MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
SUMMARY ANNUAL PERFORMANCE REPORT

STATE:	Montana
PROJECT NO:	F-46-R-1
JOB NO:	II-a
PROJECT TITLE:	Statewide Fisheries Investigations
STUDY TITLE:	Survey and Inventory of Coldwater Lakes
JOB TITLE:	Northwest Montana Coldwater Lakes Investigations: Noxon Rapids and Cabinet Gorge Reservoirs Segment
PROJECT PERIOD:	July 1, 1987, through June 30, 1988

The attached detailed report, pages 7-9, addresses attainment of project objectives from a number of funding sources for work at Noxon Rapids and Cabinet Gorge Reservoirs. Funding sources include: the F-46-R-1, Job II-a Federal Aid project (D-J and state matching funds); state funding of certain objectives; and Washington Water Power Company funding. Remaining objectives under Job II-a are covered under other reports.

Following is a summary of Federal Aid Job II-a objectives and degree of attainment.

Fed Aid Job Obj.	Obj. # in Attached Report	Objective
II-a #1	#1, pg. 7	Manage lake and reservoir water levels to minimize impacts on fish populations.

The Company was able to fulfill the terms of the Noxon Rapids Reservoir operation. Maximum drawdown during the report period was about six feet in May 1988. Objective was met.
NOTE: THIS OBJECTIVE WAS FUNDED ENTIRELY WITH STATE FUNDS.

II-a #5	#2, pg. 8	Provide lake fisheries to sustain an increase of 32,600 angler days by 1992 through natural reproduction and hatchery plants. Provide kokanee fisheries for 12-14" fish at a catch rate of 1 fish/hour.

Data presented in this report indicates an increasing fish population in both Noxon Rapids and Cabinet Gorge Reservoirs. Objective was substantially met. Kokanee portion of this objective is applicable to other coldwater lakes covered by Job II-a.

Fed Aid Job Obj.	Obj. # in Attached Report	Objective
II-a #11	#3, pg. 9	Attempt to acquire sites and provide facilities on all lakes and reservoirs capable of sustaining more than 300 days of fishing per year on a priority basis at the rate of one lake per year.

Since 1985, the Company and Department have constructed or improved two boat ramps in Cabinet Gorge Reservoir and four in Noxon Rapids Reservoir. The Company, Department, and U.S. Forest Service are exploring methods to fund and construct at least one additional boat ramp and campground on each reservoir. Objective was met.
NOTE: THIS OBJECTIVE WAS FUNDED ENTIRELY WITH STATE FUNDS.

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STATE: Montana

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ABSTRACT

Cabinet Gorge and Noxon Rapids reservoirs are heel to toe run-of-the-river hydroelectric impoundments on the Clark Fork River near Thompson Falls, Montana. They are owned and operated by the Washington Water Power Company, Spokane, Washington. This report briefly describes results of fishery management activities in the two impoundments from 1952 through 1985 and provides greater detail of studies and management efforts in 1986, 1987, and first half of 1988.

Prior to 1986 Noxon Rapids Reservoir was subject to a spring drawdown averaging 35 feet and daily and weekly fluctuations of 2 feet and 10 feet respectively. Attempts to establish a viable sports fishery using hatchery reared salmonids were essentially a total failure. Effective July 1, 1986, the Company imposed a drawdown limit of 10 feet upon itself. The Company and Department embarked upon an intensive fishery management program which stressed recovery and enhancement of existing fish species, i.e., brown trout (Salmo trutta), largemouth bass (Micropterus salmoides), smallmouth bass (Micropterus dolomieui) and burbot (Lota lota).

Drawdown of Cabinet Gorge Reservoir is limited to a maximum of 15 feet due to penstock depth in the dam. The 15 foot maximum draft was realized often prior to filling of Noxon Rapids Reservoir in 1958. Since 1958 Cabinet Gorge Reservoir has been used as a re-regulation impoundment for Noxon Rapids discharge. In recent years depth of drawdown has seldom exceeded 6 to 8 feet but frequency of 3 to 4 feet drafts has increased. Research has indicated that fish management measures such as fish planting done in Noxon Rapids will impact Cabinet Gorge; therefore little direct activity has been placed in Cabinet Gorge since 1965.

INTRODUCTION

Prior to completion of Cabinet Gorge Dam in 1953, the Clark Fork River drainage downstream from the Thompson Falls Dam served as spawning and rearing area for migratory fish from Lake Pend Oreille, Idaho. Species of game fish

moving upstream from Lake Pend Oreille included bull trout (Salvelinus confluentus), cutthroat trout (Salmo clarki), mountain whitefish (Prosopium williamsoni), lake whitefish (Coregonus clupeaformis), and kokanee (Oncorhynchus nerka). Other species of gamefish found in the Clark Fork river before impoundment included rainbow trout (Salmo gairdneri), brook trout (Salvelinus fontinalis), westslope cutthroat trout (Salmo clarki lewisi), Yellowstone cutthroat trout (Salmo clarki bouvieri), brown trout and largemouth bass. Non-game fish included sculpins (Cottus spp), longnose dace (Rhinichthys cataractae), redside shiner (Richardsonius balteatus), black bullhead (Ictalurus melas), squawfish (Ptychocheilus oregonensis), yellow perch (Perca flavescens), largescale (Catostomus macrocheilus) and longnose suckers (Catostomus catostomus), peamouth (Mylocheilus caurinus), and pumpkinseed (Lepomis gibbosus). Since impoundment four additional species have been planted in the system. These are northern pike (Esox lucius), coho salmon (Oncorhynchus kisutch), smallmouth bass and burbot. The northern pike were from a illegal introduction while the other three were planned introductions.

Fish species no longer found in either impoundment include only the sculpins, brook trout, Yellowstone cutthroat trout, kokanee and coho salmon. Of the game fish only the westslope cutthroat trout, bull trout and mountain whitefish are native species. Of the nongame fish only the bullhead, pumpkinseed and perch were introduced by man.

Cabinet Gorge and Noxon Rapids reservoirs are both owned and operated by Washington Water Power Company (Company). Cabinet Gorge was completed in 1953 and Noxon Rapids in 1958. Both reservoirs are run-of-the-river impoundments with the primary purpose of electrical production. Other minor purposes include water-based recreation and limited seasonal storage capacity. The Company and Montana Department of Fish, Wildlife and Parks (Department) have cooperated in fishery management and investigations since 1953. The Company contracted $187,000 to the Department in 1958 for fisheries mitigation for both reservoirs. From 1958 through 1985 the Company also voluntarily contributed considerable equipment, technical services and personnel as the need arose in support of continuing Department management efforts.

Both Noxon Rapids and Cabinet Gorge reservoirs are integrated into the Northwest Power Pool under terms of the Northwest Power Coordination Agreement. Prior to 1986, the Bonneville Power Administration or other utilities could request energy from the Company which often resulted in deep (26 to 54 feet) spring drawdowns of Noxon Rapids Reservoir. In 1985 the Company informed Bonneville Power Administration that Noxon Rapids would be operated within 10 feet of full pool except during extreme emergencies effective July 1, 1986, for an indefinite period of time.

Starting in spring 1985 and for at least 5 years, the Company agreed to give an annual $10,000 grant to the Department to assist in planting burbot and brown trout into Noxon Rapids each year. In 1988 the purpose of this grant-in-aid was expanded to include developing a source of smallmouth bass for planting into Noxon Rapids and habitat improvement projects in either or both reservoirs. In addition to the grant-in-aid the Company also hired a fishery technician for 27-30 months starting October 1986. This technician is assigned to work under the direction of

the Department on investigations of aquatic life in Noxon Rapids and Cabinet Gorge reservoirs. This report will include information collected using funding from several sources. These sources and time-frames were: 1953-1966, Company contract funds and Department funds; 1967-1981 Company and Dingell-Johnson funds; 1982-1987 Company and State of Montana funds; and July 1, 1987 through the present, Company grant-in-aid, Company and Dingell-Johnson funds. This report will also present information on both cold and warm water fish populations.

BACKGROUND

Cabinet Gorge Reservoir

Cabinet Gorge Reservoir, completed in 1953, impounded about 18 miles of the Clark Fork River extending from near the town of Noxon, Montana to about 1/4 mile into the State of Idaho (Figure 1). At full pool elevation of 2,175 feet msl the surface area is 3,400 acres while at maximum drawdown of 15 feet area is reduced to 2,450 acres. Water exchange rate during spring high water is about one to three days and during the remainder of the year about one week.

Pool fluctuation of the reservoir during the years of 1953-1958 ranged up to 3 feet per day and 15 feet per week. During the period of 1959-1985 fluctuations still ranged up to 3 feet per day but maximum drafts seldom exceeded 10 feet. Since 1986, daily fluctuations ranged up to about 3 feet but maximum fluctuations seldom exceeded 5 to 6 feet.

Fisheries management of Cabinet Gorge Reservoir from 1953 through 1963 included planting 1.7 million kokanee, 1.2 million Yellowstone cutthroat trout, 0.1 million coho salmon and 0.5 million rainbow trout. These planted fish did not establish self sustaining populations and contributed very little to a sport fishery. From 1966 through 1980 about 5,000 catchable size rainbow trout were planted annually in Bull River Bay near a Forest Service campground. Starting in 1985 and expected to end in 1988, about 25,000 eyed brown trout eggs per year will have been planted in Elk Creek with the hope of establishing a spawning population. In 1985, about 300 burbot scheduled to be planted in Noxon Rapids Reservoir had to be planted in Cabinet Gorge due to an unexpected drawdown of the former reservoir.

Essentially the fishery management of Cabinet Gorge Reservoir from the mid-1960's to 1985 was to spend very little time and effort since what developed in Noxon Rapids Reservoir would likely develop in Cabinet Gorge. This management theory is based upon the rapid fish passage over and through Noxon Rapids Dam into Cabinet Gorge Reservoir. Since 1986 management theory for Cabinet Gorge still recognizes fish passage over Noxon Rapids Dam as being a major factor but also that management should strive to build upon existing small populations of suitable game fish, notably brown trout and largemouth bass.

