MONTANA DEPARTMENT OF FISH AND GAME

FISHERIES DIVISION

June 1978

# FLATHEAD BASIN FISHERY PROPOSALS

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## INTRODUCTION

Flathead Lake and the Flathead Rivers in northwestern Montana and southeastern British Columbia, Canada are well known as pristine, oligotrophic waters. The sport fishery is famed for its spring runs of Dolly Varden (Salvelinus malma), cutthroat trout (Salmo clarki), and fall runs of kokanee salmon (Onchorhynchus nerka) which annually migrate from the lake into the rivers to spawn. Recently fisheries and limnological research in Flathead Lake and river areas upstream have increased due primarily to the need for suitable land, timber, and water resource management plans in the face of exploitation of coal and gas reserves in the drainage.

The system has never been holistically studied, and until recently a paucity of accurate biotic and chemical data has persisted even though investigations were initiated in the early 1900's (Potter 1976). Published research studies have recently encompassed the drainage to a limited degree physically, chemically and ecologically. It is now clear that the lake-river system functions as a single ecosystem; river discharges influence the limnology of Flathead Lake, and the spawning, larval, and juvenile fish ecology of migrating species is an important part of the structure and function of upstream communities.

Activities associated with timber harvest, flood control, hydroelectric generation and fossil fuel mining in the drainage have, in certain areas, altered natural ecosystem processes enough that specific effects may be quantified. Yet, the system presently retains pristine qualities. Extensive additional resource exploitation that may lack ecological foresight is presently in progress or imminent, particularly in oil and coal reserves. Certainly, progress toward development of sound resource use plans has been made as best evidenced by the sincere efforts of the Flathead 208 Planning Board, Canadian Department of Environment and other state, federal and international groups. These programs have been very limited. The proposal asks for necessary funds to scientifically delineate and quantify these ecosystem processes and develop management strategies to prevent degradation of their natural structure and function in the Flathead Lake-River ecosystem.

### The Flathead Lake-River Fishery

Flathead Lake and its tributaries are interconnected biotically by spawning migrations of several species of adult fish from the lake into upstream areas and by subsequent movement of larval and juvenile fish back to the lake (Block 1955, Johnson 1963, Hanzel 1976). Only 10 of the 23 presently known resident fishes are native. Nine of these are adfluvial. Distance moved upstream for spawning

vary by or within species and range from the mouth area of the Flathead River to 100 miles or more upstream and into tributaries.

Dolly Varden, westslope cutthroat, kokanee, and some whitefish live in Flathead and other lakes in the drainage as sub-adults and adults, migrating into tributaries to spawn. These are termed adfluvial populations. Dolly Varden and cutthroat eggs hatch and young fish live in tributaries and rivers for two to three years. Whitefish and kokanee eggs hatch and young migrate soon after hatching into downstream areas. They become adults in two to four years. Variations in habits of Dolly Varden, westslope cutthroat, and mountain whitefish cause some racial strains to live as adults in larger streams but still migrate into small tributaries to spawn. Upon hatching, the young generally stay in small tributaries from one to three years before migration into larger streams. These are termed fluvial populations. Additional variation, either genetic or somatic, cause some westslope cutthroat and mountain whitefish to live their entire life span in smaller tributaries, although access to larger streams or lakes is possible; these are termed stream resident populations. Some species and/or populations complete their life histories without leaving Flathead Lake or other lakes in the drainage.

The migrational aspects of the fishery have received a fair amount of study (see Block 1955, Hanzel 1959, and Hanzel 1970-76), but trophic relationship and quality and quantity of available spawning and larval habits are poorly documented. Rahrer (1963) studied aspects of age and growth of Dolly Varden, yellow perch, peamouth, and squawfish in localized areas at the north end of Flathead Lake. Knowledge of the fishery to 1972 has been summarized by Gaufin, Prescott and Tibbs (1976).

Construction of Hungry Horse Dam blocked access to a major spawning area, the South Fork Flathead River and its tributaries. The Swan and Stillwater rivers have also been blocked by dams to some extent. The Stillwater River Dam was removed in 1962 and spawning runs of some game fish are starting to reestablish there.

It has been estimated that 60 percent of the original spawning runs of westslope cutthroat trout and Dolly Varden from Flathead Lake were blocked by construction of Hungry Horse Dam. In addition, some spawning and rearing areas for whitefish and kokanee were inundated by Hungry Horse Reservoir. The reservoir has developed viable cutthroat, whitefish, and Dolly Varden populations and has supported a fair fishery. But the quality and quantity of this fishery has declined in recent years. Reduced numbers and size of game fish in Hungry Horse Reservoir are thought to be a direct result of increased seasonal withdrawal and changes in water level manipulations.

As has been documented for aquatic insects, alteration of river flow and thermal regimes by hypolimnial releases from Hungry Horse Reservoir apparently have changed spawning migrations (i.e., prolonged or delayed rate of migration thus reducing egg survival) of most adfluvial species. Movements of juveniles downstream likely are also affected. Local anglers and Department of Fish and Game personnel have observed that water regulation has increased utilization of the mainstream Flathead River by spawning kokanee salmon and decreased shoreline

spawning in Flathead Lake. Significant mortality in fall-spawned eggs probably occurs in Flathead Lake due to fall and winter drawdown thus favoring adfluvial populations.

It is also significant that kokanee populations key spawning movements by river temperatures and select spawning sites in lotic areas thermally moderated by lake discharges. In the years immediately after kokanee were introduced into Flathead Lake, most spawning occurred along the lake shoreline during fall turnover (about 7 C). For reasons not fully elucidated, kokanee now spawn most abundantly in MacDonald Creek just above its confluence with the Middle Fork. Often more than 300 bald eagles and several grizzly bears congregate annually in the fall to feed on salmon concentrated on the spawning beds. Some successful spawning also apparently occurs in the mainstream Flathead River below the confluence of the South Fork; this trend appears to be increasing (Hanzel 1970-76). Both of the consumers are listed as rare and endangered by the U. S. Fish and Wildlife Service. This area of MacDonald Creek is naturally influenced by hydrodynamics of deep Lake MacDonald and kokanee spawn during fall overturn when temperatures in the creek are around 7° C. However, kokanee spawn with some success in the South Fork below Hungry Horse Dam and in Swan River below the small hydroelectric diversion dam near Bigfork. Again, thermal moderation by the lakes upstream increases temperatures in late fall to about 7 C in these areas slightly above ambient mainstream river temperature, providing a good thermal key for adfluvial populations. Furthermore, hypolimnial dishcarges from Hungry Horse Reservoir during late summer and fall moderate the mainstream Flathead River and may explain observed increases of river spawning. The quality of river spawning sites in the South Fork directly below Hungry Horse Dam is, however, questionable due to extreme variation in water volume and the compacted nature of the substrata.

One final aspect of the fishery deserves mention. Populations of northern pike (Esox lucius) are being discovered in new areas of the drainage every year. This carnivorous and highly competitive exotic occurs abundantly in the Flathead River below Flathead Lake and in lower Stillwater Lake. Their status in Flathead Lake is not known, but at least a few specimens have been taken there.

## OBJECTIVES OF PROPOSED FISHERIES RESEARCH

Part A. Temporal and Spatial Fish Distribution (A-1 North Fork, A-2 Middle Fork)

Thorough inventory of fish spawning habitat and complete documentation of fish movements in the North and Middle Forks of the Flathead River are needed. This research is proposed in two temporally segregated segments, one for work on the North Fork and the other for the Middle Fork, each with the same objectives. This is necessary because of logistical problems in simultaneously deploying manpower and equipment over such a large area. The North Fork is of special interest for two reasons. The western tributaries of the North Fork drain areas already altered by timber harvest and designated for mining of fossil fuels. Coal strip mines and asssociated human concentrations are located just across the border in Canada. The eastern tributaries to the North Fork all drain Glacier and Waterton National Parks and remain in natural state. Thus, the tributaries of

the North Fork are ideally suited to quantify habitat degradation, as well as document natural life histories, and environmental requirements of migrating species.

1. Locate the varied populations in the river or tributaries at frequent intervals, monthly or more frequently, to verify residency, or migration times and patterns. Findings will be correlated with weather, time and stream flows to interpret migration distribution.

2. Determination on indices of abundance for adults by time and area for major tributaries. Findings will enable ranking of streams for strength or spawning populations, and calculation of adfluvial migration and arrival times.

3. Determine downstream migration patterns of juveniles for time, age, size of individuals and index of recruitment numbers to downstream river and lake system. Findings will be used to separate resident from fluvial or adfluvial populations, to verify periods of movement or migration, and to evaluate carrying capacity. Growth and natural mortality rates of various juvenile age classes may be correlated with habitat classifications.

4. Identify wave movements (by tributary) of migrants to and from Flathead Lake, as they sort out in time.

5. Quantify and quality habitat types for spawning and rearing of presmolts on all significant tributaries on the United States side of the border. Analyses of results in comparable streams on the east and west sides of the North Fork should allow quantification of possible deleterious impacts on the fishery.

6. Determination of minimum flows tolerable to sustain the indigenous fish species will be made as result of physical habitat surveys and biological finding. Water reservation will be made to the DNR for those instream minimum flows for fish and wildlife in the name of the Department of Fish and Game.

## Part B-1. Alteration of the Fishery by Hypolimnial Discharges

The goal of this portion of research is to firmly quantify the influence of altered discharge and temperature regimes on adfluvial and fluvial fish populations in areas below Hungry Horse Reservoir.

The objective will be to investigate and explain variations in fish life histories and behavior as a direct result of discharges from Hungry Horse Reservoir. This information will be used to make recommendations for discharge programming to ensure optimum fish production and survival in the altered areas. Consideration will also be given to planning discharge schedules relative to angler success, a matter of considerable interest to the local public. Major research emphasis will be given in study of sport fish populations (e.g., Dolly Varden, cutthroat and kokanee). However, other species will not be overlooked and as much information as possible will be gathered.

1. The influence of moderated temperature and discharge regimes on fish passing through the mainstream Flathead River on their way to spawning areas above the confluence of the South Fork will be quantified. Similar study of juveniles moving downstream will be made. We are especially interested in deciding: (a) how kokanee migrations might be prolonged, delayed or enhanced by reservoir discharges; (b) how such mechanisms operate and what the quantitative effects are on kokanee spawning success upstream; and, (c) subsequent year class strengths in Flathead Lake.

2. Evaluation of reproductive success and year class production of adfluvial and fluvial species which spawn in the South Fork and mainstream Flathead Rivers below Hungry Horse Dam will be made. Factors of interest here include: movements of adults and juvenile fish in response to flow and temperature patterns, selection of spawning sites, variation of egg and larval fish survival within altered gradient, and temperature and habitat selection by emergent fry and fingerling fish.

Part B-2. Benthic Ecology in Altered Riverine Habitats

Interrelationships in life history criteria and production of invertebrates and fish in altered areas must be carefully examined, for they may correlate independently of each other and of temperature and discharge effects. The response of fish and invertebrates may be entirely different, especially in the lower South Fork. Each responds in its own way to the experimental gradient ranging from total alteration directly below the dam to a moderate alteration in 30 miles of the main Flathead River. The main river is influenced by fluctuating water volumes and temperatures flowing from natural areas above the confluence of the South Fork, as well as those released from Hungry Horse Reservoir.

The objectives of this research are to quantify the changes in abundance and species diversity of periphyton and benthic invertebrates in those areas above the South Fork's confluence, in the South Fork below the dam, and in the main river. Also investigated will be riverine environments immediately downstream of impoundments, including lower MacDonald Creek, lower Swan River and South Fork of Flathead River below Hungry Horse Dam. Autotrophic and heterotrophic adaptations must be characterized, quantified, and compared to pristine regions of the river system. Interpretation of basic floral and faunal responses to environmental alterations will be made.

1. Temporal dynamics in physical and chemical parameters (e.g., temperature, photoperiod, turbidity, discharge, dissolved solids, etc.) will be firmly documented in the specified areas. Assessment will be made of the nutritive impact of decaying salmon for MacDonald Creek.

2. Primary productivity, including species composition, standing crops, and turn-over rates in the specified areas will be compared and will involve quantification of autorophic and heterotrophic microbial activity as it correlates with carbon fixation and detrital processing. The importance of drift and organic seston material from impoundments will be quantified and related to benthic trophic structure in the specified lotic habitats.

3. The structure and function of the macroinvertebrate community will be studied within the specified areas to illustrate quantitative differences in composition and biomass and life history compared to the ecology of the unaltered river system.

Part C. Trophic Relationships in Flathead Lake

The objectives of this research are to firmly document food chain interrelationships of the various year classes of fish in Flathead Lake with particular research emphasis on the ecological energetics of the sport fisheries (e.g., lake trout, Dolly Varden trout, cutthroat trout, kokanee salmon, mountain whitefish and lake whitefish).

1. Feeding habits of the major fish species in the lake will be determined quantitatively on a time-series basis.

2. Estimates of temporal standing crops (biomass) of major fish species in the lake will be made. Distribution maps will be constructed to demonstrate temporal and spatial (including depth) preferences of the various populations occurring at any particular time in relation to lake hydrodynamics.

