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BEAVERHEAD NATIONAL FOREST

AND

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

COOPERATIVE FISHERY PROGRAM

FIRST ANNUAL REPORT

Covering the report period August 15 to December 31, 1985

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EXECUTIVE SUMMARY

This is the first annual report on the information collected as part of the cooperative effort between the Beaverhead National Forest and the Montana Department of Fish, Wildlife and Parks to evaluate the fishery supported by streams draining the Beaverhead National Forest. The geographic area of emphasis was mutually determined to be the upper Big Hole drainage above Divide, Montana. Sample sites were selected by Forest Service personnel at the Dillon, Wisdom and Wise River Ranger Districts to supply specific fisheries information for areas under Forest management; by the Forest Hydrologist to help link watershed monitoring efforts to the fisheries each watershed supports; and by the Montana Department of Fish, Wildlife and Parks to further document the distribution and life-history of grayling in the upper Big Hole drainage. Information was collected on instream and streamside habitat conditions and fish population statistics.

Grazing and dewatering impacts were observed within several of the sampled areas including streams reaches on private and Forest Service lands. The lower portion of Big Lake Creek (on private land) was severly dewatered at the time of the survey and appeared to have been heavily impacted by livestock use. Habitat surveys documented that this stream segment provided little cover, had an extremely high width-to-depth ratio (37) and low values for percentage of undercut banks, shoreline depth, and depth of undercut banks. Relatively few brook trout were captured in this portion of the stream (12 per 1,000 feet) with burbot being the only other gamefish observed. An upper segment of Big Lake Creek on Forest land below Forest Road 945 was electrofished with 143 brook trout per 1,000 feet of stream captured. This segment of the stream was in a forested area. A segment of Governor Creek on Hairpin land was found to be in relatively good condition. The habitat information indicated that the channel had probably received impacts in the past, but was recovering. The width-to-depth ratio was high (24) and the shoreline depth and depth of undercut banks was low; however, the percentage of undercut banks was high and the soil alteration was relatively low. The area appeared to be a rest pasture. Fish population data showed that this stream segment supported 56 and 156 brook trout less than six inches and six inches and longer per 1,000 feet of stream, respectively. Two other segments of Governor Creek were electrofished. A segment up on Forest land supported similar densities as that found on the Hairpin segment, while a site nearer to the mouth supported approximately half the density of brook trout as the upper two sites. A few rainbow trout were captured in this lower segment indicating it may be important as a spawning and rearing tributary for the Big Hole River fishery. No grayling were documented in Governor Creek during this survey; however, they have been documented in lower Governor Creek during past surveys. Lower Rock Creek was sampled near its confluence with Big Lake Creek. This segment of the stream had been heavily impacted by livestock use and dewatering. It contained a relatively low density of brook trout (35 per 1,000 feet), but a relatively high density of grayling (33 per 1,000 feet) compared to all other streams sampled and based on a single electrofishing pass. Ruby Creek on Forest land near Cow Creek was the most heavily impacted stream on Forest land surveyed during 1985. The percentage of altered soil cover was the highest of any stream surveyed (45); however, the width-to-depth ratio was moderate (20),

indicating that livestock impacts may be relatively short-term and may be easily reversed with a change in grazing management. The estimated population of brook trout was 33 and eight fish less than six inches and six inches and longer per 1,000 feet of stream, respectively. This stream segment had the lowest fish population of any sampled area. Electrofishing of a short segment immediately below this area, in an area used extensively by beaver, captured approximately 1.5 times the number of brook trout. Steel Creek was sampled immediately below the Forest boundary. The livestock impacts in this area were apparently mediated by the dense willow growth adjacent to the stream channel and the presence of beavers in the area. Habitat survey data indicated that this portion of the channel had received high impact by the relatively high soil cover alteration (31%), but most other parameters indicated a relatively healthy habitat condition. The estimated population of brook trout in this segment of Steel Creek was 76 and 19 fish less than six inches and six inches and longer per 1,000 feet of stream, respectively. A lower segment of Steel Creek, below the Steel Creek Road bridge, had almost four times the density of brook trout and also supported a few grayling. Lower Steel Creek probably is important to the main Big Hole River as a spawning and rearing area for grayling and perhaps rainbow trout. Thayer Creek, a headwater tributary to Andrus Creek, on Forest land was in good condition and little impact from livestock use was observed. This stream segment supported the highest density of brook trout documented during 1985 sampling (628 brook trout captured per 1,000 feet of stream in one electrofishing pass). Upper Trail Creek, near the mouth of Sunshine Creek, was in moderately good condition and after reviewing infra-red aerial photos shot in the 1970's it appears this stream segment has recovered considerably from past grazing damage. Overhead cover was still rather sparse, but all other habitat data indicated the habitat was in relatively good condition. The estimated brook trout population was 408 and 84 fish less than six inches and six inches and longer per 1,000 feet of stream, respectively.

Streams sampled which had timber management as the primary activity in adjacent lands were all located on Forest lands. Doolittle Creek was sampled below the mouth of the North Fork Doolittle Creek. The habitat data indicated a relatively unaltered stream channel in good condition. The estimated brook trout population was 177 and 36 fish less than six inches and six inches and longer per 1,000 feet of stream, respectively. The lower portion of Trail Creek, near the Forest boundary, contained what appeared to be high quality habitat; however, the width-to-depth ratio was relatively high (21) for a forested stream. The fish population in lower Trail Creek was extremely low with approximately 19 brook trout per 1,000 feet of stream captured in a single electrofishing pass. I believe the low number of brook trout may be caused by the extremely high levels of fine sediment found in the stream channel (see below) as all size classes of fish (including those less than six inches in length) were at low densities.

Relative fish abundance and species distribution were evaluated from single electrofishing passes in 37 stream sections. The number of each species per 1,000 feet of stream length is presented in parantheses following the name of the creek section. Artic grayling were captured in the lower reaches of Rock (33), Swamp (4), and Steel (3) creeks. Past surveys found grayling in Big Lake, Francis, Governor, Lamarche, Miner, Mussigbrod, and Sandhollow creeks. Brook trout were found in Thayer (628), Sevenmile (340), upper Trail (272), upper Bryant (195), Andrus (195), upper Tie (183), lower Fox (175), two upper

sections in Governor (168 and 169), lower Steel (160), lower Bryant (158), upper Big Lake (143), O'Dell (140), upper Fox (111), Swamp (92), lower Lacy (92), lower Governor (86), Mill (85), Squaw (84), lower Tie (60), California (60), Doolittle (55), South Fork Blacktail (44), upper Lacy (42), Steel (38) near the Forest boundary, Rock (35), Ruby (23 and 14), and lower Trail (19) creeks. Cutthroat trout (identified by a cursory examination of external morphological characteristics) were captured in upper Lacy (40), upper Governor (28), Meadow (28), South Fork Willow (23), O'Dell (18), lower Fox (13), Governor (5) on Hairpin land, lower Lacy (4), Andrus (4), Thayer (3), upper Harriet Lou (3), Doolittle (2), South Fork Blacktail (2), and Steel (1) creeks. Rainbow trout and hybrids between rainbow and cutthroat were found in lower Governor (2 rainbow), California (41 rainbow), South Fork Blacktail (8 hybrids) creeks and the East Fork of Ruby River (11 hybrids).

Streambed composition was evaluated using several methods. Streambed composition is an important parameter because trout reproduction and juvenile rearing potential can be affected by streambed composition. In addition, many management activities occurring on Forest lands can affect streambed composition by increasing the amount of fine sediment delivered to the stream channel. Occular surveys found high percentages (more than 35%) of the streambed made up of fine (sand and smaller material) in Big Lake, Rock, Ruby, Steel, and lower Trail creeks. Hollow core sampling (where actual samples of the streambed were removed and analyzed in the laboratory) found that the percentages of material less than 6.3 mm (0.25 in.) were 47% in South Fork Blacktail, 43% in Trail, 32% in Doolittle, 31% in Meadow, 27% in Harriet Lou, 26% in Mill, and 24% in both South Fork Willow and East Fork Ruby River. Survival of cutthroat and rainbow trout embryos using predictions from laboratory studies ranged from 5 to 43% and from 14 to 63%, respectively, based on the amount of fine material in the streambed.

