MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA

PROJECT TITLE: STATEWIDE FISHERIES INVESTIGATIONS

PROJECT NO.: F-46-R-1

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, 1987 through June 30, 1988

ABSTRACT

Genetic analyses are presented for fish populations of 140 streams and lakes in northwestern Montana including most of the streams and lakes in the South Fork Flathead River drainage. Information collected show that many stream populations of pure westslope cutthroat trout (Salmo clarki Lewisii) do exist but that most are subject to invasion by non-native salmo; rainbow trout (Salmo gairdneri) and Yellowstone cutthroat trout (Salmo clarki bouvieri). Of 40 lake populations genetically tested, only two were found to contain aboriginal westslope cutthroat. The other lakes contained hatchery westslope, hybridized westslope or non-native salmo.

Genetic evidence is presented that indicates native westslope cutthroat and interior rainbow trout inhabit streams in the Yaak River drainage with little exchange of genetic material.

BACKGROUND

Historically the westslope cutthroat trout was the most widespread trout species in Montana, inhabiting the Clark Fork River drainage and almost all the Kootenai River drainage in western Montana and the Missouri River system above the city of Great Falls in eastern Montana (Behnke 1979). Pure westslope cutthroat trout have disappeared from much of their original range due to introduction of non-native fish and habitat deterioration. It is now considered a species of special concern in Montana. The work described in this report is an effort to fill data gaps in anticipation that a westslope cutthroat trout hatchery broodstock will play an important role in the perpetuation of this species.

Montana Department of Fish, Wildlife and Parks (DFWP) tried to develop and maintain three pure westslope cutthroat hatchery broodstocks from 1952 through 1982. The advent of genetic analysis using electrophoresis to determine population purity and diversity in recent years lead to a fourth attempt in 1983. Genetic analysis plus development of breeding schemes to minimize loss of genetic traits in brookstocks has opened a new era of broodstock management.

The fish population genetic analysis described in this report were undertaken for the following reasons:

1. Determining pure aboriginal populations of westslope cutthroat trout suitable for founding a new hatchery broodstock and future maintenance or expansion of this broodstock.
2. A drainage-wide analysis of fish populations in the South Fork Flathead River with emphasis on protection, enhancement, or restoration of the westslope as the only Salmo.
3. Determining extent of interior rainbow trout populations in the Kootenai River drainage below Kootenai Falls. Interior rainbow trout is also considered a species of special concern in Montana.

Work presented in this report includes that done from spring 1983 through spring 1988. During this period only a small portion of the work was funded by Federal Aid to Fish restoration. Other funding sources were State of Montana through DFWP or University of Montana (UM) and very limited private funds. Work done in lakes in the South Fork Flathead River drainage will be the subject of a master's thesis from UM. All genetic analysis was done by the UM Genetics Laboratory (UMGL) while all field collections were made by DFWP personnel.

OBJECTIVES AND DEGREE OF ATTAINMENT

Objectives for the Dingell-Johnson portion of this report include one each from the following jobs: Northwest Montana Coldwater Stream Investigations and Northwest Montana Coldwater Lakes Investigations. These objectives were:

7. To maintain or expand populations of species of special concern (westslope cutthroat trout, bull trout, and inland rainbow trout). (Project No. F-46-R-1 I-a.)
7. Manage regulations and stocking to protect or expand species of special concern. (Project No. F-46-R-1 II-a

Both objectives were attained.

The other objective was to determine those lakes and streams with pure aboriginal westslope cutthroat trout suitable for inclusion into a now westslope cutthroat trout hatchery broodstock. This broodstock has been established, but the search for high mountain lake aboriginal westslope continues.

PROCEDURES

Collection of Fish

Collection of fish from streams for genetic analysis was accomplished by electrofishing, angling, or a combination of the two methods. Collection sites were generally selected within a mile of the stream mouth. Exceptions to this general rule included streams with known barriers including falls and road culverts and those suspected to have different populations within the stream

length. Collection of fish from lakes was generally done by a combination of angling and/or gill netting. An attempt was made to collect fish from a wide range of lengths.

With one exception, fish caught were retained whole, packed in ice within four hours of capture, and frozen within 60 hours of capture. Genetic laboratory standards indicate that, after killing, fish can be stored at about 50°F for no more than 60 hours or proteins used in genetic analysis will denature.

In one case (Sunburst Lake) insufficient ice was packed in to store whole fish. Instead fish heads and livers were iced, packed out, and immediately sent to UMGL for analysis. Genetics analysis uses eye, muscle, and liver tissue, but it is recommended that whole fish be submitted for examination. Also, fish flesh as well as digestive tracts were examined for parasites.

