lake is regulated by Kerr Dam, constructed on the outlet in 1938. The Flathead River enters the north end of the lake. The lower 35 km of the river is regulated by Kerr Dam, and is slough-like with a silt bottom. The remainder of the river has a moderate gradient and gravel-rubble bottom for 55 km to its forks.

The South, Middle and North forks drain areas of approximately equal size in portions of the Great Bear and Bob Marshall wildernesses, Glacier National Park and the Flathead National Forest (Figure 1). The upper North Fork drains southern British Columbia. The South Fork is regulated and the main stem below the South Fork is partly regulated by Hungry Horse Dam, located on the South Fork 8 km above its mouth. The Swan River enters Flathead Lake near the mouth of the Flathead River.

Many fish species are migratory within the lake-river system. Adfluvial bull trout and cutthroat grow to maturity in Flathead Lake, ascend the river system and its tributaries to spawn, then return to the lake. Bull trout spawn in the tributary system in the fall; cutthroat spawn in the spring. Juveniles of these species rear in the tributary and river systems from 1-4 years before returning to the lake. There are also fluvial and resident populations of westslope cutthroat, and a few resident populations of bull trout.

Fisheries monitoring sites are located on 16 tributaries in the Flathead Basin (Figure 1). Five tributaries were selected in the North Fork Drainage, seven in the Middle Fork Drainage, and four in the Swan Drainage. In addition, a river site is located on the North Fork between Ford and Whale Creek.

MONITORING/EVALUATION PROGRAM

The proposed program is designed to monitor: 1) bull trout spawning population in the river system, 2) the abundance of westslope cutthroat and bull trout juveniles in selected rearing tributaries and, 3) streambed conditions in important bull trout spawning streams. The program will result in a continuous, time series data base for westslope cutthroat and bull trout in the Flathead River Basin. This information will provide an important basis for adaptive management of the fish populations and habitat in the basin. All of the work proposed in this plan will be coordinated with the fisheries management staff of Region One MDFWP. We will assist the management staff in monitoring the fishery in Flathead Lake.

Fish abundance estimates are proposed for four tributaries and one site on the river near Whale Creek in the North Fork Drainage (Table 1). In the Middle Fork Drainage, three tributaries were selected for fish abundance monitoring. Electrofishing methods (two-pass, mark-recapture) will be used to estimate westslope cutthroat and bull trout abundance in tributaries (Shepard and

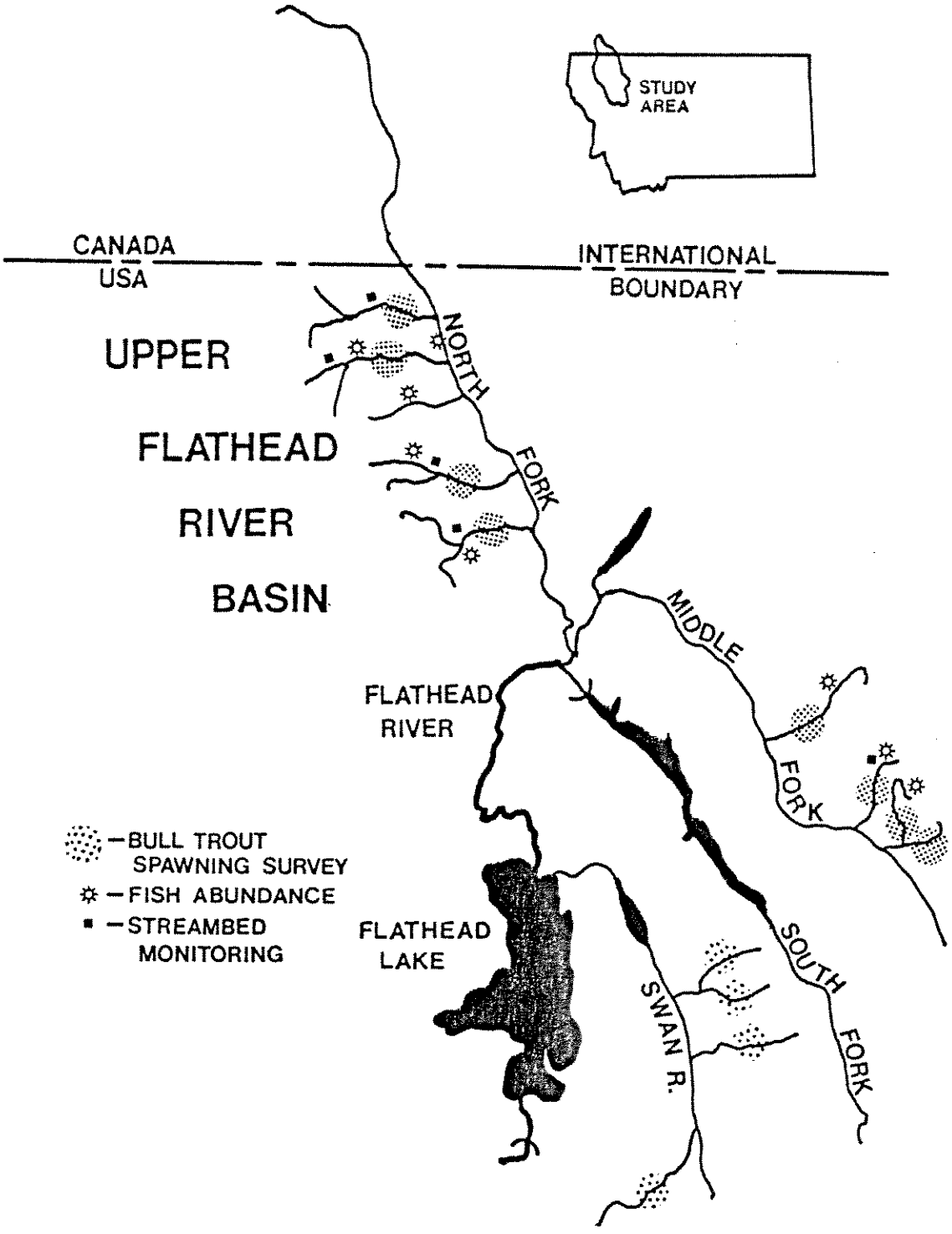

Figure 1. Fisheries monitoring sites in the Flathead Basin.

