FISHERIES INVESTIGATIONS IN THE MADISON AND GALLATIN RIVER BASINS

ANNUAL REPORT FOR 2005

Federal Aid Project F-113-R- 5

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January 2006

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ABSTRACT

Estimates of fish abundance for fish six inches total length or longer were 1,251 rainbow and 1,599 brown trout/mile in the Norris section of the Madison River in spring 2005. Abundance was 2,682 rainbow and 2,520 brown trout/mile in the Pine Butte section, and 1,782 rainbow and 2,201 brown trout/mile in the Varney section in the fall. These values suggest stable fish abundance in river sections above Ennis when compared to other recent sampling, a hopeful sign that fish are adjusting favorably to the presence of *Myxobolus cerebralis.*

Estimates of fish abundance for fish six inches total length or longer were 323 rainbow and 395 brown trout/mile in the Logan section of the Gallatin River in spring 2005. Both values are within the usual variation in abundance we normally observe in this area of the river, suggesting stable populations.

Estimates of fish abundance for fish six inches total length or longer were 601 rainbow and 250 brown trout/mile in the Thompson section of the East Gallatin River in spring 2005. Abundance was 967 rainbow and 856 brown trout/mile in the Upper Hoffman section, and 1,389 rainbow and 407 brown trout/mile in the Lower Hoffman section in the fall. Estimates from the Hoffman sections especially indicate declining trout abundance compared to other sampling in recent years. These declines coincide with a significant increase in *M. cerebralis* infection rates for rainbow trout fry exposed to river water in recent bioassays of the East Gallatin River.

The average size of rainbow trout caught in gillnets at Hebgen Reservoir in 2005 was 17.3 inches. Brown trout averaged 17.8 inches. These average lengths are similar to lengths from other comparable sampling in recent years. Catch rates of most species commonly caught in this reservoir increased this year compared to results in 2004.

The average size of rainbow trout caught in gillnets at Cliff Lake in 2005 was 12.5 inches. Average length this year is longer than in our most recent other samples, however the lake has not been sampled since 2002. Catch rate of rainbow trout was 4.0 fish/net, less than in other recent samples. These combined observations suggest that rainbow trout may be less abundant now, perhaps a consequence of long-term drought.

The total number of adult Yellowstone Cutthroat trout counted above Hyalite Reservoir in the West Fork of Hyalite Creek this spring was 6,070 fish. This number is nearly double the number of fish observed spawning in this area in 2004. The total number of adult arctic grayling was 849 fish, also nearly double the number of fish observed in 2004. The increasing number of fish spawning in this area of the creek over the last few years coincides with the installation of artificial logjams in 2002 that were intended to improve fish habitat. The consequence that this increased spawning activity may have for the recreational fishery of the reservoir, however, is uncertain at this time.

OBJECTIVES

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

State Program Activities and Objectives

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

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

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

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

Statewide activities and objectives are addressed locally by ongoing fisheries investigations and management activities intended to enhance aquatic habitats and recreational fisheries in the Madison and Gallatin River basins.

Local Project Objectives

In fiscal year 2005 (July 1, 2004 to June 30, 2005), project objectives for state project number 3340 (the Madison and Gallatin River drainages) were identical to the statewide objectives listed above. Project objectives are intended to guide continuing efforts to maintain and enhance local fisheries. In support of these efforts, the following data collections, compilations, and analyses are reported here under separate headings:

A. Estimates of trout abundance in three sections of the Madison River based on spring and fall sampling in 2005.

B. Estimates of trout abundance in one section of the Gallatin River based on spring sampling in 2005.

C. Estimates of trout abundance in three sections of the East Gallatin River based on spring and fall sampling in 2005.

D. Summary of gillnet catches at Hebgen Reservoir in 2005.

E. Summary of gillnet catches at Cliff Lake in 2005.

F. Summary of spawner counts at Hyalite Reservoir in 2005.

State survey, inventory, and fish population management objectives are addressed under headings A through F. Technical guidance and aquatic education objectives are addressed on an ongoing basis by meetings with various angler groups, school groups, journalists, and the public. In fiscal year 2005 these meetings included educational seminars for local school children, watershed associations, and meetings with local angling groups to discuss a variety of fisheries topics. Landowner contacts and consultations occurred routinely each month in conjunction with administration of the *Montana Natural Streambed and Land Preservation Act* and the *Montana Stream Protection Act*.

PROCEDURES

A. Estimates of trout abundance in three sections of the Madison River based on spring and fall sampling in 2005.

This spring and fall we sampled trout abundance in three sections of the Madison River (Table 1; Figure 1) normally examined as part of routine fisheries surveys in this drainage (e.g., Tohtz 2005; Byorth 2000a). Fish\[A] were sampled in each section with electrofishing gear mounted on a drift boat. This gear included a 5,000-watt generator and a Coffelt Model VVP-15 rectifying unit. The cathode was a steel plate attached to the bottom of the drift boat, the anode was a single hand held (mobile) electrode connected to the power source by about 30 feet of cable. Fish were collected in live cars, identified, measured to the nearest 0.1 inch\[B], and weighed to the nearest 0.01 pound. Trout were marked with fin clips and returned to the stream. Recapture sampling was conducted about two weeks later in each section. Data were processed using FA+, a computer program developed by FWP for processing electrofishing records (Anon. 2004). Fish numbers were estimated using the log-likelihood model. Estimates were evaluated for reliability at alpha = 0.05. Fish were separated into one-inch length groups for most analyses.

Table 1. River sections where trout abundance was sampled in the Madison River in 2005.

Section name	Last mark date	Length (ft)	Upstream boundary \[1]	
Pine Butte	09/02/04	15,840	North	45.87111
			West	111.56582
Varney	09/08/04	21,120	North	45.23119
			West	111.75187
Norris	03/11/04	21,120	North	45.58512
			West	111.59400

1. Latitude and longitude (decimal degrees, WGS84 datum).

A. Common names are used in this report. Scientific names are listed in Appendix A.
B. Unless otherwise noted, all fish lengths in this report are total lengths (TL).

Figure 1. River sections where trout abundance was sampled in the Madison River in 2005. Finer detail of each section is provided in Appendix B.

B. Estimates of trout abundance in one section of the Gallatin River based on spring sampling in 2005.

This spring we sampled trout abundance in one section of the Gallatin River (Table 2; Figure 2) as part of our routine fisheries surveys (e.g., Tohtz 2005; Byorth 2000b). Fish handling and marking procedures were identical to those described in Part A, above. Recapture sampling was conducted about two weeks later in each section. Data were processed using FA+, a computer program developed by FWP for processing electrofishing records (Anon. 2004). Fish numbers were estimated using the log-likelihood model. Estimates were evaluated for reliability at alpha = 0.05. Fish were separated into one-inch length groups for most analyses.

Table 2. River section where trout abundance was sampled in the Gallatin River in 2005.

Section name	Last mark date	Length (ft)	Upstream boundary \[1]	
Logan	03/15/04	22,704	North West	45. 93853 111. 49242

1. Latitude and longitude (decimal degrees, WGS84 datum).

Figure 2. River section where trout abundance was sampled from the Gallatin River in 2005. Finer detail of each section is provided in Appendix B.

Photo 1. Portion of the Pine Butte section of the Madison River sampled in 2005.

Photo 2. Portion of the Varney section of the Madison River sampled in 2005.

Photo 3. Portion of the Norris section of the Madison River sampled in 2005


Photo 4. Portion of the Logan section of the Gallatin River sampled in 2005.

C. Estimates of trout abundance in three sections of the East Gallatin River based on spring and fall sampling in 2005.

This spring and fall we sampled fish abundance in three sections of the East Gallatin River (Table 3; Figure 3). Fish were sampled in each section with electrofishing gear mounted on a small drift boat. This gear included a 4,500-watt generator and a Leach direct current rectifying unit. The cathode was a steel plate attached to the bottom of the drift boat; the anode was a single hand held (mobile) electrode connected to the power source by about 30 feet of cable. Fish handling and marking procedures were identical to those described in Part A, above. Recapture sampling was conducted about two weeks later in each section. Data were processed using FA+, a computer program developed by FWP for processing electrofishing records (Anon. 2004). Fish numbers were estimated using the log-likelihood model. Estimates were evaluated for reliability at alpha = 0.05. Fish were separated into one-inch length groups for most analyses.

Table 3. River sections where trout abundance was sampled in the East Gallatin River in 2005.

Section name	Last mark date	Length (ft)	Upstream boundary \[1]	
Upper Hoffman	09/19/04	3,907	North	45.72578
			West	111.06575
Lower Hoffman	09/1904	5,280	North	45.72913
			West	111.73875
Thompson	03/16/04	6,336	North	45.80669
			West	111.13220

1. Latitude and longitude (decimal degrees, WGS84 datum).

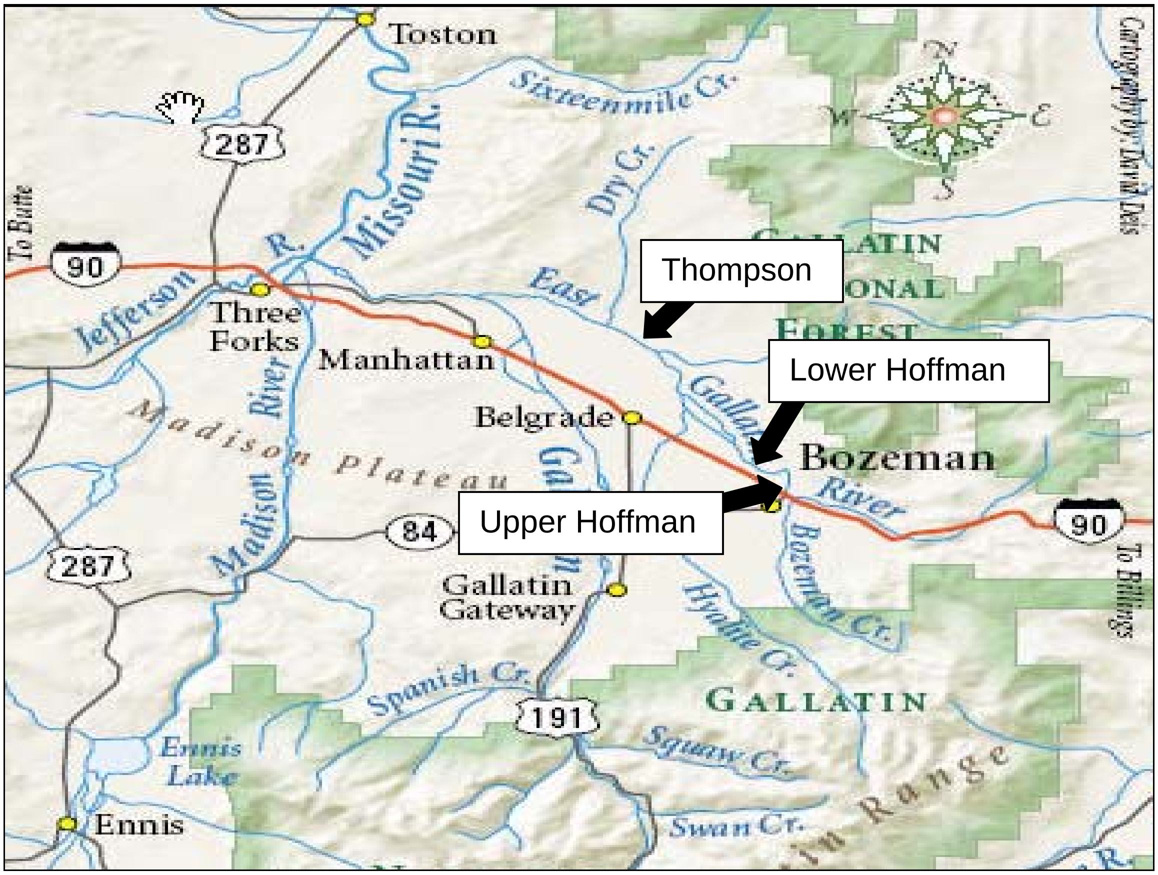

Figure 3. River sections where trout abundance was sampled from the East Gallatin River in 2005. Finer detail of each section is provided in Appendix B.

Photo 5. Portion of the Upper Hoffman section of the East Gallatin River sampled in 2005.


Photo 6. Portion of the Lower Hoffman section of the East Gallatin River sampled in 2005.


Photo 7. Portion of the Thompson section of the East Gallatin River sampled in 2005.

D. Summary of gillnet sampling at Hebgen Reservoir in spring 2005.

Gillnet sampling of Hebgen Reservoir in 2004 mimicked previous spring sampling (e.g., Byorth and Weiss 2003). We used 11 sinking and 14 floating experimental gillnets deployed over the course of three nights at nineteen different locations (Figure 4) to determine the entire sample. Each net was six-feet wide and 125 feet long with five equal-size panels of different mesh size graded by half-inch increments from one to three inches (bar measure).

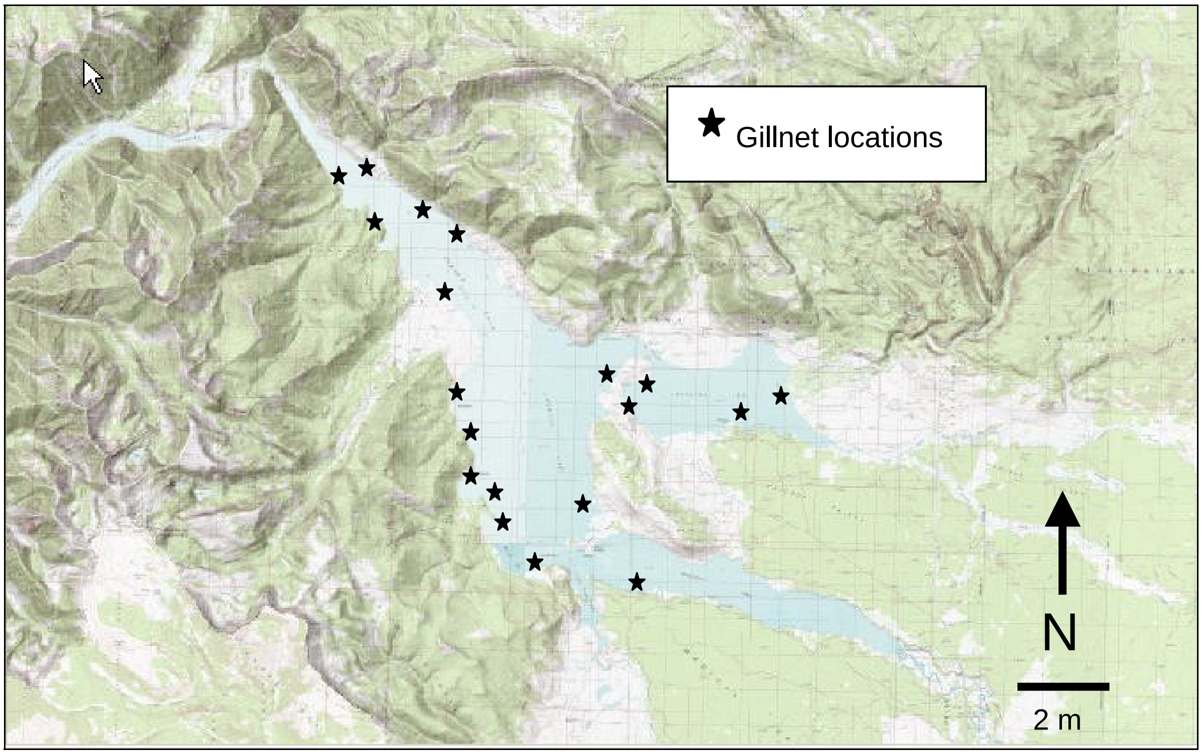

Figure 4. Location of gillnets used to sample fish from Hebgen Reservoir in spring 2005.