UMGL standards require at least a 25 fish sample for a 95 percent confidence and a 50 fish sample for 99 percent confidence on genetic testing. In many cases occurrence of non-native genetic material in a suspected westslope cutthroat population could be confirmed with less than 25 fish. In a few instances, more than 25 fish were collected from populations suspected of being aboriginal westslope.

After fish were collected and frozen, samples were sent to UMGL where they were stored for up to six months in super cold freezers. Genetic analysis was done using standard techniques as described by Leary, Allendorf, et al. (1987).

Collection of Fish for Establishment of Broodstock

Fish from about 40 streams were genetically analyzed in 1983 and 1984 to determine those containing pure aboriginal westslope cutthroat trout. The streams were selected by the author based on surveys he had conducted over the years. Populations sampled included streams in North Fork and South Fork Flathead , Kootenai, and lower Clark Fork drainages. Populations included both stream resident and adfluvial life histories. Samples for disease testing were sent to the USF&WS laboratory in Fort Morgan, Colorado, from those streams deemed suitable for collection of broodstock fish.

Wild fish captured were trucked to the Murray Springs Hatchery and held for about one year, then transferred to the Washoe Park Hatchery in Anaconda. Water temperatures at Murray Springs is a constant 51-52°F which is good for growth. Water temperatures at Washoe Park vary from near freezing in winter to mid-50°F in summer which appears ideal to promote reliable and fertile male and female gametes.

RESULTS AND DISCUSSION

Broodstock Establishment

In summer 1983 and 1984 about 6,400 pure westslope cutthroat were caught by electrofishing or downstream trapping (Hungry Horse and Emery creeks) and

transferred to the Murray Springs hatchery. Streams and number of fish captured are listed in Table 1. Most fish collected from streams with adfluvial populations ranged from 3 to 7 inches total length and 1-3 years of age. Fish collected from streams with resident populations ranged from 3 to 10 inches total length and included some fish over 3 years of age.

Table 1. Streams and number of westslope cutthroat captured and moved to Murray Springs hatchery as now broodstock.

Year	Stream	Dominant Population Type	Number Moved
1983	Emery	Adfluvial	800
	Hungry Horse	Adfluvial	1,150
	Felix	Resident	200
	Ball	Adfluvial	145
	Branch	Adfluvial	175
	Connor	Adfluvial	350
	Quintonkon	Resident	150
	Battery	Resident	35
		TOTAL	3,005
1984	Emery	Adfluvial	400
	Hungry Horse	Adfluvial	650
	Felix	Resident	100
	Branch	Adfluvial	130
	Connor	Adfluvial	470
	Quintonkon	Resident	365
	Tin	Adfluvial	240
	Battery	Resident	25
	N.Branch Marten[1]	Resident	300
	S.Branch Marten[1]	Resident	300
	Vermilion above falls[1]	Resident	450
		TOTAL	3,430

1 These streams are in the lower Clark Fork River drainage. All other streams are in the South Fork Flathead River drainage.

Most of the wild fish doubled their length during the year they were held in the Murray Springs Hatchery. Some of the fish exhibited scoliosis, probably from electrical shock. Getting the wild fish to accept a hatchery diet was a major problem but was solved by adding ground liver to the normal dry pelleted food. Fish of all sizes were held together to reduce human bias in the selection of broodstock. Mortality during their first year in captivity averaged about 25 percent.

This new broodstock is now being held at the Anaconda hatchery where it produced about one million eggs in both 1987 and 1988. Most of the original wild fish will have died by spring 1989, leaving future production to their offspring.

Of special interest to future management of this westslope cutthroat brood is maintaining genetic variability in this subspecies of cutthroat. UMGL has to date genetically analyzed pure westslope cutthroat populations from about 50 streams. While most individuals within a given population are very similar to each other, no two of these populations are similar and they are generally distinct enough that separation is possible. Maintenance of broodstock diversity would require adding fish or gametes from several populations. This is in direct contrast to rainbow trout where genetic diversity occurs between individuals in a single population but little diversity occurs between populations (Leary and Allendorf 1987).

Genetic Surveys

Genetic surveys for streams in the South Fork Flathead River drainage are listed in Table 2 (east-side streams) and Table 3 (west-side streams). Almost all the streams listed in Table 2 contain pure westslope cutthroat trout populations even though many had been planted with Yellowstone cutthroat trout in past years. Only those streams with 100 percent pure westslope cutthroat trout that are isolated from upstream and downstream invasion by non-native Salmo genes should be considered suitable for addition to the existing broodstock without extensive genetic analysis.

In two instances, Felix and Riverside creeks above Forest Road #38, removal or repair of barrier culverts will reduce protection from invasion and change their potential broodstock rating to the next lower rating.