A literature review on the habitat requirements by life-stage for salmonid species found in the upper Big Hole drainage were summarized in a tabular form. Recommendations for next year's portion of the study are made.

ACKNOWLEGEMENTS

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INTRODUCTION

A cooperative agreement was reached between the Beaverhead National Forest (BHNF) and the Montana Department of Fish, Wildlife and Parks (MDFWP) on July 30, 1985 for the purpose of developing "a positive, aggressive fisheries program for each Ranger District on the Beaverhead National Forest". It was mutually agreed that initial efforts would concentrate on the Wisdom and Wise River Districts. The BHNF was responding to public concerns expressed over planned activities on the Forest within the Big Hole drainage outlined in the BHNF Forest Plan. Seventy (70) percent of the comments received by the BHNF on the Forest Plan focused on the Big Hole drainage and the majority of those comments expressed concerns that management activities would adversely impact water quality and fish resources. The MDFWP was concerned over the paucity of information available documenting the status of the upper Big Hole River fishery, particularly regarding the fluvial grayling population which inhabits this section of river. This grayling population is the last known fluvial (riverine) grayling population documented in the contiguous 48 states. MDFWP and BHNF also needed information on the use of upper Big Hole River tributaries by fish supporting the river fishery.

The objectives of this investigation, as stated in the cooperative contract, are:

1. Collection of baseline fisheries and hydrologic information in areas that are designated for intensive timber harvest activities.

2. Determine fish populations in selected streams.

3. Determine existing situation and limiting factors to stream game fish populations including barriers to fish passage, riparian conditions, and sedimentation, etc.

4. Identify streams which contribute significantly to recruitment of mainstem river fish populations.

5. Work with the Forest Service Zone Fisheries Biologist to develop a positive fisheries program regarding habitat protection and enhancement opportunities.

METHODS

Habitat Surveys

Fish habitat was surveyed in several stream reaches to determine the best sampling design and to begin documenting the present condition of the habitat. Streams were segregated into reaches of relatively homogeneous flow, channel gradient, and valley configuration. Selection of sample sites were based on recommendations from Beaverhead National Forest District and Supervisor's Office personnel. Reach surveys were conducted in Governor and Thayer creeks on the Dillon Ranger District and Big Lake, Doolittle, Rock, Ruby, Steel and Trail creeks on the Wisdom Ranger District (Table 1).

Streambed samples were taken from potential spawning habitats in eight streams including Mill, South Fork Willow, Doolittle, South Fork Blacktail, Trail, Harriet Lou and Meadow creeks and the East Fork of Ruby River. All of the above streams, with the exception of Trail Creek, are streams which will be monitored by the Beaverhead National Forest Hydrologist for streamflow and suspended (and bedload in several streams) as part of a long-term monitoring program to test and calibrate the R1/R4 sediment model. These samples were analyzed for particle size composition to determine the relative "health" of the spawning areas.

Reach Surveys

Within each reach the following habitat parameters were estimated:

1. Wetted width to the nearest tenth of a foot;
2. Channel width to the nearest tenth of a foot;
3. Average water depth across a transect to the nearest inch;
4. Thalweg depth to the nearest inch;
5. Water depth at each shoreline to the nearest inch;
6. Percentage of instream cover to the nearest whole percent expressed as percent of water surface area where instream cover was provided;
7. Percentage of overhead cover within one foot of the water's surface to the nearest whole percent expressed as the percent of the water's surface area covered.
8. Percentage of overhead cover more than one foot above the water's surface to the nearest whole percent expressed as the percent of the water's surface covered.
9. Embeddedness of the streambed ranked as 0-25%, 25-50%, 50-75%, 75-100% and determined by estimating how much of the larger cobble material was surrounded (embedded) by fine material;
10. Compaction of the streambed ranked as low, moderate or high and determined by the ease of pushing a booted foot into the streambed;
11. D-90 which is the diameter in inches to the nearest inch of a streambed particle which is larger than ninety percent of the remaining streambed material;
12. An ocular estimate of the percent of silt (0 to 63 microns), sand (63 microns to 2.0 mm), small gravel (2.0 mm to 0.25 inches), large gravel (0.25 to 3.0 inches), cobble (3.0 to 10.0 inches), and boulders (larger than 10.0 inches) within the streambed;
13. Soil alteration rating from Platts et al. (1983);

Table 1. Legal descriptions, land ownership, and primary land uses adjacent and upstream from portions of stream reaches sampled to estimate habitat condition during 1985.

Stream	Reach	Legal description	Land ownership	Land use
Big Lake Ck	1	T 3S;R15W;Sec19	Private	Grazing, hay
Doolittle Ck	1	T 1S;R14W;Sec28	F. S.	Timber
Governor Ck	2	T 7S;R14W;Sec 8	Private	Grazing
Rock Ck	1	T 3S;R15W;Sec19	Private	Grazing, hay
Ruby Ck	2	T 3S;R18W;Sec25	F. S.	Grazing
Steel Ck	2	T 3S;R14W;Sec 5	Private	Grazing, timber
Thayer Ck[1/]	1	T 7S;R14W;Sec26	F. S.	Grazing, timber
Trail Ck	1	T 2S;R17W;Sec22	F. S.	Timber, grazing
Trail Ck	2	T 1S;R18W;Sec21	F. S.	Grazing, timber

1/ Thayer Creek is a major tributary of Andrus Creek and is sometimes, mistakenly, referred to as "Andrus Creek".

14. Vegetation stability from Platts et al. (1983);
15. Percent of side channels defined as channels flowing less than 25 percent of the stream's flow.

Estimates of these parameters were obtained by taking measurements at 10 to 40 randomly selected transects in a half mile section of each reach. At each transect the habitat was classified into one of the following habitat types:

1. Pool - deep, slow moving water providing fish holding water;
2. Riffle - shallow fast moving water;
3. Run - moderately deep areas which may have fast or slow velocities;
4. Pocketwaters - riffle or run type areas broken up by small pools which do not extend from bank to bank. These small pools are usually formed downstream from some type of instream structure such as large boulders or logs.

The above measurements were averaged for each habitat type within the reach and for the reach as a whole. Width and depth measurements were used to calculate a width-to-depth ratio. Width-to-depth ratios higher than 15 indicate that the channel may have lost its capacity to contain peak streamflows and the channel is more vulnerable to flood damage.

Streambed Sampling

Ten streambed samples were removed from each suspected spawning area using a hollow core sampler similar to that described by McNeil and Ahnell (1964). The samples were taken using techniques described by Shepard et al. (1984). Individual samples generally weighed between 15 and 20 pounds which should accurately describe the streambed material (Shirazi and Seim 1979). Samples were oven dried and shaken through a seive series containing the following seive openings: 50.8, 25.4, 12.7, 9.5, 6.3, 4.76, 2.38, 0.85, and 0.074 mm. The material suspended in the water column during sampling was estimated using an Imhoff settling cone. That material was converted from a wet volume to a dry weight measurement using the regression equation calculated by Shepard and Graham (1982):

$$\text{Dry Weight} = 0.279*(\text{Wet Volume}) - 0.048.$$

This value was added to the weight of the material passing through the 0.074 mm seive before the calculations for streambed composition were made. Streambed composition was estimated for each sample to the nearest whole percentage for material retained on each seive. The amount of fine material (less than 0.25 in. of 6.3 mm) has been shown to be directly related to survival of trout eggs to hatching and emergence (Tappel and Bjornn 198*) and to the ability of the streambed habitat to support young trout during summer and especially winter conditions (Bjornn et al. 1977). Once fine sediment levels exceed 20 percent, for incremental increases in fine sediment there is an associated reduction in trout embryo survival to emergence and a reduction in juvenile rearing capability.

One liter water samples were taken from within the corer during streambed sampling to more accurately estimate the wet volume to dry weight conversion factors for geologies represented on the Forest. Three samples were taken in each of the three basic different geologic types.

Fish Abundance Estimates

Fish abundance was assessed in 35 sections of 24 streams. Inventoried sections ranged in length from 200 to 1,375 feet. A Coffelt backpack electrofisher Model BP-1C was used in all sections. Abbreviations used for fish species throughout this report are: EBT = Eastern brook trout; RB = rainbow trout; AG = artic grayling; LING = burbot; HB = hybrids between rainbow and cutthroat trout; MWF = mountain whitefish; and WCT = westslope cutthroat trout.