Photo 8. Hebgen Reservoir.

E. Summary of gillnet sampling at Cliff Lake in 2005.

Gillnet sampling of Cliff Lake in 2005 mimicked previous fall sampling (e.g., Byorth and Weiss 2003). We used one sinking and four floating experimental gillnets deployed overnight at five different locations (Figure 5) to determine the entire sample. Each net was six-feet wide and 125 feet long with five equal-size panels of different mesh size graded by half-inch increments from one to three inches (bar measure).

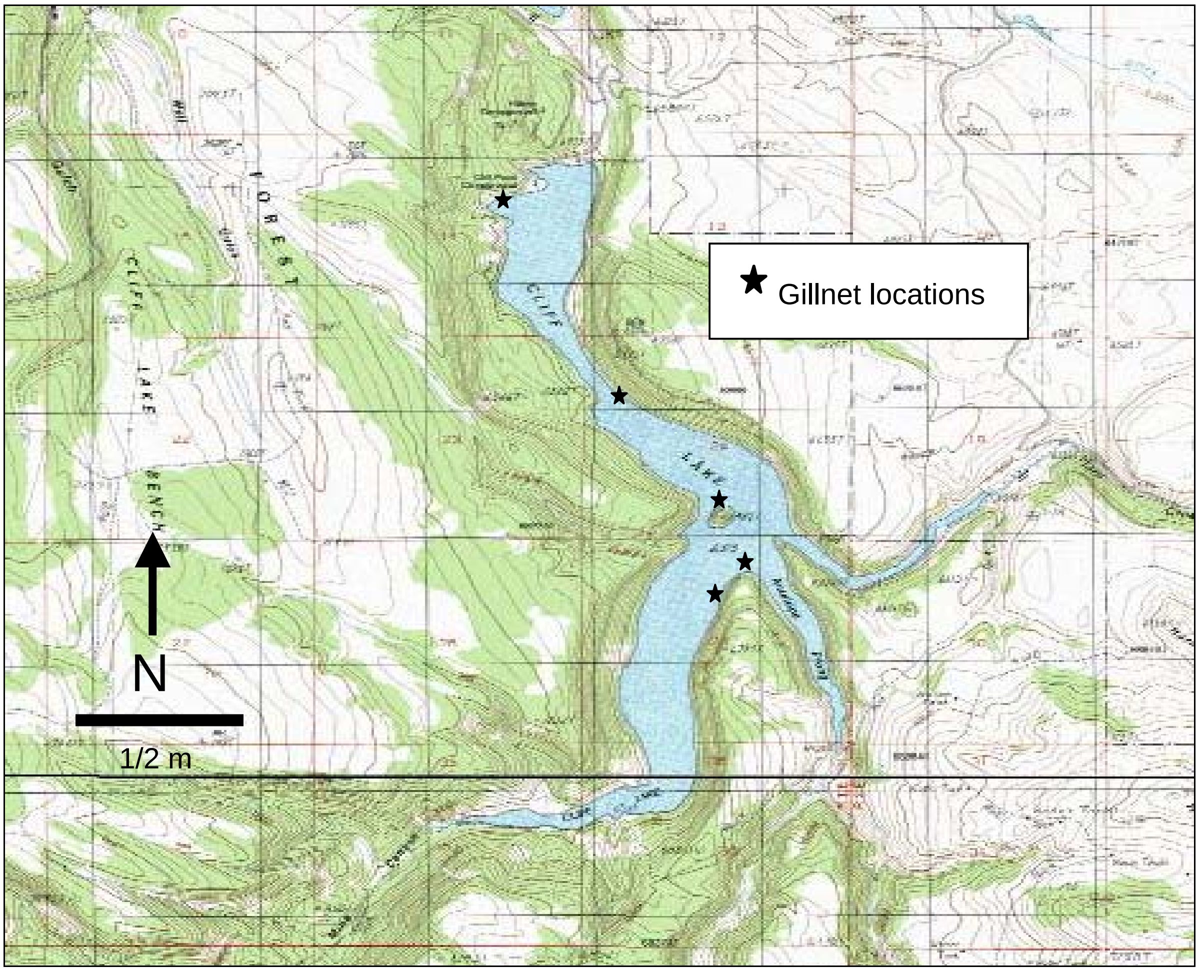

Figure 5. Location of gillnets used to sample fish from Cliff Lake in fall 2005.

F. Summary of spawner counts at Hyalite Reservoir in 2005.

Spawner surveys of Yellowstone cutthroat trout and arctic grayling were performed above Hyalite Reservoir in the West Fork of Hyalite Creek once each week throughout the spawning season. Observers counted adult fish while walking upstream, beginning at the reservoir and ending at a point approximately one-half mile above the reservoir.

RESULTS AND DISCUSSION

A. Estimates of trout abundance in three sections of the Madison River based on spring and fall sampling in 2005.

Most of our data for rainbow and brown trout from each of the sections sampled in 2005 fit the log-likelihood model well. Individual and pooled data\[C] for rainbow trout captured this spring in the Norris section modeled at probability values less than 0.05 (Table 4).

Table 4. Trout/mile in three sections of the Madison River based on spring and fall sampling in 2005. Estimates are for fish six inches (TL) or longer.

Section (last mark date):			Overall model			Pooled model		
Fish species	N	SD	DF	Chi-square	P	DF	Chi-square	P /1
Pine Butte (September 11):								
Rainbow trout	2,682	439	4	6.43	0.17	3	6.41	0.09
Brown trout	2,520	265	8	14.51	0.07	8	14.52	0.07
Varney (September 8):								
Rainbow trout	1,782	186	10	12.25	0.27	9	12.20	0.20
Brown trout	2,201	93	11	17.03	0.11	11	17.03	0.11
Norris (March 11):								
Rainbow trout	1,251	77	10	23.02	0.01	6	18.03	0.01
Brown trout	1,599	125	10	11.89	0.29	7	7.94	0.34

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

Pine Butte Section

Our surveys in the Pine Butte section of the Madison River this year showed rainbow and brown trout abundance similar to estimates from surveys made in the past few years (Figure 6; Figure 7; see also Figures 8 and 9). This is a welcome result. Recent surveys suggest an increase in rainbow trout abundance compared to surveys conducted in the mid 1990s. Declining abundance at that time was attributed especially to the effects of whirling disease on trout fry (e.g. Byorth 2000a). Rainbow trout now seem to be adapting to the presence of life with *Myxobolus cerebralis.* Other lines of evidence suggest that this adjustment includes the possibility that rainbow trout are developing some resistance to whirling disease effects (Vincent et al. 2005; Figure 8). If true, this resistance may partly explain better survivorship of young fish observed in recent years (Figure 9).

C. Our analyses include a procedure that "pools" data by combining one-inch length groups of fish into new groups that contain at least three recaptured fish. Results of this analysis are reported in Table 4 as outputs of the pooled model.

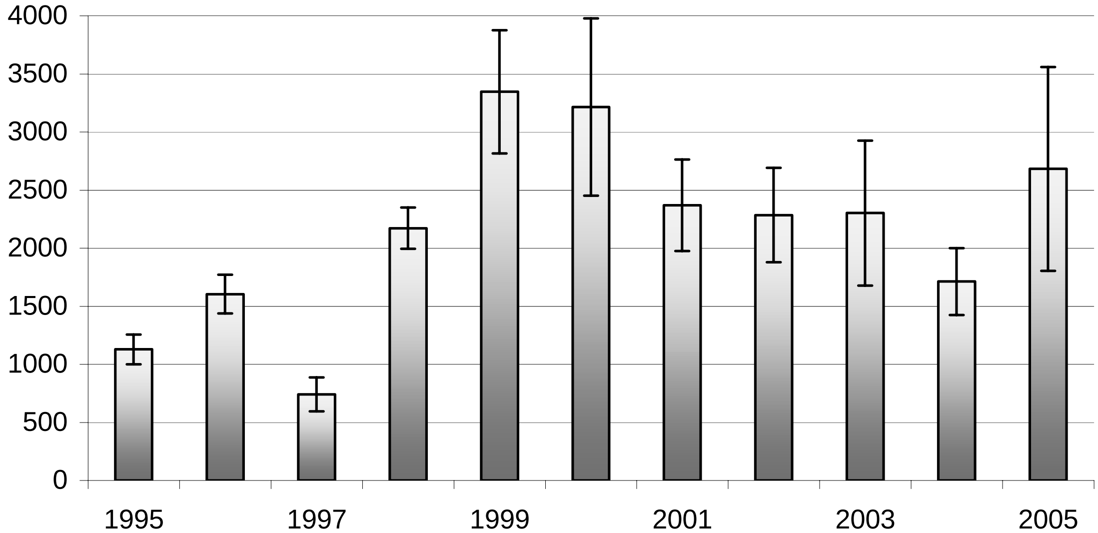

Figure 6. Rainbow trout abundance in the Pine Butte section of the Madison River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

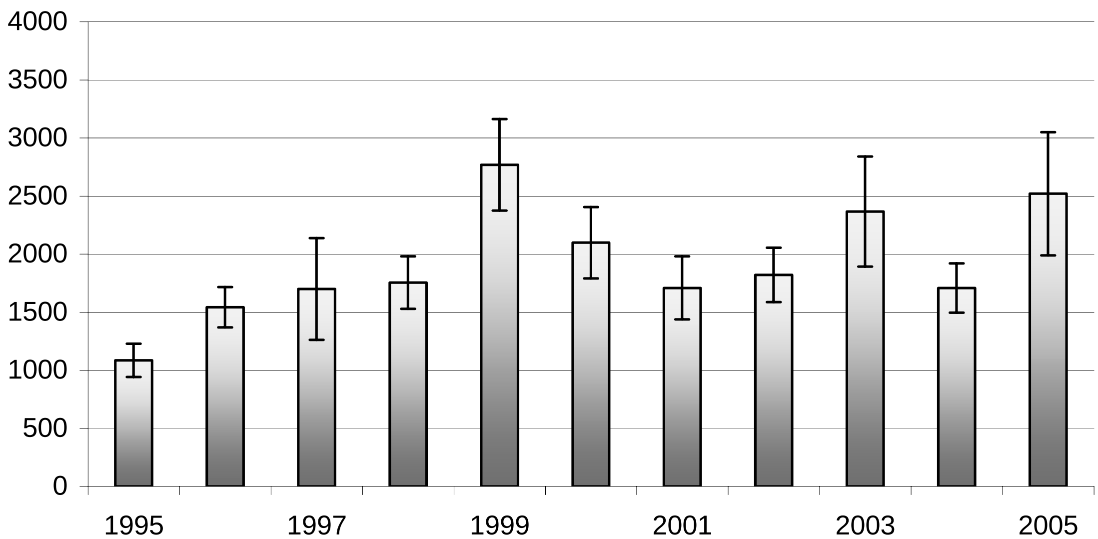

Figure 7. Brown trout abundance in the Pine Butte section of the Madison River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

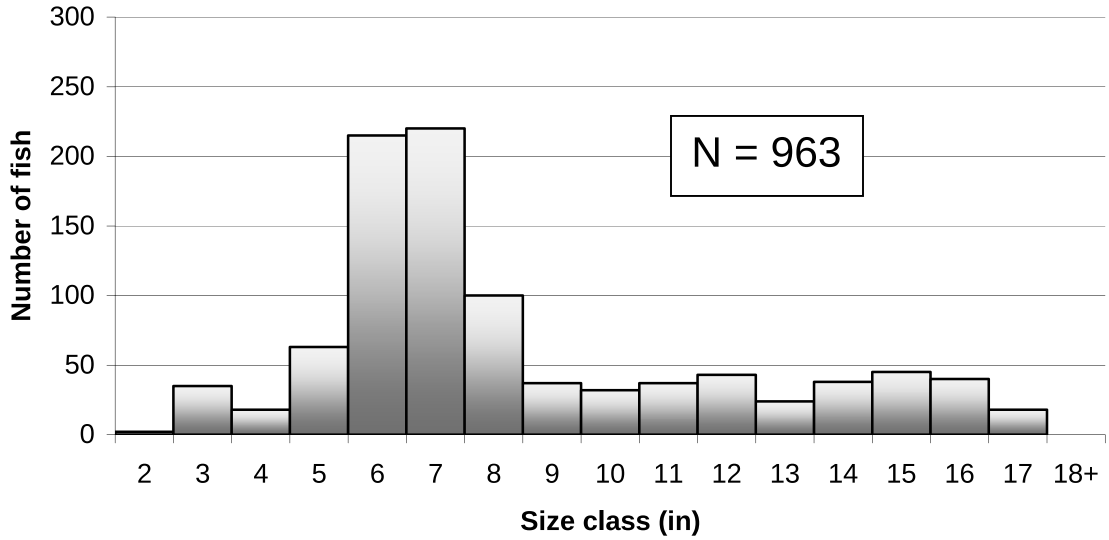

Figure 8. Length frequency distribution of rainbow trout captured in the Pine Butte section of the Madison River in September 2005.

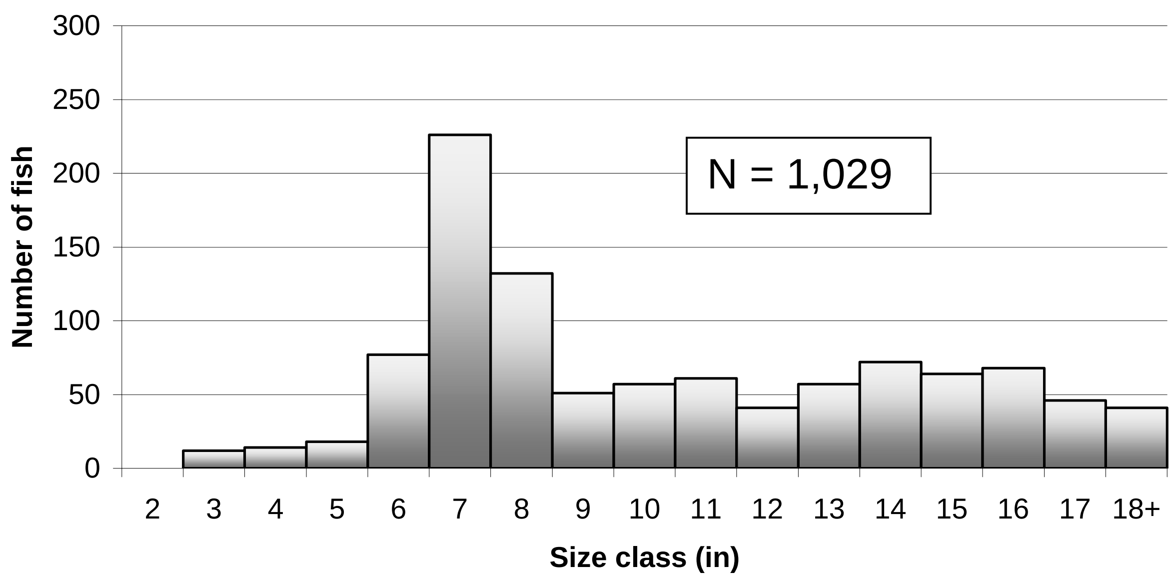

Figure 9. Length frequency distribution of brown trout captured in the Pine Butte section of the Madison River in September 2005.

