F-78-R-5/6
Region 3

FISHERIES INVESTIGATIONS IN THE YELLOWSTONE AND SHIELDS RIVER BASINS, PARK COUNTY, MONTANA

ANNUAL REPORT FOR 1999

Federal Aid Project F-78-R-~~4~~ 5/6

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ABSTRACT

Estimates of rainbow, brown, and cutthroat trout abundance in the Corwin Springs, Mill Creek Bridge, and Springdale sections of the Yellowstone river were similar in 1999 to estimates from previous years. Fish numbers near Livingston increased. In the Ninth Street section, rainbow trout larger than seven inches were 975 fish/mile this year compared to 594 fish/mile in 1998.

Mountain whitefish showed a pattern of decreasing abundance in the Yellowstone as the river flows east from Livingston. Densities of about 14,000 fish/mile in sections south of Livingston gradually declined to less than 3,000 fish/mile near Springdale.

Samples of Yellowstone cutthroat trout from the Yellowstone river were 83 to 97 percent unhybridized fish when tested for hybridization with rainbow trout.

Yellowstone cutthroat trout sampled from two sections of Mill creek where log jams and pools had been installed to enhance fish habitat were found at densities similar to those documented before the projects had been installed. Flood damage apparently compromised potential benefits.

Mountain whitefish abundance in the Shields river was estimated to be less than 500 fish/mile in sections north of Wilsall. Abundance was about 1,300 fish/mile near Clyde Park. Brown trout abundance was much less variable: about 140 fish/mile were found in all sections where mountain whitefish had also been sampled.

Yellowstone cutthroat trout occurred at densities from 280 to 958 fish/mile in east valley tributaries of the Shield river. Size structure suggests well established, self-sustaining, resident populations.

The average size of rainbow trout in spring gillnet catches at Dailey lake was 15.0 inches this year. Walleye also averaged 15.0 inches. Yellow perch were 6.3 inches, much smaller than typical the last few years.

The 1998 creel survey at Dailey lake showed that most people wanted to catch yellow perch. Seventy-one (71) percent of anglers expressing a preference fished for yellow perch. By comparison, 16 percent of anglers fished for rainbow trout, and 13 percent fished for walleye. Yellow perch comprised 95 percent of the total fish harvest in 1998.

OBJECTIVES

Funds for this project are provided by grants from the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777k) supporting the Montana Statewide Fisheries Management Program. This program consists of two elements: Fisheries Management in Montana, and Statewide Program Coordination. The Fisheries Management element includes four activities, each with associated objectives:

State Program Activities and Objectives

1. Survey and Inventory
To survey and monitor the characteristics and trends of fish populations, angler harvest and preferences, and to assess habitat conditions in selected waters.

2. Fish Population Management
To implement fish stocking programs and/or fish eradication actions to maintain fish populations at levels consistent with habitat conditions and other limiting factors.

3. Technical Guidance
To review projects by government agencies and private parties which have the potential to affect fisheries resources, provide technical advice or decisions to mitigate effects on these resources, and provide landowners and other private parties with technical advice and information to sustain and enhance fisheries resources.

4. Aquatic Education
To enhance the public's understanding, awareness and support of the state's fishery and aquatic resources and to assist young people to develop angling skills and to appreciate the aquatic environment.

Statewide activities and objectives are addressed locally by ongoing fisheries investigations and management activities intended to enhance aquatic habitats and recreational fisheries in the upper Yellowstone and Shields river basins.

Local Project Objectives

In fiscal year 1999 (July 1, 1998 to June 30, 1999), project objectives for state project number 3301 (the Yellowstone and Shields drainage areas) were identical to the statewide objectives listed above. Project objectives are intended to guide continuing efforts to maintain and enhance local fisheries. In support of these efforts, the following data collections, compilations, and analyses are reported here under separate headings:

A. Estimates of rainbow, brown, and cutthroat trout abundance in four sections of the Yellowstone river based on spring sampling in 1999.

B. Estimates of mountain whitefish abundance in five sections of the Yellowstone river based on spring sampling in 1999.

C. Genetic tests of Yellowstone cutthroat trout collected from the Yellowstone river in 1998.

D. Estimates of Yellowstone cutthroat abundance in two sections of Mill creek based on fall sampling in 1999.

E. Recent fish sampling in the Shields river drainage.

F. Summary of 1999 spring gillnet catches at Dailey lake.

G. Summary of creel survey information from Dailey Lake collected from October through December 1998.

State survey, inventory, and fish population management objectives are addressed under headings A through G. Technical guidance and aquatic education objectives are addressed on an ongoing basis by meetings with various angler groups, school groups, journalists, and the public. In fiscal year 1999 these meetings included participation in a Governor's task force investigating management issues affecting the upper Yellowstone river, other committee and public sessions concerning fishing access site developments and related river concerns, educational seminars for local elementary school children, and meetings with local angling groups to discuss a variety of fisheries topics. Landowner contacts and consultations occurred routinely each month in conjunction with administration of the Montana Natural Streambed and Land Preservation Act and the Montana Stream Protection Act.

PROCEDURES

A. Estimates of rainbow, brown, and cutthroat trout abundance in four sections of the Yellowstone river based on spring sampling in 1999.

This spring we sampled trout abundance in four sections of the Yellowstone river that are normally examined as part of routine fisheries surveys (Table 1; Figure 1). Section lengths were re-measured this year at all locations to account for changes associated with record high spring discharges in 1996 and 1997, and to document channel adjustments that regularly occur from more typical river processes over time.

Table 1. Survey sections where trout abundance was sampled from the Yellowstone river in 1999.

Section name	Survey date	Length (ft)	Approximate location /1		
Corwin Springs	04/08/99	24,552	upper boundary	North West	45 06′ 500″ 110 47′ 371″
			lower boundary	North West	45 09′ 779″ 110 50′ 230″
Mill Creek Bridge	04/06/99	26,664	upper boundary	North West	45 25′ 167″ 110 38′ 523″
			lower boundary	North West	45 27′ 415″ 110 37′ 505″
Ninth Street	03/31/99	11,814	upper boundary	North West	45 39′ 290″ 110 33′ 009″
			lower boundary	North West	45 40′ 738″ 110 32′ 092″
Springdale	03/29/99	20,064	upper boundary	North West	45 41′ 697″ 110 16′ 815″
			lower boundary	North West	45 43′ 730″ 110 14′ 336″

1. Latitude and longitude (degrees, minutes, seconds).

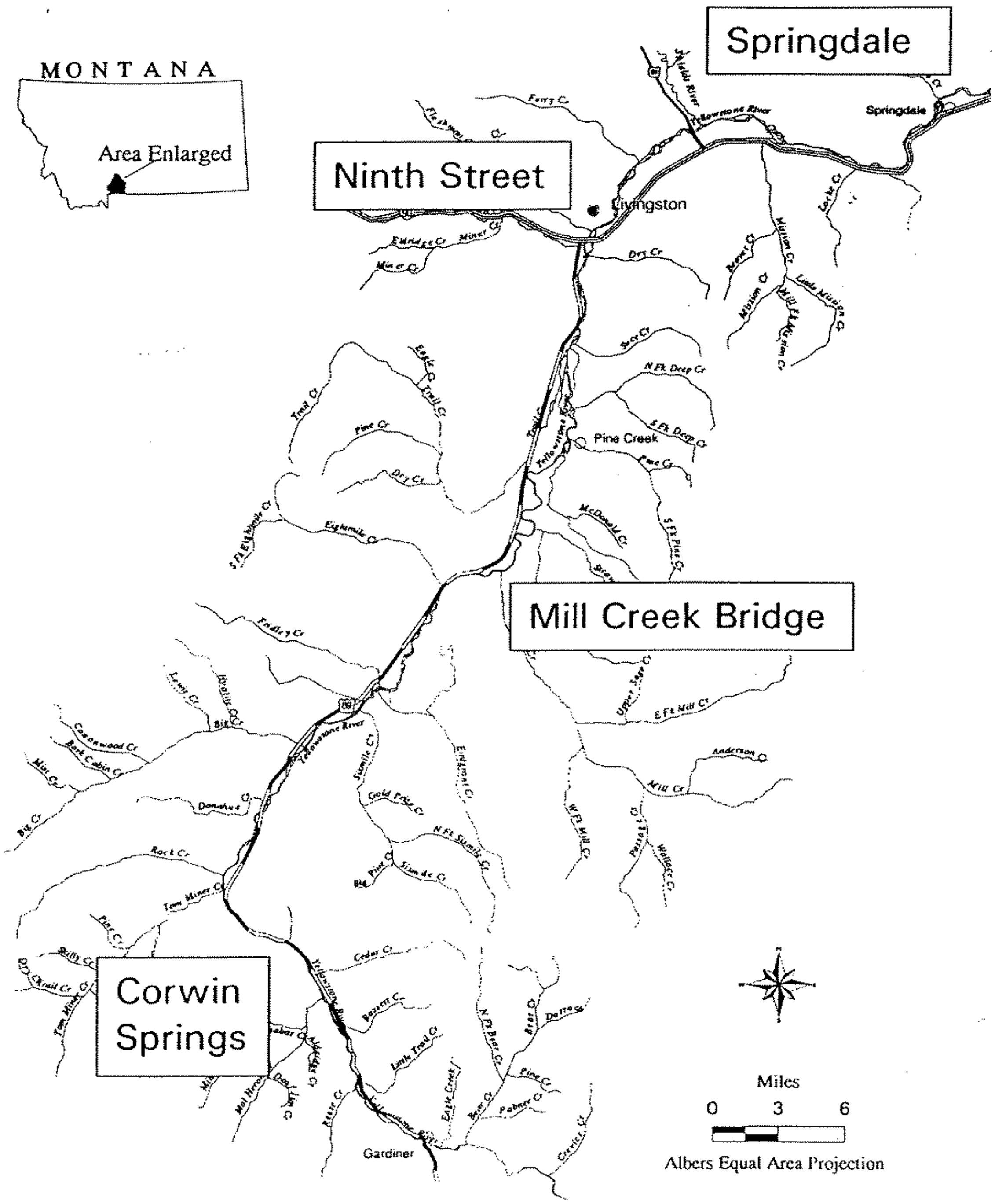

Figure 1. Upper Yellowstone river drainage showing four areas where trout abundance was sampled from the Yellowstone river in 1999.

Fish were sampled with electrofishing gear mounted on an aluminum-hulled jet boat. This gear included a 5,000-watt generator and a Coffelt Model VVP-15 rectifying unit. Anodes were metal hoops with stainless steel droppers suspended from twin booms at the bow of the boat. The boat hull served as the cathode.

Fish were collected in live cars, identified [A], measured to the nearest 0.1inch [B], and weighed to the nearest 0.01 pound. Trout were marked with fin clips and returned to the river after marking. Recapture sampling occurred about two weeks later in each section. Fish abundance was estimated using a log-likelihood model available in software from Montana Fish, Wildlife and Parks (FWP; Anon. 1994). Estimates were evaluated for reliability at alpha = 0.05. Fish were separated into one-inch length groups for all abundance analyses.

B. Estimates of mountain whitefish abundance in five sections of the Yellowstone river based on spring sampling in 1999.

This spring we sampled mountain whitefish abundance in five sections of the Yellowstone river. Four of these samples were collected from river sections where we also sampled trout abundance (see part A, above). The fifth sample was collected near Mallard's Rest (Table 2; Figure 2) in a section of the river used to monitor mountain whitefish abundance regularly (e.g., Shepard 1992), but less frequently than we sample trout abundance at other locations

Table 2. Survey sections where mountain whitefish abundance was sampled from the Yellowstone river in 1999.

Section name	Survey date	Length (ft)	Approximate location /1		
Corwin Springs	04/08/99	3,102	upper boundary	North West	45 06' 500" 110 47' 371"
			lower boundary	North West	45 06' 901" 110 47' 876"
Mill Creek Bridge	04/06/99	3,168	upper boundary	North West	45 25' 167" 110 38' 523"
			lower boundary	North West	45 25' 589" 110 37' 886"

1. Latitude and longitude (degrees, minutes, seconds).

(Continued on page 7)

A. Common names for fish are used in this report. Scientific names are listed in Appendix A.

B. All fish lengths are total lengths (TL).

Table 2. Survey sections where mountain whitefish abundance was sampled from the Yellowstone river in 1999. (Continued from page 6).

Section name	Survey date	Length (ft)	Approximate location /1		
Mallard's Rest	04/07/99	7,128	upper boundary	North	45 29' 094"
				West	110 37' 248"
			lower boundary	North	45 29' 750"
				West	110 37' 962"
Ninth Street	03/31/99	6,204	upper boundary	North	45 39' 290"
				West	110 33' 009"
			lower boundary	North	45 39' 924"
				West	110 32' 372"
Springdale	03/29/99	4,422	upper boundary	North	45 41' 697"
				West	110 16' 815"
			lower boundary	North	45 41' 900"
				West	110 15' 808"

1. Latitude and longitude (degrees, minutes, seconds).

Fish handling and marking procedures were identical to those used to sample trout, described in part A, above . Fish were sampled with electrofishing gear mounted on an aluminum-hulled jet boat. This gear included a 5,000-watt generator and a Coffelt Model VVP-15 rectifying unit. Anodes were metal hoops with stainless steel droppers suspended from twin booms at the bow of the boat. The boat hull served as the cathode.

Fish were collected in live cars, identified, measured to the nearest 0.1inch, and weighed to the nearest 0.01 pound. Mountain whitefish were marked with fin clips and returned to the river after marking. Recapture sampling occurred about two weeks later in each section.

Mountain whitefish abundance was analyzed using MR4, a computer program developed by FWP for processing electrofishing records (Anon. 1994). Fish numbers were estimated using the log-likelihood model.