3. Annual production of principal lake fishes will be estimated using all available recent data on river migrations and lake recruitment of the various year classes. Historical data will be consulted for comparative purposes and to help facilitate formulation of a firm statement on the state-of-the-fishery. Major factors limiting production of the adfluvial fish populations in Flathead Lake will be identified in association with reservoir studies.

Part D. Status, Utilization and Habitat Inventory of Hungry Horse Reservoir Fishery

The objective of this research will document the present condition and utilization of the fishery in the Hungry Horse Reservoir system and investigate the influence of lake level fluctuations on production. Specific objectives are:

1. Determine age and rate of growth of major game fish species and major nongame species.

2. Determine total mortality rates on game fish and nongame fish.

3. Make estimates of temporal standing crops (biomass) of major fish species in the reservoir and determine angler harvest.

4. Inventory and quantify spawning and rearing habitat in important tributaries to the reservoir excluding the South Fork above Gorge Creek.

5. Make population estimates where numbers of fish are great enough and make population indices of abundance on lesser used tributaries.

6. Determine times of movement from reservoir to tributaries and tributaries to reservoir for cutthroat trout, Dolly Varden trout, and mountain whitefish. Both spawning populations and presmolt populations will be considered.

7. Determine food habits of game fish in the reservoir.

8. Determine food habits of nongame, forage and predation species.

## FISHERIES RESEARCH METHODS

The methods and equipment to be used in all phases of fisheries work are standard fishery methods or more recent and sophisticated electronic assessments. Fish populations will be sampled using a variety of trawls, nets and traps and other appropriate fishing gear. Several tagging programs will be employed to obtain migration and production data. In order to obtain maximum information on adfluvial populations, it will be most appropriate to perform Parts A and C starting in 1978, to facilitate a drainage-wide tagging (i.e., mark and recovery) effort.

Parts B and D must be delayed due to funding shortages for other Flathead River related studies. Funding for Parts B and D could come from the Bureau of Reclamation, as they will need this information to do a feasibility study on adding extra generators to Hungry Horse Reservoir and building a power generating reregulating reservoir below Hungry Horse Dam but above the South Fork's confluence with the main Flathead River.

These study parts should be programmed to run in the same timeframe as the North and Middle Fork studies in order to reduce the number of years that complete water quality stations need be operated on the three main forks.

Age and growth data will be generated from scale readings and length-weight frequency data. These methods are nicely summarized in Lagler (1956) and Ricker (1968). In addition, the Montana Department of Fish and Game has also required state-of-the-art acoustical gear for monitoring fish movement and biomass in the lake environment (see Thorne, Nunnallee and Green 1972).

### Part A. Temporal and Spatial Fish Distributions in the North and Middle Forks

North Fork Study Segment (A-1)

Spawning and rearing habitat in each significant tributary will be inventoried as to quality and quantity of spawning gravels. Ground surveys combined with low altitude aerial photos studied stereoptically will be used in combination to cover the 270 miles of North Fork tributaries outside Glacier National Park. Ground surveys will classify gravels as to size, potential permeability, water depth, velocities and available cover. The 134 miles of tributaries in Glacier National Park will be inventoried in cooperation with park and U. S. Fish and Wildlife personnel. Rearing habitat will be inventoried as to pools, water velocity, depth and cover just as on the west side tributaries. Spawning habitat surveys for mountain whitefish will also be made in the 52 miles of the North Fork itself.

1. Proposed yearly budget for Segment 1 (North Fork) of Fisheries Research, Part A. Temporal and Spatial Fish Distributions in the North and Middle Forks. Total time required --- 3.0 years (A-1)

| | | | | Fiscal-Years | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1978 | 1979 | 1980 | 1981 | 1982 | Total |
| A. Salaries and Benefits | | | | | | | | | |
| Project Leader | Grade 15-16 | 3 mos @ | $ 1,400 | | | | | | |
| Assistant Leader | 13 | 9 mos @ | 1,200 | | | | | | |
| Fisheries Fieldman | 10-12 | 12 mos @ | 830 | | | | | | |
| Technical Assist | 5 | 55 mos @ | 1,178 | | | | | | |
| | | Total Salaries | | 28,700 | 57,400 | 57,400 | 28,700 | | 172,200 |
| Benefits @ 17% | | Total Benefits | | 4,879 | 9,758 | 9,758 | 4,879 | | 29,274 |
| B. Permanent equipment rented from Montana Fish and Game -- see attached rental list sheet (II) | | | | 6,127 | 6,127 | 6,127 | | | 18,381 |
| C. Expendable Equipment | | | | | | | | | |
| Wire trap leads | | | 600.00 | | | | | | |
| Steel fence posts | | | 130.00 | | | | | | |
| Plastic vials | | | 200.00 | | | | | | |
| Preservatives | | | 50.00 | | | | | | |
| Miscellaneous | | | 100.00 | | | | | | |
| Fish tags | | | 700.00 | | | | | | |
| | | Total Equipment | | 1,780 | 1,780 | 1,780 | | | 5,340 |
| D. Travel | | | | | | | | | |
| Auto -- 1,500 miles @ 15¢/mile | | | 2,250.00 | | | | | | |
| Boat, gas and oil | | | 1,200.00 | | | | | | |
| Per Diem | | | | | | | | | |
| | | Total Travel | | 5,000 | 7,200 | 7,200 | 3,700 | | 23,100 |
| Airplane reconnaissance photos 135 miles @ $200/mile | | Total | | 10,000 | 17,000 | | | | 27,000 |
| E. Publication Costs | | | | | | 1,000 | | | 1,000 |
| F. Other Costs | | | | | | | | | |
| Laboratory analysis of caloric value & organism identification | | | 2,900 | | | | | | |
| Secretarial and Graphic Arts | | | 800 | 3,700 | 3,700 | 3,700 | 3,700 | | 14,800 |
| | | | | | | | | | $291.095 |
| | | Grand Totals | | 60,186 | 102,965 | 86,965 | 40,979 | | |

II. Annual rental costs for equipment to be used by Montana Department of Fish and Game in segment 1 (North Fork) of Fisheries Research, Part A. Temporal and spatial fish distributions in the North and Middle Forks.

| Item | Cost/Mo. | Months Used | Totals | |
|---|---|---|---|---|
| Scientific | | | | |
| Foxoboro thermograph | 15.00 | 12 | $ 180 | |
| Scale reading equipment | 10.50 | 2 | 21 | |
| Length-weight equipment | 5.00 | 11 | 55 | |
| Current meter | 18.00 | 6 | 108 | |
| Microscopes | 13.50 | 2 | 27 | |
| Hydraulic scale press | 12.00 | 2 | 24 | $ 415 |
| Electrical | | | | |
| 2 My-T-Lite generators | 30.00 | 9 | 270 | |
| 2 Variable voltage regs | 50.00 | 9 | 450 | |
| 2 Boom shockers | 40.00 | 9 | 360 | |
| 1 Backpack shocker | 18.00 | 3 | 54 | |
| 1 Small boat shocker | 10.00 | 3 | 30 | |
| 2 Electrodes & dip nets | 20.00 | 12 | 240 | 1,404 |
| Boats and Motors | | | | |
| 2-18 ft. john boats | 30.00 | 18 | 540 | |
| 1-16 ft. john boat | 12.00 | 4 | 48 | |
| 1-14 ft. john boat | 10.00 | 3 | 30 | |
| 115 hp jet engine | 110.00 | 18 | 1,980 | |
| 55 hp jet engine | 80.00 | 4 | 320 | |
| 2 boat trailers | 20.00 | 18 | 360 | 3,278 |
| Fish Traps and Nets | | | | |
| 15 box traps | 90.00 | 3 | 270 | |
| 4 fry traps | 80.00 | 3 | 240 | |
| 1 wolf trap | 30.00 | 4 | 120 | |
| 20 emergent traps | 200.00 | 2 | 400 | 1,030 |
| | Total | | | $6,127 |

Migration patterns of mature trout in spawning runs will be followed up on the North Fork to determine their time and duration. Recovery methods using electrofishing gear on booms and large flat-bottom jet boats will facilitate capture for identification and enumeration of spawning run segments. Smolt and adult game fish will be marked or tagged as necessary for immediate documentation of migration patterns and identification in future recoveries both in Flathead Lake and in the rivers. Adult sampling in the mainstream Flathead and North Fork rivers will vary from once or more a week to monthly, depending on the stage of the migration run and river flood stages.

Electroshocking with small boats or hand electrodes and hook and line fishing will be used to identify tributary use by adults of the major game fish species. Sections of individual streams will be routinely electrofished to determine trout age-class structure, trout numbers per unit area of rearing space, and condition factors. Growth and trophic data will also be collected in as many tributaries as possible. Population estimates, growth rates, condition factors and mortality rates will be determined (Ricker 1971) for each species of game fish collected in the North Fork drainage. Similar data for nongame species will be collected when possible and as time permits. Correlations will be made to limnological data in detail, using appropriate statistical designs. Standing crop estimates of presmolts will be made in major tributary streams by electrofishing. These data will be obtained seasonally and extend through the hatching and emergence period. Quantification of smolt movement toward Flathead Lake will be made several days a week by fishing downstream traps at the mouths of several tributaries. Winter ice cover and high water will prohibit sampling at times; also some important stream sections are inaccessible. Therefore, data will be extrapolated for some streams during periods of the year when traps cannot be operated.

Middle Fork Study Segment (A-2)

Middle Fork studies will be less extensive, but require more manpower, due to the number of large streams in the roadless and wilderness areas. Methods will be as above on the North Fork segment.

Part B-1. Alteration of Fishery by Hypolimnial Discharges

Study Segments B-1 and B-2 have been redesigned and funds for these segments are being sought from Bureau of Reclamation funding (Boise office). These segments must be funded concurrent with E.P.A. funding in order to provide Water Quality Chemical data in the same time frame as the North Fork and Middle Fork Segments. The complete study proposal made to the Bureau of Reclamation is included in Appendix ( B ).

Part B will not be initiated in FY 1978 as planned, but will be delayed at least until 1979. This part may be further delayed if the Bureau of Reclamation fund assistance is not forthcoming.

III. Proposed yearly budget for Segment 2 (Middle Fork) of Fisheries Research, Part A. Temporal and Spatial Fish Distributions in the North and Middle Forks. Total time required -- 3.0 years

| | | | | Fiscal-Years | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1978 | 1979 | 1980 | 1981 | 1982 | Total |
| A. Salaries and Benefits | | | | | | | | | |
| Project Leader | Grade 15-16 | 2 mos/yr | $ 2,800 | | | | | | |
| Assistant Leader | 13 | 12 mos/yr | 14,400 | | | | | | |
| Fisheries Fieldman | 10 | | 9,960 | | | | | | |
| Technical Assist. | 5 | 36 man mos/yr | 15,740 | | | | | | |
| | | Total Salaries | | | 42,400 | 42,400 | 42,400 | | 127,200 |
| Benefits @ 17% | | Total Benefits | | | 7,208 | 7,208 | 7,208 | | 21,624 |
| B. Permanent equipment rented from Montana Fish and Game see attached rental list sheet (IV.) | | | | | 4,651 | 4,651 | 4,651 | | 13,953 |
| C. Expendable Equipment | | | | | | | | | |
| Fish tags | | | 1,500 | | | | | | |
| Vials | | | 200 | | | | | | |
| Wire net leads -- 600 feet | | | 700 | | | | | | |
| Steel posts | | | 130 | | | | | | |
| | | Total Equipment | | | 2,530 | 2,530 | 2,530 | | 7,590 |
| D. Travel | | | | | | | | | |
| Auto | 30,000 mi @ 15¢/mile | | 4,500 | | | | | | |
| Boat -- gas and oil | | | 1,000 | | | | | | |
| Per diem | | | 3,880 | | | | | | |
| | | Total Travel | | | 9,380 | 9,380 | 9,380 | | 28,140 |
| Airplane reconnaissance photos | | Total | 20,000 | | | 20,000 | | | 20,000 |
| E. Publication Costs | | Total | 1,000 | | | | | 1,000 | 1,000 |
| F. Other Costs | | | | | | | | | |
| Laboratory analysis and identification of forage organisms | | | 2,900 | | | | | | |
| Secretarial and graphic arts | | | 800 | | | | | | |
| | | Total Other | 3,700 | | 3,700 | 3,700 | 3,700 | | 11,100 |
| | | Totals | | | 69,869 | 89,869 | 69,869 | 1,000 | 230,607 |

IV. Annual rental costs for equipment to be used by Montana Department of Fish and Game in segment 2 (Middle Fork) of Fisheries Research, Part A. Temporal and spatial fish distributions in the North and Middle Forks.