Streams listed in Table 3 (west-side streams) include many with hybridized populations between westslope cutthroat, Yellowstone cutthroat, and rainbow trout. The few streams with pure westslope do not contain head water lakes while the many streams with hybrid populations have headwater lake(s). Almost all the lakes lie within the boundaries of the Jewel Basin Special Management Area administered by the USFS. Most of the lakes have been planted with either rainbow trout or Yellowstone cutthroat trout in past years and in recent years with westslope cutthroat from the Arlee broodstock or the Anaconda hatchery broodstock.

Genetic analysis of fish from lakes draining into the South Fork system outside of the Bob Marshall Wilderness (BMW) are listed in Table 4. Comparison of genetic makeup with species known to have been planted clearly indicates that MDFWP planting records are not complete; e.g., the Jewel Lakes were populated by rainbow trout but there are no recorded plants.

The background section of this report presented a brief statement of DFWP efforts to develop and maintain a pure westslope broodstock. The genetic make up of fish from several lakes in the Jewel Basin area demonstrates that some of the early westslope cutthroat trout broodstocks contained non-westslope genetic material. DFWP records indicate that only one lake, very likely barren, was planted once with supposedly westslope cutthroat trout from the Hamilton hatchery. This lake, North Bigelow, now contains pure westslope individuals as well as westslope x rainbow trout hybrids. Three lakes, Jenny, Doris #2, and Fawn, have very poor spawning potential and are considered dependent upon hatchery fish. All three lakes had been planted with an early westslope cutthroat trout stock in the mid-1980's and all three contained mostly westslope but also a few rainbow x westslope hybrids.

Table 2. Genetic make-up of fish collected from streams entering South Fork Flathead River and Hungry Horse Reservoir from Flathead Mountain Range between Bob Marshall Wilderness boundary and Hungry Horse Dam.

		Number of Fish Analyzed as[1]			Wct Considered as		
Water Body	Fish Planting History[2]	Wct	WctxYct	WctxRb	Hybridized	Wct for Mgmt[3]	Suitable for Broodstock[4]
Emery Creek	Yct-38, 41, 48, 49, 50	27				b	
Hungry Horse Creek	Yct-36, 48, 50	48				b	
Riverside Creek Drainage							
Below FS Rd#38	Yct-37, 48, 40, 41, 43, 48-50	25				b	
Above FS Rd#38		25					x
Ryle Creek		25					x
Tent Creek		23		2		a	
Murray Creek	Yct-38	28				b	
McInernie Creek		28				b	
Deep Creek		23		2		a	
Canyon Creek		26				b	
Harris Creek		25				b	
Paint Creek		17					x
Felix Creek	Yct-36, 37, 40, 49	25				b	
North Fork Logan Creek	Yct-48, 49, 50	26				b	
South Fork Logan Creek	Wct-40	20				b	
Hoke Creek	Yct-36	35				b	
Baptiste Creek		14			Sample not large enough to classify		
Lower Twin Creek	Yct-48, 49, 50	37	2			b	
Upper Twin Creek		12			Sample not large enough to classify		
Spotted Bear River	Yct-27, 37-42, 48-50	15			Sample not large enough to classify		
Harrison Creek	Yct-41	11	2	2	x		

[1] Species abbreviations are: Wct-westslope cutthroat trout, WctxYct-westslope, Yellowstone cutthroat hybrid; WctxRb-westslope, rainbow trout hybrid.

[2] Species abbreviation followed by year planted.

[3] a-includes populations containing 2% or less non-westslope genetic material or populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

Table 3. Genetic makeup of fish collected from streams entering South Fork Flathead River and Hungry Horse Reservoir from Swan Mountain Range between Bob Marshall Wilderness boundary and Hungry Horse Dam.

		Number of Fish Analyzed as[1]						Wct Population Considered as	
Water Body	Fish Planting History[2]	Wct	WctxYct	WctxRb	WctxRbxYct	Yct	Hybridized	Mgmt[3]	Broodstock[4]
Doris Creek		25						b	
Lost Johnny Creek	Yct-38, 48, 50	22						b	
*Wounded Buck Drainage									
Lower Wounded Buck	Yct-39, 50	17	9				x		
Upper Wounded Buck		15	6				x		
Wildcat Creek		13	10				x		
Lid Creek		10					Sample not large enough to classify		
Kneiff Creek		27							x
Goldie Creek		22							x
*Clayton Creek	Yct-49	12	7	1	6		x		
Graves Creek Drainage									
*Graves Creek	Yct-35, 40, 48-51	8	8	2	9		x		
*Jones Creek		12	13				x		
*Aeneas Creek	Yct-49	15		15			x		
*Forest Creek									
Below falls	Yct-40	30		1				a	
Above falls		9	2				x		
*Wheeler Creek Drainage									
Below falls	Yct-38, 48-50	41	9				x		
Above falls						3			
Sullivan Creek Drainage									
Sullivan Creek	Yct-51	25						b	
Quintonkin									
Below Posey Cr	Yct-51	22						b	
Above Posey Cr		25							x
Ball		62						b	
Branch		25						b	
Cannon		25						b	
Clark Creek		26						b	
*Soldier Creek		26						b	
Tin Creek		30						b	
Bunker Creek	Yct-41	10	5				x		

[1] Species abbreviations are: Wct-westslope cutthroat trout, WctxYct-westslope, Yellowstone cutthroat hybrid; WctxRb-westslope, Rainbow trout hybrid; WctxRbxYct-westslope,Rainbow, Yellowstone cutthroat hybrid; Yct-Yellowstone cutthroat trout.

