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

STATE: MONTANA
PROJECT TITLE: STATEWIDE FISHERIES INVESTIGATIONS

PROJECT NO.: F-46-R-4
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, 1990 THROUGH JUNE 30, 1991

ABSTRACT

Evaluation of efforts to replace non-native Oncorhynchus and hybridized O. with native O. clarki lewisi (westslope cutthroat trout) is described. Starch gel electrophoretic identification was made of fish collected from seven mountain lakes and three streams.

BACKGROUND

Historically the westslope cutthroat trout was the only Oncorhynchus species present in most of Montana except the Yellowstone River drainage. This species has been displaced, replaced or hybridized with other fish species throughout much of its original range. Electrophoretic identification of fish populations was started in 1982 when the Department committed to rebuilding its westslope cutthroat trout (Wct) hatchery brood stock. This genetic work has since developed into a drainage-wide survey of the South Fork Flathead River above Hungry Horse Dam, a continual search for genetically pure aboriginal Wct in lakes, a tool to evaluate efforts to restore pure Wct in selected waters within the South Fork Flathead River drainage, and a tool to identify sensitive species potentially affected by U.S. Forest Service activities.

OBJECTIVES AND DEGREE OF ATTAINMENT

Objectives included one from the Northwest Montana Coldwater Lakes Investigations (F-46-R-4, I-a) and one from the Northwest Montana Stream Investigations (F-46-R-4, II-a). These objectives were:

Northwest Montana Coldwater Lakes Investigations,

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 (Salvelinus confluentus), and inland (redband) rainbow trout (Oncorhynchus mykiss.)]

These objectives were attained.

PROCEDURES

Collection for Electrophoretic Analysis

Collection of fish from streams was accomplished by electrofishing, angling explosives (M-80 firecrackers) or seining (a fine-mesh baseball cap) while fish from lakes were caught by angling or gill netting. Fish caught were retained whole, packed in wet ice or dry ice shortly after capture and frozen within 48 hours after capture. The samples were then transported to University of Montana Population Genetics Laboratory, stored in -80° C freezers and analyzed using starch gel electrophoresis by laboratory personnel. Fish from all streams and lakes except for part of the Tom Tom Lake sample were identified electrophoretically.

Visual Species Identification

Meristic or visual identification of rainbow trout (Rb), Wct, and Yellowstone cutthroat trout (O. clarki bouvieri), is generally easy and reliable when dealing with pure populations. Genetic analysis of fish collected from Tom Tom Lake in 1986 showed a pure Yct trout population. Westslope cutthroat fingerlings planted in Tom Tom Lake in 1985 through 1989 would not have bred with the Yct until at least 1988. Fish caught in 1990 that were 5 inches long or longer were visually identified except for a 32 fish sample that was retained for laboratory analysis. The electrophoretic analysis agreed with the sight identification. All fish less than 5 inches long were electrophoretically identified and did include several first generation hybrids.

Lengths, weights and scale samples for age-growth analysis were collected from each water body except Fitzsimmons Creek.

RESULTS AND DISCUSSION

Brood Stock Candidates

Montana's present Wct brood stock was derived by capturing about 6,000 yearling and older fish from 13 different streams in 1983 and 1984. We would still like to add aboriginal Wct from lake sources into this brood. Since 1985, fish from 60 mountain lakes have been tested for purity and only 5 have been found to contain pure aboriginal Wct. Three of these lakes are within the Bob Marshall Wilderness and too remote to be a source of fish for the brook stock. Two lakes in the North Fork Flathead River drainage are accessible and should be good sources for future brood stock additions.

In 1990 one lake, Weasel Lake, was tested for genetic purity. According to Department planting records, this lake in the Wigwam River drainage east of Eureka, Montana had never been planted. However, genetic analysis disclosed that the lake was populated by Wct and a few westslope-Yellowstone cutthroat hybrids. Four percent of the genes analyzed were Yct and the remainder Wct.