| Item | Cost/Mo. | Months Used | Totals | |
|---|---|---|---|---|
| Scientific | | | | |
| Foxoboro thermograph | 15.00 | 12 | $180 | |
| Scale reading equipment | 10.50 | 2 | 21 | |
| Length-weight equipment | 5.00 | 7 | 35 | |
| Current meter | 18.00 | 7 | 126 | |
| Microscopes | 13.50 | 2 | 27 | |
| Hydraulic scale press | 12.00 | 2 | 24 | $ 413 |
| Electrical | | | | |
| 2 My-T-Lite generators | 30.00 | 5 | 150 | |
| 2 Variable voltage regs | 50.00 | 5 | 250 | |
| 2 Boom shockers | 40.00 | 5 | 200 | |
| Backpack fish shocker | 18.00 | 3 | 54 | |
| 2 Electrodes and dip nets | 20.00 | 5 | 100 | 754 |
| Boats and Motors | | | | |
| 18-ft. john boat | 15.00 | 7 | 105 | |
| 16-ft. john boat | 12.00 | 3 | 36 | |
| 14-ft. john boat | 10.00 | 3 | 30 | |
| 115 hp jet engine | 110.00 | 7 | 770 | |
| 55 hp jet engine | 80.00 | 3 | 240 | |
| 18 hp outboard | 35.00 | 3 | 105 | 1,286 |
| Fish Traps and Nets | | | | |
| 12 Box traps | 72.00 | 4 | 288 | |
| 2 Fry traps | 40.00 | 4 | 160 | |
| 10 Emergent traps | 100.00 | 4 | 400 | 848 |
| Backcountry Travel | | | | |
| Horse and saddle | 75.00 | 18 | | 1,350 |
| | | Total | | $4,651 |

Movements of Dolly Varden, cutthroat trout and other migrants through the main Flathead River will be monitored by capture with electrofishing gear. Resident fish will be similarly sampled. Adult spawners will be tagged in conjunction with the North Fork study. Downstream movement of smolts will be sampled with electrofishing gear, hook and line fishing, nets and traps and marked by tagging or cold branding. Study of age, cohort growth, and food habits of smolts and adults will be made in the main river at a site near Kalispell. This will be the principal river recovery area for smolts and adults tagged in upstream tributaries. Therefore, it is important that Parts A and B of the Fisheries Research be accomplished in the same time frame if at all possible. Age and growth will be calculated from scale readings and population information from tagging studies.

An inventory of kokanee salmon spawning areas in the mainstream Flathead River will be quantified into suitable areas available at various water discharge elevations. Habitat availability and quality will be correlated with discharge from Hungry Horse Reservoir, normal river flows and other limnological data. Ground surveys will be made on known, heavily-used spawning areas. These data will be supported by aerial photos taken and analyzed for the whole area from Bab Rock Canyon to Kalispell.

Measurements of salmon egg mortality will be made by excavating spawning redds and capturing eggs and larvae in benthic nets. The ratio of dead to live eggs will be visually quantified by laboratory counts of samples. Mortality related to dewatering of redds and critical temperatures will be determined during low stream flows of short (i.e., 12 to 24 hours) and long (i.e., several days) duration. Vertical temperature profiles will be monitored in the redds to measure the effect of ambient air temperatures on gravel bars which become exposed and rise above the stream surface for various periods of time.

Emerging kokanee fry will be trapped to determine the effects of various discharge rates on downstream movement of young salmon. Salmon egg and fry survival rates will yield information on year class recruitment and may be correlated with year class strengths of adults in Flathead Lake. Whitefish ecology will also be studied. Salmon redds and whitefish spawning areas dried by reduced discharges will be evaluated on the basis of spawning habitat (and hence production) lost by artificial fluctuations in river volume. Fish population estimates or indices of abundance will be made through evaluation of all mark and recapture, and spawning data. The fisheries habitat in severely altered sections of the South Fork below Hungry Horse Dam will be inventoried for existing resident and migratory species. Projection of habitat quantity and quality will be estimated for populations expected to exist in a rereg reservoir. Much depends on the design and discharge pattern developed by the engineering feasibility study and relationships to the needs of the fishery in the mainstream Flathead River.

## B-2. Alteration of the Benthic Populations by Hypolimnial Discharges

An important aspect of this research is to determine exactly how discharges from Hungry Horse Reservoir affect diel behavioral patterns, especially during

V. Proposed yearly budget for Fisheries and Limnological Research (Part B-1 and B-2 combined from original proposal) by hypolimnial discharges. Total time required 00 4.0 years. Part B-1 and B-2 to be funded by Bureau of Reclamation starting March FY 1979 through Sept. 1982

| | | | | Fiscal Years | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1978 | 1979 | 1980 | 1981 | 1982 | Total |
| A. | Salaries and Benefits | | | | | | | | |
| | Project Leader | Grade 15-16 | 3 mos/yr $ 4,320 | | | | | | |
| | Assistant Leader | 13 | 12 mos/yr 14,400 | | | | | | |
| | Fisheries Fieldman | 10 | 12 mos/yr 9,960 | | | | | | |
| | Technical Assist | 5 | 40 man mos/yr 17,940 | | | | | | |
| | | | Total Salaries | | 27,588 | 56,660 | 60,332 | 34,311 | 178,891 |
| | Benefits @ 17% | | Total Benefits | | 4,690 | 9,632 | 10,256 | 5,834 | 30,412 |
| B. | Permanent equipment rented from Montana Fish and Game -- see attached rental list sheet (VI) | | | | 4,717 | 9,434 | 9,434 | 4,717 | 28,302 |
| C. | Expendable Equipment | | | | | | | | |
| | Fish tags | | 1,500 | | | | | | |
| | Wire trap leads | | 700 | | | | | | |
| | Steel fence posts | | 130 | | | | | | |
| | | | Total Equipment | | 4,530 | 3,530 | 3,530 | | 11,590 |
| D. | Travel | | | | | | | | |
| | Auto | 15¢/mile | | | | | | | |
| | Boat -- gas and oil | | | | | | | | |
| | Per diem | | | | | | | | |
| | | | Total Travel | | 3,765 | 7,530 | 7,530 | 3,765 | 22,590 |
| | Airplane reconnaissance photos made with BR operations account | | | | | | | | |
| E. | Publication Costs | | Total 1,000 | | | | | 1,000 | 1,000 |
| F. | Other Costs | | | | | | | | |
| | Laboratory costs (fish food analysis and identification | | | | 5,184 | 10,523 | 11,144 | 10.089 | 36,940 |
| G. | Contingency | | | | 1,519 | 15,690 | 10,773 | | 27,982 |
| | | | Grand Totals | | 51,993 | 112,999 | 112,999 | 59,716 | 337,707 |

VI. Annual rental costs for equipment to be used by Montana Department of Fish and Game in Fisheries Research, Part B. Alteration of fishery and limnology by hypolimnial discharges. FY March 1979 through FY Sept. 1982

| Item | Cost/mos | Est. Mos | | Est. Cost |
|---|---|---|---|---|
| Scientific Equipment | | | | |
| 2 Multiprobe recording thermographs | 60.00 | 24 mos | | $ 1,440.00 |
| 2 foxoboro thermographs | 15.00 | 24 | | 360.00 |
| scale reading equipment | 10.50 | 4 | | 42.00 |
| fish weights & measures | 18.00 | 12 | | 216.00 |
| current meter | 18.00 | 4 | | 72.00 |
| microscopes | 13.50 | 10 | | 135.00 |
| hydraulic scale press | 12.00 | 2 | | 24.00 |
| Insect drift nets | 30.00 | 80 | | 2,400.00 |
| | | | Total | $ 4,689.00 |
| Electric | | | | |
| 2 My-T-Lite generators | 15.00 | 10 | | $ 150.00 |
| 2 variable voltage regs | 25.00 | 10 | | 250.00 |
| 2 fish shockers boom | 22.00 | 10 | | 220.00 |
| back pack shocker | 18.00 | 4 | | 72.00 |
| 2 electrodes, dipnets & tags | 10.00 | 10 | | 100.00 |
| | | | Total | $ 792.00 |
| Boats & Moors | | | | |
| 2-18 foot john boats | 30.00 | 14 | | $ 420.00 |
| 16 foot john boat | 25.00 | 7 | | 175.00 |
| 14 foot john boat | 18.00 | 3 | | 54.00 |
| 2-115 hp jet engines | 110.00 | 14 | | 1,540.00 |
| 55 hp jet engine | 80.00 | 7 | | 560.00 |
| 16 hp outboard | 35.00 | 4 | | 140.00 |
| | | | Total | $ 2,889.00 |
| Fish Traps & Nets | | | | |
| 4 fry traps | 20.00 | 16 | | $ 320.00 |
| 20 emergent traps | 10.00 | 60 | | 600.00 |
| 8 box traps | 6.00 | 24 | | 144.00 |
| | | | Total | $ 1,064.00 |
| | | | Grand Total | $ 9,434.00 |

emergence of insect populations. In cooperation with the Bureau of Reclamation, discharge volumes from the dam will be experimentally raised and lowered at precise time intervals so that variances in drift and benthic activity may be quantified. Stanford (1975) indicated that such an approach would yield very valuable ecological information.

This study will also require 2.5 years to complete. The first year will be devoted entirely to field work, including experimental rearing and discharge studies. Field collections will be made during the second year, along with thermal laboratory experiments. The final six months will be used to analyze data and prepare manuscripts.

Part C-1. Trophic Relationships in Flathead Lake

Estimates of fish biomass (i.e., population size) will be made using the latest developments in acoustical methods and in combination with purse seine and midwater trawl catches. Echo traces will be quantified to identify particular species at specific depths; simultaneous open water seine and trawl catches at the same depths will allow verification of sonar-determined species composition and abundance. The acoustical gear will also permit thorough study of diel migrations or activity patterns. Depth, seasonal and geographical distributions of various populations will be determined from temporally collected sonar data. Acoustical data will also be supported by pelagic and littoral gill netting programs.

Major lake factors which could likely limit fish populations will be assessed for lake trout, mountain whitefish and lake whitefish, and limiting factors for kokanee. Dolly Varden and cutthroat are most likely tributary or mainstream oriented, and will be assessed mostly in upper drainage studies. However, the standing crop and trophic dynamics of these species will be thoroughly studied in the lake.

Lake trout and spawning areas are believed to be limited. Sonar reconnaissance and quantification of spawning areas will be made. Existing Montana Fish and Game netting data will be reanalyzed and combined with new findings on lake trout status.

An attempt will be made to assess recruitment of kokanee, cutthroat and Dolly Varden to the lake in conjunction with upstream studies. Methods and reliable gear to sample waters as large and debris-laden as the Flathead River in the area immediately upstream of the Flathead Lake confluence have not been developed, but we will make an extreme effort to get an index of recruitment levels during the study. Fry nets, trap nets and possibly sonar gear will be used.

Part C-2. Flathead Lake Creel Census

An extensive Flathead Lake creel census was planned for study year 1981 to provide harvest and age class data for game fish. Angler use will be monitored drainage-wide with concentration on Flathead Lake and the lower Flathead River. The census would be especially valuable in gathering data leading to production estimates and involve the public in the research effort. Direct fisherman contacts would be made by Montana Department of Fish and Game personnel and mailable data

forms will be made available throughout the drainage. Extensive media coverage will be devoted to the program to enhance public involvement and cooperation. The creel census portion of the study will not be done if reduced funding limits the total fishery study.

It is extremely important that Segments C-1 and C-2 (Flathead Lake Trophic Study and Flathead Lake Creel Census) be conducted in the same time frame as the water quality data is acquired. This is especially critical information for the problems of nutrient use and energy transfer of energetics of the system. This assessment of the incorporation of nutrient elements into fish flesh and its potential removal from the sytem or transfer back upstream. Nutrients transferred upstream are recycled in the system as mortality of adults spawning, particularly salmon decompose in headwater areas.

Specific trophic habits and interrelations in the Flathead Lake fishery will be determined from stomach analyses of specimens obtained by seining, trawling and gill netting. Stomachs will be collected and preserved from individual fish for later analysis. Species composition of food items will be identified and recorded. Total volume of stomach contents will be obtained and columetric measurements will be made for selected taxonomic groups. Temporal series of trophic data will be analyzed for protein, carbohydrates, fats and ash.

Part D. Status, Utilization and Habitat Inventory of Hungry Horse Reservoir Fishery

Due to allocation of EPA funding to other disciplines, the Hungry Horse Reservoir and its related tributaries has been set back in time awaiting other funding dollars.

Methods to be used in the reservoir will be the same as for Part C. Trophic Relationships in Flathead Lake, except the acoustical population work, will be limited to total fish biomass estimates. This is due to our inability to transport the large vessel used on Flathead Lake to Hungry Horse Reservoir; we will use smaller, trailered craft. Age and growth rates will be determined, but food habit studies will not be done on the reservoir populations.

Tributary streams to the reservoir will be subjected to the same type of study using the same methods and equipment and analysis for tributaries as the North Fork tributaries. Initial studies will be made on 1) Spotted Bear River, 2) South Fork of the Flathead River below Meadow Creek Gorge, 3) Sullivan Creek, 4) Hungry Horse Creek, 5) Emery Creek, 6) Wheeler Creek, 7) Dorris Creek, and 8) Wounded Buck Creek. Other tributaries and secondary streams will be studied as needed.

