Madison River Drainage Fisheries

and

Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program

2004

Annual Report
to
PPL Montana
Environmental Division
Butte
www.pplmontana.com

and

Turner Enterprises, Inc.
Bozeman

by

Pat Clancey & Travis Lohrenz
Montana Fish, Wildlife, & Parks
Ennis
April 2005

www.fwp.mt.gov

INTERNET WEB PAGES CITED IN THIS REPORT
(in alphabetical order)

Aquatic Nuisance Species Task Force……..www.anstaskforce.gov
Blue Ribbon Flies ……www.blueribbonflies.com
Lower Madison River Monitoring page….
www.madisondss.com/ppl-river.cfg/ppl-madison.php
Montana Fish, Wildlife, & Parks……..www.fwp.mt.gov
New Zealand Mudsnail in the Western USA…….. www.esg.montana.edu/aim/mollusca/nzms
Northwest Marine Technologies…….www.nmt.us
PPL Montana……...www.pplmontana.com
Protect Your Waters……www.protectyourwaters.net
Whirling Disease Foundation……..www.whirling-disease.org

MFWP personnel took all photos in this report unless otherwise credited.

EXECUTIVE SUMMARY

One young-of-the-year Arctic grayling and nine young-of-the-year mountain whitefish were captured during seining in Ennis Reservoir in 2004. Populations of two year old & older rainbow trout in both long-term monitoring sections in the upper river remained relatively static compared to 2003, but decreased in the Norris section of the lower river. Brown trout numbers decreased in all sections, but are still within their long-term historic range. Fifty-nine fish in the Bypass Reach were implanted with radio transmitters to monitor their movements seasonally and in response to flow changes. New Zealand mudsnails were at moderate densities in Darlinton Ditch and did not exhibit obvious impacts on baetid mayflies or fish, but did depress periphyton biomass. In a laboratory setting at slightly higher density mudsnails did depress survivorship of baetids. Sentinel young-of-the-year rainbow trout continue to develop severe whirling disease infection in the Madison River. Comparisons between1999 and 2004 rainbow trout spawning characteristics show that timing of spawning remains similar, but a higher proportion of spawning occurred in the Pine Butte section in 2004. A higher percentage of *T. tubifex* were infected with whirling disease in 2004 than in 1999. Water temperature was monitored at 14 sites throughout the Madison River, and air temperature at 7 sites. The Sun Ranch Hatchery was used to incubate westslope cutthroat trout eggs from five streams in 2004, with over 800 young-of-the-year stocked into each of two rearing ponds. The Cherry Creek Native Fish Introduction Project continued in 2004 with the second round of scheduled treatments in Phase I. Results of 2004 treatments revealed that 2003 stream treatments were highly effective, but 57 fish were captured with gillnets in Cherry Lake after the 2004 treatment. Redd counts show that the rainbow trout spawning run into Hebgen Reservoir tributaries was similar to 2003, but less than half as strong as in 2002. Juvenile rainbow and brown trout were captured in screw traps and by other means in two tributaries of Hebgen and coded wire tagged. Fish entrainment was documented in the West Madison Canal, but permission to install a self-cleaning screening system was not granted by the water-right holders due to uncertainties that the screen would operate properly.

TABLE OF CONTENTS

FERC Articles addressed in this report

FERC Article	item	report topic	page number Methods	page number Results
403 - Madison Development	(4)	Madison Bypass	8	28
408	(2)	Hebgen Tributary Spawning	22	37
	(3)	Hebgen Tributary Spawning	22	37
	(5)	Population Estimates	6	28
	(8)	Westslope Cutthroat Trout C&R	15	36
409	(1)	Aquatic Nuisance Species - Whirling Disease	14	35
	(6)	Fish Entrainment	26	40
	(8)	Westslope Cutthroat Trout C&R	15	36
412	(1)	Population Estimates	6	28
	(5)	Madison Grayling	4	26
		Westslope Cutthroat Trout C&R	15	36
	(6)	Madison Bypass	8	28
	(7)	Madison Bypass	8	28
	(8)	Madison Bypass	8	28
	(10)	Westslope Cutthroat Trout C&R	15	36
	(11)	Population Estimates	6	28
413	(1)	Temperature Monitoring	12	33

INTRODUCTION

Montana Fish, Wildlife, & Parks (MFWP) has conducted fisheries studies in the Madison River Drainage since 1990 to assess the status of the Arctic grayling *Thymallus arcticus* population of Ennis Reservoir, and to address effects of hydropower operations at Hebgen and Ennis dams on fisheries (Byorth and Shepard 1990, MFWP 1995, MFWP 1996, MFWP 1997, MFWP 1998a, MFWP 1999a, MFWP 2000, MFWP 2001, MFWP 2002a, MFWP 2003, MFWP 2004a). This work has been funded through an agreement with the owner and operator of the dams, initially Montana Power Company (MPC), now PPL Montana. The original agreement between MFWP and MPC was designed to anticipate relicensing requirements for MPC's hydropower system on the Madison and Missouri rivers, which includes Hebgen and Ennis dams, as well as seven dams on the Missouri River (Figure 1). PPL Montana has maintained the direction set by MPC, and convened several committees to address fisheries, wildlife, water quality, and recreation issues related to the operation of the hydropower facilities on the Madison and Missouri rivers. These committees are composed of representatives of PPL Montana and several agencies. Each committee has an annual budget and authority to spend money that is provided to them by PPL Montana to address the requirements of PPL Montana's FERC license for operating the Madison & Missouri dams. The Madison Fisheries Technical Advisory Committee (MadTAC) is composed of personnel of PPL Montana, MFWP, the U.S. Fish & Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the U.S. Bureau of Reclamation (BLM). Each entity has equal authority in decision making within the TAC. Collectively, the nine dams on the Madison and Missouri rivers are called the 2188 Project, which refers to the Federal Energy Regulatory Commission (FERC) license number that authorizes their operation. The Federal Energy Regulatory Commission issued PPL Montana a license to operate the 2188 Project for 40 years (Federal Energy Regulatory Commission 2000). The license details the terms and conditions PPL Montana must meet during the license term, including fish, wildlife, and recreation protection, mitigation, and enhancement measures.

During the late 1990's, numerous entities developed the Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana (MUCAWCTM). The MUCAWCTM, which was formalized in 1999 (MFWP 1999), identifies Conservation & Restoration Goals and Objectives for westslope cutthroat trout (WCT) *Oncorhynchus clarki lewisi* in Montana. The Plan states "The management goal for westslope cutthroat trout in Montana is to ensure the long-term, self-sustaining persistence of the subspecies within each of the five major river drainages they historically inhabited in Montana (Clark Fork, Kootenai, Flathead, upper Missouri, and Saskatchewan), and to maintain the genetic diversity and life history strategies represented by the remaining populations." Objectives are:

1. Protect all genetically pure WCT populations
2. Protect introgressed (less than 10% introgressed) populations
3. Ensure the long-term persistence of WCT within their native range
4. Providing technical information, administrative assistance, and financial resources to assure compliance with listed objectives and encourage conservation of WCT.

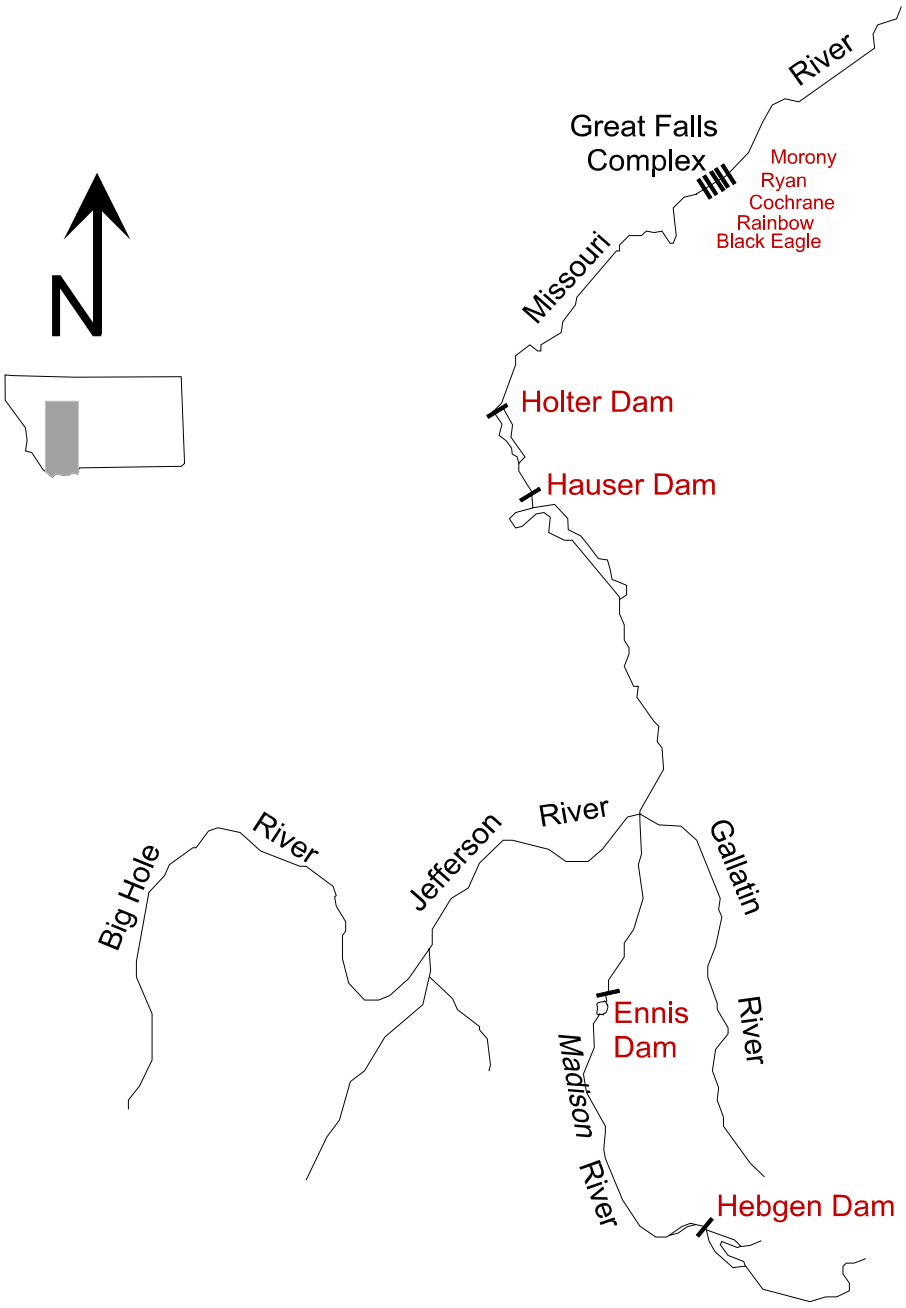


Figure 1. Locations of PPL Montana dams on the Madison and Missouri rivers.

5. Design and implement an effective monitoring program by the year 2002 to document persistence and demonstrate progress towards goal

Objective 3 further states "The long-term persistence of westslope cutthroat trout within their native range will be ensured by maintaining at least ten population aggregates throughout the five major river drainages in which they occur, each occupying at least 50 miles of connected habitat…". Within the Missouri River Drainage, four geographic areas are identified, including the upper Missouri, which consists of the Big Hole, Gallatin, and Madison subdrainages.

Entities participating in the development of the MUCAWCTM were American Wildlands, Montana Chapter of the American Fisheries Society, Montana Department of Natural Resources and Conservation (DNRC), Montana Farm Bureau, MFWP, Montana Stockgrowers Association, Montana Trout Unlimited, Montana Wildlife Federation, Natural Resource Conservation Service, BLM, USFS, USFWS, and private landowners.

Late in 1996, MFWP initiated a program entitled "The Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program". The goal of this effort is to conserve and restore the native westslope cutthroat trout in the Madison River drainage. Fieldwork for this effort began in 1997 in tributaries of the Madison River. The agreement between MFWP and PPL Montana includes provisions to address issues regarding species of special concern.

In recognition of the severity of the situation faced by the westslope cutthroat trout, and in keeping with the philosophy of promoting native species on their properties, Turner Enterprises, Incorporated (TEI) offered access to the Cherry Creek drainage on the Flying D Ranch to assess its suitability for introducing westslope cutthroat. Cherry Creek, a tributary to the Madison River, was identified as an opportune location to introduce genetically pure WCT, and it will provide an opportunity to meet or fulfill MUCAWCTM objectives 3, 4, & 5. MFWP determined in 1997 that introducing westslope cutthroat to Cherry Creek is feasible, but would require the removal of all non-native trout presently in that portion of the drainage (Bramblett 1998, MFWP 1998b). MFWP, TEI, and the Gallatin National Forest (GNF) subsequently entered into an agreement to pursue this effort. The agreement outlines the roles and responsibilities of each party, including the GNF, which manages the public land at the upper end of the Cherry Creek drainage. Administrative and legal challenges of the Cherry Creek Project delayed its implementation from 1999 - 2002. The project was successfully implemented in 2003.

The Sun Ranch has entered into an agreement to assist MFWP with westslope cutthroat trout conservation and recovery. The ranch built a small hatchery facility and a rearing pond to facilitate development of a westslope cutthroat trout broodstock for the Madison and Missouri river drainages, and provided personnel to assist with fieldwork and conduct hatchery operations.

MFWPs' management objective for Hebgen Reservoir is the establishment of a self-sustaining rainbow trout *Oncorhynchus mykiss* fishery. In 1979, MFWP abandoned stocking domesticated strains of rainbows and initiated stocking wild Eagle Lake and

DeSmet strains of rainbow trout (Hetrick 1993). The expectation was that the wild strains would augment existing spawning runs and wild production would exceed hatchery contribution to the Hebgen rainbow trout population (Hetrick 1993). Byorth (2004) suggested that up to a third of the rainbows creeled are of hatchery origin. Consequently, MFWP continues to stock 100,000 fingerling Eagle Lake rainbows annually to supplement the Hebgen rainbow fishery.

Efforts to identify bottlenecks affecting rainbow trout recruitment continued in 2004. In addition to following up portions of the Montana State University graduate work completed in 2003 (Watschke, in prep), a project was undertaken to track the emigration of rainbow fry from the South Fork Madison River into Hebgen Reservoir, and to see if predation on age 0 rainbow trout by Utah Chubs *Gila atraria* was occurring in the reservoir. Tributary surveys were completed by the Hebgen Lake Ranger District (Sestrich 2004) to assess stream condition, identify habitat needs, and conduct redd counts.

METHODS

Madison Grayling

A beach seine (Figure 2) is used to monitor index sites in Ennis Reservoir (Figure 3) for young-of-the-year grayling and other fish species. A 125'x 5'x ¼" mesh seine with a 5'x 5'x 5' bag is fed off a moving boat in water up to five feet deep, with a worker in the water at each end of the seine. The seine is pulled through shallow water near the shoreline for some distance, then onto the shoreline where captured fish are enumerated by species. If beds of macrophytes (aquatic plants) where juvenile fish are likely to rear are present and accessible, the seine is pulled through them.