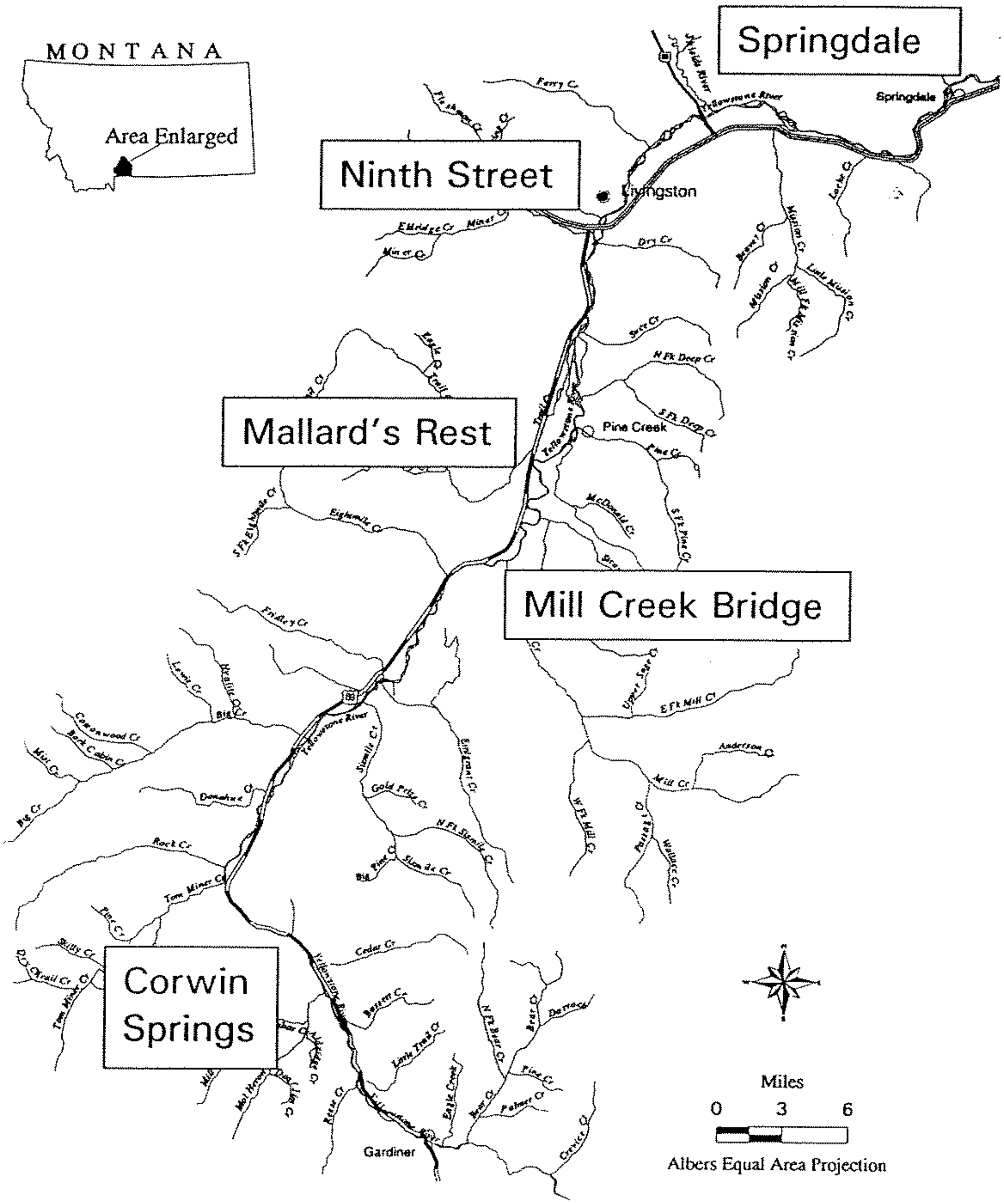

Figure 2. Upper Yellowstone river drainage showing five areas where mountain whitefish abundance was sampled from the Yellowstone river in 1999.

C. Genetic tests of Yellowstone cutthroat trout collected from the Yellowstone river in 1998.

Yellowstone cutthroat trout were collected at three locations in the Yellowstone river during spring sampling in 1998. These fish were sacrificed to test for their degree of hybridization with rainbow trout. Our intention was to collect large samples at different locations from which statistically meaningful information about their genetic status and probability of hybridization could be determined.

Fish were collected with electrofishing gear mounted on an aluminum-hulled jet boat. This gear included a 5,000-watt generator and a Coffelt Model VVP-15 rectifying unit. Anodes were metal hoops with stainless steel droppers suspended from twin booms at the bow of the boat. The boat hull served as the cathode.

Fish were collected during recapture sampling of trout in the Corwin Springs, Mill Creek Bridge, and Springdale sections of the Yellowstone river (see section A above, Figure 1; Table 3). Fish were held in live cars after sampling. A sub-sample of fish was randomly taken from all fish identified as Yellowstone cutthroat trout. These fish were frozen before being delivered to the Fish Genetics Laboratory of the University of Montana, Missoula, where genetic tests were completed.

Table 3. Areas from which Yellowstone cutthroat trout were collected from the Yellowstone river in 1998 to test for hybridization with rainbow trout.

Section name	Approximate location /1			Collection date	Sample size
Corwin Springs	upper boundary	North West	45 06' 500" 110 47' 371"	05/01/98	30
	lower boundary	North West	45 09' 779" 110 50' 230"		
Mill Creek Bridge	upper boundary	North West	45 25' 167" 110 38' 523"	04/30/98	36
	lower boundary	North West	45 27' 415" 110 37' 505"		
Springdale	upper boundary	North West	45 41' 697" 110 16' 815"	04/27/98	20
	lower boundary	North West	45 43' 730" 110 14' 336"		

1. Latitude and longitude (degrees, minutes, seconds).

D. Estimates of Yellowstone cutthroat trout abundance in two sections of Mill creek based on fall sampling in 1999.

Two sections of Mill creek were sampled this fall to determine cutthroat trout abundance in areas where stream improvement projects had been installed by Forest Service personnel. These projects, built in 1993, included placement of large woody debris and the construction of pools to improve habitat conditions for fish. Some of the installations had to be rebuilt in 1996 to repair damage caused by that year's exceptionally large spring runoff (Tohtz 1996a).

Fish monitoring in the treated areas of Mill creek was begun in 1990, before habitat treatments were completed (e.g., Shepard 1993a). This monitoring has been continued periodically (Tohtz 1996a; Tohtz 1996b) to determine the efficacy of the projects, and their effect on local fish populations. This year we sampled the "Pool" and "Logjam" treatment areas, using section boundaries established in August 1996 (Tohtz 1996b; Table 4; Figure 3). We sampled fish using removal techniques to estimate abundance, rather than repeat the mark-recapture sampling used in other surveys. Our change of technique was intended to control high variances of previous surveys, and to better characterize fish densities in these relatively short stream reaches.

Table 4. Survey sections where Yellowstone cutthroat trout abundance was sampled from Mill creek in 1999.

Section name	Survey date	Section length (ft)	Approximate location			
Pool	10/19/99	962	Upper Boundary	North West	45 110	17′ 010″ 30′ 707″
			Lower Boundary	North West	45 110	17′ 098″ 30′ 895″
Logjam	10/18/99	1,935	Upper Boundary	North West	45 110	17′ 240″ 31′ 346″
			Lower Boundary	North West	45 110	17′ 260″ 31′ 769″

1. Latitude and longitude (degrees, minutes, seconds).

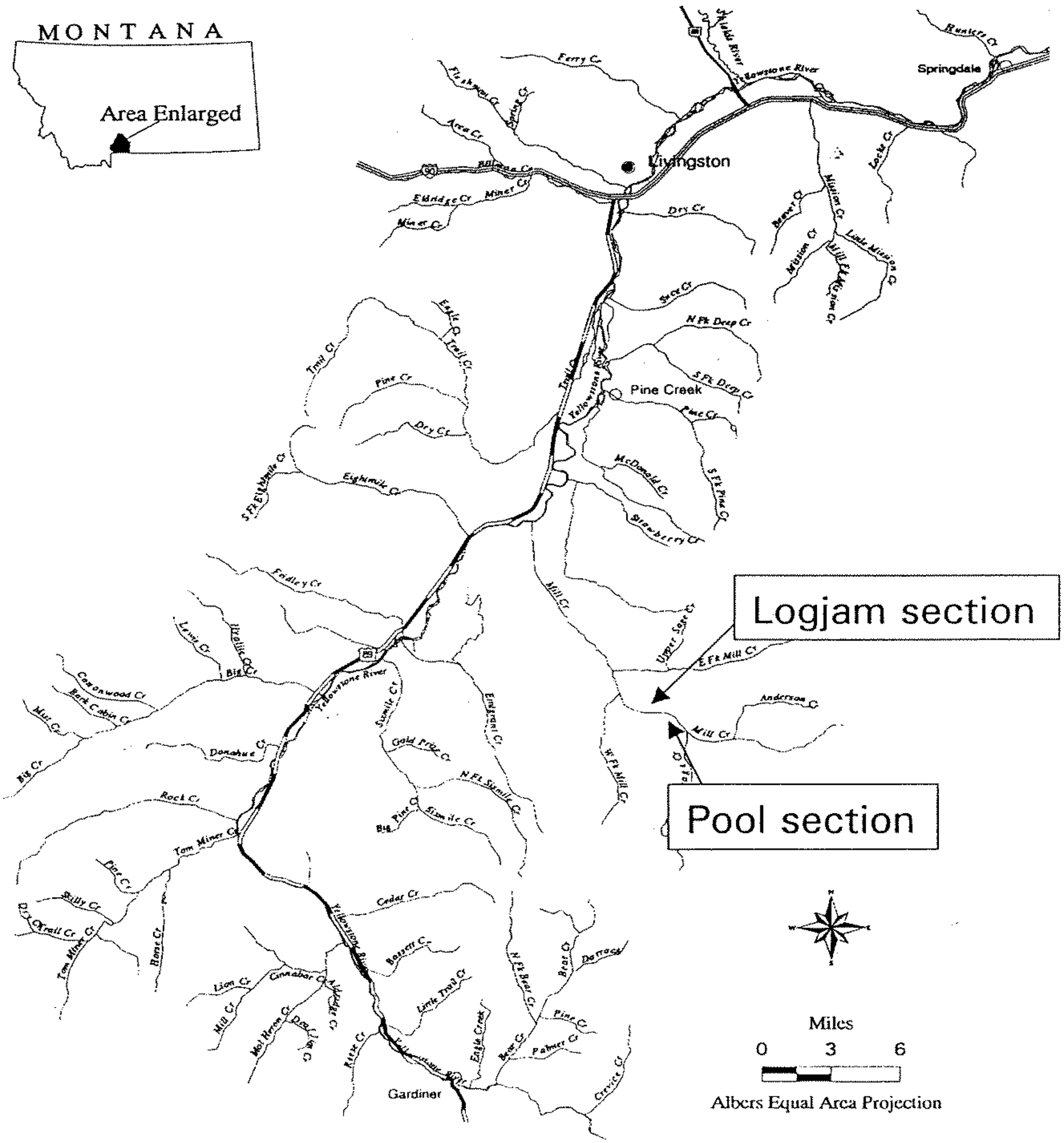

Figure 3. Mill creek drainage showing two areas where Yellowstone cutthroat trout abundance was sampled in 1999.

Fish were sampled with electrofishing gear mounted on a small utility boat. This gear included a 4,500-watt generator and a Leach direct current rectifying unit. The cathode was a steel mesh attached to the side of the boat; the anode was a single hand held (mobile) electrode connected to the power source by about 30 feet of cable.

In all cases fish were collected in live cars, identified, measured to the nearest 0.1 inch, and weighed to the nearest 0.01 pound. Trout collected in each pass through the section were held in live cars separately until all sampling was completed. All fish were returned to the stream after data collections were completed.

Fish abundance was estimated using MicroFish 3.0 (VanDeventor and Platts 1985), a computer software package developed especially to process electrofishing records obtained by removal methods.

E. Recent fish sampling in the Shields river drainage.

This year we sampled fish in one established section (the Todd section near Clyde Park) and three new sections of the Shields river. We also sampled fish at new locations in six tributaries of the Shields river that flow into the main river from its east valley drainage (Table 5; Figure 4).

Table 5. Survey sections in the Shields river drainage sampled in 1999.

Stream name	Section name	Length (feet)	Location /1
Shields river	Todd	7,500	T2N, R09E, S33
Shields river	Coral	1,040	T4N, R09E, S04
Shields river	Tomschin	1,125	T4N, R09E, S29
Shields river	Hamilton Road	< 1,000 /2	T4N, R09E, S25
Porcupine creek	Westling	800	T4N, R09E, S11
North Fork Elk creek	North Fork Elk	< 1,000 /2	T4N, R09E, S13
South Fork Elk creek	Lobaugh	500	T4N, R09E, S25
Daisy Dean creek	Ned	< 1,000 /2	T3S, R09E, S12
Horse creek	Goffena	750	T3N, R09E, S23
Cottonwood creek	Hunter	1,113	T2N, R10E, S07

1. Township, Range, Section
2. Section was not sampled quantitatively.

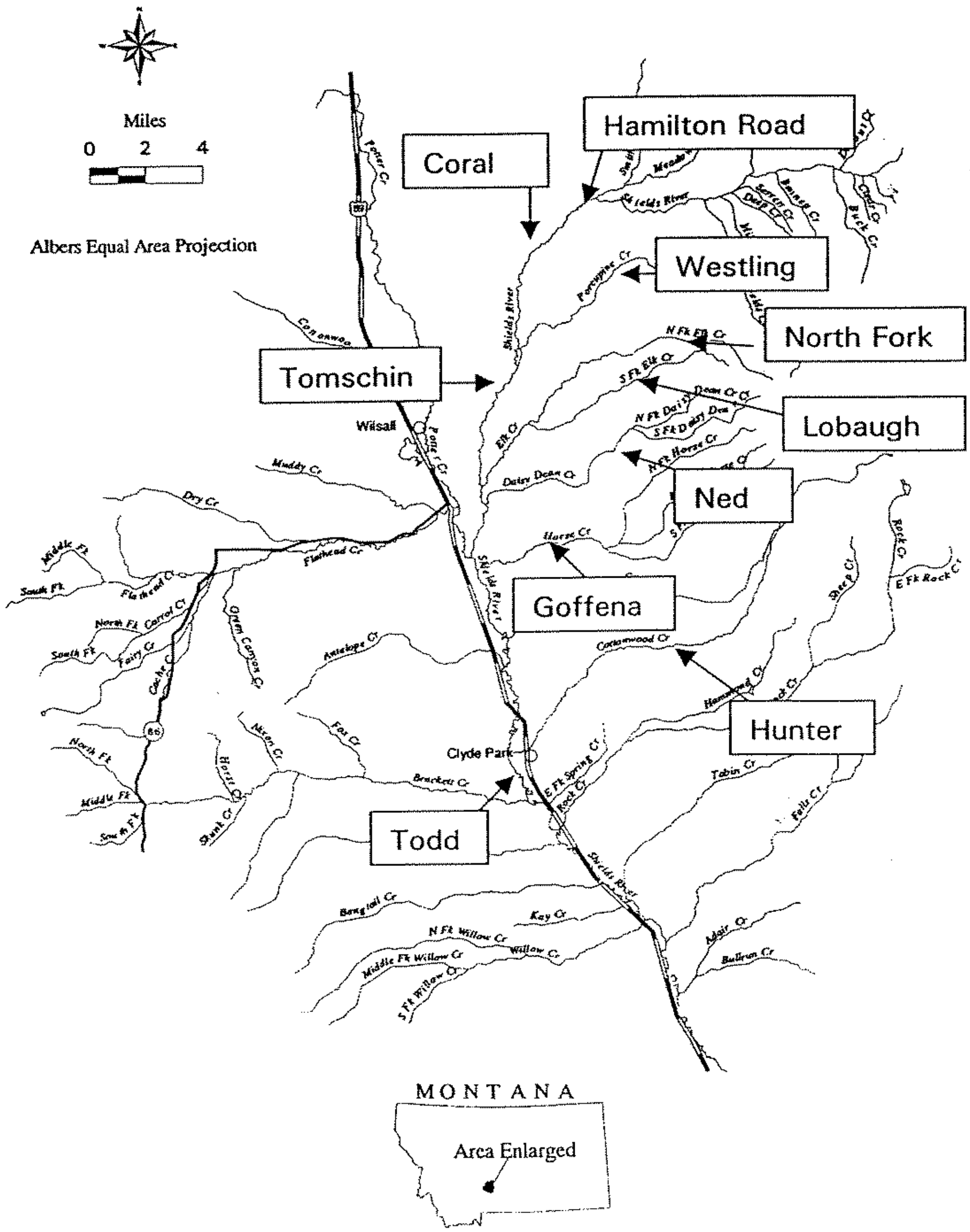

Figure 4. Shields river drainage showing ten locations where fish were sampled from the Shields river and some of its east valley tributaries in 1999.