Fisheries investigations on Cabinet Gorge Reservoir have been limited to sporadic gill net fish population surveys (1954-1987), rainbow trout movements (1963-1967), and brown trout redd surveys in Bull River (1980-1987). Some of these data will be presented later in this report.

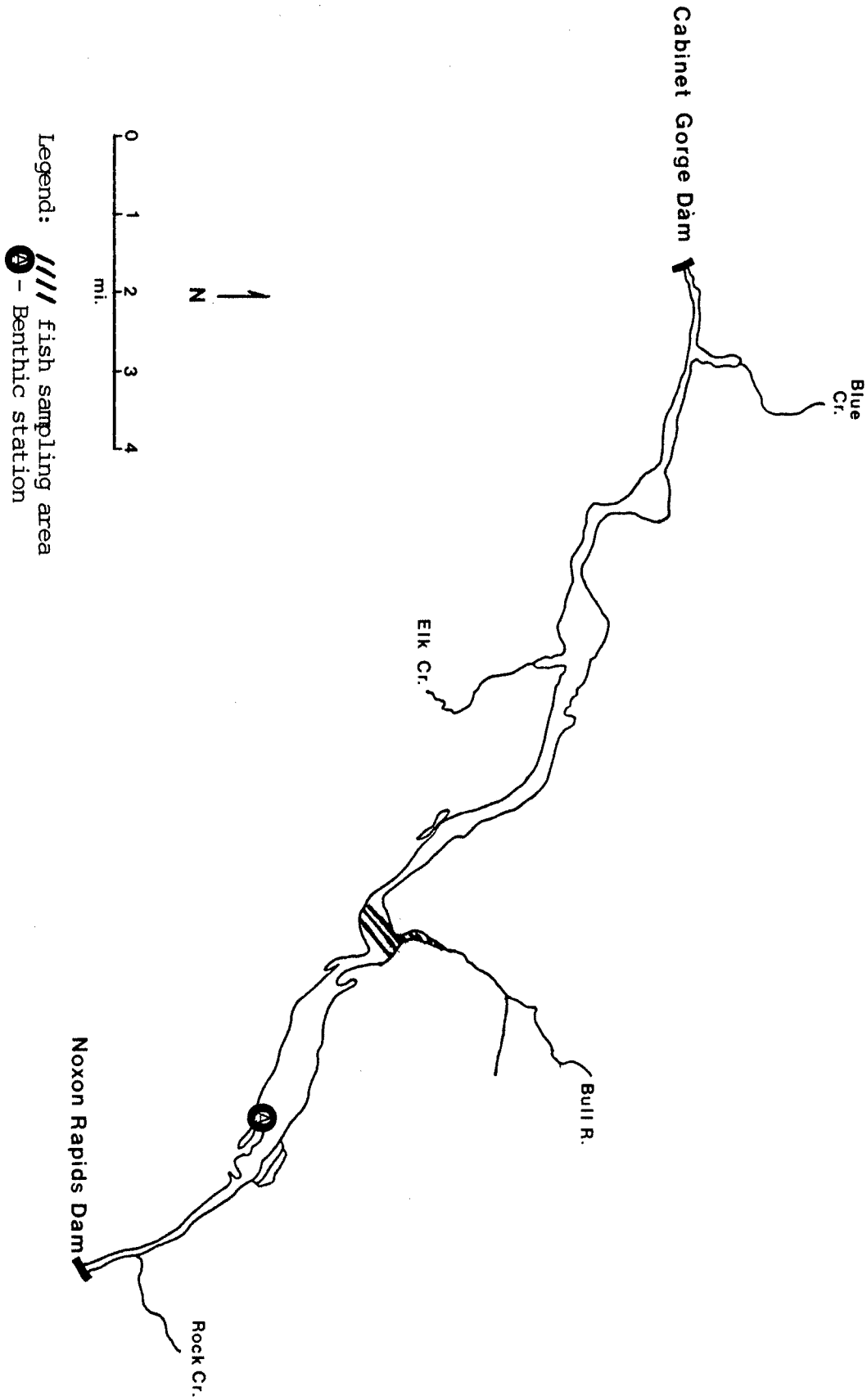

Figure 1. Cabinet Gorge Reservoir and fish and benthic sampling sites.

Noxon Rapids Reservoir

Noxon Rapids Reservoir, first filled in 1959, impounded about 38 miles of the Clark Fork River extending upstream from Cabinet Gorge Reservoir to about one mile west of Thompson Falls, Montana (Figure 2). This reservoir at full pool of 2,331 feet msl has a surface area of 8,600 acres and at maximum drawdown of 54 feet an area of 5,500 acres. Water exchange rates are rapid being about one week during spring runoff and three weeks during the remainder of the year. The upper 20 miles of the reservoir upstream from Vermillion River most closely resembles a wide slow-moving river while the lower 18 miles resembles a lake.

Fisheries management for the years of 1958-1962 in Noxon Rapids Reservoir included chemical treatment of the Clark Fork River prior to dam closure in August, 1958 and planting large numbers of rainbow trout starting in September 1958. These fish were catchable size in summer 1959. Angler success was excellent in 1959 through spring 1961 but declined drastically in summer 1961 through 1962. Areas of angler harvest seemed to indicate downstream movement of fish out of Noxon Rapids into Cabinet Gorge Reservoir and further downstream into Lake Pend Oreille, Idaho. In 1964 more of the fish planted in Noxon Rapids were caught in Cabinet Gorge Reservoir than in Noxon Rapids Reservoir. The greatest avenue of movement out of Noxon Rapids was through spill discharge. Spill discharge of 40,000 cfs or more precipitated mass downstream movements. Frequency of some spilling at Noxon Rapids Dam is 9 out of 10 years and frequency of spilling of 40,000 cfs or more is about one out of two years. Duration of spilling has varied from a few days to several weeks.

During the years of 1966 through 1979 fishery management activities were limited to planting various fish species trying to establish an acceptable sports fishery. These efforts were unsuccessful. Species and numbers planted included brown trout (690,000 fry), kokanee (1,000,000 fry), westslope cutthroat trout (962,000 fingerlings), rainbow trout (200,000 fingerlings) and 423 burbot. Fish population sampling did indicate that small populations of brown trout, bull trout, lake whitefish and largemouth bass were existing in both Noxon Rapids and Cabinet Gorge reservoirs.

For the years of 1961 through 1979 Noxon Rapids Reservoir was drafted in the spring an average of 35 feet ranging from 26 to 54 feet. This spring drawdown, reservoir spilling and short water retention time were considered the prime culprits limiting the fish production potential. Short retention time severely limits plankton numbers, spilling causes fish movement out of the reservoir while drawdown limits benthic organism production and in-reservoir fish reproduction.

For the period of 1980-1984 maximum drawdown of Noxon Rapids was only 12 feet and this for only about ten days. Reasons for the reduced drafting was related to favorable water conditions and power needs within the Company's service area and within the Pacific Northwest in general. Fish population sampling indicated a limited increase in game fish and forage fish. In summer 1982 and 1983 smallmouth bass fingerlings were planted into Noxon Rapids and by 1984 these fish had started to be caught by anglers. Largemouth bass were also increasing in numbers.

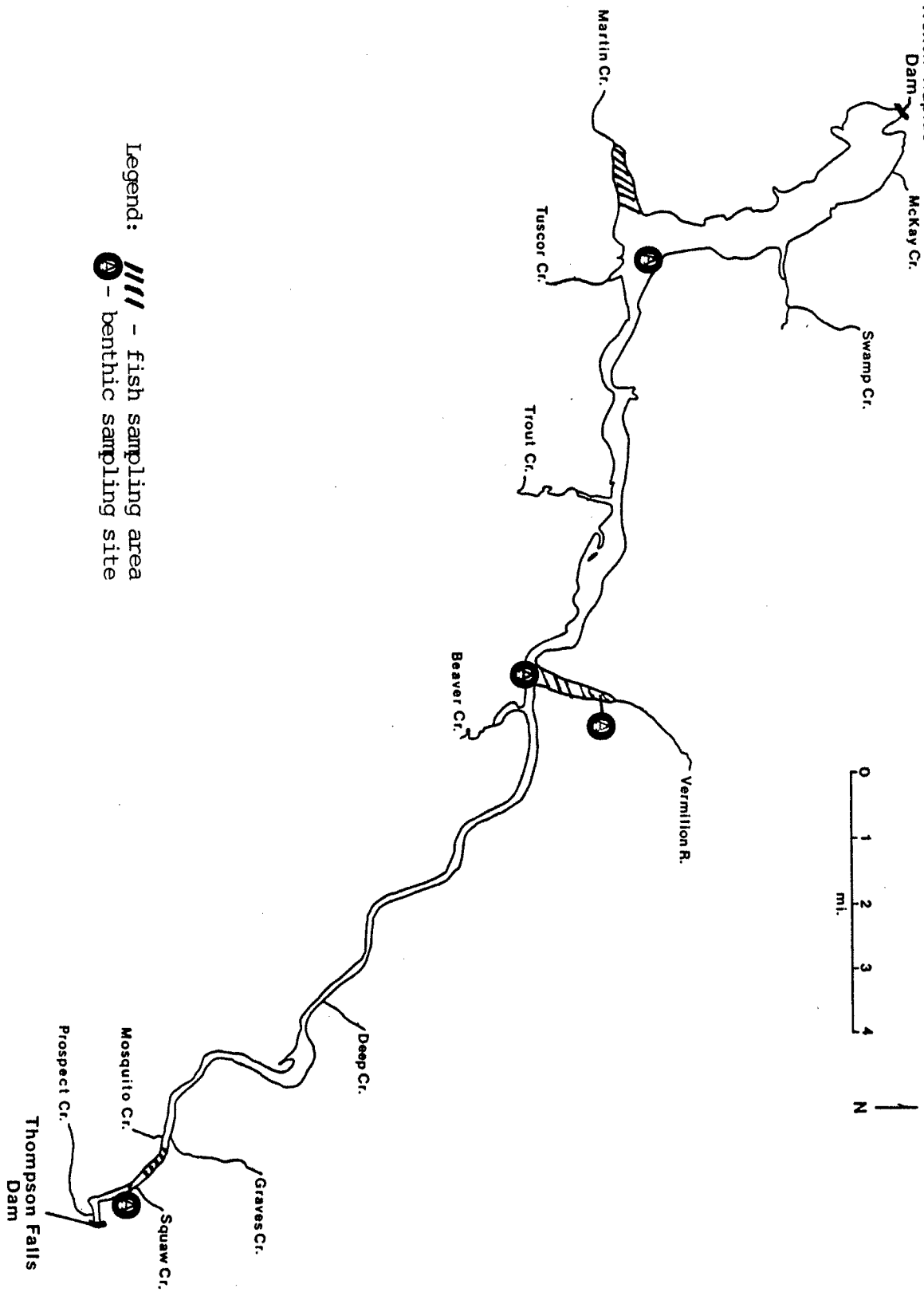

Figure 2. Noxon Rapids Reservoir and fish and benthic sampling sites.