Table 1. Summary of fish abundance estimates for the Flathead Basin monitoring plan (WCT=westslope cutthroat trout; DV=bull trout).

Drainage	Stream	Species	Worker-Days Field	Worker-Days Data Analysis
Tributaries	Big	WCT, DV	8	1
North Fork	Coal Drainage	DV, WCT	24	2
	Red Meadow	WCT	8	2
	Whale	DV	8	2
Middle Fork	Ole	DV, WCT	3	1
	Morrison	DV	3	1
	Challenge	WCT	3	1
River				
North Fork near Whale Creek		WCT	8	1
		Subtotals	65	11
		Total	76	

Graham 1983). Westslope cutthroat density in one section of the North Fork Flathead River will be estimated by four snorkelers making two complete passes through a 3 km section (Slaney and Martin 1986).

Bull trout redd surveys will be conducted on four tributaries in each of the North Fork and Swan drainages (Table 2). Six tributaries will be monitored in the Middle Fork Drainage. Survey methods and exact locations of the monitoring sites on each tributary are presented in Shepard and Graham (1983) and Leathe and Enk (1985).

Substrate size composition will be measured in five tributaries (Table 3). All sites are important bull trout spawning areas. Methods and locations for streambed monitoring are presented in Shepard and Graham (1983) and Weaver and Fraley (1985).

A total of 185 man days are required for the Flathead Basin Plan (Table 4). The budget for the proposed evaluation plan is presented in Attachment A.

Table 2. Monitoring sites and man-day requirements for bull trout spawning surveys.

Drainage	Stream	Worker-Days Field	Worker-Days Data Analysis
North Fork	Coal	4	1
	Whale	4	
	Trail	2	1
	Big	2	
Middle Fork	Ole	2	
	Morrison	6	1
	Lodgepole	2	
	Granite	2	1
	Dolly Varden	4	
	Schafer	2	1
Swan	Goat	2	1
	Squeezer	2	
	Lion	2	
	Elk	2	1
	Subtotals	38	7
	TOTAL	45	

Table 3. Streambed monitoring sites and man-day requirements for the Flathead Basin monitoring plan.

Drainage	Stream	Site	Worker-Days: Field	Worker-Days: Laboratory and data analysis
North Fork	Big	Skookoleel Creek Road Bridge	2	2
	Whale	Whale Buttes Road Bridge	2	2
	Trail	Junk car site	2	2
	Coal	Dead Horse Bridge Above South Fork Bridge, South Fork Coal Creek	6	6
Middle Fork	Granite Creek below trailhead		2	2
		Subtotals	14	14
		TOTAL	28	

Table 4. Summary of activities outlined in the Flathead Basin Fisheries monitoring plan (includes some contribution from the permanent Region One staff.

	Worker Days								
Activity	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	TOTAL
Fish abundance estimates	10	40	15	--	--	--	--	--	65
Bull trout spawning site survey	--	2	40	--	--	--	--	--	42
Streambed monitoring	--	4	10	--	--	--	--	--	14
Laboratory and data analysis	--	--	--	6	14	6	6	--	32
Report preparation	--	--	--	--	--	4	4	8	16
Coordination/ administration	3	3	3	3	3	3	2	1	21
TOTALS	10	43	24	59	17	11	10	5	190

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Attachment A

FLATHEAD RIVER BASIN
EVALUATION/MONITORING BUDGET ESTIMATE

April 1, 1988 - March 31, 1989

Proposed evaluation period April 1988 - March 1993

A. SALARIES

Title	Grade/ Step	FTE	Salaries and Benefits	Total
Project Biologist/Manager	15/10	.40	$14,058.21	
Fisheries Fieldworker I	08/06	.45	8,798.43	
Secretary/Word Processor	08/06	.04	736.97	
TOTAL SALARIES				$23,594

B. CONTRACTED SERVICES $ 0

C. SUPPLIES AND MATERIALS

Field supplies	$1,000
Office supplies and materials	500
TOTAL SUPPLIES AND MATERIALS	$ 1,500

D. COMMUNICATIONS $ 700

E. TRAVEL AND TRANSPORTATION

Transportation (4,800 mi. @ .25/mi.)	$ 1,200
Per diem (121 days in field x 14.50/day)	1,754
TOTAL TRAVEL	$ 2,954

F. RENT $ 2,000

G. UTILITIES $ 500

H. MAINTENANCE/REPAIR

Minor field equipment maintenance	$ 1,500
TOTAL MAINTENANCE/REPAIR	$ 1,500

I. EQUIPMENT

SUBTOTAL	$32,748
Less MDFWP Share	14,737
Subtotal	18,011
Overhead 15.5%	2,791
Plus MDFWP Share	14,737
GRAND TOTAL	$35,540