Our fieldwork involved sampling established river sections and conducting new surveys to better understand fish distribution and abundance in the Shields river drainage. Most of this work was concentrated in an area of the drainage where aerial reconnaissance of stream conditions had been completed in support of a local watershed association (Appendix B). Our specific sampling objectives varied, depending on location. In some places we attempted to develop population estimates from electrofishing capture records. At others we less rigorously documented species composition, or perhaps documented the presence of certain species, especially Yellowstone cutthroat trout. Where possible we also collected Yellowstone cutthroat trout to test their genetic status from areas that had not been sampled before (Table 6).

Table 6. Fisheries investigations in the Shields river drainage in 1999.

Stream name	Section name	Survey date	Type of survey/ procedure	Number of fish for genetics tests /1
Shields river	Todd	03/15/99	Mark-recapture estimate	13
Shields river	Coral	03/23/99	Removal estimate	5
Shields river	Tomschin	03/16/99	Removal estimate	3
Shields river	Hamilton Road	03/18/99	Qualitative inventory	2
Porcupine creek	Westling	05/05/99	Removal estimate	34
N.F. Elk creek	North Fork Elk	07/06/99	Qualitative inventory	44
S.F. Elk creek	Lobaugh	07/06/99	Removal estimate	29
Daisy Dean creek	Ned	10/21/99	Qualitative inventory	25
Horse creek	Goffena	10/13/99	Removal estimate	30
Cottonwood creek	Hunter	03/22/99	Removal estimate	32

1. Yellowstone cutthroat trout. All fish were sent to the Fish Genetics Laboratory, University of Montana, Missoula, to test for hybridization with rainbow trout. Results are not yet available.

Fish were sampled with electrofishing gear mounted on a drift boat, mounted on a small utility boat, or mounted on a backpack frame, depending on the size of stream and flow conditions encountered when sampling was conducted. Boat mounted gear included a 4,500-watt generator and a Leach direct current rectifying unit. Depending on which boat was used, the cathode was a steel plate mounted on the bottom of the boat, or a steel mesh attached to the side of the boat. The anode was a single hand held (mobile) electrode connected to the power source by about 30 feet of cable.

Backpack mounted gear included a 350 watt generator and a Coffelt Mark 10 rectifying unit. The cathode was a trailed steel cable; the anode was a single hand held electrode attached to the power source by about six feet of cable.

In all cases fish were collected in live cars, identified, measured to the nearest 0.1 inch, and weighed to the nearest 0.01 pound. Where abundance estimates were attempted, fish were either marked and released for later sampling, or collected and held during multiple-pass surveys through a section. In the latter case, all fish would be held in live cars separately until sampling was completed. In all cases fish were returned to the stream after data collections were completed.

Fish abundance was estimated using a log-likelihood model available in software from FWP (Anon. 1994), or with MicroFish 3.0 (VanDeventor and Platts 1985), a computer software package developed especially to process electrofishing records obtained by removal methods.

F. Summary of 1999 spring gillnet catches at Dailey lake.

Gillnet sampling in 1999 mimicked previous spring sampling: a single overnight set using two floating and two sinking experimental gillnets (Shepard 1993b) determined the entire sample. Results from the 1999 sample are compared to earlier gillnet catches.

G. Summary of creel survey information from Dailey lake collected from October through December 1998.

A creel survey of anglers fishing at Dailey lake was begun in January 1998 to determine catch rates for sport fish, estimates of harvest, and estimates of angling pressure. The survey was completed in December 1998. Results here supplement information reported for the January through October 1998 portions of the creel survey (Tohtz 1998). For convenience, the entire survey results are repeated in this report.

The creel survey was stratified by day type: weekends and holidays were combined; regular weekdays were treated separately. Survey effort was ten days each month (Table 7), each day selected at random in approximate proportion to the monthly occurrence of different day types (weekdays, or weekends and holidays). Surveys were conducted only during daylight hours.

Table 7. Days on which creel observations and angler interviews were conducted at Dailey lake from January through December 1998. All dates were randomly selected.

Month	Calendar date									
January	03,	06,	07,	15,	18,	19,	22,	29,	30,	31
February	02,	04,	07,	08,	11,	12,	13,	15,	17,	22
March	02,	06,	07,	08,	11,	12,	13,	14,	16,	22
April	01,	02,	11,	14,	15,	18,	20,	24,	25,	26
May	01,	02,	06,	08,	09,	15,	18,	24,	27,	31
June	01,	03,	04,	07,	14,	15,	17,	20,	21,	22
July	08,	11,	12,	15,	17,	19,	22,	26,	28,	31
August	01,	02,	06,	11,	16,	18,	22,	26,	28,	31
September	02,	09,	10,	12,	20,	23,	25,	26,	27,	29
October	02,	04,	11,	17,	21,	22,	24,	26,	29,	30
November	05,	06,	08,	12,	15,	16,	17,	26,	29,	30
December	03,	05,	06,	08,	13,	16,	20,	22,	24,	29

To avoid bias in angler counts and catch rates that could occur because lake use and fish feeding behavior is different at different times of the day, each day was divided into three equal-length observation periods (morning, mid-day, and evening). One of these periods was chosen at random for angler interviews and counts each survey day (Table 8). The length of each observation period was adjusted for changes in available light that occur throughout the year (Tohtz 1998).

Four angler counts were made during each observation period: the first at the start of the period; the remaining three at randomly selected times within the period. The largest number of anglers observed was presumed to represent typical angler use that day.

Estimates of angling pressure, fish catch, and fish harvest were developed using database and spreadsheet software programs on personal computers.

Table 8. Number of weekdays, weekends and holidays, and periods of day when creel observations and angler interviews were conducted at Dailey lake from January through December 1998.

	Totals		Surveyed					
			weekdays			weekend/holidays		
Month	Weekdays	weekend/holidays	(am)	[md]	pm	(am)	[md]	pm
January	20	11	(3)	[2]	1	(3)	[2]	1
February	18	10	(3)	[1]	2	(1)	[0]	3
March	21	10	(2)	[3]	1	(1)	[1]	2
April	21	9	(3)	[1]	2	(1)	[2]	1
May	20	11	(2)	[2]	2	(0)	[2]	2
June	22	8	(3)	[2]	1	(3)	[0]	1
July	23	8	(3)	[2]	1	(1)	[2]	1
August	21	10	(3)	[2]	1	(0)	[2]	2
September	21	9	(3)	[1]	2	(1)	[2]	1
October	21	10	(1)	[2]	3	(2)	[2]	0
November	18	12	(2)	[1]	3	(3)	[0]	1
December	22	9	(1)	[4]	1	(1)	[1]	2

RESULTS AND DISCUSSION

A. Estimates of rainbow, brown, and cutthroat trout abundance in four sections of the Yellowstone river based on spring sampling in 1999.

Data for rainbow, brown, and cutthroat trout from each of the sections sampled in 1999 fit the log-likelihood model well (Table 9). This year we were able to reliably estimate the abundance of all three species at each survey location, including the Ninth Street section, where cutthroat and brown trout densities have been too low recently for us to produce this type of estimate (e.g., Tohtz 1997; Tohtz 1998).

Table 9. Trout/mile in four sections of the Yellowstone river based on spring sampling in 1999. Estimates are for fish seven inches (TL) or longer.

Section (mark date):			Overall model			Pooled model		
Fish species	N	SD	DF	Chi-square	P	DF	Chi-square	P /1
Corwin Springs (April 8):								
Rainbow trout	384	99	6	3.00	0.81	5	1.32	0.93
Brown trout	159	56	7	12.01	0.10	4	8.29	0.08
Cutthroat trout	542	90	6	10.02	0.12	6	10.02	0.12
Mill Creek Bridge (April 6):								
Rainbow trout	220	45	7	8.45	0.29	5	5.94	0.31
Brown trout	170	48	9	8.64	0.47	3	5.48	0.14
Cutthroat trout	339	67	5	10.15	0.07	5	10.15	0.07
Ninth Street (March 31):								
Rainbow trout	975	118	6	9.50	0.15	6	9.50	0.15
Brown trout	280	55	8	11.02	0.20	4	7.02	0.14
Cutthroat trout	167	54	1	2.00	0.16	----------	----------	---------- /2
Springdale (March 29):								
Rainbow trout	408	109	7	13.44	0.06	7	13.44	0.06
Brown trout	246	85	8	4.46	0.81	4	1.92	0.75
Cutthroat trout	148	42	5	8.94	0.11	4	8.76	0.07

1. N = estimated number; SD = standard deviation; DF = degrees of freedom; P = probability value.
2. Insufficient DF for this model.

Rainbow and cutthroat trout abundance in the Corwin Springs and Mill Creek Bridge sections this year was similar to estimates from previous years (Figure 5; Figure 6). The abundance of cutthroat trout especially suggests very good recruitment in these areas following the large floods of 1996 and 1997.

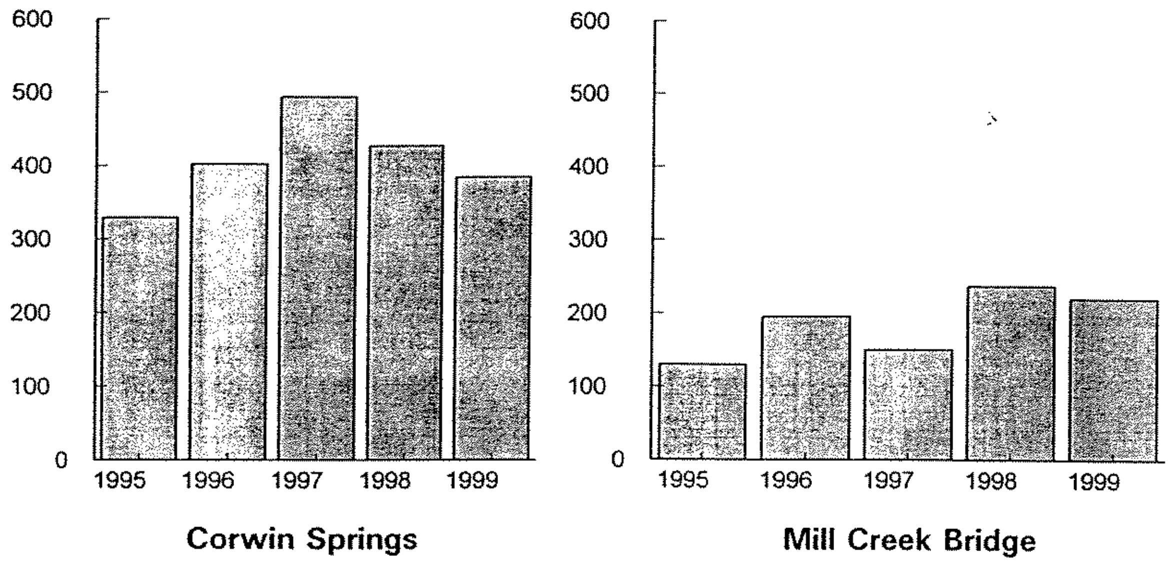

Figure 5. Rainbow trout abundance in the Corwin Springs and Mill Creek Bridge sections of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scales are fish/mile.

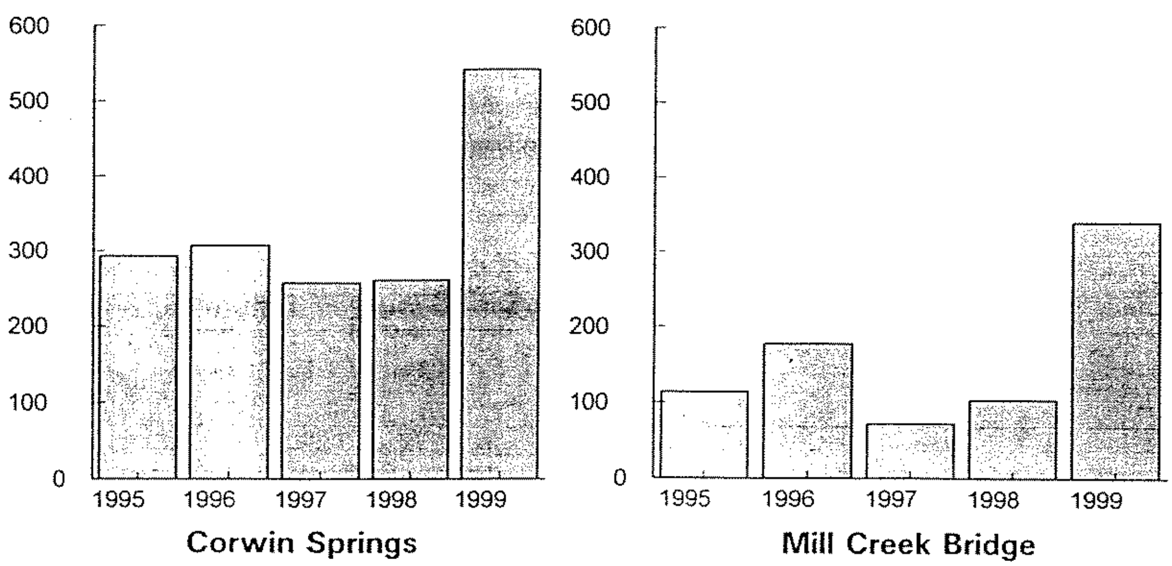

Figure 6. Yellowstone cutthroat trout abundance in the Corwin Springs and Mill Creek Bridge sections of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scales are fish/mile.

Brown trout abundance in the Corwin Springs section this year was similar to last year's estimate (Figure 7). Brown trout abundance in the Mill Creek Bridge section was less than last year's unusually large estimate (Figure 7). Our result this year

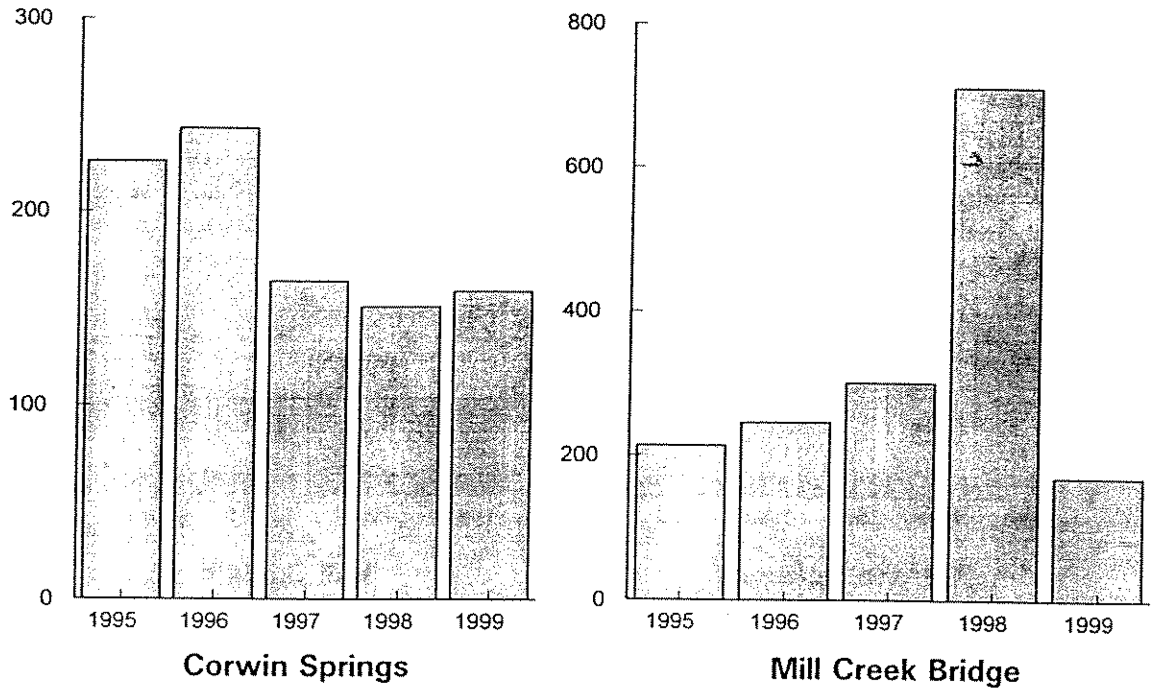

Figure 7. Brown trout abundance in the Corwin Springs and Mill Creek Bridge sections of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scales are fish/mile. Vertical scales differ.

reinforces the idea that last year's large estimate was an artifact of sampling, rather than an actual population increase. This likelihood was suggested in an earlier report (Tohtz 1998).

