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A STREAM HABITAT AND FISHERIES ANALYSIS FOR SIX TRIBUTARIES TO THE BIG BLACKFOOT RIVER

Montana Department of Fish, Wildlife & Parks

A STREAM HABITAT AND FISHERIES ANALYSIS

FOR SIX TRIBUTARIES TO THE

BIG BLACKFOOT RIVER

A cooperative project between the Bureau of Land Management and the Montana Department of Fish, Wildlife and Parks

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ABSTRACT

A stream habitat inventory using a slightly modified version of the Hankin and Reeves (1988) methodology was undertaken for six tributaries to the Blackfoot River in summer 1990. This summary report combines small scale regional variables (ie. geographical position, land-use, landforms, etc.) with habitat specific information. Stream habitat information was combined with fisheries data for further evaluation. Evaluation of the combined fisheries/habitat condition implies that current management of land, riparian and stream systems in some instances adversely impact aquatic resources in all six sampled streams. Uncontrolled grazing on agricultural lands and poor logging practices in mountain riparian areas are two primary land-use practices that cause stream habitat degradation and depressed fisheries. The report identifies not only limiting factors that reduce habitat quality, but also outlines broad measures that could correct existing stream habitat damage to the benefit of Blackfoot River and tributary fisheries.

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Introduction

A stream habitat inventory was undertaken the summer of 1990 for three spring creeks and three basin-fed tributaries to the Blackfoot River. The primary objectives of the inventory was to determine present condition of the stream and relationship to its potential or desired condition. The analysis of habitat components were then combined with fisheries data for further analysis. Discussion of the combined analysis focus on factors that limit trout production. This summary report outlines broad measures that could correct existing stream/riparian problems for each of the six tributaries. Corrective measures have the potential to improve stream habitat to the benefit of not only resident tributary fish but also migratory Blackfoot River fish that rely on tributaries for life-cycle processes.

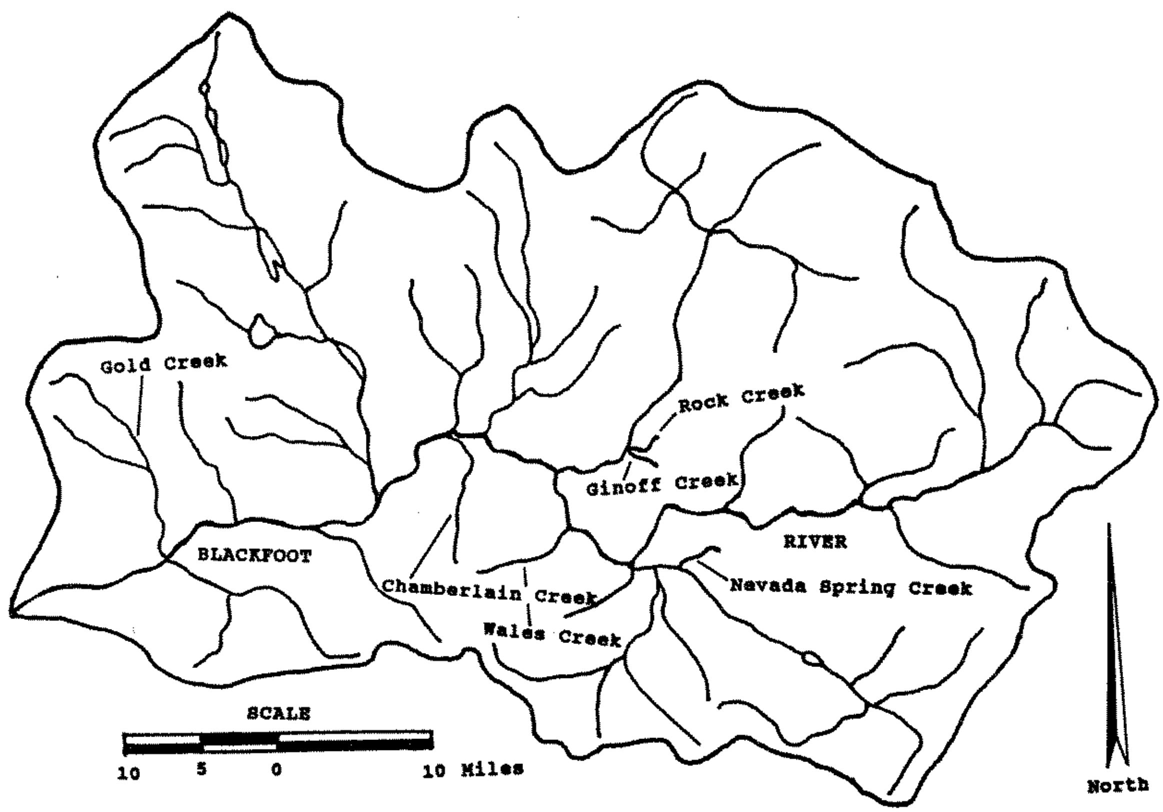


Figure 1 Blackfoot Basin map with study streams.

