Madison River/Ennis Reservoir Fisheries

and

Madison River Drainage Westslope Cutthroat Trout Conservation and Restoration Program

2003
Annual Report
to
PPL Montana
Environmental Division
Butte
www.pplmontana.com

and

Turner Enterprises, Inc.
Bozeman

by

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Montana Fish, Wildlife, & Parks
Ennis
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Montana Fish, Wildlife & Parks
www.fwp.state.mt.us

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

Aquatic Nuisance Species Task Force……………..www.anstaskforce.gov
Montana Fish, Wildlife, & Parks…………………..www.fwp.state.mt.us
New Zealand Mudsnail in the Western USA…….. www.esg.montana.edu/aim/mollusca/nzms
PPL Montana……………………………………...www.pplmontana.com
Protect Your Waters………………………………www.protectyourwaters.net
Whirling Disease Task Force…………………….. whirlingdisease.org

All photos in this report were taken by MFWP personnel unless otherwise credited.

EXECUTIVE SUMMARY

No young-of-the-year Arctic grayling were captured during seining in Ennis Reservoir in 2003. Several anglers reported catching adult grayling in the Madison River south of Ennis throughout the summer, as well catching adult at the inlet of Ennis Reservoir and in the Bypass section of the river below Ennis Dam. Populations of two year old & older rainbow trout in both long-term monitoring sections in the upper river decreased, though yearling numbers increased over those seen in recent years. In the Norris section in the lower river, two year old & older rainbow trout were at their highest level in 15 years. Two year old & older brown trout numbers in all three sections were within their long-term historic range, and yearling numbers were high. There are no noticeable, consistent detrimental effects of thermal stress on growth among 2, 3, and 4 year-old rainbow or brown trout in the lower river when compared to the upper river. Twenty-eight fish in the Bypass Reach were implanted with radio transmitters to monitor their movements seasonally and in response to flow changes. Neither juvenile brown trout nor sculpins in 30-day caged feeding studies in Darlinton Ditch ingested New Zealand Mudsnails. Whirling disease sentinel rainbow trout young-of-the-year continue to develop severe infection. 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 for the Elkhorn Mountains Westslope Cutthroat Trout Restoration Program, and half of those fry were stocked in the Sun Ranch Rearing Pond. The Cherry Creek Native Fish Introduction Project proceeded successfully in 2003 despite a lawsuit filed in federal court the day the project was initiated. Persistent drought severely reduced the volume of water in the streams, and all sentinel and observable free swimming fish were killed by the treatments. Adult and juvenile amphibians exhibited no mortality from the treatments, though western toad tadpoles did. The rainbow trout spawning run into Hebgen Reservoir tributaries was less than half as strong as in 2002.

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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 1997a, MFWP 1998a, MFWP 1999a, MFWP 2000, MFWP 2001, MFWP 2002a, MFWP 2003). This work has been funded through an agreement, initially with Montana Power Company (MPC), now with PPL Montana, owner and operator of the dams. 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 WCT. 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

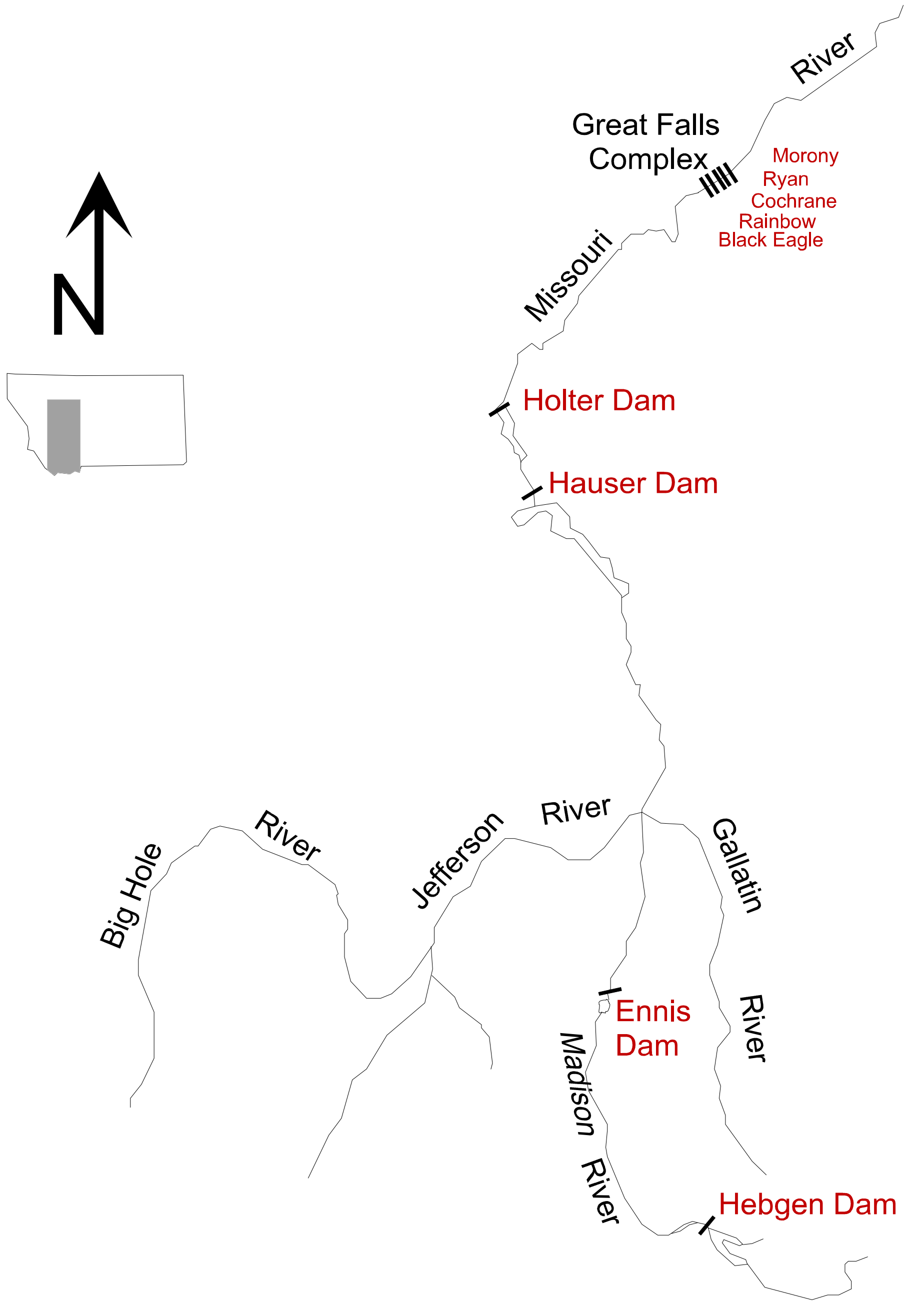


Figure 1. Locations of PPL Montana dams on the Madison and Missouri rivers.

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 (*Oncorhynchus clarki lewisi*) 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.

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.

Gillnetting

Gillnets were used to sample adult fish in Ennis Reservoir in early October 2003. Gillnettng is typically conducted in Ennis Reservoir in August, but was postponed due to other work priorities. Experimental nets, composed of five 25-foot panels of progressively larger mesh (¾", 1", 1 ¼", 1 ¾" 2") were set at four locations and left to fish overnight (Figure 3). For shoreline sets, the smallest mesh was set in the shallowest water, the largest mesh in the deepest water. Floating nets were used at the shallow south end of the reservoir, and one floating and one sinking net were used at the north end. Because the south end of the reservoir is so shallow, floating nets are capable of sampling the entire water column. At the deeper north end, a floating net and a sinking net were required to sample pelagic and benthic areas, respectively. Captured fish were removed from the nets, separated by species, measured, weighed, enumerated, and released.

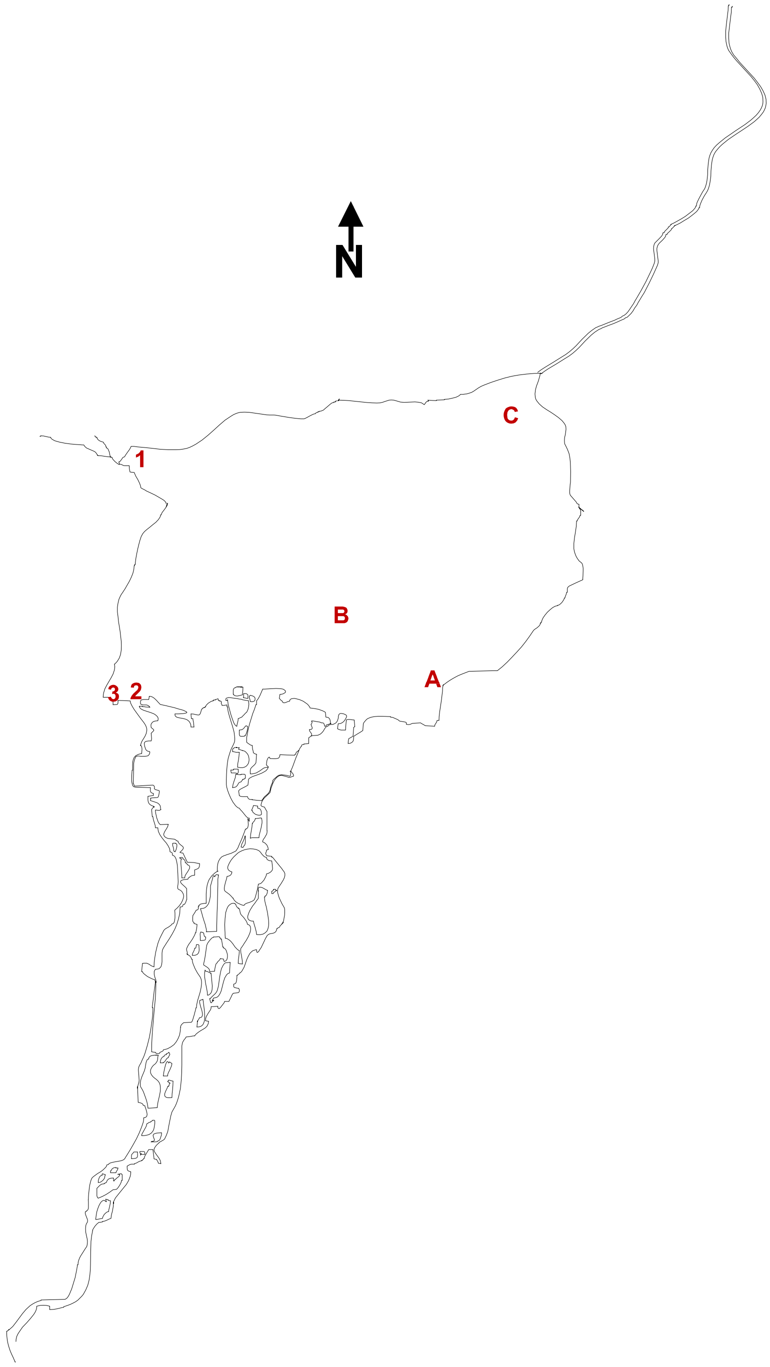


Figure 3. Locations of Ennis Reservoir gillnet (letters) & seining (numbers) sites.

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 (Figure 5).

Fish captured for population estimates are weighed and measured, marked with a fin clip, and released. A log-likelihood statistical analysis (MFWP 1997b) is used to estimate trout populations in several sections of the Madison River (Figure 5). 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.

Trout Growth

Comparison of trout growth in sections of the upper and lower Madison River was initiated in 2002 (MFWP 2003). In this report, statistics calculated from historic population estimates are used to compare average length and average weight for 2, 3, & 4 year-old rainbow and brown trout. These comparisons are being done to provide information relative to the lower Madison thermal issue, downstream of Ennis Reservoir. There is some thought

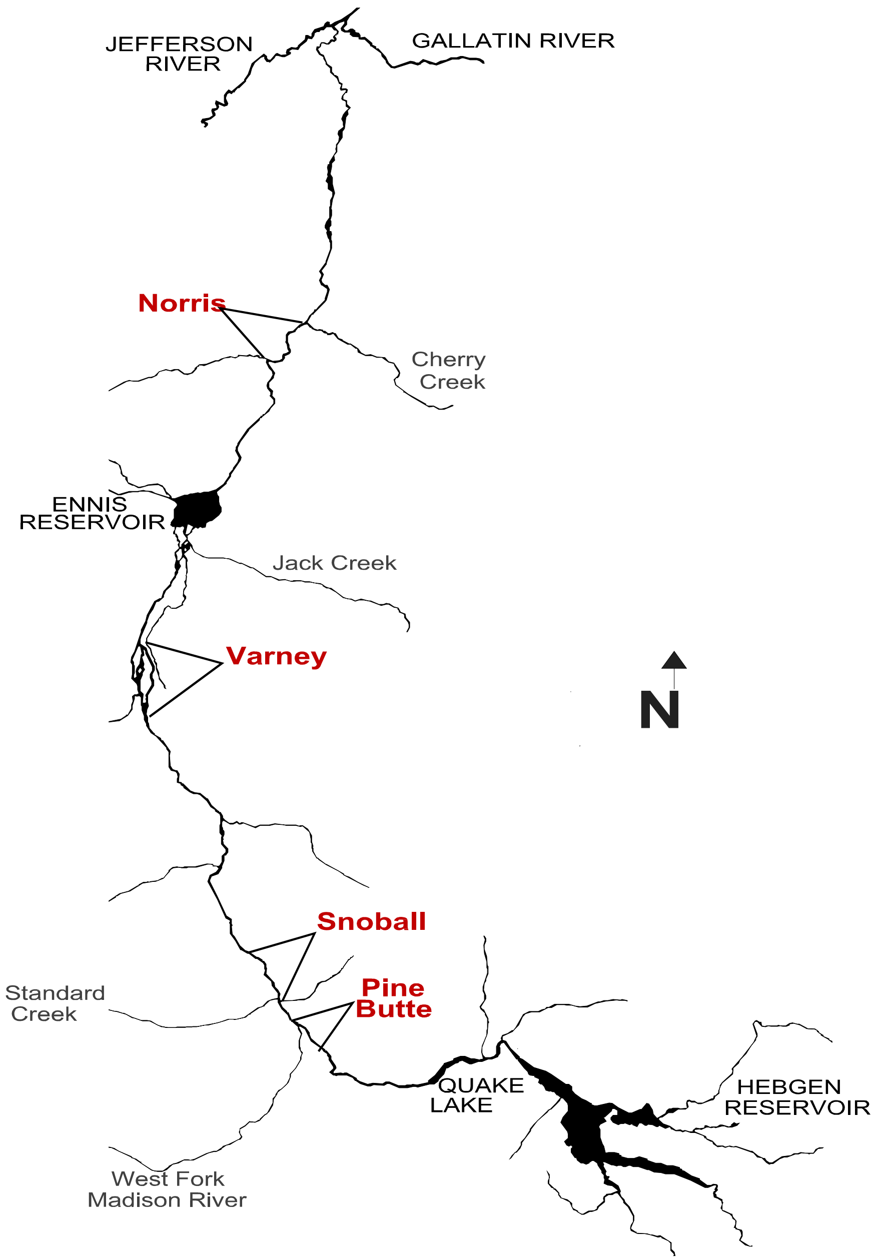


Figure 5. Locations of Montana Fish, Wildlife, & Parks 2003 Madison River population estimate sections.

that Ennis Reservoir acts as a solar collector causing high water temperatures in the Madison River below the reservoir, negatively affecting trout growth. The Norris estimate section (Figure 5) is within the area suspected to be affected, while the Pine Butte and Varney estimate sections are not. Estimates in the Norris section are routinely conducted in spring

(March) while estimates in the Pine Butte section are routinely conducted in the fall (September). However, in some years estimates are conducted in Pine Butte in March for special information needs. Only those years in which spring estimates were conducted in Pine Butte are used in this comparison. The Pine Butte and Varney sections are compared for 1980-1999. Estimates are routinely conducted in fall in both of these 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, 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 28 fish in the Bypass reach of the Madison River (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, 2003.