Initial Genetic Surveys

Hall Lake, headwater of Hall Creek tributary to Swan Lake was sampled and found to contain only coastal rainbow trout. Hall Creek was chemically treated in fall 1990 to reduce resident fish populations prior to introduction of Wct that, hopefully, will emigrate into Swan Lake, mature there and return to Hall Creek for spawning. Hall Lake will be planted with westslope cutthroat starting in 1991 and continuing for several years in an effort to "swamp-out" the rainbow trout. The report section immediately following describes the "swamp-out" technique.

Lupine Lake is a headwater lake in the Logan Creek drainage west of Kalispell, Montana, and prior to 1979, was planted with and supported a population of Yct. In 1979, 1984 and 1989 this lake was planted with Wct. Six fish were angled from this lake in September 1990 and analyzed as four Wct x Yct hybrids and two Wct.

Fish collected from Fitzsimmons Creek, a headwater tributary of Stillwater River north of Whitefish, Montana, were analyzed as pure Wct. Fish from North Fork Keeler Creek near Troy, Montana, were collected and analyzed in response to a U.S. Forest Service request. Only pure Wct were found in an area about three miles above the North Fork's mouth. Westslope cutthroat trout, brook trout Salvelinus fontinalis) and brook trout-bull trout hybrids were present in an area near the junction of North Fork Keeler Creek and Keeler Creek.

Evaluation of "Swamp-Out" Technique

The genetic survey and results of the "swamp-out" method of genetic restoration of westslope cutthroat trout populations in lakes in the South Fork Flathead River drainage is the subject matter for a Master's Degree program. It is expected that G. Kevin Sage, University of Montana Population Genetics Laboratory, will finish this thesis by fall, 1991. He is also planning on excerpting selected material and writing articles for publication in appropriate professional journals. The thesis subject matter will also include a description of external and internal parasites found in Rb, Yct, Wct and hybrids thereof.

This job progress report will only include general information on results of the "swamp-out" for three lakes and one outlet creek.

A genetic survey of many streams and most lakes within the South Fork Flathead River drainage was started in 1983 and completed in 1988. A review of the findings indicated that streams without headwater lakes had an excellent chance of containing pure Wct even if the stream had been planted with another trout species. On the other hand, streams with no planting history but with headwater lakes that had non-native or hybridized fish usually contained a hybridized trout population. This indicated that headwater lakes were the key factor regulating hybridized stream populations. Therefore, if headwater lakes could be restored to pure Wct then downstream waters might also be restored.

Chemical treatment of a large number of mountain lakes, was deemed impractical, economically unfeasible and controversial. Further review of the genetic survey data did indicate another method worthy of consideration. Analysis of fish collected from two lakes, Wildcat in the South Fork Flathead drainage and Red Meadow in the North Fork Flathead drainage showed near-pure Wct for Wildcat and pure Wct for Red Meadow. Both these lakes' fish populations had been classified as Yellowstone cutthroat trout by Department personnel in the late 1960s and early 1970s. Red Meadow Lake had been planted with about 300,000 Yct from 1932 through 1963 and with about 3,000 Wct annually in 1968, 1970, 1975 and 1980. Wildcat Lake had been planted with Yct in 1938, 1941 and 1953 and with Wct in 1965, 1978 and 1979. The histories of both Red Meadow and Wildcat lakes changing from Yct to Wct following planting with the latter species led to the formulation of the "swamp-out" theory.

The primary basis for this theory is that Wct is superior to other trouts within its native range and thus in relatively undisturbed habitat will replace non-native species or hybridized populations. Replacement is theorized to occur in the short term through competition and in the long term through interbreeding which will gradually dilute non-native genetic material to a non-detectable level. It is not known how long it will take interbreeding to dilute non-native genetic material to non-detection levels because it depends upon Wct continuing to breed with non-native and hybridized fish. In most cases the time period may be at least 20 years if a supply of Wct is available for breeding purposes. Both

the short- and long-term process require frequent plantings of Wct into the subject water.

Region One has been planting 22 lakes in the South Fork Flathead River drainage. Fourteen of these lakes are outside the Bob Marshall Wilderness and include two lakes with non-native trout populations and 12 with hybridized Wct populations. Thirteen of the lakes were planted annually starting in 1985 and terminating in 1989. One lake containing a hybrid swarm of Wct x Yct was first planted in 1986 and is scheduled for annual plants through 1994. Eight lakes within the Bob Marshall Wilderness have been planted annually starting in 1988 and scheduled to continue through 1994. Adjustments to the planting schedule will be made as genetic data becomes available.