[2] Species abbreviation followed by year planted.

[3] a-includes populations containing 2% or less non-westslope genetic material or populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

* Streams with lakes in drainage.

Table 4. Genetic makeup of fish from lakes in Swan Mountain Range draining into streams entering South Fork Flathead River between Bob Marshall Wilderness boundary and Fawn Creek immediately below Hungry Horse Dam.

Water Body	Fish Planting History[2]	Number of fish Analyzed as[1]							Wct Population Considered as		
		Wct	Yct	Rb	WctxYct	WctxRb	WctxRbxYct	RbxYct	Hybridized	Wct for Mgmt[3]	Suitable for Broodstock[4]
Hungry Horse Reservoir	Yct-48, 50	37			8					a	
Fawn Creek Drainage											
Doris #1	Barren until planted with Wct in 1986										
Doris #2	Wct-67, 69, 77, 82, 85	29				3				a	
Doris #3	Wct-67, 69, 77, 82, 85	26								a	
Fawn	Wct-69, 79, 84	29				2				a	
Doris Creek Drainage											
Jenny	Yct-53; Wct-79, 84	25				1				a	
Wounded Buck Drainage											
Wildcat	Yct-38-41, 53, 65										
	Wct-78, 79	16			4				x		
Clayton Creek Drainage	Wct-82, 85										
Clayton	Rb-28; Yct-26, 27, 39,										
	50, 53	20			23				x		
Graves Creek Drainage											
Graves Creek											
Handkerchief	Yct-36, 48, 52, 53, 57	2			8	6	5		x		
Cliff	Wct-67, 68, 75, 84	25								a	
7 Acres (2)	Wct-67, 75, 80	25								a	
Black	Yct-38,49; Wct-73,79,84	21			1	5	5		x		
Blackfoot	Yct-38, 65; Wct-84	5		8		3			x		
Jones Creek Drainage											
Upper Pilgrim		15				7			x		
Big Hawk	Yct-41; Wct-67,75,80,84	5	2		41				x		
Aeneas Creek Drainage											
Crater	Yct-38, 65, 66, 67										
	Wct-75, 80	27				2				a	
Three Eagles	Wct-67, 75, 80, 84	22			4					a	
Squaw	Yct-38, 41, 65										
	Wct-67, 75, 80, 84	26								a	
Forest Creek Drainage											
Margaret	Yct-48; Wct-82	25			1					a	
Wheeler Creek Drainage											
N. Bigelow	Wct-60	21				4			x		
Tom Tom	Yct-41	11									
Bunker Creek Drainage											
*Dior	Yct-39	No fish caught									
*Sunburst			14					11			

[1] Species abbreviations are: Wct-westslope cutthroat trout; Yct-Yellowstone cutthroat trout; Rb-rainbow trout; WctxYct-westslope, rainbow trout hybrid; WctxRbxYct-westslope, rainbow, Yellowstone cutthroat hybrid; RbxYct-rainbow, Yellowstone cutthroat trout hybrid.

[2] Species abbreviation followed by year planted

[3] a-includes populations containing 2% or less non-westslope genetic material or populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

* These lakes are within the Bob Marshall Wilderness.

The genetic analysis of lakes and outlet streams surveyed in the BMW are listed in Table 5. The species found indicate that all the lakes except those found in the Gordon Creek drainage were probably barren when first planted. Only one lake, Doctor, was found to contain pure westslope cutthroat trout. Doctor Lake was also the only lake surveyed containing non-salmo species; in this case bull trout (Salvelinus confluentus) and mountain whitefish (Prosopium williamsoni).

Table 5. Genetic makeup of fish from lakes and streams in South Fork Flathead River drainage within Bob Marshall Wilderness.