Implant date	Species	Length (inches)	weight (lbs)	Transmitter weight as a percent of fish weight
4/16/03	Rb	14.7	1.22	1.40
	Rb	13.7	1.10	1.54
	LL	20.3	2.76	0.73
	LL	17.1	1.64	1.24
	LL	20.2	2.64	0.77
	LL	15.2	1.21	1.39
4/28/03	Rb	15.2	1.32	1.28
	Rb	15.2	1.40	1.21
	Rb	12.8	0.85	2.00
	Rb	13.2	0.92	1.84
	Rb	12.9	0.98	1.73
	Rb	12.3	0.84	2.02
	LL	14.0	1.07	1.59
	LL	12.5	0.83	2.04
10/10/03	Rb	15.6	1.65	1.03
	Rb	13.6	1.20	1.41
	Rb	14.3	1.32	1.28
	Rb	13.5	0.98	1.73
	Rb	15.9	1.54	1.01
	Rb	13.5	0.82	2.07
	Rb	13.0	0.88	1.93
	Rb	13.8	1.10	1.54
	LL	16.9	1.86	0.91
	LL	14.0	1.04	1.63
	LL	15.9	1.48	1.15
	LL	14.2	1.11	1.53
	MWF	13.7	1.16	1.46
	MWF	15.9	1.79	0.95

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

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.

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.

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.

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.

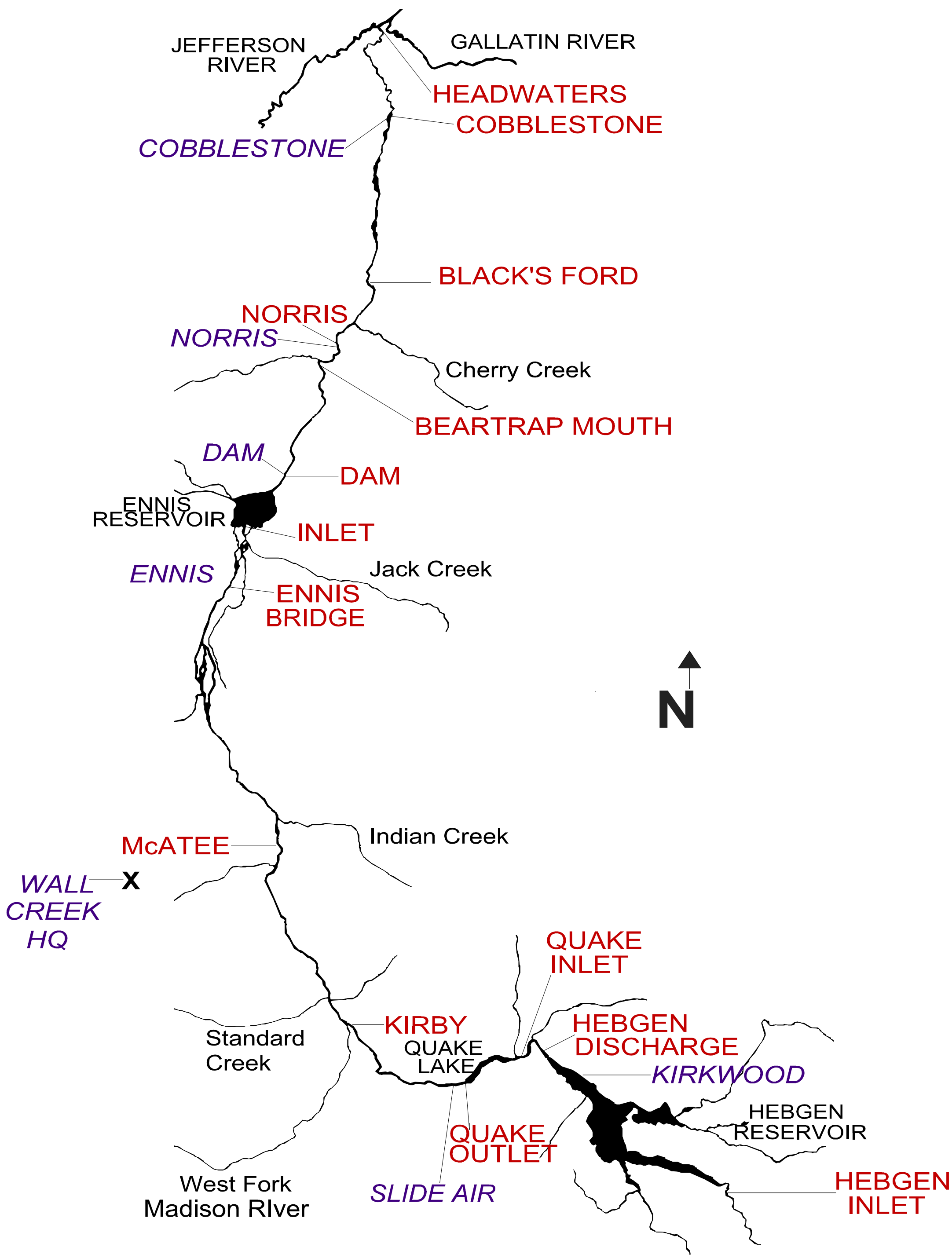


Figure 10. Locations of Montana Fish, Wildlife, & Parks 2003 temperature monitoring sites. Air temperature sites are blue, water temperature sites are in red.

Aquatic Nuisance Species

Aquatic Nuisance Species (ANS) have become one of the greatest concerns for aquatic resource managers and are having the greatest impact on the nations waterways, including those in Montana. Whirling disease has had severe ecological, social, and economic impacts in western and southwestern Montana, including the Madison Drainage, and other ANS may have similar affects. A working group comprised of personnel from state and federal agencies and private organizations, including FWP and PPL Montana, produced the Montana Aquatic Nuisance Species Management Plan (Montana Aquatic Nuisance Species Technical Committee 2002). The goal of the Montana Aquatic Nuisance Species Management Plan is to minimize the harmful ecological, economic, and social impact of ANS through prevention and management of introduction, population growth, and dispersal into, within, and from Montana. The Plan includes a system to classify all nonindigenous aquatic species in Montana, identifies the proper management for each class, details current authorities and programs, and sets objectives that will lead to the accomplishment of the Plan goal. The priority list, ANS descriptions, and management actions from the Montana ANS Plan are in Appendix A. The full plan is available from FWP.

A low power radio broadcast system called a Traveler Information System (TIS) was purchased and installed near West Yellowstone. The TIS notifies anglers and water recreationists of the presence of NZMS in the Madison River and Hebgen Reservoir, and instructs them on methods of reducing the likelihood of transporting NZMS and other ANS to other waters. Additional messages may also be broadcast by the system, including 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 and has been operational since spring 2003. Because of the time required for design approval and permitting of highway signs announcing the broadcast to motorists, placement of the signs will not occur until spring 2004. Funding for the purchase installation, and signage (Figure 11) 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.

<u>New Zealand Mudsnails</u>

New Zealand Mudsnails (NZMS) have spread throughout the Madison River since first detected in 1994. On-going studies by researchers at Montana Sate University have been underway in Darlinton Ditch, a spring creek and irrigation canal near Three Forks, to assess NZMS impacts on fish food habits and growth. Gut contents of captured fish were examined by use of gastric lavage, a non-lethal method used to remove the stomach contents by flushing water into the stomach causing the contents to be regurgitated.

Whirling Disease

Whirling disease monitoring continued in 2003 in the Madison River, using sentinel cage techniques described in previous reports (MFWP 1999a).

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 removal of competing or hybridizing non-native trout where necessary. Stream habitat surveys were conducted throughout much of the Madison Drainage from 1997 – 1999 (MFWP 1998, 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

In 2003, known genetically pure westslope cutthroat trout populations in southwest Montana were too stressed and diminished by persistent drought and long-term population isolation to contribute gametes for the Sun Ranch broodstock. Gametes collected in the Elkhorn Mountains Westslope Cutthroat Trout Recovery Program were reared at the Sun Ranch Hatchery. Personnel of that project collected gametes from several streams in the Elkhorn Mountains, fertilized them on-site, and transported them to the Sun Ranch Hatchery incubation and hatching (Figure 12), and resulting fry were transferred to the Sun Ranch Rearing Pond (Figure 13).

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 13). Due to the large size of the project area, the project will be completed in phases. The areas treated in 2003 were Cherry Lake and its outlet stream and tributaries downstream to a barrier that prevents brook trout from moving upstream

Figure 12. Sun Ranch Hatchery rearing troughs.

Figure 13. Sun Ranch westslope cutthroat trout rearing pond.

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 2003 treatment areas are primarily on the GNF (Figure 14).

Preparatory fieldwork consisting of determining fish distributions, conducting streamflow dye tests, collecting sentinel fish, and salvaging fish was initiated in July. Bioassays were conducted August 1-3 on a small tributary of Cherry Creek, treatments began August 4 at Cherry Lake. Backpack shockers were used to determine fish distributions and to collect both sentinel & salvage fish in each segment of stream that was treated in 2003.

Bioassays were conducted by setting up one application station and applying antimycin (product name Fintrol) at a concentration of 12 parts per billion (ppb), exactly as done in stream treatments (described below). Two bioassays were run simultaneously – travel time & effective concentration. For the travel time bioassay, sentinel rainbow trout were placed in flow-through net bags at locations determined by dye tests to be 15, 30, 60, 90, 120, 180, & 240 minutes downstream of the application station. This bioassay was designed to determine how far downstream from the application station the Fintrol remained active. For the effective concentration bioassay, sentinel rainbow trout were placed in buckets each holding 6 gallons of water. Fish in these buckets were not exposed to flowing stream water. Rather, treated and untreated stream water was mixed in proportions to expose fish to concentrations of 12, 10, 8, 4, 2, and 0 ppb antimycin. Water in the buckets was aerated with portable aquarium pumps and every hour 3 gallons of water in the buckets was replaced in the proper proportion to maintain the test concentration. Each sentinel bag and bucket received four fish.

After completion of the travel time & effective concentration bioassays, neutralization bioassays were conducted. This was done by running an antimycin station at 12 ppb while simultaneously running a station 15 minutes downstream which applied 5 parts per million (ppm) potassium permanganate ($KMnO_4$) to the antimycin treated water. Sentinel fish were held in net bags 15, 30, & 60 minutes below the $KMnO_4$ station. A chlorine meter was used to measure $KMnO_4$ reduction at points 15 & 30 minutes downstream of the $KMnO_4$ station. Reduction occurs as $KMnO_4$ is consumed by instream biological demand and by interaction with antimycin, so as those demands to consume $KMnO_4$ are fulfilled, less $KMnO_4$ is reduced.

Stream discharge for bioassays and stream treatments were 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.

Project treatments were initiated at Cherry Lake. An inflatable raft and electric motor were used to distribute Fintrol throughout the 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, lake water, and dye. A battery powered pump was attached to

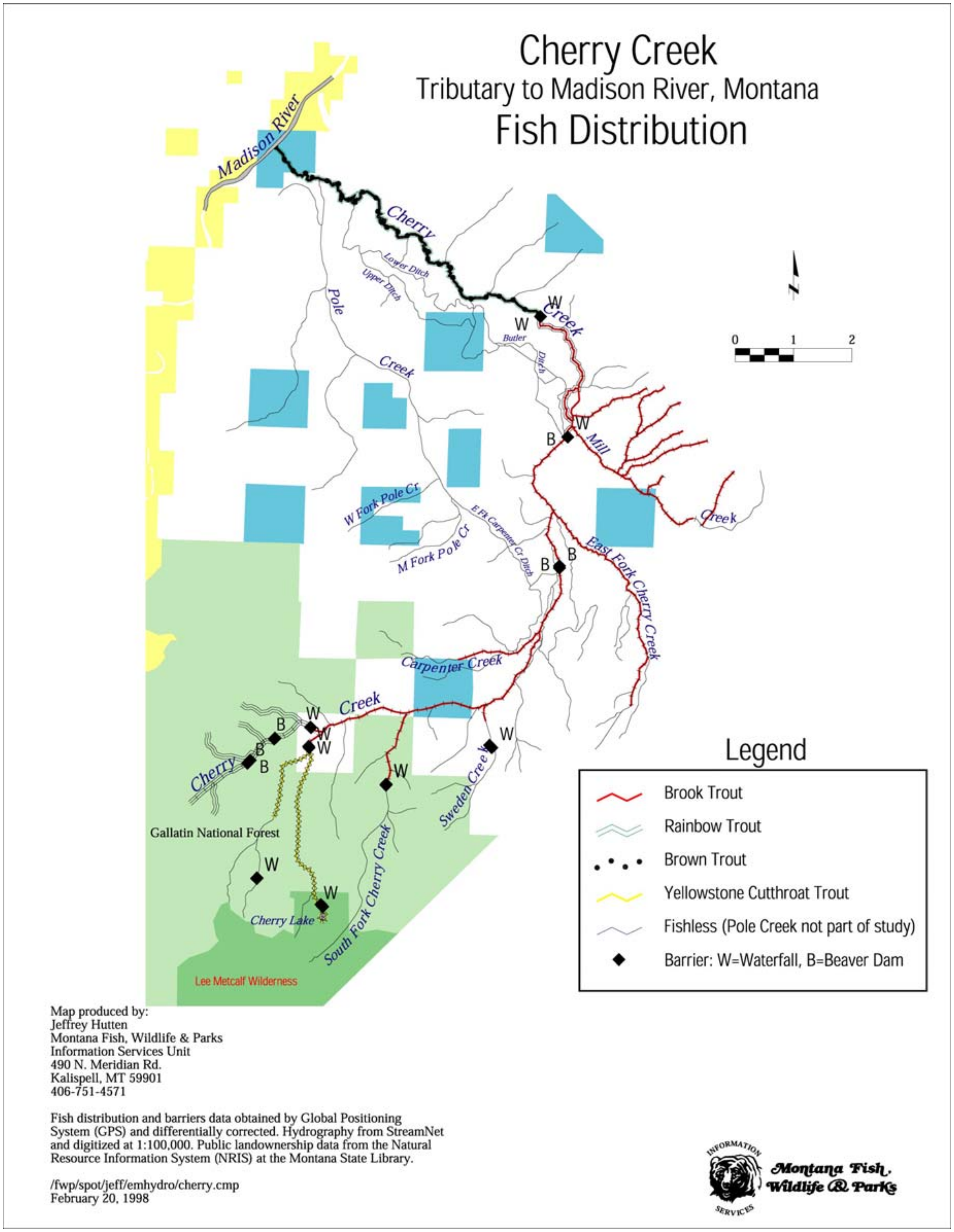


Figure 14. Cherry Creek Drainage. Landownership patterns have changed since this map was produced.

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.

the 14-gallon container and the Fintrol mixture was pumped into the lake through plastic tubing and a metal pipe end affixed to the outboard motor near the propeller. The dye in the mixture allowed the workers to monitor the distribution of the mixture throughout the lake. The plastic tubing was long enough to allow the pipe end to be lowered near the bottom of the lake so Fintrol could be dispersed deep. The lake was then monitored both visually and with gillnets. The maximum concentration of Fintrol applied to the lake in one application was 4 ppb. One application required 4-5 hours to complete. A gas-powered outboard motor was required to complete the treatments of the lake, as the electric motor consumed battery power too quickly to complete one treatment of the lake. Permission to use the gas motor in the Wilderness Area was received from the USFS during the EA process in 1998.

Simultaneous with the lake treatment, drip stations and backpack sprayers were used to treat the inlet streams and the lake perimeter areas too shallow for the raft to access.

Sentinel Yellowstone cutthroat trout for the lake treatment were captured on-site with hook & line and held at several points around the lake in net bags, including the deepest point found in the lake (27 feet).

Stream treatments were made using trickle application systems (Figure 16). The system consists of a 3-½ 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 of Fintrol mix empties in 3 to 3-½ hours. Applications are designed using a 6-7 hour application period, so the bucket must be refilled and the process repeated once at each application point each day.

Treatments on the Cherry Lake fork of the drainage were begun on August 5 at the outlet of Cherry Lake, and proceeded downstream through August 10. These treatments included a large unnamed tributary to Cherry Lake Creek. Treatments on the Cherry Creek fork were initiated on August 12 and continued through August 16. 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

Rainbow trout spawning and fry production in Hebgen Reservoir tributaries is being evaluated through a Master of Science Project at Montana State University. The MadTAC funded over 70 percent of the cost of the two-year project. The project is entitled “An Assessment of Tributary Potential for Wild Rainbow Trout Recruitment in Hebgen Reservoir, Montana.” The goal of the project is to assess the potential for wild rainbow trout recruitment to Hebgen Reservoir from tributaries and to identify potential limiting factors. A final report and Masters Degree Thesis is in preparation.

Upstream migrating spawning rainbow trout were captured and enumerated using standard fish traps, while outmigration of rainbow fry and juveniles was monitored using drift nets and screw traps (Figure 19). Stream spawning and rearing habitat quality were evaluated using standard inventory procedures, and redd counts were made using standard ocular survey methods (Watschke and McMahon 2002).

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.

Figure 19. Screw trap in Duck Creek, tributary to Hebgen Reservoir.