In March 1985, Bonneville Power Administration requested energy from the Company which required drafting Noxon Rapids Reservoir. The reservoir was drawn down 28 feet by late March and was not refilled until late April. This drawdown following five years of relatively stable water levels created a public outcry. Several meetings between the Company, Department, and the Montana representatives on the Northwest Power Planning Council resulted in the Company informing Bonneville Power Administration and other parties of the coordination agreement that Noxon Rapids Reservoir would be operated as described below effective July 1, 1986 for an indefinite time. Major points of the new operation plan are:

1. Maximum drawdown will be limited to 10 feet except that in the second and succeeding years of a critical water period as defined by the Pacific Northwest Coordination Agreement drafting may reach 36 feet but only on a pro-rata basis with all other reservoirs in the coordinated system.
2. Reservoir levels will be within one foot of full pool by May 15 each year and the reservoir will be operated within four feet of full pool thereafter until September 30.
3. The rate of drafting will be limited to two feet per day and 10 feet per week.
4. The Company reserves the right to deviate from the above operational criteria in the event of an emergency such as unscheduled project maintenance, system failure or extended period of weather extremes.

The Company also agreed to station a biological technician in the Noxon Rapids, Cabinet Gorge area for about 30 months starting October 1986. The salary and travel expenses were to be the responsibility of the Company while the Department was to provide technical guidance and expertise, most equipment and manpower when needed. The first year's work (October 1986-December 1987) concentrated on determining quantity and quality of benthic organisms in the reservoirs and continuation of trend fish population sampling. Dr. David Bennett of University of Idaho was enlisted as a technical advisor on the benthic portion of the study. The second year's work (January 1988 - March 1989) will concentrate on spawning habits and habitats of game fish species, trend sampling and angler utilization. This technician will also become involved in community activities as a representative of the Company and represent both the Company and Department at area service and sportsman club meetings.

OBJECTIVES AND DEGREE OF ATTAINMENT

Project objectives as they relate to Noxon Rapids and Cabinet Gorge reservoirs and degree of attainment include those for this Federal Aid Project, those for the special grant from the Company and for the Company technician. These objectives include both coldwater and warmwater fish species and for work from spring 1985 through June 1988. Objectives and degree of attainment are listed below. Objectives 1 through 3 related to Federal Aid Project 3121 (Northwest Montana Coldwater Lakes Investigations and Objectives 4 through 6 relate to Federal Aid Project 3151 (Northwest Montana Warmwater Lake Investigations).

1. Manage lake and reservoir water levels to minimize impacts on fish populations. The Company was able to fulfill the terms of the Noxon Rapids

Reservoir operation. Maximum drawdown during the report period was about six feet in May, 1988.

2. Provide lake fisheries to sustain an increase of 32,600 angler days by 1992 through natural reproduction and hatchery plants. Data presented in this report indicates an increasing fish population in both Noxon Rapids and Cabinet Gorge reservoirs.

3. Attempt to acquire sites and provide facilities on all lakes and reservoirs capable of sustaining more than 300 mandays of fishing per year on a priority basis at the rate of one lake per year. Since 1985, the Company and Department have constructed or improved two boat ramps in cabinet Gorge Reservoir and four in Noxon Rapids Reservoir. The Company, Department, and U. S. Forest Service are exploring methods to fund and construct at least one additional boat ramp and campground on each reservoir.

4. Establish and maintain fishable populations (catch rate = 0.25 fish/hour) of smallmouth bass and burbot in Noxon and Cabinet Gorge reservoirs. Data presented in this report indicates an increasing population of smallmouth bass. Survey of burbot populations has not yet been done but is scheduled.

5. Attempt to acquire and develop access sites on all lakes and reservoirs with the potential for more than 500 mandays of fishing annually. First priority should be given to Lake Blaine and those lakes with adjoining Champion or Plum Creek Timberlands property. See Objective 3 above.

6. Enhance fish populations through the placement of artificial habitat. The Company, Department, U. S. Forest Service, and local sportsman clubs cooperated on the installation of Christmas tree reefs in one area of the reservoir and felling tall (100 foot average) coniferous trees into the reservoir at another site. Site inspections were made for additional reef construction or tree felling.

7. Collection and analysis of data from Noxon Rapids Reservoir and Cabinet Gorge reservoirs including fish, benthic and plankton. All work was completed except that no plankton samples were collected.

8. Obtain and plant brown trout in Noxon Rapids Reservoir. The quota included planting 150,000 eyed eggs in tributaries of Noxon Rapids and Cabinet Gorge each year for 1985, 1986, and 1987, and 150,000 fingerlings into Noxon Rapids in 1986, 1987, and 1988. Essentially these objectives were met or exceeded.

9. Obtain and plant up to 3,000 burbot into Noxon Rapids in 1985, 1986, 1987 and 1988. Through June 1988 about 1,960 burbot have been planted into Noxon Rapids Reservoir and 470 into Cabinet Gorge.

10. Propose fishing regulation changes as needed. Noxon Rapids and Cabinet Gorge Reservoirs were opened to set line fishing with a maximum of three lines per person from January 1 through September 30. This regulation change became effective March 1, 1988.

11. An attempt will be made to rear smallmouth bass fry for planting in Noxon Rapids and/or Cabinet Gorge Reservoirs. No smallmouth bass have been planted in Noxon Rapids since 1983 due to unavailability from Montana's hatchery system. In addition, Department personnel have conducted searches for other smallmouth sources with no success except at two commercial hatcheries. Price for fish from these hatcheries ranged from $300-400 per 1,000 fingerlings. The Department acquired permission to use a 1/2 acre farm pond for rearing smallmouth bass.

FISH PLANTING AND HABITAT IMPROVEMENTS, PROCEDURES, AND RESULTS

Fish Planting

The Company has given the Department a direct grant-in-aid of $10,000 per year in 1985, 1986, 1987 and 1988 to obtain and plant burbot and brown trout into Noxon Rapids and Cabinet Gorge Reservoirs. Brown trout eggs were obtained from three sources including wild fish spawning in Willow Creek near Whitehall, Montana, a private hatchery near Lewistown, Montana, and from the U.S. Fish and Wildlife Service Hatchery at Saratoga, Wyoming.

Procedures for brown trout included planting about 150,000 eyed eggs each year in selected tributaries of Noxon Rapids and Cabinet Gorge Reservoirs. An additional 150,000 brown trout fingerlings 4 inches long were to be planted directly into Noxon each year in 1986, 1987 and 1988. Planting time was to be before the reservoir reached 60°F surface temperature and after reservoir spilling was finished for the year.

The number of brown trout eyed eggs and source of eggs that have been planted in Prospect Creek, Vermillion River, Graves Creek, Trout Creek and Marten Creek tributaries to Noxon Rapids and Elk Creek tributary to Cabinet Gorge include by year 1985 - 149,000 from Willow Creek; 1986 - 108,000 from Willow Creek and 1987- 155,000 from Saratoga, Wyoming. The number of fingerling brown trout planted in Noxon Rapids include: 1986 - 194,000 from Willow Creek; 1987 - 219,000 from the private hatchery and 1988 - 42,000 in May from Saratoga and an anticipated 150,000 in September from the Saratoga Hatchery.

Samples of brown trout from each of the three planting sources and from the existing population in the reservoir have been electrophoretically tested by University of Montana Genetics Laboratory. The genetics data has not been fully analyzed at this time but preliminary results indicate that small differences are discernible between the four groups. It may be possible in the future to determine which group of fish contributed the most to an increased reservoir population.

Locating a reliable source of burbot created a problem since this species is not raised in hatcheries. In 1985 trapping of wild populations was attempted in Lake Koocanusa in Montana and British Columbia, lower St. Mary Lake on the Blackfoot Indian Reservation near Browning, Montana, Oahe Reservoir in South Dakota, and Red Rocks Lakes in the Red Rocks National Bird Refuge near Lima, Montana. The Red Rocks Lakes were selected as the most reliable source. Another source was located in fall 1987 in the Red Rocks River immediately downstream from Lima Reservoir.

Capturing of fish from Red Rocks Lakes was accomplished by fishing about 10 trap nets for 2 to 3 days. Captured fish were held in live boxes. Fish were captured from the Red Rocks River using electrofishing gear and held in live boxes. Fish were transported to Noxon Rapids Reservoir in a tank truck. The following number were planted in Noxon Rapids Reservoir: 1985 - 400, 1986 - 220, 1987 - 1,200 and spring 1988, 140. In 1985 and 1986, 470 were released into Cabinet Gorge. Size of burbot planted ranged from about 6 inches to 30 inches.

Several difficulties were encountered collecting burbot from the Red Rocks Lakes and River. Red Rocks Lakes (upper and lower) are large, very shallow water bodies. Each lake is about 1,500 surface acres but average depth on the lower lake is about 3 feet and about 5 feet for the upper lake. Jet drive boats are a requirement for spring work while row boats are needed for fall work due to heavy weed growths. Muskrats damaged several nets and a holding pen allowing about 200 fish to escape. Water temperatures appear to be very critical to a successful trapping operation. Water temperatures above 60 to 65°F appear to cause burbot to become very inactive and difficult to capture. As an example in early June 1985 temperatures were about 48°F and 12 net nights caught 750 burbot compared to early May, 1986 when lake temperatures were 70°F and 30 net nights caught only 120 fish. Electrofishing equipment used to capture burbot from the Red Rocks River included a backpack shocker putting out about 1 amp of power and a 110v unit putting out about 10 amps. Delayed 24 hour mortality using 10 amps was almost 100 percent while mortality using 1 amp was about 5 percent.