		Number of Fish Analyzed as[1]				Wct Population Considered as		
Water Body	Fish Planting History[2]	Wct	Rb	Yct	WctxYct	Hybridized	Wct for Mgmt[3]	Suitable for Broodstock[4]
Little Salmon Creek Drainage								
Palisades Lake		No fish caught						
Big Salmon Creek Drainage								
Big Salmon near Pendent			3					
Woodward Lake	Rb-28; Yct-30		2					
Necklace Lake	Rb-28		8					
Lena Lake	Rb-31		67					
Gordon Creek Drainage								
Gordon Cr near Shaw Cabin		6			4	X		
Lick Lake	Yct-38			35				
Koesler Lake	Yct-28-30, 65				26	X		
Doctor Lake	Yct-28-30, 49	85						X
George Lake	Yct-65	1			26	X		
Young Creek Drainage								
Pyramid Lake	Yct-50			12				
South Fork near Big Prairie		49		1			a	

[1] Species abbreviations are: Wct-westslope cutthroat trout, WctxRb-westslope, rainbow trout hybrid, WctxYct-westslope, Yellowstone cutthroat hybrid, WctxRbxYct-westslope, rainbow, Yellowstone hybrid.

[2] Species abbreviations followed by year planted.

[3] a-Includes populations containing 2% or less non-westslope genetic material or populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

The South Fork Flathead River drainage has long been treated as the major stronghold of native westslope cutthroat trout in the continental United States. Genetic analysis of many of the streams and lakes within the drainage indicates that non-westslope populations and hybrid populations exist in good numbers. It is the DFWP's position that efforts have to be made to replace non-native and hybrid populations.

To this effect, DFWP chemically treated the four Jewel Basin lakes in 1986 to remove the existing rainbow trout and replanted the lakes with fish from the latest westslope broodstock. Further, genetic analysis of fish from Wildcat Lake and Creek (Table 3, 4) and Red Meadow Lake (Table 6) indicated planted westslope cutthroat trout would replace Yellowstone cutthroat trout. Starting in 1984-85 all lakes considered hybridized in the Jewel Basin area were to be planted with westslope cutthroat trout for at least five consecutive years to dilute out the hybrid genes. In 1986, Lena and Woodward lakes within the BMW were planted with westslope cutthroat trout. Starting in 1988 all lakes within the BMW except Otis, Doctor, and Palisades, may be planted for several consecutive years.

Genetic analysis of stream populations tested in the North Fork Flathead River drainage are listed in Table 6. Of special interest is Hay Creek and Hay Lake. Other than Doctor Lake in the Bob Marshall Wilderness, Hay Lake is the only other lake found to contain a pure aboriginal westslope population. In spring 1988 male gametes were collected from Hay Lake fish and crossed into eggs from the Anaconda broodstock.

Moose Creek was considered a pure aboriginal westslope stream until a second collection was done in spring 1987 at a site about 7 miles further upstream from the original 1983 collection site. This second collection contained two fish carrying rainbow trout genes. It is considered likely that the hybrids originated from a headwater lake planted with fish from an early westslope cutthroat broodstock.

Genetic analysis of fish from some streams and lakes in the lower Clark Fork River drainage are listed in Table 7. Of special note are several streams and lakes. Deerhorn Creek and Canyon Creek both contained one F1 generation rainbow-westslope hybrid. Cataract Creek, planted once with Yellowstone cutthroat in 1941 contained a population of Yellowstone-westslope hybrids with genetic material about evenly divided between the species. West Fork Trout Creek contained mostly pure westslope but a few westslope-rainbow hybrids. The West Fork as well as Rock Creek Meadows were reportedly planted with rainbow trout by a private individual in the early 1960's. Rainbow genetic material was found in fish from Rock Creek Meadows as well as Yellowstone cutthroat. Yellowstone cutthroat material likely originated from a DFWP planting in Rock Lake.

The sample taken from lower Swamp Creek tested pure westslope, yet Wanless Lake and adjacent Cirque Lake #3 contained partially or totally hybridized populations of westslope and Yellowstone cutthroat trout. DFWP has no records that fish were ever planted in either lake. A private individual reportedly planted both Wanless and Cirque Lake #3 in 1931. In 1931 the planted fish had to be Yellowstone cutthroat trout. The upper two lakes, Cirque #1 and #2, undoubtedly contained aboriginal westslope cutthroat but have been planted with hatchery westslope cutthroat in recent years.

Table 6. Genetic makeup of fish from streams and lakes drainage the North Fork Flathead River from Whitefish Mountain Range between mouth and U. S. Canada border.