Field Methods

Habitat inventories were completed using a slightly modified version of the methodologies described by Hankin and Reeves (1988).

The stream habitat inventory broke study stream into **stream**

reaches. Reaches are units of stream length with homogenous habitat features and/or size. Reaches were terminated at junctions with other drainages, at gradient changes (>2%), at major topographic features or at one-half mile intervals if no distinguishing features were found. All reaches were recorded on 1:24,000 USGS topographic maps. **Stream gradient** was determined using a clinometer and recorded at the beginning of each reach and several times over the course of the reach.

Beginning at the first habitat unit in a stream, the observer identifies its **habitat type**, and then measures length and mean width to the nearest 0.5 m with a 30 meter measuring tape. Stream surface area was measured using mean length and mean width values for all habitat types within a given reach. Average length was calculated by averaging the linear lengths of habitat units to the nearest one-half meter. Channel width was measured from waters edge to waters edge. Mean depths were measured with a meter staff to the nearest centimeter.

In a systematic sample of units within a given habitat type accurate measurements of unit characteristics were then made. In this survey either 10% or 50% of the all habitat units were accurately measured. The first unit to be accurately measured was determined by drawing random numbers between 1 and 10. For example, if the number were 5 then under a 10% intensity survey, accurate measurements would be taken every fifth, fifteenth, twenty-fifth pool, etc. Accurate measurements were fixed at 1-2 m intervals along the length of the unit to calculate total unit length and width.

The **habitat type** classification partitions a stream into similar physical habitats. These basic habitat types are: pool, riffle and run (or glide). **Pool units** included secondary channel, backwater, trench, plunge, lateral scour, dammed, alcove, corner and under scour pools. **Riffle units** included secondary channel, low gradient bedrock, low gradient gravel, low gradient cobble, low gradient boulders, rapids and cascades. **Structural Associations** of pools include boulder, large wood, enhancement structure, beaver dam, culvert, small wood falls, stream-bend, rootwad and bar. Pocket water is associated with riffle habitat units.

Stream substrate composition was visually estimated to the nearest 5%. Stream substrate composition was classified into the following classes: boulders (> 30 cm), cobbles (8-29 cm), gravel (0.3-7 cm), sand and silt (<0.3 cm), and bedrock. **Percent surface fines** is determined with the use of a one square-foot wire mesh screen with 49 intersections. Three random frame tosses of the wire mesh screen are made for each habitat type measured. The number of intersections that have particle sizes less than 0.30 cm are counted and divided by 49.

Eroding banks and **undercut banks** were used to gauge **bank conditions.** These variables were measured using the linear distance of eroding or undercut for both banks. The total linear distance was recorded to the nearest 0.5 m. In addition, **overhanging vegetation, instream cover, overhead bank cover, aquatic vegetation,** were measured. Overhead cover is defined as an undercut bank having an overhang of at lease 7.5 cm and at least 15 cm water depth under the overhang. Both bank measurements were summed and the total linear distance at each measured habitat unit recorded to the nearest 0.5 m. Bank measurements were recorded for pools and runs only. Overhanging vegetation is defined as streamside vegetation overhanging within 12 inches of water surface. Both bank measurements were summed and the total linear distance recorded to the nearest 0.5 m. Overhanging vegetation is recorded for pools and runs only. Aquatic vegetation includes algal mats, mosses, or rooted aquatic plants that provide cover to fish. The amount of aquatic vegetation within the habitat unit was visually estimated to the nearest 5%. Instream cover, defined as any structure that provides protective cover for fish ie. algae, boulders, woody debris, was visually estimated to the nearest 5%.