Results of analysis of fish samples from three lakes and one outlet stream being subjected to the "swamp-out" are presented below.

Lower Bighawk Lake

Lower Bighawk Lakes lies in the Jewell Basin Special Management Area at an elevation of 6,000 feet, its size is 43 surface acres, has a maximum depth of 32 feet, standard conductance was 130 and reproductive capacity was judged adequate. The lake was likely barren until planted with Yct in 1941. The lake was planted with Wct in 1967, 1975, 1980 and 1984. A 48 fish sample caught in summer 1986 was determined to be 48 percent Yct and 52 percent Wct genetic material. Of the 48 fish analyzed, 41 were Wct x Yct, 5 were Wct and 2 were Yct.

Lower Bighawk Lake was planted with about 5,000 fingerling Wct yearly from 1985 through 1990. A 9 fish sample caught in summer 1990 was determined to contain 83 percent Wct and 17 percent Yct genes. Of the 49 fish analyzed, 19 were Wct, 30 were Wct x Yct hybrids and 1 was a Yct.

The changing genetic composition of trout in Lower Bighawk Lake may be a good example of the "swamp-out" working at two different rates; ie., from 1967 through 1986 and from 1986 through 1990. Planting of Wct on top of a Yct population in 1967, 1975, 1980 and 1984 resulted in a genetic mix of about 50:50. Planting in 1986 through 1990 appears to have accelerated the rate of replacement of Yct genetic material.

Continued heavy planting of low productivity lakes created a concern that growth rates would be affected. Scales for age and growth analysis were collected from both the 1986 and 1990 samples. These data are presented in Table 1. It is noted that sample sizes are small and might be biased.

Table 1. Age and growth of Wct and Wct x Yct, Lower Bighawk Lake, 1986 and 1990.

		Length in Inches at Annulus				
Year	Species	I	II	III	IV	V
1986	Wct	2.5(5)*	5.5(5)	7.7(2)	10.8(1)	
1990	Wct	2.3(14)	5.1(14)	8.1(11)	10.5(4)	11.9(1)
1986	Wct x Yct	2.8(38)	5.5(38)	8.4(34)	10.7(25)	12.2(8)
1990	Wct x Yct	2.7(24)	5.6(24)	8.2(16)	11.2(4)	

*Number in parenthesis is size of sample.

The growth data show little change between fish caught in 1986 versus those caught in 1990.

Blackfoot Lake

Blackfoot Lake is in the Jewell Basin Special Management Area at an elevation of 5,570 feet, it has 17 surface acres, a maximum depth of 22 feet, a standard conductance of 80 units and total dissolved solids value of 50 ppm. Reproductive capacity was judged as excellent consisting of two inlet streams. Prior to the 1986 genetic survey Blackfoot Lake had been planted with Yct in 1938 and Wct in 1965, 1984 and 1985. A 21 fish sample collected in 1986 included 5 Wct and 16 Rb. Genetic material in the sample was 24 percent Wct and 76 percent Rb. The presence of Rb in this lake clearly demonstrates that historic planting records are not totally accurate.

Blackfoot Lake was planted with about 2,000 fingerling Wct annually in 1986 through 1990. A 34 fish sample caught in summer 1990 was analyzed as 68 percent Wct and 32 percent Rb genetic material. The sample include 10 Rb, 22 Wct and 2 Rb x Wct hybrids, both of which were first generation crosses.

Scales for age and growth analysis were collected in both 1986 and 1990. These data are shown in Table 2 below.

Table 2. Age and growth of trout collected from Blackfoot Lake in 1986 and 1990.

		Length in Inches at Annulus					
Year	Species	I	II	III	IV	V	VI
1986	Rb	2.2(14)*	4.1(14)	6.9(14)	9.5(11)	11.7(7)	13.1(2)
1990	Rb	2.4(9)	5.4(9)	8.7(9)	11.0(3)	13.5(1)	
1990	Rb x Wct	3.1(2)	6.3(2)	8.8(1)			
1986	Wct	2.2(5)	4.6(4)	7.9(4)	10.2(3)		
1990	Wct	2.7(22)	5.6(22)	9.2(18)	11.7(3)		

*Number in parenthesis is sample size.

