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

STATE: MONTANA PROJECT TITLE: STATEWIDE FISHERIES INVESTIGATIONS

PROJECT NO.: F-46-R-2 STUDY TITLE: SURVEY AND INVENTORY OF COLDWATER STREAMS

JOB NO.: I-a, II-a (Partial) JOB TITLE: NORTHWEST MONTANA COLDWATER STREAM INVESTIGATIONS (SPECIES OF SPECIAL CONCERN SEGMENT)

PROJECT PERIOD: JULY 1, 1988 THROUGH JUNE 30, 1989

ABSTRACT

Genetic analysis was done on fish collectedfrom six streams and lakes and from one and outlet stream as a follow-up after planting the lake for three years with westslope cutthroat trout (Oncorhynchus clarki lewisi). General biological information is presented on 55 high mountain lakes surveyed during the collection of fish for genetic analysis.

BACKGROUND

Historically the westslope cutthroat trout was the most widespread trout species in Montana occupying all the Clark Fork River drainage and most of the Kootenai River drainage in western Montana and the Missouri River drainage above Great Falls, Montana. Pure westslope cutthroat trout have been replaced or displaced from much of their original range due to introduction of non-native fish and habitat destruction or deterioration. Work described in this report is an effort to determine locations of pure westslope cutthroat populations and develop methods to purify hybridized westslope cutthroat populations and replace non-native populations with westslope cutthroat without resorting to chemical rehabilitation.

OBJECTIVES AND DEGREE OF ATTAINMENT

Objectives included two from the Northwest Montana Coldwater Lakes Investigations (F-46-R-2, I-a) and one from the Northwest Montana Stream Investigations (F-46-R-2, II-a). These objectives were:

Northwest Montana Coldwater Lakes Investigations:

5. Provide lakes 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.

7. Manage regulations and stocking to protect or expand species of special concern.

Northwest Montana Coldwater Streams Investigations:

7. To maintain or expand populations of species of special concern (westslope cutthroat trout, bull trout, and inland rainbow trout).

All objectives were attained.

PROCEDURES

Collections for Genetic Analysis

Collection of fish from streams was accomplished by electrofishing using a backpack shocker, angling, or a combination of both methods. Collection of fish from lakes was done by a combination of gill netting and angling. An attempt was made to collect fish from a wide range of lengths. Fish caught were retained whole, packed in ice within four hours of capture and frozen within 60 hours of capture. After fish were collected and frozen, they were sent to University of Montana Genetics Laboratory, stored at -80°C and analyzed using standard techniques (Leary, Allendorf, et al., 1987).

Genetic testing requires at least a 25-fish sample for a 95 percent confidence limit and a 50-fish sample for 99 percent confidence. In many cases occurrence of non-native genetic material in a westslope cutthroat population can be detected with less than 25 fish. In those lakes suspected of containing aboriginal westslope cutthroat suitable for inclusion into a brood stock, 50 or more fish were collected and analyzed.

Fish samples from 3 lakes and 3 streams were lost due to an electrical outage affecting the Department's freezers. Personnel were able to recollect fish from two lakes and two streams but not Big Salmon Lake and Gordon Creek which are about 20 and 30 miles inside the Bob Marshall Wilderness respectively.

Lake Survey

Certain information was collected from lakes during the time it took to collect fish for genetic analysis. Included were maximum lake depth, an estimate of abundance of spawning and location of spawning area, pH, total dissolved solids, water sample for laboratory determination of specific conductance, and fish scales for age and growth determinations. Lake area and location was determined from U. S. G. S. quad maps and aerial photographs.

Brood Stock Development

Montana's westslope cutthroat trout brood stock was collected from 13 streams in 1983 and 1984 and included resident and adfluvial fish. The current and ongoing effort is to add mountain lake aboriginal genetic material to this brood stock. Fertilized eggs or sperm from suitable mountain lake westslope cutthroat were to be collected and added to the hatchery brood stock.

RESULTS AND DISCUSSION

Addition of Mountain Lake Gametes to Brood Stock

Genetic testing indicated that aboriginal westslope cutthroat trout exist in five lakes of which three (Doctor, Upper and Lower Sage) are located within the confines of the Bob Marshall Wilderness. Disease testing done on the remaining lakes, Cyclone and Hay, indicated no viral or bacterial pathogens present in the westslope cutthroat trout. Cyclone Lake westslope cutthroat were heavily infected with a parasitic trematode.