Figure 2. Beach seining in Ennis Reservoir.

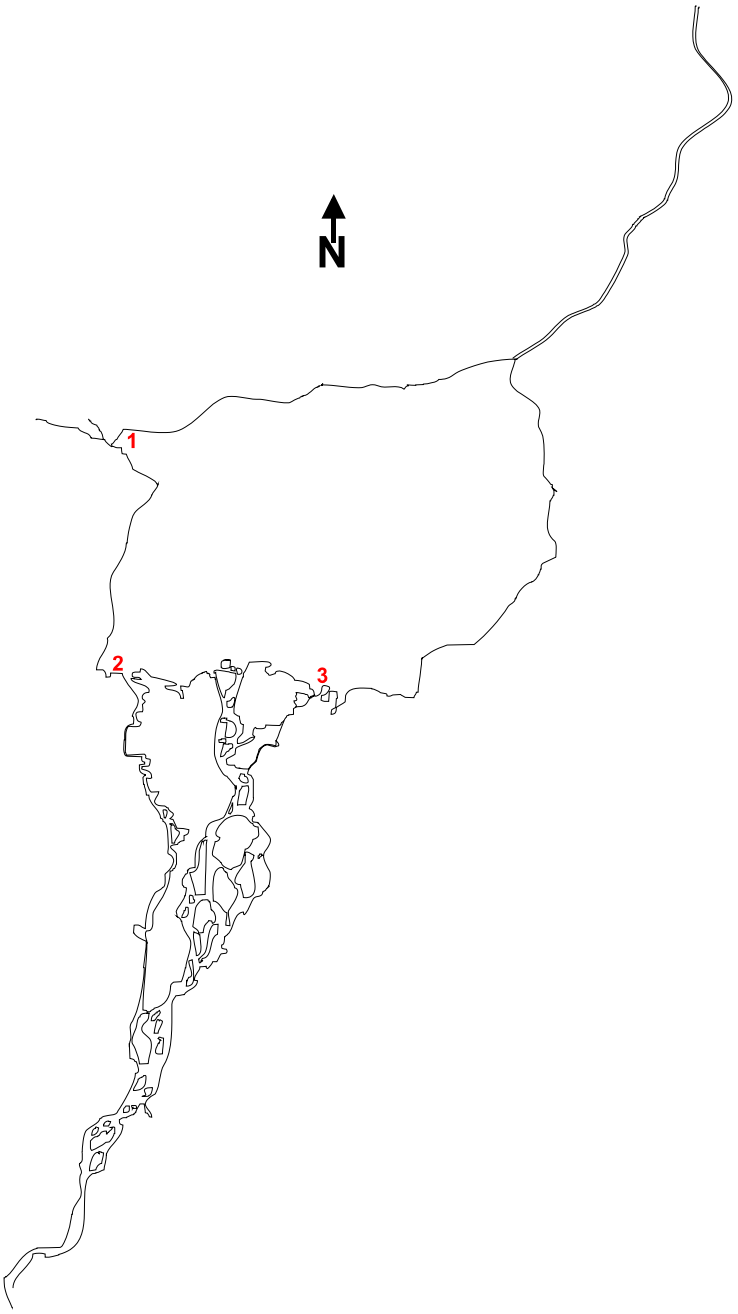


Figure 3. Locations of Ennis Reservoir seining sites.

Surveys of spawning grayling were conducted in April between Valley Garden Fishing Access Site and Ennis Reservoir using mobile anode electrofishing. A review of Montana's grayling populations by the USFWS for consideration of listing as a Threatened species prompted the effort.

Population Estimates

Electrofishing from a driftboat mounted mobile anode system (Figure 4) is the principle method used to capture Madison River trout for population estimates in several sections of the Madison River (Figure 5). Fish captured for population estimates are weighed and measured, marked with a fin clip, and released. A log-likelihood statistical analysis (MFWP 2004b) is used to estimate trout populations. Yearling fish are distinguished from two year old & older fish by taking a scale sample from up to ten of each species per half-inch group, making an impression of the scale in acetate, projecting the impression on a microfiche reader, and interpreting the age of the fish from the scale impression. Generally, the number of two year old & older fish is a better indicator of year class strength and subsequent reproductive potential. Yearling numbers serve as an after-the-fact measure of the impact of whirling disease on reproductive success the previous year. Aging is not complete for samples collect from 2000 - 2003, so fish from 5.0 to 9.9 inches are used to estimate yearling abundance, and fish larger than 9.9 inches are assumed to be two-year-old & older for those years. The estimates may change after aging is completed.

Figure 4. Electrofishing (shocking) in the Norris section of the Madison River.

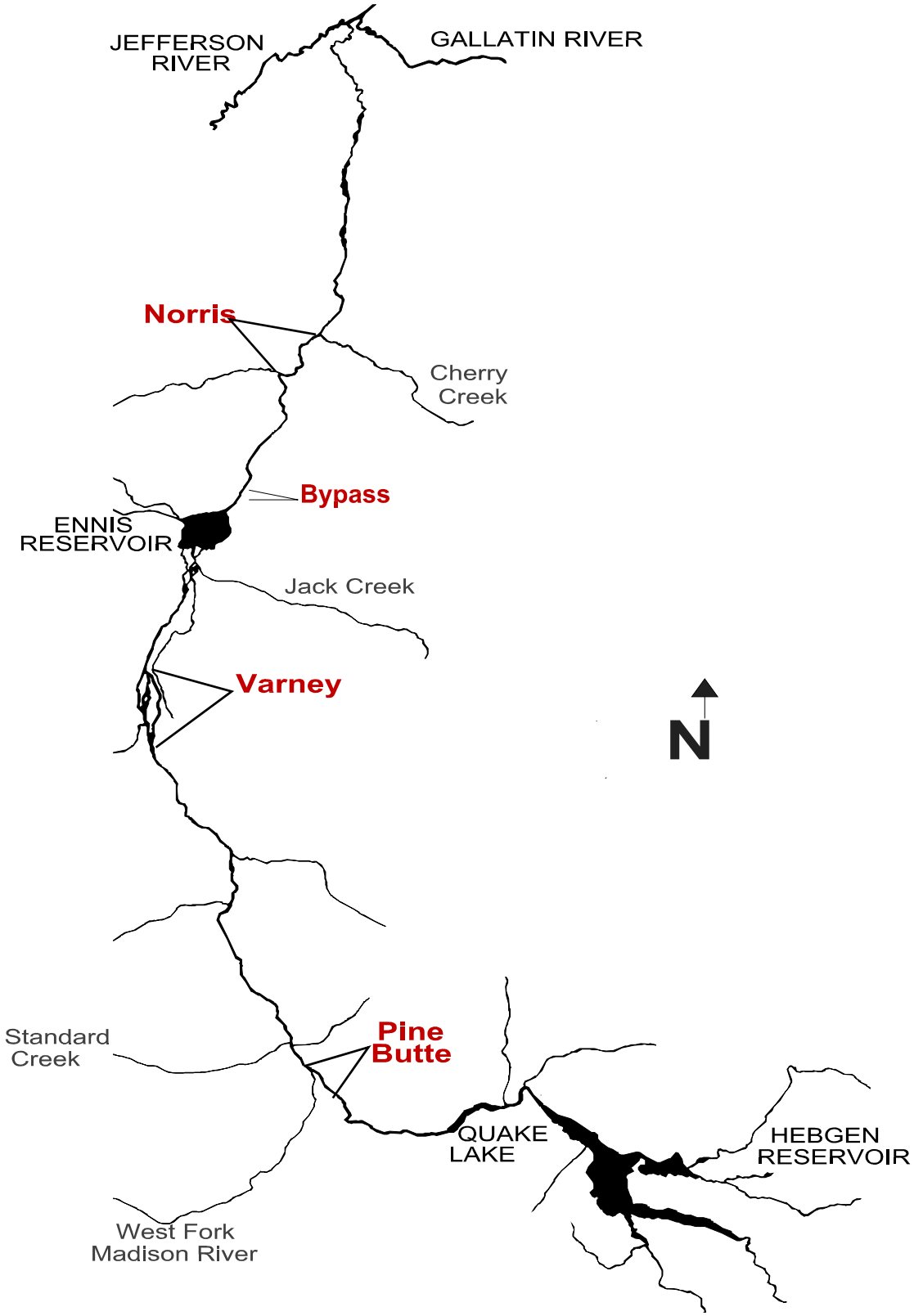


Figure 5. Locations of Montana Fish, Wildlife, & Parks 2004 Madison River population estimate sections.

Madison Bypass

In 2002 a remote radio telemetry monitoring system was installed in the Bypass Reach of the Madison River between Ennis Dam (Figure 6) and Madison Powerhouse to assess fish movement seasonally and in response to changes in river discharge in the Bypass. Radio telemetry receivers are located at two sites to allow monitoring at the upstream and downstream ends of the Bypass. Two antennae are wired into each receiver, with one antenna set to detect transmitters at the base of the dam, one antenna set to detect transmitters at the powerhouse 1.4 miles downstream from the dam (MDNRC 1979), and two antennae set at points between the dam and powerhouse. Each of these antenna detect the transmitter signal only if the fish moves into a narrow section of the river the antenna is set to monitor, though there are some instances of a transmitter being detected on two antennae simultaneously, probably due to signal bounce off the bedrock walls of the canyon.

Figure 6. Ennis Dam on the Madison River. The gray metal pipeline (penstock) on the left transports water from Ennis Reservoir to the Madison Powerplant, approximately 1.4 miles downstream from the dam.

Coded radio transmitters were implanted in 59 fish in the Bypass reach of the Madison River in 2004 (Table 1). All transmittered fish swam away vigorously after recovery from the implant procedure. Two transmitter models were used, one has a rated life of 250 days, the other a rated life of 350 days. The transmitters weigh 7.7 and 9.2 grams, respectively. A rule-of-thumb states that the transmitter should weigh no more than 2 percent of the fish's weight, so this means that the smallest fish to receive a transmitter should weigh no less than 385 grams (0.85 lbs) or 460 grams (1.01 lbs).

Table 1. Statistics of fish implanted with coded radio transmitters in the Bypass Reach of the Madison River, 2004. Rb = rainbow trout; LL = brown trout; MWF = mountain whitefish.

Implant date	Species	Length (inches)	weight (lbs)	Transmitter weight as a percent of fish weight
3/15/04	Rb	15.7	1.38	1.47
	Rb	17.0	1.81	1.12
	Rb	15.2	1.47	1.38
	Rb	16.0	1.47	1.38
	Rb	15.2	1.37	1.48
	Rb	16.2	1.48	1.37
	Rb	16.8	1.74	1.16
	Rb	15.9	1.32	1.54
	Rb	16.8	1.63	1.24
	Rb	17.0	2.08	0.97
	Rb	14.7	1.12	1.81
	Rb	18.2	2.40	0.84
3/25/04	Rb	15.0	1.14	1.49
	Rb	15.1	1.13	1.50
	Rb	16.2	1.18	1.44
	Rb	15.2	1.10	1.54
	LL	17.3	1.49	1.14
	LL	16.0	1.24	1.37
	LL	17.2	1.80	0.94
	LL	16.1	1.39	1.22
	LL	16.6	1.50	1.13
	LL	15.6	1.31	1.29
	LL	16.9	1.56	1.09
	LL	16.2	1.28	1.33
	MWF	15.2	1.24	1.37
	MWF	16.3	1.58	1.07
10/5/04	Rb	14.2	1.19	1.43
	Rb	13.7	0.86	1.97
	Rb	14.2	1.02	1.66
	Rb	13.9	0.89	1.91
	Rb	12.7	0.78	2.17
	Rb	13.4	0.82	2.07
	Rb	14.9	1.05	1.62
	Rb	15.5	1.39	1.22
	Rb	14.7	1.25	1.36
	Rb	16.0	1.49	1.14
	Rb	14.8	1.11	1.53
	Rb	13.7	1.02	1.66
	LL	16.2	1.60	1.06

Table 1, continued

10/5/04	LL	13.9	1.02	1.66
	LL	16.9	1.92	0.88
	LL	18.7	2.01	0.84
	LL	15.7	1.59	1.07
	LL	17.5	1.92	0.88
	LL	21.0	3.28	0.52
	LL	16.9	1.73	0.98
	LL	17.2	1.79	0.95
	LL	17.2	1.70	1.00
	LL	14.3	1.01	1.68
	LL	16.9	1.63	1.04
	LL	14.0	0.92	1.84
	LL	21.5	4.00	0.42
	LL	20.2	2.97	0.57
	MWF	16.7	1.90	0.89
	MWF	15.3	1.21	1.40
	MWF	16.9	1.87	0.91
	MWF	13.4	1.18	1.44
	MWF	16.4	0.88	1.93
10/6/04	Rb	15.0	1.04	1.63

To implant the transmitter, fish are anesthetized to facilitate handling during the implant procedure. After the fish is anesthetized, it is placed ventral side up on foam padding in a tray containing river water and it's head is submersed. A small incision is made on the ventral side of the fish anterior to the pelvic girdle, and the skin posterior to the pelvic girdle is broken with the scalpel. A grooved director is inserted into the body cavity through the anterior incision and fed posteriorly past the pelvic girdle. It is used to capture the tip of a catheter needle that is inserted behind the pelvic girdle and directed anteriorly (Figure 7). This method prevents the sharp tip of the catheter needle from injuring the internal organs of the fish. The transmitter antenna is inserted into the catheter tip and fed posteriorly until the transmitter is inserted into the body cavity (Figure 8). The grooved director and catheter needle are removed from the fish and the incision is closed with surgical staples or sutures (Figure 9). The actual implant procedure, from placement of the fish into the surgical tray to release into the recovery cage, lasts 1– 2 minutes. Fish are held in a live cage until fully recovered. Prior to being released, the incision is examined to insure the closure is secure.

Three relocation flights were conducted to determine where fish migrating out of the Bypass went – one flight in May, one in September, and one in January 2005.

Figure 7. Catheter needle and grooved director being set in place to implant a radio transmitter in a rainbow trout in the Bypass Reach of the Madison River.

Figure 8. Radio transmitter being placed in a rainbow trout. Note the transmitter antenna exiting the body cavity and trailing behind the pelvic fins.

Figure 9. Stapled incision on a rainbow trout after implantation of a radio transmitter in the Bypass Reach of the Madison River.

Temperature Monitoring

Water temperature was recorded at 14 sites and air temperature at seven sites throughout the course of the Madison River from above Hebgen Reservoir to the mouth of the Madison River at Headwaters State Park (Figure 10). Optic StowAway temperature loggers recorded temperature in Fahrenheit every 30 minutes. Air temperature recorders were placed in areas that were shaded 24 hours per day. Intensive monitoring is conducted to corroborate previous modeling, to continue building the data set for the model, and to monitor the effectiveness of measures designed to reduce high temperature impacts to aquatic life.