RESULTS AND DISCUSSION

Madison Grayling

During 2003, anglers reported catching adult Arctic grayling off Rainbow Point in Ennis Reservoir, near the river inlet at the south end of the reservoir, and in the Bypass section between Madison (Ennis) Dam & Powerhouse.

Beach seining in Ennis Reservoir was conducted in October. No young-of-the-year Arctic grayling were captured, but two young-of-the-year mountain whitefish (*Prosopium williamsoni*) were captured near the mouth of Fletchers Channel. Site descriptions, catch, and additional information are in Appendix B. In post-spawning surveys, Jeanes (1996) found young-of-the-year Arctic grayling and mountain whitefish are sympatric in both the river and reservoir.

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 20) 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.

Figure 20. The Madison River ice gorge at the U.S. Highway 287 Bridge at Ennis, November 2002.

Gillnetting

Table 2 summarizes the 2003 gillnet data for Ennis Reservoir. As in previous years, Utah chub are the most abundant species captured. More rainbow trout were captured in 2003 than in any year since gillnetting began in 1995.

Table 2. Summary of October 2003 gillnet catch in Ennis Reservoir. Length is in inches, weight is in pounds.

	UC[1]	Wsu	LnSu	Rb	LL
Avg.length	10.1	14.3	7.8	15.9	16.9
Avg.weight	0.6	1.1	0.2	1.6	2.0
Number sampled	135	70	1	16	18

[1] UC = Utah Chub; Wsu = White Sucker; LnSu = Lognose sucker; Rb = rainbow trout; LL = brown trout

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 2000-2003 is not complete except for the Norris section in 2000. Until age sample analyses are complete, estimates for those years 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 21-24 illustrate historic population levels of rainbow trout per mile for the four estimate sections completed in 2003. In Pine Butte, age 2 & older rainbows showed a decrease from the two previous years, while in Varney they were intermediate to the two previous years. Yearling numbers are encouraging in both sections. In Norris age 2 & older are more abundant than they have been since 1988.

Brown trout numbers per mile are illustrated in Figures 25-28. In Pine Butte, the number of age 2 & older brown trout decreased for the fourth consecutive year, but yearling numbers appear to be higher than any previous year on record. In Varney, numbers of both

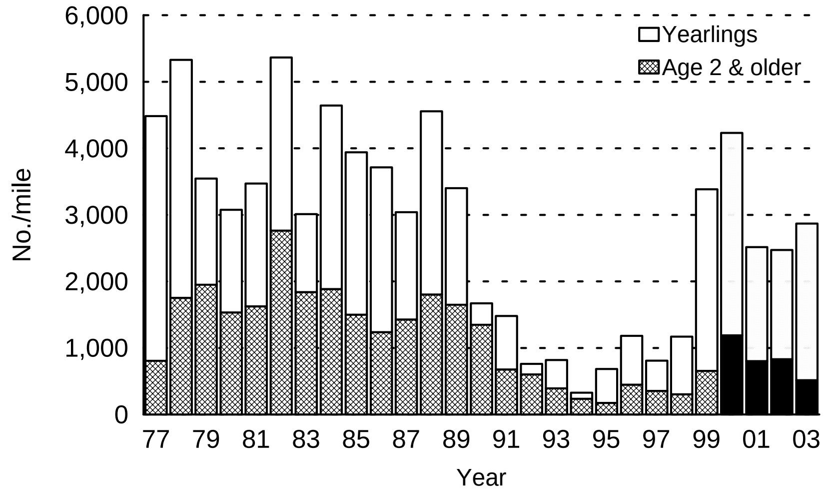


Figure 21. Rainbow trout populations in the Pine Butte section of the Madison River, 1977-2003, fall estimates. Data for 2000 - 2003 are provisional pending completion of age samples.

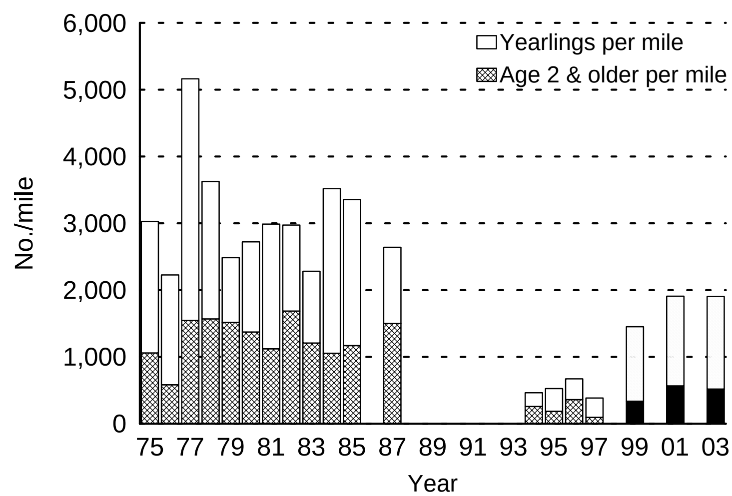


Figure 22. Rainbow trout populations in the Snoball section of the Madison River, 1975-2003, fall estimates. Data for 1999 - 2003 are provisional pending completion of age samples.

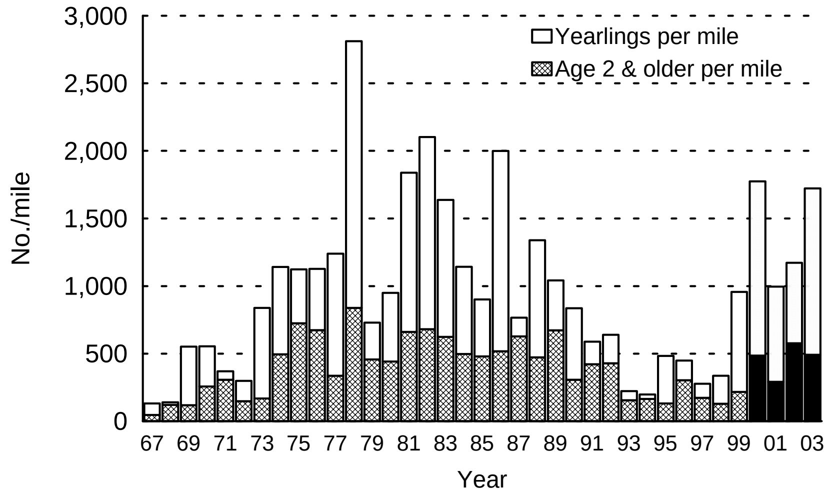


Figure 23. Rainbow trout populations in the Varney section of the Madison River, 1967-2003, fall estimates. Data for 2000 - 2003 are provisional pending completion of age samples.

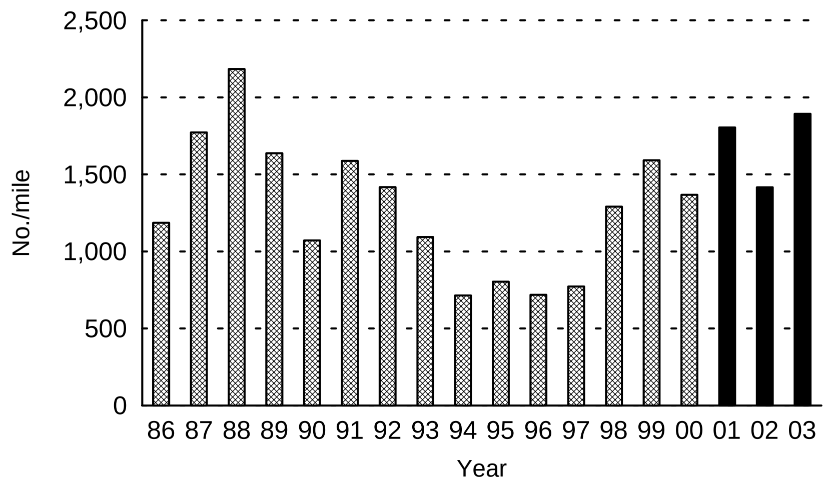


Figure 24. Rainbow trout populations in the Norris section of the Madison River, 1986-2003, spring estimates. Data for 2001 - 2003 are provisional pending completion of age samples.

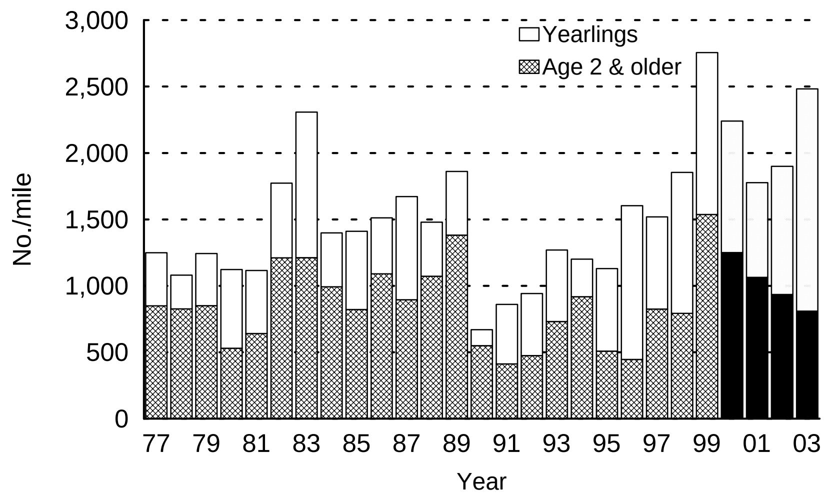


Figure 25. Brown trout populations in the Pine Butte section of the Madison River, 1977-2003, fall estimates. Data for 2000 - 2003 are provisional pending completion of age samples.

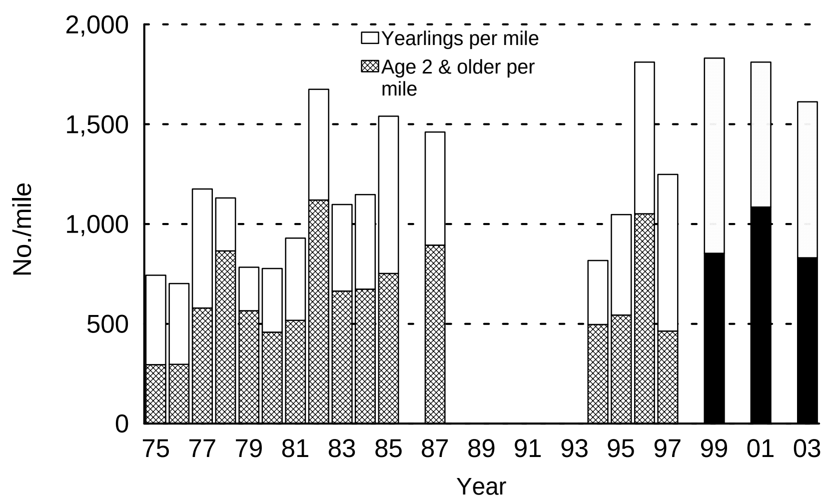


Figure 26. Brown trout populations in the Snoball section of the Madison River, 1975-2003, fall estimates. Data for 2000 - 2003 are provisional pending completion of age samples.

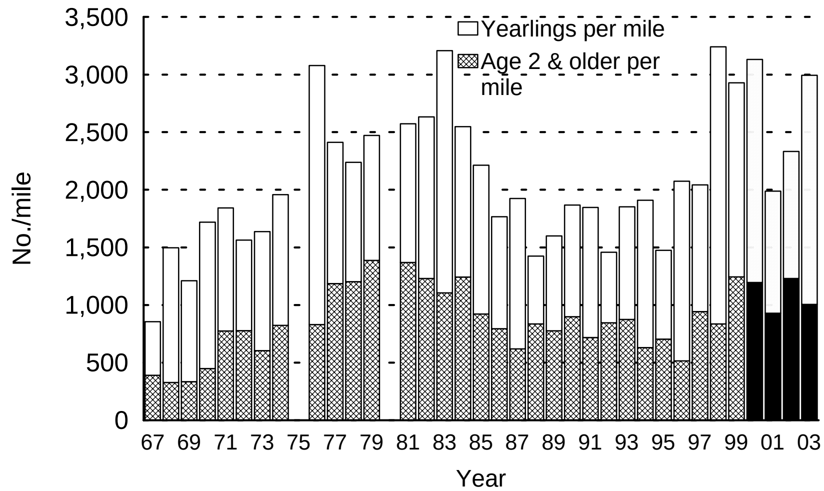


Figure 27. Brown trout populations in the Varney section of the Madison River, 1967-2003, fall estimates. Data for 2000 - 2003 are provisional pending completion of age samples.

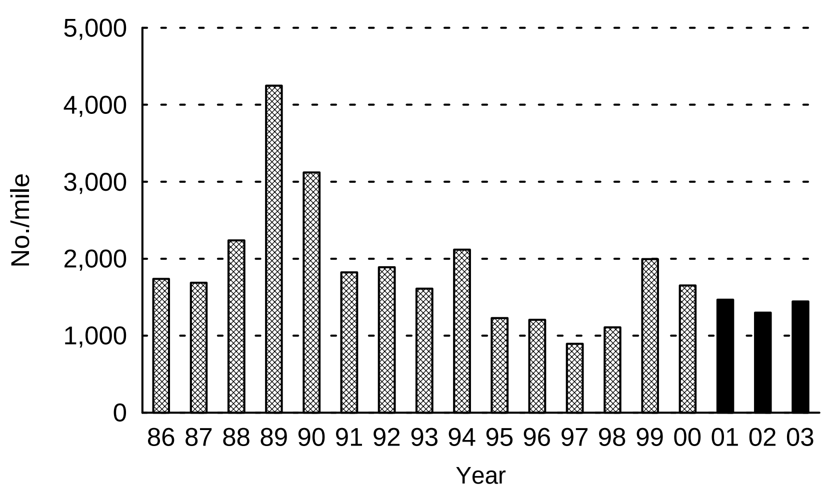


Figure 28. Brown trout populations in the Norris section of the Madison River, 1986-2003 spring estimates. Data for 2001 - 2003 are provisional pending completion of age samples.

yearling and age two & older brown trout are high. Brown trout numbers in the Norris section below Ennis Reservoir remained similar to those seen in recent years.

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

Trout Growth

Average length and average weight of 2, 3, and 4 year old trout in the Pine Butte and Norris sections (Figure 5) were compared for 1980, 1986, 1989, 1992, 1994-96, the only years in which corresponding estimates were conducted. Appendix D contains charts illustrating these comparisons. Because spring comparisons are made with only seven years, bar charts are used to display those comparisons. Fall comparisons span 20 years, so line charts are used to display those comparisons.

Rainbow trout

Average length and average weight of two-year-old rainbow trout in the Norris section show no distinct negative trends compared with average length and average weight of two-year-old rainbow trout in the Pine Butte section, as measured in spring population estimates. Through the 1980's, three-year-old and four-year-old rainbow trout consistently exhibited lower average length and average weight in Norris than in Pine Butte, but that distinction was not apparent in the 1990's. Rainbow trout average length and average weight was not negatively affected with the onset and establishment of whirling disease in the Pine Butte section in 1991.

All three ages classes exhibit higher average length and average weight in the Varney section than in the Pine Butte section, as measured in fall population estimates.

Brown trout

Two-year-old and three-year-old brown trout exhibit higher average length and average weight in the Norris section that in the Pine Butte section. Four-year-old brown trout generally achieve similar average length in the Pine Butte and Norris sections, while those in Pine Butte exhibit slightly-to-moderately higher average weight in 6 of the 7 years.

Neither two-year-old or three-year-old brown trout consistently exhibited higher average length or average weight in the Pine Butte section compared to the Varney section, but four-year-olds in the Varney section consistently showed higher average length and average weight than those in Pine Butte.

Madison Bypass

Most radio tagged fish in the Bypass section remained there throughout 2003, though seven rainbow trout, five brown trout, and two mountain whitefish departed the Bypass by the end of 2003. Six of the seven rainbow trout departed the Bypass between early January and mid-May, perhaps to spawn. One rainbow, which was implanted on April 16 and departed the Bypass on April 26, was located adjacent to the Greycliff Fishing Access Site on June 9. It had moved about 23 miles downstream from its tagging site. Four radio tagged brown trout departed the Bypass in 2003, three of them in the spring, one in fall. Both mountain whitefish that were radio tagged were female and laden with eggs when implanted in early October. They both departed the Bypass in mid-October, likely to spawn.

During a tracking flight on June 9, six radio tagged fish were located downstream of the Bypass and except for the rainbow trout relocated near Greycliff, they were all in the Bear Trap Canyon. Two rainbow trout and two brown trout were between the Madison Powerhouse and Bear Trap Creek, a distance of about 4 miles, and one rainbow of undetermined gender was located between Bear Trap Creek and the Warm Springs Fishing Access Site, about 7 miles below its tagging site at the dam.