The Cyclone Lake cutthroat were expected to spawn in either or both of two inlet streams. It was discovered after spawning was completed that all spawning took place in the outlet and not in the inlets. No attempt was made to collect gametes from Hay Lake in 1989. Sperm was collected from 10 Hay Lake males in 1988 and used to fertilize brood eggs in the Washoe Park Hatchery.

Genetic Surveys

Initial Analysis

Fish were collected from 3 streams in the South Fork Flathead River drainage: Gorge Creek, Mid Creek, and the South Fork Flathead River near Black Bear. Genetic analysis indicated that the Mid Creek and South Fork Flathead River contained only westslope cutthroat trout material.

The sample from Gorge Creek was collected immediately above the Bob Marshall Wilderness boundary and about 9 miles downstream from Sunburst Lake. Analysis indicated that 24 of the 25 fish were pure westslope cutthroat while the 25th fish was a Yellowstone cutthroat (Oncorhynchus clarki bouvieri) x westslope cutthroat hybrid. Sunburst Lake is populated by essentially pure Yellowstone cutthroat trout [a very small amount of rainbow trout (Oncorhyrchus mykiss) genes may also be present]. The Gorge Creek sample seems to indicate that trout drifting out of Sunburst Lake may have poor survival in the creek or that they do not hybridize well with the westslope cutthroat living in Gorge Creek.

Gorge Creek drains into Bunker Creek which in turn drains into the South Fork Flathead River near the Bob Marshall Wilderness boundary. A small sample of fish caught in Bunker Creek near the mouth of Gorge Creek in 1984 included 10 pure westslope and 5 westslope x Yellowstone cutthroat hybrids. Genetic analysis of fish from the South Fork Flathead River below Bunker Creek has not been done.

Forty-six trout were collected from Flathead River near Kalispell, Montana, in March, 1989, for genetic analysis. Project personnel visually identified 40 of these fish as westslope cutthroat trout and 6 as rainbow

trout. Genetic analysis proved that field identification of these specimens by field personnel was correct. Each of the 40 fish identified as westslope were pure westslope cutthroat and the 6 identified as rainbow trout were, in fact, pure rainbow trout.

Genetic analysis was made of two other stream populations, one from upper Good Creek in the Stillwater River drainage near Kalispell and one from Deadhorse Creek near Heron, Montana. Both these samples tested as pure westslope cutthroat trout.

Fish from 4 lakes in the South Fork Flathead River drainage within the boundaries of the Bob Marshall Wilderness were collected and analyzed. Two lakes, Upper and Lower Sage, in the headwaters of Marshall Creek east of Seeley Lake, Montana, contained pure westslope cutthroat trout thought to be aboriginal and suitable for inclusion into a brood stock. Ross Creek Lake, in the headwaters of Ross Creek east of Seeley Lake, Montana, contained brook trout (Salvelinus fontinalis).

A 50-fish sample was collected from Big Salmon Lake, but 31 were lost when the Department freezer's electricity was cut off. Analysis of the remaining 19 fish indicated that all were pure westslope cutthroat trout. It is known that lakes in the Salmon Creek drainage above Big Salmon Lake are populated by rainbow trout. It is suspected that Big Salmon Lake does contain some hybridized rainbow x westslope cutthroat trout. The presence of pure westslope would strongly indicate that Big Salmon Lake is populated by a weakly hybridized population and not by a hybrid swarm.

Re-Analysis

Fish from Wildcat Lake and Wildcat Creek about 4 miles below Wildcat Lake were genetically tested in 1984 and 1988. In 1985, 1986, and 1987 about 5,000 one-inch westslope cutthroat trout were helicopter planted into Wildcat Lake. Genetic testing of fish from Wildcat Lake in 1984 indicated that the sample contained 96.9 percent westslope genes and 3.1 percent Yellowstone genes. The 1988 testing indicated the sample contained 97.7 percent westslope genes and 2.3 percent Yellowstone genes. This small percent increase of westslope genes was not significant.

The 1984 Wildcat Creek sample included 90.2 percent westslope and 9.8 percent Yellowstone genes while the 1988 sample included 97.2 percent westslope genes and 2.8 percent Yellowstone genes (Sage, 1989). This increase in amount of westslope cutthroat genetic material was highly significant. The suspect reason for the increase in westslope genetic material in the creek is drift of planted fish out of the lake into the creek and displacement of hybrid creek fish.

The westslope cutthroat trout gene increases in Wildcat Lake and Wildcat Creek are the first measured effects of increased westslope cutthroat planting on hybridized fish. Additional genetic testing is scheduled for summer 1989 in lakes planted with westslope cutthroat on top of pure rainbow trout, Yellowstone cutthroat and hybrids between Yellowstone cutthroat, rainbow, and westslope cutthroat.