Burbot do transport well in tank trucks and at densities 3 or 4 times as heavy as recommended for trout. Transportation mortalities of burbot moved from Red Rocks Lakes to Noxon Rapids Reservoir, about a 400 mile trip, have averaged 0.1 percent.

Smallmouth bass fry were planted into the upper end of Noxon Rapids in 1982 (125,000) and in 1983 (50,000). Since 1983 smallmouth bass have not been available in Montana's hatchery system and may not be until about 1989. Spending authority for the Company's grant-in-aid was expanded in 1988 to include attempting to rear smallmouth bass in the Noxon area for planting in either Noxon Rapids or Cabinet Gorge reservoirs. A one-half acre pond abut 15 feet deep located near Heron, Montana, was offered to the Department by the landowner for this experiment. In early April 1988, the pond was drained, a bottom screw gate drain installed, existing trout population removed, about three cubic yards of gravel added to the existing gravel and then refilled. The pond was fertilized with ten pounds dry 10-10-10 fertilizer, inoculated with plankton, and planted with about 50 adult redside shiners.

In early May, 20 adult smallmouth bass were released into the pond. Six of these bass were from Horseshoe Lake near Bigfork, Montana, while the remainder were from Noxon Rapids Reservoir. As of June 20, water temperatures in the pond were too low to induce spawning although some fish appeared to be paired up.

Habitat Improvements

The Department applied for and received the Army Corps of Engineers "404" permits for adding tree reefs and felled trees along the shoreline in selected areas of Noxon Rapids Reservoir. The reefs comprised of 200 5 to 8 foot high coniferous trees anchored in concrete blocks were installed in an area upstream and downstream from the Montana Highway 200 bridge at Trout Creek, Montana. People from area bass clubs, U.S. Forest Service, the Company and Department built the reefs in late May, 1988. Ten coniferous trees ranging in height from 75 to 125 feet were felled into the reservoir between Tuscor Creek and the mouth of Marten Bay in June 1988. The tree trunks were anchored to the bank by cabling to nearby trees. Personnel from the U.S. Forest Service, Trout Creek Bass Club, Company and Department participated in this work project.

Site inspections were made by Company and Department personnel of an area between Robinson's Rock and the east shoreline between Tuscor and Swamp Creek for addition of tree reefs in 1989. Work continued on finding methods to anchor trees into the shoreline between Graves Creek and Squaw Creek where water current is present year around.

FISHING ACCESS DEVELOPMENT

Starting in 1985 the Company constructed one new ramp and improved four existing boat ramps on Noxon Rapids and Cabinet Gorge Reservoirs. The improved ramps are located at Bull River Bay U.S. Forest Service campground (Cabinet Gorge Reservoir), North Shore and Finley Flat U.S. Forest Service campgrounds (Noxon Rapids Reservoir) and Trout Creek Community Park (Noxon Rapids Reservoir). The new ramp is located at Noxon Bay (Cabinet Gorge Reservoir) immediate to the town of Noxon and is located on Company land. Ramps were constructed with double wide concrete logs usable down to about six feet of reservoir drawdown.

The Company and U.S. Forest Service are preparing plans to install one additional boat ramp on each reservoir. Locations are Eddy Creek flat on Cabinet Gorge and Marten Creek bay on Noxon Rapids Reservoir. Work has been tentatively scheduled for 1989.

STATUS OF FISH POPULATIONS

Methods

Population Sampling

Fish populations of both reservoirs have been sampled periodically using gill nets. Prior to 1987 gill nets used included 25 foot-long sections of 0.75 inch , 1.0 inch, 1.25 inch, 1.5 inch and 2.0 inch bar measure mesh. Starting in 1987 the 0.75 inch mesh was eliminated to reduce catch of yellow perch. Comparison of size of fish caught by the two types of nets indicated that the 0.75 inch mesh seldom caught fish greater than six inches total length. Therefore, to make the catches from the two net types comparable all fish less than six inches total length were deleted from the data. Prior to 1987 only sinking gill nets were used for population sampling. Since 1987 both floating and sinking gill nets have been utilized. Sampling sites used each spring and fall have been comparable since 1960 and include an area around Graves Creek (upper reservoir), Vermilion Bay (mid-reservoir) and Marten Bay (lower reservoir) all in Noxon Rapids and Bull River area in Cabinet Gorge Reservoir.

All game fish caught in nets were weighed, measured (total length) and scale samples taken for age and growth analysis. All fish from about one-third of the nets were weighed and measured. Non-game fish from the remaining nets were counted.

Time of year sampled has included both spring and fall. Spring sampling is done when surface temperatures are in the 48°F to 52°F range immediately prior to start of yellow perch spawning. Actual time of sampling has varied from mid-April

through mid-June and has occasionally overlapped with start of perch spawning. Fall sampling is done before the start of brown trout spawning movement up tributaries and has varied from mid-October to mid-November. For the past two years and for the foreseeable future fall sampling will be scheduled for the third weekend of October to concide with a three-day equipment operation school sponsored by the Company for University of Idaho undergraduate fishery students.

Age and Growth

Age and growth was determined by impressing scales on acetate and reading the impressions under varying magnifications depending upon species. A straight line relationship between scale length and body length with a zero intercept was assumed. Length at annulus formation was read from a nomograph. This method has been used since 1960.

Brown Trout Spawning Populations

Estimates of brown trout spawning populations have been made by counting redds in reservoir tributaries. These counts are made when stream temperatures have fallen to about 35°F which generally occurs in late November to mid-December. Redd counts were made on sections in Prospect Creek, Vermilion River, and Marten Creek (Noxon Rapids tributaries) in fall 1986 and 1987 and in Bull River (Cabinet Gorge tributary) from 1980 through 1987.

Benthic Sampling

Benthic samples were collected from four stations in Noxon Rapids and one in Cabinet Gorge. Stations are denoted in Figures 1 and 2 and correspond to netting areas. They are Graves Creek area, inner Vermilion Bay, south shore opposite Vermilion Bay and north shore opposite Marten Bay in Noxon Rapids Reservoir and Noxon bay of Cabinet Gorge near the town of Noxon, Montana. Samples were collected in mid-December 1986, April, May and September 1987. Samples were not collected from the inner Vermilion Bay and south shore area in December, 1986, since this area of the reservoir became ice-covered immediately prior to scheduled sampling. The April, 1987, samples were collected about one week before Noxon Rapids was drawn down ten feet while the May, 1987 samples were collected about two weeks after the reservoir was refilled.

Samples collected in December 1986, and April 1987, were obtained using a 1/4 square foot Ponar dredge while those collected in May and September were obtained using a 1.0 square foot Ponar dredge. Depths sampled included 3 feet, 8 feet, 15 feet, and 40 feet. These depths correspond to reservoir operation where drafting to 4 feet occurs frequently, 10 feet generally at least once a year, between 10 feet and 36 feet still a possibility under the current operation plan and in excess of 36 feet extremely rare.

FINDINGS

Fish Populations - Cabinet Gorge Reservoir

Average catch per gill net night for bottom net sets for the years of 1960, 1969, 1982 and 1987 is presented in Table 1. These data indicate that total catch

per net has not varied much over the years but that species composition has changed considerably.

Table 1. Average catch per net night in bottom gill net sets in Cabinet Gorge Reservoir, spring and fall of 1960, 1969, 1982, and 1987.

	Number	Average catch per net night by Species[1]											
Year	of nets	Rb	DV	LL	MWf	LWf	LmB	FSu	CSu	Sq	CRC	YP	Total
1960	16	3.9	0.6	0.0	0.2	1.0	0.0	3.9	6.2	2.8	4.9	1.3	21.8
1969	15	0.0	0.7	0.8	0.2	1.0	0.0	0.2	0.2	10.7	13.6	1.9	29.2
1982	6	0.0	0.0	0.5	0.0	3.0	0.0	0.4	0.2	3.1	12.5	9.7	23.6
1987	4	0.0	0.0	2.5	0.0	3.0	0.3	0.0	2.0	3.9	11.9	4.5	27.9

[1]Abbreviations are: Rb = rainbow trout, DV = bull trout, MWf = mountain whitefish, LWf = lake whitefish, FSu = longnose sucker, CSu = largescale sucker, CRC = peamouth, YP = yellow perch, LL = brown trout, LmB = largemouth bass, Sq = squawfish

Catch of both longnose and largescale suckers has decreased while catches of northern squawfish and peamouth appear to be relatively stable. Numbers of yellow perch appear to have increased over time. Increased numbers of perch are probably related to reduced depth of drawdowns increasing spawning success. Largemouth bass are seldom caught in gill nets so the catch of one fish in 1987 may be significant. Casual observations and angler reports do indicate increasing numbers of largemouth bass in Cabinet Gorge, generally confined to the area between Bull River Bay and the Noxon bridge. Again, reduction in depth of drawdown in recent years is thought to have increased spawning success.

The catch of mountain whitefish and bull trout has declined to zero fish. It is known that both species are still present in the reservoir in small numbers. Mountain whitefish can be caught in the Noxon Rapids Dam afterbay area in early spring and late fall. Lack of suitable spawning areas and planktonic food in the reservoir are considered the major factors controlling population levels. Lack of spawning habitat and rearing area is thought to be the major factor controlling bull trout numbers. Beaver dams blocking access into upper Bull River, their major spawning and rearing area, in the early 1980's is thought to be the major problem. An occasional bull trout redd was seen in lower Bull River in 1985-1987 where none were seen in the early 1980's. Current status of the beaver dam located on private land is not known at this time.

Rainbow trout have not been caught by netting since 1960. Netting data and other information from past studies indicate that rainbow trout remain in the reservoir for only a short time following planting.