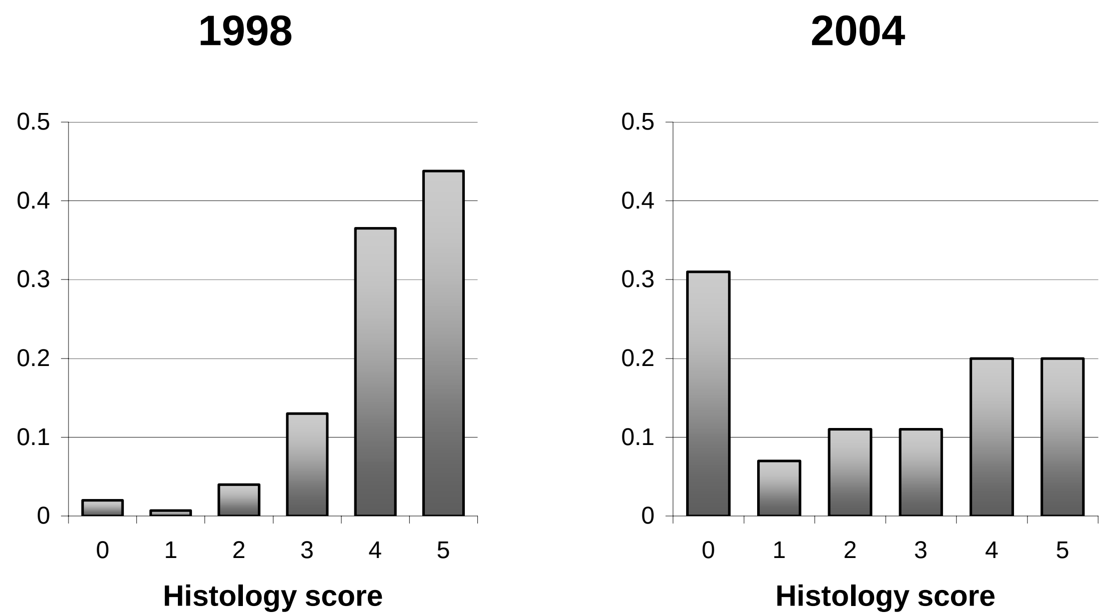

Figure 10. Proportion (vertical axes) of newly hatched rainbow trout assigned to different histology score categories after fish were exposed to controlled numbers of infective *Myxobolus crerebralis* spores under laboratory conditions. Histology scores are an index of infection intensity. For rainbow trout, histology scores above 2.5 are associated with significant fish mortality at very young age that has measurable effects on population abundance. Fish in this experiment were hatched from eggs taken from rainbow trout in the Pine Butte section of the Madison River in 1998 and 2004.   Fifty fish were exposed in each experiment. All data and information adapted from Vincent et al. 2005.

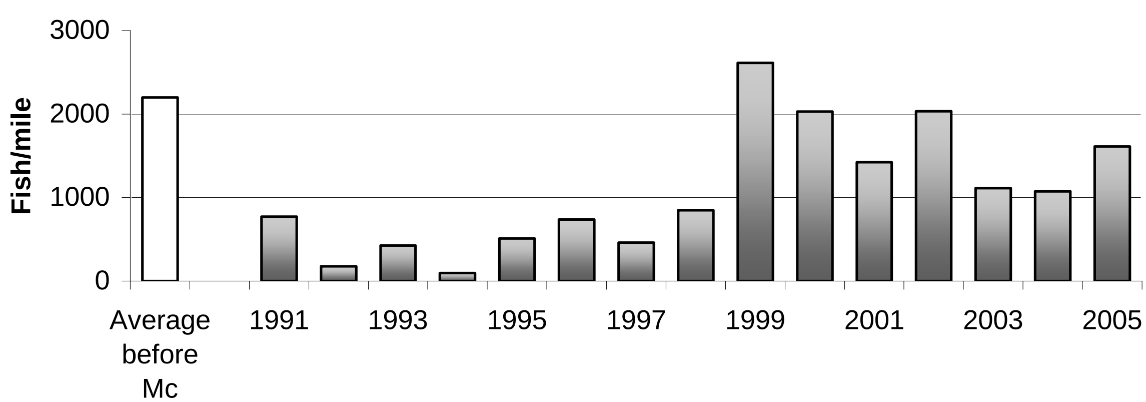

Figure 11. Estimates of yearling rainbow trout abundance in the Pine Butte section of the Madison River before and after the establishment of *Myxobolus cerebralis* (*Mc*).

Varney Section

Our estimate of rainbow trout abundance this year in the Varney section of the Madison River was similar to last year and continues to show increased abundance of rainbow trout in this section compared to estimates from samples collected in the mid 1990s (Figure 12; see also Figure 13). The rainbow trout population in this portion of the river has apparently recovered significantly from dramatic population declines of the 1990s attributed to whirling disease (Vincent 1996; Byorth 2000a).

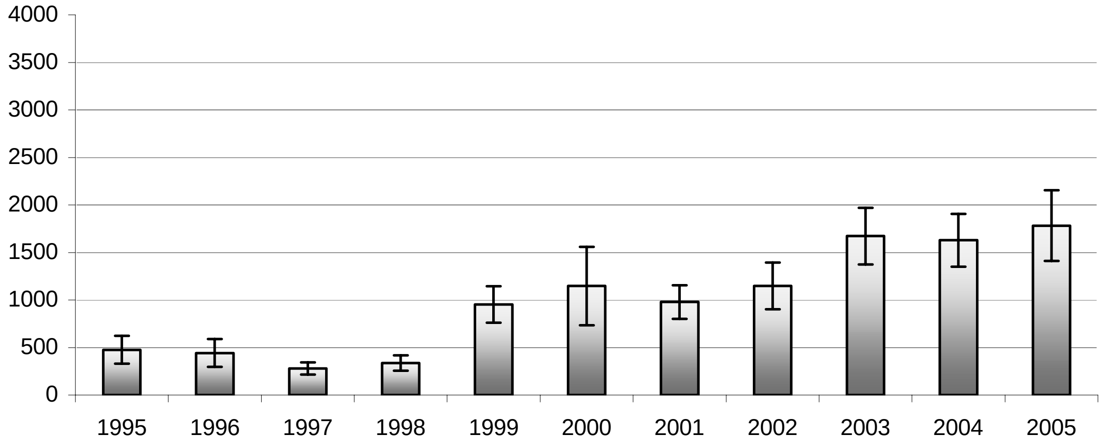

Figure 12. Rainbow trout abundance in the Varney section of the Madison River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

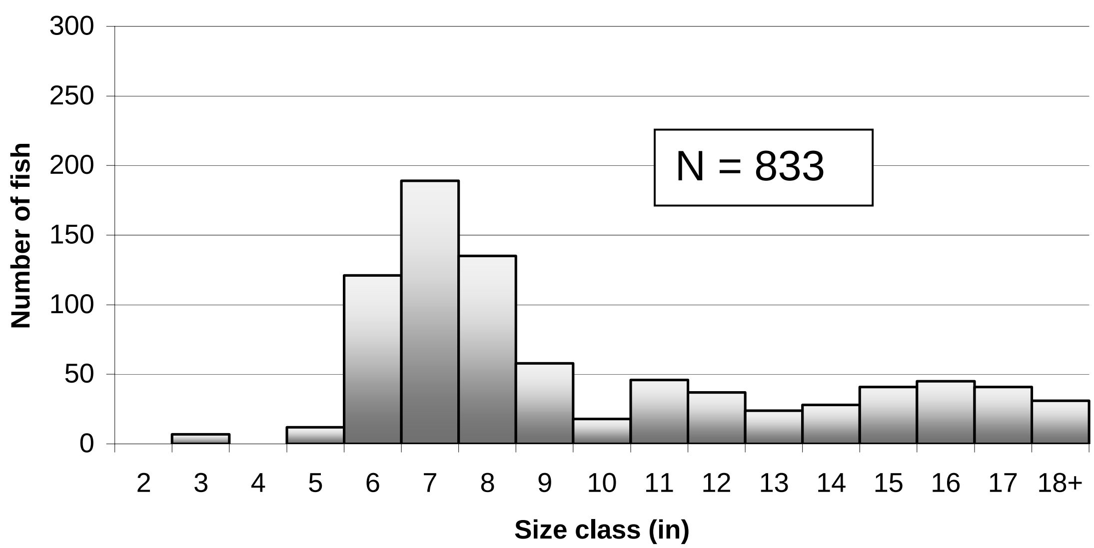

Figure 13. Length frequency distribution of rainbow trout captured in the Varney section of the Madison River in September 2005.

Brown trout abundance was similar this year compared to our estimate in 2004. Our estimate this year is well within the usual variation in abundance we have observed in this section for at least the last ten years, suggesting stable recruitment and survivorship year to year (Figure 14; see also Figure 15).

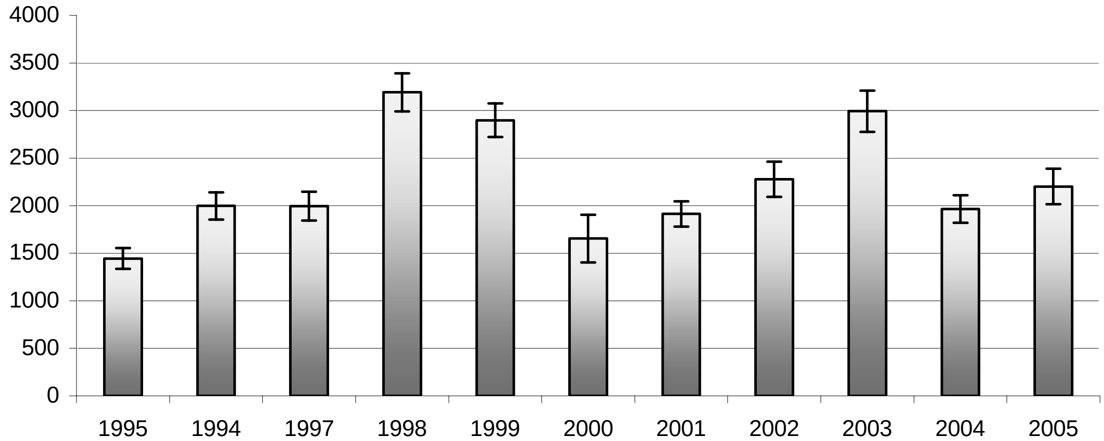

Figure 14. Brown trout abundance in the Varney section of the Madison River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

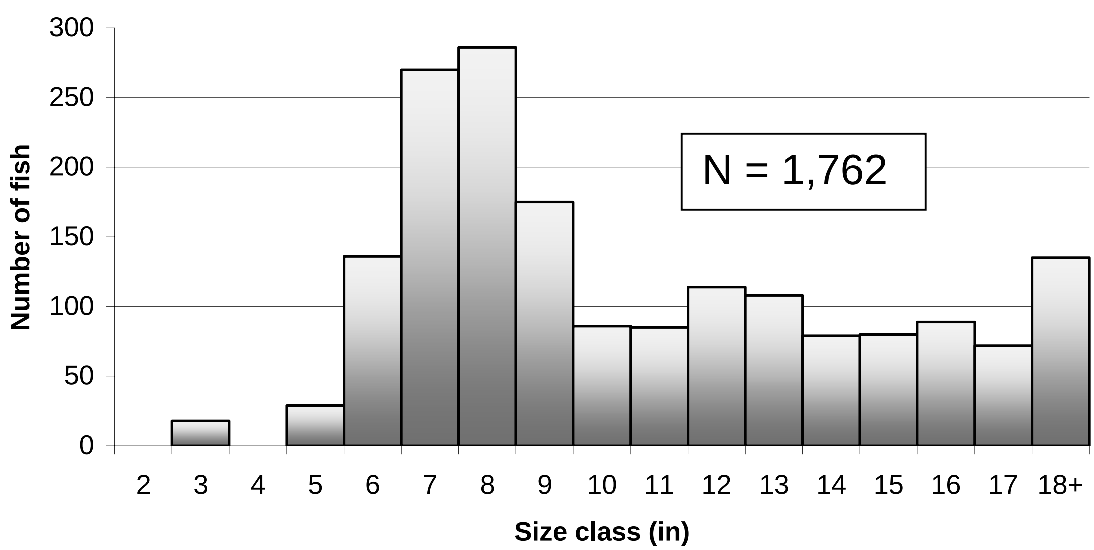

Figure 15. Length frequency distribution of brown trout captured in the Varney section of the Madison River in September 2005.

Norris Section

Rainbow and brown trout abundance in the Norris section of the Madison River were similar this year compared to last year. Abundance of both species is within the usual variation in abundance we have observed since 1998, the year that rainbow trout first began to show meaningful population increases while adjusting to the presence of *M. cerebralis* in the drainage (Figure 16; Figure 17; see also Figures 18 and 19).