PPL Montana has implemented a 'pulse flow' system in the Madison River below Ennis Reservoir to address high water temperature that could potentially cause fish kills. Real-time or near real-time meteorological and temperature monitoring is conducted at numerous sites. Data from these sites is used to predict water temperature the following day, which determines the volume of discharge that will occur. The increase in water volume in the lower river reduces the peak water temperature that would occur at the 1100 cfs base flow. Water is released from Ennis Reservoir in the early morning so that it is in the lower river during the warmest part of the day. Up to an additional 1300 cfs may be passed over the dam so that the lower river flows increase from 1100 cfs to 2400 cfs during the heat of the day, reducing the peak temperature. Discharge from Hebgen Dam typically does not fluctuate on a daily basis during pulse flows, but is occasionally adjusted to increase or decrease the volume of water going into Ennis Reservoir, where daily fluctuations in the lower river are controlled.

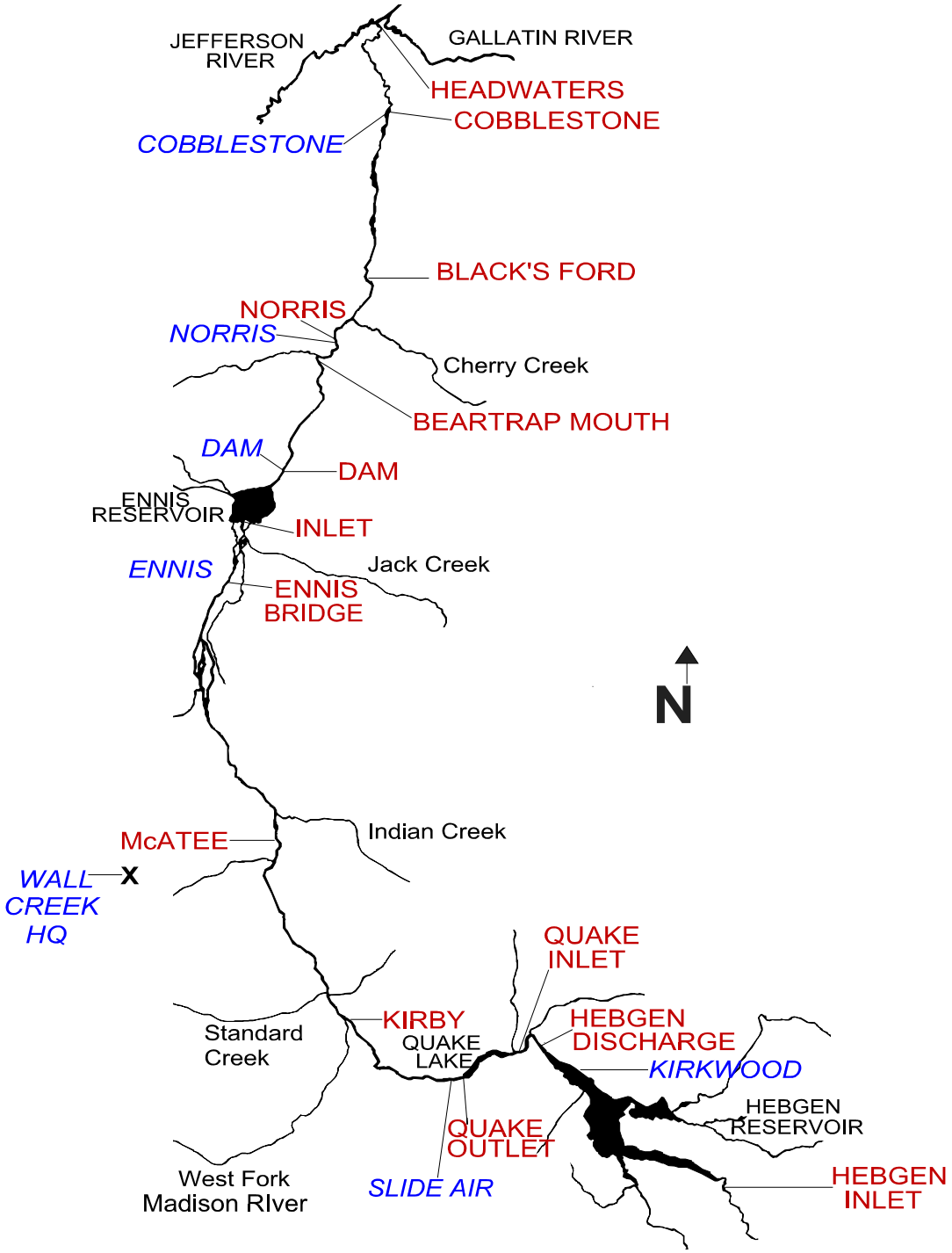


Figure 10. Locations of Montana Fish, Wildlife, & Parks 2004 temperature monitoring sites. Air temperature sites are blue, water temperature sites are in red.

The meteorological and temperature data monitored in the lower river may be viewed in real-time or near-real time at http://www.madisondss.com/ppl-river.cfg/ppl-madison.php.

Aquatic Nuisance Species

Highway signs announcing FWP's West Yellowstone Traveler Information System (TIS) (Figure 11) were placed at 5 locations in spring 2004. The TIS notifies anglers and water recreationists of the presence of New Zealand mudsnails in the Madison River and Hebgen Reservoir, and instructs them on methods of reducing the likelihood of transporting New Zealand mudsnails and other ANS to other waters. Additional messages broadcast by the system include messages on whirling disease, zebra mussels, weed control, and TIPMont, the FWP hotline to report hunting & fishing violations. The system broadcasts at the AM frequency of 1600 KHz. Funding for the purchase installation, and signage of the system was provided by a $9,800 grant from the Pacific States Marine Fisheries Commission as part of an effort to prevent the westward spread of zebra mussels.

Figure 11. Roadside sign announcing the Traveler Information System at West Yellowstone.

The State of Montana hired an Aquatic Nuisance Species Coordinator in 2004. The position is responsible for developing and coordinating ANS control & management activities among state agencies as well as between state and non-state entities. The ANS Coordinator is an employee of FWP.

New Zealand Mudsnails

New Zealand Mudsnails have spread throughout the Madison River since first detected in 1994. Studies in Darlinton Ditch, a spring creek and irrigation canal near Three Forks, to assess New Zealand mudsnails impacts on fish food habits and growth by researchers at Montana Sate University has been completed (Cada 2004).

Whirling Disease

Whirling disease monitoring continued in 2004 in the Madison River using sentinel cage techniques. Each cage holds 50 young-of-the-year rainbow trout for 10 days. At the

end of the 10 day period, fish are transferred to whirling disease free water in a laboratory, where they are held until they are 90 days old, at which time they are euthanized and sent to the Washington Animal Disease Diagnostic Lab (WADDL) for analyses. Additionally, sentinel fish were placed in several tributaries of Hebgen Reservoir - the Madison River, Black Sands Spring, the South Fork of the Madison, and Duck, Cougar, and Grayling creeks.

A study entitled "Evaluation of Increased Survival of Young-of-the-Year Wild Rainbow Trout in the Upper Madison River in the Face of Increased WD Infection Intensities in Wild Rainbow Trout Spawning Areas" (Clancey & Kerans 2004) was undertaken in the Madison River in 2004 to address four objectives:

1) Determine if 2004 young-of-the-year wild rainbow trout have developed an increased resistance to *M. cerebralis* as compared to young-of-the year tested in 1998;
2) Determine if the life history of the upper Madison River rainbow trout has changed allowing them to avoid areas of heavy *M. cerebralis* infections;
3) Determine if the spawning period of rainbow trout has shifted to dates earlier or later then those found in 1998 and 1999, thus taking advantage of dates where infection risk is lower, and;
4) Determine if infection in tubificids and *Tubifiex tubifex*, abundances of tubificids and *T. tubifex*, and environmental conditions have changed since 1999 in selected spawning and rearing areas.

Dave Kumlien, Executive Director of the Whirling Disease Foundation, presents two articles regarding whirling disease on the Blue Ribbon Flies webpage. These articles summarize some of the advances that have been made by whirling disease researchers and additional information that is needed. To view these and other articles, go to www.blueribbonflies.com, click on Journal, then on Articles and Essays.

Westslope Cutthroat Trout Conservation and Restoration

Efforts to conserve and restore genetically pure westslope cutthroat trout in the Madison Drainage center on maintaining genetically pure populations, high quality stream habitat, adequate instream flow, and, where necessary, removal of competing or hybridizing non-native trout. Stream habitat surveys were conducted throughout much of the Madison Drainage from 1997 – 1999 (MFWP 1998a, Sloat et al. 2000). Backpack electrofishing was used to survey fish species. Removal of non-native species will require use of the EPA registered fish-pesticides (piscicides) rotenone or antimycin.

Sun Ranch Westslope Cutthroat Trout Brood

Gametes for the Sun Ranch Westslope Cutthroat Trout program were collected from five streams in 2004, including three streams in the Elkhorn Mountains. Only sperm was collected from the population of one stream in the upper Madison Drainage, and was used to fertilize eggs collected from one Elkhorn population.

All fertilized eggs were transported to the Sun Ranch Hatchery for incubation and

hatching (Figure 12), and resulting fry were transferred to the Sun Ranch Rearing Pond (Figure 13) or to another privately owned pond near Toston. These fish will be used to produce fertilized eggs that will be placed in streamside incubators to seed new populations of westslope cutthroat trout or to propagate the brood population of the Sun Ranch Pond.

Occasionally, when project personnel are unavailable to do so, USFWS personnel from the Ennis National Fish Hatchery caretake the eggs or fry at the Sun Ranch Hatchery. Generally, this requires few days each year, but is an important contribution to the program.

Cherry Creek Native Fish Introduction Project

The Cherry Creek Native Fish Introduction Project was initiated in 2003. The project area is comprised of over 60 miles of stream habitat and the 7-acre, 105 acre-foot Cherry Lake, and includes all of the Cherry Creek Drainage upstream of a 25-foot waterfall approximately 8 miles upstream of the Madison River confluence. Species present in the project area are brook trout, rainbow trout, and Yellowstone cutthroat trout (YCT) (Figure 14). The large size of the project area requires that the project be completed in phases. Each phase will be treated for at least two consecutive years. The areas treated in 2003 & 2004 were Cherry Lake and its outlet stream and tributaries downstream to a barrier that prevents brook trout from moving upstream into the area occupied solely by YCT, and main Cherry Creek above a barrier that prevents brook trout from moving upstream into the area occupied solely by rainbow trout. Both treatment areas are primarily on the GNF (Figure 14).

Preparatory fieldwork consisted of relocating application station markers, posting sentinel fish downstream of the 2004 treatment area, setting up the detoxification station, and some electrofishing to assess thoroughness of 2003 treatments. Since water chemistry parameters were unchanged from 2003, bioassays were not conducted in 2004. Bioassay results from 2003 are available (MFWP 2004a). Fintrol was applied to streams in 2004 at 10 ppb, the same concentration used in 2003. Treatments were initiated on August 1 at Cherry Lake.

Stream discharge for stream treatments was measured following standard USGS protocols, and a staff gauge was temporarily put in place to determine if discharge changed appreciably during or prior to treating a given section of stream. Discharge was measured in a stream section the evening prior to treatment of that section, which allowed calculation and preparation of the piscicide that night or the next morning.

An inflatable raft and outboard motor were used to distribute Fintrol throughout Cherry Lake (Figure 15). Two people occupied the raft, one steering the raft, the other periodically filling a 14-gallon container with a mixture of Fintrol and lake water. A venturi suction system was used to apply the Fintrol mixture to the lake through plastic tubing and a metal piece affixed to the outboard motor near the propeller. The lake was then monitored both visually and with gillnets. The lake was treated to a concentration of nearly 11.2 ppb on August 1, with no subsequent application of Fintrol in 2004. Permission to use the gas motor in the Wilderness Area was received from the USFS

Figure 12. Sun Ranch Hatchery rearing troughs.

Figure 13. Sun Ranch westslope cutthroat trout rearing pond.

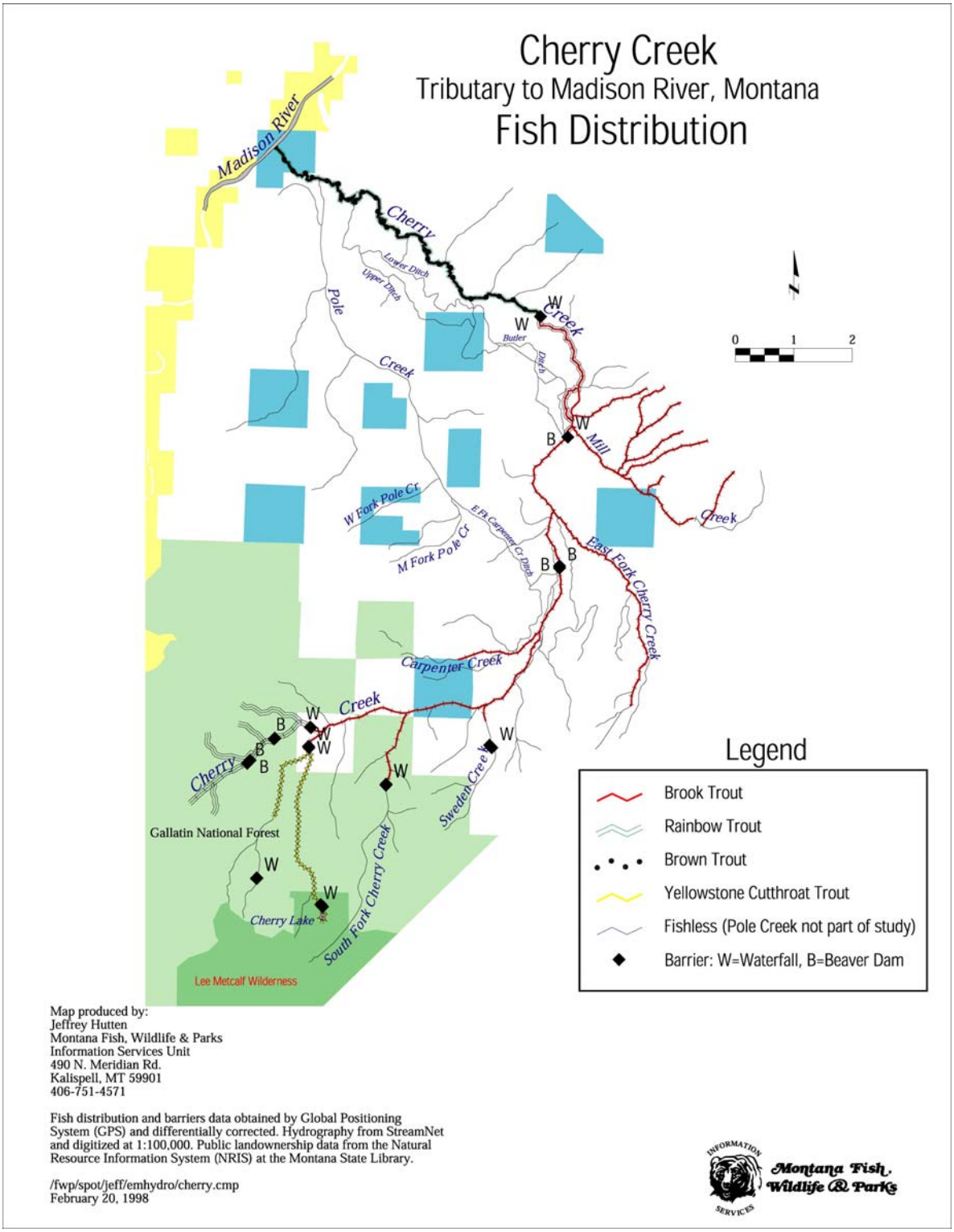


Figure 14. Cherry Creek Drainage. Landownership patterns have changed since this map was produced.