Organic/Woody debris was measured with two independent methods; 1) **Organic debris** was recorded and measured for every 10th piece of woody debris encountered in the reach. This provides an index to the amount of woody debris within the entire length of the sampled stream. **Length** and **diameter** was measured with a meter tape and/or measuring staff and recorded to the nearest centimeter. 2) **Active woody debris, inactive and potential woody debris** provide the second index of woody debris for individual habitat types and units. **Active woody debris** must provide overhead cover an/or pool scouring at high flows. Debris has to be stable and capable of providing habitat over an extended period of time. For this reason, debris under 10 cm in diameter or less that 1.0 meter in length that do not appear to contribute to channel habitat was not recorded. However debris of this size which has obviously been in the creek channel for several years should be recorded. The number of structures is recorded for intensively surveyed units. **Inactive debris** is large pieces of relatively stable woody material having a diameter greater than 10 cm and a length greater than 1.0 m but is at the present time not providing instream habitat. **Potential woody debris** is a parameter designed to gather data on trees which potentially could enter the channel and remain, effectively providing instream cover and diversity. Potential debris recruitment trees are determined by visually counting trees parallel to the habitat unit with a DBH large enough to create instream cover. Measurements are preformed for each bank. Measurements are made at the waters edge, parallel to the habitat unit, and extend to the high water channel. A minimum DBH of 30.5 cm is required before a tree can be tallied. Trees with a 30.5 DBH would provide a minimum diameter capable of withstanding natural forces and thus remain in the system providing woody structure and habitat diversity.

Dominant and **subdominant riparian vegetation** provides an overview of what riparian vegetation exists. **Successional Stage** further identifies the structure and composition of the riparian zone. According to the classification used in this study 10 possible successional stages occur. They range from very early successional stages, a non-stocked riparian of less than 300 trees/acre and less than 10% crown cover, to a senescent stand in the late stages of succession. This late-stage community has a poorly stocked mature overstory with 10-40% crown cover and a poorly stocked understory.

Road encroachment was measured for each bank for all intensively surveyed habitat units. Encroachment is recorded if the distance from the stream high water mark to the toe of the road slope is less than 30 meters. Encroachment is considered: low if between 10 and 30 m; medium if between 5 and 10 m; and high if less than 5 m.

Rock Creek and Ginoff Creeks: Spring Creeks of Kleinschmidt Flat.

Lowland outwash plains along the axis of the upper Blackfoot Valley from Lincoln to the Clearwater River dissect glacial valley moraine. Alluvial aquifers within these outwash plains produce spring creeks. One of the largest outwash plains of this type is Kleinschmidt Flat. Basin-fed streams to the north and east continuously replenish the aquifer upon entering the plain. With decreasing elevation at the south end of Kleinschmidt Flat, water seeps from the aquifer into a braided series of glacial outwash stream channels to form the modern spring creek complex. The two principal spring creeks of Kleinschmidt Flat, Rock and Ginoff Creeks, flow west with a 1% gradient before joining just above the highway 200 bridge. Rock Creek then flows another 200 feet to its confluence with the North Fork of the Blackfoot River. The discharges of Rock Creek and Ginoff Creek were respectively 53 cfs and 25 cfs in July 1989.