In mid April, seven attempts by rainbow trout to leap Ennis Dam were observed in an approximate two-minute period. On other occasions, attempts to pass the dam have been observed, but those attempts were not as intense as those observed in mid April. None of the radio tagged fish were detected at the dam for extended periods of time or at times of year that indicate they were attempting to pass the dam.

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 2003, and Appendix E1 contains thermographs for each location. Appendix E2 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

<u>New Zealand Mudsnails</u>

Researchers at Montana State University isolated 17 mottled sculpin and 29 juvenile brown trout in cages in NZMS-positive and NZMS-negative sections of Darlinton Ditch to assess growth and diet (Cada personal communication 2003). Analysis of the gut content of the caged fish after 30 days revealed no NZMS, but one newly hatched (less than 1 mm) NZMS was found to have been ingested by a 9-inch brown trout captured while collecting fish for the cage studies. Baetid mayflies were equally selected by caged brown trout in both the NZMS-positive and negative areas (Smith personal communication 2004), but analyses of diet selectivity compared to available food has not yet been completed. Previously these researchers have seen depressed Baetid mayfly densities in NZMS-positive areas of Darlinton Ditch in fall samples. During the 30 day period, caged brown trout gained weight while sculpin lost weight, though that loss may have been due to density dependent factors on the cages. However, sculpins in high NZMS density cages lost more weight than sculpins in low NZMS density cages (Cada personal communication 2004).

Table 3. Maximum and minimum temperatures (^oF) at selected locations in the Madison River Drainage, 2003. Air and water temperature data were recorded 4/20-10/2 (7944 readings) unless otherwise indicated. Thermographs for each location are in Appendix E1.

	Site	Max	Min
Water	Hebgen inlet	79.15	42.81
	Hebgen discharge	67.16	37.50
	Quake Lake inlet	66.32	36.75
	Quake Lake outlet	66.52	37.39
	Kirby Bridge	70.49	35.92
	McAtee Bridge	71.25	34.43
	Ennis Bridge	74.33	37.01
	Ennis Reservoir Inlet	78.47	36.29
	Ennis Dam	75.89	46.57
	Bear Trap Mouth	78.15	44.39
	Norris	78.40	44.08
	Blacks Ford	80.50	41.45
	Cobblestone	81.60	42.38
	Headwaters S.P. (Madison mouth)	81.75	42.85
Air	Kirkwood Store	99.40	23.43
	Slide	100.72[1/]	23.52
	Wall Creek HQ	96.85	23.51
	Ennis Fisheries Office	100.43	23.40[2/]
	Ennis Dam	98.76	25.90
	Norris	100.79	30.41
	Cobblestone	92.44	25.35

[1/] The maximum temperature detectible by the recorders is approximately 100.7F.
[2/] The minimum temperature detectible by the recorders is approximately 23.4^{o}F.

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

Whirling Disease

The rainbow trout population in the upper Madison River was severely depressed in the mid-1990's due to an invasion of whirling disease, but in recent years has shown some recovery (Figures 21-24) despite the persistent high infection rates as measured by caged sentinel rainbow trout and (Vincent pers.comm. 2004). While Age 2 & older rainbow trout abundance in the Pine Butte section is currently in a downward trend, their abundance in the Varney section is stable or increasing, and the number of yearlings in both sections has been at or near pre-whirling disease levels since 1999. Fieldwork in 2004 will include efforts to begin determining possible causes for this trend.

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

Westslope Cutthroat Trout Conservation and Restoration

Sun Ranch Westslope Cutthroat Trout Program

Gametes were collected from three streams by personnel conducting the Elkhorn Mountains Westslope Cutthroat Trout Recovery Program. Ferilized 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 near Toston being used for the Elkhorns Program. In 2003, 566 fry were stocked into the Sun Ranch Pond.

Cherry Creek Native Fish Introduction Program

The Cherry Creek Native Fish Introduction Project was scheduled to commence in August 2002 after the Montana First Judicial District Court dismissed a lawsuit in March of that year. Project opponents filed notice in June 2002 that they were going to sue in federal district court in early August, so MFWP decided to postpone the project to avoid incurring costs associated with project preparation only to potentially be stopped from implementing treatments. The threatened lawsuit was not filed in 2002, so in 2003 MFWP decided to proceed with the project despite another threatened lawsuit. Preparatory fieldwork was initiated in mid-July, and bioassays were initiated on August 1. Project opponents filed a lawsuit in Federal District Court on August 4, the day antimycin treatments began. They requested a stay to stop the application and also requested an order to prevent the project from continuing until the lawsuit was resolved. The judge denied both requests due to the late date of the filing and to technical errors made in the filing process. The litigating attorney and the FWP attorney negotiated a date - August 20 - after which FWP agreed not to apply any more antimycin in the Cherry Creek drainage in 2003, but allowed enough time to complete the scheduled 2003 treatments.

Bioassays were conducted August 1-3 to determine how far downstream antimycin remained active, to determine the concentration of antimycin necessary to cause 100 percent mortality of non-native fish in the streams, and to determine the concentration of potassium permanganate ($KmnO_4$) necessary to neutralize the antimycin (Appendix Tables F1, F2, F3). Discharge of the stream on which bioassays were conducted was 0.049 cfs, so 4.18 milliliters (ml) of Fintrol were required to achieve 12 ppb for a 7-hour application.

Cherry Lake was treated on August 4, 6, & 20, with 4 ppb applied each day. After each application, four 125-foot long gillnets were set in the lake to monitor for surviving fish. The August 6 & 20 treatments were conducted due to the capture or sighting of fish after previous treatments. The August 6 treatment was required after 3 fish were captured in the gillnets that morning. No fish were then seen or captured until several days later when packers went into the lake to remove equipment. It was decided to complete the stream treatments prior to returning to the lake for additional monitoring or treatments. The August 20 treatment was required after 2 fish were seen rising on August 19. Two fish were captured in gillnets the morning of August 20 prior to initiating the treatment – an 11" male & a 12" female. A dead 13" female was recovered during the application, but she had been dead for at least some time as fungus was growing on the gills and fins. Cherry Lake tributaries that had been treated on August 4 were dry by August 19, so any fish remaining in those tributaries would have moved into the lake.

Based on the results of the bioassays and to ensure thorough stream treatments, antimycin was applied to the stream at 10 ppb and application stations were placed 30 minutes apart, except in a high gradient section of Cherry Lake Creek were stations were placed 15 minutes apart and on a section of a Cherry Creek tributary where several stations were placed 45 minutes apart. All sentinel and free-swimming fish observed during treatments succumbed to the applications, while most aquatic invertebrates and all mature amphibians survived the treatments. Sentinel western (boreal) toad tadpoles exhibited mortality during the treatments, but adult western toads and numerous adult and juvenile spotted frogs were observed during and after the treatments.

Personnel from MFWP, Montana Department of Environmental Quality, Montana State University, Gallatin National Forest, Lewis & Clark National Forest, and Turner Enterprises spent 284 worker-days completing the project in 2003, including all preparatory and support activities and treatments. A total of 4.9 gallons of Fintrol were required to complete the treatments and bioassays in 2003 - 3.7 gallons for Cherry Lake and 1.2 gallons for the 11 miles of stream. Drought conditions that have persisted for several years severely reduced the quantity of water needing treatment. In September 1998, discharge at the downstream end of the Cherry Lake fork was 6 cfs, and at the downstream end of the Cherry Creek fork was 2 cfs. In 2003, the greatest discharge measured during the August treatments was 1.1 cfs in the Cherry Lake fork.

Hebgen Reservoir Tributary Spawning

Tributaries of Hebgen Reservoir were monitored in 2002 and 2003 to enumerate rainbow trout redds, to assess fry production, and to evaluate spawning potential. Detailed results will be published in a Master of Science thesis.

The number of rainbow trout redds observed in 2003 was approximately 30 percent of the number observed in 2002, however their distribution was similar in both years. Estimates of fry production were made based on the number of redds observed each year, estimated egg deposition per female, and the estimated survival-to-emergence. Over 2.4 million rainbow trout fry were estimated to have been produced in Hebgen Reservoir tributaries in 2002, while 657,000 were estimated to have been produced in 2003 (Watschke, personal communication 2004).

Results of the 2001-2002 Hebgen Reservoir creel census are in Appendix G.

CONCLUSIONS AND FUTURE PLANS

The Madison (Ennis) Reservoir grayling population continues to persist at low levels, and anglers reported routinely catching them at the south end of Ennis Reservoir in 2003.

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 continue to be affected by whirling disease, but have shown some recovery from the low levels seen in the mid 1990’s. Contrarily, for the past several years, sentinel fish deployed in the Madison River have continued to show high infection rates and severity, and sites previously known to have low infection severity have shown increasing infection severity. Surveys will be conducted in 2004 in cooperation with the Whirling Disease research staff to determine if rainbow trout have changed their spawning distribution to favor less infected spawning areas.

By the end of 2003, only 14 of 42 fish implanted with radio transmitters in the Bypass section had departed the area since monitoring began in July 2002. Six of seven rainbow trout that departed the Bypass did so in winter or early spring, possibly on spawning movements. Both whitefish that were radio tagged were females laden with eggs, and departed in mid-October. Whitefish are fall-spawners. Additional tags will be deployed at least twice annually for the next several years.

Neither rainbow nor brown trout in the lower Madison River (downstream of Ennis Dam) exhibit obvious or consistent negative affects of thermal stress on growth when compared to fish in the upper river (Hebgen Dam to Ennis Reservoir) for the seven years that comparative data are available.

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 and an on-going Montana State University Master of Science project studying the effects of NZMS in Darlinton Ditch. The FWP

Aquatic Nuisance Species Coordinator will be responsible for developing programs to address aquatic nuisance species, including the NZMS.

The Sun Ranch Westslope Cutthroat Trout Program relied on gametes from the Elkhorn Mountains Westslope Cutthroat Trout Recovery Program for the 2003 year-class. Drought induced depletion of local populations prevented their use. We anticipate that in 2004 we will be able to use gametes from at least one stream near Dillon as well as another year-class provided by the Elkhorns Program.

The Cherry Creek Native Fish Introduction Project will resume in 2004 with the second scheduled treatment of Cherry Lake and the upper forks of the drainage (Figure 14). Given that approximately 284 worker-days were required to complete the preparatory fieldwork and treatments in 2003, FWP plans in 2004 will be to conduct the second treatment of Phase 1 only, and will not attempt to also complete the first treatment of Phase 2.

Fewer rainbow trout were observed in spawning runs in Hebgen Reservoir tributaries in 2003 than in 2002, resulting in a lower fry production as well. With completion of the MSU Master of Science Project on the Hebgen tributaries, MFWP will absorb those duties as well as expanding the study into Hebgen Reservoir in an attempt to determine the fate of juvenile rainbow trout after they emigrate from natal streams into the reservoir.

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

Cada, C. 2004. Personal communication.

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

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.

Montana Aquatic Nuisance Species Technical Committee. 2002. Montana Aquatic Nuisance Species Management Plan, October 15, 2002. 148 pages.

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. 1997a. 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. 1997b. MarkRecapture Version 5.0. A Software Package for Fishery Population Estimates.

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. 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. 2001a. 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. 2001b. Environmental Assessment - Darlinton Ditch New Zealand Mud Snail Control Project, May 2001.

Montana Fish, Wildlife, & Parks. 2001c. Decision Notice – Darlinton Ditch New Zealand Mud Snail Control Project, July 2001.

Montana Fish, Wildlife, & Parks. 2001d. Environmental Assessment – Sun Ranch Fish Pond Eradication Project, December 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. 2001 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

Vincent, E.R. 2003. Personal communication.

Watschke, Darin, and Thomas McMahon. 2002. An Assessment of Tributary Potential for Wild Rainbow Trout Recruitment in Hebgen Reservoir, Montana. Progress Report, October, 2002.

Appendix A

MONTANA AQUATIC NUISANCE SPECIES MANAGEMENT PLAN

Priority List, ANS descriptions, and Management Actions

PROBLEMS AND CONCERNS

THREATENED IMPACTS FROM AQUATIC NUISANCE SPECIES

Nonindigenous Aquatic Animals

When species are introduced into a new environment there is the potential for significant ecological, economic, and social effects. Once introduced, there may be no natural controls, such as pathogens, parasites, and predators. Lack of natural controls may allow a population to increase at an exponential rate. Establishment of new species can cause the disruption of native species in the ecosystem as the introduced species may prey upon, out compete, or transmit disease to the native species. The introductions of harmful nonindigenous aquatic nuisance species into Montana waters have already caused severe impacts. These include the elimination of native fishes through competition, hybridization, and altering of habitats. Economic losses also occur and with loss of income due to the loss of sporting opportunities and tax dollars going to the control of these species.

ANS have sprung up across Montana due to intentional or and unintentional actions. Ballast water discharge from ships is the most significant source of unintentional introductions of ANS to coastal and estuarine waters. Ballast water is obviously not a problem in Montana, however animals introduced into the U.S. through the ballast water pathway are a serious threat here. The same principle applies to smaller watercraft in this area. ANS such as the zebra mussel and New Zealand mud snail can attach to the hull or fishing gear or be moved in the live wells or bait buckets from one body of water to another.

There are several other pathways through which ANS are introduced. Water diversions allow fish from different drainages to invade new habitats potentially causing serious problems. Importation of fish through the aquarium trade can put bodies of water at risk of invasion. Although aquaculture is well regulated in Montana, the out of state propagation of animals for commercial or recreational purposes provides a potential source for ANS. ANS may be introduced through intentional, illegal releases. This plan provides a reference point to be observed to decrease misguided attempts to change state fishery resources.

Nonindigenous Aquatic Plants

The spread of nonindigenous aquatic plants causes significant economic and ecological problems throughout North America. Invasive, non-native species are one of the leading threats to the ecological integrity of forests, grasslands, and waterways. Recognizing the threat to western aquatic ecosystems and water delivery systems caused by nuisance exotics has raised concerns with representatives from state, provincial, and federal agencies as well as private water interests.

Aquatic vascular plants include ferns and flowering plants that grow submersed in water, float on the water surface, or have basal portions inundated with foliage and upper parts emersed. Diverse in form and habit, many aquatic plant species have become established in the United States outside of their natural range. Introduced intentionally or escaping from cultivation, nonindigenous plants can colonize aquatic communities where they compete with and often displace native species. Hydrilla (*Hydrilla verticillata*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are examples well known for their ability to alter physical and biological functions of aquatic systems. They impact water quality, recreational uses of water, and fisheries. A wide variety of pondweed (*Potomogeton* spp.) species clog irrigation and drainage ditches. Filamentous and planktonic algae can clog waterways, impact water quality, and produce toxic blooms in lakes and ponds. Emergent species such as purple loosestrife (*Lythrum salicaria*) reduce wildlife cover and habitat. Saltcedar, or tamarisk (*Tamarix* spp) seriously degrades wetlands, completely drying up some lakes, ponds, and river areas.

Pathways for introduction of aquatic plant species include: boats and trailers, the aquarium trade, nursery and garden centers, and mail order and internet suppliers.

Pathogens (including Whirling Disease)

Pathogens may include bacteria, viruses or parasites. They may potentially enter Montana on plants or animals imported into Montana or through the water in which plants or animals are transported. When pathogens are allowed into a new aquatic environment, they have the capability to infect native or existing plants or animals and cause disease. Pathogens introduced into Montana waters can cause disease and are potentially harmful to fish, plants and other animals. Importation of pathogenic organisms must be regulated and spread of these pathogens must be controlled. Organisms, such as *Myxobolus cerebralis*, the parasite which causes whirling disease in Salmonid fish, have the potential to severely impact wild trout fisheries in Montana, resulting in serious loss of recreational activity and financial loss to Montana. Diseases, like whirling disease, are especially devastating to a state like Montana, which relies on wild trout for most of its stream and river fisheries. Viral pathogens present in the Pacific Northwest have resulted in losses of millions of trout and salmon. These viruses must be kept out of Montana through tightly regulated fish import laws.