Catch per Unit Effort

A single electrofishing pass was made in section(s) of Andrus, Thayer, Fox, Governor, and the South Fork Blacktail creeks on the Dillon District; Bryant, California, Harriet Lou, Lacy, Meadow, O'Dell, and Sevenmile creeks on the Wise River District; and Big Lake, Doolittle, Rock, Ruby, Squaw, Steel, Swamp, Tie, and Trail creeks on the Wisdom District. District personnel had requested fishery information for these streams to help in planning timber sale EA's and revise grazing allotment management plans. The East Fork of Ruby River and the South Fork of Willow, South Fork of Blacktail, Doolittle, Harriet Lou, Meadow, and Mill creeks were sampled to provide fishery data on streams sampled by the Forest Hydrologist for streamflow and sediment. The MDFWP was interested in documenting the presence or absence of grayling in Governor, Big Lake, Squaw, Steel, and Swamp creeks. The total number of each species captured in one electrofishing pass was used to provide relative abundance estimates. These values were standardized to number of fish per 1,000 feet of stream length.

Population Estimates

Populations estimates were made in a section of five streams using either a two-pass (Seber and LeCren 1967) or mark-recapture (Everhart et al. 1975) estimator. The Wisdom Ranger District needed fishery information for Trail, Ruby, Steel, and Doolittle creeks, while the Dillon District needed information on Governor Creek. In addition, Doolittle Creek was selected as a streamflow/sediment monitoring watershed by the Forest Hydrologist.

Length, Weight and Condition Factor

Lengths in inches to the nearest tenth and weight in pounds to the nearest hundreth were obtained from captured fish. Condition factors were computed according to the formula:

$$\text{Condition (C)} = \text{Weight} * (100{,}000) / \text{Length}^{3}.$$

Average length and and average weight and their ranges are reported along with condition factors. No condition factors were reported for burbot.

RESULTS

Habitat

Summaries of habitat measurements can be found in tables 2 through 4 and Appendix A. Segregating reaches into habitat units (ie. pools, riffles, etc.) usually allowed for more precise estimates of measured parameters (lower standard deviations of width and depth measurements, Appendix A). In general, aquatic habitat in streams reaches on private ground (Big Lake, Governor, and Rock creeks) was in poorer condition than habitat on Forest land. This is illustrated by low values for instream cover, percentage of undercut banks, shoreline depth, undercut bank depth, and to a lesser extent overhead cover percentages (Tables 2 and 3). These streams also had higher values for such parameters as percentage of altered soils, and width-to-depth ratios. Steel Creek was not considered to be heavily impacted by private land practices since the area measured was near the Forest Boundary. A short description of each stream reach's relative habitat condition follows.

Big Lake Creek

Reach 1 of Big Lake Creek was severly dewatered at the time of the habitat survey. It contained several braided channel areas and numerous backwater sloughs. There was abundant suitable spawning habitat within the reach (Table 4). The habitat composition was well balanced between pools and riffles with abundant high quality pools (although the sever dewatering reduced the water depths in these pools). The absence of the pocketwater habitat type is expected in reaches flowing through meadows. There was very little cover present in the reach; however, the lack of instream cover was related to water level. The width-to-depth ratio was the highest of any stream surveyed, indicating the channel has been degraded (most likely by livestock trampling). The percentage of undercut bank, shoreline depth, and depth of undercut banks also indicated a degraded channel.

Doolittle Creek

The sample section within reach 1 of Doolittle Creek was located immediately above a beaver pond area and below the mouth of the North Fork Doolittle Creek. The channel was confined to a single channel and woody debris accounted for much of the channel structure. This reach contains abundant spawning habitat. The habitat unit composition was well balanced and the pocketwater type accounted for 17 percent of the total, indicative of a higher gradient mountain-type stream with cobble and boulder making up a larger portion of the streambed. Cover within the stream was low to moderate, but overhead cover values were high. Some soil alteration has occured, perhaps from high streamflows. The width-to-depth ratio indicates a relatively stable and undamaged channel which the undercut bank and shoreline depth estimates support.

Governor Creek

The portion of reach 2 sampled in Governor Creek flows through a willow and grass meadow bottom. The channel within the sampled area was confined to a

Table 2. Physical habitat means for wetted width, channel width, average depth, thalweg depth, shoreline depth, and width-to-depth ratio by reach for streams surveyed during 1985.

Stream	Reach	Wetted width (ft.)	Channel width (ft.)	Average depth (in.)	Thalweg depth (in.)	Shore-line depth (in.)	Width-to-depth ratio
Big Lake Ck	1	21.9	44.7	7	11	2	37:1
Doolittle Ck	1	11.5	16.6	9	15	6	15:1
Governor Ck	2	11.8	16.6	6	10	3	24:1
Rock Ck	1	15.2	21.1	8	12	2	23:1
Ruby Ck	2	14.7	38.7	9	14	3	20:1
Steel Ck	2	9.5	12.4	11	16	9	10:1
Thayer Ck 1/	1	9.3	11.3	8	12	6	14:1
Trail Ck	1	28.1	40.1	16	26	4	21:1
Trail Ck	2	12.0	16.0	10	16	6	14:1

1/ Thayer Creek is a major tributary to Andrus Creek and is sometimes, mistakenly, referred to as "Andrus Creek".

Table 3. Mean values for instream cover, low overhead and high overhead cover, undercut bank depth, and percent soil alteration by reach for streams surveyed during 1985.

Stream	Reach	Instream cover (%)	Low overhead cover (%)	High overhead cover (%)	Undercut bank depth (in.)	Soil alteration (%)
Big Lake Ck	1	13	4	1	2.7	7
Doolittle Ck	1	18	18	30	5.4	11
Governor Ck	2	39	9	6	3.0	13
Rock Ck	1	10	14	14	1.4	8
Ruby Ck	2	15	5	6	1.6	45
Steel Ck	2	27	13	7	7.2	31
Thayer Ck 1/	1	46	11	6	4.0	15
Trail Ck	1	28	14	11	3.5	10
Trail Ck	2	42	5	4	4.0	20

1/ Thayer Creek is a major tributary to Andrus Creek and is sometimes, mistakenly, referred to as "Andrus Creek".

Table 4. Summary of habitat type composition, percentage of multiple channel areas, frequency of small and large debris accumulations, frequency of cross-channel debris accumulations, percentage of channel debris considered stable, percentage of undercut bank, and amount of spawning habitat by reach in streams surveyed during 1985.

Stream	Reach	Habitat composition (%)				Multiple channel (%)	Undercut bank 1/ (%)	Debris accumulations (no./mi.)		Cross-channel accumulations (no./mi.)	Stable debris (%)	Spawning habitat (ft.^{2}/mi.)
		Pool	Riffle	Run	Pocket			Large	Small			
Big Lake Ck	1	39	37	24	0	13	9	2	24	2	5	3,902
Doolittle Ck	1	28	30	26	17	0	33	28	84	0	30	3,947
Governor Ck	2	13	45	42	0	0	43	2	4	0	0	300
Rock Ck	1	28	36	36	0	0	9	0	30	0	10	1,760
Ruby Ck	2	36	31	29	4	14	11	10	6	0	10	412
Steel Ck	2	32	28	40	0	38	69	0	90	22 2/	10	2,285
Thayer Ck	1	24	29	22	25	5	29	32	10	29	80	4,023
Trail Ck	1	36	24	36	3	10	11	59	59	15 2/	15	512
Trail Ck	2	31	36	33	0	3	29	6	4	7	5	1,326

1/ Percentage of undercut bank was calculated by dividing the total distance of undercut bank in a mile of stream by 10,560 which is the distance of total bank along a mile (two banks x 5,280 feet).

2/ Some of these cross-channel debris accumulations were associated with beaver activity.

single channel, but unfortunately, this was not representative of the reach as a whole. The reach had numerous side channels and areas of braided channels. The reach did not contain very much spawning habitat. There were very few pools. Most of the reach was made up of riffles and runs. Instream cover was high, but overhead cover was low. The width-to-depth ratio was high indicating some bank damage has occured. The percentage of undercut banks was high, but the shoreline depth and depth of bank undercut were relatively low. Based on the above it would appear that the stream channel was damaged in the past, but has recently begin to recover. The area sampled appeared to be a rest pasture.