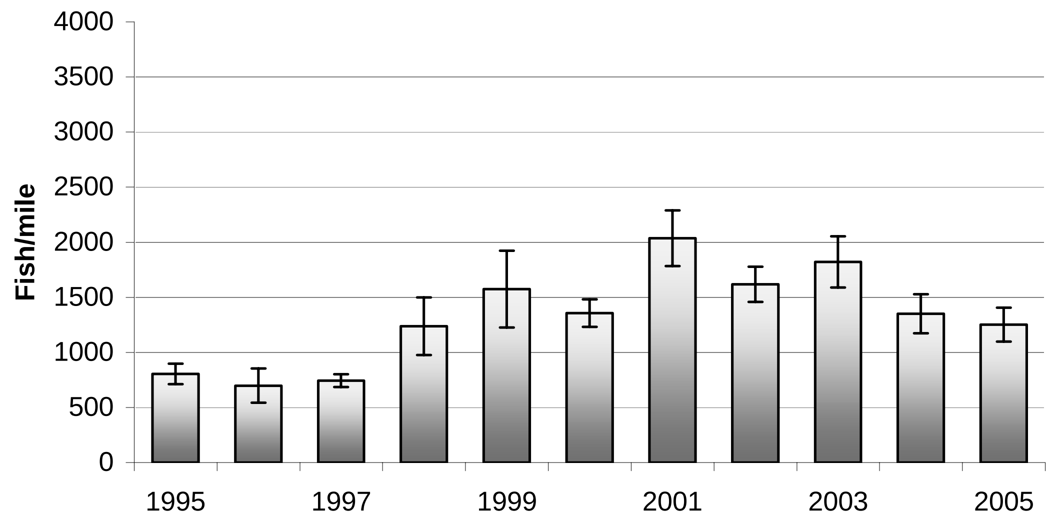

Figure 16. Rainbow trout abundance in the Norris section of the Madison River based on spring sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

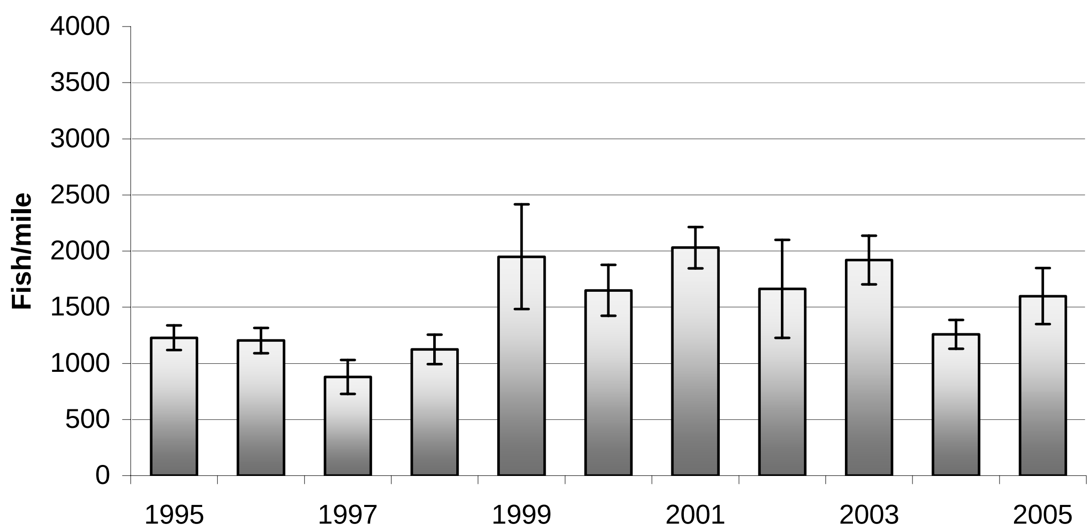

Figure 17. Brown trout abundance in the Norris section of the Madison River based on spring sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

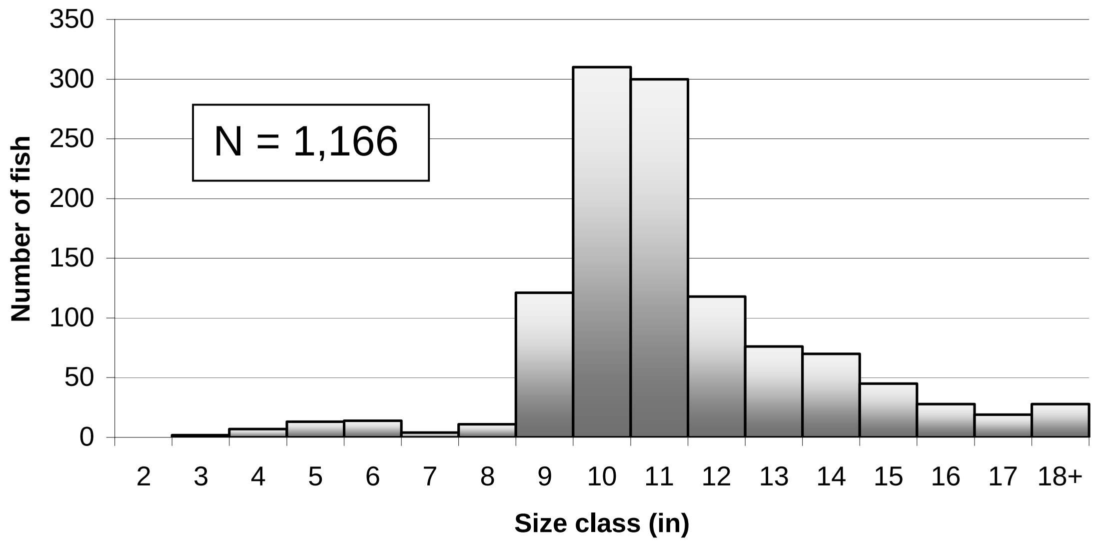

Figure 18. Length frequency distribution of rainbow trout captured in the Norris section of the Madison River in March 2005.

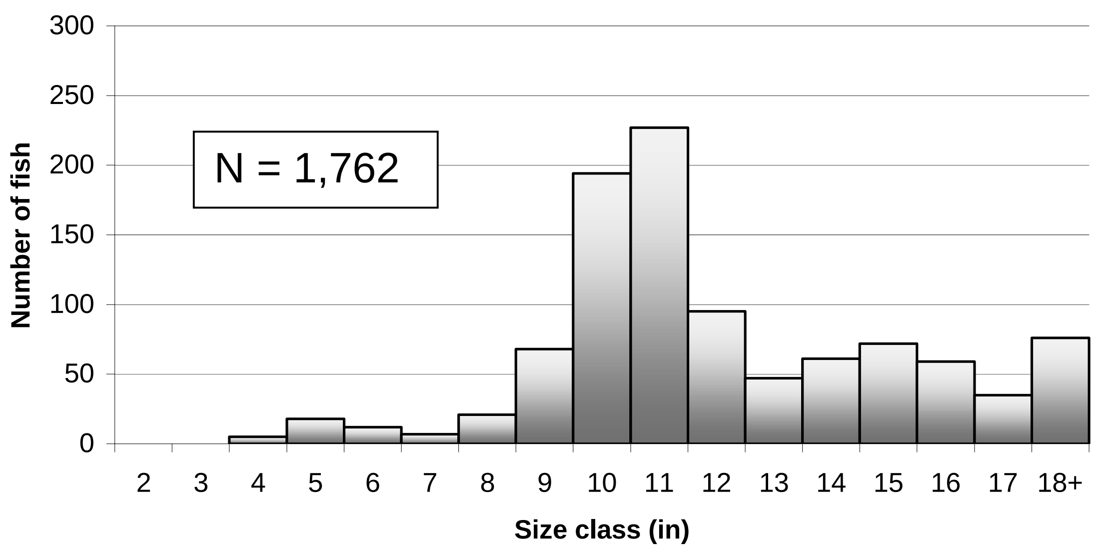

Figure 19. Length frequency distribution of brown trout captured in the Norris section of the Madison River in March 2005.

B. Estimates of trout abundance in one section of the Gallatin River based on spring sampling in 2005.

Data for rainbow and brown trout collected in 2005 from the Logan section of the Gallatin River fit the log-likelihood model well (Table 5).

Table 5. Trout/mile in one section of the Gallatin River based on spring sampling in 2005. Estimates are for fish six inches (TL) or longer.

Section (mark date):			Overall model			Pooled model		
Fish species	N	SD	DF	Chi-square	P	DF	Chi-square	P \[1]
Logan (March 15):								
Rainbow trout	323	58	6	8.72	0.19	3	4.91	0.18
Brown trout	395	62	9	12.00	0.21	2	2.57	0.28

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

<u>Logan Section</u>

Our estimate of rainbow trout abundance in the Logan section of the Gallatin River was similar this year to estimates made in the past few years (Figure 20; see also Figure 21). Taking into account the high variance of the 2004 estimate, similar abundance year to year suggests stable recruitment and survivorship in this area of the river.

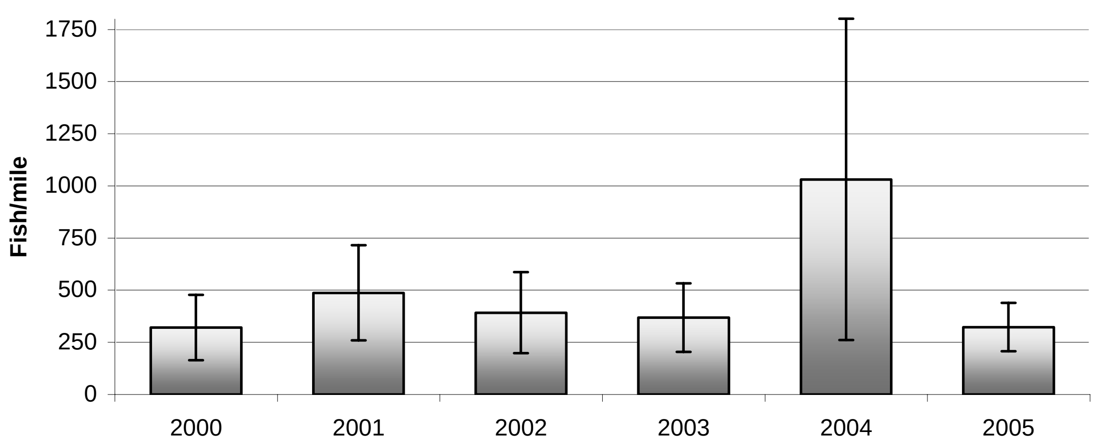

Figure 20. Rainbow trout abundance in the Logan section of the Gallatin River based on spring sampling from 2000 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

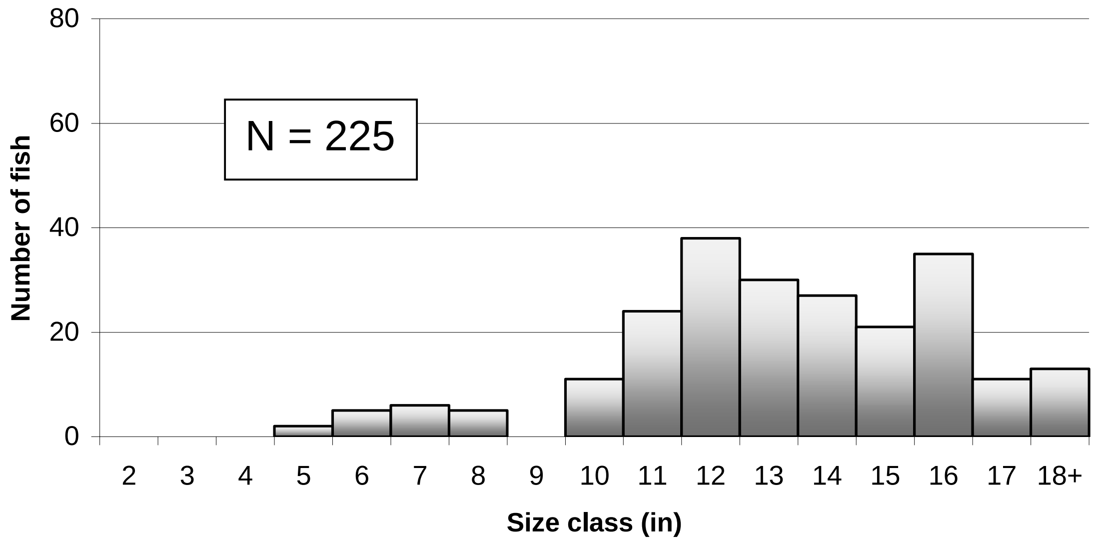

Figure 21. Length frequency distribution of rainbow trout captured in the Logan section of the Gallatin River in March 2005.

Our brown trout estimate was slightly higher this year than last year (Figure 22; see also Figure 23), perhaps indicating a reversal in the pattern of population decline suggested by estimates from this portion of the Gallatin River in recent, drought influenced, years.

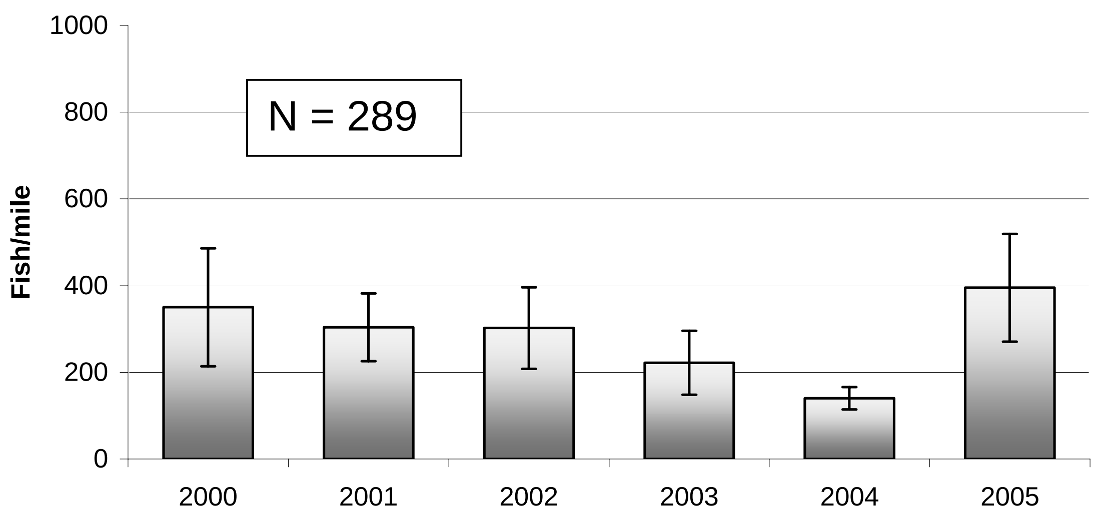

Figure 22. Brown trout abundance in the Logan section of the Gallatin River based on spring sampling from 2000 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

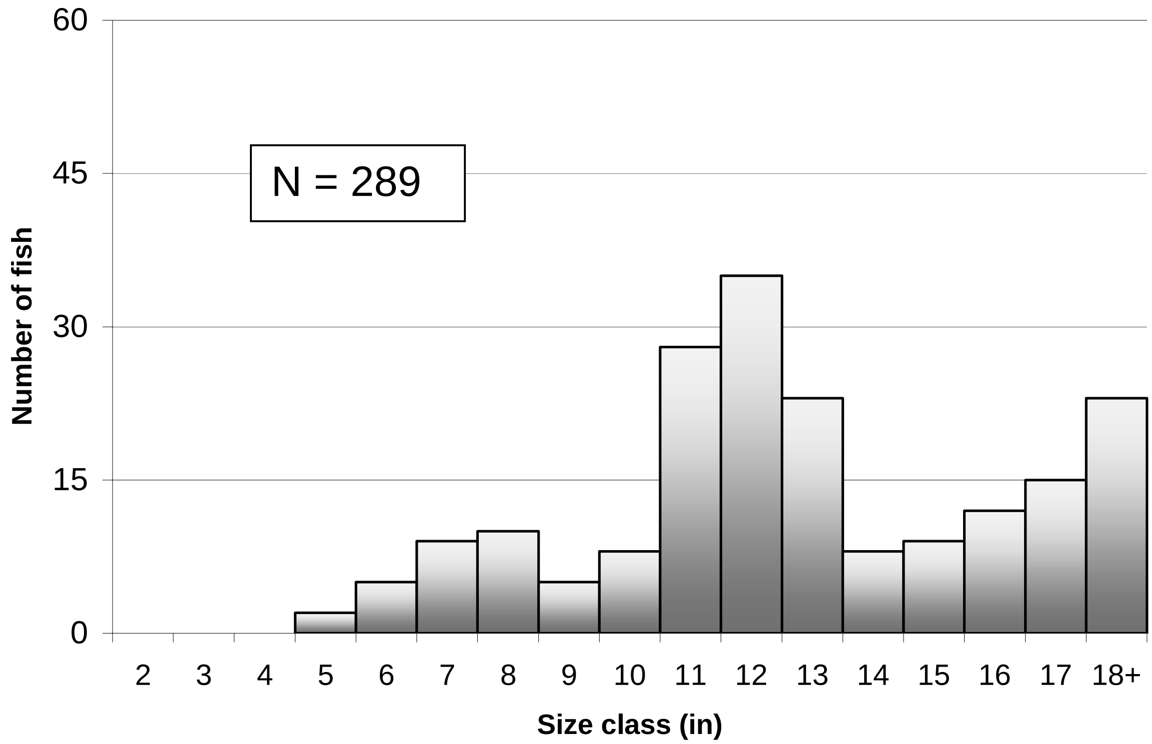

Figure 23. Length frequency distribution of brown trout captured in the Logan section of the Gallatin River in March 2005.