Catch of lake whitefish has remained fairly constant over the years. This species is thought to spawn within the reservoir proper, likely in the Bull River Bay area or Noxon Rapids Dam afterbay. Both species of whitefish, rainbow trout

and cutthroat trout feed primarily on plankton and insects throughout their entire life span. Reservoir drawdowns and rapid exchange rates depress these two components thereby limiting population numbers.

Casual observations indicate increasing numbers of pumpkinseed and redside shiners in Cabinet Gorge. These two species are rarely caught in gill nets due to their small size. Because of their small size they are important as forage fish for larger predator fish principally largemouth bass, bull trout and brown trout. Northern pike do occur in this impoundment but, at this time, are uncommon and are usually five pounds or larger. Reproduction of pike is likely almost totally eliminated by reservoir fluctuations. Cutthroat trout have been caught rarely and these fish are most likely strays from tributary streams.

Average catch of brown trout has increased markedly from 1960-1982 to 1987. Brown trout redd counts (Table 2) made in Bull River from the mouth of East Fork Bull River downstream to the McDowell bridge from 1980 through 1987 indicate this increase to be a true increase and not a figment of gill net sampling. Number of redds counted each year has shown a steady increase from 10 redds in 1980 to 94 in 1987. Brown trout start entering bull River about the middle of October but most spawning does not start until mid-November when water temperatures drop to the low 40F and is finished when water temperature drops to 34°F. Final redd counts in Bull River (and other reservoir tributaries) are generally made in mid-December.

Brown trout are known to also spawn in East Fork Bull River, Pilgrim Creek and in the Noxon Rapids Dam afterbay area downstream to about the mouth of Rock Creek. Redd counts are not made in these areas due to volume of water in the afterbay area, Pilgrim Creek being dry about 2 out of 3 years and East Fork Bull River being ice-covered before the end of spawning.

Table 2. Number of brown trout redds counted each year from 1980 to 1987, Bull River between East Fork Bull River and McDowell Bridge.

Year	1980	1981	1982	1983	1984	1985	1986	1987
No. of Redds Counted	10	31	49	26	53	46	64	94

The available data does indicate an increasing population of brown trout in Cabinet Gorge Reservoir. Increased survival of this species is thought related to better food supplies in the reservoir namely benthic production and increased forage fish abundance. Limiting factors likely to appear in the future may be in-reservoir food supply and availability of spawning area.

Limited data has been collected about the size of adult, spawning brown trout inhabiting Cabinet Gorge Reservoir. Size of male and female fish for the years of 1964, 1979, 1986 and 1987 is shown in Table 3. It would appear that little change has occurred in the size a spawning adult even though population levels have increased markedly in recent years.

Table 3. Length in inches of male and female spawning brown trout caught from Cabinet Gorge Reservoir in fall 1964, 1979, 1986, and 1987.

	Males		Females	
Year	Average size and range	Number of fish	Average size and range	Number of fish
1964	18.3 - 23.7 - 26.5	8	18.7 - 21.8 - 24.1	6
1979	16.0 - 19.6 - 24.5	10	13.0 - 19.1 - 24.7	12
1986	14.6 - 18.5 - 24.1	13	16.1 - 18.4 - 24.1	11
1987	19.9 - 22.4 - 28.8	7	13.9 - 20.3 - 24.8	11

Limited age and growth data were calculated for brown trout from Cabinet Gorge Reservoir in 1969 and combined 1985, 1986, and 1987. These data are presented in Table 4.

Table 4. Age and growth of brown trout, Cabinet Gorge Reservoir, 1969 and 1985-1987.

	Length in Inches at Annulus							
Year(s)	I	II	III	IV	V	VI	VII	VIII
1969	3.5(8)*	6.1(8)	10.3(8)	14.6(7)	16.2(5)	19.2(4)	21.6(2)	25.4(1)
1985-87	3.4(35)	7.6(34)	12.3(33)	15.2(26)	18.6(9)	21.6(3)	22.7(2)	

*Number in parenthesis is sample size.

The growth data taken at face value disregarding the small 1969 sample size seems to indicate a small increase in growth rates of brown trout. The data does seem to indicate increased growth of the 1985-1987 fish during their second year of life which remains constant thereafter. It is considered that brown trout juveniles move downstream into the reservoir as fry or fingerlings and that the second year is the first full year in the reservoir. Increased growth during this second year should be an expression of better living conditions in the reservoir.

Bottom fauna sampling done in Cabinet Gorge Reservoir will be presented with the data from Noxon Rapids Reservoir.

Fish Populations, Noxon Rapids Reservoir

Average catch per gill net night for bottom net sets for the years of 1960, 1969, 1982 and 1987 for all stations combined are shown in Table 5. These data indicate a fairly stable total catch for the years of 1960, 1969 and 1982 followed by a marked increase in 1987. Much of the 1987 increase was made up of yellow

perch, squawfish and largescale suckers but four species appeared or reappeared in the catch from early years of impoundment. These species were the largemouth bass, northern pike, bullhead and smallmouth bass.

Table 5. Average catch per net night in bottom gill net sets in Noxon Rapids Reservoir, spring and fall of 1960, 1969, 1982, and 1987.

	Number	Average catch per Net Night by Species[1]													
Year	of nets	Rb	DV	LL	MWf	LWf	LmB	SmB	NP	FSu	CSu	Sq	CRC	Yp	Bh	Total
1960	33	5.8	0.9	0.4	4.6	0.5	0.2	0.0	0.0	6.7	4.1	0.6	0.0	2.3	0.1	26.7
1969	17	0.2	0.3	0.3	0.0	0.5	0.0	0.0	0.0	0.0	2.9	0.4	20.8	3.9	0.0	29.3
1982	11	0.1	0.3	0.4	0.5	2.7	0.0	0.0	0.0	1.6	1.5	2.4	14.5	7.0	0.0	31.0
1987	23	0.2	0.4	0.8	0.2	0.3	0.3	0.1	0.1	0.2	4.6	4.6	19.3	19.0	1.9	52.0

[1]Abbreviations are: Rb = rainbow trout, DV = bull trout, LL = brown trout, MWf = mountain whitefish, LWf = lake whitefish, LmB = largemouth bass, SmB = smallmouth bass, NP = northern pike, FSu = longnose sucker, CSu = largescale sucker, Sq = northern squawfish, Bh = black bullhead, CRC = peamouth, Yp = yellow perch

Largemouth bass do not become entangled in gill nets as easily as most fish so that the catch of 0.3 fish per net in 1987 is thought to be indicative of an increasing population. Increasing angler harvest, limited shoreline seining, and snorkeling also indicate an increasing largemouth population. Largemouth usually spawn in early July when the reservoir is at or near full pool, suggesting that the increasing population may be a result of better food supply, not reproductive failure.

Small numbers of largemouth bass were aged and growth calculated for samples collected in 1987 and 1982. These data are shown in Table 6.

Table 6. Age and growth of largemouth bass collected from Noxon Rapids Reservoir in 1982 and 1987.

	Length in Inches at Annulus									
Year	I	II	III	IV	V	VI	VII	VIII	IX -	XVI
1982 S.S.*	2.6	4.7	7.6	9.6	10.9	12.2	13.9	13.3	17.5	27.2
1987	3.3	7.5	10.3	12.8	14.4	16.4				
S.S.	26	26	19	8	7	4				

*Sample size; sample size for 1982 data is not known but is thought to be between 50 and 75 fish.

Scales collected in 1982 were aged by Dr. David Bennett of University of Idaho while aging of 1987 samples was done by the author. If analysis is true then the data clearly shows a very marked increase in growth rates of largemouth bass. Improved growth rates would be a reflection of improved forage supply and aquatic insect production.

In 1982 and 1983 respectively, 125,000 and 50,000 two inch long smallmouth bass were planted in the upper end of Noxon Rapids Reservoir. Distribution studies done in 1985 determined that survival of the planted fish was good, that the greatest number of fish were still located in the upper 10 miles of the reservoir but that some fish had moved downstream into the lower end of the reservoir. Gill net sampling done in 1987 caught a total of seven fish, all from the Graves Creek area and all pre-spawning adults ranging in length from 12 to 15 inches total length.

The first spawning of the smallmouth planted in 1982 should have occurred in spring 1986 since some fish were 11 to 12 inches long in fall 1985. Whether or not spawning occurred in 1986 has not been ascertained. Successful spawning did occur in spring 1987 as fry were observed by snorkeling shoreline immediately below the Flatiron Ridge boat landing. Several fry were captured and positively identified as smallmouth bass.

Northern pike invaded Noxon Rapids in the early 1970's from upstream sources. This species is not abundant, apparently being very well controlled by reservoir drawdown. The pike is an early spring spawner and an eight-foot drawdown in early May 1987, stranded numerous strings of pike eggs. It is anticipated that pike successfully spawned in spring 1988 since the maximum drawdown was only six feet May 5 and 6 and was refilled by May 8. Whether or not increased numbers of northern pike in the reservoir will be beneficial or deleterious has not been determined at this time.

Although burbot were planted in the reservoir in 1985, 1986 and 1987, none were caught in the 1987 sampling. As far as is known only one burbot has been caught by angling and this one by a set line fisherman in the Finley Flat area. Increased efforts to locate burbot are being planned for 1988-89 using large mesh gill nets and trap nets if time and personnel are available.

The largest increase in net catch in 1987 compared to previous years was made up of yellow perch. This species, although not a game fish by Montana law, is a desirable food fish actively sought by anglers. The average size, range of size and size distribution is shown in Table 7.

Table 7. Average length, range, and length distribution of yellow perch caught by gill nets in Noxon Rapids Reservoir 1960, 1969, 1982, and 1987.