Rock Creek

The area sampled in Rock Creek (reach 1) was through Rutledge's old corral and had been impacted by livestock in the past. The channel was confined to a single channel. The reach contained a moderate amount of spawning habitat. There was a good mix of pools, riffles, and runs, typical of a meadow-type stream. Instream cover was low, but overhead cover was moderate. The width-to-depth ratio was high, and the percentage of undercut banks, shoreline depth, and depth of undercut were all low indicating a damaged channel. The willow stand lining portions of the bank provided overhead cover, but were not dense enough to protect the streambanks from livestock.

Ruby Creek

The portion of reach 2 of Ruby Creek which was sampled was in the vicinity of where Cow Creek enters Ruby Creek. This portion of the creek had what appeared to be heavy livestock use. The stream often flowed through several channels and there was evidence of active beaver dams below the area surveyed. The reach contained little spawning habitat. The three habitat types typical of a meadow stream (pools, riffles and runs) were present in similar freqencies. Debris accumulations in the channel were sparse. Instream cover and both overhead cover types were scarce. The percentage of soil cover which was altered was very high (the highest of any reach surveyed) indicating that livestock trampling was a problem. The width-to-depth ratio was moderate indicating that severe livestock impacts have probably been short-term, but the percent of undercut banks, shoreline depth, and depth of undercut data illustrate that impacts are presently occurring. If the present livestock practices continue, channel changes (ie. increasing width-to-depth ratios) are likely.

Steel Creek

The portion of Steel Creek (reach 2) surveyed was near the Forest Service boundary immediately below the confluence of the South Fork of Steel Creek. This portion of the stream channel had active beaver dams and was a willow bottom which appeared to receive moderate grazing. This reach of Steel Creek has numerous multiple channel portions, probably a result of the beaver activity. The reach contained a moderate amount of spawning habitat. The habitat composition was predominated by pools and runs which was also a result of the beaver activity. There were numerous debris accumulations and several cross-channel accumulations caused by beaver activity. Instream cover was moderate and overhead cover was low to moderate. The percentage of altered soil cover was relatively high. The width-to-depth ratio was low indicating a healthy channel. The percentage of undercut banks, shoreline depth, and depth of undercut banks data indicated a healthy channel. It appeared that the impacts from livestock grazing were somewhat mediated by the presence of beaver.

Thayer ("Andrus") Creek

Thayer Creek, sometimes mistakenly referred to as "Andrus" Creek, reach 1 was inventoried below the Selway Road. This portion of the stream is predominated by meadow (transitional rangeland) which received what appeared to be a moderate amount of livestock grazing. This reach of the stream channel was mostly confined to a single channel. The reach contained abundant spawning habitat. The habitat was composed of equal percentages of all four habitat types with pockets in pocketwaters being composed of cobble, debris and soil mats. There was a moderate amount of debris in the channel. Instream cover was abundant, but overhead cover was sparse. The percentage of altered soil cover was moderately low. The width-to-depth ratio was moderately low, indicating a healthy channel. The percentage of undercut banks, shoreline depth, and depth of undercut banks data also indicated a relatively stable channel which has received little visible impacts from land-use practices.

Trail Creek

Reach 1 of Trail Creek had abundant recent beaver activity and flows through a narrow willow bottom. There was no evidence of grazing along the stream bottom. The channel split occassionally into numerous channels. The reach did not contain very much spawning habitat due to the amount of fine sediment within the streambed (see below). The habitat composition was predominated by pools and runs. The channel contained abundant debris, some of which was beaver-caused. Instream and overhead cover was moderate. The width-to-depth ratio was high, probably because of high peak streamflows which spread and flatten the channel. Trail Creek has a large high elevation drainage basin in which large amounts of snow accumulate. Another potential cause of the high width-to-depth ratio is the restriction of the valley-bottom by State Highway 43. The percentages of undercut banks, shoreline depth, and depth of undercut banks were moderate.

The area surveyed for reach 2 of Trail Creek was located near the mouth of Sunshine Creek. The stream flowed through meadows in the valley bottom with timmbered slopes on both sides. The meadow appeared to receive moderate livestock grazing. The stream channel was confined mostly to one channel in the area surveyed, but in other areas of the reach multiple channels were noted. The reach contained a low to moderate amount of spawning habitat. Habitat composition in the reach was equally divided among pools, riffles and runs. The channel contained little debris. Instream cover was abundant, but overhead cover was sparse. The width-to-depth ratio was relatively low indicating a moderately healthy channel. The percentage of undercut banks, shoreline depth, and depth of undercut banks data all indicated a moderately healthy channel. After reviewing old infra-red aerial photos of this reach, it appears that this reach has recovered to a degree from past grazing practices. It remains to be documented through time whether this recovery is complete, or if present practices are adequately protecting the stream channel.

Streambed Composition

Visual Estimates

Visual estimates of surficial streambed composition are presented in Table 5. The only stream surveyed which contained relatively high percentages of the larger streambed material (cobble and boulder) was Doolittle Creek. The streambeds of Thayer and Governor creeks also contained a relatively high amount of large material. The D-90 diameters corroborate the composition data with streambeds having higher percentages of large materials also having larger D-90 averages. The streams which contained a high percentage of fine material (silt and sand) were Big Lake, Rock, Ruby, and Steel creeks, and reach 1 of Trail Creek. Embeddedness percentages were also high for the above streams with the exception of Big Lake Creek. I have no explaination for this anomaly.

Hollow Core Sampling

Streambed composition of potential spawning areas estimated from hollow core sampling are shown in Table 6 and Appendix B. The pertinent statistics estimated from these samples (Table 6) illustrate the relatively high fine sedimentation of spawning areas in Doolittle, Meadow, South Fork Blacktail, and Trail creeks. The selection of the sample site in Meadow Creek may have biased the result for that stream, but the other samples were thought to accurately reflect the streambed condition. It was obvious that the drainages underlain by granitic geologies (Doolittle, Trail, and to a lesser extent Meadow) delivered large amounts of fine sediment to the stream channel. The South Fork of Blacktail Creek had the highest percentage of its streambed composed of fine material. This drainage is underlain primarily by tertiary sediments. All of the sampled drainages have been impacted to some extent by land-use practices. It is recommended that unimpacted drainages be sampled next field season in an attempt to document the natural (base-rate) condition of streambeds draining various geologies. This would allow comparisons to be made between unimpacted and impacted drainages.

A comparison of the two sites where both a visual and hollow core sample estimate of streambed composition were made was inconclusive. In Trail Creek reach 1, the visual estimate of fine material (silt and sand = 42%) and the hollow core sample (43%) were in close agreement. However, in reach 1 of Doolittle Creek the visual estimate (23%) was much lower than the hollow core sample (32%). The reason for this discrepency is unclear, however, the visual estimate was conducted on September 19 while the hollow core samples were collected on November 4. The new road being constructed in the drainage was known to have delivered sediments to the stream channel, especially during the intense fall rainstorms. It is possible this new sediment accounted for the difference. More sampling is needed to confirm if visual estimates can be directly correlated to hollow core sample estimates and to determine if fine sediments did indeed increase in Doolittle Creek's streambed.

Table 5. Mean values for substrate variables including visual estimates of substrate composition, embeddedness[1/], and D-90[2/] by reach for streams surveyed during 1985.

Stream	Reach	Substrate composition (%) Silt	Sand	Small gravel	Large gravel	Cobble	Boulder	Embed-dedness (%)	D-90 (in.)
Big Lake Ck	1	25	23	19	25	9	0	35	4.7
Doolittle Ck	1	8	15	16	26	19	17	27	9.8
Governor Ck	2	13	11	19	29	25	3	27	6.9
Rock Ck	1	22	21	23	30	5	0	52	3.2
Ruby Ck	2	20	18	21	26	14	1	54	4.9
Steel Ck	2	23	45	14	14	5	0	80	3.6
Thayer Ck[3/]	1	12	16	26	27	8	11	20	7.0
Trail Ck	1	12	30	23	22	10	3	67	5.5
Trail Ck	2	8	23	25	29	11	4	15	6.0

1/ Embeddedness values are the percentage (by depth) that large streambed material is surrounded ("embedded") by fine material.

2/ D-90 is the diameter of a streambed particle which is larger than 90 percent of all streambed material.