C. Estimates of trout abundance in three sections of the East Gallatin River based on spring and fall sampling in 2005.

Most data for rainbow and brown trout from each section of the East Gallatin River sampled in 2005 fit the log-likelihood model well. Individual and pooled data for rainbow trout captured in the Upper Hoffman section, and individual data for rainbow trout captured in the Lower Hoffman section, modeled at probability values less than 0.05 (Table 6).

Estimates of fish abundance, particularly rainbow trout abundance in the Hoffman sections (see below), continue to be less than was usual before the onset of whirling disease. As previously discussed (Tohtz 2005), less abundance can be attributed in part to loss of smaller fish associated with a significant increase in *M. cerebralis* infection rates for rainbow trout fry. Continuing drought is likely a factor as well, perhaps exacerbating the influence of *M. cerebralis* by concentrating spores in less water, especially in spring.

Table 6. Trout/mile in threes sections of the East Gallatin River based on spring and fall sampling in 2005. Estimates are for fish six inches (TL) or longer.

Section (mark date): Fish species	N	SD	Overall model DF	Overall model Chi-square	Overall model P	Pooled model DF	Pooled model Chi-square	Pooled model P [1]
Upper Hoffman (September 19):								
Rainbow trout	967	46	6	13.11	0.04	6	13.11	0.04
Brown trout	856	76	6	11.96	0.06	5	11.25	0.05
Lower Hoffman (September 14):								
Rainbow trout	1,389	38	9	19.78	0.02	7	9.89	0.19
Brown trout	407	31	7	10.30	0.17	5	8.53	0.13
Thompson (March 16):								
Rainbow trout	601	25	10	7.24	0.70	8	6.52	0.59
Brown trout	250	22	9	2.46	0.98	6	2.10	0.91

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

Upper Hoffman Section

Rainbow trout abundance in the Upper Hoffman section of the East Gallatin River was low again this year especially compared to estimates from the late 1990s (Figure 24; see also Figure 25). Brown trout abundance has remained much more stable and similar year to year throughout this same sampling period (Figure 26; see also Figure 27).

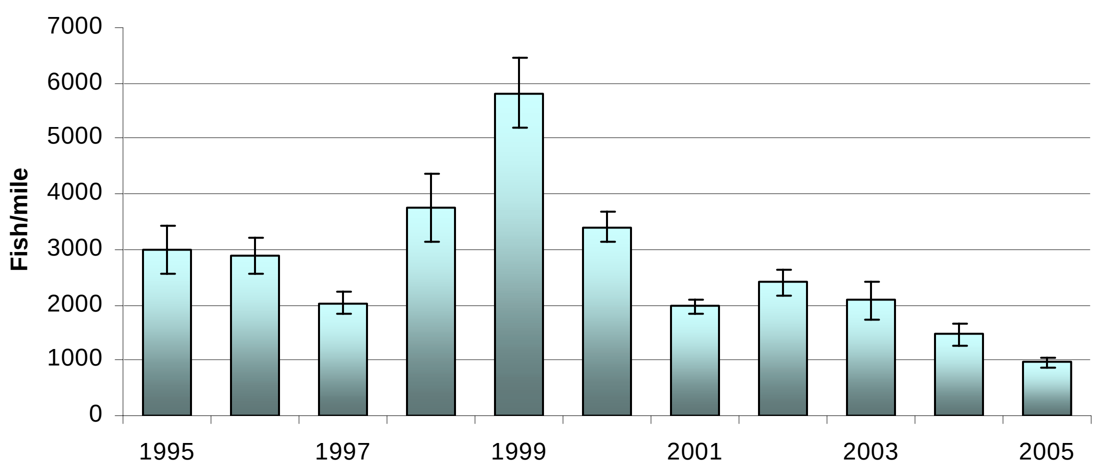

Figure 24. Rainbow trout abundance in the Upper Hoffman section of the East Gallatin River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer.

Error bars show plus or minus 2 SD of each estimate.

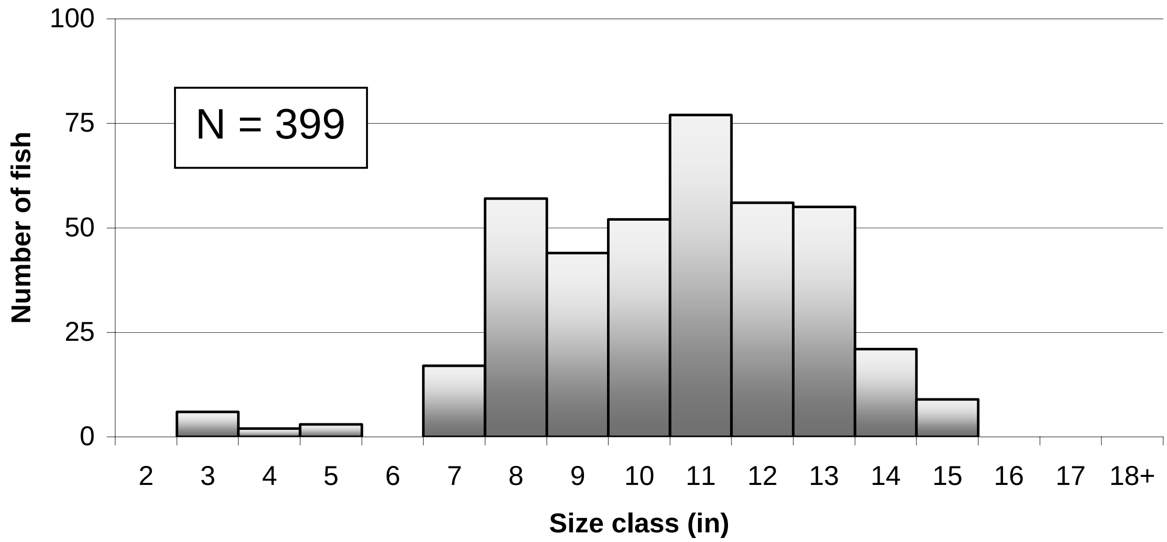

Figure 25. Length frequency distribution of rainbow trout captured in the Upper Hoffman section of the East Gallatin River in September 2005.

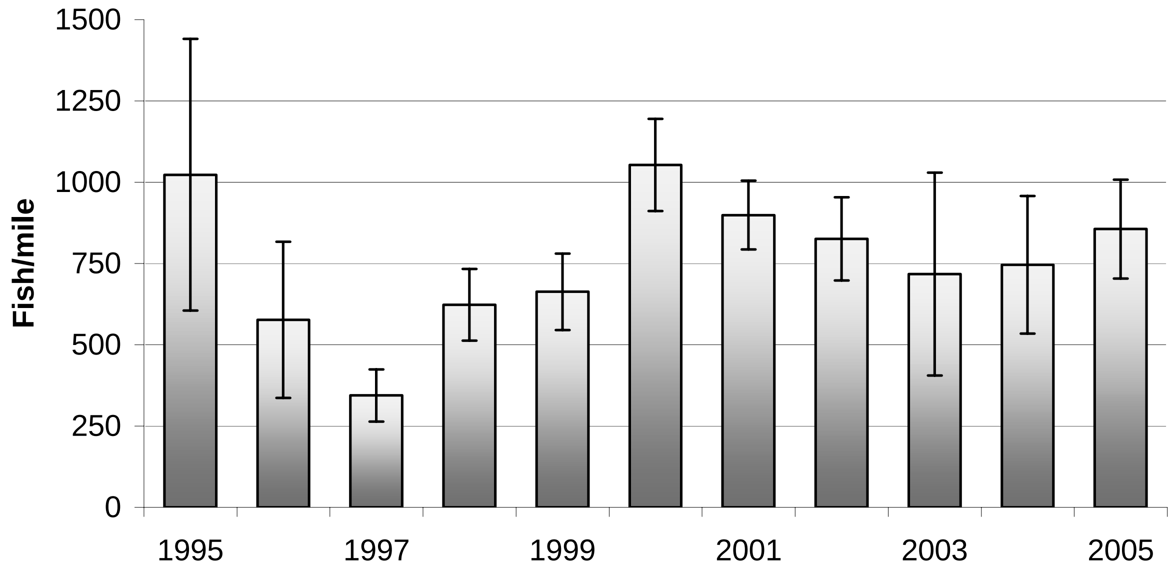

Figure 26. Brown trout in the Upper Hoffman section of the East Gallatin River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

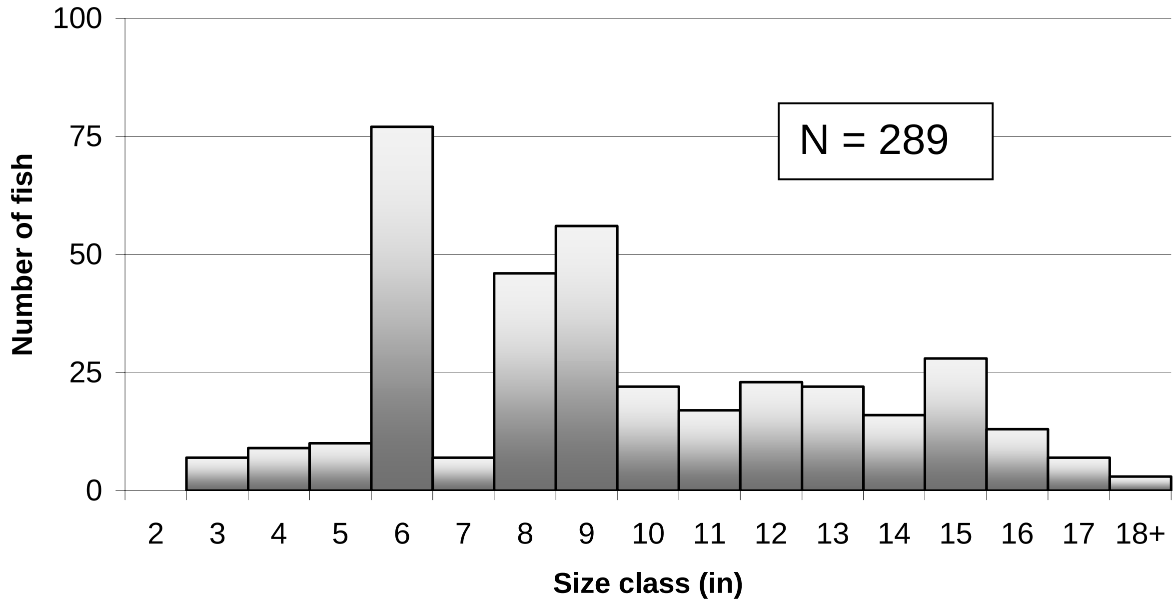

Figure 27. Length frequency distribution of brown trout captured in the Upper Hoffman section of the East Gallatin River in September 2005.

Lower Hoffman Section

The Lower and Upper Hoffman sections fall close together and are physically very similar to each other. The main feature distinguishing the two sections is the fact that the Lower section is downstream from the Bozeman Sewage Treatment Facility's effluent discharge to the East Gallatin River. Nutrient effects in particular alter the character of the East Gallatin River below this point of discharge. The effluent discharge can also provide significantly more flow below the point of discharge at certain times, for example during low flow periods in late summer which have recently been exacerbated by drought. Although the ecological character of the river is different in the Upper and the Lower Hoffman sections, rainbow trout abundance shows a similar pattern of decrease in both sections in recent years (Figure 28; see also Figure 29). Low rainbow trout abundance was evident in the Lower section again this year. Brown trout abundance was similar this year to last year's estimate (Figure 30; see also Figure 31).

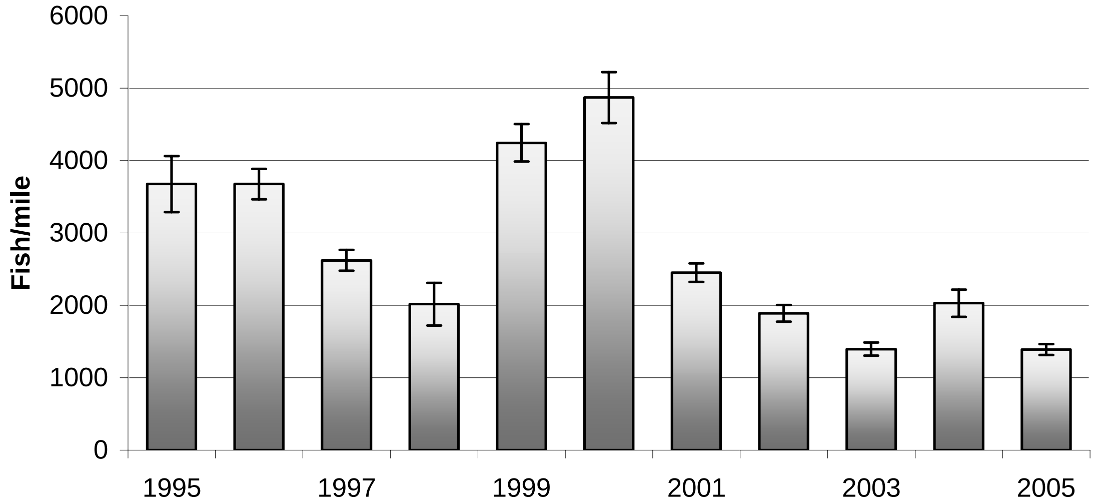

Figure 28. Rainbow trout abundance in the Lower Hoffman section of the East Gallatin River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

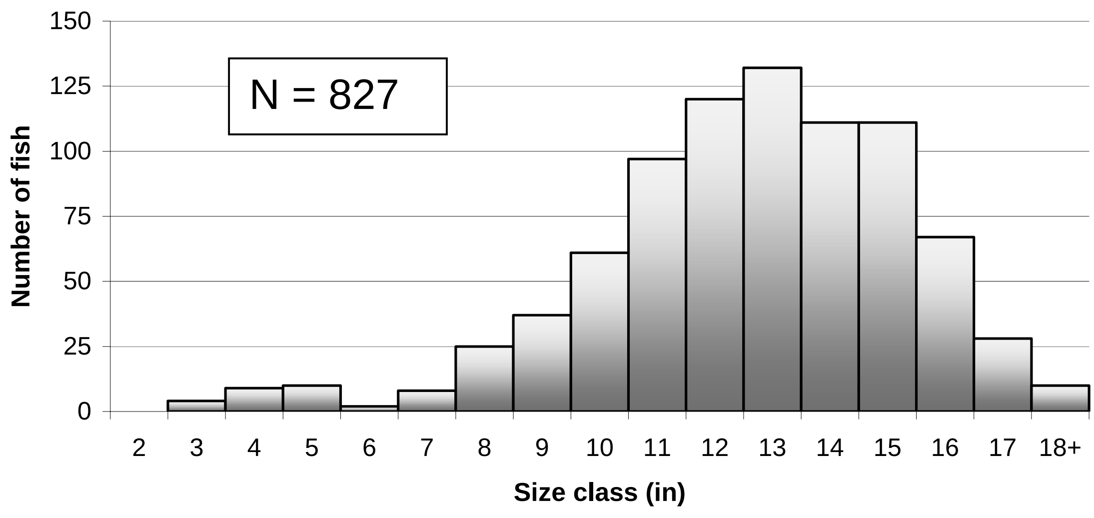

Figure 29. Length frequency distribution of rainbow trout captured in the Lower Hoffman section of the East Gallatin River in September 2005.