Water Body	Fish Planting History[2]	Number of Fish Analyzed as[1] Wct	WctxRb	WctxYct	WctxRbxYct	Wct Population Considered as Suitable for Hybridized	Wct for Mgmt[3]	Broodstock[4]
Canyon Creek Drainage								
McGinnis Creek		25						X
DePuy Creek	Yct-40	27						X
Big Creek Drainage								
Big Creek	Yct-25,26,29,36,37,38 39,49,43; Rb-34	17	2				a	
Langford Cr	Rb-34	14	1				a	
Skookolee: above falls		11					a	
Kletomas Creek		22	2				a	
Nicola Creek		25					b	
Coal Creek Drainage								
Coal Creek	Yct-36,37,39,40,42	26					b	
Cyclone Creek		23					b	
S.F. Coal Creek		25					b	
Moran Creek		29					b	
Hay Creek Drainage								
Hay Creek	Yct-36,37,38,42	27					b	
Hay Lake and Inlet		63						X
Red Meadow Creek Drainage								
R.Meadow below falls	Yct-34,38,40,42,48, 49, 50, 51	21		1			a	
R.Meadow Lake	Yct-32,36,38,39,44,45, 60,61,62,63,68							
	Wct-70,75,80	23					a	
S.F.Red Meadow Cr.		24						X
Moose Creek		48	2				a	
Whale Creek Drainage								
Whale Cr. above falls		1		24				
Teepee Creek		25					b	
Yakinikak Creek		26						X
Colts Creek		26						X

[1] Species abbreviations are: Wct-westslope cutthroat trout, WctxRb-westslope, rainbow trout hybrid, WctxYct-westslope, Yellowstone cutthroat hybrid, WctxRbxYct-westslope, rainbow, Yellowstone hybrid.

[2] Species abbreviations followed by year planted.

[3] a-includes populations containing 2% or less non-westslope genetic material or populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

Table 7. Genetic makeup of fish from streams and lakes drainage the lower Clark Fork River from Thompson River drainage downstream to Idaho-Montana border.

Water Body	Fish Planting History[2]	Number of Fish Analyzed as[1]				Wct Population Considered as		
		Wct	WctxRb	WctxYct	WctxRbxYct	Hybridized	Wct for Mgmt[3]	Suitable for Broodstock[4]
Thompson River Drainage								
Little Rock Creek		11	1			sample too small to rank		
Four Lakes Creek		8				sample too small to rank		
Deerhorn Creek		62	1				a	
Prospect Creek Drainage								
Crow Creek		17					b	
Cooper Creek		25					b	
Dry Creek	Yct-49	25					a	
Deep Creek		63						x
Vermilion River Drainage								
Vermilion Rv above falls		27						x
Cataract Creek	Yct-41			28		x		
Canyon Creek		20	1				a	
Trout Creek Drainage								
West Fork Trout Creek		23	2				a	
Swamp Creek Drainage								
Mid Swamp Creek	Yct-34, 36, 53; Wct-77-7[5]	22					a	
Wanless Lake				30		x		
Cirque Lake #3		12		13		x		
Cirque Lake #2	Wct-68	17					b	
Cirque Lake #1	Wct-68	19					b	
Marten Creek Drainage								
North Branch Marten		25						x
South Branch Marten		27						x
McKay Creek		25					b	
Rock Creek Drainage								
Rock Creek	Yct-39,40,42,44-46 Rb-41, 45, 46	24					a	
EF Rock Creek		21					b	
EF Rock Creek Meadows		9		2	10	x		
Rock Lake	Yct-34	3		8		x		
Bull River Drainage								
EF Bull River	Yct-44, 45, 51							

[1] Species abbreviations are: Wct-westslope cutthroat trout, WctxRb-westslope, rainbow trout hybrid, wctxYct-westslope, Yellowstone cutthroat hybrid, WctxRbxYct-westslope, rainbow, Yellowstone hybrid.

[2] Species abbreviations followed by year planted.

[3] a-includes populations containing 2% or less non-westslope genetic material in populations dependent upon planting for their existence. b-These populations tested as pure westslope, thought to be all or partially aboriginal, may be subject to invasion by non-native Salmo and should not be used for broodstock purposes without further testing.

[4] These populations tested a pure westslope, thought to be all or mostly aboriginal and isolated from invasion.

Genetic analysis of fish collected from miscellaneous drainages including the Yaak River are listed in Table 8. Except for the Yaak River samples, fish were collected by non-project personnel but analyzed for general survey knowledge. Of special note were fish from Donaldson and Herrig creeks. Donaldson Creek is a small inlet of Lake Mary Ronan used extensively by Salmo for spawning, while Herrig Creek is the only spawning inlet for Little Bitterroot Lake. Both lakes have good reputations for yielding large rainbow trout to anglers and both contain good numbers of kokanee (Oncorhynchus nerka). One strain of interior rainbow trout, the kamloops or Girard rainbow may be genetically inclined to feed on kokanee. Unfortunately genetic identification cannot yet determine differences between kamloops and other races of interior rainbow trout.

The Yaak River samples excluding Arbo Creek were from streams above Yaak Falls. Yaak Falls and Kootenai River Falls have been suggested as the eastern-most barriers dividing the Kootenai River drainage into native westslope and native interior rainbow ranges. Data presented in Table 8 indicate that interior rainbow and westslope cutthroat trout may both be native to the Yaak River system above Yaak Falls. The two samples from 17-Mile Creek further indicate division between the two species with little interchange of genetic material.