3/ Thayer Creek is a major tributary to Andrus Creek and is sometimes, mistakenly, referred to as "Andrus Creek".

Table 6. Cummulative percentage of streambed material by dry weight less than 0.25 in. (6.3 mm) and predicted survival of cutthroat and rainbow trout embryos from egg to emergent fry (from Irving and Bjornn 1984) in potential spawning areas of streams sampled during 1985. Sampled reach and legal description of sample sites are included.

Stream	Reach	Legal description	Percentage of material 0.25 in.	Predicted survival (%)[1/]	
				Cutthroat trout	Rainbow trout
Doolittle Ck	1	T 1S;R14W;Sec28	32	25	43
East Fork Ruby R	1	T11S;R 3W;Sec 5	24	41	63
Harriett Lou Ck[2/]	1	T 1N;R12W;Sec36	27	34	52
Meadow Ck[3/]	1	T 1N;R12W;Sec36	31	24	43
Mill Ck	2	T 2S;R 4W;Sec23	26	37	58
South Fork Blacktail Ck	1	T12S;R 5W;Sec30	47	5	14
South Fork Willow Ck	2	T 3N;R 3W;Sec13	24	43	61
Trail Ck	1	T 2S;R18W;Sec13	43	7	18

1/ Many of these streams do not support populations of cutthroat or rainbow trout; however, these relative survival values are presented to rank the relative condition of the spawning habitat.

2/ Harriett Lou Creek contained a streambed composed of large angular boulder and cobble surrounded by fine material. There was almost no observed potential spawning area and obtaining hollow core samples of the streambed was extremely difficult. These data are of questionable value.

3/ The only potential spawning area located near an access point in Meadow Creek was immediately downstream from an old bridge site. This area may have contained an abnormally high level of fine sediment contributed from the bridge area and may not accurately reflect the streambed condition as a whole.

Fish Abundance Estimates

Catch per Unit Effort

Catch per unit effort information can be used to assess species distribution and relative abundance of each fish species (Table 7). It appears that the general distribution of fish in the upper Big Hole drainage consists of populations of cutthroat and, in some cases, rainbow trout inhabiting the upper headwater portions of tributaries; brook trout inhabiting lower gradient areas, especially where beaver activity occurs (including the valley bottoms along the mainstem river); and grayling and, in some cases, rainbow trout inhabiting the lowermost portions adjacent to the mainstem river.

Thayer Creek supported the highest relative abundance of brook trout, while relative high brook trout abundance was documented in Andrus, Fox, upper Governor, Bryant, O'Dell, Sevenmile, upper Big Lake, Steel, upper Tie, and upper Trail creeks. Cutthroat trout were documented in Andrus, Thayer, Fox, Governor, Harriett Lou, Lacy, Meadow, O'Dell, Doolittle, Steel, South Fork Blacktail, and South Fork Willow creeks. The identification of these cutthroat trout was based on a cursory examination of external morphological features and it is recommended that electrophoretic analyses be done to confirm the genetic purity of these populations. In several of the streams hybrids between cutthroat and rainbow trout were noted. Arctic grayling were documented in Rock, Steel, and Swamp creeks. As mentioned previously, all these grayling were observed in the lowermost portions of these tributaries. A summary of grayling distribution documented in the drainage is presented in Table .

Population Estimates

Population estimates were calculated for a reach in each of the following creeks: Doolittle, Governor, Ruby, Steel, and Trail creeks (Table 9). Reach 2 of Governor Creek had the highest number of brook trout six inches and longer, while reach 2 of Trail Creek had the highest number of brook trout less than six inches. Reach 2 of Ruby Creek supported extremely low numbers of trout. This population may be limited by the habitat degradation which has been occuring in this reach of Ruby Creek (see above). Doolittle Creek had high numbers of small brook trout, but relatively few larger fish. This lack of larger fish in the sample section could be due to fishing harvest, especially by a road construction crew which was camped immediately above the sample section for the entire summer, or because the larger fish held in beaver ponds immediately below the sample section. Steel Creek also appeared to have a relatively low number of large fish which could also be related to fishing pressure.

Table 7. Relative fish abundance by species in streams draining the Beaverhead National Forest by Ranger District derived from single pass electrofishing catches using a Coffelt BP-1C backpack electrofisher during 1985.

Stream	Legal description	Section length (ft.)	Number per 1,000 feet					
			EBT	WCT	RB	AG	LING	OTHER
		DILLON DISTRICT (D-1)						
Andrus Ck	T7S;R14W;Sec 5C	565	195	4	--	___	2	--
Fox Ck	T7S;R14W;Sec12D	550	175	13	--	--	--	--
Fox Ck	T6S;R14W;Sec33D	450	111	--	--	--	--	--
Governor Ck	T6S;R14W;Sec 5C	500	86	--	2	--	32	--
Governor Ck	T7S;R14W;Sec 6D	1,375	168	5	--	--	3	--
Governor Ck	T7S;R14W;Sec32B	325	169	28	--	--	--	--
Saginaw Ck	T7S;R15W;Sec10	Flow less than an estimated 0.25 cfs - not sampled						
Thayer Ck	T7S;R14W;Sec26B	320	628	3	--	--	--	--
		WISE RIVER DISTRICT (D-2)						
Bryant Ck	T1N;R12W;Sec 8A	500	158	--	--	--	--	--
Bryant Ck	T1N;R13W;Sec25B	200	195	--	--	--	--	--
California Ck	T3N;R11W;Sec30D	580	60	--	41	--	--	--
Harriet Lou	T1S;R12W;Sec12B	300	--	3	--	--	--	--
Harriet Lou	T1S;R12W;Sec 1A	250	No fish observed					
Lacy Ck	T2S;R12W;Sec 6D	250	92	4	--	--	20	--
Lacy Ck	T3S;R12W;Sec 2A	500	42	40	--	--	--	--
Meadow Ck	T1N;R12W;Sec36A	500	--	28	--	--	--	--
O'Dell Ck	T3S;R13W;Sec25A	500	140	18	--	--	--	--
Sevenmile Ck	T3N;R12W;Sec23A	400	340	--	--	--	--	--
		WISDOM DISTRICT (D-3)						
Big Lake Ck	T3S;R15W;Sec19D	1,000	12	--	--	--	20	--
Big Lake Ck	T4S;R16W;Sec32A	350	143	--	--	--	--	--
Doolittle Ck	T1S;R14W;Sec28C	640	55	2	--	--	--	--
Rock Ck	T3S;R15W;Sec19D	400	35	--	--	33	--	--
Ruby Ck	T3S;R18W;Sec25A	1,000	14	--	--	--	--	--
Ruby Ck	T3S;R17W;Sec30B	350	23	--	--	--	--	--
Squaw Ck	T1N;R14W;Sec27D	500	84	--	--	--	10	--
Steel Ck	T2S;R15W;Sec34A	600	160	--	--	3	2	--
Steel Ck	T3S;R14W;Sec 5C	880	38	1	--	--	--	--
Swamp Ck	T2S;R15W;Sec16C	500	92	--	--	4	12	--
Tie Ck	T2S;R17W;Sec 2B	500	60	--	--	--	10	--
Tie Ck	T1S;R17W;Sec34C	350	183	--	--	--	32	--
Trail Ck	T1S;R18W;Sec31A	1,000	272	--	--	--	17	--
Trail Ck	T2S;R17W;Sec22D	570	19	--	--	--	12	--

Table 7. (cont.)

Stream	Legal description	Section length (ft.)	Number per 1,000 feet EBT	WCT	RB	AG	LING	OTHER
			SHERIDAN DISTRICT (D-6)					
E. Fk. Ruby R	T11S;R 3;Sec 5B	475	--	--	--	--	--	11 HB
Mill Ck	T4S;R 4W;Sec23B	550	85	--	--	--	--	--
S Fk Blacktail Ck	T12S;R5W;Sec 30C	500 1/	44	2	--	--	--	8 HB
S Fk Blacktail Ck	T12S;R5W;Sec 30C	300 2/	37	--	--	--	--	--
			MADISON DISTRICT (D-7)					
S. Fk. Willow Ck	T3S;R 3W;Sec13C	400	--	23	--	--	--	--

1/ Section shocked in a downstream electrofishing.

2/ Section shocked in an upstream electrofishing.

Table 8. Waters in the Big Hole Drainage where the presence of grayling has been documented by life stage and source.