Lake Survey

Limited biological and chemical data were collected from each lake surveyed for genetic analysis of fish populations. These data are presented in Tables 1 through 5 for lakes in the South Fork Flathead River drainage, North Fork

Flathead River drainage, and lower Clark Fork River drainage. Headings include physical parameters, chemical parameters including pH, total dissolved solids (TDS), standard conductance (SC), species present Yct=Yellowstone cutthroat trout, WCT=westslope cutthroat trout, Rb=rainbow trout and hybrids thereof, and reproductive capacity and location classed as adequate, less than (adequate) or more than (adequate) located in the I=inlet(s), O=outlet, or S=shoreline.

Genetic ranking has been divided into 5 categories and include:

1. non-native--no westslope genetic material in sample
2. hybridized--population considered hybridized even though some individuals may be westslope
3. pure-planted--populations considered almost all or all westslope but dependent upon hatchery plants for many individuals
4. pure management--populations tested almost pure westslope but may be somewhat dependent upon hatchery fish, and
5. pure aboriginal--populations tested pure westslope with no history of being planted with hatchery fish.

Of the 56 lakes described in Tables 1 through 5, only 5 were classified pure aboriginal westslope cutthroat trout. Three of these lakes, Upper and Lower Sage and Doctor lakes, are within the confines of the Bob Marshall Wilderness while 2, Hay and Cyclone, are within roaded areas in the North Fork Flathead River drainage. Upper and Lower Sage and Hay lakes are all small lakes that have never been planted while Doctor and Cyclone lakes are all 40 acres or larger, contain species other than westslope cutthroat, and all have been planted with rainbow and/or Yellowstone cutthroat trout in the 1930's-1940's. Mechanics of westslope cutthroat trout resisting hybridization within a multispecies complex may be worthy of scientific exploration.

Four lakes, Koessler and George in the Bob Marshall Wilderness, Wanless in the lower Clark Fork River drainage, and Lower Bighawk in the Jewel Basin hiking area contained populations of Yellowstone x westslope cutthroat hybrids considered to be a swarm. All other lakes with hybrid populations consisted of individual fish with non-random gene distribution. Non-random gene distribution between individual fish indicates some resistance to interbreeding between subspecies or species.

Three lakes, Doris #2, Jenny, and Fawn (Table 2), are largely or totally dependent upon hatchery plants to maintain population numbers. Yet each lake contained pure westslope cutthroat trout and small numbers of westslope x rainbow hybrids. Source of these few hybrids was likely Montana's brood stock used for planting up through 1985. This suspect brood stock has now been replaced.

Table 1. Physical, chemical, and biological characteristics of lakes in the Jewel Basin hiking area, South Fork Flathead River drainage.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Aeneas	27N 18W 05	07/25/86	5990	3	15				Barren	Adequate, O

Lake will not support fish.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Bighawk, Lower	28N 18W 15	07/03/86	6000	43	32	7.8		130	Yct,Wct, WctxYct	Adequate, I, O, S

Genetic Status: Hybridized

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Yct	2.5*	4.7	7.5	9.9	11.6	10.7 - 12.9
Wct	2.5(5)	5.5	7.7(2)	10.8(1)		5.8 - 10.8
YctxWct	2.8(38)	5.5	8.4(34)	10.7(25)	12.2(8)	6.2 - 14.3

*Number in parenthesis is sample size
Wct year classes present: 1984, 1983, 1982
Years Wct planted: 1984

Population considered a hybrid swarm.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Bighawk, Upper	28N 18W 22	07/02/86	6400	3±	30±	6.8		120	Wct	None

Genetic Status: Pure Planted

One large (24"±) Wct caught but released, lake should be considered as capable of supporting fish but with no reproductive capability, and will be planted in future.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Birch	27N 18W 32	07/25/86	6210	29	105				Wct, WctxYct	Less Than, O

Genetic Status: Hybridized

Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Wct	2.3(24)	4.9	7.5(5)	9.2	10.5	10.6(1)	5.2 - 11.8
WctxYct	2.2(1)	4.8	7.7	9.6	11.3	12.3	12.5

Wct year classes present: 1984, 1981, 1980
Year Wct planted: 1984, 1980

This lake is the only Jewel Basin lake that drains into the Swan River.

Table 1 continued.