Cutthroat, rainbow, and brown trout abundance in the Springdale section was similar in 1999 to estimates from previous years (Figure 8; Figure 9). Fish numbers remain stable at this location.

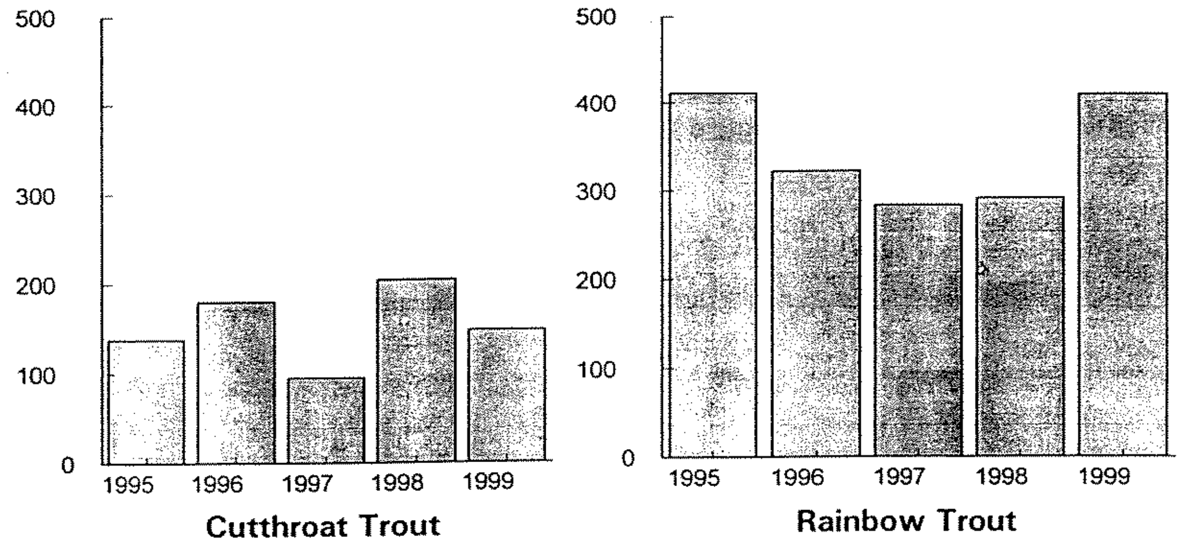

Figure 8. Yellowstone cutthroat and rainbow trout abundance in the Springdale section of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scales are fish/mile.

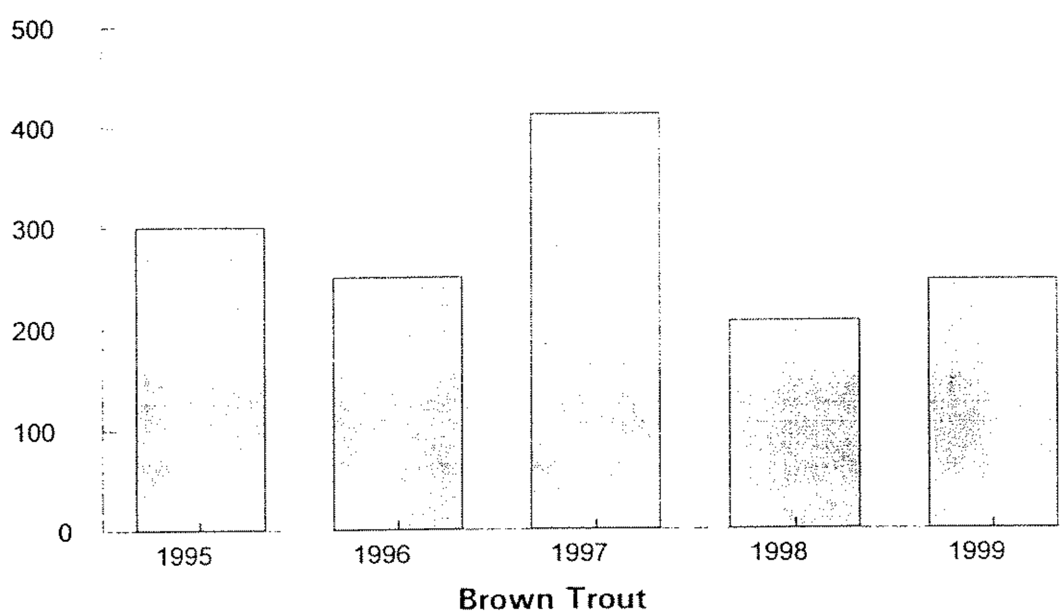

Figure 9. Brown trout abundance in the Springdale section of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scale is fish/mile.

Cutthroat and brown trout in the Ninth Street section were captured in adequate numbers this year to produce reliable population estimates using mark-recapture techniques. Their abundance was similar to previous years for which these types of estimates are available (Figure 10).

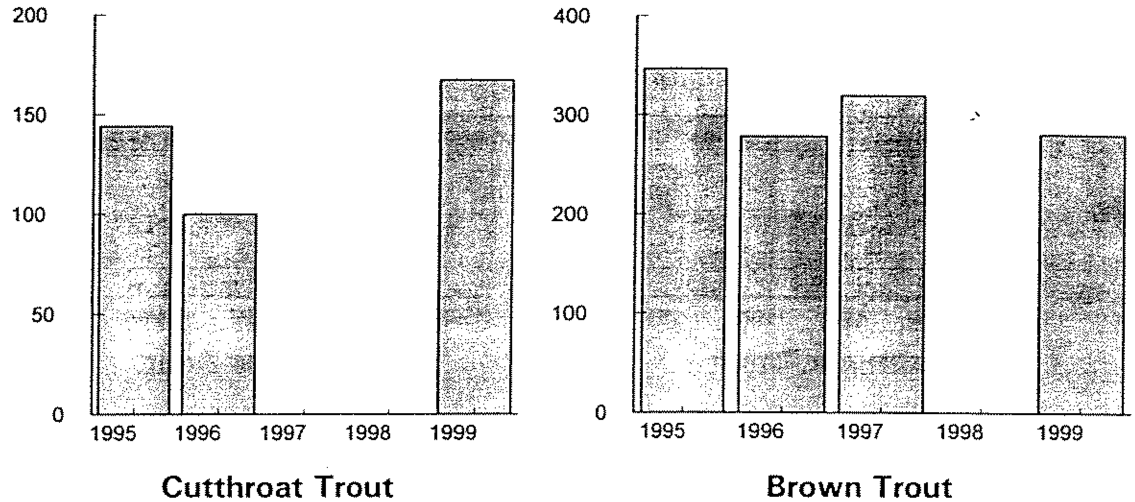

Figure 10. Yellowstone cutthroat and brown trout abundance in the Ninth Street section of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scales are fish/mile. Vertical scales differ. Missing values are years for which no reliable estimate could be calculated from the available capture data.

Rainbow trout abundance in the Ninth Street section increased this year, reversing a three-year trend of population declines (Figure 11). This increase coincides with

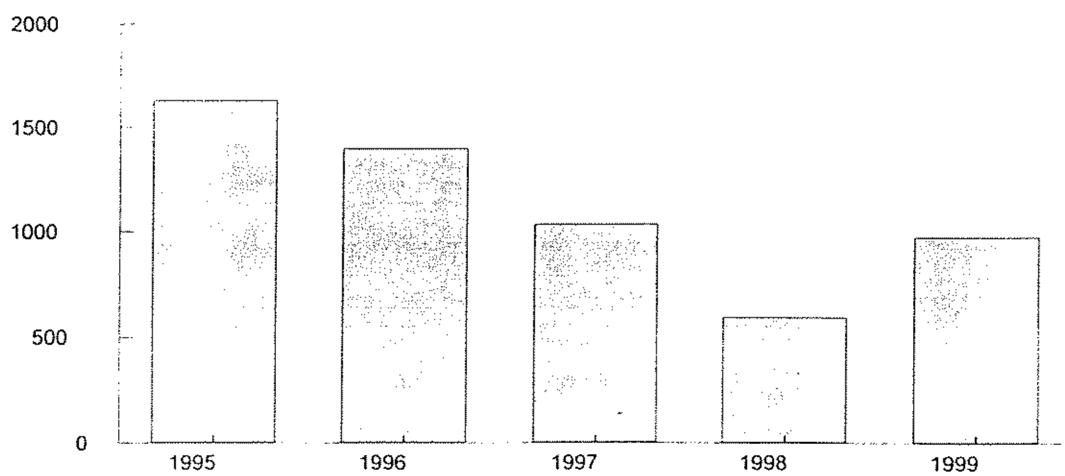

Figure 11. Rainbow trout abundance in the Ninth Street section of the Yellowstone river based on spring sampling from 1995 through 1999. Estimates are for fish seven inches (TL) or longer. Vertical scale is fish/mile.

the re-establishment of habitat features lost during unusually large floods in 1996 and 1997. Apparently, fish that had moved out of this area as a consequence of channel modifications caused by the large floods (e.g., Tohtz 1998) are returning now that the channel has had an opportunity to heal.

The number of rainbow trout between six and twelve inches in the Ninth Street section this year was similar to numbers estimated in previous surveys. Healthy recruitment and survivorship of young fish apparently continues in this area of the river, perhaps increasing after the large floods that occurred in 1996 and 1997 (Figure 12).

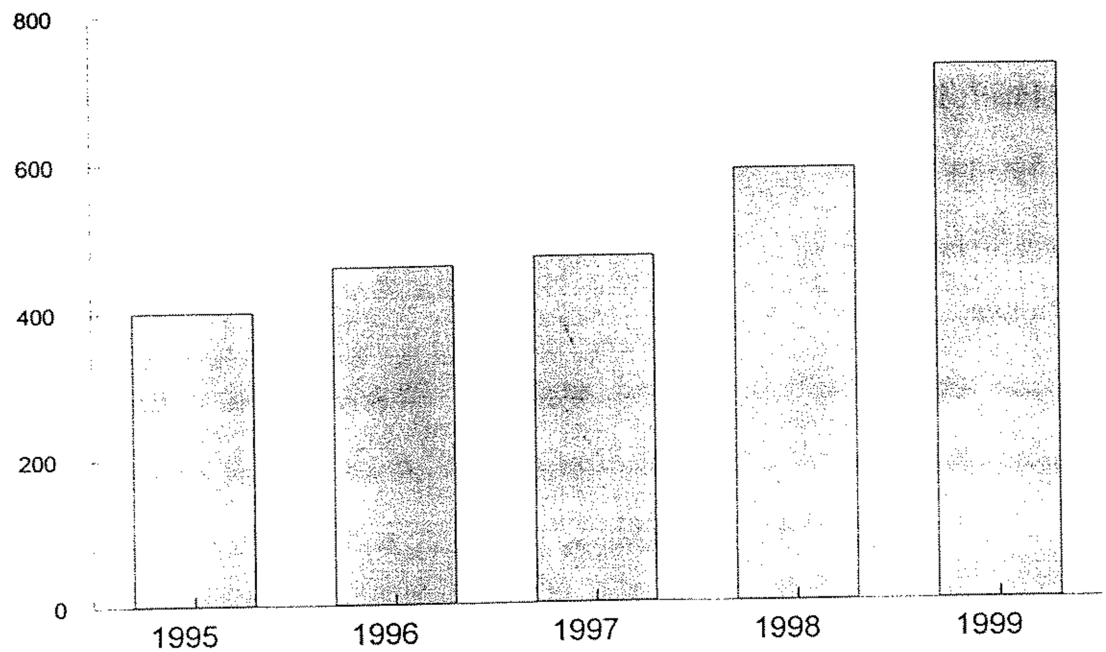

Figure 12. Abundance of rainbow trout between six and twelve inches (TL) in the Ninth Street section of the Yellowstone river based on spring sampling from 1995 through 1999. Vertical scale is fish/mile.

B. Estimates of mountain whitefish abundance in five sections of the Yellowstone river based on spring sampling in 1999.

Data for mountain whitefish from each of the sections sampled in 1999 fit the log-likelihood model well (Table 10). Whitefish abundance gradually declines as the river leaves the Paradise valley and turns east near Livingston, Montana (Figure 13). This decline coincides with changes in river conditions associated with different valley-bottom types that the river flows through as it progresses downstream.

Table 10. Mountain whitefish/mile in five sections of the Yellowstone river based on spring sampling in 1999. Estimates are for fish six inches (TL) or longer.

			Overall model			Pooled model		
Section (mark date):	N	SD	DF	Chi-square	P	DF	Chi-square	P /1
Corwin Springs (April 8):	12,595	1,051	6	5.01	0.54	3	3.02	0.39
Mill Creek Bridge (April 6):	10,837	1,189	6	2.45	0.87	3	2.05	0.56
Mallard's Rest (April 7):	14,572	1,471	6	1.91	0.93	4	1.33	0.86
Ninth Street (March 31):	7,398	855	6	5.63	0.47	4	5.53	0.24
Springdale (March 29):	2,626	243	7	5.47	0.60	3	3.46	0.33

1. N = estimated number; SD = standard deviation; DF = degrees of freedom; P = probability value.

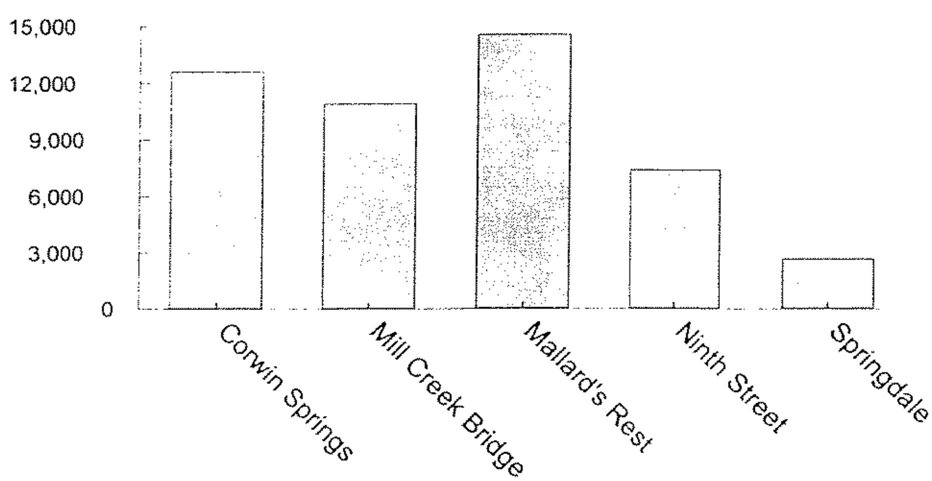

Figure 13. Mountain whitefish abundance in the Yellowstone river at five different locations, based on spring sampling in 1999. Estimates are for fish six inches (TL) or longer. Vertical scale is fish/mile. Section locations are identified in Table 2 and Figure 2.