Status of Aquatic Nuisance Species in Montana - Priority for Action

All nonindigenous species impact native species and habitat in some manner, but not all of them pose a significant threat, and some provide an economic and recreational benefit in certain areas. While it is hard to elucidate the effects that species will have once they are introduced, there are species whose current or potential impacts on native species and habitats and economic and recreational activity in Montana are known to be significant. These ANS are a priority for management actions. At the same time, the ability to manage each species varies greatly, and the resources available are limited. Management efforts must, therefore, be focused on species where actions can produce the greatest benefit. In recognition of the known threats, impacts, and potential problems of certain ANS and the state's current management capabilities, a system to classify species was developed that recommends management activities for each classification. Yet, because impacts either do not occur immediately or may not be apparent until well after establishment, effort must also be devoted to assessing the overall impacts of nonindigenous species, regardless of their classification. The following are examples of species to be addressed by the Montana ANS management plan. This list is not comprehensive, but is provided to illustrate species in each management class. The Plan provides for an on-going assessment of potential priority class species.

PRIORITY CLASS 1

Priority Class 1 species are currently not known to be present in Montana, but have a high potential to invade and there are limited or no known management strategies for these species. Appropriate management for this class includes prevention of introductions and eradication of pioneering populations. Examples of species that need to be addressed under this management class are discussed below.

Zebra Mussel (*Dreissena polymorpha*)

In the late-1980s, the zebra mussel was discovered in Lake St. Clair, between Lake Huron and Lake Erie. Zebra mussels were introduced from Eastern Europe via ballast water discharge from European freighters. This species spread rapidly to 20 states in the Mississippi River drainage. Nationwide expenditures to control zebra mussels in water intake pipes, water filtration equipment, and electric generating plants are estimated at $3.1 billion over 10 years (OTA, 1993).

Zebra mussels can easily survive overland transport from the Midwest to Montana while attached to boat hulls or in live wells, engine cooling systems, or bait buckets. Live zebra mussels have been found at California agricultural stations on boats from the Midwest, and in Washington on boats destined for British Columbia. The zebra mussel is a prolific fouling organism with great potential to disrupt fish passage facilities and cause ecological and economic damage in the Pacific Northwest.

Rusty Crayfish (*Orconectes rusticus*)

Only three species of crayfish are thought to be native in Montana, *Orconectes virilis, Pacifastacus leniusculus and P gambelii. O. imnunis,* which has been found in the south central region of the state, is an introduced species (Dr. W. Gould, Professor Emeritus, MSU, Bozeman, MT). The native populations could be seriously impacted by introduction of a non-native species of crayfish, such as the rusty crayfish *O. rustucus*. The rusty crayfish has eliminated native *Orconectes* species and has had serious negative impacts on macrophyte populations in some states. The rusty crayfish has not been found in Montana, but it has been transplanted to new waters in other states resulting in viable populations. Native crayfish are also susceptible to a variety of bacteria and viruses, which could be introduced with non-native crayfish.

Egeria (*Egeria densa*)

Egeria, an aquatic plant from South America, was presumably imported for the aquarium trade. It has few natural predators to keep its growth in check, and when introduced to a lake, it often forms dense mats that displace native aquatic plants. These mats are unsightly, interfere with recreation, and degrade fish habitat.

Hydrilla (*Hydrilla verticillata*)

Hydrilla, another aquatic plant, was imported into the United States from Asia in the early 1950s for use in aquariums, and was likely introduced into the wild near Tampa and Miami, Florida. Hydrilla is currently the most abundant aquatic plant in Florida, where it grows in thick surface mats and displaces native vegetation. Distribution in the United States now ranges from Connecticut southward along the coast to Texas. The plant is also present in California and Washington. Several inland states (Pennsylvania, Tennessee and Arizona) also have populations. Established populations of hydrilla are not known to occur in Montana, although surveillance efforts have been limited. Hydrilla is most likely to spread when plant fragments are carried along with recreational boats into new habitat.

Hydrilla causes major problems with water use. In drainage and irrigation canals, it greatly reduces flow and causes clogging, which can result in flooding and damage to canal banks, structures, and pumps. In utility cooling reservoirs, hydrilla can disrupt flows necessary for adequate water-cooling. Hydrilla can interfere with recreational and commercial vessel navigation. In addition to interfering with boating by fisherman and water skiers, hydrilla hampers swimming, displaces native vegetation communities, and can damage sportfish populations. The economic consequences of aquatic weed infestations can be staggering. Annual expenditures to control aquatic weeds in the United States (most of them nonnatives, such as hydrilla) are reported to be $100 million (OTA, 1993).

Zander (*Stizostedion lucioperca*)

Walleye (*Stizostedion vitreum)* and native sauger (*S. canadense)* have two closely related species in Eastern Europe, the zander or European pike-perch (*S. lucioperca)* and the Volga pike-perch or Volga zander, (*S. volgensis) (*Courtenay and Robins 1989).

The North Dakota Game and Fish Department successfully imported the zander from Finland in 1989 and stocked Spirtwood Lake as an experimental introduction. North Dakota netting surveys did not catch any zander and they concluded that the introduction had failed. In August 1999 an angler caught an age 2+ zander, which was verified by Department of Fisheries and Oceans in Winnipeg. The zander matched the zander from Finland using mitochondrial DNA test. This verified that the North Dakota zander had reproduced. There is a possibility that the zander is in the Missouri River. Spiritwood Lake has overflowed several times into the James River, a tributary of the Missouri River (Courtenay 2001).

Potential impacts of the zander in the Missouri River Drainage fishes include displacement, predation, and hybridization with walleye and sauger. Although the extent of their impact and distribution in the Missouri River is largely unknown it would be prudent to keep them out of Montana waters.

Round Goby (*Neogobius melanostomus*)

This fish is a bottom-dwelling fish, native to eastern Europe that entered the eastern Great Lakes in ballast water. They can spawn several times per year, grow to about 10 inches, are aggressive, and compete with native bottom-dwellers. The round goby, was introduced, via ballast water, into the St. Clair River and vicinity on the Michigan-Ontario border where several collections were made in 1990. The numbers of native fish species have declined in areas where this goby has become abundant. The round goby has been found to prey on darters, other small fish, and lake trout eggs and fry in laboratory experiments (Marsden, J. E., and D. J. Jude, 1995). The round goby's potential range includes Montana.

Ruffe (*Gymnocephalus cernuus*)

The ruffe (*Gymnocephalus cernuus*) is a small perch-like Eurasian fish. It was apparently introduced to the Great Lakes in the St. Louis River near Duluth, Minnesota from a ballast water discharge. In Europe the ruffe feeds on whitefish eggs and competes with other more desirable fish. The spiny dorsal fins of the ruffe discourage predation by other fish. In Lake Superior, the species of fish that is most affected by the ruffe is the yellow perch. Populations of perch have declined up to 75% in water bodies where the ruffe have become established. If established in Montana, there could be serious affects to our lake and reservoir fisheries.

Spiny Water Flea (*Bythotrephes cederstroemi*)

The spiny water flea is not actually an insect, but a tiny (less than half an inch long) crustacean with a long, sharp, barbed tail spine. A native of Great Britain and northern Europe east to the Caspian Sea, the animal was first found in Lake Huron in 1984, probably imported in ballast water of a transoceanic freighter. Since then populations have exploded and the animal can be found throughout the Great Lakes and some inland lakes.

The effects spiny water fleas will have on the ecosystems of the Great Lakes region are unclear. The animals compete directly with young fish for food, such as Daphnia zooplankton. Spiny water flea also reproduces rapidly. During warmer summer conditions, each female can produce up to 10 offspring every two weeks. As temperatures drop in the fall, eggs are produced that can lie dormant all winter.

It is not known if this exotic will have larger impacts on inland lakes. Spiny water fleas eggs and adults spread unseen in bilge water, bait buckets, and livewells. In addition, fishing lines and downriggers will often be coated with both eggs and adults.

Heterosporosis (Parasite of perch and other fish species)

Heterosporosis is a microscopic parasite, which has the potential to infect several fish species resulting in muscle lesions and can cause serious harm to fish. The parasite was first reported in yellow perch, but may also be found in walleye, northern pike, fathead minnows or other fish species. This parasite has been reported in fish in Minnesota and Wisconsin. It has never been reported in Montana, but has the potential to become established in Montana fish if infected fish are imported into Montana. The parasite causes milky white lesions with a granular texture in fish fillets. Severity of the infection will vary between infected fish populations, but in heavily infected fish as much as 80% of the fillet may be affected.

Infectious Hematopoietic Necrosis (IHN)Virus

IHN virus is an example of a pathogen, which is not currently known to occur in Montana, but which has the potential to cause serious mortality if it is introduced. It is a pathogen known to occur in fish in states west of Montana. We must constantly be on guard to ensure it is not imported into Montana with fish imported from other states. For this reason, IHN virus and other viral pathogens are listed as "pathogens of concern" on Montana import and disease laws. Fish may not be imported into Montana unless they have been tested and found free of IHN virus.

Asian Carp (Four Species)

The black carp (*Mylopharyngodon piceus*) has been approved for release for stocking commercial aquaculture ponds to control snails and will surely escape into the wild just as the other three species of Asian carp, the silver (*Hypophthalmichthys molitrix*), bighead (*H. nobilis*) and the grass carp (*Ctenopharyngodon idella*) have. The latter three species were released in the 70s, 80s and early 90s for aquaculture and pond applications and have now developed large wild populations in the Missouri River basin. Large numbers of bighead carp have been reported "piling up' in large numbers below Midwestern dams and it is quite likely that they will get past the dam one way or another and proceed up the Missouri River. The bighead carp, a plankton feeder may compete for food with paddlefish and bigmouth buffalo, as well as with forage fishes. All three species compete for food with the larval stages of our native game fish. These carp also have the ability to capitalize on inundated river habitats such as Fort Peck Reservoir.

Although the extent of their impact and distribution in the Missouri River is largely unknown it would be prudent to keep them out of Montana waters.

Tench (*Tinca tinca*)

The tench, a member of the family Cyprinidae, was introduced into Idaho in the 1880s. Tench are now found throughout the Pend O'reille and the Coeur d' Alene river drainages including downstream from Cabinet Gorge Dam. Tench have a high reproductive potential grow to 15 inches in Idaho and much larger in their native Europe. They may be a competitor for with game fish and native cyprinids (Moyle 1976).

Nutria (*Myocastor coypus*)

The only known mammalian ANS is the nutria, *Myocastor coypus*. It is found in and around fresh and saltwater ponds and swamps. Nutrias were initially introduced into North America and farmed for their fur. Since their introduction, some animals have escaped these farms and established localized breeding populations from Texas to Virginia, Washington and Oregon, and in the Great Lakes area. Presently, they are considered to be a pest species, disrupting irrigation systems, destroying native aquatic vegetation, and crops. Additionally, by disturbing the balance of the native biota they provide an advantage for non-native plant species to become established. The literature indicates that they have been reported in Montana (Stevenson 1976) but there are no reports of reproducing populations at this time. However, this is a species which would not be welcome here.

PRIORITY CLASS 2

Priority Class 2 species are present and established in Montana and have the potential to spread in Montana and there are limited or no known management strategies for these species. These species can be managed through actions that involve mitigation of impact, control of population size, and prevention of dispersal to other waterbodies. Examples of species addressed under this management class are discussed below.

New Zealand Mud Snail (*Potamopyrgus antipodarum*)

Native to New Zealand but long established in Australia and Europe, this species was discovered in North America in 1987 in the Snake River in south-central Idaho. Population levels can exceed 100,000 snails per square meter (NCSE, 1999). New Zealand mud snails (NZMS) have become established in every major river drainage in Yellowstone National Park, in the Madison River Drainage in Montana, at several other locations in the western U.S., and in Lake Ontario, New York. Modes of transportation may include hitchhiking on recreational equipment and other equipment used in water, in the guts of harvested or illegally transported fish, or via transport on waterfowl and other aquatic birds. Effects on native aquatic invertebrates are being documented in the Madison River and in Darlington Ditch, a small stream along the lower Madison River. NZMS degrade habitat due to their high reproductive capacity and the subsequent impacts on invertebrate food sources. Fish receive little, if any, nutritive value from eating the snail. The snail has an operculum that it closes when threatened, which prevents digestive juices from reaching the soft tissue of the snail's body when ingested by fish.

Whirling Disease (*Myxobolus cerebralis*)

Whirling disease is caused by a metazoan parasite that infects cartilage tissue of most Salmonid species. The whirling disease parasite was first introduced to the United States from Europe in the 1950s, probably through trout infected in Europe. This parasite has a two-host life cycle which includes both the primary Salmonid host and a common aquatic worm (*Tubifex tubifex*). Infective spores are produced in each host and are capable of spreading the disease in a variety of ways. The disease is now known to occur in over 20 states. Whirling disease has become a major problem in some western states, and has caused major declines in some wild rainbow trout populations and is especially severe in Colorado and Montana. Currently whirling disease has been found in over 95 bodies of water in Montana with severe infections in the Madison River, mid-Missouri River near Helena, Rock Creek near Missoula, Big Blackfoot River and many smaller wild trout streams. In the Madison River, population declines in wild rainbow trout have been as high as 80% (Vincent, 1996).

PRIORITY CLASS 3

Priority Class 3 species are not known to be established in Montana and have a high potential for invasion and appropriate management techniques are available. Appropriate management for this class includes prevention of introductions and eradication of pioneering populations. Examples of species that need to be addressed under this management class are discussed below.

Eurasian Watermilfoil (*Myriopyllum spicatum*)

Eurasian watermilfoil (EWM) was accidentally introduced to North America from Europe. Spread westward into inland lakes primarily by boats and water birds, it reached the Midwestern states between the 1950s and 1980s. A key factor in the plant's success is its ability to reproduce through stem fragmentation and runners. A single segment of stem and leaves can take root and form a new colony. Fragments clinging to boats and trailers can spread the plant from lake to lake. Once the plant is established it is almost impossible to eradicate it.

Asian tapeworm (*Bothriocephalus acheilognathi*)

The Asian tapeworm is not known to be present in Montana at this time. As with any fish pathogen or parasite, if the Asian tapeworm is introduced and does become established in Montana, it will be extremely difficult or impossible to eradicate. For this reason, it is essential that this parasite not be introduced into Montana waters. The Asian tapeworm may infect many species of game, forage and bait fish. It has the potential to do serious harm to fish if introduced into Montana waters. This parasite was introduced into the United States through shipments of infected grass carp from China. It has spread into several states with infected fish. The tapeworm can result in mortality, but most often is responsible for reduced growth and poor condition of infected fish.

PRIORITY CLASS 4

Priority Class 4 species are present and have the potential to spread in Montana but there are management strategies available for these species. These species can be managed through actions that involve mitigation of impact, control of population size, and prevention of dispersal to other waterbodies. Examples of species addressed under this management class are listed below.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a wetland invader that was imported from Europe in the early 1800s for its medicinal value and for the beautiful purple spikes of the blooming plant. Unsuspecting visitors to an infested wetland often admire the beauty of the marsh when purple loosestrife is in bloom, unaware that it has displaced native plants and animals. Its vegetative dominance may increase the likelihood of listing additional native species under the ESA. Purple loosestrife is still sold as an ornamental in nurseries in some states, though 24 states, including Montana, have listed it as a noxious weed and prohibit its sale. It is found in 42 of the contiguous states, and could invade the remaining six. The plant is extremely difficult to eradicate although recently a suite of biological control agents have proven effective in suppressing the plant. Estimated losses are $45 million per year in control costs and forage loss (ATTRA, 1997). The Montana Purple Loosestrife Task Force has developed a statewide management plan for this species and active eradication programs are currently underway in Lake and Cascade counties in Montana..

Yellow Flag Iris (*Iris pseudacorus)*

Yellow iris is a rhizomatous emersed wetland forb. It has very showy yellow iris flowers, and is a tall plant with long, flat, dark green, sword-like leaves. This invasive plant propagates by both seed and underground rhizomes. The drought tolerant rhizomes break off, and spread downstream, as does the seed. Poisonous if ingested, and irritating to the skin, yellow iris is fast growing, fast spreading, and very competitive. It forms almost impenetrable thickets. It was brought into the United States in the early 1900's as an ornamental and has been used for erosion control, as a dye and fiber plant, and in sewage treatment cells. In Montana, Lake County suffers from invasion throughout the irrigation ditch systems and the wetlands, as well as spreading down the Flathead River into Sanders County. It is also well established in Missoula and Flathead counties.

Flowering Rush (*Butomus umbellatus*)

Flowering rush was introduced through the North American shipping trade at the turn of the century in ballast as long-lived seed and possibly reproductive bulblets into the ecosystems of Quebec and Michigan. Use as an ornamental provided this invasive plant another route to the Midwest and expedited it's spread westward to the Idaho panhandle and Northwestern Montana, where it is reported to be out-competing the native willows and cattails. An emergent in shallow areas of lakes, flowering rush has umbellate pink flowers and grows to 3 (three) feet tall on triangular stems. It has a submersed form also, which can grow in water 10 (ten) feet deep.