Figure 15. Inflatable raft set-up used to apply Fintrol to Cherry Lake. Note the red dyed liquid in the tubing on the port side of the raft.

during the EA process in 1998. Simultaneous with the lake treatment, drip stations and backpack sprayers were used to treat the inlet streams, the lake perimeter areas too shallow for the raft to access, and a section of the outlet stream.

Stream treatments were made using trickle application systems (Figure 16). The system consists of a 3½ gallon plastic bucket & lid, garden hose, a gate valve, and a commercially available automatic dog watering bowl. A plastic elbow is fixed to a hole drilled in the bottom of the bucket, a short section of garden hose and the gate valve is clamped to the elbow (Figure 17), and a longer section of garden hose attached the assembly to the dog waterer. The bucket is partially filled with filtered stream water, the Fintrol is added, then the bucket is topped off with filtered stream water and stirred with a wooden dowel. At a predetermined time, the gate valve is opened, allowing the mixture to flow into the bowl, where it then trickles into the stream through a small hole drilled in the bottom of the bowl (Figure 18). Typically, one bucket empties in 3 to 3½ hours. Applications are designed using a 7-hour application period, so the bucket must be refilled and the process repeated once at each application point each day.

Figure 16. Trickle system and sentinel fish bag on Cherry Lake Creek. The sentinel fish bag is upstream of the Fintrol application point to monitor the effectiveness of the station above the one shown here.

Figure 17. Elbow & gate valve assembly.

Figure 18. Close-up view of the dog waterer trickling Fintrol mixture into the stream during the Cherry Creek Project.

Treatments on the Cherry Lake fork of the drainage were begun on August 1 at the outlet of Cherry Lake, and proceeded downstream through August 5. These treatments included a large unnamed tributary to Cherry Lake Creek. Treatments on the Cherry Creek fork were initiated on August 7 and continued through August 11. A section of Cherry Lake Creek was re-treated on August 12 because a significant rainstorm on the night of August 2 doubled streamflow so the August 3 Fintrol treatment was only ½ the intended concentration. The August 12 treatment was used to bring the cumulative concentration of Fintrol in that section to 10 ppb.

Stations were placed at selected points along the stream and started at predetermined times to coordinate application of the mixture with the other stations along the stream. Backpack sprayers were used each day to treat off-channel water and larger pools. The 5 gallon sprayers were filled with water and Fintrol mixture in the same manner as the stationary trickle systems, with 10 ml Fintrol per 5 gallons (18,927 ml) water, so the Fintrol concentration in the spray tank was 528,346 ppb, necessitating only small amounts of spray from the backpack sprayer to treat standing water areas.

Aquatic invertebrates and amphibians were monitored and exposed to treated waters in experimentally designed studies during the course of the treatments.

Hebgen Reservoir Tributary Spawning

Juvenile Fish Trapping

Based on previous studies (Watschke in prep, Hetrick 1993), two streams were selected to monitor juvenile rainbow trout production. Duck Creek originates in the northwestern portion of Yellowstone National Park (YNP) and flows westerly into Hebgen Reservoir. A screw trap was placed 100 yards downstream of U.S. Highway 191 to monitor young-of-the-year and yearling rainbow trout emigration into Hebgen. The Duck Creek screw trap was operated from April 8 through July 2, 2004.

The South Fork Madison River is a tributary of Hebgen Reservoir that originates at Reas Pass on the Montana-Idaho border. It flows northerly for approximately 19 miles where it enters Hebgen. A screw trap was installed approximately ¾ miles north of the US Highway 20 bridge (Figure 19). Trap operation began on April 8th and ceased September 28th.

Fish less than 50mm captured in the screw traps were sorted from debris and removed from the traps using a rectangular screen and small aquarium nets, larger fish were removed with dip nets. All fish were placed in a holding container until they were worked. Fish were identified to species, enumerated, marked with a fin clip, and rainbow trout were injected with a coded wire tag. After being worked, fish were held in a live car until they recovered, then released below the trap.

Figure 19. South Fork Madison screwtrap. MFWP photo by Chad Taber.

Efficiency trials were conducted periodically during trapping operations. After being captured, worked, and marked, fish were released at a site 150 yards above the trap on Duck Creek, and at a site 200 yards above the South Fork Madison trap. Fish larger than 25 mm were used to evaluate trap efficiency.

Coded Wire Tagging

Coded-wire tagging is a method of marking fish with a small injectable uniquely numbered magnetized wire (Figure 20). The wire has a 0.25 mm diameter and is cut from a roll by an injector that implants the tag hypodermically. The wire is cut by the injector to a length of 1.1 mm or 0.5 mm.

A coded wire tagging study was conducted at the Bozeman Fish Technology Center to determine if coded wire tagging would be a feasible method for identifying and monitoring y9oung-of-the-year rainbow ranging from 19mm to 24mm total length. Fish were separated into four lots each containing 250 fish. Lots A and B were anesthetized and then tagged using different head molds. Various head molds were tested to determine which was easiest and most efficient to manipulate fry into for tag injection. Lot C was anesthetized but not tagged, and lot D was used as the control group, so was not anesthetized or tagged. After tagging, fish were held in the appropriately labeled bin and observed for behavioral changes, which result from deep tag placement, and for mortality. Tag retention was checked in lots A and B daily for one week by scanning fish with a coded wire tag detector. On July 1st, 481 rainbow fry were tagged at the South Fork Madison trap site to determine if the same results could be obtained in a field setting. Mortality and retention were observed in the fry for four days.

Figure 20. Coded wire tagging a 22 mm rainbow trout. MFWP photo by Chad Taber.

Coded wire tags were injected into young-of-the-year and yearling rainbow trout to track emigration, to explore Utah Chub predation on rainbow fry, to serve as a mark for determining wild versus hatchery contribution to the reservoir fishery, and to identify which tributary is the main contributor to the rainbow population in Hebgen. Rainbow fry captured in screw traps were sorted from other fish species and placed in a large holding container. Prior to tagging they were separated into batches of approximately 20 and anesthetized. Once the fry were tagged, they were scanned to confirm the presence of the tag and then placed in a holding tank to recover. A small number fry were sacrificed periodically and dissected on site to ensure tag placement was appropriate. Once recuperated, they were subjected to a Bismarck Brown dye bath. The dye remained on the fish about six days, and was used as an aid in identifying previously tagged fry during recovery efforts such as electrofishing and downstream trapping. Tagging was conducted through August 11.

Coded Wire Tag Recovery

Three sock-type fry traps were installed approximately three miles downstream of the South Fork Madison screw trap to recapture tagged fry. The traps were constructed of electrical conduit and clear plastic containers attached to a fine mesh sock. The traps were operated from July 5 through August 3. Traps were placed along the bank margins to maximize the probability of capturing emigrating fry. The traps were cleaned and checked daily, if possible, and operated seven days per week. All fish captured were enumerated and identified to species; rainbow fry were scanned for the presence of a coded wire tag and examined for physical evidence of Bismarck Brown dye. In addition, all rainbow fry that did not exhibit presence of a coded wire tag or Bismarck Brown dye were coded wire tagged to increase the number of fry marked for the reservoir portion of the study.

Electrofishing was also used to recover coded wire tagged fry in the South Fork Madison River and in shoreline areas of Hebgen Reservoir. A backpack shocker was used to sample the South Fork Madison River and a boat mounted boom shocker was used to sample the reservoir shoreline in the South Fork Madison Bay. Six sample sections were established in the South Fork between the screw trap and the river mouth. Bank margins, macrophytes and backwaters were electrofished. Captured fry were enumerated and scanned for the presence of coded wire tags.

Gut Analysis

Gastric lavage was performed on adult mountain whitefish *Prosopium williamsoni*, rainbow trout and brown trout *Salmo trutta*. Stomach contents were analyzed for the presence of rainbow fry and for coded wire tags. Utah chub stomachs were removed for gut content analysis and to look for the presence of coded wire tags.

Stream Temperature and Flow Monitoring

Staff gauge sites were established on Duck Creek and the South Fork Madison and calibrated with periodic stream discharge measurements throughout the study. A gauge reading was taken each day the screw traps were worked. Discharge measurements were taken using a AA velocity meter following standard USGS protocols.

Tributary temperatures were monitored using Onset Tidbit temperature Loggers. Tidbits were installed in the following tributaries in February and were collected in November: Duck Creek, Cougar Creek, Grayling Creek, Black Sands Springs Creek, South Fork Madison River, Madison River, Cherry Creek, and Trapper Creek. The Grayling Creek Tidbit was not recovered.

Redd Counts

Redd count surveys were conducted as a joint effort in 2004 between MFWP and USFS personnel in continuation of an effort to monitor tributary contribution for the Hebgen Basin (Watschke, in prep). Surveys were initiated after run off. Redds were visually identified by the characteristic half moon depression and berm on the downstream side of the depression (Figure 21). Redd surveys were conducted on the South Fork Madison, Black Sand Springs, Gneiss, Campanula, Grayling, Cherry, Watkins, Rumbaugh, Trapper, and Duck creeks.

Figure 21. Rainbow trout redd. Darin Watschke photo.

Fish Entrainment

Efforts have been initiated to evaluate fish entrainment into irrigation ditches along the Madison River. With permission of the water right holders, surveys are conducted in the Fall to determine if significant numbers of fish enter into ditches and become stranded there after the headgate is closed, and thus lost to the river population. Surveys are conducted several consecutive years and also will be conducted as drought diminishes and normal and high water years occur.

RESULTS AND DISCUSSION

Madison Grayling

A total of 19 grayling were captured in 24 man-days of shocking in the Channels section just upstream of Ennis Reservoir in April. Size ranged from 11.9 to 16.4 inches and 0.51 to 1.43 pounds.

Arctic grayling require loose, recently scoured gravels and cobbles to broadcast their eggs over during spawning each spring (Byorth and Shepard 1990). It is possible that winter and spring ice scour on stream banks makes such gravels available. The duration and severity of the Madison River ice gorge may affect the spawning success of the Ennis Reservoir grayling. The Madison River ice gorge (Figure 22) occurred in November 2002, and for approximately all of March 2003 but occurred for a relatively short period in March 2004. During none of these periods did the gorge extended far upstream beyond the Town of Ennis. Formal records of the ice gorge are not kept, so correlating past icing conditions to corresponding year-class strength of Ennis Reservoir grayling is not possible.

Beach seining in Ennis Reservoir for young-of-the-year Arctic grayling was conducted in late September. One young-of-the-year grayling was captured in Meadow Creek bay, and 9 young-of-the-year mountain whitefish were captured along the south end of the reservoir and in Meadow Creek bay. Site descriptions, catch, and additional information are in Appendix A. In post-spawning surveys, Jeanes (1996) found young-of-the-year Arctic grayling and mountain whitefish are sympatric in both the river and reservoir.

The USFWS is re-evaluating the petition to list fluvial Arctic grayling as a Threatened species in light of a lawsuit filed in 2003 by the Center for Biological Diversity (CDB). The USFWS has proposed to CBD that they will complete a listing review by April 2007. A listing would likely include all grayling populations construed to be fluvial, either through behavioral traits or genetic similarity to Big Hole River fluvial (river-dwelling) grayling. Madison grayling are genetically very similar to Big

Figure 22. The Madison River ice gorge at the U.S. Highway 287 Bridge at Ennis, November 2002.

Hole fish, but exhibit adfluvial behavior. They reside in Ennis Reservoir all year except when they enter the Channels area of the Madison River in April to spawn.

Genetic differences between organisms are measured on a scale ranging from 0 (alleles at all loci are identical) to infinity (alleles at all loci are different). An allele is a variable form of a gene. Arctic grayling populations across Montana and Wyoming exhibit very little genetic variation from one another (Leary 1990). The maximum distance between all grayling populations examined (fluvial and adfluvial) is 0.0132.

MFWP is developing a Candidate Conservation Agreement with Assurance (CCAA) for fluvial Arctic grayling in the Big Hole Drainage. Landowners who sign onto the CCAA must develop and implement pro-active site-specific land management conservation measures in cooperation with agencies that will reduce or eliminate detrimental habitat conditions for the grayling. If the grayling subsequently becomes listed as a Threatened or Endangered species, participating landowners will not be required to take additional measures on their property beyond those identified in their plan.

Population Estimates

Population estimates were conducted in the Norris section in March and in the Pine Butte and Varney sections in September (Figure 5). Aging of samples collected from 2000-2004 is not complete except for the Norris section in 2000 and the Pine Butte section through 2003. Until age sample analyses are complete, estimates are provisional.

In the charts illustrating annual population trends, stacked bars represent yearling and age 2 & older classes, with the top of the combined bars depicting the total population. Because Norris estimates are conducted in March each year, yearling fish are too small to capture in adequate numbers to derive an estimate of their abundance.

Figures 23-25 illustrate historic population levels of rainbow trout per mile for the three estimate sections completed in 2004. In Pine Butte, age 2 & older rainbows remain similar to the previous year, but yearling numbers decreased. The rainbow population in Varney remained very similar to the previous year, while age 2 & older in Norris decreased from the previous year, but remain high compared to historic trends.

Brown trout numbers per mile are illustrated in Figures 26-28. In Pine Butte, the number of age 2 & older brown trout decreased compared to 2003, but yearling numbers are high. In Varney, yearling and age 2 & older remain high, but they decreased in the Norris section.

Appendix B contains historic population levels of two year old & older rainbow and brown trout (+ 80% C.I.) for each section.

Madison Bypass

Sixteen of the 59 fish radio tagged fish in the Bypass section in 2004 were documented to have departed the Bypass. Table 2 summarizes information about fish relocated during tracking flights in 2003 through January 3, 2005. Fish were relocated in the river as far downstream as the lower end of the Cobblestone Fishing Access Site, a distance of approximately 30 river miles.

Rainbow and brown trout populations in the Bypass (Figure 29) compare favorably with population levels in other sections of the Madison River (Figures 23-28). The preponderance of holding sites among the boulder and cobble substrate allows for a greater density of fish than other river sections. Whirling disease did not have a severe population impact on trout in the Bypass and Norris sections downstream of Ennis Reservoir, presumably due to the different temperature regime than that which exists in the upper river.