C. Genetic tests of Yellowstone cutthroat trout collected from the Yellowstone river in 1998.

Hybridization with rainbow trout is considered a serious threat to the continued persistence of Yellowstone cutthroat trout in many areas, and is frequently cited among the primary factors responsible for the declining distribution and abundance of this fish. Concern about the status of this fish is sufficient to have prompted the filing of a petition to list the Yellowstone cutthroat trout as a threatened species under the Endangered Species Act (16 U.S.C. 1531 et seq.). This petition was filed in August 1998.

In light of this petition, and the general concern for the species, our genetic test results for Yellowstone cutthroat trout collected from the Yellowstone river in 1998 are especially intriguing. Each sample, regardless of where it was collected in the drainage, contained a high percentage of unhybridized fish (Table 11). These results are highly unlikely to have occurred by chance alone, suggesting that cutthroat trout are maintaining their unhybridized identity in the Yellowstone river despite coexistence with rainbow trout. Implied in this result is that a significantly high rate of non-random mating occurs within the drainage. It seems reasonable that a variety of factors would influence the persistence of the unhybridized species despite the obvious potential for hybridization with rainbow trout. In the absence of a better understanding of these factors, it also seems reasonable that a conservative management approach is best. Actions to disrupt continuous stream systems, or to eradicate established fish populations, should be undertaken cautiously, and only after meticulous consideration of their possible consequences. Well-intended projects could have harmful effects if they are implemented too hastily and in ignorance of an understanding of mechanisms already operating to maintain the genetic integrity of the fish.

Table 11. Results of genetic tests on Yellowstone cutthroat trout collected from the Yellowstone river in 1998. Tests examined potential hybridization with rainbow trout.

Sample section	Unhybridized fish in the sample	Hybridized fish in the sample	Percent unhybridized	Other results /1
Corwin Springs	25	5	83	
Mill Creek Bridge	33	1	97	1 rainbow trout 1 brown trout
Springdale	18	1	95	1 rainbow trout

1. Fish other than Yellowstone cutthroat trout included with samples as quality controls.

D. Estimates of Yellowstone cutthroat trout abundance in two sections of Mill creek based on fall sampling in 1999.

Cutthroat trout abundance in the Logjam section was similar in 1999 to abundance determined in 1996 (Figure 14). Compared to similar surveys made before and after the logjam projects were installed (Tohtz 1996a; Tohtz 1996b) it appears that these treatments do not appreciably influence local trout distributions or abundance at this location. Loss of many of the log installations to high water events, especially in 1996, may party explain the lack of population response apparent in this treatment section.

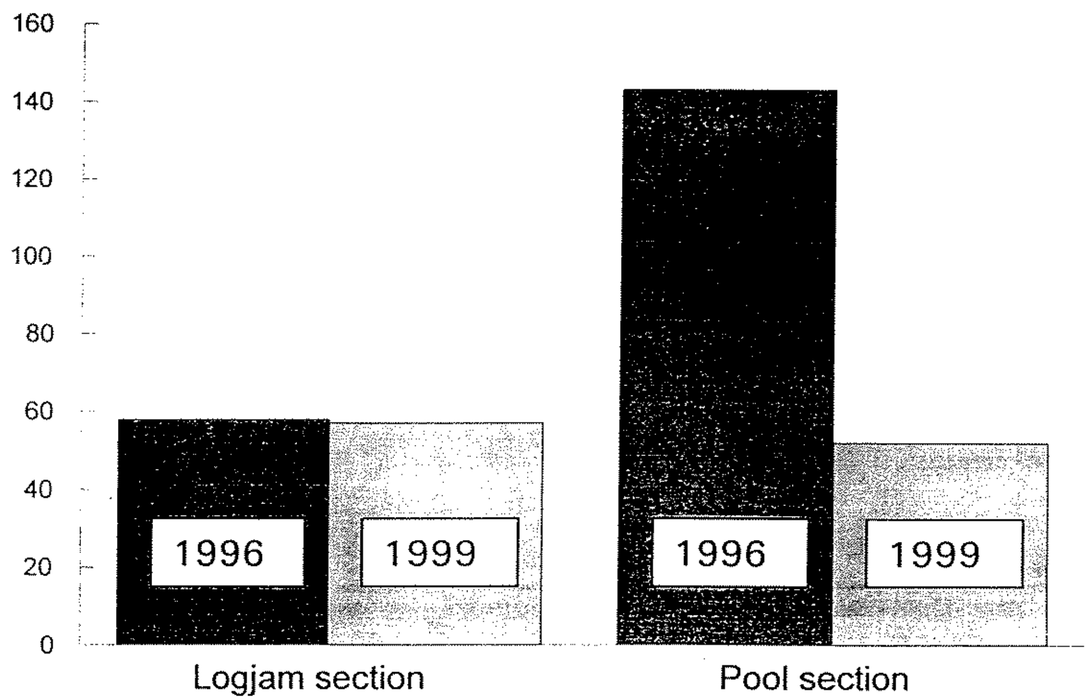

Figure 14. Comparison of Yellowstone cutthroat trout abundance in 1996 and 1999 in two sections of Mill creek where different habitat structures had been installed to improve habitat for fish. Vertical scales are fish/1,000 feet. Section locations are identified in Table 4 and Figure 3.

Cutthroat trout abundance in the Pool section was less in 1999 than 1996 (Figure 14). This decrease follows an initial increase in cutthroat numbers documented immediately after the pool enhancement features had been completed (Tohtz 1996a). Fewer fish in 1999 suggests that loss of the artificial pools over the years has influenced local fish densities. Whether or not these influences pertain to fish production and survivorship, and not just to fish distribution, remains questionable.

Most fish captured at both locations in Mill creek were less than nine inches long (Figure 15).

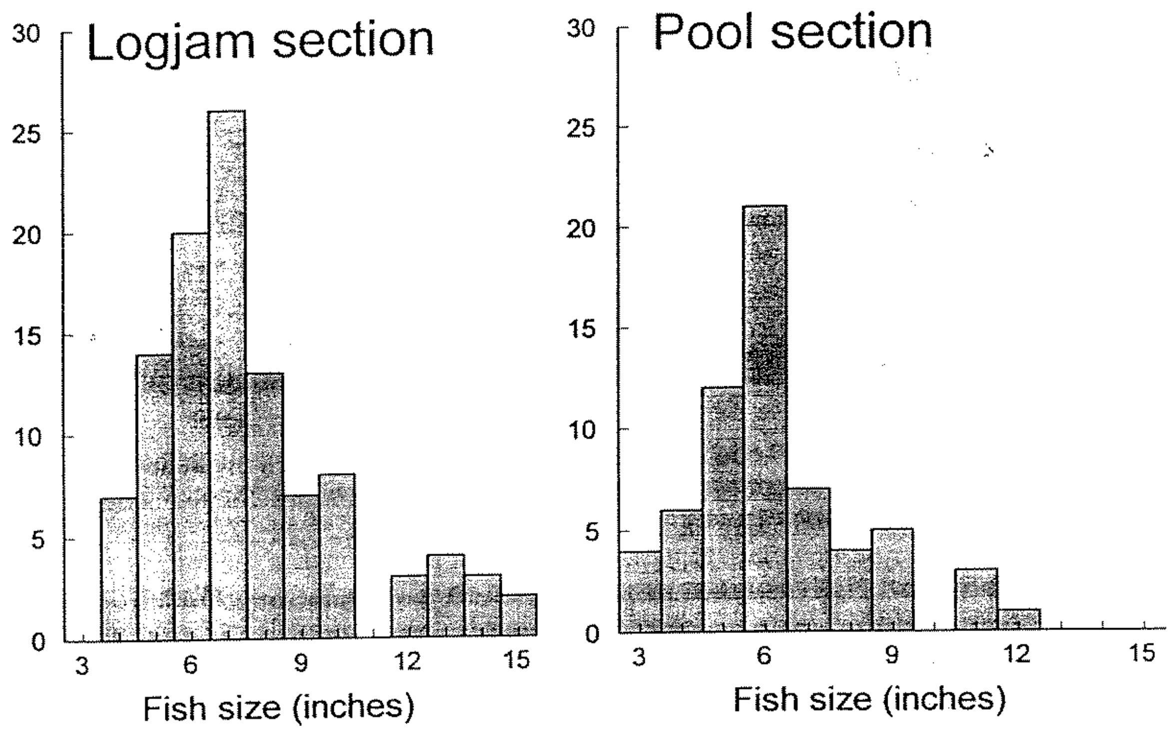

Figure 15. Length frequency distributions of Yellowstone cutthroat trout captured in two sections of Mill creek in October 1999. Vertical scales are number of fish. Section locations are identified in Table 4 and Figure 3.

E. Recent fish sampling in the Shields river drainage.

Shields river mainstem

Mountain whitefish and brown trout dominate the mainstem Shields river fishery upstream from Clyde Park (Figure 4). In this area, mountain whitefish show much greater abundance at downstream sites compared to upstream sites; brown trout abundance tends to be similar at different locations throughout most of the main river channel (Figure 16).

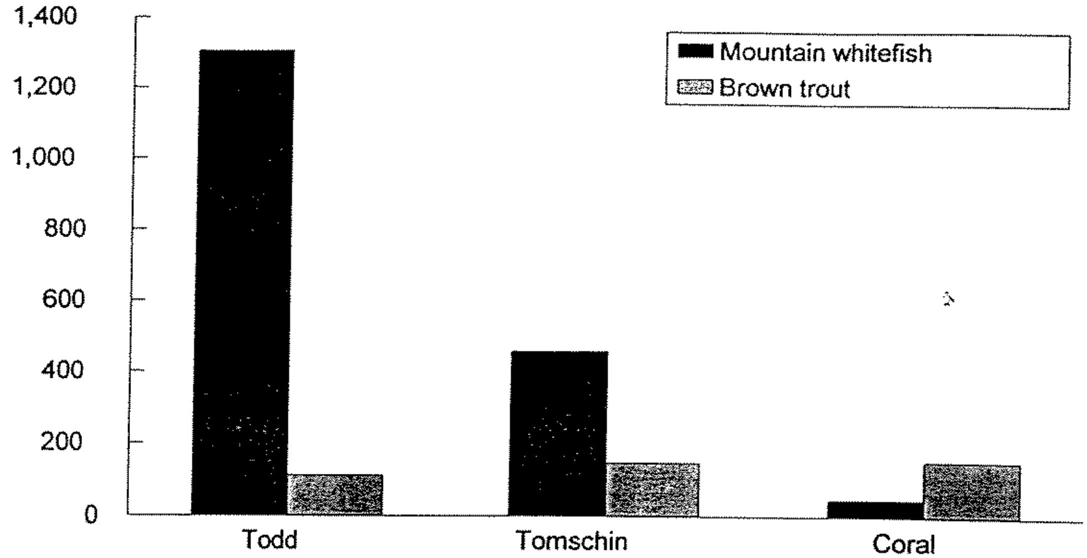

Figure 16. Mountain whitefish and brown trout abundance at three locations in the Shields river based on spring sampling in 1999. Vertical scale is fish/mile. Section locations are identified in Table 5 and Figure 3.

Other, less abundant, fish species encountered in the mainstem Shields river above Clyde Park included the white sucker, longnose sucker, mountain sucker, longnose dace, and mottled sculpin. Yellowstone cutthroat trout were found everywhere we sampled, although often in low numbers (as few as six each thousand feet of stream near the Hamilton Road Bridge site, for example). Low numbers of cutthroat trout throughout the main Shields river make estimating their abundance difficult. However, it appears that cutthroat are more numerous in downstream sections of the main river than at upstream locations, a distribution pattern similar to mountain whitefish.

Shields river tributaries

Yellowstone cutthroat trout were the most common fish encountered in each of the east-valley tributaries that we sampled this year. Cutthroat trout were surprisingly abundant. At each location that we sampled quantitatively, cutthroat densities equaled, or greatly exceeded, densities typically found in the mainstem Yellowstone river (Table 12). Size structure of the samples suggest well established, self-sustaining, resident populations (Figure 17).

Less abundant fish species encountered in the Shields river tributaries included the white sucker, longnose sucker, mountain sucker, longnose dace, and mottled sculpin. A single lake chub was captured in Porcupine creek.

Table 12. Yellowstone cutthroat trout abundance in four tributaries of the Shields river sampled in 1999.

Stream name: (section)	Number of fish (pass 1, 2, 3)	Probability of Capture	Estimated fish/mile	Standard error
Porcupine : (Westling)	34, 10, 2	0.77	280	2.92
South Fork Elk: (Lobaugh)	29, 8, 4	0.68	486	5.75
Horse: (Goffena)	105, 16, 3	0.85	873	2.04
Cottonwood: (Hunter)	137, 36, 21	0.66	958	9.23

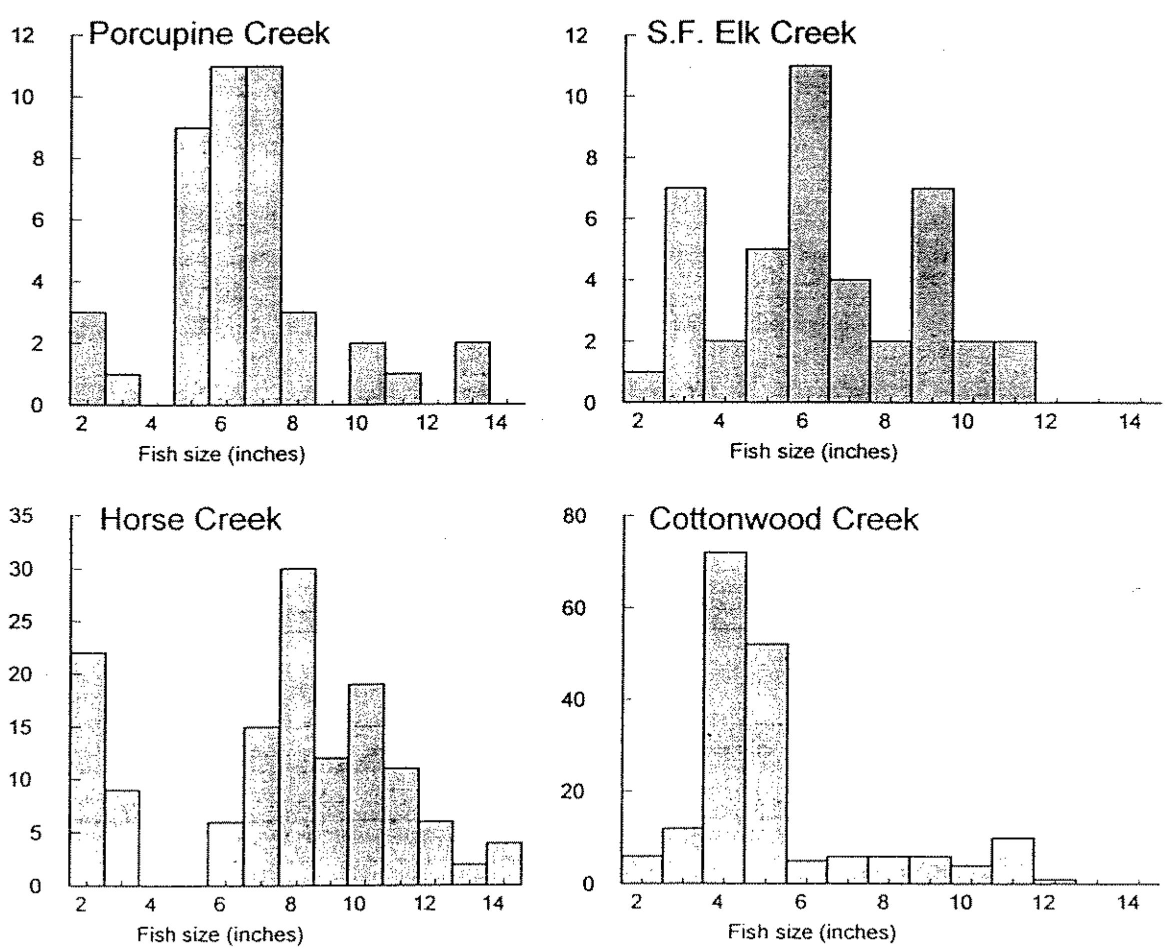

Figure 17. Length frequency distributions of Yellowstone cutthroat trout in four tributaries of the Shields river sampled in 1999. Vertical scales are number of fish.