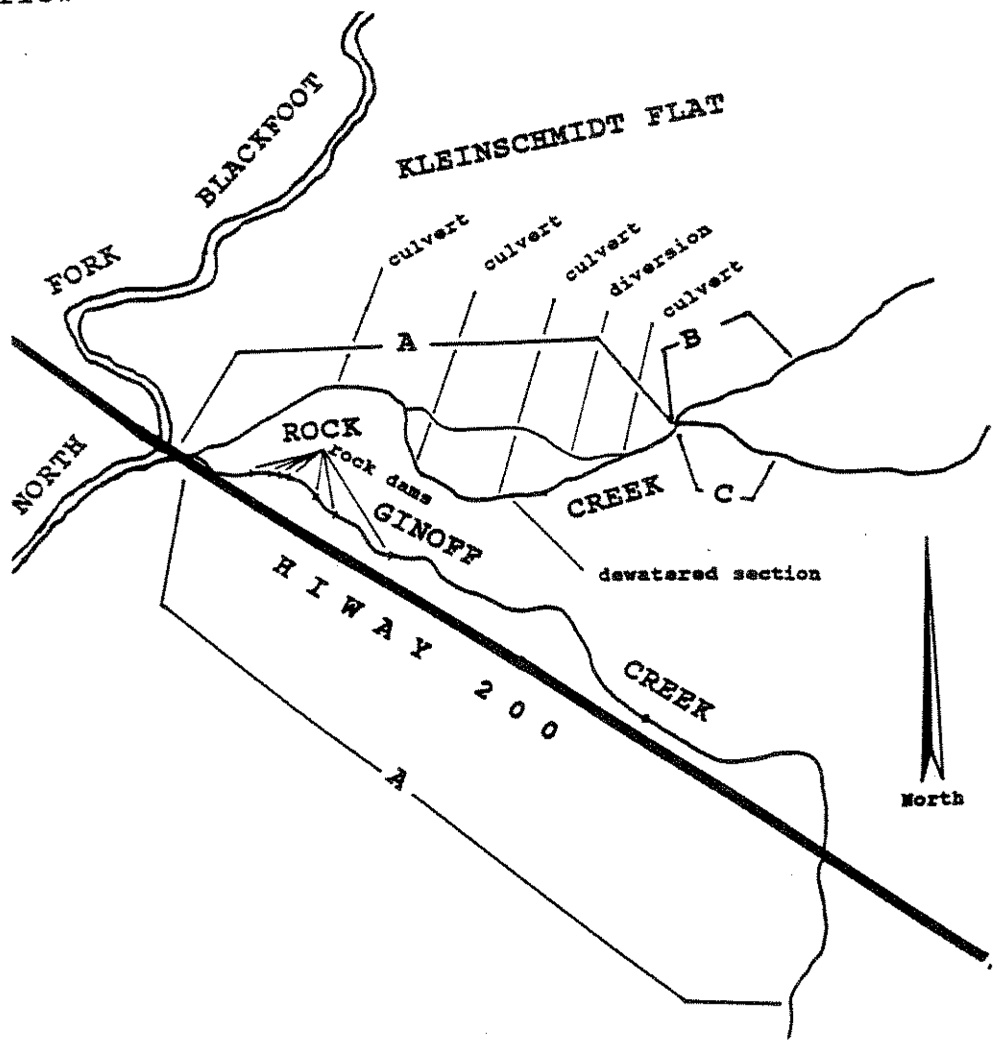


Figure 2 Map of Rock and Ginoff Creeks.

Rock Creek

Results

Rock Creek was divided into 3 reaches and sampled at the 50% intensity level. Reach A extends from the mouth upstream 1.2 mile to the forks. Reach B extends 0.3 miles up the north channel and Reach C extends 0.2 miles up the west branch of the spring creek.

Of 57 units the survey recorded 22 riffles, 19 runs and 16 pools. Riffles covered 52% of the mean stream surface area, followed by 38% runs and 11% pools. The mean length for all habitat units was 44 meters, mean width was 10 meters. The stream widens in upstream reaches (fig. 3). Mean depth was 39 centimeters and mean maximum depth was 54 cm.

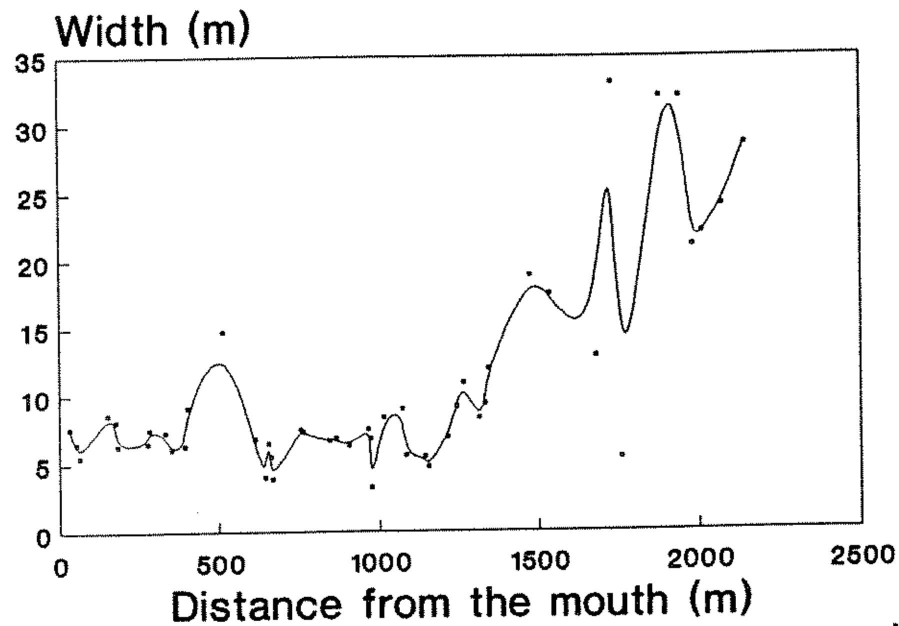


Figure 3 Stream width for sampled habitat units of Rock Creek.