Year	1960	1969	1982	1987
Average Length in Inches	8.4	7.8	6.5	8.0
Range of Length	6.5-11.5	6.0-11.5	6.0-10.8	6.3-11.8
Length Distribution in Inches				
6.0-6.9	6.3%	18.3%	92.3%	3.5%
7.0-7.9	28.1	43.3	2.6	56.4
8.0-8.9	35.6	23.3	0.0	28.8
9.0-9.9	25.0	0.0	0.0	8.7
10.0-10.9	3.1	1.7	5.1	1.3
11.0 or more	1.0	3.4	0.0	1.3
Average Catch Per Net	2.8	3.9	7.0	19.0

Average size of perch was the largest in 1960 but average catch per net night was also the lowest (2.8 per net) of the four years. Average size declined in both 1969 and 1982 although catch per net night increased to 7.0 fish. By 1987 average size of perch had increased to 8.0 inches from a low of 6.5 inches and catch per net night had increased from 7 to 19 fish per net. The increased numbers of perch coupled with an increase in size is a direct effect of less drawdown in the 1980's compared to earlier years. In the early 1960's perch in the reservoir reached 8 inches total length in about 3.5 years and during the mid-1960's to early 1980's in about 4.5 years. Fish collected in 1987 reached 8 inches total length in about three and one-half years.

Most perch fishermen consider that perch should be about 8 inches long to yield a reasonable fillet. Chances of catching 8-inch long or longer perch have increased in 1987 to fourfold over 1960 and twentyfold over 1982.

Growth rates for yellow perch for the three periods of reservoir operation are shown in Table 8. Period A is from start of reservoir filling in 1958 through 1961. Fish caught during this period would have lived either in the new impoundment or partly in the impoundment and in the river prior to impoundment. Period B extends from 1966 to 1976 and fish caught during this time period would have lived entirely in the impoundment which had an average annual fluctuation of 35 feet. Period C includes only fish collected in 1986 and 1987 that had lived their life in the reservoir since 1980. Maximum drawdown since 1980 has included one 12-foot draft in early May 1984 and a 28-foot draft in April-May 1985.

Table 8. Age and growth of yellow perch collected from Noxon Rapids Reservoir in 1960 and 1961 (Period A), 1966 to 1976 (Period B), and 1986 to 1987 (Period C).

		Length in Inches at Annulus					
Species	Period	I	II	III	IV	V	VI
YP	A	3.0(43)*	5.6(29)	6.9(18)	8.5(5)	10.1(3)	
	B	2.9(42)	5.1(42)	6.2(34)	7.2(13)	8.0(6)	9.0(2)
	C	2.7(37)	5.4(37)	7.2(32)	8.2(9)	9.4(2)	10.1(1)

* Number in parenthesis is sample size.

Growth of yellow perch in Period C appears to be about equal or slightly slower than Period A but faster than growth in Period B.

Black bullheads were uncommon in the gill net catch of 1960, were absent in 1969 and in 1982 but increased to about 2 fish per net in 1987. Most of the fish caught in 1987 were from 8 to 10 inches total length and probably from the same year class. Pectoral spines were sent to University of Idaho for aging but results have not yet been returned.

Two species of fish important as forage fish for larger predators present in the reservoir are seldom caught by gill nets. These two, redside shiners and pumpkinseed, appear to be increasing in numbers. Limited stomach content analysis

of smallmouth and largemouth bass in 1984 showed that pumpkinseed, redside shiners and peamouth were the most commonly eaten fish while other major components included aquatic insects and crayfish.

Catch of rainbow trout declined after 1960 with cessation of planting hatchery fish. All of the rainbow trout caught in 1969 and 1982 were from natural reproduction. About 100,000 McConaughy strain rainbow trout were planted into the reservoir in 1986 and some of these fish should have been large enough to enter the gill net catch in 1987, but no marked increase in rainbow catch occurred. Number of bull trout caught each year since 1960 has been similar. Bull trout numbers in the reservoir are thought to be more controlled by tributary spawning and rearing capacities than by reservoir conditions.

Catch of mountain whitefish has declined markedly since 1960. Pre-impoundment studies indicated that this whitefish was the most abundant salmonid in the Clark Fork River. Factors thought to have caused the population decline include lack of spawning areas and low plankton numbers in the reservoir. Numbers of lake whitefish have remained constant except for a temporary increase in 1982.

Numbers of brown trout caught in 1960, 1969, and 1982 were very similar followed by a 100 percent increase in 1987. Brown trout redd counts made in sections of three tributaries in 1986 and 1987 indicate the increase in net catch is a function of an increased naturally spawned population. Brown trout were first planted into the reservoir in late spring 1986 as 2 to 4 inch long fish and very few of these fish would have entered the net catch of 1987. Almost all of the fish caught in fall 1987 were adults. Results of redd counts made in 1986 and 1987 are listed in Table 9. Stream sections counted included Prospect Creek from Shorty Gulch to Clear Creek, Vermillion River from first helicopter log landing to reservoir and Marten Creek from second cabin downstream to reservoir.

Table 9. Number of brown trout redds in sections of Prospect Creek, Vermilion River and Marten Creek, 1986 and 1987.

	Number of Redds	
Stream	1986	1987
Prospect Creek	12	15
Vermilion River	12	26
Marten Creek	25	36

Limited data has been collected on size of spawning brown trout in Noxon Rapids and these data are shown in Table 10 below. It does appear that fish measured in 1986-87 were somewhat smaller than those from 1965.

Table 10. Length in inches of male and female spawning brown trout caught in Noxon Rapids Reservoir in 1965, 1986, and 1987.

	Males		Females	
Year	Average Length and range	Number of fish	Average Length and range	Number of fish
1965	17.0 - 22.9 - 26.0	14	13.7 - 21.1 - 25.5	18
1986	14.7 - 17.5 - 21.1	5	16.2 - 17.3 - 19.2	9
1987	15.4 - 21.9 - 25.7	11	14.1 - 18.6 - 21.5	6

Age and growth information for fish collected in 1960-61, 1966-76, and 1986-87 is compared in Table 11. These data do indicate improved growth rates for the fish collected in 1986-87 over the other two collection periods. As spawning populations increase, population pressures within the natal streams may force more and more young fish out as young-of-the-year into the reservoir where better growth conditions may exist. This theory may account for the better first year growth of the 1986-87 fish compared to earlier years. Casual observations of brown trout stomachs indicate they start eating fish at about 10 inches long. Growth of the 1986-87 fish was greatest during their third and fourth year of life compared to a year later for trout from the 1966-76 period.

Table 11. Age and growth of brown trout collected from Noxon Rapids Reservoir in 1960 and 1961 Period A, 1966 to 1976 Period B, and 1986 and 1987 Period C.

Species	Period	I	II	III	IV	V	VI	VII	VIII
LL	A	2.7(21)*	5.5(21)	10.1(21)	12.8(16)	15.3(2)			
	B	3.1(52)	6.2(52)	10.7(49)	14.2(45)	17.2(42)	19.6(40)	22.8(17)	23.8(2)
	C	3.3(37)	6.5(36)	11.8(32)	15.0(21)	18.4(8)	20.7(4)		

*Number in parenthesis is sample size.

Numbers of nongame fish, suckers, squawfish, peamouth, have generally increased with time. Following chemical treatment of Noxon Rapids peamouth were not caught in nets until about 1964. It appears that carrying capacity was reached by about 1969 and numbers have remained about the same thereafter. Catch of squawfish was also low following chemical treatment but this species started to increase with increased reservoir stabilization which occurred in 1980. Numbers of largescale suckers have varied from year to year with no apparent reason. Catch of longnose suckers is limited to the spring sampling when this species is in shallow water preparing to spawn. Longnose suckers normally inhabit deeper waters than that gill netted.

Benthic Sampling, Noxon Rapids and Cabinet Gorge Reservoirs

Because of rapid exchange rates neither Noxon Rapids or Cabinet Gorge reservoirs produce much plankton. Reservoir drawdown and dewatering of the

littoral zones depresses benthic populations. Nature of reservoir hydroelectric operations precludes increasing time of exchange rates but lent itself well to limiting drawdown. The main task of the Company technician assigned to reservoir studies was to determine invertebrate benthic populations. Data for the four sampling stations in Noxon Rapids and one station in Cabinet Gorge are presented in Tables 13a through 17a and are compared to somewhat similar information collected in 1982. The 1982 data were collected by a summer employee of the Company working under the direction of the Department, and are shown in Tables 13b, 14b, 15b, and 17b. A listing of invertebrates found in the 1982 and 1987 collections is given in Table 12.

It is readily apparent that the number of families found in the benthic samples increased markedly from 1982 to 1987. Table 12 lists 21 families that were found in 1987 compared to only 8 in 1982. Data presented in Tables 13 through 17 indicate that invertebrates were most numerous in the first 15 feet of depth in both 1982 and 1987. It also appears that numbers of invertebrates have increased from 1982 to 1987.

Table 12. List of invertebrates found in benthic samples taken from Noxon Rapids and Cabinet Gorge reservoirs in 1982 and 1987.

1987	1982
Diptera (Order)	
Chironomidae (Family)	Chironomidae
Tipulidae	Not Found
Tabanidae	Not found
Oligocheata	Oligocheata
Gastropoda	
Lymnaeidae	Lymnaeidae
Phiysidae	Not found
Planorbidae	Not found
Valvatidae	Valvatidae
Pelecypoda	
Sphaeriidae	Sphaeriidae
Ephemeroptera	
Ephemeridae	Not found
Ephemerellidae	Not found
Baetidae	Baetidae
Tricorythidae	Not found
Not found	Heptageniidae
Tricoptera	
Polycentropodiae	Not found
Hydropsychidae	Not found
Rycophilidae	Not found
Lepidoptera	
Pyralidae	Not found
Coleoptera	Not found
Megeloptera	
Corydalidae	Not found
Odonata	
Gomphidae	Not found
Coenagrionidae	Coenagrionidae
Total Families: 21	Total Families: 8

Table 13a. Number of benthic organisms per square foot, Noxon Bay station, Cabinet Gorge Reservoir, December 1986-September 1987.