F. Summary of 1999 spring gillnet catches at Dailey lake.

The average number of rainbow trout caught in each gillnet at Dailey lake was larger in 1999 than in 1998; average fish length was less (Table 13). Smaller fish were missing from the catch (Figure 18) again raising the concern first remarked upon last year (Tohtz 1998) that the recreational fishery may suffer in the future from lack of new fish entering the larger size classes. A request to increase rainbow stocking by 10,000 fish this spring was intended in part to ameliorate this possibility. These fish were not available (Table 14), but will be requested again next spring.

Table 13. Summary of gillnet catches at Dailey lake based on spring sampling from 1990 through 1999.

		Rainbow trout		Yellow perch		Walleye	
Year /1	Set date	Fish/net	Mean TL (inches)	Fish/net	Mean TL (inches)	Fish/net	Mean TL (inches)
1990	04/30	8.2	12.8	48.7	7.4	4.7	11.4
1991	05/14	5.3	14.8	21.8	7.5	3.0	12.0
1992	05/04	7.3	15.1	58.3	7.7	4.5	12.7
1993	------------	---------------------- no		information	------------	---------------------------	
1994	05/12	9.3	15.2	32.3	8.7	11.5	11.3
1995	05/18	13.5	14.6	71.5	8.0	2.5	13.7
1996	------------	---------------------- no		information	------------	---------------------------	
1997	04/23	9.8	17.4	35.8	8.8	15.3	14.6
1998	05/3	5.8	18.9	59.0	8.9	15.8	10.6
1999	04/27	10.3	15.0	210.3	6.3	15.0	13.4

1. Data summaries for years 1990 through 1992 are from Shepard 1993b.

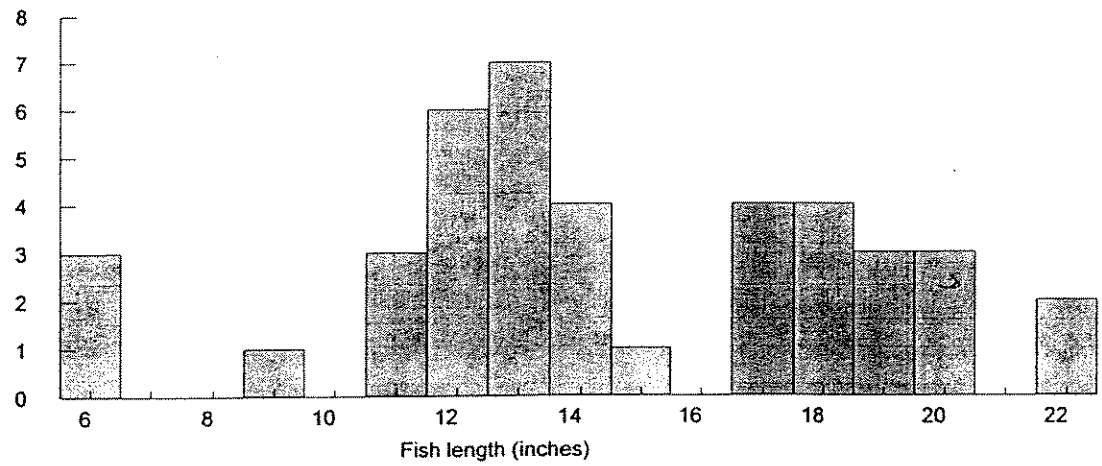

Figure 18. Length frequency distribution of rainbow trout caught in gillnets at Dailey lake in spring 1999. Vertical scale is number of fish.

Table 14. Numbers of walleye and rainbow trout stocked in Dailey lake in 1997, 1998, and 1999.

Year	Species	Variety	Number	Mean length (in)
1997	Walleye	Fort Peck	10,000	1.2
	Walleye	Fort Peck	4,810	3.2
	Rainbow trout	Eagle Lake	10,050	3.3
	Rainbow trout	Desmet	2,960 /1	6.7
1998	Walleye	Fort Peck	10,000	1.4
	Walleye	Fort Peck	5,000	2.5
	Rainbow trout	Eagle Lake	10,192	3.9
	Rainbow trout	Desmet	5,440	5.3
1999	Walleye	Fort Peck	5,000	1.6
	Walleye	Fort Peck	5,000	3.3
	Rainbow trout	Eagle Lake	10,098	4.8
	Rainbow trout	Desmet	5,000	5.3

1. Number adjusted for loss of approximately 400 fish during transport from the hatchery.

Yellow perch numbers in our samples increased significantly this spring compared to previous years (Table 13). This increase is explained by a large number of small perch captured this year (Figure 19), suggesting very strong recruitment from the 1998 spawning effort. The large number of smaller fish also accounts for the much smaller average size of yellow perch in our samples this year (Table 13).

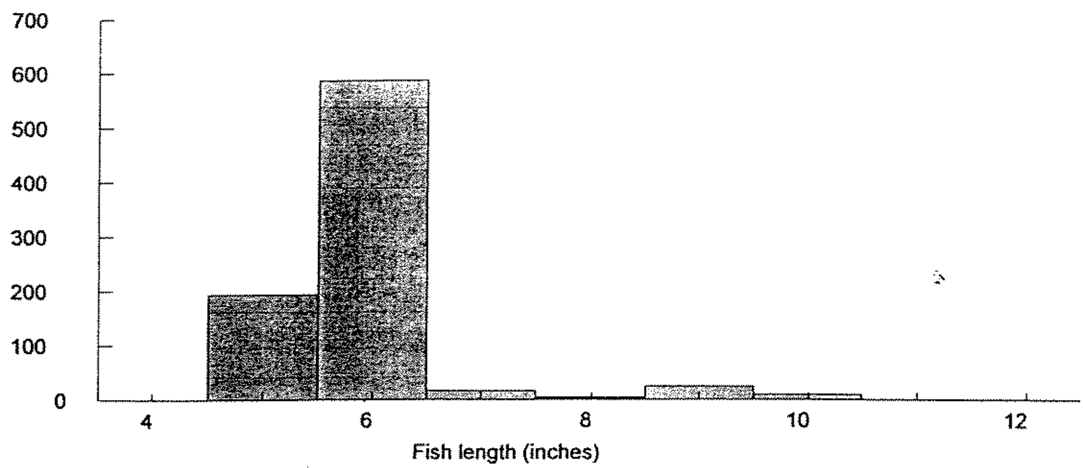

Figure 19. Length frequency distribution of yellow perch caught in gillnets at Dailey lake in spring 1999. Vertical scale is number of fish.

The number of walleye caught in our nets has been similar the last few years (Table 13). Although their average size was larger this year compared to 1998, walleye size continues to be small on average overall. At current stocking levels, Dailey lake appears to produce small-sized walleye that may nonetheless eat enough yellow perch to delay growth stunting of the yellow perch population. This situation may be changing now in light of recent strong year classes of yellow perch. Walleye stocking rates have been reduced to encourage walleye growth (Tohtz 1998). It is hoped that an increase in the number of larger-sized predators will more effectively control yellow perch abundance, preventing overpopulation and its associated low growth rates. Regardless of the success of this experiment, walleye and yellow perch size should be monitored closely in upcoming years to determine trends for the recreational fishery.

G. Summary of creel survey information from Dailey lake collected from October through December 1998.

Summaries of creel survey information collected at Dailey lake between January and September 1998 were reported last year (Tohtz 1998). From October through December 1998 we completed 70 more angler interviews (Table 15), and measured 31 more fish (Table 16).

Table 15. Creel survey counts and observations at Dailey lake from January through December 1998.

Month day type	Angler interviews	Hours fished	Mean angler count	Mean trip length (hr)	Fish kept/caught YP	RB	WE /1
January							
weekday	33	109.50	6.00	3.98	209/273	2/2	0/2
weekend	70	172.62	17.00	4.32	384/567	3/3	2/4
February							
weekday	42	107.33	8.17	4.96	336/410	1/1	1/1
weekend	17	71.70	6.00	5.00	145/175	3/3	1/1
March							
weekday	26	101.33	5.20	4.43	181/322	3/3	0/1
weekend	13	63.76	6.50	6.09	69/128	2/2	0/0
April							
weekday	12	25.82	3.00	2.54	1/1	0/9	0/0
weekend	39	80.32	10.00	2.32	10/10	1/2	0/0
May							
weekday	24	63.26	4.00	2.89	29/56	4/12	0/0
weekend	40	124.93	18.75	3.44	42/54	7/15	3/3
June							
weekday	39	136.66	6.00	3.73	69/94	2/3	4/4
weekend	39	117.51	14.25	3.95	60/107	4/4	3/3
July							
weekday	23	49.08	2.50	2.04	30/152	4/6	4/4
weekend	82	242.66	19.50	3.43	128/538	3/5	22/61
August							
weekday	35	84.16	5.00	2.68	161/279	2/2	6/30
weekend	70	220.57	12.00	3.72	290/626	3/5	27/67
September							
weekday	12	37.73	4.50	3.34	2/4	2/3	1/5
weekend	19	52.75	8.00	3.37	13/70	3/4	0/21

1. YP=yellow perch; RB=rainbow trout; WE=walleye (Continued on page 34)

Table 15. Creel survey counts and observations at Dailey lake from January through December 1998. (Continued from page 33).

Month day type	Angler interviews	Hours fished	Mean angler count	Mean trip length (hr)	Fish kept/caught YP	RB	WE /1
October							
weekday	19	53.50	3.67	3.59	16/23	2/2	1/2
weekend	13	24.25	3.00	2.48	9/17	0/0	2/3
November							
weekday	5	10.00	1.50	3.33	0/2	0/1	0/0
weekend	7	1.00	2.00	0.50	0/0	0/0	0/0
December							
weekday	7	6.23	2.67	1.04	0/0	0/1	0/0
weekend	19	35.17	4.50	2.30	243/274	3/4	0/0

1. YP=yellow perch; RB=rainbow trout; WE=walleye

Table 16. Mean length of yellow perch, rainbow trout, and walleye measured during creel surveys at Dailey lake from January through December 1998.

	Yellow perch			Rainbow trout			Walleye		
Month	Length (in)	SD	N	Length (in)	SD	N	Length (in)	SD	N \1
January	8.5	1.9	483	13.6	2.3	5	12.3	0.8	2
February	8.9	1.7	284	17.2	4.5	3	10.2	4.2	2
March	8.8	1.2	189	17.1	1.6	3	11.5	0	1
April	-----	-----	0	27.0	0	1	-----	-----	0
May	9.7	1.1	42	18.6	0.9	8	12.1	2.2	4
June	9.0	1.2	87	16.7	0.7	6	11.0	1.6	7
July	8.8	1.2	78	13.5	5.0	10	11.3	1.1	26
August	7.1	1.5	222	15.1	2.0	5	12.4	1.4	29
September	10.2	0	1	12.7	2.5	5	17.5	0	1
October	7.5	1.5	15	13.7	2.1	3	14.2	0.7	3
November	-----	-----	0	-----	-----	0	-----	-----	0
December	7.3	1.1	18	19.5	2.7	2	-----	-----	0

1. SD=standard deviation (inches); N=sample size

Angling pressure at Dailey lake from October through December was low compared to spring or summer months: estimated catch and harvest for these months comprised less than eight percent of the annual total (Table 17). Most fish caught during this period were yellow perch captured in December after ice had again formed on the lake.

Table 17. Angling pressure, fish catch, and fish harvest estimates based on creel survey information collected at Dailey lake from January through December 1998.

Month day type	Angler hours	Angler days	Estimated catch YP	RB	WE	Estimated harvest YP	RB	WE /1
January								
weekday	1,095	275	3,572	26	26	2,734	26	0
weekend	1,424	330	7,960	42	56	5,391	42	28
February								
weekday	966	195	8,359	20	20	6,850	20	20
weekend	538	108	2,197	38	13	1,820	38	13
March								
weekday	1,064	240	4,612	43	14	2,592	43	0
weekend	478	79	2,384	37	0	1,285	37	0
April								
weekday	271	107	19	167	0	19	0	0
weekend	542	234	78	16	0	78	8	0
May								
weekday	633	219	614	132	0	318	44	0
weekend	1,031	300	920	256	51	716	119	51
June								
weekday	1,503	403	1,016	32	43	746	22	43
weekend	705	178	1,230	46	34	690	46	34
July								
weekday	564	277	1,090	43	29	215	29	29
weekend	1,456	424	3,559	33	404	847	20	146
August								
weekday	884	330	2,799	20	301	1,615	20	60
weekend	1,654	445	3,801	30	407	1,761	18	164
September								
Weekday	396	119	100	75	125	50	50	25
weekend	356	106	966	55	290	179	41	0

1. YP = yellow perch; RB = rainbow trout; WE = walleye

(Continued on page 36)

Table 17. Angling pressure, fish catch, and fish harvest estimates based on creel survey information collected at Dailey lake from January through December 1998. (Continued from page 35).