Growth of fish taken from Blackfoot Lake appears to be consistent within each years' sample regardless of the species but between years it appears that growth was much faster for the fish collected in 1990 compared to those collected in 1986. No explanation of this phenomena is proposed at this time.

Another interesting factor for the Blackfoot Lake fish population is the low number of hybrids in the 1990 sample. Two reasons are suspected and include method of catching fish and spawning conditions. Both the 1986 and 1990 samples were collected totally by angling. One or the other species might have been more susceptible to capture by this method. The two inlet spawning streams include one apparently of spring origin and one from surface water discharge. The spring-origin stream water temperature measured in August 1986 and 1990 was about 5° F warmer than the other inlet. It is the authors experience that rainbow trout spawn at a lower temperature than westslope cutthroat trout raising the possibility that each species may spawn in separate inlets and reducing the

chances for inter-breeding.

If the 1986 and 1990 fish samples were representative of the lake's trout population, it would appear that the Wct are outcompeting the Rb displacing the latter from the lake. Dilution of Rb genetic material by hybridization may not be much of a factor in restoration of this lake to Wct.

Tom Tom Lake

Tom Tom Lake lies a few miles south of the Jewell Basin Special Management area at an elevation of 5,825 feet. Its surface area is 10 acres, has a maximum depth of 33 feet and specific conductance was measured as 9 units. Fish reproductive capacity was judged as excellent consisting of two inlet streams. Prior to the 1986 genetic survey Tom Tom Lake had been planted one time with Yct in 1941. An 11 fish sample collected in 1985 were all Yellowstone cutthroat trout.

About 1,000 Wct fingerlings were planted in the lake annually between 1985 and 1989. Analysis of fish caught during the 1990 sampling was done using two methods and included visual identification of fish five inches long or longer (2 years old or older) with a sub-sample identified by electrophoresis and electrophoretic analysis of all fish less than five inches. All of the large fish were caught by hook and line while the smaller fish were caught by hook and line, M-80 firecrackers and using a small mesh baseball cap as a seine. The latter method was used to capture young-of-the-year fish from the inlet streams.

Fish taken from the lake or inlet streams were identified:

Fish two years old or older	31 Yct and 61 Wct
Fish one year old	1 Yct, 7 Wct and 4F1 hybrids
Fish 0 years old	0 Yct, 8 Wct and 3F1 hybrids

Scales for age and growth analysis were collected in both 1986 and 1990 from fish 5 inches long or longer.

These data are presented in Table 3 below.

Table 3. Age and growth of trout from Tom Tom Lake, 1986 and 1990.

		Length in Inches at Annulus				
Year	Species	I	II	III	IV	V
1985	Yct	2.9(11)*	5.3(11)	7.2(11)	8.7(6)	10.0(2)
1990	Yct	2.3(19)	4.3(19)	6.1(17)	7.8(12)	9.3(1)
1990	Wct	2.6(12)	4.9(12)	7.0(1)	8.4(2)	

*Number in parenthesis is size of sample.

It does appear that planting of Tom Tom Lake may have depressed growth rates of Yct between 1986 to 1990. The species make-up of the catch has materially changed indicating fair survival of the planted Wct. Some interbreeding of the two cutthroats has also taken place, first occurring in 1989.

Wheeler Creek outlet of Tom Tom Lake

Tom Tom Lake is the headwater lake of Wheeler Creek which drains into Hungry Horse Reservoir. This creek is divided into two areas by a barrier falls located about 4-5 miles downstream from Tom Tom Lake. Wheeler Creek below the falls

contains resident trout and is used for spawning and rearing by adfluvial trout from the reservoir. In 1984 about 1,500 feet of Wheeler Creek above the falls equally divided between areas about one mile and three miles below Tom Tom Lake were electrofished. Total catch was three fish and genetic analysis showed all three were Yellowstone cutthroat trout. The same areas were electrofished in 1990 and catch included 14 Yct, 2 Wct and 14 F1 hybrids. The larger catch in 1990 indicates increased escapement from Tom Tom Lake by mostly Yct and hybrids.