Date	Sample Depth (in feet)							
	3		8		15		25 (bottom)	
12/09/86	Chironomidae	(46.0)	Chironomidae	(66.0)	Chironomidae	(176.0)	Chironomidae	(152.0)
	Tipulidae	(36.0)	Oligocheata	(240.0)	Tipulidae	(2.0)	Tabanidae	(2.0)
	Oligocheata	(166.0)	Sphaeriidae	(4.0)	Tabanidae	(6.0)	Oligocheata	(83.0)
	Planorbidae	(2.0)	Planorbidae	(14.0)	Oligocheata	(136.0)	Sphaeriidae	(4.0)
			Tricorthidae	(2.0)	Sphaeriidae	(10.0)	Planorbidae	(8.0)
			Coleoptera	(2.0)	Planorbidae	(48.0)		
					Valvatidae	(4.0)		
					Lymnaeidae	(2.0)		
					Tricorythidae	(2.0)		
05/15/87	Chironomidae	(2.5)	Chironomidae	(31.0)	Chironomidae	(9.0)	Chironomidae	(2.0)
	Oligocheata	(8.5)	Tipulidae	(3.5)	Tipulidae	(6.5)	Tipulidae	(3.5)
	Sphaeriidae	(10.0)	Tabanidae	(5.5)	Oligocheata	(3.0)	Oligocheata	(4.5)
			Oligocheata	(41.0)	Sphaeriidae	(1.0)	Sphaeriidae	(1.0)
			Sphaeriidae	(7.5)	Planorbidae	(0.5)		
			Planorbidae	(7.5)				
			Valvatidae	(7.5)				
			Physidae	(0.5)				
			Baetidae	(0.5)				
			Gomphidae	(0.5)				
09/10/87	Chironomidae	(14.5)	Chironomidae	(133.5)	Chironomidae	(11.0)	Chironomidae	(3.5)
	Oligocheata	(1.0)	Oligocheata	(55.5)	Tipulidae	(33.5)		
	Sphaeriidae	(6.5)	Planorbidae	(16.5)	Oligocheata	(2.5)		
	Planorbidae	(1.0)	Sphaeriidae	(31.5)	Sphaeriidae	(2.5)		
			Valvatidae	(6.5)	Planorbidae	(0.5)		
			Physidae	(0.5)				

Table 13b. Number of benthic organisms per square foot, Noxon Bridge station,[1] Cabinet Gorge Reservoir, 1982.

Date	Sample Depth (feet) 6		30		60	
06/04/82	Chironomidae	(20)	[2]		[2]	
	Valvatidae	(4)				
	Oligocheata	(8)				
06/30/82	Chironomidae	(76)	[2]		[2]	
	Lymnaeidae	(40)				
	Sphaeriidae	(16)				
	Oligocheata	(12)				
07/29/82	Chironomidae	(72)	Chironomidae	(76)	Chironomidae	(16)
	Valvatidae	(4)				
	Sphaeriidae	(4)				

[1]The Noxon Bridge station was located in uninundated river channel about one-fourth mile upstream from the Noxon Bay station.
[2]Current too strong to take sample.

Table 14a. Number of benthic organisms per square foot, north shore station, Noxon Rapids Reservoir, December 1986-September 1987.

Date	Sample Depth (in feet) 3		8		15		40	
12/10/86	Chironomidae	(36.0)	Chironomidae	(18.0)	Chironomidae	(14.0)	Chironomidae	(18.0)
	Oligocheata	(2.0)	Oligocheata	(170.0)	Oligocheata	(136.0)	Oligocheata	(100.0)
			Hydroptilidae	(2.0)	Coenagrionidae	(6.0)	Planorbidae	(2.0)
	Rycophilidae	(4.0)	Sphaeriidae	(6.0)				
	Coenagrionidae	(2.0)	Planorbidae	(18.0)				
	Polycentropodidae	(6.0)						
	Sphaeriidae	(2.0)						
	Planorbidae	(4.0)						
04/09/87	Chironomidae	(16.0)	Chironomidae	(148.0)	Tipulidae	(4.0)	Chironomidae	(16.0)
	Oligocheata	(12.0)	Tipulidae	(104.0)	Sphaeriidae	(4.0)		
			Oligocheata	(228.0)	Planorbidae	(8.0)		
			Sphaeriidae	(4.0)				
			Planorbidae	(2.0)				
			Polycentropodidae	(4.0)				
05/14/87	Chironomidae	(1.5)	Chironomidae	(42.0)	Chironomidae	(39.0)	Chironomidae	(1.5)
	Tipulidae	(1.5)	Tipulidae	(6.0)	Tipulidae	(1.5)	Tipulidae	(1.5)
	Oligocheata	(5.0)	Oligocheata	(9.5)	Oligocheata	(10.5)	Oligocheata	(1.0)
	Planorbidea	(0.5)	Sphaeriidea	(4.0)	Planorbidae	(8.0)	Planorbidae	(1.0)
	Physidae	(0.5)	Planorbidae	(9.0)	Physidae	(4.0)	Physidae	(0.5)
	Lamnaeidae	(0.5)	Physidae	(5.5)	Lymnaeidae	(0.5)	Tricorythidae	(0.5)
	Polycentropodidae	(0.5)	Lymnaeidae	(0.5)	Baetidae	(1.5)		
	Ephemeridae	(0.5)	Polycentropodidae	(7.0)	Polycentropodidae		(5.5)	
			Ephemeridae	(3.0)	Ephemeridae	(1.5)		
			Baetidae	(3.0)				
			Coenagrionidae	(2.0)				
09/17/87	Chironomidae	(10.5)	Chironomidae	(1.0)	Chironomidae	(3.5)	Chironomidae	(0.5)
	Oligocheata	(33.5)	Oligocheata	(19.5)	Oligocheata	(13.5)	Tipulidae	(1.0)
	Planorbidae	(0.5)	Sphaeriidae	(0.5)	Planorbidae	(0.5)	Oligocheata	(1.5)
			Planorbidae	(1.0)				
			Physidae	(0.5)				

Table 14b. Number of benthic organisms per square foot, Trout Creek station[1], 1982.

Date	Sample Depth (in feet) 6		30		60	
05/24/82	Chironomidae	(12)	Chironomidae	(28)	Chironomidae	(12)
	Lymnaeidae	(28)	Sphaeriidae	(4)		
	Valvatidae	(315)				
	Sphaeriidae	(88)				
	Coenagrionidae	(8)				
07/28/82	Chironomidae	(80)	Chironomidae	(76)	Chironomidae	(16)
	Oligocheata	(12)	Sphaeriidae	(4)	Oligocheata	(88)
			Oligocheata	(68)		

[1]The Trout Creek station is about four miles upstream from north shore station.

Table 15a. Number of benthic organisms per square foot, inner Vermilion Bay station, Noxon Rapids Reservoir, April-September, 1987 (lake frozen over prior to December 1986 sampling).

	Sample Depth (feet)							
Date	3		8		15		27 (bottom)	
04/13/87	Chironomidae	(28.0)	Chironomidae	(276.0)	Chironomidae	(16.0)	Tipulidae	(20.0)
	Tipulidae	(12.0)	Tipulidae	(48.0)	Tipulidae	(48.0)	Oligocheata	(8.0)
	Oligocheata	(20.0)	Oligocheata	(56.0)	Oligocheata	(4.0)		
	Sphaeriidae	(12.0)	Sphaeriidae	(76.0)	Baetidae	(4.0)		
	Planorbidae	(4.0)	Ephemeridae	(8.0)				
	Baetidae	(4.0)	Coenagrionidae	(4.0)				
	Polycentropodidae	(4.0)	Corydalidae	(4.0)				
			Planorbidae	(28.0)				
05/19/87	Chironomidae	(4.0)	Chironomidae	(201.5)	Chironomidae	(15.5)	Chironomidae	(7.0)
	Tipulidae	(3.0)	Tipulidae	(18.5)	Tipulidae	(5.5)	Tipulidae	(1.5)
	Oligocheata	(3.5)	Oligocheata	(13.5)	Oligocheata	(31.5)	Oligocheata	(20.5)
	Sphaeriidae	(5.5)	Sphaeriidae	(23.0)	Sphaeriidae	(2.0)		
	Planorbidae	(2.5)	Planorbidae	(20.0)				
	Lymnaeidae	(0.5)	Physidae	(5.0)				
	Ephemeridae	(0.5)	Polycentropodidae	(1.0)				
			Ephemeridae	(1.0)				
			Baetidae	(1.5)				
			Epheralidae	(2.0)				
09/02/87	Chironomidae	(5.0)	Chironomidae	(241.0)	Chironomidae	(30.5)	Chironomidae	(46.0)
	Oligocheata	(10.0)	Tipulidae	(18.0)	Tipulidae	(4.0)	Tipulidae	(2.5)
	Sphaeriidae	(33.5)	Oligocheata	(108.5)	Oligocheata	(12.0)	Oligocheata	(15.5)
	Physidae	(1.0)	Sphaeriidae	(10.5)	Sphaeriidae	(1.0)	Baetidae	(1.5)
	Polycentropodidae	(0.5)	Planorbidae	(4.0)	Planorbidae	(1.0)		
	Planorbidae	(3.0)						

Table 15b. Number of benthic organisms per square foot, inner Vermilion Bay station, 1982.

	Sample Depth (feet)	
Date	19	
06/16/82	Chironomidae	(28)
07/28/82	Chironomidae	(12)
	Oligocheata	(40)

Table 16. Number of benthic organisms per square foot, outer Vermilion Bay station, Noxon Rapids Reservoir, April-September 1987.