The Bureau of Reclamation does not feel they can fund this segment under study funds which are specific for proposed construction. Operation and Management funds do not seem to be obtainable, although reservoir operation and drawdowns of up to 150 feet have serious impact on fish and fish food organisms and the general limnology of the reservoir. In addition, several townships of U.S. Forest Service land in the South Fork drainage are under consideration by the U.S. Forest Service and BLM for permit applications for gas and oil exploration and development. These are in the same geological formations for which applications are being considered in the North Fork and South Fork drainages. There are 1,034,000 acres of land comprising the South Fork drainage above Hungry Horse Dam of which 619,000 are in the Bob Marshall Wilderness.

VII Proposed yearly budget for Fisheries Research, Part C Trophic relationships in Flathead Lake Total time required -- 3.0 years (C-1)

| | | | | Fiscal-Years | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1978 | 1979 | 1980 | 1981 | 1982 | Total |
| A. | Salaries and Benefits | | | | | | | | |
| | Project Leader | Grade 15-16 | 2 mos/yr | | | | | | |
| | Assistant Leader | 13 | 6 mos/yr | | | | | | |
| | Technical Assist | 5 | 6 man mos/yr | | | | | | |
| | | | Total Salaries | | | 14,200 | 14,200 | 14,200 | 42.600 |
| | Benefits @ 17% | | Total Benefits | | | 2,414 | 2,414 | 2,414 | 7,242 |
| B. | Permanent Equipment rented from Montana Fish and Game -- see attached rental sheet (VIII) | | | | | 11,161 | 11,161 | 11,161 | 33,483 |
| C. | Expendable Equipment | | | | | | | | |
| | Plastic vials (stomach preservative) | | 800.00 | | | | | | |
| | Floats and markers | | 200.00 | | | | | | |
| | | | Total Equipment | | | 1,000 | 1,000 | 1,000 | 3,000 |
| D. | Travel | | | | | | | | |
| | Auto 5,000 miles @ 15¢/mile | | 750.00 | | | | | | |
| | Boat gas and filters | | 750.00 | | | | | | |
| | Per diem | | 3,880.00 | | | | | | |
| | | | Total travel | | | 5,380 | 5,380 | 5,380 | 16,140 |
| | Airplane reconnaissance photos @ $200/mile | | | | | | | | |
| | | | Total | | | 1,1000 | 1,000 | 1,000 | 3,000 |
| E. | Publication Costs | | Total | | | | | 1,000 | 1,000 |
| F. | Other Costs | | | | | | | | |
| | Laboratory analysis | | | | | | | | |
| | Fish food caloric analysis and identification | | 2,900 | | | | | | |
| | Secretarial and graphic arts | | 800 | | | | | | |
| | Telephone and postage | | 200 | | | | | | |
| | | | Total Other | | | 3,900 | 3,900 | 3,900 | 11,700 |
| | | | Totals | | | 39,055 | 39,055 | 40,055 | 118,165 |

VIII Annual rental costs for equipment owned and to be used by Montana Department of Fish and Game in Fisheries Research, Part C. Trophic relationships in Flathead Lake.

| Item | Cost/Mo | Months Used | Totals | |
|---|---|---|---|---|
| Scientific | | | | |
| Scale reading equipment | 10.50 | 2 | 21.00 | |
| Length and Weight Equipment | 5.00 | 12 | 60.00 | |
| Current Meter | 18.00 | 3 | 54.00 | |
| Microscopes | 13.50 | 2 | 27.00 | |
| Fineline acoustical sounder | 60.00 | 3 | 180.00 | |
| Hydraulic scale press | 12.00 | 2 | 24.00 | |
| Bathy thermometer | 30.00 | 3 | 90.00 | |
| Net depth recorder | 30.00 | 3 | 90.00 | $ 546.00 |
| Boats and motors | | | | |
| "Dolly Varden" a 35' vessel and 2 man crew | 2,250.00 | 4 | 9,000.00 | |
| Seine barge and motor | 100.00 | 1.5 | 150.00 | |
| 16-foot boat and motor | 65.00 | 4 | 260.00 | 9,410.00 |
| Fish Traps and Nets | | | | |
| Purse (600' x 50') | 160.00 | 1.5 | 240.00 | |
| Midwater trawl | 50.00 | 2.5 | 125.00 | |
| 7 gill nets | 280.00 | 3 | 840.00 | 1,205.00 |
| | | Total | | $ 11,161.00 |

IX Annual budget for creel census to be completed in FY 81 as a part of Fisheries Research, Part C. Trophic relationships in Flathead Lake. Total time required -- 1.0 year (C-2) *

| | | | Fiscal-Years 1978 | 1979 | 1980 | 1981 | 1982 | Total |
|---|---|---|---|---|---|---|---|---|
| A. Salaries and Benefits | | | | | | | | |
| Project Leader | Grade 15-16 | 1 mos/yr @ 1,400 | | | | | | |
| Assistant Leader | 13 | 12 mos/yr @ 14,400 | | | | | | |
| Technical Assist | 5 | 36 man mos/yr 25,200 | | | | | | |
| | | Total Salaries | | | | 41,000 | | 41,000 |
| Benefits @ 17% | | Total Benefits | | | | 6,970 | | 6,970 |
| B. Permanent equipment rented from Montana Fish and Game see attached rental list sheet (X) | | Total | | | | 3,000 | | 3,000 |
| C. Expendable Equipment | | | | | | | | |
| Forms, envelopes & stationery | | | | | | | | |
| Computer rental | | Total Equipment | | | | 5,468 | | 5,468 |
| D. Travel | | | | | | | | |
| Auto 30,000 miles @ 15¢/mile | | 4,500 | | | | | | |
| Boat, gas and oil | | 1,200 | | | | | | |
| Per diem | | 3,880 | | | | | | |
| | | Total Travel | | | | 9,580 | | 9,580 |
| Airplane reconnaissance photos | | Total | | | | 1,000 | | 1,000 |
| E. Publication costs | | | | | | | 1,800 | 1,800 |
| F. Other Costs | | | | | | | | |
| Office rental | | 1,500 | | | | | | |
| Secretarial and graphic arts | | 1,000 | | | | | | |
| Postage -- 30,000 stamps & cards | | 3,900 | | | | | | |
| | | Total Other | | | | 6,400 | | 6,400 |
| | | Total Project Costs | | | | 73,418 | 1,800 | 75,218 |

* This part of the project has been withdrawn from the proposal due to reduced federal funding. It will be reinstated in the project if alternate funding can be found

X Annual rental costs for equipment to be used by Montana Department of Fish and Game during creel census portion of Fisheries Research, Part C-2 Trophic relationships in Flathead Lake

| Item | Cost/Mo. | Months Used | Totals | |
|---|---|---|---|---|
| Scientific | | | | |
| 4sets length-weight equipment | 20.00 | 36 | 720.00 | 720.00 |
| Boats and Motors | | | | |
| 16-foot "V" hull boat | 30.00 | 12 | 360.00 | |
| 15-foot Larson boat | 25.00 | 12 | 300.00 | |
| 55 hp outboard | 80.00 | 12 | 960.00 | |
| 18 hp outboard | 35.00 | 12 | 420.00 | |
| 2 boat trailers | 20.00 | 12 | 240.00 | 2,280.00 |
| | | Total | | $3,000.00 |

XI. Proposed yearly budget for Fisheries Research, Part D. Status utilization and habitat inventory of Hungry Horse Reservoir fishery. Total time required -- 3.0 years

| | | | | Fiscal Years | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1978 | 1979 | 1980 | 1981 | 1982 | Total |
| A. | Salaries and Benefits | | | | | | | | |
| | Project Leader | Grade 15-16 | 2 mos/yr $ 2,800 | | | | | | |
| | Assistant Leader | 13 | 12 mos/yr 14,400 | | | | | | |
| | Fisheries Fieldman | 10 | 12 mos/yr 9,960 | | | | | | |
| | Technical Assist | 5 | 36 man mos/yr 15,040 | | | | | | |
| | | | Total Salaries | | | 42,200 | 42,200 | 42,200 | 126,600 |
| | Benefits @ 17% | | Total Benefits | | | 7,174 | 7,174 | 7,174 | 21,522 |
| B. | Permanent Equipment rented from Montana Fish and Game see attached rental list sheet (XII) | | | | | 13,558 | 13,558 | 13,558 | 40,674 |
| C. | Expendable Equipment | | | | | | | | |
| | Fish tags | | 1,000 | | | | | | |
| | Plastic vials | | 200 | | | | | | |
| | Wire trap leads -- 600 feet | | 700 | | | | | | |
| | Steel fence posts | | 130 | | | | | | |
| | | | Total Equipment | | | 2,030 | 2,030 | 2,030 | 6,090 |
| D. | Travel | | | | | | | | |
| | Auto -- 30,000 miles @ 15¢/mile | | 4,500 | | | | | | |
| | Boat gas and oil | | 1,400 | | | | | | |
| | Per diem | | 3,920 | | | | | | |
| | | | Total Travel | | | 9,820 | 9,820 | 9,820 | 29,460 |
| | Airplane reconnaissance photos | | Total 3,000 | | | 1,000 | 1,000 | 1,000 | 3,000 |
| E. | Publication Costs | | Total 1,000 | | | | | 1,000 | 1,000 |
| F. | Other Costs | | | | | | | | |
| | Laboratory analysis | | | | | | | | |
| | Food caloric analysis and identification | | | | | | | | |
| | U.S.G.S. Water Quality (7 mos) (assumes Bureau of Reclamation continues current water flow records at Twin Creek during this study | | | | | | | | |
| | | | Total Other 10,833 | | | 2,900 | 2,900 | 2,900 | 8,700 |
| G. | Contingency | | Total | | | 7,933 | 7,933 | 7,933 | 23,799 |
| | | | Grand Total | | | 86,615 | 86,615 | 87,615 | 260,945 |

XII. Annual rental costs for equipment to be used by Montana Department of Fish and Game in Fisheries Research, Part D. Status, utilization and habitat inventory of Hungry Horse Reservoir fishery

| Item | Cost/Mo | Months used | Totals | |
|---|---|---|---|---|
| Scientific | | | | |
| 25 Maximum-minimum thermometers | 25.00 | 9 | $ 225.00 | |
| Scale reading equipment | 10.50 | 3 | 32.00 | |
| Length-weight equipment | 5.00 | 9 | 45.00 | |
| Current meter | 18.00 | 9 | 162.00 | |
| Fineline acoustical sounder | 60.00 | 4 | 240.00 | |
| Hydraulic Scale press | 12.00 | 3 | 36.00 | |
| Plankton net | 7.50 | 6 | 45.00 | |
| Net depth recorder | 30.00 | 3 | 90.00 | |
| Clark Bumpas plankton | 30.00 | 3 | 90.00 | $ 965.00 |
| Electrical | | | | |
| 2 My-T-Lite generators | 15.00 | 12 | 180.00 | |
| 2 Variable voltage regs | 25.00 | 12 | 300.00 | |
| Boom shocker | 20.00 | 3 | 60.00 | |
| 2 Electrodes and dip nets | 10.00 | 3 | 30.00 | |
| Backpack shocker | 18.00 | 6 | 108.00 | 678.00 |
| Boats and motors | | | | |
| Two 18-foot john boats | 30.00 | 18 | 540.00 | |
| 55 hp jet engine | 80.00 | 6 | 480.00 | |
| 14-foot john boat | 10.00 | 6 | 60.00 | |
| 115 hp jet engine | 110.00 | 12 | 1,320.00 | |
| 28 hp outboard | 35.00 | 9 | 315.00 | 2,715.00 |
| Fish traps and nets | | | | |
| 10 fry traps | 200.00 | 10 | 2,000.00 | |
| 10 box traps | 60.00 | 10 | 600.00 | |
| 20 gill nets | 800.00 | 8 | 6,400.00 | |
| Midwater trawl | 50.00 | 4 | 200.00 | 9,200.00 |
| | | | Total | $13,558.00 |

## Principal Investigator

This proposal is to be under the direction and supervision of Robert E. Schumacher, Regional Fisheries Manager, Montana Department of Fish and Game, Kalispell.