Month day type	Angler hours	Angler days	Estimated catch YP	RB	WE	Estimated harvest YP	RB	WE /1
October								
weekday	562	157	357	31	31	248	0	16
weekend	182	73	73	0	28	83	0	19
November								
weekday	90	27	54	27	0	0	0	0
weekend	9	18	0	0	0	0	0	0
December								
weekday	69	66	0	29	0	0	0	0
weekend	237	103	2,177	32	0	1,931	24	0

1. YP=yellow perch; RB=rainbow trout; WE=walleye

With completion of the 1998 creel survey it is clear that most people fishing at Dailey lake are interested in catching yellow perch. Seventy-one (71) percent of anglers expressing a species preference during our surveys fished for yellow perch. By comparison, 16 percent of anglers fished for rainbow trout, and only 13 percent fished for walleye. Among fish actually harvested in 1998, most (95 percent) were yellow perch. Continuing management to control perch size and abundance is consistent with the Montana Warmwater Fisheries Management Plan objectives for Dailey lake (Anon. 1997). This program is also consistent with the desires of the majority of anglers interviewed at Dailey lake in 1998.

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APPENDIX A: Common and scientific names for fish referred to in this report.

Common name	Scientific name
Brown trout	*Salmo trutta*
Lake chub	*Couesius plumbeus*
Longnose dace	*Rhinichthys cataractae*
Longnose sucker	*Catostomus catostomus*
Mottled sculpin	*Cottus bairdi*
Mountain sucker	*Catostomus platyrhynchus*
Mountain whitefish	*Prosopium williamsoni*
Rainbow trout	*Oncorhynchus mykiss*
Walleye	*Stizostedion vitreum*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*
Yellowstone cutthroat trout (cutthroat trout)	*Oncorhynchus clarki bouvieri*

APPENDIX B: Upper Shields Rapid Aerial Assessment Review.

Upper Shields Rapid Aerial Assessment Review

Prepared by:

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Fisheries Biologist
Montana Fish, Wildlife and Parks

January 20, 1999

Upper Shields Rapid Aerial Assessment Review

Introduction:

On May 12, 1998 an aerial survey of portions of the Shields river and several of its tributaries was conducted by the USDA Natural Resources Conservation Service (NRCS) in collaboration with the Montana Department of Natural Resources and Conservation, Montana Fish, Wildlife and Parks (FWP), and the USDA Forest Service (USFS). This survey used an NRCS Rapid Aerial Assessment (RAA) protocol that has been successfully applied in other areas to identify and characterize non-point source pollution sites, and to otherwise document general watershed conditions. The primary goal of the May 12 survey was to gather information to characterize current conditions in the watershed, in support of activities of the Upper Shields Watershed Association, a group of private landowners organized in part to protect and improve watershed health throughout the upper Shields river area (Attachment 1).

The review that follows is an overview of information collected during the May 12 aerial survey from the perspective of fisheries biologists working for FWP and the USFS. This review is prepared in response to requests for this assessment from NRCS (December 15, 1998) and the Montana Department of Environmental Quality December 31, 1998). This review is intended to supplement ongoing efforts by the NRCS to assess watershed condition at this time. An attempt is made to correlate observations and remarks made here with the Global Positioning System (GPS) mapping of data produced and provided by NRCS (Attachment 2). When available, recent fisheries information is included in the discussion of flight observations for each of the surveyed streams.

Survey methods:

A helicopter was used to complete this RAA: the approximately three hour flight included portions of the upper Shields river and twelve of its east valley tributaries (Table 1; Figure 1). One pilot and three observers participated in the survey. Stream information was collected in twelve data categories established before the survey began (Table 2). Data collection responsibilities were divided between the three observers in the aircraft: one person identified stream features and start and stop intervals for a second person who recorded that information using a Trimble ProXL GPS unit; the third observer filmed the waterways during the flight using a hand held video camera. The helicopter maintained an altitude between approximately 500 and 600 feet, and flew slightly offset from directly over the streams to allow video recording of the flight.

Table 1. Stream reaches surveyed during the May 12, 1998 Rapid aerial Assessment of the upper Shields river watershed.

1. Mainstem Shields river: from headwaters to the town of Clyde Park.
2. Smith creek: from headwaters to its confluence with the Shields river.
3. Porcupine creek: from headwaters to its confluence with the Shields river.
4. North Fork Elk creek: from headwaters to its confluence with Elk creek.
5. Dry creek: from headwaters to its confluence with the South Fork of Elk creek.
6. South Fork Elk creek: from confluence with Dry creek to its confluence with Elk creek.
7. North Fork Elk creek: from headwaters to its confluence with Elk creek.
8. Elk creek: from confluence with the North and South Forks of Elk creek to its confluence with the Shields river.
9. North Fork Daisy Dean creek:from headwaters to its confluence with Daisy Dean creek.
10. Daisy Dean creek: from confluence with the North Fork Daisy Dean creek to its confluence with the Shields river.
11. South Fork Horse creek: from headwaters to its confluence with Horse creek.
12. Horse creek: from confluence with the South Fork Horse creek to its confluence with the Shields river.
13. Cottonwood creek: from headwaters to its confluence with the Shields river.

Table 2. Rapid Aerial Assessment point data and line data collected during the May 12, 1998 aerial survey of the upper Shields river watershed.

Point data categories	Line data categories
Floodplain obstruction	Channelized reach
Instream structure	Reference (healthy) reach
irrigation return	Unhealthy reach
Logging	Unhealthy riparian zone
Stream crossing	Other feature
Stream obstruction	
Disturbed area	

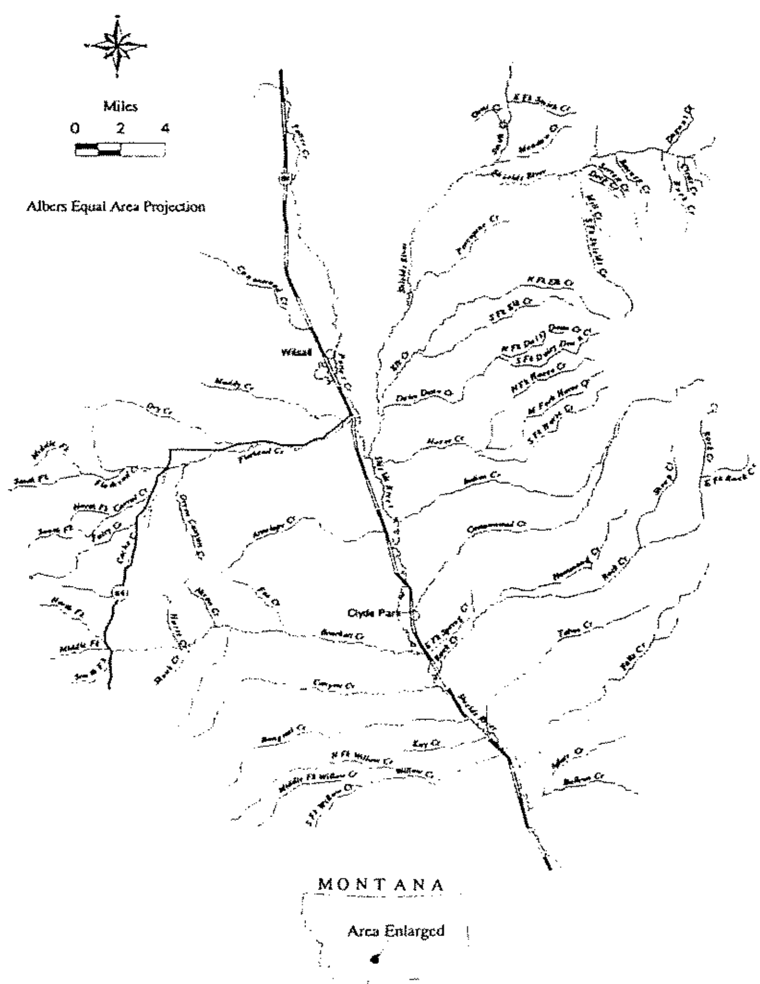

Figure 1. Upper Shields watershed showing stream reaches surveyed during the May 12, 1998 Rapid Aerial Assessment.

Results and Discussion by stream:

Shields river

The Shields river from its headwaters to Clyde Park was the longest stream segment surveyed during this RAA, and contains the most diversity of stream size, gradient, and habitat features. GPS recordings showed 24 line data entries (15 unhealthy reaches, 7 reference reaches, 2 channelized reaches), and 21 point data entries (9 stream crossings, 9 instream structures including beaver dams and irrigation diversions, 2 stream obstructions, probably referring to log jams, 1 logging site). Several features were not recorded because the number of features and their rate of encounter during the survey exceeded abilities to make meaningful distinctions with the GPS equipment.

The extreme upper drainage of this river has been logged extensively in the past, including riparian harvest, particularly in some of its small headwaters tributaries such as Dugout creek. Past logging activities in combination with the removal of large woody debris from the riparian corridor has affected the stream in several ways. Sediment input to the stream has been increased above normal background levels, as evidenced in the braided stream reaches and depositional features (point bars, midchannel bars) that occur immediately below the logged portions of the drainage. This braiding is unusual in undisturbed headwaters zones: normally they are supply limited, meaning that stream sediment transport capacity within these zones usually exceeds the available sediment supply. The absence of large structural components such as trees in the logged areas increases water velocity and erosive potential in the drainage while limiting the development of new habitat features such as pools and associated overhead cover which are particularly important to fish. Increased water velocity is expressed downstream as actively eroding banks which in turn contribute sediment that will fill spaces between stream substrate materials, especially in lower gradient areas. The combined result in some portions of the Shields headwaters area is widened channels in braided configurations with less stable, actively eroding banks; other areas show increased velocity expressed as actively eroding banks and the absence of bed form features usually associated with large woody debris. Both situations result in diminished water quality and degraded fish and wildlife habitat.

Yellowstone cutthroat trout (YCT) collected from the headwaters area of the Shields river and several small tributaries have been tested and shown to be unhybridized fish (Table 3). In view of the August 1998 petition to list YCT as threatened under the

Endangered Species Act, these areas have become especially important to conservation planning for this species.

Table 3. Yellowstone cutthroat trout collections made for genetic testing in the upper Shields river and several of its small headwaters tributaries.

Stream	Year	Location/1	Sample size	Test result
Shields river	1988	5N,11E,S18	22	unhybridized
Shields river	1989	5N,11E,S18	25	unhybridized
Mill creek	1990	5N,11E,S27	11	unhybridized
Deep creek	1990	5N,11E,S26	10	unhybridized
Bennett creek	1990	5N,10E,S24	10	unhybridized
Turkey creek	1986	5N,11E,S21	13	unhybridized
Lodgepole creek	1986	5N,11E,S16	4	unhybridized
Dugout creek	1992	4N,11E,S08	5	unhybridized

1. Township, Range, Section

Reference areas (healthy reaches) occur in all areas of the stream length that was surveyed, but these reaches are relatively short and disconnected from one another by longer stretches of disturbed or degraded stream. Healthy reaches are distinguished from unhealthy reaches primarily by their intact riparian zones, often extending hundreds of feet away from the stream channel. Stream channels in healthy areas show few actively eroding banks, and a meandering geometry that includes undercut banks and riffles and pools that suggest well developed bed form features, a critical component of good fish habitat. A stable equilibrium of stream flow and materials to be transported results in these conditions. Destruction of riparian vegetation can disrupt this equilibrium.

Unhealthy reaches (the majority of the stream length we surveyed) particularly below the logged areas were influenced primarily by agriculture, a not surprising result since agriculture is the primary activity in this watershed. Grazing, hay, and crop production are the primary factors contributing to degraded stream health. Stream reaches in which the riparian corridor has been severely restricted or eliminated (by grazing or some other form of clearing) are frequently associated with actively eroding banks. These banks become sites where landowners try to prevent erosion using various bank stabilization techniques, at considerable expense. Bank stabilization projects in turn can exacerbate problems at these locations, or create unanticipated problems at other locations both upstream and downstream from the original source of concern. Unhealthy stream segments along the Shields river show a range of degradation, from minimally affected riparian zones to totally denuded areas in which portions of the stream have been straightened or artificially constricted (usually by stream crossings). The effort required to restore stream health, and the ability of the stream to recover from various harmful impacts, will vary depending on the severity of damage and the stream characteristics at a particular location.

The lower portions of the Shields river surveyed show extensive braiding and active bank erosion. The river is much larger in its lower reaches than was true in the headwaters areas: all of the tributaries surveyed in this RAA contribute their flows to the Shields river by the time the river reaches Clyde Park. Stream processes in the lower reaches are the same as occur upstream. The larger volume of water downstream exaggerates erosion: some banks show evidence of mass wasting. Depositional features (point bars, islands, mid -channel bars) are also exaggerated in scale downstream compared to upstream reaches.

Private ponds occur at several locations in this drainage, some very near the banks of the Shields river. Although private ponds provide several benefits to landowners, including fire protection, livestock water, and private fisheries, ponds also pose risks to wild fisheries, including disease, and their potential to function as sources of fish species that might threaten native populations. State law requires that private ponds be licensed for fisheries. Presently these pond licenses will almost always restrict species to YCT, in order to protect unhybridized populations in this area of the Shields river drainage. Unfortunately, in the past, many ponds received authorization for rainbow and sometimes brook or brown trout or other fish species. These ponds now constitute a threat to conservation efforts ongoing for YCT. If possible these fisheries should be converted to YCT wherever a landowner is willing to cooperate with this change in pond management on their property.

Smith creek

Smith creek is a small stream tributary to the Shields river in its headwaters area. GPS recordings showed 1 line data entry (unhealthy reach) and 1 point data entry (stream obstruction, in this case a beaver dam).

The upper portions of Smith creek have been heavily logged, including riparian harvest. Some portions have been grazed sufficiently to eliminate riparian vegetation. Both situations increase fine sediment loading, evidenced in braiding and depositional features that would not be expected in this headwaters zone if stream conditions were improved. Beaver activity has exacerbated channel displacement and re-routing in some areas.

Several artificial ponds were recorded on film. These ponds pose the same risks described in the discussion of ponds in the Mainstem Shields river drainage, above.

Brook trout and YCT occur in Smith creek. There is some evidence that brook trout are displacing YCT, a concern to be addressed in conservation planning for these species. Fish were collected for genetics testing in 1988 and 1992 at one location (6N,10E,S06, sample size was 23 and 1, respectively): in both samples all fish were unhybridized YCT.

<u>Porcupine creek</u>

Porcupine creek is a small, low gradient, stream, that joins the Shields river just below its headwaters area. GPS recordings showed 11 line data entries (6 unhealthy reaches, 5 reference reaches) and 8 point data entries (2 stream obstructions, 4 instream structures, in this case irrigation diversions, 2 irrigation returns).

Unhealthy reaches in this stream result primarily from agricultural uses, particularly those that denude riparian vegetation. Unhealthy zones, with actively eroding banks and braided or sometimes straightened channels, contrast conspicuously with healthy sections. Healthy sections show intact willow and other deciduous vegetation, a stable meander geometry, and well established pools and other bed features, usually developed in a single, sinuous, channel. The porcupine drainage provides many examples of contrasting grazing impacts on the stream, at fence lines, and sometimes in different fields separated only by the stream.

<u>North Fork of Elk creek</u>

The North Fork of Elk creek is a tributary of Elk creek that originates in the foothills of the Crazy Mountains, and joins Elk creek low in the Shields river valley. GPS recordings showed 11 line data entries (6 unhealthy reaches, 2 reference reaches, 3 channelized reaches) and 6 point data entries (1 stream obstruction, 3 instream structures, in this case irrigation diversions, 1 irrigation return).