	Sample Depth (feet)							
Date	3		8		15		40	
04/13/87	Chironomidae	(16.0)	Chironomidae	(196.0)	Chironomidae	(52.0)	Chironomidae	(24.0)
	Oligocheata	(120.0)	Tipulidae	(28.0)	Tipulidae	(16.0)	Tipulidae	(8.0)
	Sphaeriidae	(28.0)	Oligocheata	(24.0)	Oligocheata	(12.0)	Oligocheata	(28.0)
	Planorbidae	(32.0)	Planorbidae	(164.0)	Planorbidae	(16.0)	Sphaeriidae	(4.0)
			Physidae	(8.0)	Valvatidae	(4.0)	Planorbidae	(4.0)
			Polycentropodidae	(16.0)	Ephemeridae	(8.0)		
			Baetidae	(8.0)				
			Coenagrionidae	(4.0)				
05/10/87	Chironomidae	(1.0)	Chironomidae	(64.5)	Chironomidae	(5.5)	Chironomidae	(8.5)
	Tipulidae	(0.5)	Tipulidae	(15.5)	Oligocheata	(9.0)	Tipulidae	(3.0)
	Oligocheata	(42.5)	Oligocheata	(75.5)	Planorbidae	(0.5)	Oligocheata	(8.5)
	Sphaeriidae	(4.0)	Sphaeriidae	(27.5)	Ephemeridae	(5.5)	Baetidae	(0.5)
			Planorbidae	(5.5)	Gomphidae	(0.5)	Sphaeriidae	(0.5)
			Physidae	(1.5)				
			Baetidae	(1.0)				
			Ephemeridae	(0.5)				
			Coenagrionidae	(1.5)				
09/02/87	Chironomidae	(0.3)	Chironomidae	(32.5)	Chironomidae	(2.0)	Chironomidae	(5.0)
	Oligocheata	(1.5)	Tipulidae	(4.5)	Oligocheata	(36.5)	Tipulidae	(2.5)
	Sphaeriidae	(42.0)	Oligocheata	(36.0)	Planorbidae	(2.5)	Oligocheata	(37.0)
	Planorbidae	(72.5)	Planorbidae	(2.5)			Planorbidae	(0.5)
	Valvatidae	(1.0)					Ephemeridae	(0.5)
	Lymnaeidae	(1.5)						
	Physidae	(1.0)						
	Baetidae	(1.0)						

Table 17a. Number of benthic organisms per square foot, Graves Creek sample station, Noxon Rapids Reservoir, December 1986-September 1987.

Date	Sample Depth (feet) 3		8		15		40	
12/11/87	Chironomidae	(24.0)	Chironomidae	(8.0)	Chironomidae	(4.0)	Chironomidae	(16.0)
	Tipulidae	(8.0)	Oligocheata	(22.0)	Oligocheata	(54.0)	Oligocheata	(362.0)
	Oligocheata	(142.0)	Polycentropodidae	(2.0)	Sphaeriidae	(0.5)		
	Ephemeridae	(2.0)	Pyralidae	(2.0)				
	Coleoptera	(2.0)	Sphaeriidae	(2.0)				
	Gomphidae	(2.0)						
04/13/87	Chironomidae	(24.0)	Tipulidae	(4.0)	Empty		Oligocheata	(28.0)
	Oligocheata	(80.0)	Oligocheata	(4.0)				
05/22/87	Chironomidae	(1.0)	Chironomidae	(0.5)	Tipulidae	(1.0)	Chironomidae	(2.0)
			Tipulidae	(2.0)	Oligocheata	(0.5)	Tipulidae	(0.5)
			Oligocheata	(64.0)			Oligocheata	(42.5)
			Gomphidae	(0.5)				
09/01/87	Chironomidae	(7.5)	Chironomidae	(9.0)	Chironomidae	(1.5)	Chironomidae	(18.5)
	Oligocheata	(59.5)	Tipulidae	(4.0)	Tipulidae	(1.5)	Oligocheata	(54.5)
			Oligocheata	(38.0)	Oligocheata	(8.0)		
			Baetidae	(1.5)				

Table 17b. Number of benthic organisms per square foot, Graves Creek station, Noxon Rapids Reservoir, 1982.

Date	Sample Depth (in feet) 6		30	
05/25/82	Baetidae	(4)	[1]	
	Oligocheata	(8)		
07/29/82	Nothing		Heptageniidae	(4)
			Oligocheata	(4)
			Chironomidae	(4)

[1]High velocities at this station prevented sampling.

Drawdown benthic sampling, Noxon Rapids, April, 1987

The 10 foot drafting of Noxon Rapids presented the Company technician an opportunity to measure some of the benthic invertebrate losses immediately following dewatering. One group of data collected on stranding of snails and clams was obtained by counting dead animals in 36 square feet of bottom at 3 feet below full pool after drawdown had reached 4 feet and at 8 feet below full pool after drawdown had reached 9 feet. These transects were counted at two locations: Marten Creek Bay and Trout Creek boat landing area. Number of dead animals is shown in Table 18.

Table 18. Number of snails and clams per square foot of bottom stranded by April-May 1987 drawdown of Noxon Rapids Reservoir at two locations and two depths.

	Trout Creek		Marten Bay	
Organism	3	8	3	8
Snails				
Lymnaiidae	0.75	0.00	2.22	0.67
Physidae	0.97	0.33	9.39	1.56
Planorbidae	12.64	23.25	4.33	11.83
Clams				
Sphaeriidae	1.30	2.47	9.83	5.33

The second set of data was on number of crayfish (*Pacifasticus spp*) stranded and killed in the "bass ponds" near the Trout Creek boat landing. These ponds are in actuality a series of three pot holes connected to the main reservoir by channels not much more than 4 to 5 feet deep. The largest pothole is about 9 to 10 feet deep while the other two are about 5 to 6 feet deep. Crayfish corpses were counted along transects 60 feet long by 3 feet wide with two in each of the shallower pot holes. Number of corpses counted are the minimum number since bird predation accounted for an unknown number. Also, number of crayfish killed is likely not representative of the main reservoir since they could not easily escape to deep water because of channel constriction. Corpse counts are shown in Table 19.

Table 19. Number of crayfish corpses found in four transects in dewatered "bass ponds" near Trout Creek, Noxon Rapids Reservoir, May 1987.

	Transect				
	One	Two	Three	Four	Average
Number of Corpses	43	41	61	24	42.25

CONCLUSIONS

Development and maintenance of an acceptable sports fishery has always been the Department goal in Noxon Rapids and Cabinet Gorge reservoirs. Attainment of this goal is closer to hand now than at any time since impoundment of Cabinet Gorge in 1953 and Noxon Rapids in 1958. The major factor allowing the establishment of an acceptable fishery has been reduction of reservoir drafting from an average of 35 feet per year to 10 feet per year. The Company must be commended for limiting reservoir drawdown.

Improvement has been documented in most aspects of reservoir fishery biology. Data indicate an increase in abundance and diversity of benthic organisms. Abundance of most fish species appears to have increased. Growth rates of largemouth bass, brown trout, and yellow perch have increased over past years. Recent fish species introductions, namely smallmouth bass, have survived and are reproducing. Success of transplanting burbot and planting brown trout into Noxon Rapids Reservoir has not been determined yet but the preliminary outlook is good. Data presented shows that the existing 10-foot drawdown does have a deleterious effect upon crayfish and molluscs.

Since late April, 1988, commercial crayfish fishermen have been operating on both reservoirs. As far as is known, the catch from Noxon Rapids Reservoir has averaged about 800 pounds of crayfish per week (Michael Connerly, Signal Crayfish, pers. comm.). Crayfish appear to be important food items for several fish species in both reservoirs including squawfish, yellow perch, both species of bass, brown trout, and burbot. Deleterious effects of an unregulated crayfish harvest upon fish is not known.

RECOMMENDATIONS

1. It is recommended that the Company extend the term of employment of their fishery technician assigned to Noxon Rapids and Cabinet Gorge reservoirs for at least two years past the expected termination date of April 1989. During this extension he would concentrate his efforts on the following jobs:

   a. Contour Mapping of Noxon Rapids Reservoir - An accurate contour map of the reservoir is needed primarily for fine-tuning of drawdown limits and for use by recreationists. The 10-foot drawdown limit was a preliminary recommendation to provide the company with some operational freedom yet limit dewatering of littoral zones. Better knowledge of reservoir bottom configuration could refine recommendations to manage reservoir drawdown.
   b. Timing of In-reservoir Fish Spawning - Further limits were placed on reservoir operation by requiring full pool elevations by May 15 each year. This date was arbitrarily selected to protect bass spawning. Good knowledge of spawning times of both bass species, northern pike, and two important prey species, yellow perch and redside shiners, may allow some liberalization of drawdown limits.
   c. Food Habits of Bass, Brown Trout, Burbot, and Yellow Perch - Good knowledge of seasonal food habits of the above species will provide information about effects of allowable reservoir operation

and other operations such as commercial crayfish harvest on the fishery.

d. Continuation of Benthic Organism Sampling - Benthic sampling should be continued at two stations each spring, late summer, and late fall for the next several years. Continued reservoir operation within the 10-foot drawdown limitation should result in increased benthic production both as to abundance and diversity.

e. Specialized Fish Sampling - Brown trout planted in the reservoir starting in 1985 should reach spawning age in 1989 - 1991. Extensive redd counts should be done starting in fall 1988 through 1991 and should include all suitable tributary sections. Intensive trapping of spawning runs entering two tributaries would be desirable. burbot transplanted into the reservoir starting in 1985 have ranged from juvenile to adult fish. Specialized sampling using large size and small size mesh gill and trap nets during the winter months should be done to determine spawning areas, presence of spawning fish, and success of spawning.

2. It is recommended that the Department continue ongoing management efforts on both reservoirs. These include:

a. Conduct spring and fall gill netting to collect pertinent data about fish populations characteristics such as age and growth, size, and abundance.

b. Conduct brown trout redd counts in selected streams reaches to document spawning use.

c. Install habitat improvement structures within the reservoirs and in tributary streams to provide spawning, rearing, and feeding habitat for bass and brown trout.

d. Obtain and plant appropriate fish species with emphasis on smallmouth bass in both reservoirs.

e. Determine effects of commercial crayfish harvest on crayfish population and recommend harvest levels of crayfish to:
   1) ensure base population
   2) provide needed food base for fish
   3) provide recreational harvest.
   4) provide a commercial harvest.

Both Company and Department efforts have to be closely coordinated and complementary to each others' efforts and goals.

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Waters referred to:	Noxon Rapids Reservoir	05-9328
	Prospect Creek	05-5648
	Vermilion River	05-7712
	Trout Creek	05-7424
	Marten Creek	05-4432
	Cabinet Gorge Reservoir	05-8512
	Elk Creek	05-2560
	Bull River	05-0864
	E.F. Bull River	05-2272

Key words - reservoir operation, benthic sampling, yellow perch, smallmouth bass, brown trout

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