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PART II

| | | North Fork | Middle Fork | Flat-head River | Flat-head Lake | Creel Census | Hungry Horse |
|---|---|---|---|---|---|---|---|
| | 78 | 28,700 | | | | | |
| | 79 | 57,400 | 42,400 | 27,588 | | | |
| Salaries | 80 | 57,400 | 42,400 | 56,660 | 14,200 | | 42,200 |
| | 81 | 28,700 | 42,400 | 60,332 | 14,200 | 41,000 | 42,200 |
| | 82 | | | 34,311 | 14,200 | | 42,200 |
| | | | | | | | |
| | 78 | 4,879 | | | | | |
| | 79 | 9,758 | 7,208 | 4,690 | | | |
| Benefits | 80 | 9,758 | 7,208 | 9,632 | 2,414 | | 7,174 |
| | 81 | 4,879 | 7,208 | 10,256 | 2,414 | 6,970 | 7,174 |
| | 82 | | | 5,834 | 2,414 | | 7,174 |
| | | | | | | | |
| | 78 | 6,127 | | | | | |
| | 79 | 6,127 | 4,651 | 4,717 | | | |
| Equip Rent | 80 | 6,127 | 4,651 | 9,434 | 11,161 | | 13,558 |
| | 81 | | 4,651 | 9,434 | 11,161 | 3,000 | 13,558 |
| | 82 | | | 4,717 | 11,161 | | 13,558 |
| | | | | | | | |
| | 78 | 1,780 | | | | | |
| | 79 | 1,780 | 2,530 | 4,530 | | | |
| Equipment | 80 | 1,780 | 2,530 | 3,530 | 1,000 | | 2,030 |
| | 81 | | 2,530 | 3,530 | 1,000 | 5,468 | 2,030 |
| | 82 | | | | 1,000 | | 2,030 |
| | | | | | | | |
| | 78 | 5,000 | | | | | |
| | 79 | 7,200 | 9,380 | 3,765 | | | |
| Travel | 80 | 7,200 | 9,380 | 7,530 | 5,380 | | 9,820 |
| | 81 | 3,700 | 9,380 | 7,530 | 5,380 | 9,580 | 9,820 |
| | 82 | | | 3,765 | 5,380 | | 9,820 |
| | | | | | | | |
| | 78 | 10,000 | | | | | |
| | 79 | 17,000 | | | | | |
| Aerial Photo | 80 | | 20,000 | | 1,000 | | 1,000 |
| | 81 | | | | 1,000 | 1,000 | 1,000 |
| | 82 | | | | 1,000 | | 1,000 |
| | | | | | | | |
| | | | | | | | |

PART II Cont.

| | | North Fork | Middle Fork | Flat-head River | Flat-head Lake | Creel Census | Hungry Horse |
|---|---|---|---|---|---|---|---|
| | 78 | | | | | | |
| | 79 | | | | | | |
| Publication | 80 | | | | | | |
| | 81 | 1,000 | | | | | |
| | 82 | | 1,000 | 1,000 | 1,000 | 1,800 | 1,000 |
| | | | | | | | |
| | 78 | 3,700 | | | | | |
| | 79 | 3,700 | 3,700 | 5,184 | | | |
| Other Costs | 80 | 3,700 | 3,700 | 10,523 | 3,900 | | 2,900 |
| | 81 | 3,700 | 3,700 | 11,144 | 3,900 | 6,400 | 2,900 |
| | 82 | | | 10,089 | 3,900 | | 2,900 |
| | | | | | | | |
| | 78 | | | | | | |
| | 79 | | | 1,519 | | | |
| Contingency | 80 | | | 15,690 | | | 7,933 |
| | 81 | | | 10,773 | | | 7,933 |
| | 82 | | | | | | 7,933 |
| | | | | | | | |
| | 78 | 60,186 | | | | | |
| | 79 | 102965 | 69,869 | 51,993 | | | |
| Totals | 80 | 86,965 | 89,869 | 112,999 | 39,055 | 86,615 | 86,615 |
| | 81 | 40,979 | 69,869 | 112,999 | 39,055 | 73,418 | 86,615 |
| | 82 | | 1,000 | 59,716 | 40,055 | 1,800 | 87,615 |
| | | | | | | | |
| | | | | | | | |
| Grand Totals | | 291,095 | 230,607 | 337,707 | 118,165 | 75,218 | 260,345 |
| | | | | | | | |
| | | | | | | | 1,313,637 |

PART II Cont.

| | | North Fork | Middle Fork | Flat-head River | Flat-head Lake | Creel Census | Hungry Horse |
|---|---|---|---|---|---|---|---|
| | 78 | | | | | | |
| | 79 | | | | | | |
| Publication | 80 | | | | | | |
| | 81 | 1,000 | | | | | |
| | 82 | | 1,000 | 1,000 | 1,000 | 1,800 | 1,000 |
| | | | | | | | |
| | 78 | 3,700 | | | | | |
| | 79 | 3,700 | 3,700 | 5,184 | | | |
| Other Costs | 80 | 3,700 | 3,700 | 10,523 | 3,900 | | 2,900 |
| | 81 | 3,700 | 3,700 | 11,144 | 3,900 | 6,400 | 2,900 |
| | 82 | | | 10,089 | 3,900 | | 2,900 |
| | | | | | | | |
| | 78 | | | | | | |
| | 79 | | | 1,519 | | | |
| Contingency | 80 | | | 15,690 | | | 7,933 |
| | 81 | | | 10,773 | | | 7,933 |
| | 82 | | | | | | 7,933 |
| | | | | | | | |
| | 78 | 60,186 | | | | | |
| | 79 | 402965 | 69,869 | 51,993 | | | |
| Totals | 80 | 86,965 | 89,869 | 112,999 | 39,055 | 86,615 | 86,615 |
| | 81 | 40,979 | 69,869 | 112,999 | 39,055 | 73,418 | 86,615 |
| | 82 | | 1,000 | 59,716 | 40,055 | 1,800 | 87,615 |
| | | | | | | | |
| | | | | | | | |
| Grand Totals | | 291,095 | 230,607 | 337,707 | 118,165 | 75,218 | 260,345 |
| | | | | | | | |
| | | | | | | | 1,313,637 |

PART III
Research Narrative Statement

I. Biographical sketches

| | |
|---|---|
| Schumacher, Robert E. ) | |
| Huston, Joe E. ) | |
| May, Bruce ) | Appended to this statement (C) |
| Appert, Sue ) | |
| Hanzel, Delano A. ) | |
| Domrose, Robert J. ) | |

Robert Schumacher will be the Principal Investigator and Joe Huston will be special Supervisory Budget Project Leader. Under Huston's supervision will be an assistant project leader (M.S. in the fishery or limnological field) for each project segment. Mr. Schumacher will spend an estimated five percent of this time on project leader supervision, but will charge none of his time to the EPA funded effort. He will charge his time to a Habitat Preservation Project, entirely state funded.

Joe Huston will spend approximately 60 percent of his time on the Flathead Basin Project, EPA funded, and 20 percent of his time on a state funded Reservoir and Tributary Project which will be the non-federally funded portion.

Bruce May, a project biologist, has been project biologist for a Corps of Engineers funded study on the Kootenai River and Koocanusa Reservoir. He will be shifted to spend 50 percent of his time to the Flathead Project in 1978-79 and about 75 percent of his time in subsequent years.

2. Objectives of this Project

The primary objective of the study proposal by Schumacher and Stanford, 1976, was to obtain baseline data to describe the quality and quantity of the entire aquatic community ecology of the Flathead drainage above Kerr Dam at Polson, Montana.

We felt that in order to challenge habitat degradation expected from coal strip mines and gas-oil exploration and development on the Flathead River and its tributaries, the state and federal government had to have sufficient data base to demonstrate the type and amount of degradation to the aquatic habitat and to mitigate against those losses by whatever actions were available.

The objectives of each Fisheries Study Segment, as stated in the Study Proposal (page 4) will be the key elements to a successful obtainment of the primary objective. After the initial appropriation was made to the EPA budget, a local Steering Committee determined that certain other discipline elements should be added to the total study. Stanford and Schumacher's Study Proposal was essentially separated into two studies, although the same coordination and cooperation will be maintained. Therefore, the complementing parts of the aquatic study, limnology and water quality, will be submitted by Jack Stanford for the same project area and for the same primary objective. A copy of his study proposal is appended for reference.

3. Results and/or Benefits Expected

The inventory of physical aquatic habitat in quantitative terms of stream widths, depths, velocities, flows, and bottom material types will provide baseline reference data. These data can be used to mitigate against alteration of the various fish habitat types by erosion, sediments, channel alteration, by road building for timber management, and for coal, or gas and oil exploration and development.

Vertical photographic coverage of the major portion of the stream habitat will be recorded in color from low altitude flights to document the stream and bank conditions at the survey time.

Fish population estimates, growth rates, migration patterns, and production rates will document the combined assessment of the quantity and quality of the fish stream habitat. Control areas will be initiated inside Glacier National Park which are being surveyed by that agency and fish population data will be acquired by Montana Department of Fish and Game for major park streams.

4. Approach

A. A detailed work plan is described in the project proposal (Appendix A). The project could be delayed if an extreme fire season in the forest caused large areas to be closed to travel on mountain roads and trails.

A large plus for the study is indicated by the complementary and cooperative studies being done on the drainage by the Flathead National Forest, Glacier National Park, and by 208 studies on non-point phosphorus sources and the extensive limnology and water quality project for which Jack Stanford is submitting a grant application for the EPA Flathead Study.

The Bureau of Reclamation has indicated they will try to fund Segments B-1 and B-2 beginning March, 1979, (Appendix B).

B. Montana Department of Fish and Game owns or will purchase with state funds, all fisheries research gear necessary to carry out the proposed project. These items include nets, boats, traps, and other scientific equipment listed on the rental sheets of the fisheries budgets (pages 8 through 23). The work on Flathead Lake will be carried out primarily with the aid of the Department's Bistol Bay type purse seiner. This vessel is 10 meters (34 feet) long and is equipped with a state-of-the-art sonar apparatus for monitoring movement and size of fish populations in addition to gathering hydrographic data. The boat also is rigged for trawling or purse seining; a submarine thermograph may be used from the cabin.

Labortory facilities at the Montana Department of Fish and Game Regional office in Kalispell are limited. A wet laboratory for fish work plus scale reading and data analysis are available. Any additional work space or equipment needed will be available at the UMBS. The desks, office space, field space, and equipment space are available at the Montana Fish and Game headquarters for all personnel on the project.

C. As indicated in the project proposal (Appendix B), Study Segments B-1 and B-2 are under consideration for a grant from the Bureau of Reclamation, totalling $330,000, with work to be done in 1979 through the first half of 1982. Data and analysis will be done in the same units for measure as the other Flathead work, for data comparability.

D. The Montana Department of Fish and Game has been operating five 30-day recording thermographs at U.S.G.S. water gauging stations on the main Flathead tributaries. In addition, the Department has been funding three other recording thermographs operated by U.S.G.S. on the other major tributaries. The Flathead National Forest is supplying thermograph data on four other North Fork tributaries.

The Study Proposal contains an equipment rental sheet for each project segment and thermograph rental is included for the study period. Thermal data have been published or exist in the Department's files for the South Fork and Flathead River at Columbia Falls and near Flathead Lake, since 1964, for historical records.

The Department, expecting an earlier allocation of funds, started the field survey of the physical habitat, downstream trapping of smolts, and tagging of migrating prespawning adults on the North Fork tributaries in 1976 and early 1978. In addition, the Bureau of Reclamation provided funds for a contract for tagging upstream migrating adult trout in the spring of 1977 and 1978. The data resulting from both these preliminary works will become a part of the total study reports.

E. An annual progress report will be sumitted to the EPA Flathead Steering Committee by April 1 of each year. In addition, a Narrative Summary is prepared for the Department of Fish and Game each month by project leaders indicating work done on the specific areas of the project. A copy of related summaries will be forwarded monthly to the study area manager. Individual payrolls of the Department have hours and salaries delineated for each project for accounting purposes.

F. All fisheries work will be done by Department employees. Some chemical analyses of fish foods and flesh will be done at the University of Montana or the University of Montana Biological Station. Data acquired in the field will be by standard fishery study methods. Statistical summaries, estimates, and correlations will be made among interdependent parameters and tests of significance for population work will be the state of the art, using Kruskal-Wallis non-parametric ranking test.

5. General Project Information

A. The physical habitat inventory and classification information will be placed in the Interagency Fish Data Base (bank), a computer data storage system assessible to U. S. Fish and Wildlife Agency, U. S. Forest Service, Montana Department of Fish and Game, Montana Division of State Forestry, Department of Natural Resources, and Department of Health and Environmental Sciences. Original field data will be kept in Regional Department files until micro-fische copies are made and filed. All information gathered by the Fish and Game is public information and can be had by request. Some small retrieval cost or copy costs may be charged for data bank material if large numbers of papers are requested.

B. If the monies are adequate to fund the entire aquatic study proposal, the data base will be sufficient for predictive modeling. For instance, an impact of 20 percent loss of spawning or nursery habitat on a major tributary could be analyzed in terms of changes in Flathead Lake fish population, the number of returning adults to any stream, changes in growth rate etc.

Management plans for forest and timber management are subject to alteration and method improvement if serious water quality or fisheries resources degradation can be shown.

All information on production and harvest of game fish will be used for developing needed changes in Fish and Game regulations on seasons and harvest.

There will be no more impact on the environment from this study than from other recreationalists' use of the road and footpaths. Major portion of sampling gear for capture and tagging studies will not harm individual fish or populations.

The major benefits to be derived from the complete aquatic study, fishery and limnology are listed below, not necessarily in order of importance.