Based on the strong population of both rainbow and brown trout in the Bypass and the accessibility Bypass fish have to spawning habitat throughout the lower river as shown by radio tracking, placement of spawning gravel in the Bypass is not necessary. Availability of spawning habitat is not limiting the trout population in this short section of the river.

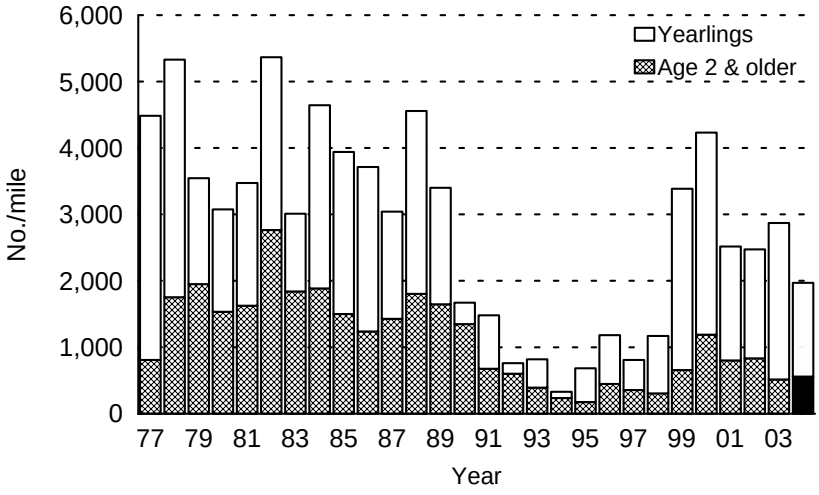


Figure 23. Rainbow trout populations in the Pine Butte section of the Madison River, 1977-2004, fall estimates. Data for 2004 are provisional pending completion of age samples.

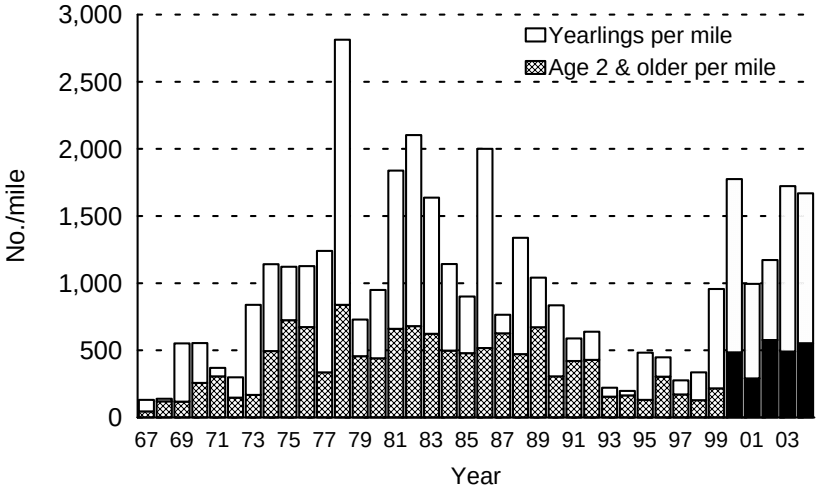


Figure 24. Rainbow trout populations in the Varney section of the Madison River, 1967-2004, fall estimates. Data for 2000 - 2004 are provisional pending completion of age samples.

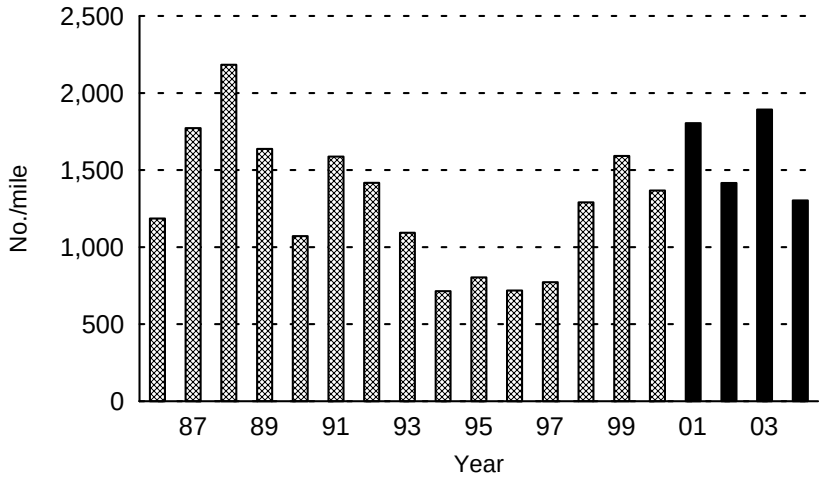


Figure 25. Rainbow trout populations in the Norris section of the Madison River, 1986-2004, spring estimates. Data for 2001 - 2004 are provisional pending completion of age samples.

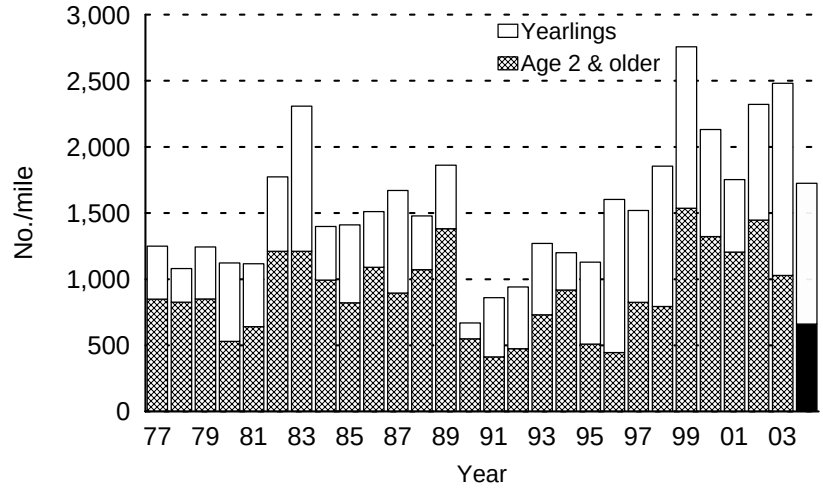


Figure 26. Brown trout populations in the Pine Butte section of the Madison River, 1977-2004, fall estimates. Data for 2004 are provisional pending completion of age samples.

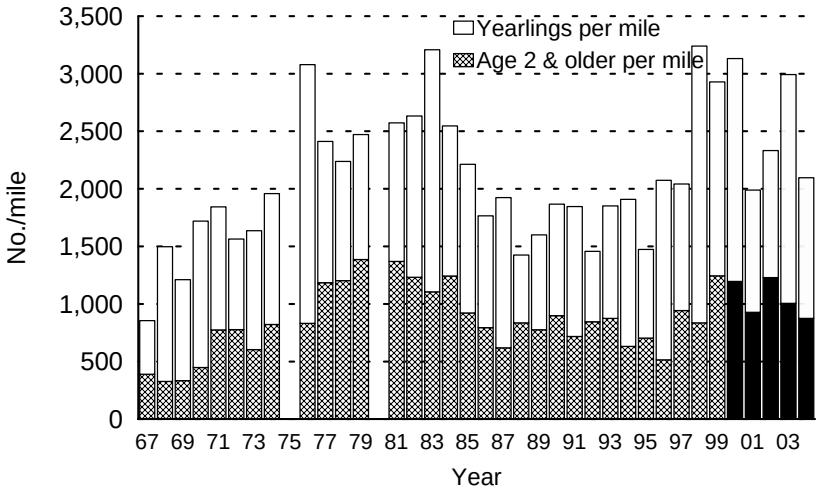


Figure 27. Brown trout populations in the Varney section of the Madison River, 1967-2004, fall estimates. Data for 2000 - 2004 are provisional pending completion of age samples.

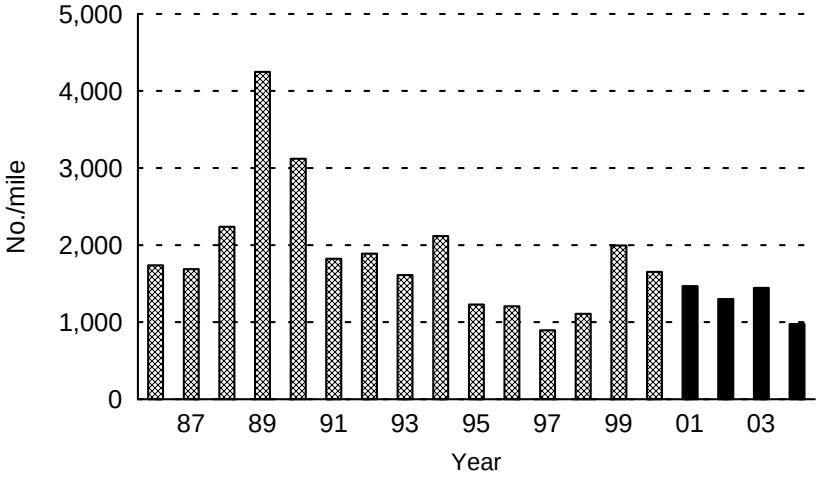


Figure 28. Brown trout populations in the Norris section of the Madison River, 1986-2004 spring estimates. Data for 2001 - 2004 are provisional pending completion of age samples.

Table 2. Length (inches), gender, & location information of fish captured in the Madison Bypass 2002 - 2004, implanted with radio transmitters, and later relocated below the Bypass. Rb = rainbow trout; LL = brown trout; MWF = mountain whitefish.

	Length/gender[A/]	Implant date	Departed Bypass	Relocation date	Relocation site[B/]
Rb	13.7 U	11/6/02	1/2/03	6/9/03	2
Rb	13.2 U	11/6/02	2/17/03	6/9/03	2
Rb	13.9 U	11/6/02	5/15/03	6/9/03	3
Rb	14.7 U	4/16/03	4/26/03	6/9/03	5
LL	20.2 U	4/16/03	Unknown	6/9/03	2
LL	15.5 U	4/16/03	5/28/03	6/9/03	2
Rb[C/]	15.7 F	3/15/04	4/6/04 6/4/04	5/5/04 9/14/04	3 3
Rb	16.2 M	3/15/04	4/25/04	5/5/04	5
Rb	18.2 M	3/15/04	4/10/04	5/5/04	3
Rb	17.0 F	3/15/04	7/4/04	9/14/04	2
Rb	16.8 M	3/15/04	7/19/04	9/14/04	4
Rb	14.7 M	3/15/04	4/30/04	9/14/04	2
Rb	18.2 M	3/15/04	4/10/04	9/14/04	3
Rb[D/]	15.0 U	10/6/04	11/28/04	1/3/05	5
LL	15.6 M	3/25/04	8/13/04	9/14/04	2
LL	16.9 F	10/5/04	10/14/04	1/3/05	3
LL	17.5 U	10/5/04	10/10/04	1/3/05	3
LL	21.0 M	10/5/04	11/5/04	1/3/05	3
LL	20.2 U	10/5/04	11/9/04	1/3/05	4
MWF	16.9 U	10/5/04	10/9/04	1/3/05	6
MWF	13.4 U	10/5/04	10/16/04	1/3/05	2
MWF	16.4 U	10/5/04	10/10/04	1/3/05	6

[A/]F= female; M= male; U= undetermined

[B/]Relocation sites: 2 = Madison Powerhouse to Beartrap Ck.
3 = Beartrap Ck to Warm Springs FAS
4 = Warm Springs FAS to Blacks Ford FAS
5 = Blacks Ford FAS to lower end Greycliff FAS
6 = lower end Greycliff FAS to Cobblestone FAS parking lot
7 = Cobblestone FAS parking lot Interstate 90
8 = Interstate 90 to Missouri River

[C/]Returned to the Bypass on May 17 before departing again on June 4.

[D/]Caught, implanted, and released in the pool at the base of Ennis Dam.

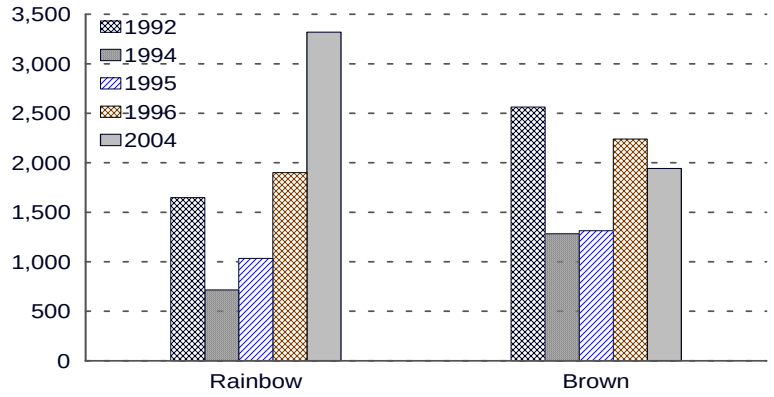


Figure 29. Population estimates (number/mile) of rainbow and brown trout in the Bypass section of the Madison River, spring estimates. Discharge (cfs) in the Bypass during estimates were: 1992, 1118-1685; 1994, 90; 1995, 355-560; 1996, 82-200; 2004, 100. 1992 estimate by PPL Montana personnel.

Presently there is no evidence that trout exhibit a strong effort to pass upstream of Ennis Dam. A few rainbow trout are observed in the spring attempting to leap the dam, and none of the radio tagged fish migrate up to the dam during spawning season or any other time of year.

Temperature Monitoring

Optic StowAway temperature recorders were deployed throughout the Madison River to document air and water temperatures (Figure 10). Table 3 summarizes the data collected at each location in 2004, and Appendix C1 contains thermographs for each location. Appendix C2 contains thermographs at selected locations showing the 24-hour diurnal temperature fluctuation of each site around the warmest date of the year.

Aquatic Nuisance Species

New Zealand Mudsnails

The Montana Aquatic Species Coordinator is developing a plan to address New Zealand mudsnails. Specifically, these actions include :

1) petitioning New Zealand mudsnails for listing as a Prohibited species in Montana.
2) Developing a statewide management plan for New Zealand mudsnails, an important portion of which will describe actions to be undertaken when New Zealand mudsnails are found in or near a hatchery.
3) Increasing monitoring efforts statewide.

Table 3. Maximum and minimum temperatures (^{o}F) at selected locations in the Madison River Drainage, 2004. Air and water temperature data were recorded 4/24-10/6 (7944 readings) unless otherwise indicated. Thermographs for each location are in Appendix C1.