Table 1. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Black	28N	18W	29	07/31/86	5870	50	100+	8.1	30	98	Wct, WctxRb Wct,Rb,Yct	Adequate, I, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Hybridized	Wct	2.4(28)	5.1	7.0(6)			4.8 - 10.0
	WctxRb	2.5(4)	5.4	8.3(2)	10.1(1)		8.2 - 11.6
	WctxRbxYct	2.4(6)	4.7	7.4(5)	9.9(2)	12.0(1)	5.8 - 13.7

Wct year classes present: 1984, 1983
Years Wct planted: 1984

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Blackfoot	28N	18W	19	08/02/86	5570	17	22	7.8	50	80	Wct, Rb, WctxRb	Adequate, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Hybridized	Rb	2.2	4.1	6.9(14)	9.5(11)	11.7(7)	13.1(2)	5.6 - 14.2
	Wct	2.2(5)	4.6(4)	7.9	10.2(3)			3.7 - 11.8
	WctxRb	3.2(2)	6.1(1)	9.1	10.4			5.2 - 11.4

Wct year classes present: 1985, 1984, 1983
Years Wct planted: 1984

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Clayton	28N	18W	16	07/08/86	5970	58	100	7.4	40	120	Wct, WctxYct	Adequate, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Hybridized	Wct	2.5(18)	5.6	8.2(15)	10.9(6)			7.5 - 12.2
	WctxYct	2.4(20)	5.2	7.9(18)	10.5(17)	12.5(5)	13.8(2)	7.3 - 16.2

Wct year classes present: 1984, 1983, 1982
Years Wct planted: 1985

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Cliff	28N	18W	28	07/28/86	5600	22	74	7.9		130	Wct	Less than, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Hybridized	Wct	2.6(25)	5.9(24)	9.7(7)	12.9(3)	13.8(2)	4.6 - 14.5

Wct year classes present: 1985, 1984, 1983, 1982, 1981
Years Wct planted: 1984

Table 1 continued.

Table 1. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Crater	27N	18W	08	07/15/86	5975	24	75	6.7		44	Wct, WctxRb	Less than Adequate, I, O

Genetic Status: Hybridized

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	2.5(27)	5.5	8.1(9)	10.4(5)	11.7(4)	5.8 - 13.2
WctxRb	2.9(2)	5.6	8.5			10.0 - 10.1

Wct year classes present: 1984, 1983, 1982, 1981
Years Wct planted: 1984, 1980

Jewel,North	28N	18W	19	09/85	6000	6	25	8.2		40	Rb	More Than, I, O
Jewel,West	28N	18W	19	09/85	6040	2	4				Rb	More Than, I, O
Jewel,South	28N	18W	19	09/85	6040	6	17	8.2		40	Rb	More Than, I, O, S
Jewel,East	28N	18W	19	09/85	6040	4	9				Barren	None

Genetic Status: Unknown

Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Rb	2.3(31)	4.3	6.4	8.0(26)	9.4(17)	11.3(5)	7.3 - 12.9

North, South and West Jewel lakes are connected with no barriers, upstream or downstream, present. East Jewel is isolated. All four lakes were treated with rotenone in September 1986 and successfully planted with WCT in August 1987.

Pilgrim, Lower	27N	18W	15	08/15/86	6365	29.4	135	6.8		160	Wct, WctxRb	Adequate, S

Genetic Status: Hybridized

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	3.0(14)	6.0(14)	8.7(10)	11.2(4)	12.9(2)	6.8 - 14.2
WctxRb	3.5(6)	6.4(5)	9.0(4)	10.5(1)		6.4 - 11.8

Department records indicate lake never planted but suspect rainbow planted in late 1920's.

Pilgrim, Upper	27N	18W	15	08/15/86	6625	2.8	10	7.2		110	Barren	None

Lake probably will not support fish.

Table 1 continued.

Table 1. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Seven Acres, Lower	28N	18W	27	07/29/86	5550	13	76	7.9		100	Wct	Adequate, I, O

Genetic Status: Pure-Planted

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	2.4(24)	5.0	7.3(13)	8.9(8)	10.7(2)	4.8 - 11.5

Wct year classes present: 1984, 1983, 1982, 1981
Years Wct planted: 1984

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Seven Acre, Upper	28N	18W	28	07/29/86		6170	7				None	None

Lake is barren and should not support fish.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Squaw	27N	18W	05	07/16/86		6035	3	15	8.4	90	Wct	Adequate, O

Genetic Status: Pure-Management

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	2.5(24)	5.2	7.1(18)	9.0(10)	10.0(1)	5.3 - 10.4

Wct year classes present: 1984, 1983, 1982, 1981
Years Wct Planted: 1984, 1980

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Three Eagles, Lower	27N	18W	10									