Saltcedar (*Tamaricaceae spp.)*

This invasive small tree or large shrub remains a popular ornamental despite its classification as a "successful" weed. Thousands of tiny pink to white flowers are produced throughout the spring and summer. One mature plant can produce ½ million seeds each year. As well as reproducing by the wind and water borne seed, saltcedar can reproduce vegetatively. Large saltcedar plants can use up to 200 gallons of water a day; reducing and even eliminating water flow. It out-competes native plant communities, degrades wildlife habitat and has resulted in the decline of many species. Tamarisk reduces recreational and agricultural use, and increases wildfire frequency. In Montana, counties east of the divide are experiencing a tremendous impact from the rapid spread of the competitive saltcedar. Western Montana has an abundance of these ornamentals that pose a threat. A very active group of weed fighters are working together to develop a Montana Saltcedar management plan that targets a statewide survey, containment, and eradication program.

Curley Pondweed *(Potamogeton crispus)*

Curley-leaf pondweed is a perennial, rooted, submerged aquatic vascular plant native to Eurasia, Africa, and Australia. By 1950 most of the U. S. was infested by this species. By late spring it may form dense mats which interfere with recreation and limit the growth of native aquatic plants. By July, this plant senesces and forms vegetative propagules called turions. The turions are dispersed by water movement throughout a water body. Turions may also be transferred to uninfested lakes by the usual means. In some areas it may not be considered a problem but in shallow lakes it can grow dense enough to affect recreational boating and fishing. It can alter the nutrient dynamics of a fertile lake causing heavy summer algae blooms (Iowa ANS Plan 2000).

Nonindigenous fish (rainbow, brook, lake and brown trout, bass, walleye, Northern pike, and other warmwater fish species) and amphibians (bullfrogs)

These species have been introduced, intentionally and unintentionally, into Montana and are well established in some areas. Fish and bullfrogs have been implicated in the decline of native salmonids and amphibians. Impacts of introduced fishes on native fish species include predation, introduction of diseases and parasites, competition for food and space, and hybridization. In some cases non-natives may be controlled for conservation and restoration of native species. Some species, *e.g*. walleye, largemouth bass, lake trout and rainbow trout, are the basis of popular fisheries that provide recreational benefit to many Montanans. In addition, recreational angling can provide substantial economic benefits to local economies. While these species have established populations, there are areas of the state where they do not occur, and management is limiting their spread. An environmental assessment is required (MCA 87-5-711) before a fish introduction can legally occur.

Bacterial fish pathogens

Bacterial fish pathogens, such as *Aeromonas salmonicida* (Furunculosis), are present in some Montana watersheds. *Aeromonas salmonicida* is the bacterial pathogen that causes a disease known as furunculosis in fish. This bacterium is known to occur in several Montana watersheds. In the wild it generally does not cause serious problems in fish. However, when fish become stressed, the pathogen can result in a disease problem with high potential mortality. Management actions that can reduce elevated water temperatures or other stress factors may have a significant impact on reducing impact of this pathogen on fish. Furunculosis in a hatchery can often be successfully treated with antibiotics. Because of the potential negative impact of this fish pathogen on Montana's wild and cultured fisheries, import and transport of fish infected with this pathogen should be closely regulated. Montana law prohibits the importation of live fish infected with this bacterial fish pathogen and other known bacterial pathogens.

MANAGEMENT ACTIONS

The goal of the Montana ANS Management Plan is to:

Minimize the harmful ecological, economic, and social impact of ANS through prevention and management of introduction, population growth, and dispersal of ANS into, within, and from Montana.

The goal will be achieved through implementation of a plan that:

- emphasizes prevention of introductions;
- requires an impact assessment and review for all aquatic nonindigenous species prior to their importation, transport, or use in Montana;
- allows for early detection;
- includes development of contingency plans;
- permits appropriate and timely management response to new and existing populations;
- protects and restores native plant and animal communities;
- provides for easy access to accurate and up-to-date species distribution and management information;
- incorporates education and research elements;
- recommends funding levels adequate for effective implementation;
- produces agency collaboration through an invasive species council;
- facilitates inter-jurisdictional coordination with state, federal and tribal agencies; and
- seeks cooperative solutions with the private sector and user groups.

It is not possible to address all potential invaders, their impacts, and the constraints and contingencies that may develop. Consequently, this plan is intended to be adaptable to changing circumstances. The activities and priorities of the plan will be reviewed regularly with a report produced by the Aquatic Nuisance Species Task Force, which will include recommendations for updating and modifying management activities and priorities and continuation or termination of various strategies as appropriate.

Appendix B

Description of young-of-the-year Arctic grayling beach seining locations in Ennis Reservoir, and catch at each site. See Figure 2 for site locations.

Species abbreviations:

AG	Arctic grayling
MWF	mountain whitefish
WSu	white sucker
UC	Utah chub
Rb	rainbow trout
LL	brown trout
LND	long nose dace

September 28, 2004

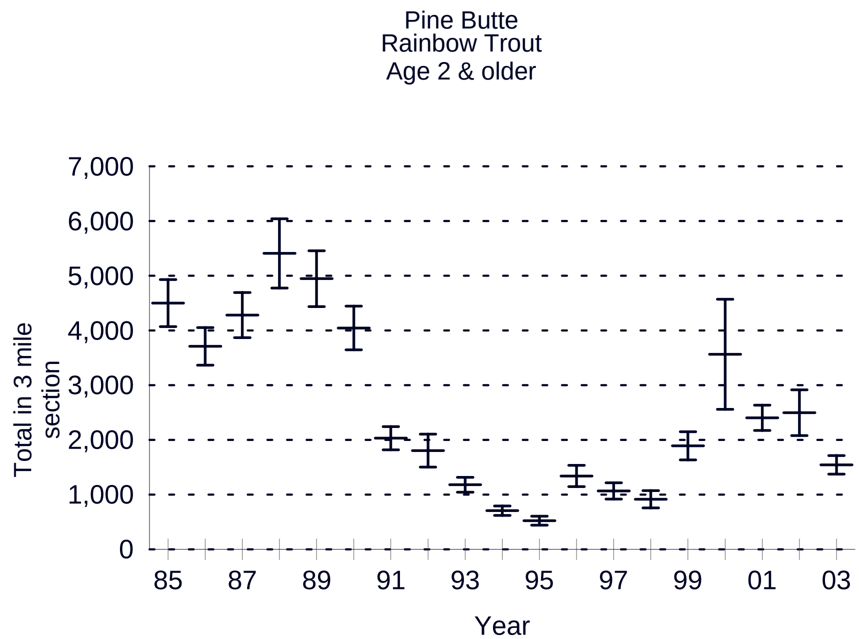
Site and time seined	AG	MWF	Note
Grassy point 300' west of Fletchers (Fig 2, site 2) 1100 hrs	0	0	A few juvenile Utah chubs (UC), White suckers (WSu), & long-nose dace (LND). Macrophytes sparse
Backwater area west of Fletchers (Fig 2, site 2) 11121 hrs	0	1	MWF: 110 mm 29 juv UC 12 juv WSu macrophytes dense
Reservoir shoreline east of Moore's Ck mouth (Fig 2, site 2) 11137 hrs	0	6	MWF: 125, 118, 134, 117, 122, 110 mm 2 juv LND dozens of juv UC 4 juv WSu macrophytes present but not dense
Upstream in Moore's Ck mouth (Fig 2, site 2) 1200 hrs	0	0	2 yoy LL: 104, 80 mm dozens of juv UC & Wsu 10 juv LND macrophytes abundant
East of Mad Riv mouth along cattails 1252 hrs	0	1	MWF: 119 mm 1 yoy LL: 98 mm few juv UC & Wsu macrophytes sparse, filamentous green algae abundant
East of Mad Riv mouth perpendicular to shore 1312 hrs	0	0	Few juv UC & Wsu Macrophytes sparse, filamentoud green algae abundant
Willows at Petersen rental to willows at Meadow Ck FAS 1402 hrs	0	0	14 juv Wsu 11 juv UC macrophytes sparse
Downstream in Meadow Ck from cattail patch to mouth 1455 hrs	1	1	AG: 147 mm MWF: 113 mm 1 yoy LL: 93 mm dozens juv UC & Wsu dense macrophyte patch at mouth of stream seined

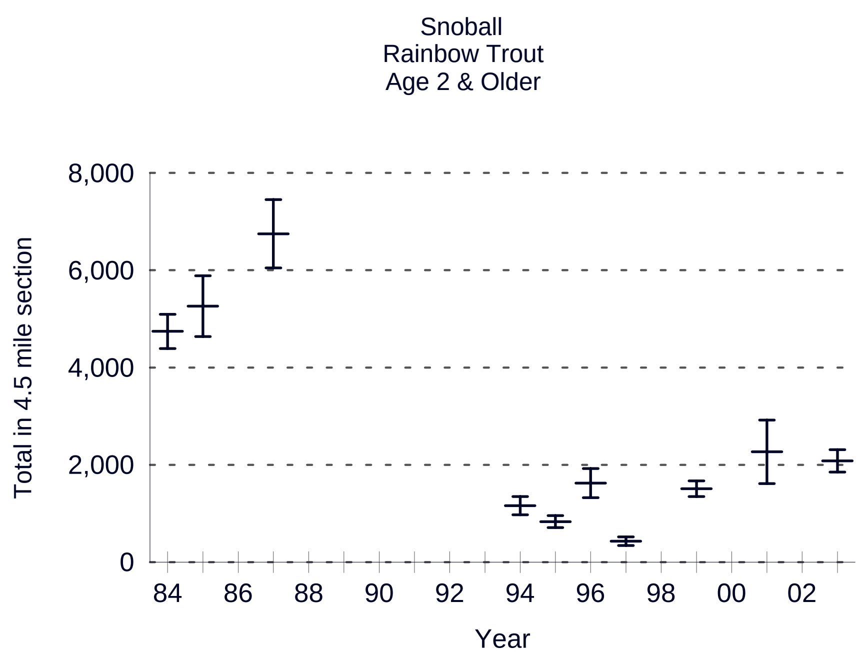
Appendix C

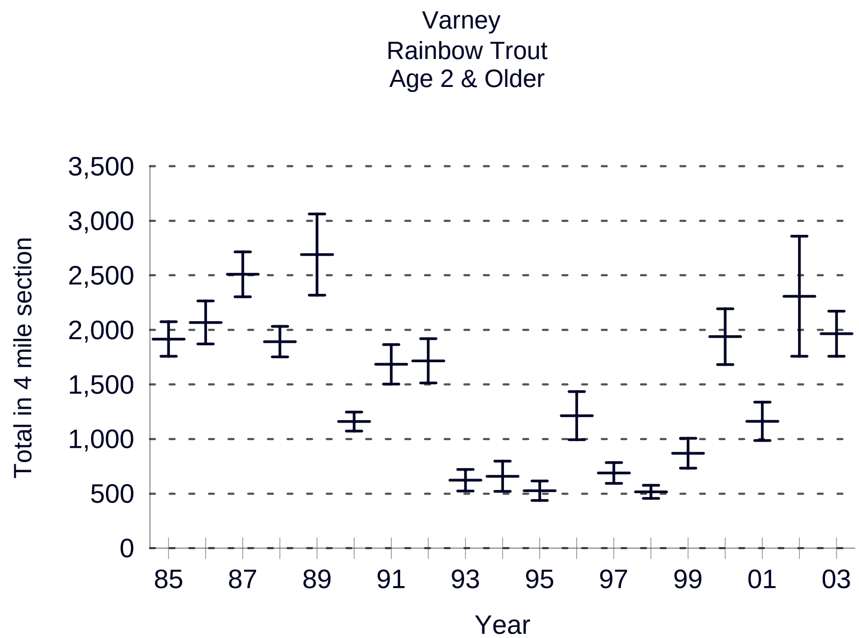
Population estimates (total number in section ± 80 percent Confidence Intervals) of age 2 & older rainbow and brown trout in the Madison River

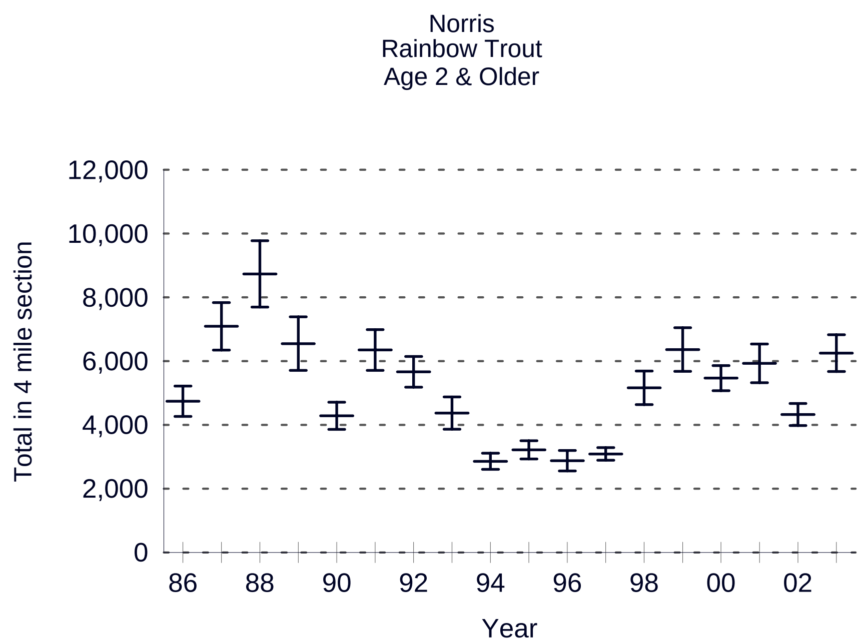
section lengths

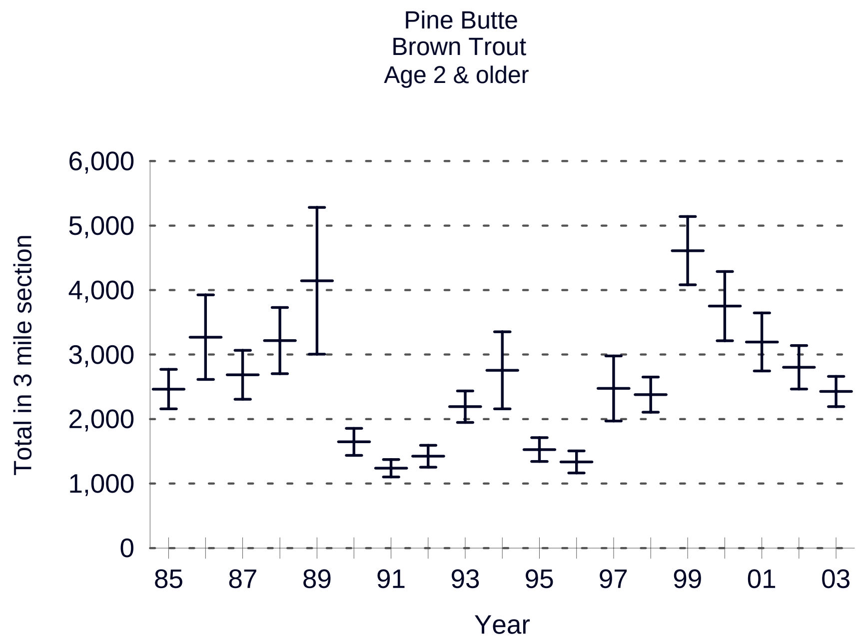
Pine Butte – 3 miles
Snoball – 4 miles
Varney – 4 miles
Norris – 4 miles


Pine Butte
Rainbow Trout
Age 2 & older
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total in 3 mile section
85
87
89
91
93
95
97
99
01
03
Year