1. Baseline data to prevent degradation of fishery or fishery habitat.

2. Baseline data to mitigate for losses of the quantity and quality of the habitat.

3. Information on which to support a legal water right and water reservation of minimum in-stream flows for fish and wildlife for each subdrainage studied. Costs of legal filing will be that of the Department of Fish and Game.

4. Population density and mortality rates on which to base more refined fishery regulations.

5. Migration times and numbers of adults by stream to measure value of complete fishing closures of subdrainages. Migration times and numbers of sub-adults leaving nursery areas to determine vulnerability of such migrations to periodic discharge or unusual climatic events of which cause exceedence of water quality standards.

6. An index of energy and nutrient transfer will be on hand from water quality study and will be available to assess important transfers from upstream areas to Flathead Lake and vice versa.

7. An environmental value of the lake-river system to the angler and to the local economy will be determined in terms of man days of angler use and catch rates.

8. Under the Bureau of Reclamation funding (B-1 and B-2) data will be provided to the Bureau to project kokanee egg survival or mortality rates associated with various discharge flows during spawning and incubation. This will help determine minimum flow rates which will allow a conservation of water for most efficient electrical generation coupled with an adequate kokanee population in Flathead Lake and provide good fishing catch rates.

# APPENDIX B

Flathead Study segments B-1 and B-2 are of special interest to the Bureau of Reclamation as the information obtained would be a benefit and probably necessary before they can initiate a request for authorization to construct a reregulation dam below Hungry Horse Dam. They are in the process of a Suitability Study now, which precedes a Feasibility Study. The Department of Fish and Game will be the grantee for the study if the Bureau's Feasibility Study is approved. A copy of the work proposal has been approved by the Bureau to fit their data needs, in addition the study methods and parameter measurements are compatible with the whole Flathead Study.

Should the Bureau be unable to justify a Feasibility Study and, therefore, could not fund Segments B-1 and B-2, EPA funding should be made available for the water quality, limnological and fisheries study of the river segment. This work should be done in the same time frame as the rest of the study whether by the Bureau of Reclamation or EPA funding.

# APPENDIX C

Robert E. Schumacher June 21, 1978

Address: Home: 1227 Fifth St. West, Kalispell, MT 59901 Phone: 257-1757
Office: Montana Dept. Fish and Game 490 N. Meridian, Kalispell Mt. 59901 Phone: 755-5505

Born: Heron Lake, Minnesota on October 14, 1918

Education: Attended Heron Lake Public Schools
Five years in U.S. Army Air Corps -- October, 1940 - October, 1945
University of Minnesota -- B.S. in Fish and Wildlife Management 1945-1949
University of Minnesota Graduate School 1950-1951, 34 quarter credits in Fisheries Biology and Management (thesis incomplete)

Employed: Aquatic Biologist I, Minnesota Department of Conservation March, 1950 - October, 1951 Trout Nutrition and Disease Research

Aquatic Biologist II, November, 1951 - November, 1955 Biological Trout Hatchery Management, lake and stream survey supervising

Research Biologist, November, 1955 - November, 1956 Performed research work in trout population dynamics in lakes and streams of Minnesota, supervised all trout research programs, statewide

In House report 1964, Reorganization plan, Game and Fish Division as team member

State of Montana -- District Fisheries Manager, November, 1965 to present time. Responsibility entails detailing study areas for management needs as habitat preservation, preparation of budgets, preparing long-range and short-term research plans and management plans. Coordinate our, and other, research findings into appropriate management action. Assign duties and responsibilities to fishery project leaders (all with M.S. in Fisheries Science) and supervise those plus three fisheries fieldmen and up to eight temporary summer student assistants

Reports are prepared for both management and research reports. Regulations for seasons and limits and appropriate limitations or fishing activities or developments for the region are recommended

Make field reviews of an average of 150 construction projects per year proposed by state and federal highway departments, state agencies and U.S. Forest Service and private individuals

Membership: American Fisheries Society
President North Central Division of American Fisheries Society 1960
Certified Fisheries Biologist 1964
Certified Fisheries Scientist 1970

Robert E. Schumacher

REPORTS AND SCIENTIFIC PAPERS

Schumacher, R.E. Blood sedimentation rates of brook trout as affected by furunculosis. Progressive Fish-Culturist. Vol.18, No. 4, Oct. 1956

Schumacher, R.E. Some effects of increased angling pressure on Lake Trout populations in four northeastern Minnesota Lakes. Minn. Fish and Game Investigations Fish Servies No. 3. 1961

Schumacher, R.E. Successful introduction of Mysis relicta (Loven) into a Minnesota Lake Trans Act Am. Fish. Soc. Vol.95 No. 2 April, 1966

Schumacher, R.E. Additional articles on Humpback Salmon in Lake Supervisor Probably 1957-58 A.F.S.

Special Publication No. 3 A review of comparative trout feed costs at state trout rearing stations for five consecutive years spanning a change in trout diets and feeding methods. February, 1955

A manual for operations related to trout hatchery disease control and sanitation program Sept. 1950

PUBLICATIONS COMPLETED

Investigational Report No.92
Comparison of red-gil trout food with standard feeds in Minnesota trout hatcheries with recommendations for increasing trout hatchery operating efficienty November 1, 1950

Investigational Report No. 116
The physical and chemical characteristics of Pond No. 6, St. Paul Hatchery as related to the rearing of brook trout November 6, 1951

Investigational Report 140
Aerial darkhouse census on Minnesota lakes 1951-52 and 1952-53 --Aug. 1953

Investigational Report 142
Results of fortifying standard Minnesota hatchery diet with Aureomycin and Thiamin Hydrochloride on the growth of brown trout Nov. 9, 1953

Investigational Report No. 160
Duscho Creek tagged trout study 1954 - April, 1955

Investigational Report No. 171
Aerial car counts on trout streams of southeastern Minnesota April 30 - May 1, 1955, January 26, 1956.

Delano Hanzel

June 21, 1978

Education: Montana State University -- September 1954 - June 1957
B.S. in Fish and Wildlife Management

Montana State University -- September 1957 - May 1959

Hydroacoustic Stock Estimation, Short Course, University of Washington. March 1975

Advanced Hydroacoustic Stock Assessment, Short Course, University of Washington, October 1976

Employed: Montana Fish and Game, Kalispell, Montana as Project Biologist May 1959 - May 1964

Montana Fish and Game, Kalispell, Montana as Fisheries Manager May 1964 - June 1966

Montana Fish and Game, Kalispell, Montana as Special Project Biologist - June 1966 to present

Professional Recognition: Member of American Fisheries Society since 1960
American Fisheries Society Certified Scientist
Member of Montana Chapter of American Fisheries Society
Member of American Institute of Fisheries Research Biologists

Delano A. Hanzel Account of Main Achievements

My initial work progressed from my masters thesis problem with the cutthroat trout that covered the entire state to fish migration studies of the cutthroat trout and Dolly Varden in the upper reaches of the Flathead River drainage. The movement work involved sampling three large rivers systems that drain both Glacier National Park and the Bob Marshall Wilderness Area.

While Fish Manager in this area, my responsibilities were many that ranged from specific fish investigation in both large and small-sized lakes and streams to the preliminary plans that were necessary for mitigating fish losses due to the construction of Libby Dam.

Since 1966, my work has been related to specific fisheries studies on the 126.000 surface acres of Flathead Lake. The initial goal was aimed toward establishing the basic seasonal and depth distributions of the 22 species of fish and then to proceed gathering life history characteristics of the major game fish species. This information will be used as a basis for evaluating the effects of future water development projects on the fisheries of this lake and river system. The major game fish under study include the lake trout, lake whitefish, Dolly Varden, kokanee and cutthroat trout.

Gear adaptation and development has been an important part of the lake study. The work involved buying and modifying a 35-foot commercial seiner to facilitate the working platform for handling the bulk of materials for gill netting and more recently to provide the power to fish a newly developed small meshed purse seine.

Studies associated with the lake characteristics, water chemistry, bottom organisms, and plankton communities have been coordinated with graduate students of the University of Montana, Yellow Bay Biological Station.

My most recent work has been the development of an acoustical sampling program for both Flathead Lake and other large lakes of the area. Using hydro-acoustics fish population assessments can be made.

Delano A. Hanzel LIST OF PUBLICATIONS

Hanzel, Delano A. 1960. The Distribution of the Cutthroat trout (Salmo clarki) in Montana. Proc. Mont. Acad. Sci. 19: 32-71.

Hanzel, Delano A. 1964. Evaluation of Kokanee spawning and population density in Flathead Lake and tributaries. Comp. Report, Montana Fish and Game Dept. F-7-R-12, Job II. 10pp. Multilith.

Hanzel, Delano A. 1966. Survey of cutthroat trout and Dolly Varden in the Flathead River and tributaries above Flathead Lake. Comp. Report, Montana Fish and Game Department. F-7-R-14, Job III. 8pp. Multilith.

Hanzel, Delano A. 1970. Flathead Lake, Investigation of its fish population and its chemical and physical characteristics. Comp. Report, Montana Fish and Game Department. F-33-R-3, Job I. 48 p. Multilith.

Hanzel, Delano A. 1971. The seasonal and depth distribution of the fish population in Flathead Lake. Comp. Report, Montana Fish and Game Department. F-33-R-4, Job Ia, 27p. Multilith.

Hanzel, Delano A. 1977. Angler pressure and game fish harvest estimates for 1975 in the Flathead River system above Flathead Lake. Fisheries Investigational Report, Montana Department of Fish and Game. 23p.

Newell, Robert., D. L. Anderson and D. A. Hanzel. 1978. Bottom Fauna as a indicator of Lake Typology in Flathead Lake, Montana. Northwest Science, July 1978.

Weisel, G. F., D. A. Hanzel, and R. L. Newell. 1973. The pygmy whitefish, Prosopius coulteri, in Western Montana. Fishery Bulletin. 71(2) 587-596.

Robert J. Domrose June 21, 1978

Born: Milwaukee, Wisconsin on September 19, 1929

Education: Milwaukee public schools (elementary and high)
Two years U.S. Army 1951 - 1953. Ripon College, Ripon, Wisconsin 1953 - 1954
University of Wisconsin-Milwaukee 1954 - 1956
Montana State University 1955 - 1957 B.S. in Fish and Wildlife Management
Montana State University Graduate School 1958 - 1960. M.S. in Fisheries Management, Thesis: Age and Growth of Brook Trout in Montana

Employment: Fisheries Biologist, Virginia Fish and Wildlife Commission September, 1960 to February, 1963. Striped Bass Investigations of Kerr Reservoir
Fisheries Biologist III. February, 1963 to present with Montana Department of Fish and Game
Duties and responsibilities: Management of lakes and streams in Region One(Northwest Montana)

## REPORTS AND SCIENTIFIC PAPERS

Age and Growth of Brook Trout in Montana. Montana Academy of Science 1961

Several D.J. Completion Reports of Survey and Inventory Projects, Region One -- 1964 to date

Bruce May June 21, 1978

Born: Cincinnati, Ohio on March 27, 1937

Education: Ohio State University B.S. 1963 (3.3 Accum Ave)
Ohio State University, M.S. 1966 (3.7 Accum Ave)
Aquatic and Fishery Biology
U.S. Army 1958 - 1960 -- discharge with good conduct medal

Employment: Ohio State University 1963 - 1966 as a teaching assistant in the Department of Zoology lab instructor in biology and ecology

Ohio State University as technical assistant to Dr. Milton B. Frautman doing survey work concerned with collection of fishes from central Ohio streams

North Carolina Resources Comm., Division of Inland Fisheries Fishery Biologist June, 1966 - Jan. 1969 This work concerned primarily with two F-16-R projects; 1) estimates of harvestable fish populations in municipal water supply lakes and 2) the biology of the threadfin shad in North Carolina waters. Annual Progress reports were prepared for these projects

Montana Dept. Fish and Game, Fisheries Division Jan. 1969 to present. Evaluation of the effects of Libby Dam upon fishery resources on the project area. Specific projects included, 1) Evaluation of the effects of railroad relocation ahd channelization upon fish habitat and fish populations in the Fisher River, Wolf Creek and Fortine Creek, 2) Evaluation of the effects of Libby Dam on the downstream fishery resource in the Kootenai River, 3) the establishment of spawning runs of westslope cutthroat trout in Young Creek, a tributary to Lake Koocanusa and 4) a post-impoundment fisheries study on Lake Koocanusa. Annual and Completion Reports were prepared for all projects.

Professional Recognition: American Fisheries Society
Montana Chapter of American Fisheries Society
National Wildlife Federation
Northern Plains Resource Council
Save the Kootenai Association

Bruce May

June 21, 1978

LIST OF PUBLICATIONS

May, Bruce 1969 Observations on the biology of the variegated darter Etheostoma variatum (Kirtland). The Ohio Journal of Science 69(2):85-92

May, Bruce 1973 A preliminary evaluation of the effects of gas bubble disease on fish populations in the Kootenai River below Libby Dam Proceedings Western Division American Fisheries Society, July, 1973 Salt Lake City, Utah

A paper concerned with the population dynamics of an introduced cutthroat trout population in Young Creek, a tributary to Lake Koocanusa is in the process of being edited and prepared for publication.