Stream	Legal description	Life stage	Genetic evaluation	Source
Big Lake Ck	T3S;R15W;Sec19	0 and I+		Liknes (1981)
	T3S;R15W;Sec19			I found none 1985
Francis Ck	T3S;R15W;Sec10	I+		Liknes (1981)
	T3S;R15W;Sec 3	I+		MDFWP (1981)
Governor Ck	T5S;R13W;Sec36	0 and I+		Liknes (1981)
	T5S;R15W;Sec 26	I+		MDFWP (1981)
	unknown	I+		MDFWP (1981)
	T6S;R14W;Sec 5			I found none 1985
Lamarche Ck	T2N;R13W;Sec34	I+		Liknes (1981)
Miner Ck	T6S;R16W;Sec 9	I+	probable lake stock	Liknes (1981)
Mussigbrod Ck	T1N;R16W;Sec32	I+	probable lake stock	Liknes (1981)
N. Fk. Big Hole River	T1S;R15W;Sec31	0 and I+		Liknes (1981)
Rock Ck	T3S;R15W;Sec19	0 and I+		Liknes (1981)
	T3S;R15W;Sec19	0 and I+		I found in 1985
Sandhollow Ck	T2S;R15W;Sec 8	0 and I+		Liknes (1981)
Steel Ck	T2S;R15W;Sec34	0 and I+		Liknes (1981)
	T2S;R15W;Sec34	I+		MDFWP (1981)
	T2S;R15W;Sec34	0 and I+		I found in 1985
Swamp Ck	T2S;R15W;Sec16	0 and I+		Liknes (1981)
	T2S;R15W;Sec16	0 and I+		I found in 1985

Table 9. Population estimates of the number of brook trout per 1,000 feet of stream length by reach for stream sections censused during 1985.

Stream	Reach	Legal description	Number of brook trout (80% confidence range): less than 6.0 inches	Number of brook trout (80% confidence range): 6.0 inches or longer
Doolittle Ck[1/]	1	T 1S;R14W;Sec28	177 (95 - 259)	36 (14 - 58)
Governor Ck[2/]	2	T 7S;R14W;Sec 6	56 (49 - 63)	156 (152 - 160)
Ruby Ck[2/]	2	T 3S;R18W;Sec25	33 (17 - 86)	8 (6 - 16)
Steel Ck[2/]	2	T 3S;R14W;Sec 5	76 (43 - 120)	19 (11 - 38)
Trail Ck[2/]	2	T 1S;R18W;Sec31	408 (348 - 468)	84 (81 - 87)

1/ Using a mark-recapture estimator (Everhart et al. 1975) to calculate population estimates.

2/ Using a two-pass estimator (Seber and LeCren 1967) to calculate population estimates.

Length, Weight, and Condition Factor

Average lengths, weights, and condition factors were estimated by species and stream reach for all streams sampled (Tables 10 through 13). All the fish sampled in tributaries generally ranged between three and twelve inches in length. Condition factors indicated relatively "good" condition with values between 30 to 50. Mountain whitefish, a fish having a more "slender" body-shape, had condition factors below 40.

Table 10. Mean lengths (in.), weights (lbs.), and condition factors of fish by stream and reach for stream reaches inventoried in the Dillon Ranger District during 1985.

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Andrus	1	EBT	110	6.2 (2.5 - 10.9)	0.13 (0.01 - 0.57)	49
		HB	2	9.8 (9.5 - 10.0)	0.36 (0.33 - 0.38)	38
		LING	1	8.7	0.13	
	2	EBT	201	5.4 (1.8 - 8.8)	0.07 (0.01 - 0.31)	47
		HB	1	6.2	0.07	29
Fox	1	EBT	60	5.6 (2.7 - 11.0)		
	2	EBT	96	6.0 (2.1 - 11.1)	0.10 (0.01 - 0.58)	41
	2	HB	7	6.7 (4.1 - 9.6)	0.13 (0.03 - 0.34)	37
Governor	1	EBT	43	7.5 (2.7 - 13.2)	0.19 (0.01 - 0.85)	56
		MWF	20	9.1 (4.7 - 13.5)		
		LING	16	9.1 (6.0 - 13.8)	0.17 (0.05 - 0.45)	
	2	EBT	276	7.6 (2.8 - 11.8)	0.20 (0.01 - 0.61)	39
		WCT	8	8.2 (4.8 - 10.3)	0.19 (0.03 - 0.35)	31
		LING	4	10.2 (9.8 - 10.8)	0.21 (0.17 - 0.24)	

Table 10. (continued).

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Governor	3	EBT	45	5.2 (1.8 - 8.2)	0.08 (0.01 - 0.28)	47
		HB	9	6.2 (3.2 - 8.3)	0.10 (0.02 - 0.19)	39
S Fk Blacktail	1A	EBT	22	7.6 (4.8 - 11.7)	0.22 (0.04 - 0.72)	41
		HB	4	9.2 (8.6 - 10.2)	0.32 (0.23 - 0.25)	41
		WCT	1	8.7	0.25	38
	1B	EBT	11	6.1 (3.1 - 12.2)	0.13 (0.02 - 0.76)	40

Table 11. Mean lengths (in.), weights (lbs.), and condition factors of fish by stream and reach for stream reaches inventoried in the Wise River Ranger District during 1985.

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Bryant	1	EBT	79	6.0 (2.1 - 9.2)		43
	2	EBT	39	4.1 (1.8 - 7.5)	0.04 (0.01 - 0.17)	66
California	1	RB	22	6.0 (2.2 - 9.7)	0.11 (0.01 - 0.45)	45
		EBT	35	6.6 (3.1 - 9.5)	0.12 (0.02 - 0.32)	36
		HB	2	8.1 (6.4 - 9.8)	0.24 (0.10 - 0.38)	39
		MWF	1	13.4	0.85	35
Lacy	1	EBT	1	4.8 (2.6 - 8.2)	0.06 (0.01 - 0.23)	45
		WCT	1	5.6	0.06	34
	2	EBT	21	5.9 (3.7 - 9.4)	0.11 (0.03 - 0.36)	44
		WCT	20	5.2 (2.6 - 7.8)	0.07 (0.01 - 0.21)	42
Meadow	2	WCT	14	5.3 (3.9 - 7.5)	0.07 (0.03 - 0.19)	43
Odell	1	EBT	70	5.6 (2.7 - 11.1)	0.08 (0.01 - 0.50)	41
		HB	9	5.4 (4.2 - 8.3)	0.06 (0.03 - 0.21)	34

Table 11. (continued)

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Sevenmile	1	EBT	136	4.7 (1.9 - 8.2)	0.06 (0.01 - 0.21)	55
Wyman	2	EBT	29	5.4 (2.6 - 8.4)	0.08 (0.01 - 0.27)	43
		HB	3	9.8 (8.8 - 11.1)	0.38 (0.24 - 0.58)	38
		WCT	15	6.8 (2.3 - 9.2)	0.13 (0.01 - 0.30)	39

Table 12. Mean lengths (in.), weights (lbs.), and condition factors of fish by stream and reach for stream reaches inventoried in the Wisdom Ranger District during 1985.