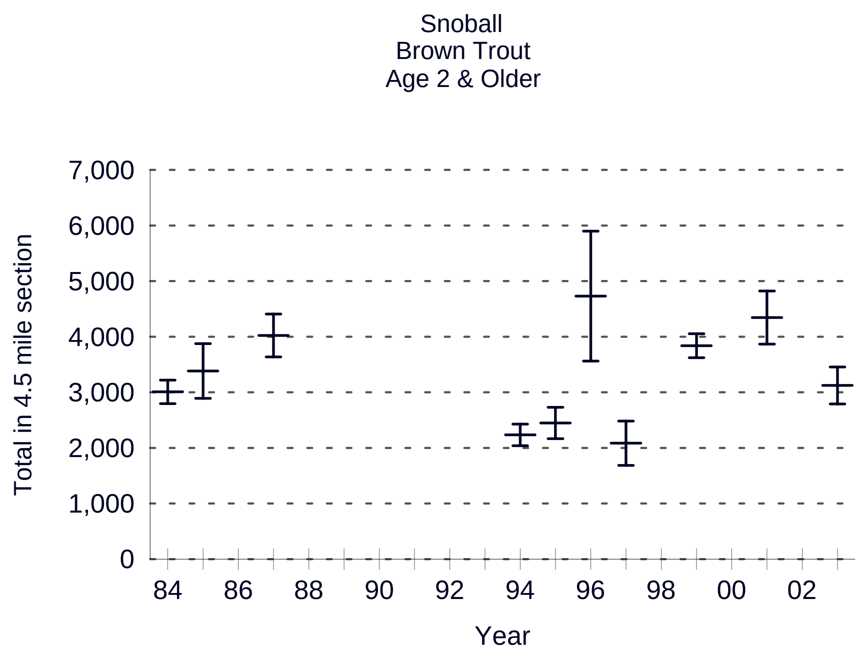

Snoball
Rainbow Trout
Age 2 & Older
8,000
6,000
4,000
2,000
0
Total in 4.5 mile section
84
86
88
90
92
94
96
98
00
02
Year


Varney
Rainbow Trout
Age 2 & Older
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Total in 4 mile section
85
87
89
91
93
95
97
99
01
03
Year

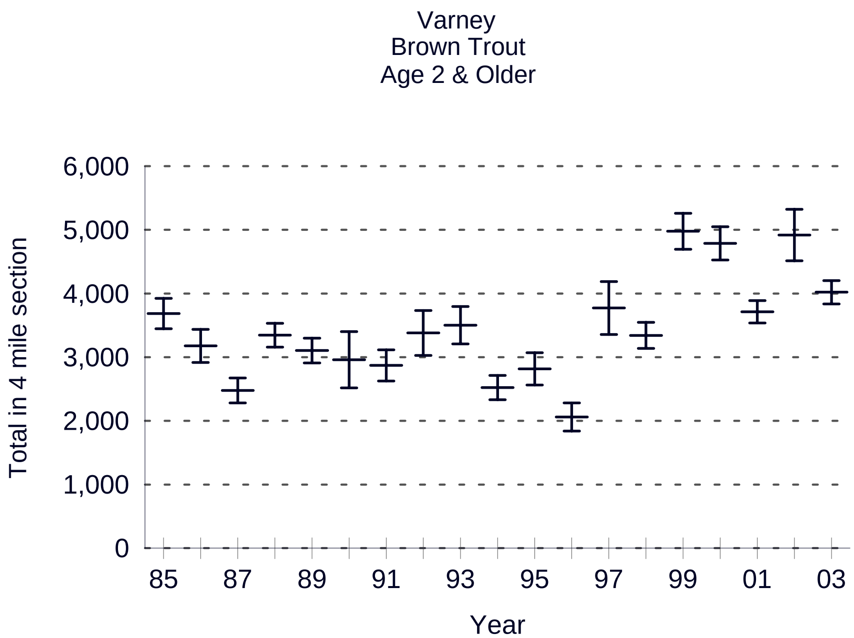

Norris
Rainbow Trout
Age 2 & Older
12,000
10,000
8,000
6,000
4,000
2,000
0
Total in 4 mile section
86
88
90
92
94
96
98
00
02
Year



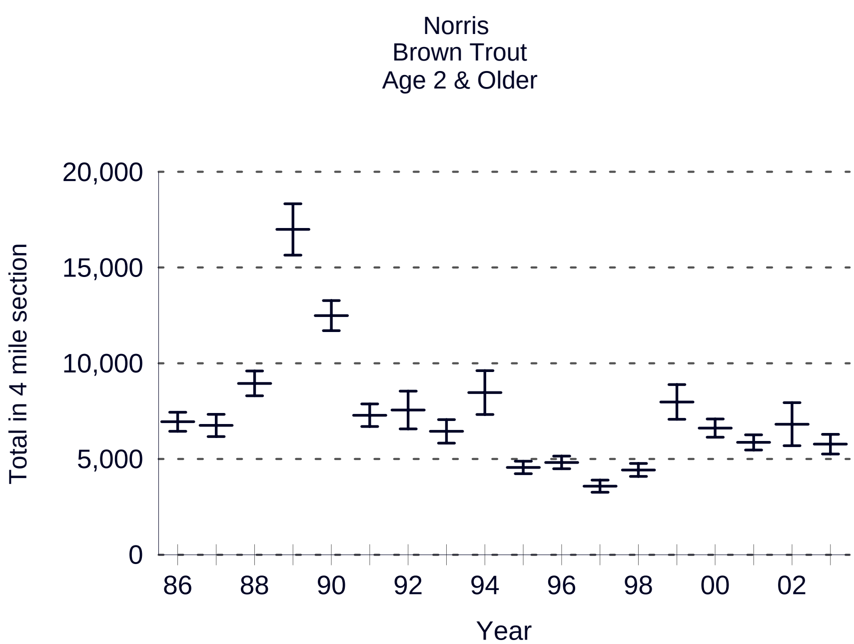
Pine Butte
Brown Trout
Age 2 & older
Total in 3 mile section
6,000
5,000
4,000
3,000
2,000
1,000
0
85
87
89
91
93
95
97
99
01
03
Year



Snoball
Brown Trout
Age 2 & Older
Total in 4.5 mile section
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
84
86
88
90
92
94
96
98
00
02
Year



Varney
Brown Trout
Age 2 & Older
6,000
5,000
4,000
3,000
2,000
1,000
0
Total in 4 mile section
85
87
89
91
93
95
97
99
01
03
Year



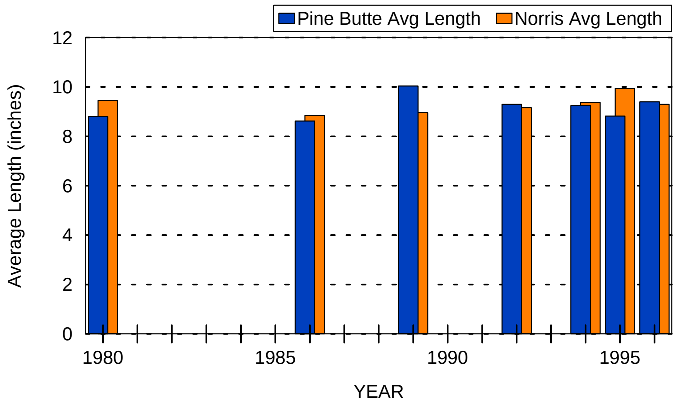
Norris
Brown Trout
Age 2 & Older
20,000
15,000
10,000
5,000
0
Total in 4 mile section
86
88
90
92
94
96
98
00
02
Year

Appendix D

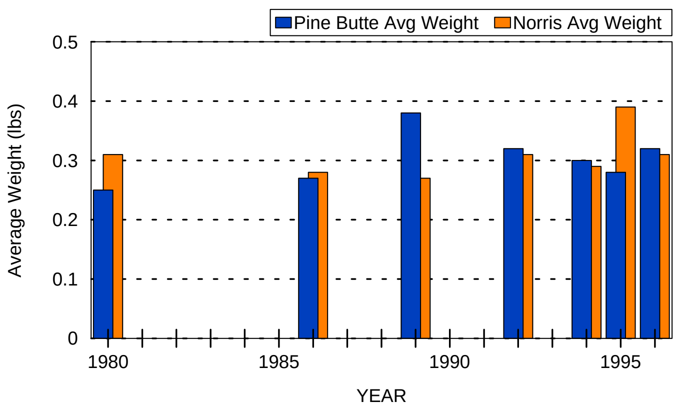
Length & weight comparison of aged spring rainbow & brown trout in the Pine Butte and Norris sections, 1986, 1989, 1992, and 1994-96 and of aged fall rainbow & brown trout in the Pine Butte and Varney sections, 1980-1999.

The top chart on each page illustrates average length, the bottom chart illustrates average weight.

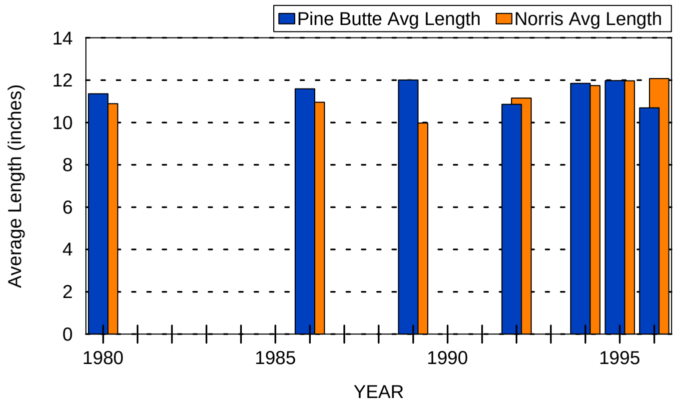
TWO YEAR OLD
SPRING RAINBOW TROUT



TWO YEAR OLD
SPRING RAINBOW TROUT



THREE YEAR OLD SPRING RAINBOW TROUT



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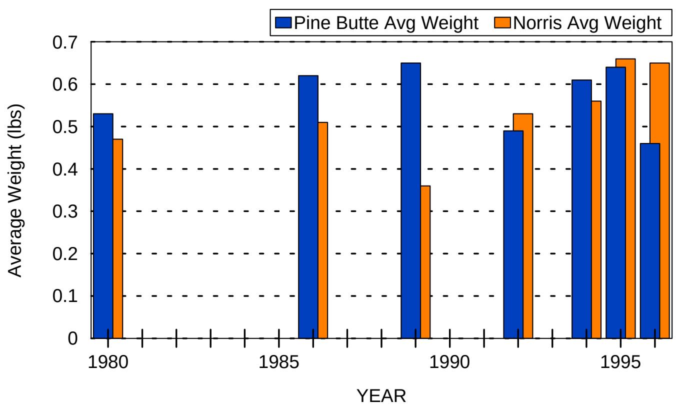
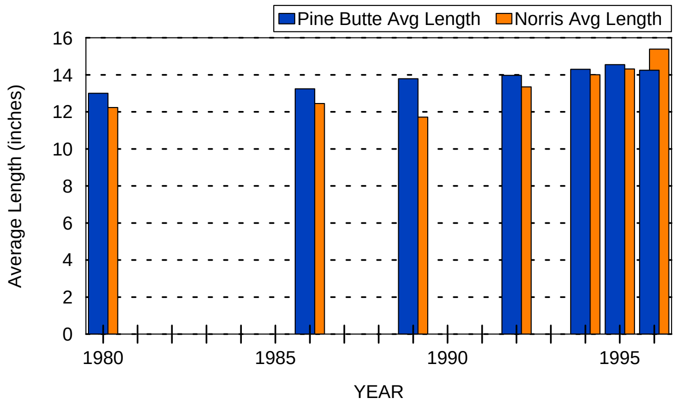


FOUR YEAR OLD SPRING RAINBOW TROUT



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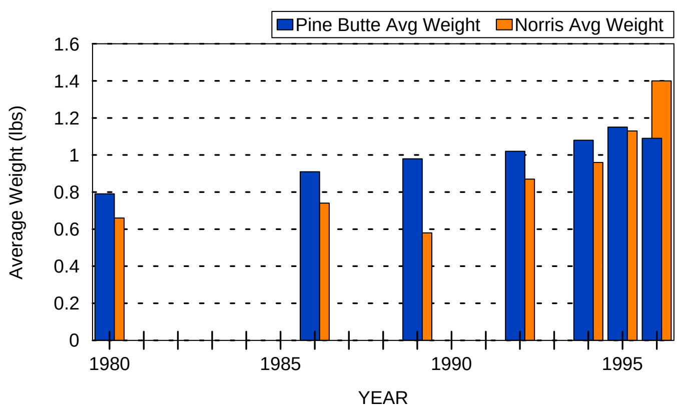
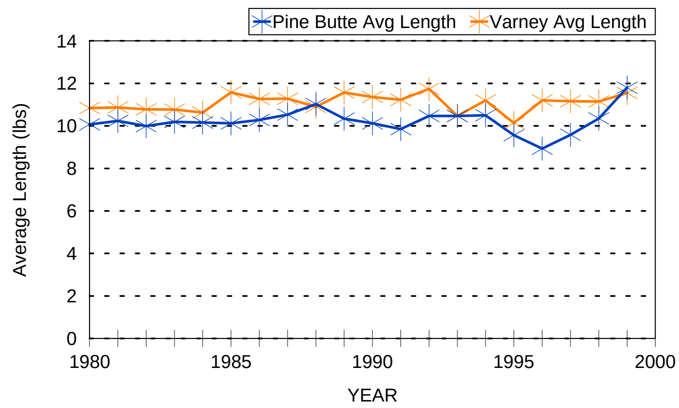


TWO YEAR OLD
FALL RAINBOW TROUT



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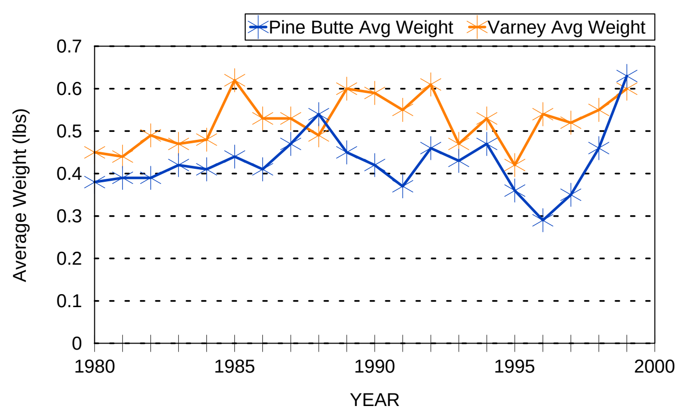
FALL RAINBOW TROUT



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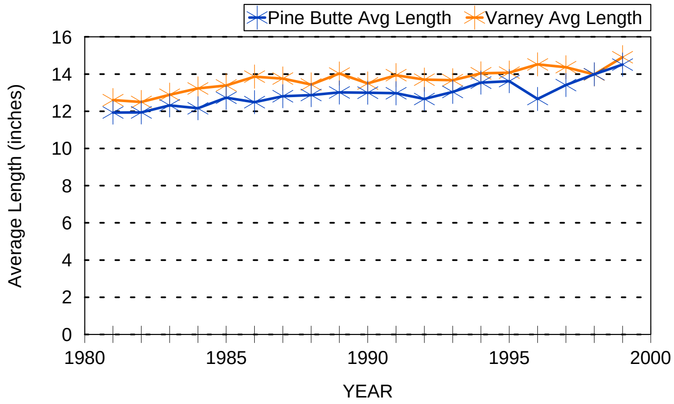
FALL RAINBOW TROUT



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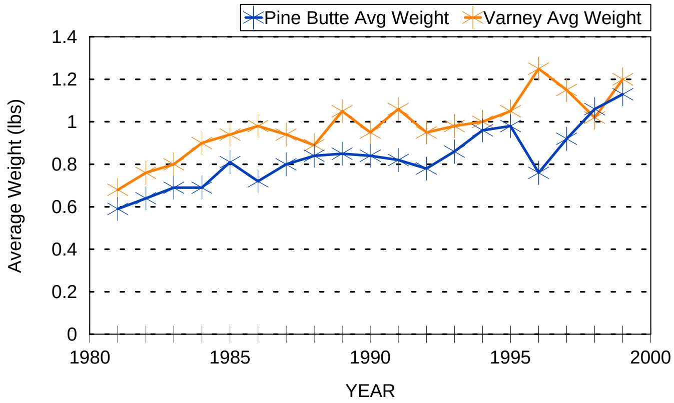
FALL RAINBOW TROUT



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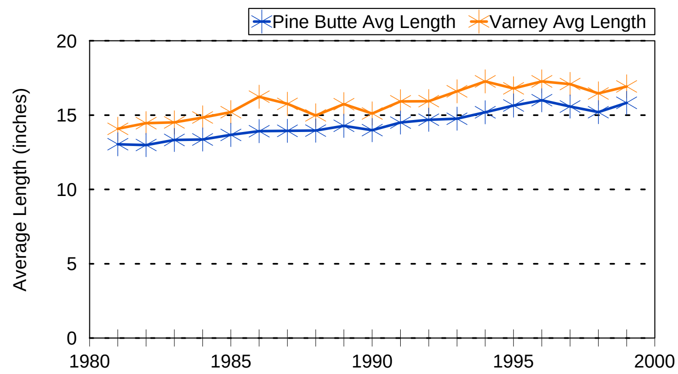
FALL RAINBOW TROUT