Lake not surveyed since it would have required mountain climbing gear to get into from the upper lake. Suspect genetic makeup similar to Upper Three Eagles.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Three Eagles, Upper	27N	18W	10	08/14/86	6340	11		6.8		140	Wct, WctxYct	Adequate, I, S

Genetic Status: Pure-Planted

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	2.8(21)	5.7(19)	8.7(17)	10.9(9)	12.3(1)	4.1 - 13.3
WctxYct	2.7(4)	5.5	8.6	10.8(2)		8.7 - 11.5

Wct year classes present: 1985, 1984, 1983, 1982, 1981
Years Wct planted: 1984, 1980

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Twin, North	28N	18W	19	07/31/86	6350	3	23	7		136	None	Less than, O
Twin, South	28N	18W	19	07/31/86	6350	4	12				None	None

These lakes were considered too shallow to support fish by two previous surveys. The lakes are connected during spring. They were planted with Wct in 1987.

Table 1 continued.

Table 1. Continued.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH TDS SC	Species Present	Reproductive Capactiy and Location
Wildcat	28N 19W 12	08/11/88	5750	39	100+		Wct, WctxYct	Adequate, I, O, S

Genetic Status: Pure-Planted

Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Wct	2.7(26)	5.7(24)	8.4(10)	10.6(3)	12.1(1)	4.5 - 12.9
WctxYct	2.5(10)	5.5	8.7(7)	11.0(5)		6.5 - 13.9

Wct year classes present: 1987, 1986, 1985, 1984, 1983
Years Wct planted: 1987, 1986, 1985

Table 2. Physical, chemical, and biological characteristics of lakes in the South Fork Flathead River drainage outside the Jewel Basin hiking area and Bob Marshall Wilderness.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH TDS SC	Species Present	Reproductive Capactiy and Location
Bigelow	27N 18W 36	08/84	6000	24	33		Wct, WctxRb	Adequate, I, S,

Genetic Status: Hybridized

Fish ranged from 6 to 16 inches total length

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH TDS SC	Species Present	Reproductive Capactiy and Location
Doris #1	29N 19W 06	07/22/86	6550	4	25	7.6 -- 65	Barren	None

This is the uppermost of three Doris lakes; previous surveys included only Doris #2 and #3. This lake planted with WCT in 1987.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH TDS SC	Species Present	Reproductive Capactiy and Location
Doris #2	29N 19W 06	07/22/86	6430	6	30	7.4 -- 100	Wct, WctxRb	None

Genetic Status: Pure-Planted

Species	Length in Inches at Annulus I	Size Range
Wct	4.4 (29)	5.3 - 8.0
WctxRb	4.4 (3)	7.1 - 9.9

Wct year classes present: 1985
Years Wct planted: 1985, 1982

This lake has no reproductive capability, therefore all fish were from 1985 hatchery plant which included some WctxRb hybrids.

One 25" fish was caught and released; most likely from the 1982 hatchery planting.

Table 2 continued.

Table 2. Continued.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Doris #3	29N 19W 06	07/22/86	6390	4	15	8.0	--	85	Wct	More Than, I, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	Size Range
Pure-Management	Wct	2.8 (25)	5.4 (24)	7.5 (16)	5.3 - 8.8

Wct year classes present: 1985, 1984, 1983
Years Wct planted: 1985, 1982

Fawn	30N 19W 31	07/23/86	6430	7	30	7.7	--	95	Wct, WctxRb	Adequate, O

Gemetic Status	Species	Length in Inches at Annulus I	II	III	IV	Size Range
Pure-Planted	Wct	2.6(26)	5.5	8.0(16)	10.8(2)	6.8 - 11.4
	WctxRb	2.5(2)	5.6	8.3		9.0 - 9.5

Wct year classes present: 1984, 1983, 1982
Years Wct planted: 1984

Handkerchief	27N 18W 01	06/20/86	3835	32	75+	Wct, WctxYct, WctxRb, WctxRbxYct, Grayling	Adequate, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	VII	Size Range
Hybridized	Wct	2.9(4)	6.4(4)	9.0(3)	11.6(1)	14.0			7.6 - 14.1
	Hybrids	2.7(10)	5.3	7.9(7)	10.5(5)	12.9(3)	17.1(1)		6.5 - 17.1
	Grayling	3.6(27)	9.0	11.4(9)	12.1(5)	13.7	14.9(4)	16.1(2)	7.2 - 17.0

Wct year classes present: 1984, 1983, 1981
Years Wct planted: none

Jenny	29N 19W 18	07/23/86		--	6	50	6.7	--29	Wct, WctxRb	None

Genetic Statis	Species	Length in Inches at Annulus I	II	Size Range
Pure-Planted	Wct	3.0 (23)	6.5	4.9 - 9.2
	WctxRb	2.4 (1)	4.9	6.7

Wct year classes present: 1984
Years Wct planted: 1984

Table 2 continued.