	Site	Max	Min
Water	Hebgen inlet	78.52	42.81
	Hebgen discharge	63.37	38.35
	Quake Lake inlet	64.57	37.31
	Quake Lake outlet	62.91	38.81
	Kirby Bridge	69.89	36.21
	McAtee Bridge	70.05	33.28
	Ennis Bridge	73.71	33.00
	Ennis Reservoir Inlet	75.05	33.71
	Ennis Dam	74.64	47.40
	Bear Trap Mouth	78.78	44.95
	Norris	79.35	44.36
	Blacks Ford	79.67	42.93
	Cobblestone	81.64	42.38
	Headwaters S.P. (Madison mouth)	79.84	41.45
Air	Kirkwood Store	83.44	23.43
	Slide	99.94	25.65
	Wall Creek HQ	90.31	24.13
	Ennis	98.01	23.40[1/]
	Ennis Dam	91.38	28.30
	Norris	88.29	33.63
	Cobblestone	86.85	27.15

[1/] The minimum temperature detectible by the recorders is approximately 23.4^{o}F.

4) Conducting boat inspections at several popular FAS in 2005, many of which are on the Madison River. This effort will assist with public education/outreach and also ensure boats are not spreading New Zealand mudsnails or other ANS.
5) Pursue purchase of a portable power washing system for cleaning boats and trailers.

Researchers at Montana State University completed their study entitled "Interactions between the invasive New Zealand Mud Snail, *Potomopyrgus antipodarum*, Baetid mayflies, and fish predators" (Cada 2004), conducted at Darlinton Ditch and in controlled laboratory settings. They could not demonstrate a negative effect of New Zealand mudsnails on baetid mayflies or fish in Darlinton Ditch, but did see indications of depressed periphyton biomass and baetid survivorship in the lab. They conclude that New Zealand mudsnails, at moderate densities of 10,000/m^2 – 15,000/m^2, will not have significant impact on baetid mayflies or fish growth, but can depress periphyton biomass. However, based on additional studies (Kerans, pers.comm.), negative impacts on baetid survivorship may begin at densities of 25,000/m^2. Additionally, as New Zealand mudsnail populations continue to develop, their currently patchy distribution may expand to become more uniform, and there may be less space available for baetids and other invertebrates to escape the impacts of New Zealand mudsnails.

Additional information on Aquatic Nuisance Species is on the web at www.anstaskforce.gov and www.protectyourwaters.net, and for New Zealand mudsnails specifically, is available at www.esg.montana.edu/aim/mollusca/nzms.

Whirling Disease

To date, few results of 2004 Madison River whirling disease samples have been received from WADDL, but those that have been received indicate high infection rates & severity between Quake Lake Dam and Lyons Bridge. Both mainstem and side channel sites exhibited average severity greater than 4.0 on the MacConnell- Baldwin Scale (Appendix D).

Infection severity of sentinel cage fish at specific sites in the Madison River has been high every year since cages were deployed except in 1998 and 1999. Relatively high May-June runoff in those years apparently resulted in lower infection of young-of-the-year rainbow trout, which was seen in the 1999 and 2000 yearling estimates (Figure 23). Sites that previously showed low to moderate infection are now showing higher infection rates and severity (Clancey & Kerans 2004, Elwell & Kerans 2005). In 2000-2002, average infection severity at the Kirby cage in the Pine Butte section has equaled or exceeded 4.0, but the rainbow trout population in the Pine Butte section exceeded what would have been expected at such high infection severity (Vincent et al 2005). The population has decreased since 2002 possibly due to the significantly higher number of spores being produced by the *T. tubifex* worms. Additional analyses are being conducted to further evaluate the possible reasons for the improved survival of wild Madison River rainbow trout produced in 2000-2002.

Results also have not been received for sentinel cages placed in Hebgen Reservoir tributaries, however, one juvenile rainbow captured in the South Fork Madison River screw trap exhibited symptoms of whirling disease.

Results of the study "Evaluation of Increased Survival of Young-of-the-Year Wild Rainbow Trout in the Upper Madison River in the Face of Increased WD Infection Intensities in Wild Rainbow Trout Spawning Areas" (Clancey & Kerans 2004) indicate that 40 percent of rainbow trout spawning occurred in the Pine Butte section in 2004 compared to 27 percent in 1999. Correspondingly, 60 percent of rainbow spawning occurred in the Raynolds Pass section in 2004 compared to 73 percent in 1999. Spawning occurred from late March through early June in both years with redds constructed at similar times relative to water temperature cues. Kruger (2002) found less than five percent of *T. tubifex* were infected with whirling disease at her sample sites in June 2000, but in June 2004 that proportion had increased to at least 36 percent, and could possibly be higher once the most accurate analyses technique is determined (Kerans pers.comm.). June is a critical period when young-of-the-year rainbow trout are highly vulnerable to whirling disease infection.

Information on whirling disease, including numerous links, is available online at www.whirling-disease.org.

Westslope Cutthroat Trout Conservation and Restoration

Sun Ranch Westslope Cutthroat Trout Program

Personnel conducting the Sun Ranch Broodstock Program collected gametes from two streams and personnel working on the Elkhorn Mountains Westslope Cutthroat Trout Recovery Program from three streams. Fertilized eggs were transferred to the Sun Ranch Hatchery for incubation and hatching, and the resulting fry were split between the Sun Ranch Rearing Pond and a rearing pond on the Bar None Ranch near Toston being used for the Elkhorns Program. In 2004, 5452 eggs were placed in incubators in the Sun Hatchery. Survival from egg to fry averaged 59 percent, but ranged from 17 – 95 percent for each egg lot. Survival from fry to pond stocking was approximately 51 percent, resulting in 821 fry stocked into the Sun Ranch Pond and 814 into the Bar None Pond.

During a snorkel survey of the Sun Ranch Pond on September 30, about 45-50 fish were observed. Two distinct size classes were evident, with about 30 – 35 fish between 12 and 17 inches, the remaining fish between 5 and 10 inches. All fish appeared to be in excellent condition. Fry have been previously stocked into the Sun Ranch Pond in 2001 – 2003, but the 2001 year-class was eradicated in February 2002 due to an error that resulted in hybridized fry being stocked into the pond (MFWP 2003). The fish seen in the snorkel survey are the result of 587 fry stocked in the pond in 2002, and 566 stocked in 2003.

Because the number of WCT in the rearing pond is low compared to the number of fry introduced since 2002, the Sun Ranch WCT Committee has decided to review the program priority of developing a broodstock and will consider focusing on replicating existing populations. If undertaken, reducing the number of fry planted in the pond each

year and focusing mainly on introducing WCT fry from the Sun Ranch Hatchery directly into recipient streams will accomplish this. Some fry from each donor population will be introduced into the pond to continue developing a genetically broad-based brood. This change would allow for replication of existing populations, one of the original goals of the program, as well as development of the Sun Ranch broodstock. Several streams in the Madison and Gallatin drainages have been identified as potential recipient streams for Sun Ranch WCT and any that are selected will be evaluated through the Environmental Assessment process, including public review.

Cherry Creek Native Fish Introduction Program

Cherry Lake was treated on August 1 with 11.2 ppb Fintrol. After application of the Fintrol, six gillnets were set in the lake to monitor for surviving fish. In 2003, 5 fish were captured in 20 gillnet-days following treatment, however, in 2004, 57 fish were captured in 432 gillnet-days. Gillnets were left to fish in the lake over winter.

In the 11 miles of stream sections that were treated in 2003, only 18 fish were seen in 2004 treatments. But in 2004, forks of two larger streams were discovered that were not treated in 2003. One required only backpack sprayer treatments, but the other required use of the application stations. No live fish were found in either stream in post treatment surveys. These streams, as well as other selected stream sections, will be electrofished in 2005 to determine if they need additional treatment in 2005.

Personnel from MFWP, Montana State University, Gallatin National Forest, and Turner Enterprises spent 240 worker-days completing the project in 2004, including all preparatory and support activities and treatments. A total of 6.4 gallons of Fintrol were required to complete the treatments in 2004 - 3.5 gallons for Cherry Lake and 2.9 gallons for the 11 miles of stream.

Hebgen Reservoir Tributary Spawning

Juvenile Fish Trapping

Table 3 summarizes the 2004 screwtrap catch for Duck Creek and the South Fork Madison and Figure 30 shows the length frequency of yearling fish handled at the Duck Creek and South Fork Madison traps. It appears that rainbow trout in Duck Creek and the South Fork Madison exhibit different life history strategies. Rainbows in Duck Creek emigrate to the reservoir primarily as yearlings while South Fork Madison rainbows emigrate primarily as young-of-the-year.

Overall trap efficiency was 17.7 percent for the Duck Creek trap. Efficiency for yearling rainbow trout was 19.7 percent and 4.1 percent for yearling brown trout. The total number of rainbows tagged was 875, all presumed to be yearlings. Few young-of-

Table 3. Numbers of yearling and young-of-the-year rainbow (Rb) and brown (LL) trout captured in screw traps in Duck Creek and the South Fork Madison in 2004.

	Young-of-the-year		Yearling	
	Rb	LL	Rb	LL
Duck Ck	5	330	1,109	149
SF Madison	10,248	9,077	389	1,743

the-year rainbow were captured in the Duck Creek trap. Peak emigration of yearling rainbow trout in Duck Creek occurred in May.

Overall trap efficiency for the South Fork Madison trap was 17.8 percent. Efficiency was 20 percent for yearling rainbows and 17.3 percent for yearling brown trout. Due to occasional problems with the coded wire tagger, only 293 yearling rainbows were tagged at the South Fork Madison screwtrap. Rainbow yearlings were captured in the greatest numbers from May 12 to May 28. Peak young-of-the-year rainbow emigration occurred from July 7 and continued through the first week of August.

Efficiency trials were not conducted with young-of-the-year fish.

Coded Wire Tagging

Coded wire tagging feasibility study results are in Table 4. Our feasibility results were similar to those of a study conducted by Northwest Marine Technology (Ransier pers. comm.). Consistent tag placement and less handling time result in a higher percent of survival and tag retention.

Table 4. Percent tag retention and percent survival of test fish used in a coded-wire tagging feasibility study.

	Tag retention	Survival
Headmold A	93	96
Headmold B	79	92
Anesthetized only	NA	97
Control	NA	97

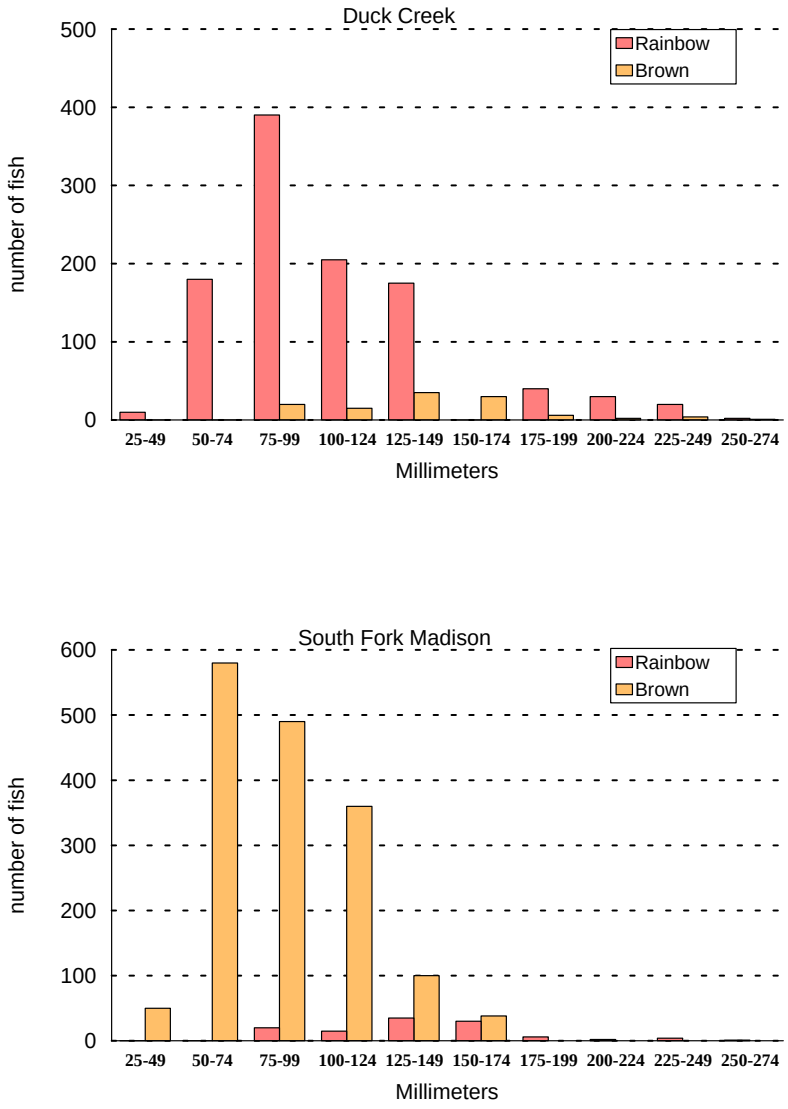


Figure 30. Duck Creek and South Fork Madison yearling length frequencies, in millimeters.

Coded Wire Tag Recovery

In the South Fork Madison and Duck Creek, 11,195 young-of-the-year rainbow trout were captured in screwtraps, drift traps, and by electrofishing and were coded wire tagged. Only 1 of 948 young-of-the-year rainbow captured in downstream fry traps was coded wire tagged. Twenty-three coded wire tagged young-of-the-year rainbow were recovered below the South Fork screw trap using a backpack electrofisher. Night

shocking efforts on Hebgen Reservoir using jetboat boom-mounted electrofishing yielded 314 young-of-the-year rainbow trout, none of which contained a coded wire tag.

Gut Analysis

Stomachs of Utah chubs, rainbow and brown trout, and mountain whitefish were examined for presence of coded wire tags and food items. Coded wire tags were not found in the stomachs of any fish. Zooplankton and macroinverterbrates accounted for the vast majority of Utah chub stomach contents. Unidentifiable fish were found in the stomachs of brown trout and rainbow trout. Only zooplankton and a few macroinverterbrates were found in mountain whitefish stomachs.

Stream Temperature and Flow Monitoring

Peak yearling rainbow trout emigration corresponds with peak mean monthly discharge in both Duck Creek and the South Fork Madison (Figure 31), while mean monthly water temperature did not exceed 50^{o}F in either stream during peak yearling emigration (Figure 32).

Over 10,000 young-of-the-year rainbow trout were captured emigrating from the South Fork of the Madison, with peak emigration in July. Peak emigration occurred on the descending limb of the hydrograph (Figure 33) when average monthly temperature exceeded 50^{o}F (Figure 34). Only five young-of-the-year rainbow were captured in Duck Creek, all in July. Temperature graphs for all monitored streams are in Appendix E.

Redd Counts

A total of 991 rainbow trout redds were counted in the Hebgen Basin in 2004 (Figure 35), which is similar to the number of redds observed basin-wide in 2003 (Sestrich 2004). Redd surveys were not conducted in Cougar Creek, Maple Creek, Red Canyon Creek or the Madison River in 2004 due to time constraints, so these totals are omitted from 2003 data for comparison purposes.