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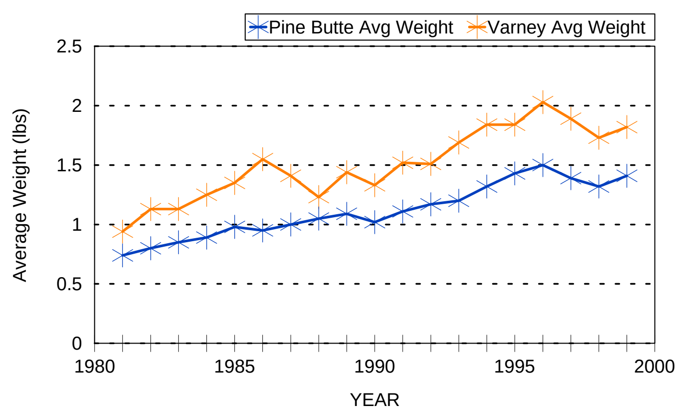
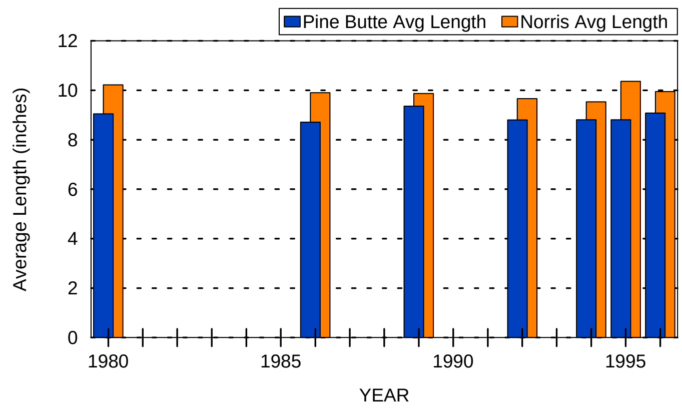


TWO YEAR OLD
SPRING BROWN TROUT



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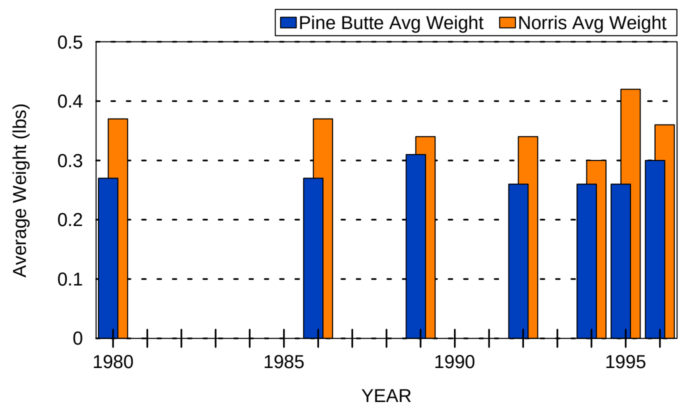
SPRING BROWN TROUT



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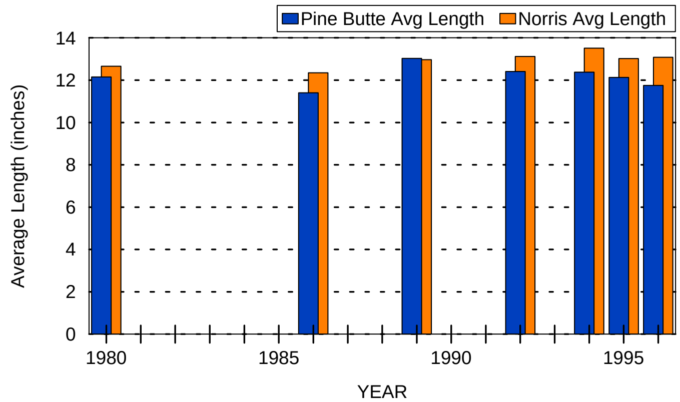

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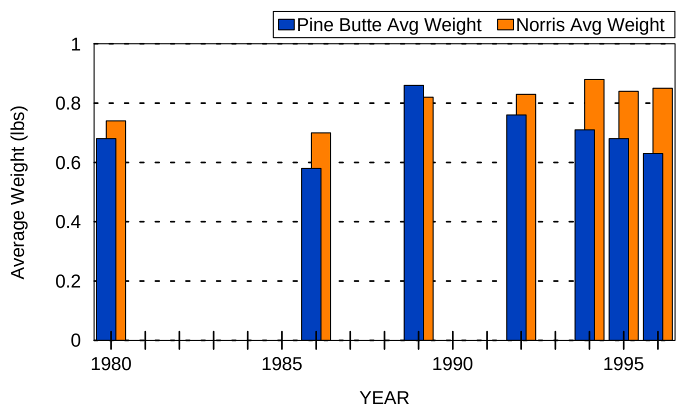
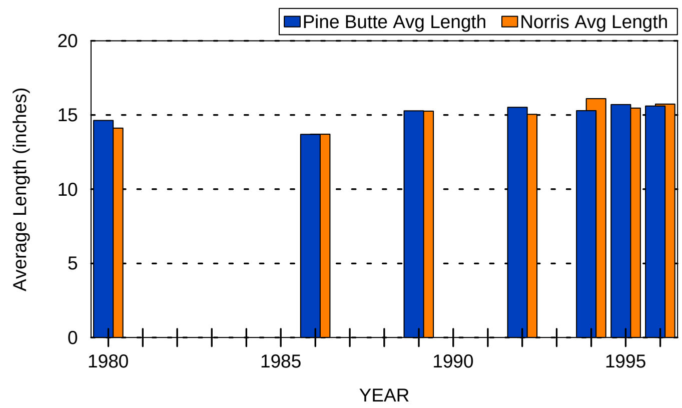
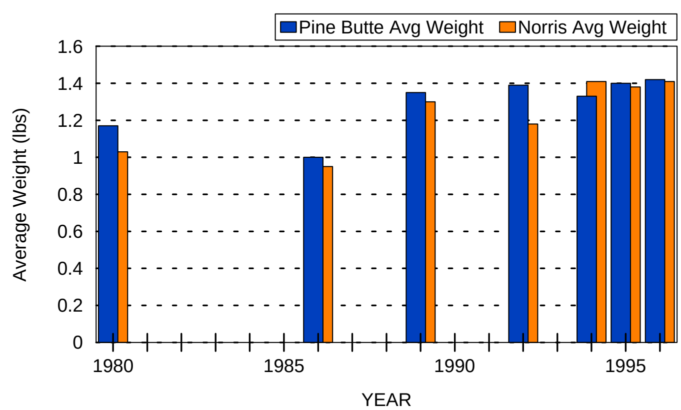
SPRING BROWN TROUT

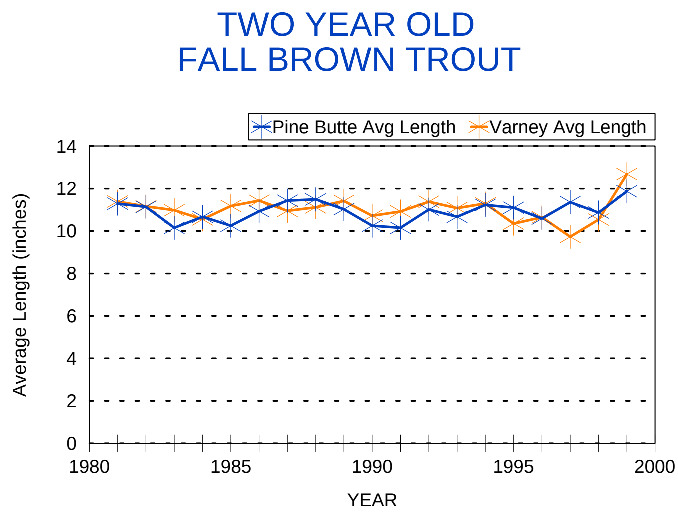


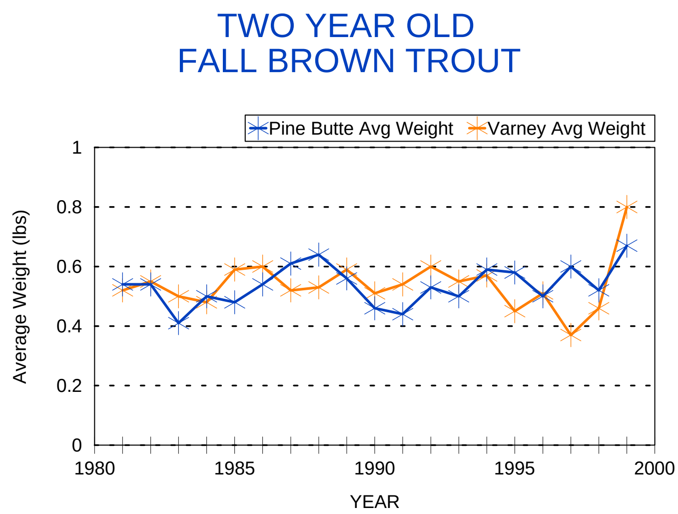
FOUR YEAR OLD
SPRING BROWN TROUT



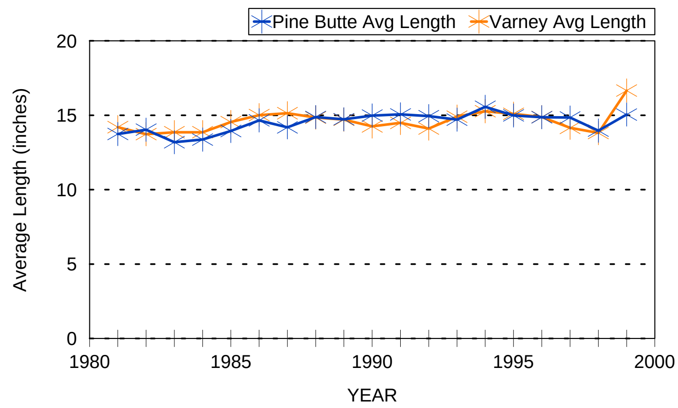
FOUR YEAR OLD
SPRING BROWN TROUT



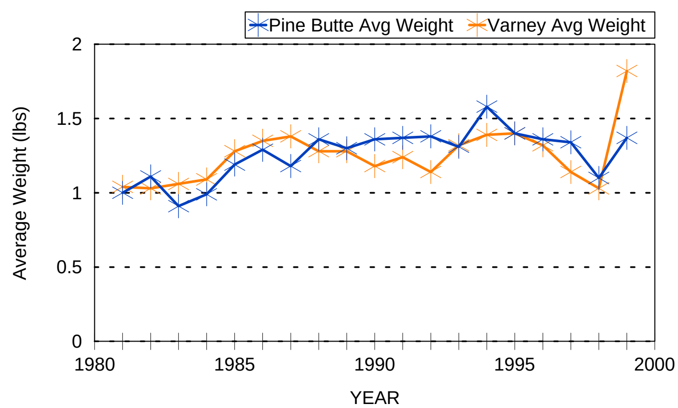

TWO YEAR OLD
FALL BROWN TROUT
Pine Butte Avg Length
Varney Avg Length
Average Length (inches)
0
2
4
6
8
10
12
14
1980
1985
1990
1995
2000
YEAR


TWO YEAR OLD
FALL BROWN TROUT
Pine Butte Avg Weight
Varney Avg Weight
Average Weight (lbs)
0
0.2
0.4
0.6
0.8
1
1980
1985
1990
1995
2000
YEAR

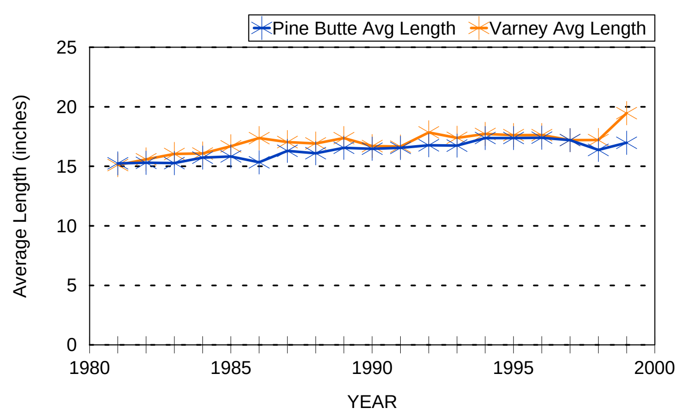
THREE YEAR OLD FALL BROWN TROUT



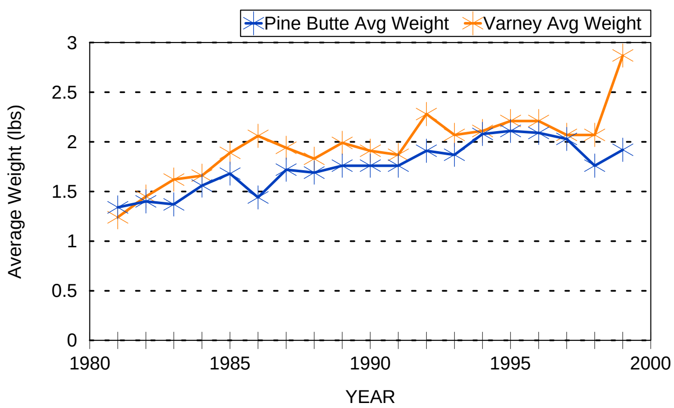
THREE YEAR OLD FALL BROWN TROUT



FOUR YEAR OLD FALL BROWN TROUT



FOUR YEAR OLD
FALL BROWN TROUT



Appendix E1

Temperature recordings from monitoring sites on the Madison River

(See Figure 10 for locations)

Appendix E2

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

Appendix F

Results of bioassays conducted for the Cherry Creek Native Fish Introduction Project, August 2003

Appendix Table F1. Percent mortality of sentinel rainbow trout downstream from a trickle station applying 12 ppb antimycin during bioassays. The station operated on August 1 from 1250 - 1930 hrs (6 hours, 40 minutes).

Travel Time (minutes below station)	Time post initial exposure (hours:minutes)	Fish condition (dead/unstable/upright)	Percent mortality
15	6:25	2/1/1	50
	21:00	4/0/0	100
	NA		
	NA		
	NA		
30	6:14	0/1/3	0
	20:44	4/0/0	100
	NA		
	NA		
	NA		
60	5:48	0/0/4	0
	20:12	0/1/3	0
	24:06	0/3/1	0
	30:19	1/2/1	25
	46:04	4/0/0	100
90	5:31	0/0/4	0
	19:59	0/0/4	0
	25:36	0/0/4	0
	29:51	0/0/4	0
	45:52	4/0/0	100
120	4:52	0/0/4	0
	19:07	0/0/4	0
	23:36	0/0/4	0
	29:30	0/0/4	0
	45:29	0/0/4	0
180	4:08	0/0/4	0
	18:00	0/0/4	0
	22:06	0/0/4	0
	28:25	0/0/4	0
	43:53	0/0/4	0
240	3:11	0/0/4	0
	5:30	0/0/4	0
	21:06	0/0/4	0
	27:25	0/0/4	0
	42:54	0/0/4	0

Appendix Table F2. Fish condition (dead/unstable/upright) of sentinel rainbow trout exposed to various bioassay concentrations of antimycin for 6 hours, 40 minutes.

Antimycin concentration (ppb)	Time post initial exposure (hours:minutes)										
	1:00	2:00	3:00	4:00	5:00	6:00	6:40	21:18	25:20	29:23	47:52
0	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4
2	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	2/1/1	3/0/1	3/0/1	4/0/0
4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	0/0/4	4/0/0			
8	0/0/3	0/0/3	0/0/3	0/1/2	1/0/2	3/0/0					
10	0/0/4	0/0/4	0/0/4	1/3/0	2/2/0	4/0/0					
12	0/0/4	0/0/4	0/0/4	1/3/0	4/0/0						

Appendix Table F3. Remaining $KMnO_4$ (expressed as a percentage of total $KMnO_4$), and fish condition (dead/unstable/upright) of sentinel rainbow trout at points downstream of bioassay neutralization station.

Travel Time (minutes below $KMnO_4$ station)	Time post $KMnO_4$:antimycin mixing (hours:minutes)	Percent $KMnO_4$ remaining	Time post initial exposure (hours:minutes)	fish condition (dead/unstable/upright)
15	2:45	14.6		
	3:45	21.9		
	4:05	25.7		
			5:41	1/0/4
			21:15	3/0/2
30	2:45	8.1		
	3:45	12.4		
	4:05	10.8		
			5:26	0/0/5
			21:00	0/0/5
60			4:56	0/0/5
			20:30	0/0/5

Appendix G

Hebgen Reservoir Creel Census
2000-2001