Table 2. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Margaret	27N	17W	19	08/20/85	5575	64	76				Wct, WctxYct	Adequate, O, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	VII	Size Range
Pure-Management	Wct	2.6(14)	6.5	9.9	13.5(2)				8.7 - 14.8
	WctxYct	2.8(1)	4.7	7.4	10.3	14.8	19.2	20.3	21.0

Wct year classes present: 1981, 1982
Years Wct planted: 1982

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Tom Tom	17N	18W	27	08/08/86	5825	10	33			9	Yct	More Than Adequate, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Non-Native	Yct	2.9(11)	5.3	7.2	8.7(6)	10.0(2)	6.3 - 11.2

Table 3. Physical, chemical, and biological characteristics of lakes in the South Fork Flathead River drainage within the Bob Marshall Wilderness.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Crimson	18N	14W	23	09/16/87	6580	15+_	15+_	8.1	45	142	Barren	Adequate, I, O

Local outfitter reported catching fish in late 1960's; lake planted in 1988.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Doctor	19N	15W	14	07/24/87	5650	48	99				Wct	Adequate, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Pure-Aboriginal	Wct	3.0(22)	5.2(20)	7.6(19)	9.3(10)	12.9(1)	6.1 - 13.5

This lake contains bull trout (Salvelinus confluentus) and whitefish (Prosopium spp.)

Table 3 continued.

Table 3. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
George	19N	15W	27	08/02/87	7110	119	200+	8.3	40	74	WctxYct	Adequate, I, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Hybridized	WctxYct	3.3(27)	6.2(22)	9.2(9)	11.5(4)	15.1(1)	5.8 - 15.6

Population considered a hybrid swarm.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Koessler	19N	15W	15	07/24/87	6010	84	200+	8.6	40	119	WctxYct	Adequate, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Hybridized	WctxYct	2.9(23)	5.6	8.4(22)	10.6(14)	12.1(6)	8.6 - 14.1

Population considered a hybrid swarm.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Lena	20N	15W	26	07/09/87	6730	72	70	7.6	<10	18	Rb	Adequate, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Non-Native	Rb	2.3(23)	5.0	8.2(22)	10.6(18)	11.9(9)	12.9(2)	5.0 - 13.7

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Lick	19N	15W	09	07/23/87	5980	16	26	8.4	30	100	Yct	Adequate, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	Size Range
Non-Native	Yct	3.3(23)	6.0(22)	8.7(14)	11.0(6)	5.1 - 13.1

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Necklace, Lower	20N	15W	17	07/09/87	6500	15+	25	83	20	60	Rb	More Than, I, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Non-Native	Rb	2.4(8)	5.6	7.9	9.7(7)	11.6(1)	7.6 - 11.9

This lake is the lowest of a series of 4-5 small lakes, all of which may support fish.

Table 3 continued.

Table 3. Continued.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Olars, Upper & Lower	23N 16W 10	09/17/87	5670 16	17 21	10 8.3	 50	 139	 None	None	Adequate, I, O

The two lakes are connected by channel. The lower lake was planted with eyed Wct eggs July, 1988.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Otis	18N 14W 26	08/26/87	7130	7	11	7.6	<10	31	Barren	Adequate, I, O

This lake will probably not support fish.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Palisade	22N 15W 07	07/87		35	15	7.9	10	22	Barren	Adequate, I

This lake probably should be left barren even though it might support fish. It has never been planted.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Pyramid	18N 14W 03	08/05/87	6930	12	21	7.9	<10	12	Yct	Adequate, S

Genetic Status: Non-Native

Species	Length in Inches at Annulus I	II	III	IV	Size Range
Yct	3.3(12)	6.3(12)	8.9(10)	11.5(2)	7.6 - 13.0

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Ross Creek	17N 14W 11	09/88	7250	4	12	8.5	20	35	Eastern Brook	Inadequate, S

Genetic Status: Non-Native

Fish caught (10) ranged from 6 to 10 inches long.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Sage, Lower (L.Marshall Cr)	18N 14W 19	09/23/88	7320	5+_	14	7.9	15	28	Wct	Less Than, S

Genetic Status: Pure-Aboriginal

Species	Length in Inches at Annulus I	II	Size Range
Wct	2.9(31)	5.9(5)	5.7 - 9.5

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Sage, Upper (U.Marshall Cr)	18N 14W 19	09/23/88	7510	10+_	21	7.8	15	24	Wct	Less Than, S

Genetic Status: Pure-Aboriginal

Species	Length in Inches at Annulus I	II	Size Range
Wct	2.9(23)	6.7	8.0 - 12.7

Table 3 continued.