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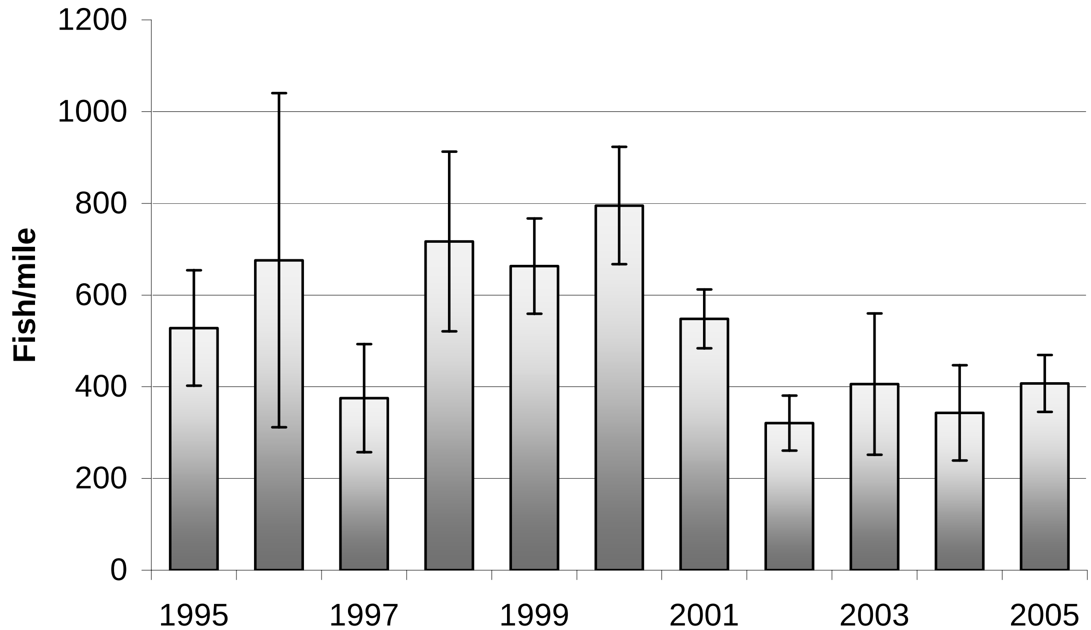

Figure 30. Brown trout in the Lower Hoffman section of the East Gallatin River based on fall sampling from 1995 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

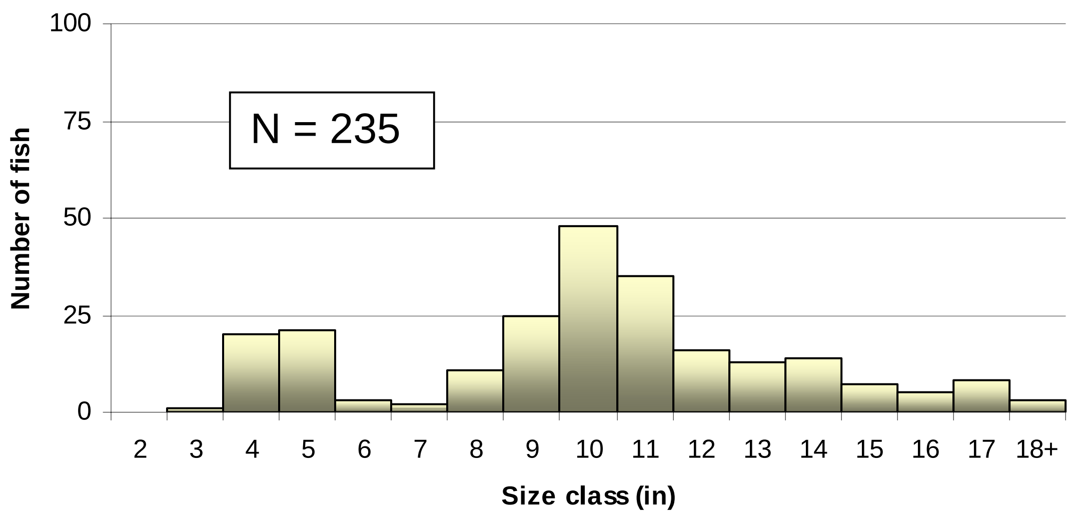

Figure 31. Length frequency distribution of brown trout captured in the Lower Hoffman section of the East Gallatin River in September 2005.

Thompson Section

Rainbow and brown trout abundance in the Thompson section of the East Gallatin River has been similar in recent years (Figure 32; Figure 33: see also Figures 34 and 35), however population monitoring was reinstated in this section only in 2001, many years after any sampling had previously been conducted in this area of the East Gallatin River. It is possible that rainbow trout declines evidenced in the Hoffman sections (see above) occurred here as well. Sampling will continue in this section for at least the next few years to follow population trends especially as compared to upstream sections.

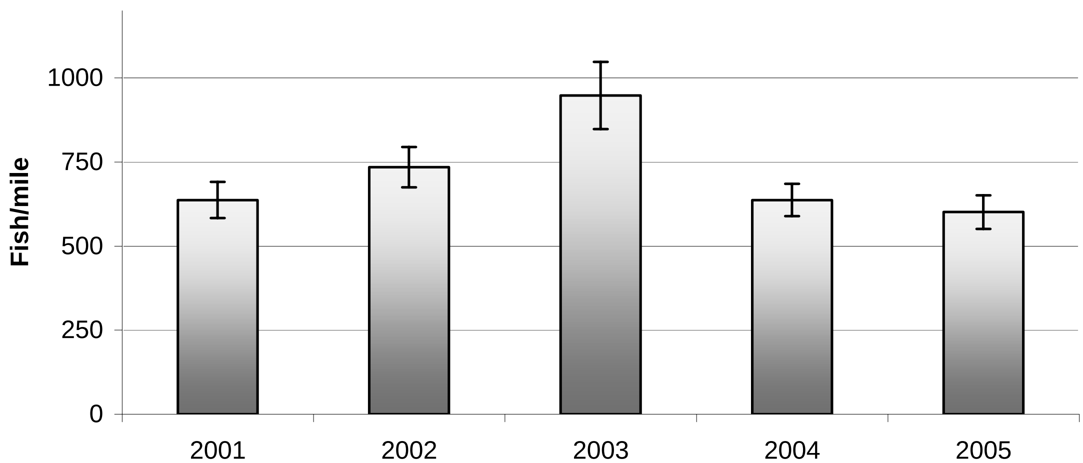

Figure 32. Rainbow trout abundance in the Thompson section of the East Gallatin River based on spring sampling from 2001 through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

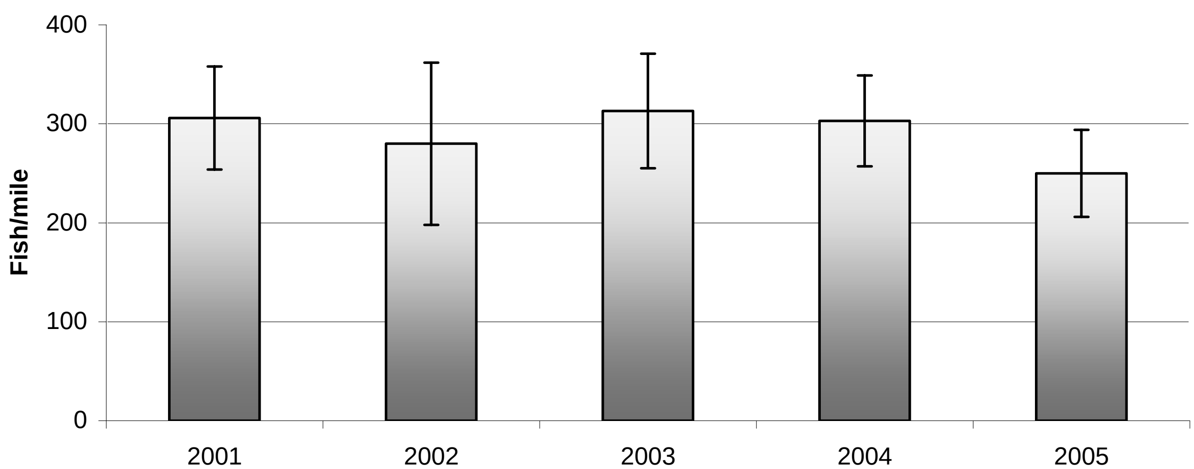

Figure 33. Brown trout abundance in the Logan section of the Gallatin River based on spring sampling from 2001through 2005. Estimates are for fish six inches (TL) or longer. Error bars show plus or minus 2 SD of each estimate.

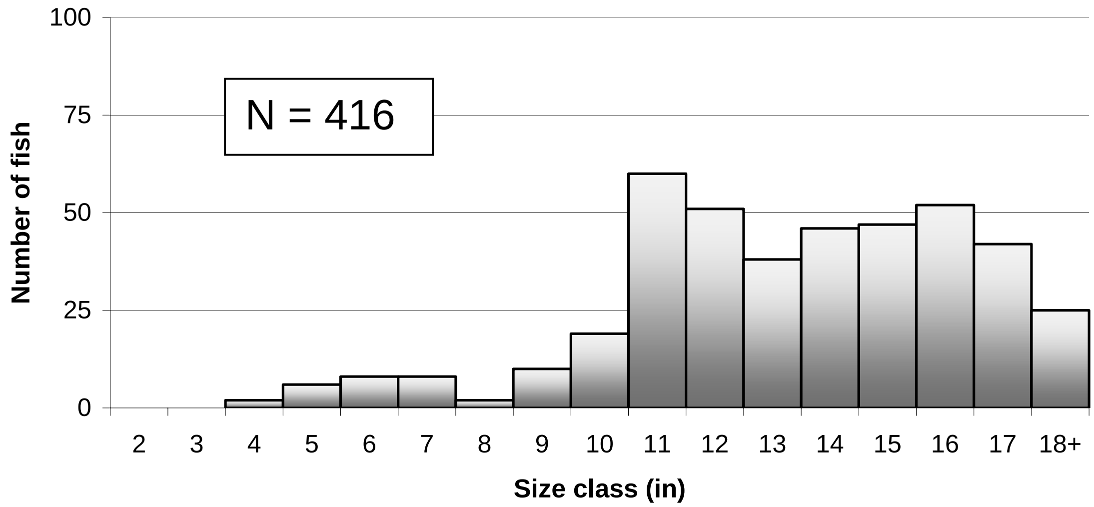

Figure 34. Length frequency distribution of rainbow trout captured in the Thompson section of the East Gallatin River in September 2005.

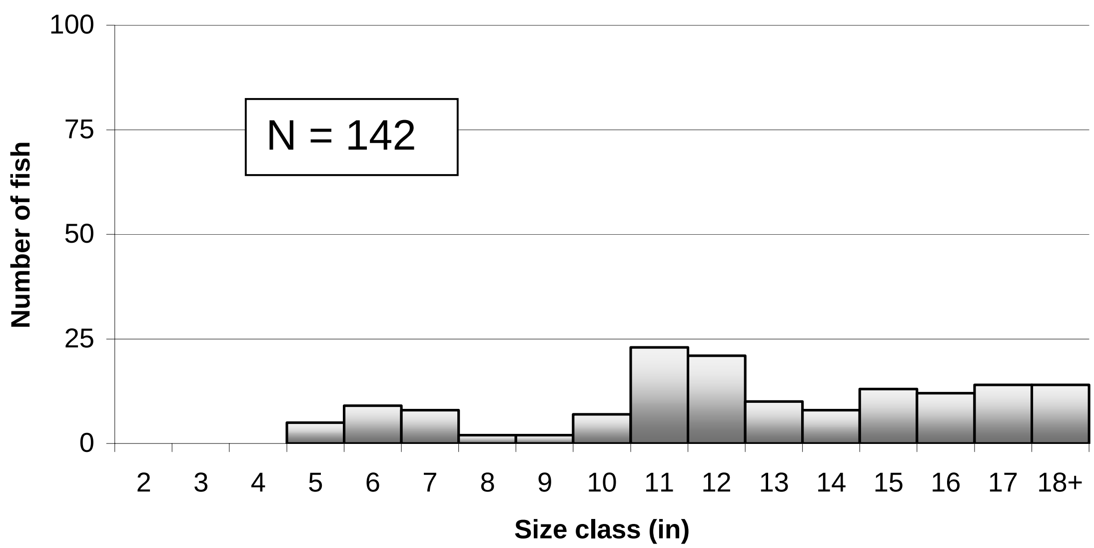

Figure 35. Length frequency distribution of brown trout captured in the Thompson section of the East Gallatin River in September 2005.

D. Summary of gillnet sampling at Hebgen Reservoir in 2005.

The average number of fish caught in each gillnet at Hebgen Reservoir was larger this spring than in 2004. Higher catch rates occurred for most species commonly caught in this reservoir, including rainbow trout, brown trout, and Utah chub (Table 7). Gillnets set during a full moon phase in 2004 could explain low catch rates that year (Tohtz 2005).

Table 7. Summaries of gillnet catches at Hebgen Reservoir based on spring sampling from 1995 through 2005.