Like Porcupine creek, unhealthy stream sections in the North Fork of Elk creek result primarily from agricultural uses. Again there are clear contrasts between healthy and degraded sections, in some areas occurring on either side of a fence. These contrasts indicate that overuse of riparian areas in some sections has compromised stream quality; they also suggest that stream health could be improved fairly easily, at low cost, if landowners involved are willing to cooperate in protecting stream riparian zones on their properties.

A sample of fish collected in 1993 from the North Fork of Elk creek (4N,10E,S16, sample size 13) was unhybridized YCT, establishing the importance of this drainage to conservation planning for this species.

The South Fork of Elk creek and Dry creek

These streams form a tributary of Elk creek originating in the foothills of the Crazy Mountains that joins Elk creek low in the Shields river valley, just upstream from the confluence of Elk creek and the North Fork of Elk creek. GPS recordings showed 6 line data entries (5 unhealthy reaches, 1 reference reach) and 6 point data entries (2 stream obstruction, 2 instream structures, in this case irrigation diversions, 2 irrigation returns).

Unhealthy stream sections in these creeks result primarily from agricultural uses, although some logging, including riparian harvest, occurred in the headwaters areas. Lower portions of the South Fork of Elk creek show a couple of exceptionally denuded riparian zones, some without any vegetation. These areas undoubtedly contribute increased fine sediment to the stream system. The absence of vegetation and its filtering effects in these areas also raise a concern about agricultural runoff and non-point source pollutants. These concerns would have to be investigated using water quality samples from the stream.

A few private ponds in the drainage raise the usual concerns about disease and the potential introduction of harmful fish species in the drainage, although no information suggests a problem a this time.

Elk creek

Elk creek is a tributary that delivers its north and south forks to the Shields river about two miles north of the town of Wilsall. GPS recordings showed 2 line data entries (unhealthy reaches) and 1 point data entry (stream obstruction, in this case a beaver dam).

The unhealthy stream sections in this creek result primarily from agricultural uses, as discussed for several streams above. A reservoir construction site near the mouth is conspicuously denuded of vegetation and is a likely source of fine sediment for the stream system. Actively eroding banks occur most frequently where riparian vegetation is compromised, or absent.

Daisy Dean creek

Daisy Dean creek is a tributary of the Shields river that originates in the foothills of the Crazy Mountains, joining the Shields river about one and one half miles north of the town of Wilsall. GPS recordings showed 10 line data entries (6 unhealthy reaches, 3 reference reaches, 1 unhealthy riparian zone) and 4 point data entries (3 stream obstructions, 1 instream structure, in this case an irrigation diversion).

Unhealthy stream sections in this creek result primarily from agricultural uses. Overgrazed riparian zones, and hay and crop fields that were established in some areas by completely eliminating riparian vegetation, result in actively eroding banks, and the loss of overhead cover that would otherwise shade the creek and provide other wildlife amenities. Unlike many of the other Shields tributaries viewed during this RAA, Daisy Dean creek also has long segments of stream with an intact and healthy riparian corridor. These segments provide an informative contrast from which to compare healthy and unhealthy reaches in this creek.

Horse creek and the South Fork of Horse creek

These streams form a tributary of the Shields river, originating in the foothills of the Crazy Mountains, and joining the Shields river near the town of Wilsall. GPS recordings showed 10 line data entries (3 unhealthy reaches, 1 reference reach, 1 unhealthy riparian zone, 5 other features, which include stream constrictions at culvert installations, and ponds) and 5 point data entries (2 stream obstructions, 3 instream structures).

In common with all the tributaries surveyed during this RAA, unhealthy stream sections in both the South Fork of Horse creek and Horse creek result primarily from agricultural uses of the drainage. Stream reaches in which the riparian corridor has been severely restricted or eliminated (by grazing or some other form of clearing) are those most frequently associated with actively eroding banks. Several culverts and bridges create flow restrictions along this waterway, disrupting the ability of the stream to transport bedload materials, a problem that is exacerbated by increased erosion along some banks near these points of constriction.

Several ponds occur in the headwaters area of the South Fork of Horse creek, raising concerns about disease and the potential introduction of harmful fish species in the drainage.

Cottonwood creek

Cottonwood creek is a long tributary that joins the Shields river near the town of Clyde Park. GPS recordings showed 11 line data entries (7 unhealthy reaches, 2 reference reaches, 1 unhealthy riparian zone, 1 other feature) and 8 point data entries (2 stream crossings, 6 instream structures).

The headwaters area of Cottonwood creek is fairly high gradient; the stream substrate includes a large cobble component, in addition to smaller materials more characteristic of the other streams surveyed in this RAA. Several irrigation projects remove water in the headwaters area, a difficult location at which to maintain headgates and diversion structures. Stream banks in the upper, timbered, reaches are fairly stable, in part because the geology of the drainage in this area includes a large proportion of bedrock outcrops that resist problems associated with erosion.

Middle portions of Cottonwood creek show areas of bedload deposition and associated channel braiding. In contrast to some of the other streams surveyed during this RAA, this stream configuration in Cottonwood creek appears to be a natural feature of the drainage, rather than the result of upstream perturbations.

Unhealthy stream sections occur primarily in the lower reaches, and are associated most frequently with damaged riparian zones and actively eroding banks. As true throughout most of the upper Shields river drainage, stream damage in Cottonwood creek results most often from agricultural activities. Sources of damage should be easy to remedy at most locations, and stream health should improve rapidly, provided only that landowners are willing to cooperate in protecting stream riparian zones on their properties.

Summary remarks:

Stream processes including erosion, transport, and deposition do not change over time, but the consequence of these processes can change depending on stream conditions. Degraded stream reaches tend to deteriorate at an accelerating rate, particularly during large flow events that exaggerate hydrologic processes and their effects on biotic communities. Given the opportunity, degraded streams can also heal rapidly, depending on drainage characteristics and flow.

Some activities would obviously benefit each of the streams surveyed in this RAA, regardless of where these activities were conducted in the drainage. Protecting existing riparian zones, and re-establishing and enhancing these zones where they have been compromised, for example, is an inexpensive action that would benefit stream health over a broad geographic area. Other activities, such as stabilizing actively eroding banks, require careful evaluation of causes before their benefits are understood. Efforts here might be better directed first to controlling excessive sediment loading upstream, for example, rather than treating all banks in ways that simply transfer problems downstream.

This RAA provided a large amount of information about stream health over a large area in a short amount of time. The attempt to identify specific features using GPS technology, and particularly to identify priority problem sites, was less successful: line data categories proved too general over any length to be very helpful after the flight; point data categories were too easily missed during the survey. The video recording of the flight helped mitigate these problems somewhat: filming the flights should certainly be mandatory in future aerial surveys.

Attachment 1: Upper Shields Watershed Association
Mission Statement and By-Laws.

MISSION STATEMENT

The Upper Shields Watershed Association is a collection of land owners and citizens of the community that share the vision that ranching, as a way of life, can and must be preserved. This group has been drawn together for the purpose of protecting and improving the land and the resources of the land since these quantities represent the very foundation of ranching. The mission of the Upper Shields Watershed Association is based on four interwoven commitments:

- **Life style** - To provide support for and to preserve the independent way of life known as "ranching" and to help educate the general public about the necessity of ranching as it relates to the economic health of the community and the state.

- **Resources** - To become educated about and to put into effect the most practical means of preserving water quality, stream banks and fish habitat, to promote sound and efficient use of the water both in streams and from underground sources, to manage timber resources for both production and esthetic value and to maintain the range resource for both present and future generations.

- **Weeds** - To seek and use all methods available to control the spread of noxious weeds in a manner that is consistent with improving the land and the range.

- **Wildlife** - To promote sound game management that will insure the existence of reasonable numbers of game birds, game animals, and native species that are in balance with the rangeland and the ranches that support these animals.

UPPER SHIELDS RIVER WATERSHED ASSOCIATION
BY-LAWS

I. NAME-LOCATION

The name of the association shall be Upper Shields River Watershed Association. Its principal mailing address shall be Natural Resources Conservation Service, 5242 US Highway 89 South, Livingston, MT 59047.

II. MISSION STATEMENT

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- Wildlife - To promote sound game management that will insure the existence of reasonable numbers of game birds, game animals and native species that are in balance with the habitat and the ranches that support these animals.

III PURPOSE AND GOALS

The purpose of the Association is:

a. to educate landowners and the public on natural resource issues
b. to inventory and document changes in the resource base
c. to develop solutions to problems which will protect agriculture while positively improving natural resources within the area.
d. to work with Federal, State, and County agencies to coordinate watershed

improvement activities in a feasible and economical manner.

e. to work with agencies to help secure funding to improve the natural resources in the watershed area.

IV. MEMBERSHIP

All farm operators from the designated area, whether owners, operators, leasers, renters, or tenants may be members. Other interested citizens who support the goals of the Association and live within the boundaries of the designated area may also be members. The designated area is the upper Shields River drainage, including all tributaries, as shown on the attached map. This designated area may be changed by recommendation of the executive committee and vote of the membership in the original designated area.

While most issues presented at the meetings of the Association shall be decided by general consensus, if a counted vote is necessary, all members present at the time of voting shall be entitled to vote.

V ASSOCIATION ORGANIZATION

a. CHAIRMAN There shall be a chairman elected annually from the general membership.

b. COORDINATOR There shall be a coordinator from the Natural Resources Conservation Service (NRCS) or other appropriate agency.

c. FACILITATOR In so far as it is needed there shall be a facilitator to conduct the Association meeting.

d. COMMITTEES Committees shall be formed as needed to address specific issues or problems relative to the watershed. Each committee will elect a chairman who will be a member of the executive committee. The initial committees shall consist of the following:

Riverbank Stabilization Committee
Weeds Committee
Endangered/Threatened Species Committee
Off-stream Watering/Off-stream Corral Committee
Dewatering/Irrigation Storage Committee
Irrigation Efficiencies (field level) Committee.

These committees may be dissolved and other committees formed as needed in the future. Each committee shall investigate its area of concern, report findings to the member of the Association, and, when possible, plan and conduct tours and/or present programs to educate the general membership relative to problems, possible solutions, and sources of funding in each area.

c. EXECUTIVE COMMITTEE There shall be an executive committee consisting of the coordinator, association chairman, and the chairmen of the various committees. The executive committee shall meet as often as necessary to coordinate work and overlapping areas of interest of the various committees. They shall assist the association chairman in setting the agenda for general meeting and making recommendations for issues to be presented to the general membership If any committee chairman is unable to attend an executive committee meeting, he shall appoint another member of his committee to attend the meetings. To minimize his own work load, the association chairman may delegate work to the various committee chairmen as necessary.

d. TECHNICAL ADVISORY COMMITTEE There shall be a technical advisory committee consisting of persons who have expert knowledge concerning the problems and possible solutions being addressed by the Association.

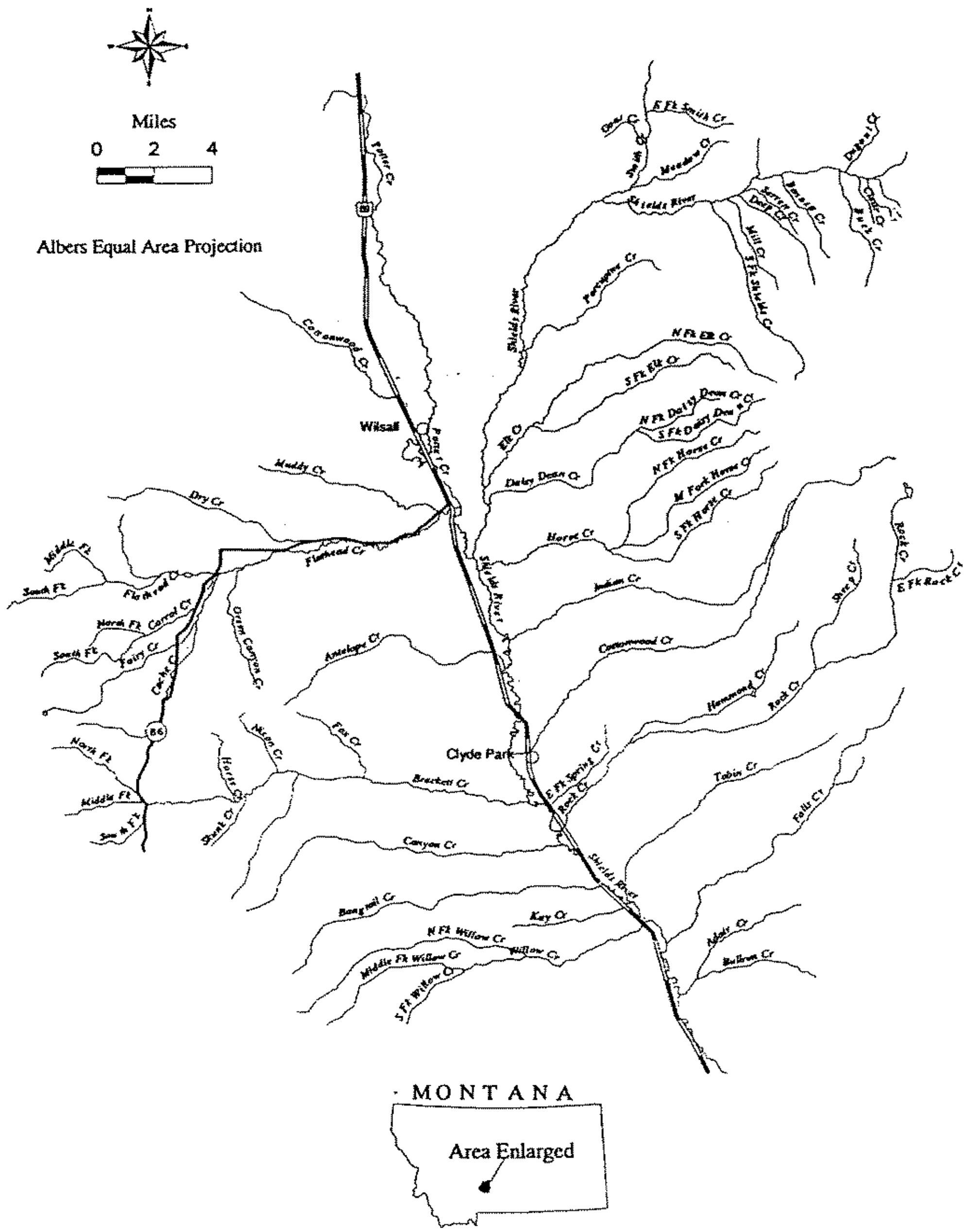
The technical advisory committee shall be consulted in the areas of their expertise as needed and shall assist in finding sources of funding for various projects. Either individually or as a group, they shall meet with the executive committee or the entire membership periodically to assist the Association in meeting its goals.

e. MEETINGS There shall be meetings of the general membership as often as is practical and necessary. Notification of meeting shall be by phone or mail. The agenda for the meetings shall be set by the executive committee and the coordinator. Minutes shall be taken by the coordinator and mailed to all members

VI ADDITIONS TO AND AMENDMENTS OF BY-LAWS

The structure, designated area, membership rules or any other part of these by-laws may be changed at any time by recommendation of the coordinator and executive committee and vote of the general membership

Attachment 2: Upper Shields watershed showing stream reaches surveyed and GPS data entries compiled during the May 12, 1998 Rapid Aerial Assessment.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Wilsall
Clyde Park
Shields River
MONTANA
Area Enlarged