Table 3. Continued.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Sunburst	23N	16W	23	07/01/87	5320	142	200+	8.0	20		RbxYct	Adequate, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	VI	Size Range
Non-Native	RbxYct	3.7(17)	7.4	10.6	13.5(12)	14.5(5)	16.3(1)	11.2-16.7

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Woodward	20N	15W	18	07/09/87	6430	65	200+	7.9	40	139	Rb	Less Than, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Non-Native	Rb	3.3(2)	6.1	10.6	16.1	18.3	19.0 - 19.6

Table 4. Physical, chemical, and biological characteristics of lakes in the Wanless chain of lakes in Lower Clark Fork River drainage.

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Cirque #1	26N	31W	16	07/27/87	5910	4	12	7.2	<10	8	Wct	Less Than, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Pure-Planted	Wct	2.2(18)	4.6	6.2	7.6(17)	8.4(3)	7.6 - 9.2

Wct year classes present: 1984, 1983, 1982
Years Wct planted: 1982

Lake Name	Location T	R	S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Cirque #2	26N	31W	16	07/27/87	5550	5	11	6.7	<10	10	Wct	Less Than, I, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Pure-Planted	Wct	2.2(15)	4.9	6.9	8.3(12)	9.3(5)	8.1 - 10.6

Wct year classes present: 1984, 1983, 1982
Years Wct planted: 1982

Table 4 continued.

Table 4. Continued.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Cirque 3 & 4	26N 31W 16	07/27/87	5290	8	15	6.4	<10	10	Wct, WctxYct	Adequate, I, O

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	Size Range
Hybridized	Wct, WctxYct	2.7(20)	6.0	7.8(16)	9.0(12)	8.1 - 11.5

Wct year classes present: 1985, 1984, 1983
Years Wct planted: none

These lakes connected by 50 foot of channel.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Wanless	26N 31W 15	07/27/87	5130	112	165	6.3	<10	9	WctxYct	Adequate, I, O, S

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	V	Size Range
Hybridized	WctxYct	2.7(24)	5.6	8.3(20)	10.5(14)	11.7(7)	7.3 - 14.6

Population considered a hybrid swarm.

Table 5. Physical, chemical, and biological characteristics of lakes in two lakes in the North Fork Flathead River drainage.

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Chemical Parameters pH	TDS	SC	Species Present	Reproductive Capactiy and Location
Cyclone	34N 21W 15	09/14/88	4100	146	25	7.8	15	38	Wct, DV, FSU Mwf	Adequate, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	IV	Size Range
Pure-Aboriginal	Wct	2.5(26)	5.5(18)	8.7(4)	10.5(2)	4.3 - 12.8

This lake also contains bull trout, mountain whitefish and and longnose suckers (Catostomus catostomus). Fish were heavily infested with larval trematodes (black spot).

Lake Name	Location T R S	Date of Survey	Elevation MSL-Feet	Area Acres	Max. Depth Feet	Species Present	Reproductive Capactiy and Location
Hay	34N 23W 11	06/16/87	5720	3	4	Wct	More Than, I

Genetic Status	Species	Length in Inches at Annulus I	II	III	Size Range
Pure-Aboriginal	Wct	2.8(11)	5.4	7.6	6.8 - 9.2

The drainage wide survey of lakes in the South Fork Flathead River drainage (Tables 1, 2, and 3) showed that many contained non-native and hybridized westslope cutthroat populations. These data gives some information about aboriginal westslope cutthroat distribution patterns. The data suggest that the majority of lakes in the South Fork outside of the wilderness had native westslope cutthroat populations. Only the 3 Jewel Basin lakes and Tom Tom Lake contained non-native populations.

Within the confines of the Bob Marshall Wilderness, most lakes were barren until planted. Genetic data seems to indicate that lakes in 2 drainages contained aboriginal westslope cutthroat. These drainages are Marshall Creek (Upper and Lower Sage lakes) and Gordon Creek (Doctor, Koessler, and George lakes). A Department survey done in the mid-1960's indicated that no barriers preventing either upstream or downstream fish movement are present in Gordon Creek between the South Fork Flathead River and Doctor Lake. Barriers do exist immediately below the outlets of George and Koessler lakes. The elevation difference between George Lake and Doctor Lake of about 1,500 feet is largely related to a falls of about 1,000 feet a short distance from the George Lake outlet. Upper and Lower Sage lakes appear to be isolated from each other and from Marshall Creek except in those years with above normal snowpack.