Table 8. Genetic makeup of fish collected from miscellaneous drainages in northwestern Montana.

	Number of Fish Analyzed as[1]					Wct Considered as		
Water Body (tributary to)	Wct	Rb[a]	WctxYct	WctxRb	Rb[b]	Hybridized	Wct for Mgmt[2]	Suitable for Brood stock[3]
Broom Creek (Swan River)	23						X	
Six Mile Creek (Swan River)	25						X	
Soup Creek (Swan River)	10		15			X		
WF Swift Creek (Whitefish Lake)	16			10		X		
Donaldson Creek (Lake Mary Ronan)	1	16[4]		3		Not rated		
Herrig Creek (Little Bitterroot Lake)		17[4]		16				
Boulder Creek (Lake Koocanusa)	7		19			X		
Dodge Creek (Lake Koocanusa)	26							X
Camp Creek (Lake Creek near Troy)	25						X	
Yaak River								
Spread Creek	4			6		X		
Pete Creek	3					Too few to rate		
WF Yaak	3					Too few to rate		
Arbo Creek	4			26		X		
17-Mile Creek near mouth				3	23			
17-Mile Creek 7 miles upstream	19							X
EF Yaak				3	19			
Caribou Creek				3	22			

[1] Species abbreviations are: Wct-westslope cutthroat trout; Rb[a]-coastal rainbow trout; WctxYct-westslope, Yellowstone cutthroat hybrids; WctxRb-westslope, rainbow trout hybrid; Rb[b]-interior rainbow trout.

[2] Westslope cutthroat trout tested pure but may be invaded by non-native Salmo.

[3] Westslope cutthroat trout tested pure, isolated from invasion and suitable for future brood stock use.

[4] These rainbow included genetic material from both coastal and interior rainbow trout.

CONCLUSIONS

Management of Westslope Broodstock

It is still considered essential to incorporate adfluvial, fluvial, stream resident and high mountain lake genetic material into the new westslope broodstock. Unfortunately finding pure aboriginal high mountain lake westslope has proved to be difficult. Out of 40 lakes surveyed to date, only two have been populated by aboriginal westslope. Male gametes from one, Hay Lake, were collected in mid-June, 1988, and used to fertilize eggs from the current Anaconda broodstock.

DFWP is aware of several aboriginal westslope lakes in Glacier National Park. Negotiations may be started seeking permission to collect eggs from one of these lakes. It is thought that aboriginal lake cutthroat may exist in a lake(s) within the boundaries of the Confederated Kootenai and Salish Indian Reservation. Project personnel have, hopefully, made arrangements to have fish samples genetically tested by UMGL in winter 1989. Project personnel will also collect fish samples from three to four lakes within Region One in summer 1988 for genetic analysis. Two lakes to be tested include Fishtrap Lake in the Thompson River drainage and Cyclone Lake in the North Fork Flathead River drainage.

Addition of fluvial cutthroat into the broodstock may be an impossibility. It is the author's opinion that fluvial cutthroat exist only in the Middle Fork and South Fork Flathead rivers within the Bob Marshall Wilderness.

RECOMMENDATIONS

It is recommended that large scale genetic sampling be discontinued after 1988 for the near future. Samples should be collected either as the need or opportunity arises.

Evaluation of westslope management strategies, i.e., the swamp-out technique should be started as soon as feasible in a select group of lakes. It is recommended that Wildcat Lake and Creek be re-sampled in summer 1988. Other lakes in the Jewel Basin area that should be reevaluated include Tom Tom Lake, Black Lake, and Clayton Lake. Re-sampling of these lakes should be done about five years after intensive planted started; therefore, in about 1990 or 1991. Reevaluation of populations in selected lakes within the BMW should include Lick, Lena, and George lakes and should be done in 1993-1994.

Collection of fish from selected waters within the South Fork portion of the Bob Marshall Wilderness is scheduled to occur in summer 1988. Waters to be sampled include Big Salmon Creek below Pendant Falls and Big Salmon Lake, Crescent lakes in the headwaters of Marshall Creek and unnamed lake(s) in the headwaters of Devine and/or Ross creeks.

Collection of fish for analysis from selected waters in the Yaak River drainage should also be done in 1988. These streams are: Pine, Hellroaring, Pete, South Fork Yaak, North Fork Yaak, West Fork Yaak above falls, and main Yaak River. It is estimated that a three-man crew can collect these samples in two days. Analysis will be done by UMGL.

Considerable data were collected from lakes in the South Fork Flathead River drainage which has not been reported. Much of these data will be presented in a master thesis to be written by George K. Sage in winter-spring 1989. That which is not and data from other lakes will be described in next year's report.

LITERATURE CITED

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

Behnke, R. J. 1979. Monograph of native trouts of the genus Salmo of western North America. Report of the USDA Forest Service, U. S. Fish and Wildlife Service, and Bureau of Land Management. 163pp.