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Big Lake	1	EBT	12	6.6 (2.7 - 9.1)	0.14 (0.01 - 0.34)	43
		LING	20	6.5 (4.1 - 8.6)	0.07 (0.03 - 0.14)	
	3	EBT	60	5.2 (1.8 - 9.5)	0.08 (0.01 - 0.34)	52
Doolittle	2	EBT	76	4.7 (2.0 - 9.1)	0.05 (0.01 - 0.27)	51
		WCT	1	4.7	0.04	39
Rock	1	EBT	14	6.3 (3.4 - 11.2)	0.12 (0.01 - 0.55)	40
		AG	13	4.3 (3.5 - 7.4)	0.04 (0.02 - 0.13)	38
		MWF	1	6.2	0.05	21
Ruby	3A	EBT	23	4.7 (2.2 - 7.8)	0.06 (0.01 - 0.20)	50
	3B	EBT	8	8.7 (5.6 - 10.5)	0.32 (0.06 - 0.53)	43
Squaw	1	EBT	42	5.6 (2.3 - 12.9)	0.10 (0.01 - 0.75)	47
		LING	5	7.0 (5.6 - 8.3)	0.10 (0.05 - 0.16)	

Table 12. (continued)

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Steel	1	EBT	96	5.4 (2.4 - 11.0)	0.09 (0.01 - 0.53)	50
		AG	2	7.5 (7.2 - 7.8)	0.13 (0.12 - 0.15)	32
		LING	1	9.4	0.16	
		MWF	13	4.6 (3.5 - 6.7)	0.04 (0.02 - 0.11)	35
	2	EBT	54	4.7 (1.8 - 10.6)	0.07 (0.01 - 0.48)	60
		HB	3	5.4 (4.5 - 6.3)	0.05 (0.03 - 0.08)	32
		WCT	1	5.4	0.05	32
		LING	8	8.7 (7.3 - 11.0)	0.14 (0.08 - 0.26)	
Swamp	1	EBT	46	6.0 (2.8 - 9.2)	0.13 (0.01 - 0.34)	58
		AG	2	7.1 (4.4 - 9.8)	0.20 (0.04 - 0.36)	43
		LING	11	7.3 (3.4 - 10.8)	0.11 (0.01 - 0.24)	
		MWF	2	11.7 (11.4 - 11.9)	0.45 (0.37 - 0.52)	28
Tie	2A	EBT	30	7.2 (2.1 - 10.1)	0.19 (0.01 - 0.42)	44
		LING	5	7.9 (6.5 - 8.7)	0.09 (0.06 - 0.11)	
	2B	EBT	64	4.5 (2.1 - 9.0)	0.06 (0.01 - 0.85)	50
		LING	1	9.1	0.15	

Table 12. (continued)

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
Trail	1	EBT	11	5.0 (2.3 - 10.2)	0.13 (0.01 - 0.84)	52
		LING	7	7.3 (5.6 - 9.7)	0.08 (0.03 - 0.18)	
		MWF	2	11.3 (10.3 - 12.3)	0.51 (0.46 - 0.56)	36
	2	EBT	385	4.4 (1.8 - 10.8)	0.06 (0.01 - 0.55)	48
		LING	27	9.7 (7.4 - 12.8)	0.20 (0.07 - 0.42)	

Table 13. Mean lengths (in.), weights (lbs.), and condition factors of fish by stream and reach for stream reaches inventoried in the Sheridan and Madison Ranger Districts during 1985.

Stream	Reach	Species	n	Length (Range)	Weight (Range)	Condition
East Fork Ruby R.	1	HB	5	7.5 (4.2 - 9.8)	0.20 (0.03 - 0.42)	39
Mill	2	EBT	47	7.5 (4.7 - 10.8)	0.19 (0.04 - 0.54)	41
South Fork Willow	3	HB	9	6.6 (3.6 - 9.0)	0.15 (0.03 - 0.28)	43

DISCUSSION

Habitat

Fish habitat was observed to be in a "degraded" condition in reach 1 of Big Lake Creek, reach 1 of Rock Creek, and reach 2 of Ruby Creek. All of these streams appeared to be negatively impacted by livestock use. Reach 2 of Ruby Creek was the one area sampled on Forest land where obvious habitat damage has occurred. Reach 1 of Thayer Creek, reach 1 of Steel Creek, reach 1 of Doolittle Creek and reach 1 and 2 of Trail Creek all had been impacted to some degree, but the stream channels still appeared to be stable.

Habitat compositions estimated during this survey were compared to habitat compositions documented in a survey conducted in 1973 (files, Beaverhead National Forest, Supervisor's Office, Dillon, MT; Table 14). The areas where these habitat surveys were conducted in close proximity were in Doolittle, Ruby, and Trail creeks (all were within one mile). The earlier survey of Doolittle Creek classified much more of the habitat as run than pool. This survey found 28 percent pool compared to seven percent in the earlier survey. The present survey observed 47 percent riffle and pocketwater which compared closely to the 55 percent riffle observed in the earlier survey. The earlier survey in Ruby Creek observed more pools and runs than riffles while the present survey classified pools, riffles and runs in nearly equal proportions. In Trail Creek the earlier survey classified much more of the habitat in runs than the present survey. We found that pools were equally represented.

Streambed compositions of reach 1 of Doolittle Creek, reach 1 of Meadow Creek, reach 1 of the South Fork of Blacktail Creek, and reach 1 of Trail Creek all indicated a high level of fine sediment which could have a negative impact on production of trout fry and rearing capacity in these streams.

Ocular estimates of streambed composition from a 1973 survey compared to the present survey for Doolittle, Ruby, and Trail creeks varied widely. Doolittle Creek's streambed was estimated by the 1973 survey to contain 32 percent fine material compared to the 23 percent estimated during the present survey; however, this 32 percent was exactly what was found in hollow core samples (Table 6). It is possible our ocular estimates of streambed composition in Doolittle Creek was unrepresentative of the stream reach. In Ruby Creek the present survey estimated that the streambed contained 38 percent fines compared to 26 percent in the previous survey. This difference could represent a "true" trend in streambed composition given the recent impacts of grazing which were observed. The surveys of Trail Creek were in agreement with both visual surveys and the hollow core samples estimating 40 percent or more fines (range: 40 - 43 percent).

Comparing 1973 ocular surveys to 1985 hollow core data for the East Fork Ruby River, and Mill and South Fork Willow creeks found that the 1973 estimates of fine sediment (range: 1 to 5 percent) were much below what was estimated from 1985 hollow core samples (range: 24 to 26 percent). I am uncertain if this discrepency indicates a "real" increase in fine sediments in these streambeds or if the ocular method for detecting fine sediments was in error.

Table 14. Habitat type compostion and streambed composition visually estimated during habitat surveys conducted in 1973.

Stream	Legal description	Habitat composition (%) Pool	Riffle	Run	Streambed composition (%) Boulder	Cobble	Gravel	Fines
Doolittle Ck	T 1S;R14W;Sec28	7	55	40	8	40	20	32
East Fork Ruby River	T11S;R 3W;Sec 5	2	56	42	32	56	9	3
Mill Ck	T 2S;R 4W;Sec23	20	65	15	59	25	15	1
Ruby Ck	T 3S;R17W;Sec20	50	20	40	--	37	37	26
South Fork Willow Ck	T 3S;R 3W;Sec13	12	70	18	45	40	10	5
Steel Ck	T 3S;R14W;Sec 4	8	40	52	27	43	18	12
Trail Ck	T 2S;R17W;Sec16	15	35	60	15	40	5	40

Fish Abundance

Unusually low fish abundances were recorded in reach 1 of Trail Creek, reach 2 of Ruby Creek, and reach 1 of Harriett Lou Creek. It appeared that the high level of fine sediment was impacting brook trout populations in Trail Creek. Although the creek is adjacent to State Highway 43 and probably receives a large amount of fishing pressure, the size structure of fish captured via electrofishing and observed snorkeling indicated that all size classes of fish were at extremely low densities. Underwater observations supported the electrofishing data that very few fish were present and that all size classes were scarce. These data support the conjecture that reproduction failure may be limiting the fish population in lower Trail Creek. The data from reach 2 of Trail Creek indictated that the reproductive success was high in this portion of the stream. Habitat degradation from livestock use appeared to be limiting the fish population in reach 2 of Ruby Creek, particularly for fish larger than six inches. Harriett Lou Creek supported a very marginal fish population of what appeared to be "pure" cutthroat trout. I believe that this stream probably did not support much of a cutthroat trout population historically, but it is possible that the construction of the road into the drainage provided access to anglers which, in turn, possibly further reduced the naturally depressed population.

Comparisons of catch-per-unit-effort data with previous efforts indicate that fish populations in lower Governor Creek, California Creek, lower Swamp Creek, and lower Trail Creek have remained fairly stable (Tables 7 and 15). Fish abundance appeared to increase in Sevenmile Creek, while in Ruby Creek, the East Fork of Ruby River, and Steel Creek fish abundance may have declined. The present abundance of brook trout in Sevenmile Creek is approximately twice as high as that documented in 1980. This difference could be explained by the distance between the sample sites (approximately two to three miles). Populations of brook trout in Ruby Creek seem to have declined abruptly between 1979 and 1985. The two sample sections are located approximately one mile apart, yet there was more than a ten-fold reduction in relative catch of brook trout between 1979 and 1985. Rainbow and cutthroat trout and their hybrids are presently at lower densities in the East Fork of the Ruby River than in 1970 and 1975. The data from Steel Creek is not comparable since the sample sections sampled different habitats (the previous sampling was done near the campground where the stream flows through a coniferous forest and has a moderately high gradient compared to the section sampled recently where the stream flows through a willow bottom with abundant beaver activity and a much lower gradient).