RECOMMENDATIONS

Since 1986 through summer 1989 those lakes with hybridized or non-native fish populations have been planted yearly with pure westslope cutthroat. Changes in the genetic makeup of fish from Wildcat Lake and Creek indicates intensive fish planting may be a viable method to replace hybrid fish with pure westslope. Evaluation of planting of pure westslope cutthroat trout on top of an existing population as a viable method for restoration of the westslope should be intensified.

Planting started in 1986 and most westslope cutthroat are 4 years of age before spawning. Dilution of hybrids through spawning with planted fish will likely not occur before spring 1990 and resultant offspring would not be catchable until about 1992. It is recommended that the following lakes be re-sampled to determine if pure westslope 1 to 3 years old have increased proportionally compared to 1986 initial surveys: Tom Tom, Black, Blackfoot, and Clayton.

The Jewel lakes were chemically treated in September 1986 to remove rainbow trout. These lakes should be sampled in summer 1989 to determine success of this chemical treatment and the follow-up planting with westslope cutthroat trout.

Continuation of intensive planting past 1990 will be contingent upon 1989 resurvey and genetic analysis.

Lakes within the Bob Marshall Wilderness area containing hybridized or non-native fish populations should be planted with westslope cutthroat for at least 5 years; i.e., through 1992. Evaluation of success should be done after 1993 or 1994.

Consideration should be given to chemical elimination of brook trout from Ross Creek lake. Brook trout can interbreed with bull trout and the offspring are sterile. Whether brook trout have invaded downstream waters is not known at this time. The survey crew estimated a chemical treatment would require about 10-15 gallons of rotenone

and a 3-man crew 3 days horse packing equipment into and out of the lake. This would require the concurrence of the U. S. Forest Service under the Wilderness Management Act.

LITERATURE CITED

Leary, Robb F., Fred W. Allendork, et al. 1987. Genetic divergence and identification of seven subspecies of cutthroat trout and rainbow trout. Trans. Amer. Fish Soc., 116:580-587.

Sage, G. Kevin. 1989. Electrophoretic analysis of trout from Wildcat Lake and Wildcat Creek. Letter from University of Motnana Genetics Laboratory, Missoula, MT, February 24. 5 p.

Prepared by: Joe E. Huston

Date: August 1, 1989

Waters Referred to:

Aeneas 08-7980-20	Bigelow, North 08-8080-03
Bighawk, Lower 08-9170-03	Bighawk, Upper 08-8100-03
Birch 07-5320-03	Black 08-8160-03
Blackfoot 08-8340-03	Cirque #1 05-8552-03
Cirque #2 05-8551-03	Cirque #3 05-8850-03
Cirque #4 05-8553-03	Clayton 08-8340-03
Cliff 08-8380-20	Crater 08-8400-03
Crimson 08-8440-20	Cyclone 08-8480-03
Doctor 08-8520-03	Doris #1 08-8525-03
Doris #2 08-8526-03	Doris #3 08-
Fawn 08-8545-03	George 08-8620-03
Handkerchief 08-8740-03	Hay 08-8780-03
Jenny 08-8900-03	Jewel North 08-9370-03
Jewel West 08- -29	Jewel South 08-9710-03
Jewel East 08-8530-03	Koessler 08-9000-03
Lena 08-9080-03	Lick 08-9100-20
Margaret 08-9180-03	Necklace, Lower 08-9360-03
Olar 08-9380-03	Otis 08-9400-20
Palisade 08-9420-20	Pilgrim, Lower 08-9460-03
Pilgrim, Upper 08-9461-03	Pyramid 08-9520-03
Ross Creek 08-5940-10	Sage, Lower 08-9173
Sage, Upper 08-9956	Seven Acres, Lower 08-9630-20
Seven Acres, Upper 08-9956-03	Squaw 08-9770-03
Sunburst 08-9800-03	Three Eagles, Lower 08-9175-03
Three Eagles, Upper 08-9958-03	Tom-Tom 08-9860-03
Twin, North 08-9940-03	Twin, South 08-9940-03
Wanless 05-0776-03	Wildcat 08-9970-03
Woodward 08-9980-03	

Key Words: genetic analysis, westslope cutthroat trout, high mountain lake survey, westslope cutthroat trout restoration