COMPLETION REPORTS

Evaluation of Mitigation Measures in Fisher River, Wolf Creek, and Fortine Creek, 1969-1972. Montana Fish and Game Report in Cooperation with the U.S. Army Corps of Engineers Contract DACW 67-70-C-001

Habitat Development of Young Creek, Tributary to Lake Koocanusa July 1, 1969-August, 1975. Montana Fish and Game Department in Cooperation with Army Corps of Engineers, Contract DACW 67-73-C-002

Kootenai River Fisheries Inventory Phase II, Part I., July 1, 1973 - June 30, 1975. Montana Fish and Game Report in Cooperation with Army Corps of Engineers, Contract DACW 67-76-C-003

Sue A. Appert June 23, 1978

Born: Akron, Ohio, on August 29, 1944

Education: Mineral Point High School, Mineral Point, Wisconsin
Cornell College, Mt. Vernon, Iowa -- 1962-1963
University of Wisconsin, Madison, Wisconsin -- 1963-1966
BA - June, 1966 - zoology
University of Wisconsin, Platteville, Wisconsin -- 1966-1967
University of Iowa, Iowa City, Iowa -- 1973-1974
University of Montana, Missoula, Montana -- 1974-1977
MA - June, 1977 - zoology

Employed: Research Assistant, Primate Laboratory, University of Wisconsin August, 1968 - January, 1970. Neurohistologist, Biochemical Technician; experience with histological techniques (microtome, cryostat, staining techniques), autoanalyzer, electrophoresis, animal testing, statistical techniques

Self-employed with husband -- August, 1966 - August, 1976 Built and managed laundromats and duplexes in Wisconsin, Iowa, and Montana; experience in management and operation of self-owned businesses; carpentry, painting, electrical work

Research Assistant, Department of Botany, University of Montana. August, 1976 - January, 1977. Air pollution research - studied the effects of various pollutants on nitrogen fixation; experience with gas chromatography

Teaching Assistant, Department of Zoology, University of Montana, March, 1976 - June, 1977. Taught discussion sections, laboratories, field trips. Also taught a course in Running Water Ecology with two other graduate students

Fisheries Fieldman, Montana Department of Fish and Game April, 1978 - present. Perform research work in trout population dynamics and limnology in lakes and streams

Membership: American Fisheries Society
North American Benthological Society

PUBLICATIONS

Appert, S. A. 1977. A Comparative Study of Lake Outlet Ecosystems. Unpublished Masters Thesis. University of Montana, Missoula.

Appert, S. A. and A. Sheldon. 1978. A Comparative Study of Lake Outlet Ecosystems. Submitted to Oikos.

Joe E. Huston June 26, 1978

Born: Del Norte, Colorado on September 30, 1933

Education: Rio Grande High School, Monte Vista, Colorado -- 1951
Colorado State University -- 1955 B.S. in Fish Management
Colorado State University -- 1959 M.S. in Fish Management

Military: U.S. Army Medical Corps 1957-58

Employed: Summer 1953 -- Nevada Game and Fish Department
Summer 1954-55 -- Colorado Game and Fish Department
Summer 1956 -- U.S. Fish and Wildlife Service and Fort Apache Indian Reservation, Arizona (Masters Thesis Work)

May, 1959 - June 30, 1960 -- Project Biologist, Montana Department of Fish and Game, Region #2, Missoula, MT

July 1, 1960 - June 30, 1974 -- Reservoir Biologist, Montana Department of Fish and Game, Helena, MT and Region #1, Kalispell, Mt. Responsible for Research and Management of Hydroelectric Impoundments in Northwestern Montana

July 1, 1974 - present -- Fisheries and Wildlife Biologist Supervisor. Responsible for Research and Management Activities on Hydroelectric Impoundments and Large River Systems.

Membership: American Fisheries Society
Certified Fisheries Scientist -- 1970

Publications:

Huston, Joe E. 1965. Investigation of two Clark Fork River Hydroelectrical Impoundments. Proceedings Mont. Acad. Sci. 25:20-40

Huston, Joe E. and Tim Vaughan. 1969. Temporal Movements of Rainbow Trout in Reservoirs, Proceedings 48th Conf. West, Assoc. State Game and Fish Comm. Reno, Nevada, pp 428-441.

# Hungry Horse Reservoir Discharge Variations and Effect on River Biota

A proposal for a study to determine the impacts on the biological community of present water discharges and periodicity of flows from Hungry Horse Reservoir. Included will be changes projected on the aquatic environment from a proposed re-regulating reservoir.

## INTRODUCTION

Problems with present artificially fluctuated discharge on the aquatic resources of the South Fork below Hungry Horse Dam and in the main Flathead River below the South Fork confluence.

Operation of Hungry Horse Reservoir for flood control, irrigation and power generation has had many impacts upon the aquatic resources of the Flathead River, Flathead Lake, Hungry Horse Reservoir and the tributaries of the reservoir. This study will include investigations into a few of the suspected and known impact areas and a literature review of related studies. These areas are delineated below.

1. Impact of reservoir releases upon fish species spawning in or moving through the Flathead River below the confluence of the South Fork of the Flathead River and in the South Fork below Hungry Horse Dam.

2. Effects of the quality and quantity of reservoir releases upon utilization of the fishery resource in Flathead River below Hungry Horse Dam and in the main reservoir itself.

3. Effects of withdrawal and changing reservoir water levels on plankton and aquatic insect production in Hungry Horse Reservoir.

4. Effects of selective withdrawal system on drafting from depths where cutthroat are concentrated.

Flathead River downstream from the confluence of the Middle and North Forks to Flathead Lake is one of the few Montana "Blue Ribbon" trout streams. Large numbers of cutthroat trout, Dolly Varden, kokanee and whitefish are harvested from this section of the river each year. The quality of this fishery is dependent upon migratory fish stocks passing through or spawning in the Flathead River. In 1975 an estimated 46,193 anglers fished this section of the river for 102,188 man hours and caught 217,610 game fish.1/

Flathead Lake and its tributary systems are an interconnected fishery ecosystem. Adult fish of several species living in the lake migrate into the tributaries to reproduce. Distances moved upstream for spawning may vary by species or within species and ranges from a few feet to over 100 miles. Species moving from the lake into the Flathead River system for spawning include, westslope trout (Salmo clarki subsp), Dolly Varden (Salvelinus malma), mountain whitefish (Prosopium williamsoni), pygmy whitefish (Prosopium coulteri), lake whitefish (Coregonus clupeaformis), kokanee (Oncorhynchus nerka), northern squawfish (Ptychocheilus oregonensis), longnose sucker (Catastomus catastomus), largescale

1/ Angler Pressure and Game Fish Harvest Estimates in the Flathead River System above Flathead Lake, 1975 by Hanzel, D.A. (in press).

sucker (C. macrocheilus), and several other minor species.

Water development projects and regulation of tributary stream flows result in dislocated spawning runs which have had detrimental effects on annual recruitment of young fish to lake populations. Blockage of migration into tributaries is a primary detriment to sustaining viable lake populations of migratory salmonid species.

Construction of Hungry Horse Dam blocked access from Flathead Lake to a major spawning area in the South Fork Flathead River and its tributaries. Other tributaries of the Flathead Lake system that have been blocked by dams include the Swan and Stillwater Rivers. The Stillwater River Dam was removed in 1962 and spawning runs of some game fish are starting to re-establish themselves.

It has been estimated that 60 percent of the migratory westslope cutthroat trout and Dolly Varden were blocked by Hungry Horse Dam from reaching spawning and rearing areas in the South Fork drainage. Smaller amounts of spawning and rearing areas for Whitefish and kokanee were inundated by Hungry Horse Reservoir. Hungry Horse Reservoir has developed viable cutthroat, whitefish and Dolly Varden populations and has supported a fair fishery. The quality and quantity of this fishery has declined in recent years. Reduced numbers and size of game fish in Hungry Horse Reservoir are thought to be a direct result of increased seasonal withdrawal and artificially manipulated changes in water level.

This proposed investigation will attempt to delineate the severity of several impacts and recommend possible changes to reduce deleterious effects of water releases from Hungry Horse Reservoir. Each of the areas to be investigated are discussed briefly in the following paragraphs.

## Impacts of Water Releases upon Spawning Populations.

Water release patterns from Hungry Horse Reservoir are high flows in fall and winter and low flows in spring and summer, the reverse of flows occurring in un-regulated streams which are high flows in spring and early summer and low flows in fall and winter. Temperature of the reservoir discharges are usually different from the natural pattern. Hungry Horse Reservoir discharges are generally about 40°F all year, cooling the river some times of the year and heating it at other times.

Two major groups of fish move out of Flathead Lake into the Flathead River system for spawning. The groups include: (a) Dolly Varden, cutthroat trout, whitefish and kokanee that move through the Flathead River to reach spawning grounds in the Middle and North Fork Flathead River drainages and (b) cutthroat, kokanee, whitefish, suckers and squawfish that spawn in the South Fork Flathead River below Hungry Horse Dam or in the Flathead River below the confluence of the South Fork Flathead River.

Fish passing through the mainstem Flathead River to reach upper drainages are subject to changes in water temperatures and volumes from reservoir releases. This may delay or prolong the rate of migration to spawning areas and thereby reduce the rate of egg survival. Investigation would attempt to provide information on timing that would minimize the impact of discharges from Hungry

Horse Reservoir.

Fish spawning in either the South Fork below Hungry Horse Dam or in the mainstem Flathead River below the South Fork are subjected to river fluctuations throughout their entire spawning cycle. Resultant eggs and subsequently, young fish, are subjected to river fluctuations until they emigrate into Flathead Lake. Fishery investigation would be limited to factors or reservoir discharges directly affecting adult and juvenile fish or spawn. These factors include: (1) movements of adult and juvenile fish in response to flow and temperature patterns, (2) selection of spawning sites, (3) effects on survival of deposited eggs, (4) effects on emergent fry and fingerling fish and (5) effects on year-class strengths in Flathead Lake, (6) the total quantity of suitable spawning sites inundated. Hungry Horse Reservoir discharges are believed to have substantially changed spawning migrations and spawning locations of kokanee. Observations by anglers and department personnel seem to indicate water regulation has increased utilization of mainstem Flathead River for kokanee spawning and decreased shoreline spawning in Flathead Lake. It is suspected that in-river spawning of whitefish and squawfish is also changed. Egg incubation of whitefish appears to be best at water temperatures below 35°F and warming effects of reservoir winter discharges may be adversely affecting egg survival. Squawfish spawn during midsummer in warmer water, spawning is likely delayed or diminished by tempering effects of reservoir discharges.

Effects of Water Releases Upon Utilization of the Fishery Resource.

Fluctuations of river levels affect fishing success and fishing pressure. Whether this effect is in river stages, from changes in fluctuations in velocity or temperature, or the fish's response to these variables, is not known. The above described variables in river flows would be correlated with anglers success rates and fishing pressure.

Effects of Reservoir Fluctuations on Benthic and Planktonic Production

Periodic fish population sampling has been done in Hungry Horse Reservoir since 1958 and has indicated a gradual decline in numbers of fish living in the reservoir. The most marked decline in numbers of fish living in the reservoir occurred in westslope cutthroat trout in the 1970-71 period. Fish food production studies in the reservoir have never been conducted and general limnological studies have been very limited.

Westslope cutthroat trout living in the reservoir are thought to have pelagic living characteristics at least for portions of their life cycle. Survival is believed to be dependent upon adequate planktonic fish food production. Bottom living insects are another source of important food items. It is thought that late summer drafting of the reservoir has altered production of plankton and bottom living organisms resulting in lower survival and poorer growth of lake-dwelling fish.

Investigations in Hungry Horse Reservoir would be primarily monitoring depth distribution of important fish species seasonally and with temperature profiles

to provide information to assist in proposing depth from which discharge would be most suitable if a selective withdrawal system were undertaken.

## Effects of Supersaturation Caused by Mixing Water Temperatures From Reservoir Discharge With North Fork and Middle Fork Flows

Mixing of reservoir discharge water of 40°F to 42°F with stream water of 32°F to 50°F causes some gas supersaturation. The degree and extent of this supersaturation downstream in the main river has not been documented. It does occur during the period of hatching of whitefish eggs and possibly as late as to coincide with some emergence and migration of kokanee salmon fry from spawning beds and movement to Flathead Lake. Kokanee fry from the McDonald Creek spawning area in Glacier Park must all pass through the mixing zone and the geographic extent of this zone. The effect on migratory or emerging fry from supersaturation probably will have to be done as a different study at some laboratory in a controlled experiment.

## Problems to be Expected or Changes in Present Problems Which Relate to a Re-reg Dam Below Hungry Horse Reservoir

The public's environmental awareness of today, demands that large developmental projects be reviewed in light of comprehensive environmental impact statement. Agency funds made available for a feasibility study must include a portion for study of the loss, damage or alteration of the aquatic resources as well as for the study of the engineering needs. We are proposing the Bureau of Reclamation fund the following study of the fisheries and related aquatic resource to determine to what extent enhancement or mitigation will accrue if a re-regulation dam is constructed below Hungry Horse Dam.