Year	Rainbow trout		Brown trout		Mountain whitefish		Utah chub	
	TL Fish/net	Mean (inches)	Fish/net	Mean TL (inches)	Fish/net	Mean TL (inches)	Fish/net	Mean TL (inches)
1995	8.1	14.7	7.8	17.0	9.8	15.5	16.2	10.4
1996	3.5	14.2	5.9	16.4	8.4	15.5	55.0	10.2
1997	3.5	14.0	6.0	15.4	7.2	14.1	60.8	10.5
1998	6.0	14.1	4.2	15.6	5.6	15.7	49.0	10.7
1999	4.3	13.5	12.6	16.0	9.7	14.9	89.8	10.6
2000	3.7	14.1	6.3	16.0	5.3	15.5	68.4	10.1
2001	1.6	14.4	6.2	16.9	8.1	15.0	25.4	10.0
2002	4.2	16.7	4.9	17.3	5.4	15.8	80.7	9.4
2003	3.0	15.4	4.0	17.6	4.2	16.1	52.8	9.9
2004	0.7	15.7	2.2	17.5	3.9	16.8	21.0	10.8
2005	3.9	17.3	6.2	17.8	3.3	16.8	24.4	10.5

The average length of rainbow and brown trout in recent samples continues to increase slightly. This trend may be associated with less fish abundance, although our catch rate in gillnets does not support this assertion (Table 7). Our ability to detect small variations in population size, however, is very limited in this type of sampling.

A higher catch rate of Utah Chubs in 2005 was predicted last year based on what appears to be a regular cycle of increasing and decreasing abundance of this species in Hebgen Reservoir (Tohtz 2005). The increase this year was small however (Figure 36). Other factors, including recent drought, may be exerting strong influence on fish populations in the reservoir at this time.

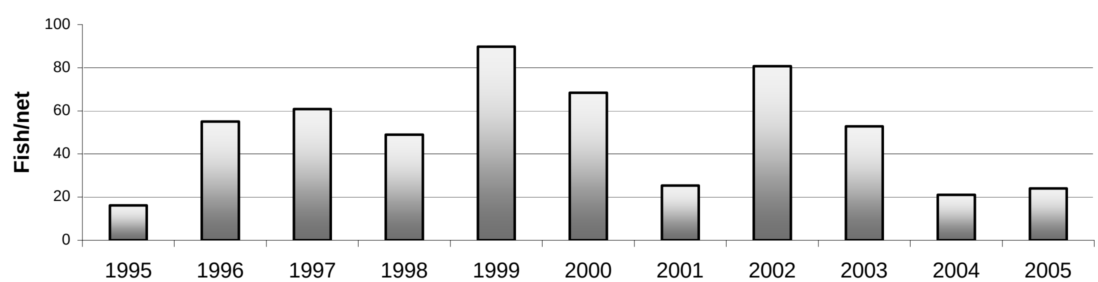

Figure 36. Average number of Utah chubs caught in gillnets set in spring at Hebgen Reservoir, 1995 through 2005.

Well over 1,000,000 rainbow trout have been stocked in Hebgen Reservoir since 1995. Although significant in terms of the number stocked each year (Table 8), the benefit to

Table 8. Rainbow trout stocked in Hebgen Reservoir from 1995 through 2005.

Year	Stocking date	Variety	Number	Mean length (inches)
1995	June 21	Eagle Lake	49,537	4.6
	August 22	Desmet	55,315	2.4
1996	July 2	Eagle Lake	37,602	4.1
	July 8	Eagle Lake	87,847	3.7
1997	July 7	Eagle Lake	40,272	3.1
	July 15	Eagle Lake	56,381	4.9
1998	July 7	Eagle Lake	39,853	4.2
	July 8	Eagle Lake	18,624	4.2
	July 16	Eagle Lake	48,384	3.0
1999	July 6	Eagle Lake	56,432	4.4
	July 14	Eagle Lake	41,856	3.1
2000	June 14	Eagle Lake	19,720	2.9
	June 26	Eagle Lake	19,352	3.0
	July 11	Eagle Lake	61,072	5.0
2001	July 17-19	Eagle Lake	107,620	6.0
2002	July 22-24	Eagle Lake	107,509	6.0
2003	June 23-24	Eagle Lake	119,195	4.5
2004	June 15-16	Eagle Lake	103,276	4.4
2005	July 6-8	Eagle Lake	97,998	5.3

the recreational fishery is uncertain. Byorth (2004) determined that hatchery rainbow trout caught by anglers during an extensive creel survey of Hebgen Reservoir in 2000 and 2001 comprised three percent of total catch based on the presence of tetracycline marks, up to 47 percent of the total catch based on highly subjective interpretations of growth marks on scales. Indications of hatchery fish caught in gillnet samples have been similarly variable. On average about 7.5 percent of rainbow trout caught in gillnets have shown tetracycline marks since that marker was first used in 2000 (Figure 37). However, the occurrence of this mark has varied from zero to twenty-five percent of the total sample. This variability probably indicates as much about the degree to which chance alone determines gillnet samples in this reservoir as it indicates about hatchery contributions to the fishery.

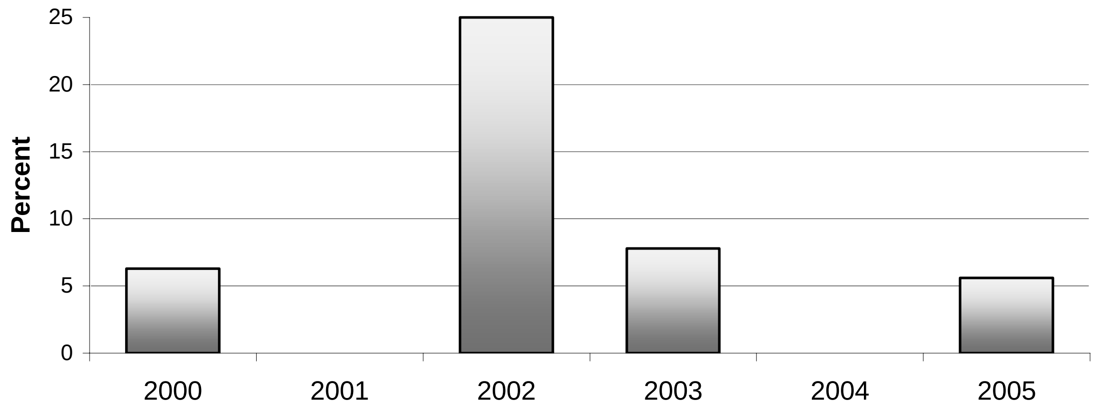

Figure 37. Percent of rainbow trout caught in spring gillnets at Hebgen Reservoir that showed tetracycline marks certainly related to a hatchery origin of the fish.

Adipose clips, used on average on 25 percent of fish stocked annually since 2001, have been observed on average in only 2.2 percent of rainbow trout caught in gillnets. Values have ranged from zero to 5.5 percent of the total catch in any year (Figure 38).

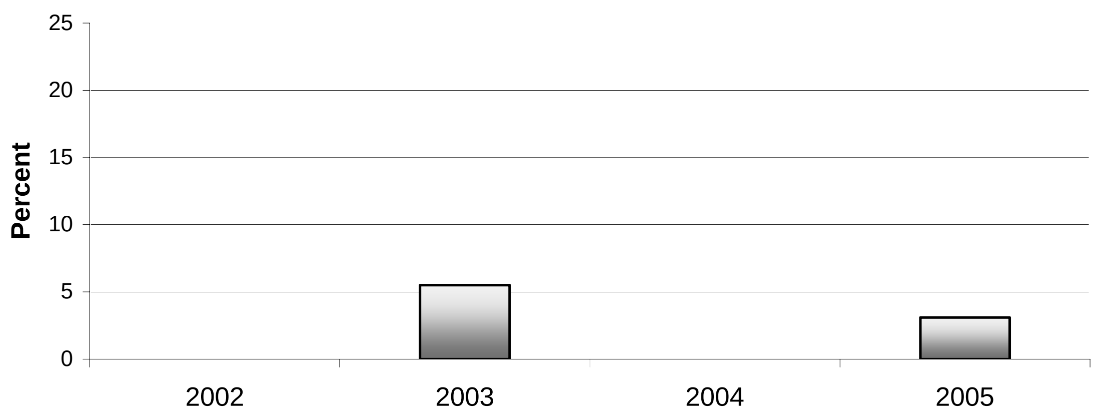

Figure 38. Percent of rainbow trout caught in spring gillnets at Hebgen Reservoir that showed adipose fin clips likely related to a hatchery origin of the fish. Fish with adipose clips were first stocked in Hebgen reservoir in 2001, after the spring 2001 gillnet sampling had already been completed.

Although a less conclusive indicator of hatchery origin, fin erosion (particularly deformed dorsal fin rays) has been consistently observed in a similar percentage of fish caught in gillnets over time. Since 1995 fin erosion has been noted on average for 10.7 percent of all rainbow trout in the samples (Figure 39). This percentage has varied between 3.9 and 16 percent in any given year.

Among fish that show other signs of hatchery origin (tetracycline mark, adipose fin clip)

71.8 percent also show fin erosion. Acknowledging that considerable variation occurs in gillnet sampling over time, and relying more heavily on the more confident indicators

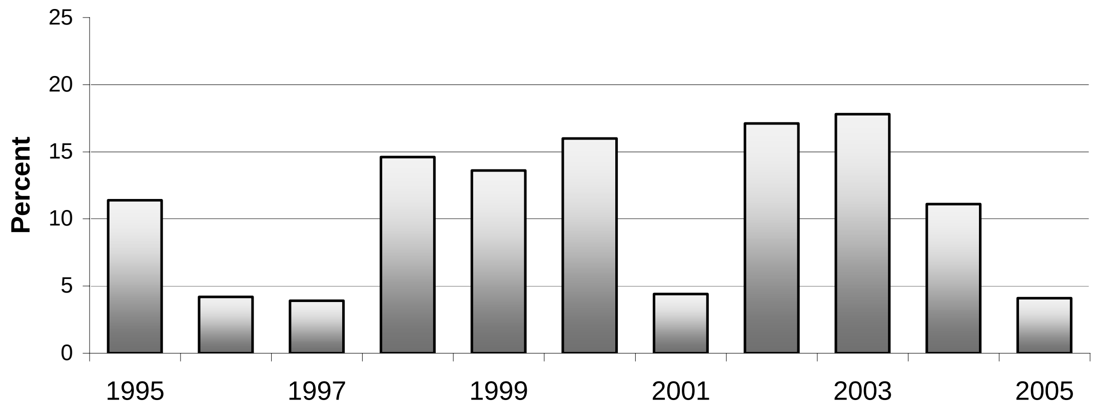

Figure 39. Percent of rainbow trout caught in spring gillnets at Hebgen reservoir that showed fin erosion that is possibly related to a hatchery origin of the fish.

of hatchery origin (tetracycline marks, adipose fin clips) than less confident indicators (fin erosion, scale check marks), on balance it appears that less than ten percent of rainbow trout caught in gillnet samples come from hatchery plants. An even lower contribution of hatchery fish to the recreational fishery also seems likely. Byorth (2004) estimated rainbow catch rate at 0.31 fish/hour at Hebgen Reservoir between June 2000 and June 2001. Estimated fishing pressure for this period was 64,811 angler hours. Total harvest was roughly 10,000 rainbow trout, or about half of the total catch. Even assuming the very high estimate that 47 percent of all rainbow trout in the creel were of hatchery origin as suggested by Byorth as an extreme, it would appear that less than five percent of the 100,000 rainbow stocked each year at Hebgen Reservoir contribute to the annual harvest. If tetracycline marks are accepted as a better indicator of the presence of hatchery fish in the creel, the percentage of rainbow trout harvested each year from the hatchery plants is less than one.

E. Summary of gillnet sampling at Cliff Lake in 2005.

Catch rate for rainbow trout caught in gillnets at Cliff Lake this fall was less than observed in recent years, and average size was larger (Table 9). These results suggest lower fish abundance, however the lake has not been sampled since 2002.

Table 9. Summaries of gillnet catches at Cliff Lake based on fall sampling from 1991 through 2005. Table adapted in part from Byorth and Weiss 2003.

Year	Survey month	Number caught	Fish/net	Mean length (in)
1991	October	46	7.7	12.4
1992	Not sampled	---	---	---
1993	October	21	4.2	15.5
1994	October	9	1.8	12.3
1995	Not sampled	---	---	---
1996	Not sampled	---	---	---
1997	Not sampled	---	---	---
1998	October	31	6.2	8.9
1999	October	26	5.2	10.9
2000	October	49	9.8	9.4
2001	October	25	6.3	10.2
2002	October	59	8.4	10.3
2003	Not sampled	---	---	---
2004	Not sampled	---	---	---
2005	September	16	4.0	12.5

Rainbow trout are naturally self-sustaining in this lake; they were last stocked in Cliff Lake from a hatchery in 1969. Fish populations sustained by wild reproduction typically respond closely to local environmental conditions. Lower abundance of rainbow trout suggested by gillnet sampling this fall may simply be a consequence of continued drought the last several years. Moisture conditions to date suggest some improvement in this situation in 2005. If true, rainbow trout abundance might be expected to increase if favorable conditions persist. Of course, other factors, such as an unusually large number of parasites found in rainbow trout at Cliff Lake (Byorth and Weiss 2003), will also influence population response.

F. Summary of spawner counts at Hyalite Reservoir in 2005.

Surveys of Yellowstone Cutthroat trout and arctic grayling spawning above Hyalite Reservoir have been conducted on a consistent basis since 1997. These surveys have been counts of fish at regular intervals (usually once each week) throughout the spawning season to assess fish reproduction that might contribute to the recreational fishery of the reservoir itself. Since 2002, these surveys have also been intended to provide information to help evaluate the efficacy of log structures placed by the USFS to enhance fish habitat and use in West Fork Hyalite Creek above the reservoir.

In 2005 our counts of Yellowstone cutthroat trout significantly exceeded all previous surveys (Table 10). Spawning activity in the survey area has essentially doubled each

Table 10. Numbers of Yellowstone cutthroat trout observed during spawner counts in the West Fork of Hyalite Creek from 1997 through 2005.

Year	Surveys	Count	Fish/survey	Date most fish observed
1997	8	364	44	June 23
1998	16	1,891	118	May 28
1999	11	1,704	155	June 11
2000	9	1,640	182	June 2
2001	8	2,643	330	June 6
2002	7	1,980	282	June 7
2003	8	1,563	195	June 16
2004	15	3,438	229	June 2
2005	8 \[1]	6,070	867	June 3

1. Water conditions on June 17, 2005 prevented fish counts on that survey day.

year since 2003, perhaps in response to the 2002 stream treatments. Similarly, counts of spawning arctic grayling in 2005 exceeded all previous surveys (Table 11). Stream conditions above the reservoir are apparently especially favorable for spawning fish in recent years. It is difficult at this time, however, to assess what increasing spawning escapement may have meant for the recreational fishery. A significant number of

Table 11. Numbers of arctic grayling observed during spawner counts in the West Fork of Hyalite Creek from 1997 through 2005.