George Lake

George Lake is in the Bob Marshall Wilderness and lies at an elevation of 7,110 feet. It has an area of 119 acres, maximum depth is in excess of 200 feet, total dissolved solids were 40 ppm and standard conductance 74 units. A survey done in 1987 disclosed a genetic make-up of the fish sampled of 32 percent Wct material and 68 percent Yct. This lake has been planted with fingerling Wct annually starting in 1988.

G. Kevin Sage had to resample this lake in summer 1990 to collect fish for parasite counts. Electrophoretic analysis of the 25 fish sample disclosed that Yct genetic material had been reduced to 59 percent and Wct had increased to 41 percent. This increase in Wct genes was due to increased numbers of small Wct which indicates survival of the planted fish.

Genetic Evaluation of Inland Rainbow (Redband) Trout

Preliminary survey of some of the fish populations in the Yaak River drainage indicated that inland rainbow trout were present. Project personnel researched the Department's fish planting records for the Yaak River drainage and forwarded this information to the Kootenai National Forest fisheries biologist and University of Montana Population Genetics Laboratory. These three entities will coordinate an intensive genetic survey of the Yaak River drainage with special emphasis on inland rainbow trout.

It is also proposed that to better define that differences do exist between coastal and inland rainbow trout that the inland rainbow trout be called the redband trout.

RECOMMENDATIONS

Future testing of fish populations being subjected to the "swamp-out" method of purification has to be done but on an orderly basis. It is proposed that the following waters be sampled in fiscal year 1992.

1. Sunburst, Woodward and Pyramid lakes in the Bob Marshall Wilderness - These lakes were first planted with Wct in 1988 and have been planted annually since then. All three lakes have been planted using horses. Sunburst has been planted with eyed eggs only days away from hatching while Woodward and Pyramid have been planted with fry. All three lakes will be planted in summer 1991 and it is proposed that the planting crew extend their trip so that they have sufficient time to catch trout for genetic analysis.

2. Blackfoot Lake - Blackfoot Lake should be resampled again in 1991 using only gill nets. Spawning inlets should be sampled to capture fry and yearling fish. Capture of yearling and younger fish can best be done using a seine, explosives or possibly chemicals in the creeks.

3. Black Lake - A large sample of fish of all sizes should be captured from this lake. Hook and line success is very erratic in this lake so gill nets will have to be used.

4. Margaret Lake - Analysis of fish collected in 1986 disclosed only a slight amount of Yct genetic material. This lake should be resampled to ascertain its "Wct for Management Purposes" status.

5. Handkerchief Lake - This lake has been planted twice with Wct since 1986 and does lie downstream of four headwater lakes that have been planted heavily since 1986. The 1986 survey disclosed a population of Wct and hybrids of Wct, Rb and Yct. Resampling should be done to detect genetic changes that may be occurring.

6. Wheeler Creek below the falls - Genetic samples were collected in 1983 and 1984 which showed low levels of Wct x Yct hybridization. This population should be resampled since it is apparent that drift out of Tom Tom Lake is occurring.

Collection of fish samples for initial genetic analysis will not be a purpose of this project in FY92. With no graduate student to do the electrophoretic analysis, samples will have to be analyzed within the constraints of the Department's contract with University of Montana Population Genetics Laboratory. It is anticipated that this project's proposed resampling added to the Laboratory's normal workload will nearly fulfill this contract.

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Date: July 8, 1991

Key words: genetic analysis, westslope cutthroat trout, restoration of westslope cutthroat trout

Waters referred to:

Blackfoot Lake	08-8180	Fitzsimmons Creek	07-1500
George Lake	08-8620	N.F. Keeler Creek	11-4680
Hall Lake	07-6600	Wheeler Creek	08-7720
Lower Bighawk Lake	08-9170		
Lupine Lake	07-7640		
Tom Tom Lake	08-9860		
Weasel Lake	11-9970		

Ref: F46R4SPP.91