The discharge fluctuations that now exist and the effect on changes in discharge volumes and water temperature has been documented (Hanzel 1965 & 1967, F-7-R-13 and 15). It is certain that some fluvial stream habitat will be lost with a re-regulating reservoir and it is equally certain that there will be a vast change in the ecological systems and the flora and fauna that can populate a re-reg reservoir fluctuating daily. "The Hydrology of Hungry Horse Reservoir, Northwest Montana" by Simons and Rorabaugh (1971) gives an adequate description of the operation of the main reservoir. A "Review of Hungry Horse Operations as They Affect Recreation and Fish Habitat" by a Review Team, Jack Frink, et al (August 1974), describe many of the operational problems.

Westslope cutthroat trout, kokanee salmon and mountain whitefish are game fish known to frequent the South Fork below Hungry Horse Dam. It is believed that sculpin and possibly an infrequent transient Dolly Varden use the area also. Some limited work has been done on insect communities and comments on periphyton have been made by Jack Stanford (1974 and 1975).

Present game fish populations in the South Fork below Hungry Horse Dam are migrant species using the main river of Flathead Lake for a necessary part of their life cycle. Construction of a re-reg dam without a fish ladder will eliminate cutthroat, kokanee and Dolly Varden from the re-reg basin. Some mountain whitefish might be sustained if the re-reg forebay does not completely

eliminate the riverine effects of the Hungry Horse discharge. A river environment and species of primary producers restricted to river characteristics, will be lost and some development of a more lotic flora and fauna will be had.

Fine silts and sediments will gradually accumulate in the re-reg basin and will eventually bury the clean rubbie-boulder streambed which has served as stable living platforms for stream insects.

Fluctuations of water levels on a daily basis will discourage littoral vegetation and nearly eliminate periphyton as a primary producer. River-type insects such as Mayflies, stoneflies and caddisflies will also disappear or diminish. Littoral seeking fish species will find it difficult to tolerate repeated fluctuation of water level.

The extreme highs and lows of the main Flathead will not be eliminated unless some change is made in minimum allowable discharge. We will make recommendation for minimum flow after this study is done and after engineering data are available on re-reg capacity, generator numbers, type and flow requirements. A preliminary estimate would be about 2000 cfs minimum discharge from the re-reg would allow abundant kokanee spawning areas to be available. The minimum flow would not be necessary during run-off periods when the North and Middle Fork flows would exceed 3500 cfs combined.

## STUDY AREA

The area of study will be that section of the Flathead River from near the Four Corners road T28N R21W Sec.27, known as Salmon Hole, to near the village of Hungry Horse T30N R19W Sec.5, and that part of the South Fork from its confluence with the Flathead River to Hungry Horse Dam.

## OBJECTIVES

1. To determine the effect of artificially fluctuated reservoir discharge on the survival of kokanee salmon reproduction.

2. To quantify the suitable kokanee spawning habitat available at discharge 1200, 3000 and 8000 cfs.

3. To make population estimates of mountain whitefish in the area of influence of Hungry Horse Reservoir and compare with population estimates in the main Flathead River above the South Fork confluence.

4. To define mountain whitefish spawning season in the main Flathead River.

5. To make population estimates, species diversity and life history characteristics of major macro-invertebrates in the Flathead River below the South Fork confluence and in the South Fork below the dam.

6. To determine the effect of artificially fluctuated flows and abnormal temperatures impacted on macro-invertebrates and periphyton in the study area.

7. To monitor delays in migration of spawning adult game fish caused by reservoir discharge on stream temperatures and flows.

8. To provide the Bureau with the Department's best estimate of necessary minimum flows by seasons or months to provide the most desirable reproduction and survival rates of kokanee salmon, and macro-invertebrates for game fish.

9. To provide the Bureau with the best estimate of desirable seasonal water temperatures for multiple outlet discharge if the department believes a multi-outlet structure would be significantly beneficial to fish.

OUTLINE OF SEGMENTS OF SPECIFIC DETERMINATIONS TO BE MADE

A. Kokanee

1. Measure spawning habitat at three discharge levels, in acres per mile of stream.

2. Mortality of eggs or embryos in gravels

   a. Correlate mortality with length and frequency of air exposure

   b. Correlate mortality with temperature vs length of exposure

   c. Determine the length of incubation season

      1. By degree days

      2. By emergence

      3. Determine delay in hatching due to exposure of redds to cold air

      4. Determine if a delayed or early hatching is desirable

B. Whitefish

1. Population estimates (standing crop) of typical whitefish inhabited areas

   a. Above South Fork confluence

   b. Below South Fork confluence

2. Define spawning season

   a. In calendar time

   b. In temperature

3. Estimate spawning habitat areas at 1200 cfs, 3000 cfs and 8000 cfs

C. Aquatic macro-invertebrates

1. Determine productivity and populations

   a. Above South Fork confluence (1 station control)

   b. Below South Fork confluence (2 stations)

   c. South Fork below dam (1 station)

2. Analyze for species, (genera) diversity index

3. Determine drift populations in main Flathead River

   a. Correlate drift with temperature changes

   b. Correlate with flow and velocity

4. Estimate change in productivity in discharge influenced area

   a. With 1200 cfs minimum flow (wetted area)

   b. With 3200 cfs minimum flow (wetted area)

5. Determine life history characteristics of major species and correlate species life history characteristics and their abundance as related to bed material size, stability, velocity, periphyton, frequency of dessication or inundation.

6. Determine periphyton productivity

   a. Determine population development with length of periods of inundation

7. Determine length of exposure to atmosphere required to destroy growth and to retard periphyton growth

D. Determine delays or pauses caused in upstream migration of adult game fish spawners caused by reservoir discharge.

   1. Correlate with changes in volume and velocity

   2. Correlate with temperature changes

E. Determine changes in anglers (snaggers) success rate from low discharge to high and from high to low discharge as well as from stable flows.

   1. Determine displacement in resting salmon school locations due to change in discharge

F. Make indices of abundance (population estimates if numbers are sufficient), of all fish species inhabiting the proposed re-reg basin for mitigative values.

1. Make spring and late fall estimates for westslope cutthroat, Dolly Varden, mountain whitefish and kokanee

2. Identify all fish species found

G. Provide the Bureau of Reclamation with the department's best estimate of recommended minimum flows during egg deposition and incubation of kokanee and whitefish spawn.

1. Without a re-regulation reservoir

2. With a re-regulation reservoir

H. Determine depth distribution of major fish species, acoustically, in Hungry Horse Reservoir during open water season.

1. Correlate with temperature profiles

2. Correlate with changes in temperature profiles with drawdown

3. Correlate fish distribution with plankton and limnological data acquired by the Bureau of Reclamation reservoir study

4. Determine food habits seasonally for Dolly Varden, cutthroat and squawfish

5. Correlate with water temperature and seasons to project loss of fish downstream from programmed selective temperature withdrawal.

I. Provide the Bureau of Reclamation with the department's best estimate of most desirable temperatures of release water for game fish species by seasons of the year and in monthly increments if possible.

## Duration and Costs of Study Proposal

The study we would recommend to start as soon as a contract could be supplied. It should be composed of A,B,C,D,E,F, and G segments. These are delineated by the manner in which reservoir discharges effect the life forms in the South Fork and in the main Flathead River below the confluence of the South Fork of the Flathead River.

If study segments H and I are funded for a later study we would propose to handle these segments under a separate contract. If it is necessary that the Hungry Horse Reservoir studies need be done in the same time frame as the river studies, we will still submit a separate study proposal and budget.

Estimated annual costs for the investigations described above are given in the attached budget. The investigations into effects of water releases upon utilization of the fishery resource in Flathead River and on aquatic flora and fauna in Flathead River are expected to be completed in three years. Investigations of discharge effects on the spawning cycle and subsequent year-class strength in Flathead Lake as affected by success of reproduction, may require five years.

We would expect to make this determination concerning year-class strength from our regular Flathead Lake study, provided state funding of the lake project continues.

Montana Department of Fish and Game will submit copies of our regular monthly narrative reports to the contracting interested agency. Detailed annual or semi-annual progress reports, segment reports and a comprehensive final report will be prepared. Final reports will be completed during the year following cessation of field studies.

The department will also continue on-going investigations studying the fish populations of Flathead Lake and North Fork Flathead River at levels dictated by state budget limitations. These investigations are funded by State of Montana monies and federal Dingell-Johnson matching funds.

Prepared By: _____
Robert E. Schumacher

Date: November 17, 1976

# HUNGRY HORSE PROJECT BUDGET 1979 - 1982

| Personnel | Grade | | *1979 1/2 yr | 1980 1 yr | 1981 1 yr | 1982 1/2 yr |
|---|---|---|---|---|---|---|
| Project Leader | 15 | | 3,137(2mo) | 4,570(3mo) | 4,858(3mo) | 5,174(4mo) |
| Assistant Leader | 13 | | 7,183 | 15,300 | 16,294 | 8,676 |
| Fisheries Fieldman | 10 | | 5,494 | 11,701 | 12,461 | 6,231 |
| Unnamed Labor | | | 8,242 | 17,553 | 18,694 | 9,955 |
| Secretarial & Graphics | | | 3,532 | 7,536 | 8,025 | 4,275 |
| | | Total | 27,588 | 56,660 | 60,332 | 34,311 |
| Benefits @ 17% | | | 4,690 | 9,632 | 10,256 | 5,834 |
| Salaries & Benefits | | Total | 32,278 | 66,292 | 70,588 | 40,145 |
| Expendable Equipment | | | | | | |
| Radio tags | | | 2,200 | 1,200 | 1,200 | |
| Floy tags | | | 1,500 | 1,500 | 1,500 | |
| Traps & leads | | | 830 | 830 | 830 | |
| | | Total | 4,530 | 3,530 | 3,530 | |
| Travel | | | | | | |
| Auto | | | 1,125 | 2,250 | 2,250 | 1,125 |
| Boat gas & oil | | | 500 | 1,000 | 1,000 | 500 |
| Per diem | | | 2,140 | 4,280 | 4,280 | 2,140 |
| | | Total | 3,765 | 7,530 | 7,530 | 3,765 |
| Publication Costs | | | | | | 1,000 |
| Laboratory Analysis | | | 400 | 400 | 400 | |
| Food Studies | | | 1,250 | 2,500 | 2,500 | 1,250 |
| U.S.GS Station (less sediment) | | | 3,534 | 7,623 | 8,244 | 4,122 |
| Rental Equipment | | | 4,717 | 9,434 | 9,434 | 4,717 |
| Contingency Fund | | | 1,519 | 15,690 | 10,774 | deficit |
| | | Grand Total | 51,993 | 112 999 | 113,000 | 54,999 (332,997. |
| Anticipated Appropriation | | | 52,000 | 113,000 | 113,000 | 52,000 (330,000. |

* Based on the Bureau of Reclamation Fiscal Year

4/17/78

## EQUIPMENT RENTAL LIST

| Item | Cost/mos | Est.Mos | Est.Cost |
|---|---|---|---|
| Scientific Equipment | | | |
| Multiprobe recording thermographs | 60.00 | 24 mos | $ 1,440.00 |
| Yoboro thermographs | 15.00 | 24 | 360.00 |
| Scale reading equipment | 10.50 | 4 | 42.00 |
| Fish weights & measures | 18.00 | 12 | 216.00 |
| Current meter | 18.00 | 4 | 72.00 |
| Microscopes | 13.50 | 10 | 135.00 |
| hydraulic scale press | 12.00 | 2 | 24.00 |
| Insect drift nets | 30.00 | 80 | 2,400.00 |
| | | Total | $ 4,689.00 |
| Electric | | | |
| 2 My-T-Lite generators | 15.00 | 10 | 150.00 |
| 2 variable voltage regs | 25.00 | 10 | 250.00 |
| 2 fish shockers boom | 22.00 | 10 | 220.00 |
| back pack shocker | 18.00 | 4 | 72.00 |
| 2 electrodes, dipnets & tags | 10.00 | 10 | 100.00 |
| | | Total | $ 792.00 |
| Boats & Motors | | | |
| 2-18 foot john boats | 30.00 | 14 | 420.00 |
| 16 foot john boat | 25.00 | 7 | 175.00 |
| 14 foot john boat | 18.00 | 3 | 54.00 |
| 2-115 hp jet engines | 110.00 | 14 | 1,540.00 |
| 55 hp jet engine | 80.00 | 7 | 560.00 |
| 16 hp outboard | 35.00 | 4 | 140.00 |
| | | Total | $ 2,889.00 |
| Fish Traps & Nets | | | |
| 4 fry traps | 20.00 | 16 | 320.00 |
| 20 emergent traps | 10.00 | 60 | 600.00 |
| 8 box traps | 6.00 | 24 | 144.00 |
| | | Total | $ 1,064.00 |
| | | Grand Total | $ 9,434.00 |

# Hungry Horse Study for biological & [illegible] years