Substrate composition varied widely depending upon habitat type. Fine sediment ranged from 0-20% of the riffle substrate. The lowest readings occurred in reach C and the highest were recorded in reach B. Overall, sand and silt comprised about 10% of the riffle substratum.

Of the 16 pools, 7 trench pools were measured, followed by 6 lateral scour pools and 3 dammed pools. Of 22 riffles, 11 were the low-gradient cobble type, followed by 10 low-gradient gravel and one riffle associated with secondary channels.

Ninety-four percent of the pools were associated with structure. Of pools with structure 40% were associated with culverts, 40% with stream bends, 13% with boulders and only 7 percent were associated with large woody debris. All sampled riffles had structural associations. Nearly all were associated with pocket water.

Riparian vegetation consists of meadow and woodland cover-types. Fifty seven percent of the sampled stream in reach A had conifers, ponderosa pine, spruce and lodgepole pine, along its banks. These woodlands were classified as immature. Meadow vegetation, grasses and sedges, dominated 34% of the bank vegetation. Willow shrublands dominated less than 10% of the bank vegetation in reach A. In reach B and C, meadow vegetation comprised 100% of the bank vegetation. This meadow community was classified in the very early stages of succession. Overall the riparian vegetation appears in the early to mid stage of plant community development.

For all sampled units, instream cover was estimated at 13% of the sampled area; aquatic vegetation covered 3% of the stream bottom; overhead cover was 9%; overhanging vegetation covered 23% of the sampled banks; and 32% of the sampled banks were reported as eroding. Only 6% of the stream banks were recorded as undercut.

Samples of upstream reaches, B and C, show a significant reduction in: 1) overhead cover; 2) overhanging vegetation; and 3), and in the amount of undercut banks when compared to reach A.

Road encroachment was recorded at 43 percent of all sampled units in reach A. The left bank had the highest percentage of encroachment, 52% compared to 33% on the right bank. Encroachment was considered high in half the samples. This light-duty road probably contributes very little to stream sedimentation. Road encroachment is not a factor in upstream reaches.

The combined average length for pools and glides in Reach A is 32 meters. This unit averages just over 1 piece of active woody debris for the reach and 0.5 pieces of inactive debris. Potential woody debris averages one tree for every 23 meters of stream bank. All forms of woody debris were absent from sampled upstream units. Rock Creek had double (2.4 pieces per 100 m) the amount of active woody debris as Ginoff Creek (1.2 pieces per 100 m) in pool habitats.

Discussion

The habitat trend in reach A was reported as static. Habitat related factors that limit the fishery include inadequate pools, inadequate stream cover, fish passage barriers and the loss of habitat by diversion withdrawal. The lack of woody debris limits the amount of protective-cover. Reduced stream habitat quality and diversity is further tied to eroded, denuded, wide and unstable banks due to livestock damage and tillage practices. At least 2 of 4 culverts and associated rock dams, placed above stream base level, create not only fish passage barriers but also reduce habitat diversity and cause sediment deposition above them.

At the point of diversion in the upper section of reach A, a rock dam impounds water and sediment, causing the stream to acquire wide, flat appearance. Below the diversion and dam structure, the main channel becomes severely dewatered although remains perennial through groundwater inflows and seepage through the dam. The dewatered stream section is perhaps the most diverse stream section in terms of pool development, riparian vegetation and instream woody debris. Water is returned to the main channel just above a culvert. This culvert was identified as a fish passage barrier. In addition, like the upstream diversion structure, the culvert increases stream base level and causes Rock Creek to impound water and sediment. Habitat diversity decreases, and Rock Creek assumes a wide, flat appearance with sediment filled substrates for about 100 meters upstream of the culvert.