Fish Entrainment

The West Madison Canal was surveyed in 2001-2004 for fish entrainment. The West Madison Canal draws water from the river on the west bank of the western river channel approximately one mile upstream of the Eight-mile Fishing Access Site. Surveys were limited in 2002 & 2003 as ice-up occurred prior to the ditch being shut down for the year, so ice cover hid stranded fish. In 2001 and 2004, when the headgate was closed prior to ice-up, several hundred or more fish, primarily trout, were observed stranded in the ditch and were lost to the population. It is unlikely that preventing those trout from becoming entrained in the ditch would increase the river population by that same number of fish due to competition, predation, and angling harvest that would occur in the river. The trout population below Varney is dominated by brown trout, and most fish observed in the ditch are brown trout. Screening methods similar to that shown in Figure 36 are

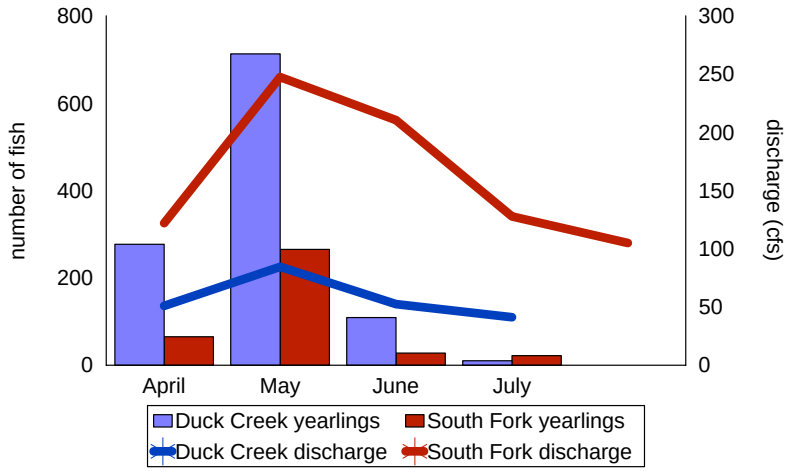


Figure 31. Number of yearling rainbow trout and mean monthly stream discharge in Duck Creek and South Fork Madison.

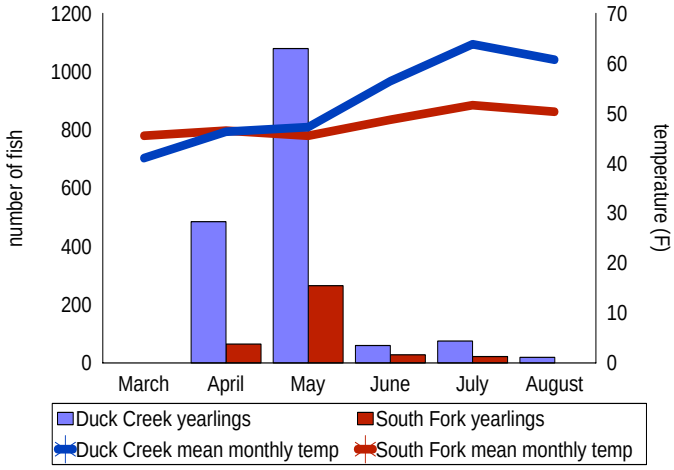


Figure 32. Number of yearling rainbow trout and mean monthly stream temperature in Duck Creek and South Fork Madison.

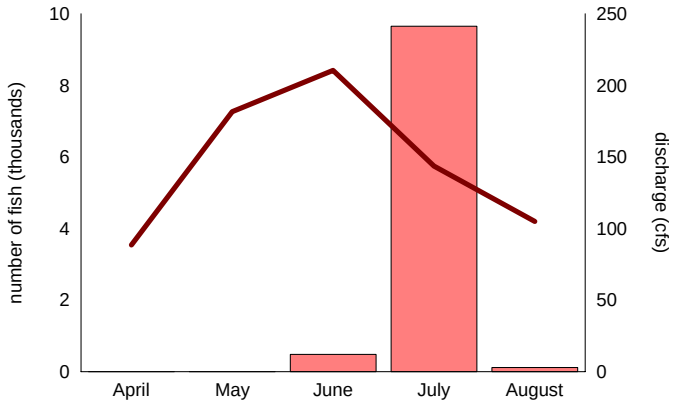


Figure 33. Number of young-of-the-year rainbow trout captured in a screw trap (bars) and mean monthly stream discharge (line) in the South Fork Madison River.

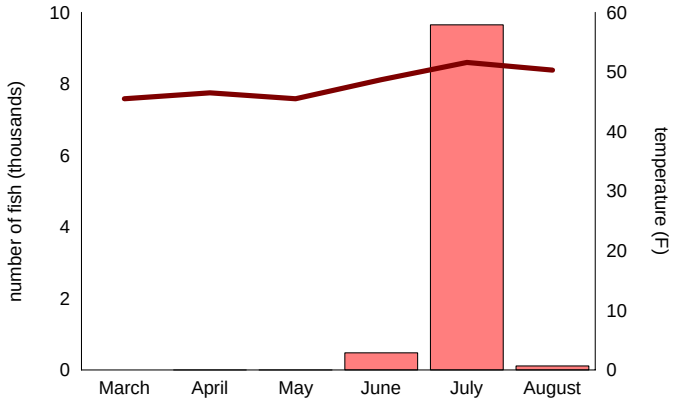


Figure 34. Number of young-of-the-year rainbow trout captured in a screw trap (bars) and mean monthly temperature (line) in the South Fork Madison River.

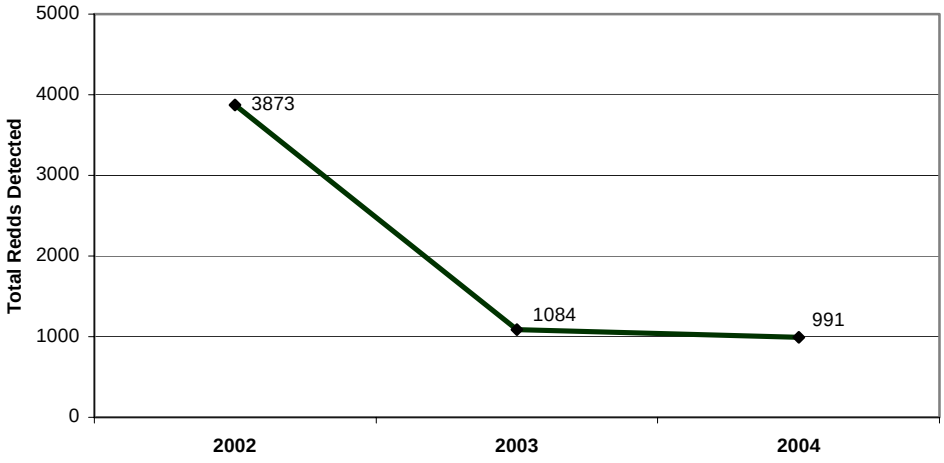


Figure 35. Rainbow trout redd counts in Hebgen tributaries, 2002 – 2004.

Figure 36. Self-cleaning fish screen.

available to reduce or eliminate entrainment. Flowing water turns a paddlewheel that powers brushes back & forth across the screen washing debris into a pipe that returns it to the river. The same pipe also allows the fish to return to the river. If water velocity is not fast enough to turn the paddlewheel, the system ceases to operate properly, and the screen can become plugged preventing the passage of water. Permission to construct such a screen in the West Madison Canal was denied due to uncertainty that the system would operate properly without frequent maintenance to prevent interruption of irrigation water to water right holders. Estimated cost of screen purchase and installation for this location is approximately $200,000, and would most likely have been provided by PPL Montana's Madison River Fisheries Technical Advisory Committee and the MFWP Future Fisheries Program.

Surveys were initiated on the Storey (Granger) Ditch in 2004, but few fish were located with electrofishing surveys about a month prior to shut down, and only 35 - 40 fish were observed in the pool behind the headgate after the ditch was closed for the season. The ditch operators close this headgate over a period of several days. The decreasing volume of water in the ditch prompts many fish to move upstream exiting the ditch and returning to the river prior to complete closure of the headgate. This ditch will be monitored in future years, and other ditches, including those on the river below Ennis Reservoir, will be monitored as permission is received.

CONCLUSIONS AND FUTURE PLANS

The Madison (Ennis) Reservoir grayling population continues to persist at low levels. While the Madison population is very similar genetically to the Big Hole population, the different life history characteristics (fluvial vs. adfluvial) will also be considered when the USFWS reviews population status for its April 2007 determination if listing as a Threatened species is warranted.

Population estimates will continue to be conducted annually in the Madison River. These data are necessary for setting angling regulations, and to monitor environmental and biological impacts on the populations.

Presently there is no evidence that trout and whitefish in the Madison Bypass require habitat supplementation. In 2004, 16 of 59 fish implanted with radio transmitters in the Bypass were later relocated as far as 30 miles downstream from the Bypass, some during their spawning season. Additionally, a population estimate shows density of both rainbow and brown trout in the Bypass section to be at least as high as any other monitored section of the river.

Maximum water temperatures in 2004 upstream of Ennis Dam generally were coolest since 2001. However, downstream of Ennis Dam, 2004 maximum water temperatures were at or near maximum highs seen since monitoring began in 1994.

The expansion of New Zealand Mudsnails, both in number and distribution and their impact on other aquatic invertebrate species will continue to be monitored through the 2188

Biological and Biocontaminant monitoring program, as well as through monitoring by aquatic biologists at Montana State University. The FWP Aquatic Nuisance Species Coordinator will be responsible for developing programs to address aquatic nuisance species, including New Zealand mudsnails.

Due to the time required to process and analyze samples of sentinel fish used for annually monitoring the severity of whirling disease infection, actual infection rates are not known for up to a full calendar year after the samples are removed from the river. After removal from the river, sentinel fish must be reared for an additional 90 days in uninfected water at the Pony facility, then processed and sent to the Washington Animal Disease Diagnostic Laboratory in Pullman, Washington. Populations of rainbow trout in the upper Madison River exhibited pre-whirling disease levels in 1999 and 2000, but have since decreased. Sentinel cage rainbow trout deployed in the Madison River have continued to show high infection rates and severity, and since 2002 sites previously known to have low infection severity have shown increasing severity. There has been no apparent shift in the timing of spawning or a shift in spawning sites that would explain the temporary population rebound seen from 1999 – 2002. Whirling disease researchers are investigating factors that may be responsible for this decline since that time.

Over 1,630-westslope cutthroat trout young-of-the-year were released into two rearing ponds as part of the Sun Ranch Westslope Cutthroat Program in 2004. Approximately half were released into each pond. Due to the low number of fish observed in the Sun Ranch Pond in September 2004, a program review is being conducted to determine if brood development should be de-emphasized and population replication prioritized. This would involve introducing either eyed eggs or fry directly from the Sun Hatchery into recipient streams rather than placing all fry in the pond. Some fry from each donor stream would be introduced into the pond each year to continue developing a genetically broad-based broodstock.

The Cherry Creek Native Fish Introduction Project will continue in 2005 with the first scheduled treatment Phase II of the project, from approximately the confluence of Cherry Creek and Cherry Lake Creek to a point approximately 4 miles downstream where an irrigation weir has been modified into an artificial barrier. Tributaries to Cherry Creek in this section will also be treated, bringing the total stream miles in Phase II to approximately 12 miles. Additionally, Cherry Lake may be treated again in 2005 because treatments in 2003 and 2004 have not completely eradicated the fish. Gillnets were placed in the lake in August 2004 and fished continually since, including overwinter. These nets will remain in place until the lake is devoid of fish, and prior to any 2005 chemical treatment, the inlets and outlets will be trapped to capture any fish attempting to spawn. Electrofishing surveys will be conducted in Phase I stream sections where fish remained after the 2003 treatment to determine if the 2004 treatment eradicated all the fish. If the surveys show fish remain in some Phase I stream sections, these areas will be treated again in 2005.

Coded wire tagging will continue to be used to monitor rainbow young-of-the-year and yearling emigration from the South Fork Madison and Duck Creek, to evaluate wild versus hatchery contribution to the reservoir, and to explore Utah chub predation on

rainbow fry. Temperature and discharge measurements will continue to be recorded and correlated with rainbow trout yearling and fry emigration. Temperature recorders will be placed upstream and downstream of a private pond on Duck Creek to determine if the pond is having an affect on water temperature and if that affects juvenile fish migration behavior. Redd counts will continue to be conducted by FWP and USFS personnel to monitor the relative contribution of individual tributaries to the total trout production in the Hebgen Reservoir system Selected tributaries of Hebgen will be tested using sentinel fish cages for presence or whirling disease.

Shoreline spawning surveys on Hebgen Reservoir will be initiated in 2005 to evaluate shoreline spawning by rainbow trout. An adult fish trap will be operated on Duck Creek to enumerate spawning rainbows and to assess the proportion of the run that is composed of previously marked hatchery fish.

Those irrigation ditches currently being surveyed for fish entrainment will continue to be surveyed in 2005, and permission to survey an additional two or three ditches will be sought. Any additional ditch surveys will be conducted as workload allows.

LITERATURE CITED

Bramblett, R.G. 1998. Environmental Assessment. Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program: Cherry Creek Native Fish Introduction. Prepared for Montana Fish, Wildlife, & Parks, April 15, 1998. 70 pages.

Byorth, P. 2004. Hebgen Reservoir Creel Survey and Contribution of Stocked Rainbow Trout to the Recreational Fishery: June 2000 to June 2001. 25 pages.

Byorth, P. and B. Shepard. 1990. Ennis Reservoir/Madison River Fisheries Investigations. Montana Fish, Wildlife, & Parks Final Report to Montana Power Company. 90 pages.

Cada, C.A. 2004. Interactions between the invasive New Zealand Mud Snail, *Potamopyrgus antipodarum*, Baetid Mayflies, and Fish Predators. MS Thesis, Montana State University. 126 pages.

Clancey, P. and B. Kerans. 2004. Evaluation of Increased Survival of Young-of-the-Year Wild Rainbow Trout in the Upper Madison River in the Face of Increased WD Infection Intensities in Wild Rainbow Trout Spawning Areas. Interim Report to the Whirling Disease Initiative.

Elwell, L.C.S, and B.L. Kerans. 2005. *Myxobolus cerebralis* on the Madison River ~ Yesterday, Today, and Tomorrow. Proceedings of the 2005 Whirling Disease Symposium, Denver, CO. Pages 63-64.

Federal Energy Regulatory Commission. 2000. Order Issuing New License, Project No. 2188-030. Issued September 27, 2000.

Hetrick, N. J. 1993. Cooperative Study on Fish Migration and Spawning in the Upper Madison River Drainage *Annual Report*: April 1993. 20 pages.

Jeanes, E. D. 1996. Behavioral Responses to Water Current of Age 0 Arctic Grayling from the Madison River, and Their Use of Stream Habitat. MS Thesis, Montana State University-Bozeman, August 1996. 60 pages.

Kerans, B.L. 2005. Personal communication.