Future Sampling Recommendations

It is recommended that future habitat surveys cover the entire stream to search for potential barriers to movement of fish between the Big Hole River and spawning habitat in tributary streams and even between rearing habitat and spawning habitat within tributaries. Surveying the entire stream will also allow for identification of habitat composition of entire reaches, anomalies in habitat within a reach, documentation of beaver activity, documentation of sediment sources (both natural and man-caused), and provide an excellent overview of the reach as a whole. Along with the survey of each entire reach,

Table 15. Relative fish abundance estimated from single pass electrofishing catches in waters sampled during previous sampling efforts.

Stream	Legal description	Year	Number per 1,000 feet						Source
			EBT	WCT	RB	AG	HB	LING	
California Ck	T 2N;R12W;Sec 1	1980	97	--	23	--	--	1	1 1/
E Fk Ruby R	T11S;R 3W;Sec 5	1970	--	--	23	--	13	--	2
		1975	--	1	9	--	5	--	2
Governor Ck	T 5S;R15W;Sec26	1979	54	--	3	2	--	10	2
Ruby Ck	T 3S;R17W;Sec20	1979	229	--	--	--	2	3	2
Sevenmile Ck	T 3N;R12W;Sec34	1980	149	--	2	--	1	--	1
Steel Ck	T 2S;R15W;Sec34	1979	462	--	--	2	--	3	2
Swamp Ck	T 2S;R15W;Sec 8	1979	78	--	--	--	--	30	2
Trail Ck	T 2S;R17W;Sec22	1979	15	--	--	--	--	17	2
		1980	7	--	--	--	--	2	2

1/ Source 1 is Oswald (1981) and 2 is Montana Department of Fish, Wildlife and Parks (1981).

a detailed habitat inventory should be done in a small representative portion of each reach, similar to the habitat surveys done in 1985. This sampled portion of the reach should be selected during the survey of the entire reach to ensure selection of a "representative" segment of the stream reach. It is further recommended that fish population estimates also be conducted in this stream reach segment to allow for the direct correlation of habitat variables to fish densities. Additional habitat variables will be measured in order to link with the Fish Habitat Relationships effort by providing them with additional information to develop models and to take advantage of models presently being developed by that group.

It is further recommended that continued testing of new methodologies be conducted for evaluating streambed condition. Hollow core sampling is relatively repeatable, but time consuming and expensive. The visual and an embeddedness technique developed by Burns (1984) will be evaluated. The sample sizes needed to detect various differences in the percentage of fine material were calculated for three different levels of sampling precision, two different levels of confidence (chance of detecting a difference when a "true" difference exists), and six different levels of difference in fine sediment between sampling times or stations (Table 16). At an 80 percent sampling confidence with a 90 percent chance of detecting a difference when a "true" difference exists ten samples are needed to detect a ten percent difference. That means that with ten samples it would require an increase of 10 percent in fine material within the streambed in order to detect that difference nine out of ten times. However, it may be possible to pool samples over several years before and after land-use activities occur, or, if an area appears to have an increase in fine sedimentation, increase the sample size to detect a smaller difference.

An attempt will be made to estimate fish populations using either mark-recapture or depletion estimates to allow for statistically analyzing whether fish populations decline in response to habitat changes resulting from land-use practices. It is recognized that in some reaches, particularly in lower reaches of tributaries near their junction with the Big Hole River, it may not be possible to conduct population estimates due to the extremely low density of fish. In those cases, catch-per-unit-effort will be used to assess distribution and relative abundance. When water clarity allows, an attempt will be made to conduct recapture runs using underwater observation (snorkeling) which will allow for the stratification of fish populations by habitat type. It is suggested that 1,000 foot long sections be censused in streams with wetted widths greater than twenty feet and mark-recapture techniques will be used. In streams twenty feet or narrower it will be possible to reduce field time and still maintain quality data by reducing the section length to 500 feet and using a depletion estimator. The key objective will be to adequately sample all habitat types which are present within the reach in the same proportion as they are represented within the reach.

Literature Review of Habitat Requirements of Grayling and Cutthroat and Rainbow Trout

A literature review of habitat requirements of the species of gamefish of interest in the Big Hole drainage was conducted to permit evaluation of available habitats within the drainage (Table 17). This review will allow land managers to understand what types of habitats these species require and will

Table 16. Sample sizes estimated to detect various differences in percentage of streambed material less than 0.25 inch (6.3 mm) at various levels of confidence in detecting a difference when a "true" difference exists and at various levels of sampling confidence (Zar 1984). Variance for these calculations was assumed to be 60.

Detectable difference (%)	90% Chance			75% Chance		
	50% CI	80% CI	90% CI	50% CI	80% CI	90% CI
2	150	200	--	56	100	165
5	20	33	50	10	20	28
7	11	18	20	6	10	15
10	6	10	12	3	6	10
12	5	7	9	2	4	7
15	3	5	6	2	3	3

Table 17. Velocity (fps), depth (ft.), substrate composition, temperature (F), and cover type preferred by grayling, cutthroat trout, rainbow trout, brown trout, and brook trout by life stage. Source references are footnoted.

Species life-stage	Velocity (range in fps.)	Depth (range in feet)	Substrate (dominant particle size range in in.)	Temperature (lethal max in F)	Cover (type and %)
Grayling [1]					
spawning	1.0 - 3.0	1.0	0.2 - 1.5	40 - 52	_[2]
egg incubation	see above	see above	see above	46 - 63	_[2]
fry	0.5	0.3 - 2.0	2.5	46 - 61	substrate
juvenile summer	0.7	0.6		46 - 61	see depth
winter	see above	4.5		see above	see above
adult summer	0.9	see above		see above	see above
winter	see above	see above		see above	see above
Cutthroat trout [3]					
spawning	1.0 - 2.0	0.5	0.1 - 3.1 5% fines [4]	_[2]	_[2]
egg incubation	see above	see above	see above	45 - 54	_[2]
fry	_[2]	35 - 60 % pools	10% fines [4]	52 - 59	see depth
juvenile	12 % of area with velocities 0.5 fps and depths 6.0 inches	35 - 60 % pools _ 30% class I pools	10% fines [4]	52 - 59	see depth
adult	see above	1.0 [5] or 1.5 [5]	_[2]	52 - 59	see above

Table 17. (continued)

Species life-stage	Velocity (range in fps.)	Depth (range in feet)	Substrate (dominant particle size range in in.)	Temperature (lethal max in F)	Cover (type and %)
Rainbow trout [6]					
spawning	1.0 - 2.3	_ 0.5	0.2 - 2.5 [4] _ 5% fines	_ 54	_[2]
egg incubation	see above	see above	see above	see above	_[2]
fry	_[2]	37 - 65 % pools	4.0 - 15.7 _ 10 % fines [4]	54 - 65 54 - 65	see depth
juvenile	_ 14% of area with depths _ 0.5 ft and velocities _ 0.5 fps also see above	also __30 % class I pools	see above	54 - 65	see depth and velocity
adult	see above	see above also thalweg _ 1.0	_[2]	54 - 65	see above

1/ From Hubert et al. 1985.

2/ No values could be found for these parameters.

3/ From Hickman et al. 1982.

4/ Preferred size range given first with the percentage of "fine" material found to be detrimental to survival given second.

5/ Cutthroat rely on high quality pools and the assumption made was that higher standing crops are assicated with more high quality pools. Pool quality is based in part on depth with the highest quality pools having depths deeper than 4.5 feet (in streams 15 feet wide or less) and 6.0 feet (in streams wider than 15 feet) and at least 30% of the area comprised of these high class pools. Thus the values for average depth of 1.5 feet (4.5 X .30) and 2.0 feet (6.0 X .30).

6/ From Raleigh et al. 1984.

provide a benchmark to compare present habitat condition with preferred habitat condition. No attempt will be made at the present time to discuss these habitat requirements. Comparisons will be made after statistical tests are run on the data collected through the next year to attempt to determine which habitat parameters are correlated to fish abundance.

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