Year	Surveys	Count	Fish/survey	Date most fish observed
1997	5	5	1	June 23
1998	14	498	36	June 22
1999	7	143	20	June 21
2000	3	130	43	June 19
2001	5	202	40	June 19
2002	7	235	34	June 24
2003	7	551	79	June 16
2004	9	470	52	June 17

2005	7	849	121	June 20

Yellowstone cutthroat trout are stocked each year at Hyalite reservoir (Table 12). Interestingly, arctic grayling have never been legally stocked in Hyalite reservoir, and their original introduction into the reservoir is unexplained. Regardless, arctic grayling are obviously naturally self-sustaining at this time.

Table 12. Yellowstone cutthroat trout stocked in Hyalite Reservoir from 1995 through 2005.

Year	Stocking date	Variety	Number	Mean length (inches)
1995	September 12	McBride	21,354	2.0
	September 12		8,646	2.6
1996	September 18	McBride	30,000	2.5
1997	September 17	McBride	30,000	2.6
1998	September 18	McBride	17,540	3.0
	September 18		12,460	2.2
1999	September 15	McBride	31,500	2.6
2000	September 20	McBride	29,274	2.5
2001	September 15	McBride	30,000	2.4
2002	September 17	McBride	28,500	2.4
2003	September 16	McBride	30,000	2.5
2004	September 20	McBride	1,050	3.4
	September 20	McBride	4,000	1.2
	September 20	McBride	7,500	2.5
	September 20	McBride	23,400	2.2
2005	July 29	McBride	30,000	2.0

Significant increases in the numbers of fish spawning above Hyalite reservoir raise at least two questions about current fish management: Should hatchery stocking of Yellowstone cutthroat trout at the reservoir be stopped to take better advantage of wild fish reproduction? And, is the catch and release only fishing regulation for arctic grayling still necessary? Answering these questions will require more information than we currently have, including better information about fish abundance in the reservoir, angling pressure, and harvest.

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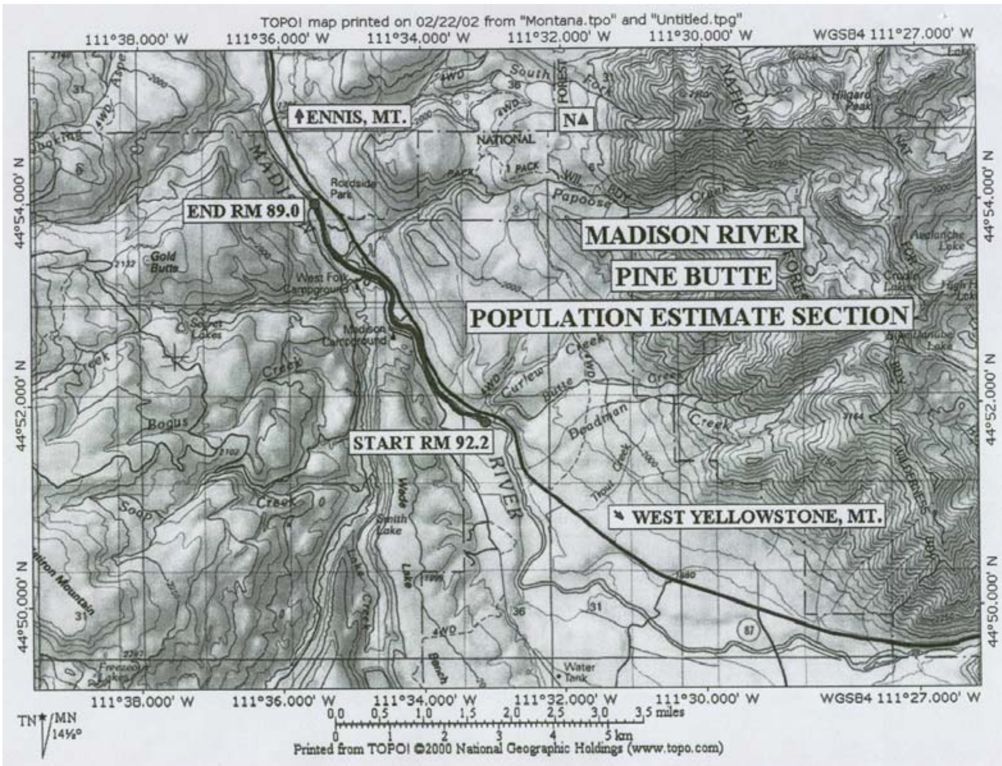
APPENDIX A: Common and scientific names for fish referred to in this report.

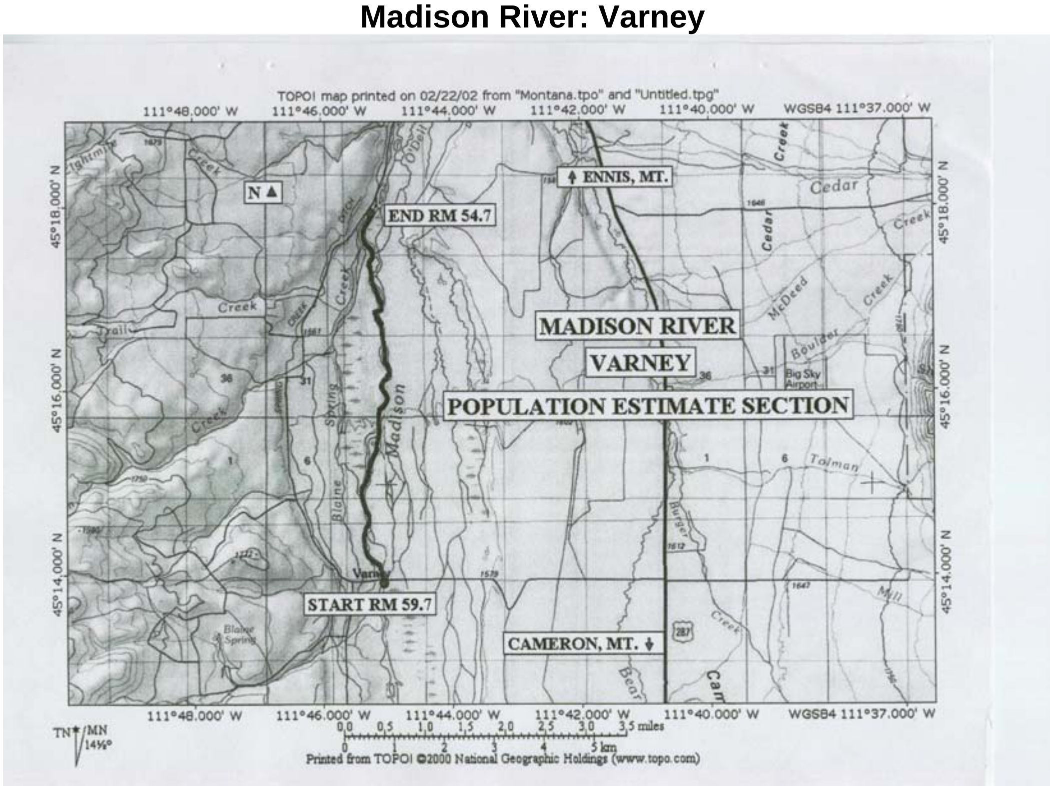
Common name	Scientific name
Brown trout	*Salmo trutta*
Mountain whitefish	*Prosopium williamsoni*
Rainbow trout	*Oncorhynchus mykiss*
Utah chub	*Gila atraria*
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*

APPENDIX B: Map details of river sections sampled in 2005. Adapted from Byorth and Weiss 2003.

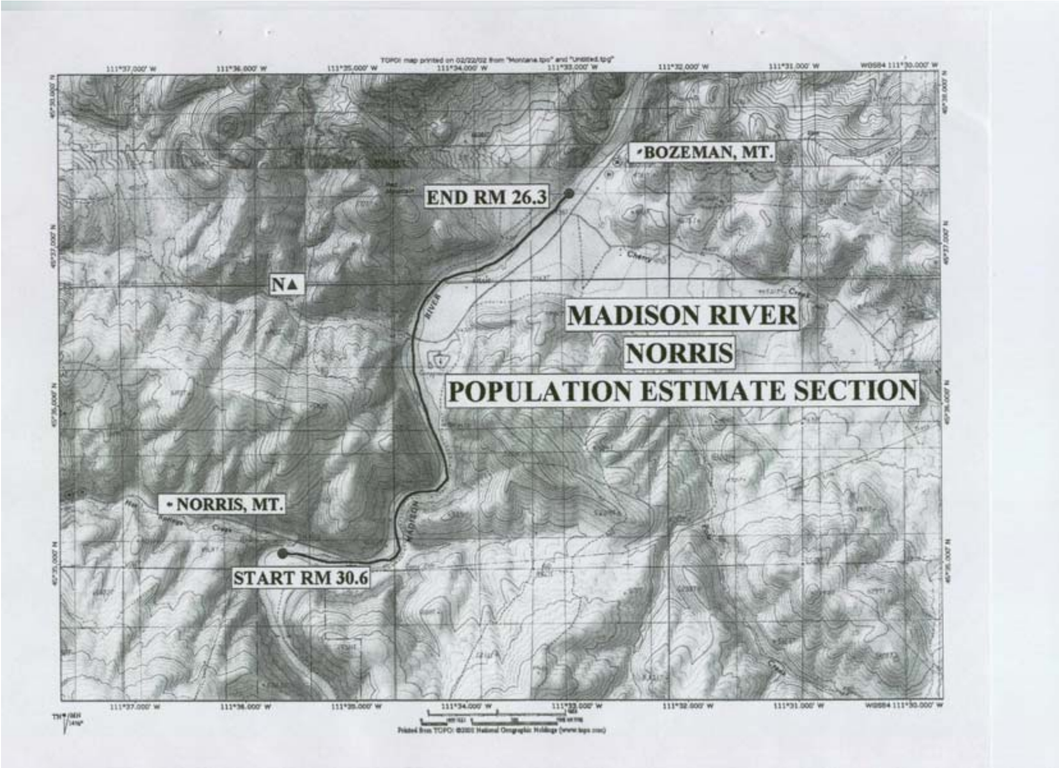
Madison River: Pine Butte



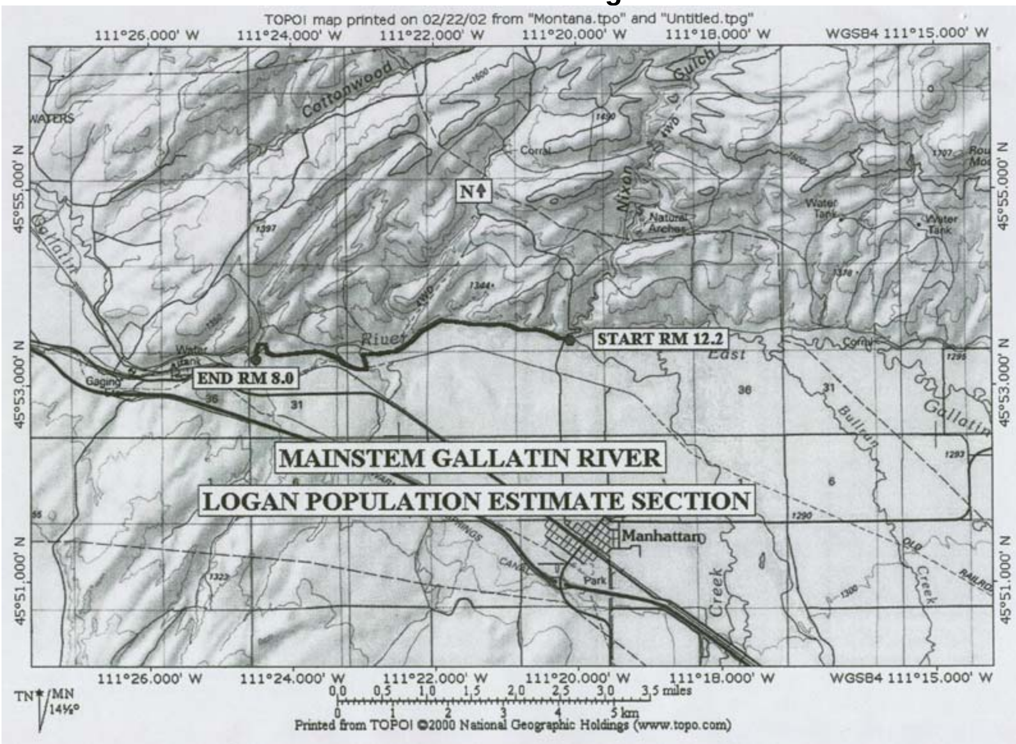
Madison River: Varney



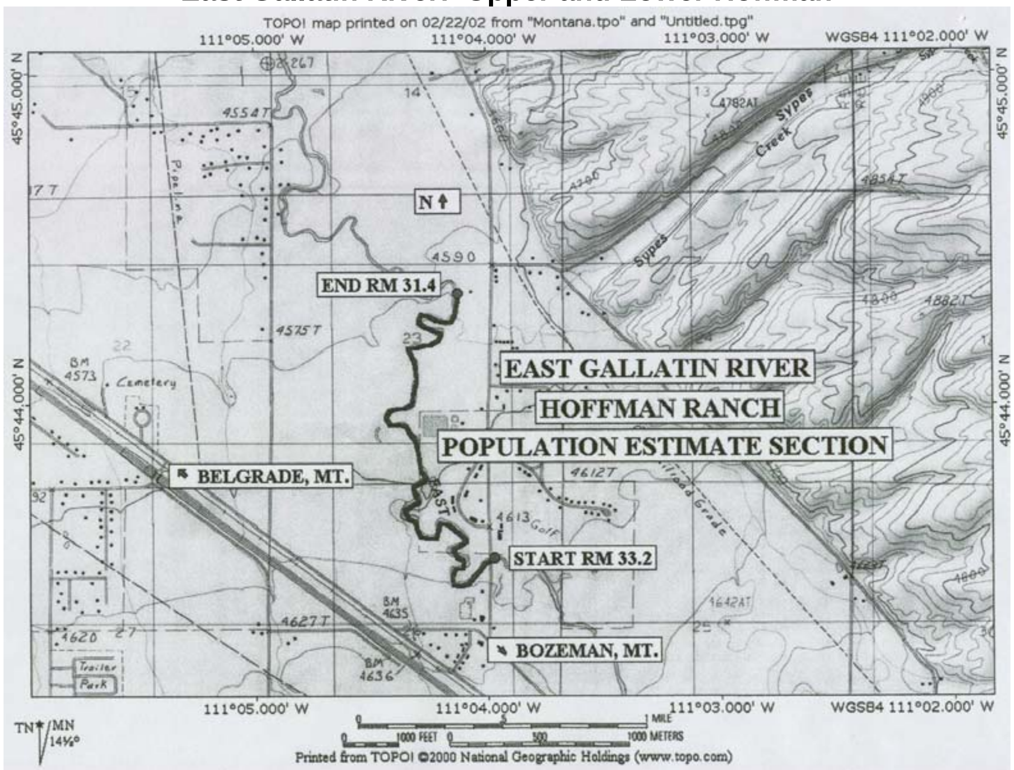
Madison River: Norris



Gallatin River: Logan



East Gallatin River: Upper and Lower Hoffman



East Gallatin River: Thompson