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Key words: genetic analysis, westslope cutthroat trout, interior rainbow trout, Salmo hybrids

Waters referred to:

South Fork Flathead River Lakes:
Big Hawk (lower) 08-9170-03
Big Salmon08-8140-03
Black 08-8160-03
Blackfoot 08-8180-03
Clayton 08-8340-03
Cliff 08-8380-20
Crater 08-8400-03
Doctor 08-8520-03
Doris #1 08-8525-03
Doris #2 08-8526-03
Doris #3
Fawn 08-8545-03
George 08-8620-03
Handkerchief 08-8740-03
Jenny 08-8900-03
Koesler 08-9000-03
Margaret 08-9180-03
Lena 08-9080-03
Necklace 08-9360-03
Lick 08-9100-20
North Bigelow 08-8080-03
Olor 08-9380-03
Palisades 08-9420-20
Pilgrim (lower) 08-9460-03
Pyramid 08-9520-03
Sunburst 08-9800-03

North Fork Flathead River Lakes:
Hay 08-8780-03
Red Meadow 08-9540-03

Streams:
Big Creek 08-0680-01
Coal 08-1620-01
Colts 08-1640-01
Cyclone 08-1840-01
DePuy 08-2100-10
Gordon 08-3040-01
Hay 08-3340-01
Kletomas 08-3840-01
Langford 08-4000-01
MCGinnis 08-4640-01
Moose 08-4880-01
Moran 08-4920-01
Nicola 08-5020-01
Red Meadows (below falls) 08-5760-01
Skookoleel (above falls) 08-6400-10
S.F.Coal 08-6620-01
S.F.Red Meadow 08-6675-01
Teepee 08-7200-01
Whale (above falls) 08-7700-01

Yaak River Drainage Streams:
Arbo 11-0080-01
Boulder 11-0540-01
Camp 11-0880-01
Caribou 11-0940-01
Dodge 11-1820-01
Donaldson 07-1210-01
E.F. Yaak 11-2060-01
Groom 07-1820-01
Herrig 07-2060-01
Pete 11-5040-01
17 Mile 11-5800-01
Six Mile 07-3960-01
Soup 07-4020-01
Spread 11-6340-01
W.F. Swift 07-4900-01
W.F. Yaak 11-7480-01

South Fork Flathead River

Lakes (continued)
Squaw 08-0770-03
Three Eagles (upper)
08-9958-03
Tom Tom 08-9860-03
Wildcat 08-9970-03
Woodward 08-9980-03

Streams:
Aeneas 08-0080-01
Ball 08-0400-01
Baptiste 08-0420-01
Branch 08-0860-01
Bunker 08-0980-01
Cannon 08-1140-01
Canyon 08-1180-10
Clark 08-1520-01
Clayton 08-1540-01
Deep 08-1010-10
Doris 08-2300-01
Emery 08-2560-01
Felix 08-2700-01
Forest 08-2820-01
Goldie 08-3030-01
Graves 08-3100-01
Harris 08-3260-01
Harrison 08-3280-01
Hoke 08-3480-01
Hungry Horse 08-3580-01
Kneiff 08-3860-01
Lid 08-4100-01
Lost Johnny 08-4360-01
Lower Twin Creek 08-7500-01
McInernie 08-4660-01
Murray 08-4980-01
N.F.Logan Creek 08-4260-01
Paint 08-5280-01
Quintonkin 08-5660-01
Riverside 08-5860
Ryle 08-6020-01
S.F.Logan Creek 08-4260-01
Soldier 08-6560-01
Spotted Bear 08-6740-01
Sullivan 08-7080-01
Tent 08-7210-01
Tin 08-7280-01
Upper Twin Creek 08-7500-01
Wheeler 08-7720-01
Wildcat 08-7860-01
Wounded Buck 08-7920-01

North Fork Flathead River

Streams (continued)
Yakinikak 08-7940-01

Lower Clark Fork Drainage

Lakes:
Cirque #1 05-8552-03
Cirque #2 05-8551-03
Cirque #3 05-8850-03
Rock 05-9424-03
Wanless 05-0776-03

Streams:
Canyon 05-1184-10
Cataract 05-1232-01
Cooper 05-1632-01
Crow 05-1760-01
Deep 05-1872-01
Deerhorn 05-1984-01
Dry 05-2128-01
E.F. Bull 05-2272-01
E.F. Rock 05-2400-01
Four Lakes 05-2896-01
Little Rock 05-4080-01
McKay 05-9620-01
Mid Swamp 05-7104-01
N.Branch Marten 05-5184-01
Rock 05-5920-01
S.Branch Marten 05-624-01
Vermilion 05-7712-01
W.F.Trout 05-8096-01