Kruger, R.C. 2002. Correlations among environmental features, *Myxobolus cerebralis* infection prevalence in oligochaetes, and salmonid infection risk in the Madison River, Montana. Master of Science thesis, Montana State University. 94 pages.

Leary, R. 1990. Letter to MFWP Biologist Pat Byorth. University of Montana Wild Trout & Salmon Genetics Laboratory, Division of Biological Sciences, Missoula, MT. September 1990.

Montana Department of Natural Resources and Conservation. 1979. River Mile Index of the Missouri River. Water Resources Division.

Montana Fish, Wildlife, & Parks. 1995. Madison River/Ennis Reservoir Fisheries. 1994 Annual Report to Montana Power Company, Environmental Division, Butte, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. May 1995.

Montana Fish, Wildlife, & Parks. 1996. Madison River/Ennis Reservoir Fisheries. 1995 Annual Report to Montana Power Company, Environmental Division, Butte, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. February 1996.

Montana Fish, Wildlife, & Parks. 1997. Madison River/Ennis Reservoir Fisheries. 1996 Annual Report to Montana Power Company, Environmental Division, Butte, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. March 1997.

Montana Fish, Wildlife, & Parks. 1998a. Madison River/Ennis Reservoir Fisheries. 1997 Annual Report to Montana Power Company, Environmental Division, Butte, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. June 1998.

Montana Fish, Wildlife, & Parks. 1998b. Decision Notice: Cherry Creek Native Fish Introduction Project. Region 3, July 6, 1998. Pat Clancey. 30 pages.

Montana Fish, Wildlife, & Parks. 1999a. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 1998 Annual Report to Montana Power Company, Environmental Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. April 1999.

Montana Fish, Wildlife, & Parks. 1999b. Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana. May 1999.

Montana Fish, Wildlife, & Parks. 2000. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 1999 Annual Report to Montana Power Company, Environmental Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. April 2000.

Montana Fish, Wildlife, & Parks. 2001. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 2000 Annual Report to Montana Power Company, Environmental Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey and Dan Downing, Ennis. April 2001.

Montana Fish, Wildlife, & Parks. 2002. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 2001 Annual Report to Montana Power Company, Environmental

Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. June 2002.

Montana Fish, Wildlife, & Parks. 2003. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 2002 Annual Report to Montana Power Company, Environmental Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. March 2003.

Montana Fish, Wildlife, & Parks. 2004a. Madison River/Ennis Reservoir Fisheries and Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program. 2003 Annual Report to Montana Power Company, Environmental Division, Butte, and Turner Enterprises, Inc., Gallatin Gateway, from Montana Fish, Wildlife, & Parks, Pat Clancey, Ennis. May 2004.

Montana Fish, Wildlife, & Parks. 2004b. FA+. Montana Fish, Wildlife, & Parks, Information Services Unit, Bozeman.

Ransier, John. 2004. Personal communication. Northwest Marine Technologies.

Sestrich C. 2004. Evaluation and Enhancement of Tributary Potential for Wild Rainbow Trout Recruitment in Hebgen Reservoir, Montana, USDA Forest Service Progress Report to PPL Montana: December 2004. 22 pages.

Sloat, M.R., B.B. Shepard, and P. Clancey. 2000. Survey of tributaries to the Madison River from Hebgen Dam to Ennis, Montana with an emphasis on distribution and status of westslope cutthroat trout. Report to Montana Fish, Wildlife, & Parks, Helena, Montana. 165 pages.

Vincent, E.R., P. Clancey, and J. Tohtz. 2005. Possible reasons for increased survival of young-of-the-year wild rainbow trout in the face of continued high prevalence of the WD parasite *Myxobolus cerebralis* in the upper Madison River. Proceedings of the 2005 Whirling Disease Symposium, Denver, CO. Pages 60-62.

Watschke, Darin. In prep. Assessment of Tributary Potential for Wild Rainbow Trout Recruitment in Hebgen Reservoir, Montana. Master of Science Thesis, Montana State University, Bozeman, MT.

Appendix A

Description of young-of-the-year Arctic grayling beach seining locations in Ennis Reservoir, and catch at each site. See Figure 3 for site locations.

Species abbreviations:

AG Arctic grayling
MWF mountain whitefish
WSu white sucker
UC Utah chub
LL brown trout
LND longnose dace

September 28, 2004

Site and time seined	AG	MWF	Note
West of Fletchers mouth 1100 hrs	0	0	Few macrophytes; a few juvenile UC, 2 LND, 1 WSu
Backwater cove west of Fletchers 1121 hrs	0	1 (110 mm)	Macrophytes dense; 29 juv UC, 12 WSu
Backwater west of Fletchers to Moores Ck mouth 1137 hrs	0	6 (125, 118, 134, 117, 122, 110 mm)	Macrophytes present; 2 juv LND, 58 UC, 4 WSu
Moores Ck mouth 1200 hrs	0	0	Macrophytes abundant; 2 juv LL, 10 juv LND, 70 juv WSu, dozens juv UC
East of river mouth along cattails 1252 hrs	0	1 (119 mm)	Abundant filamentous green algae, no macrohytes; 1 juv LL, few juv UC & WSu
East of river mouth perpendicular to cattails 1312 hrs	0	0	Sparse macrophytes, abundant filamentous green algae; few juv WSu, LND, & UC
Meadow Ck bay - along willows at Peterson Rental house 1402 hrs	0	0	Macrophytes sparse; 14 juv WSu, 11 juv UC
Mouth of Meadow Ck, south bank 1455 hrs	1 (147 mm)	1 (113 mm)	Downstream pull from cattails to mouth of creek; one patch of dense macrophytes seined; 93 juv LL, numerous juv UC & WSu

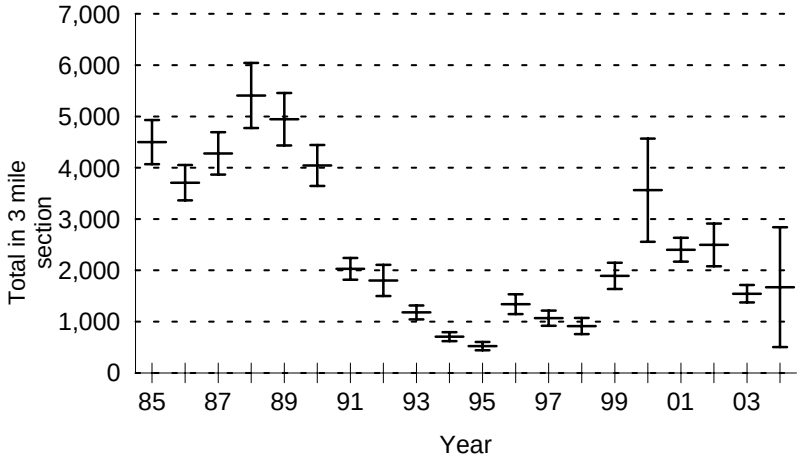
Appendix B

Population estimates (total number in section± 80 percent Confidence Intervals)
of age 2 & older rainbow and brown trout in the Madison River
See Figure 5 for section locations

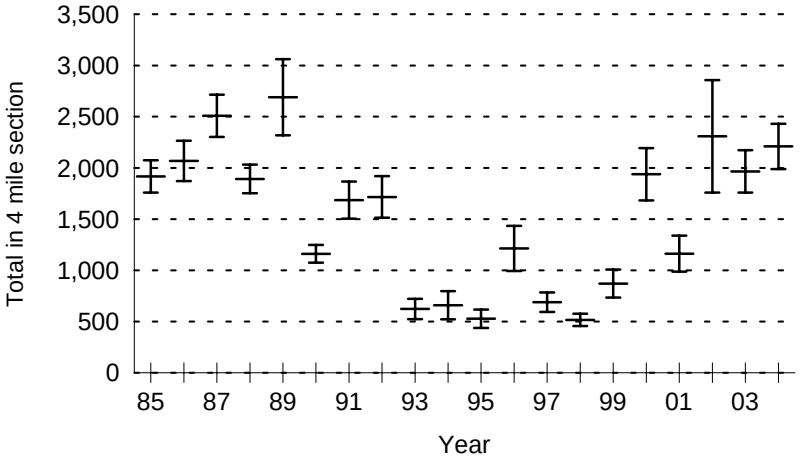
section lengths

Pine Butte – 3 miles
Varney – 4 miles
Norris – 4 miles

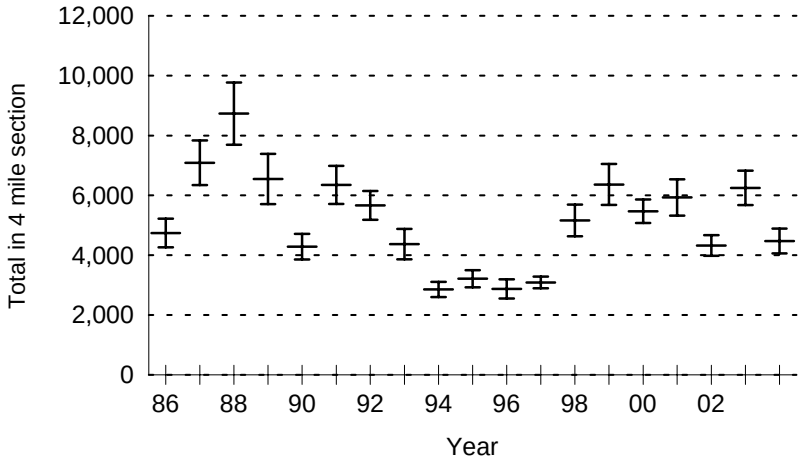
Pine Butte
Rainbow Trout
Age 2 & older



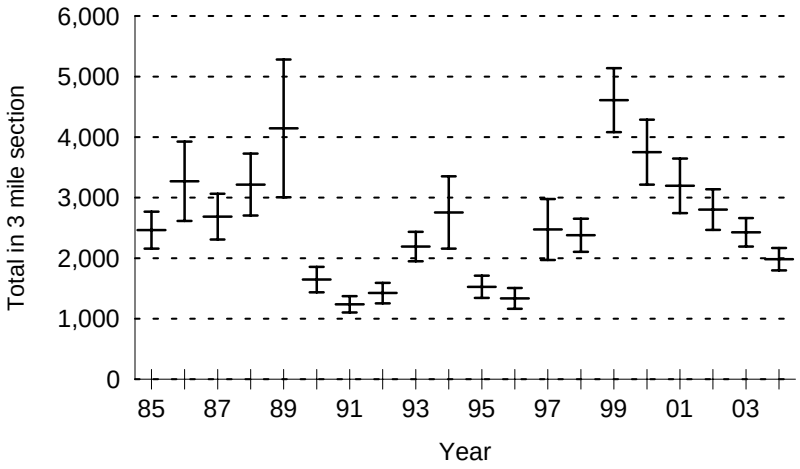
Varney
Rainbow Trout
Age 2 & Older



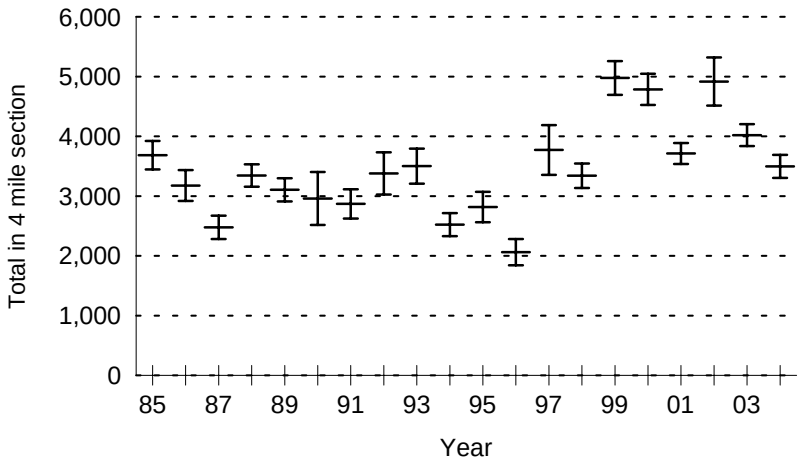
Norris
Rainbow Trout
Age 2 & Older



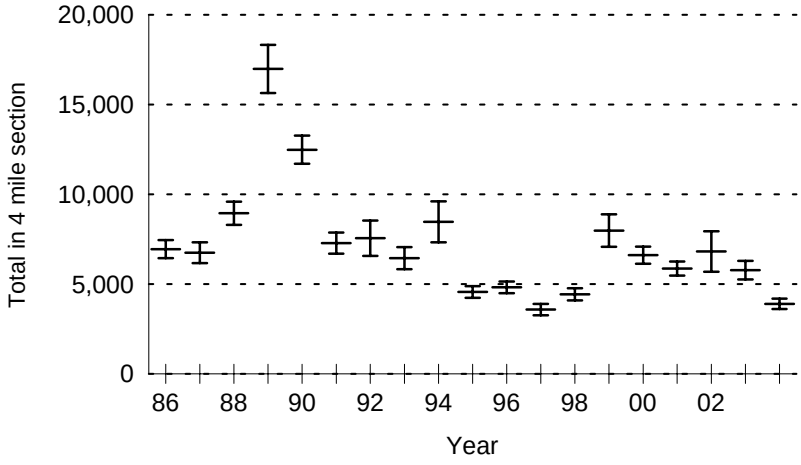
Pine Butte
Brown Trout
Age 2 & older



Varney
Brown Trout
Age 2 & Older



Norris
Brown Trout
Age 2 & Older



Appendix C1

Temperature recordings from monitoring sites on the Madison River
See Figure 10 for locations

Appendix C2

Diel water temperature fluctuations during the warmest 24 hours at selected sites

Appendix D

The MacConnell-Baldwin whirling disease grade-of-severity scale and definitions.

Grade 0: No abnormalities noted. *Myxobolus cerebralis* is not seen.

Grade 1: Small, discrete focus or foci of cartilage degeneration. No or few associated leukocytes.

Grade 2: Single, locally extensive focus or several smaller foci of cartilage degeneration and necrosis. Inflammation is localized, few to moderate numbers of leukocytes infiltrate or border lytic cartilage.

Grade 3: Multiple foci (usually 3 –4[1/]) of cartilage degeneration and necrosis. Moderate number of leukocytes are associated with lytic cartilage. Inflammatory cells extend minimally into surrounding tissue.

Grade 4: Multifocal (usually 4 or more sites[1/]) to coalescing areas of cartilage necrosis. Moderate to large numbers of leukocytes border and/or infiltrate lytic cartilage. Locally extensive leukocyte infiltrates extend into surrounding tissue.

Grade 5: Multifocal (usually 6 or more[1/]) to coalescing areas of cartilage necrosis. Moderate to large numbers of leukocytes border and/or infiltrate necrotic cartilage. The inflammatory response is extensive and leukocytes infiltrate deeply into surrounding tissue. This classification is characterized by loss of normal architecture and is reserved for the most severely infected fish.

[1/] lesion numbers typical for head, not whole body sections.

Appendix E

Temperature recordings for monitoring sites in tributaries to Hebgen Reservoir