Below the culvert, added flows and narrowing of the channel causes stream velocities to increase. Riffle development improves. Summer-rearing shoreline habitat appears sufficient due to sedges which line the banks during the growing season. Winter-rearing habitat is probably limiting because sedge die-off eliminates juvenile cover. Pool quality below the culvert remains low due to the unstable banks, lack of bank undercut, reduced instream woody debris and the corresponding reduction in protective cover. Habitat diversity increases in the lower 200 meters of stream due to increasing amounts of woody debris and improved riparian and bank conditions.

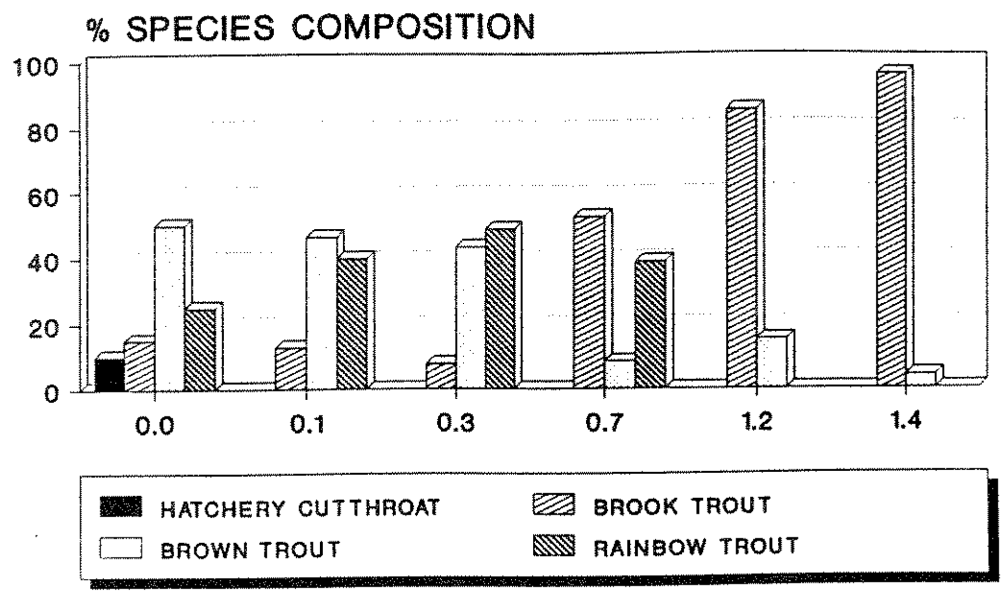
Rock Creek is a spawning tributary for migratory river fish and nursery stream for juvenile fish. The lower section of reach A provide spawning opportunity for both migratory rainbow and brown trout and recruitment to the river system it feeds. According to landowner accounts the stream historically supported resident populations and migratory runs of both bull and cutthroat trout. Both species were absent from samples of fish collected in 1989.

Fishery surveys in 1989 collected very few large adult fish except in a few pools with sufficient overhead cover. Instead juvenile brown and rainbow trout dominate the fishery, inhabiting primarily sedge shoreline habitats in the lower section of reach A. Upstream beyond culverts and into the dewatered section, catch-rates for both rainbow and brown trout declined. Brook trout dominance increased sharply. In two sections above stream mile 0.7 no rainbow trout were collected. Brown trout continued to decline while brook trout increased to comprise over 90% of the fishery (fig. 4).

The habitat trend in reaches B and C is static. Limiting factors include inadequate pools, lack of spawning areas, eroding banks, lack of bank undercut and lack of bank cover, as well as the near total loss of woody riparian vegetation. The poor quality of stream habitats in reaches B and C are largely a function of unrestricted livestock grazing.

Corrective Measures

The primary trout-habitat attributes that appear as limiting factors include: lack of cover, limited winter-rearing habitat, lack of quality pool habitat, barriers to movement and dewatered stream channels. Rock Creek has the potential for a greatly improved fishery.



1989 Data

Figure 4 Trout species composition for 6 sampled sections of Rock Creek, 1989.

Stream habitat restoration requires improved riparian management. Livestock grazing of the riparian could be managed to better protect the stream and its banks by restricting the timing and/or access of livestock to the stream. Better streamside management would reduce bank erosion, reduce stream siltation, promote regeneration of bank vegetation, help stabilize stream banks, and could greatly improve the quality of instream habitats particularly in upstream reaches B and C.

Reestablishment of shrubs and large woody bank vegetation is needed to help stabilize banks, provide future woody debris recruitment and improve protective cover for shoreline and pool habitats throughout the stream, and particularly in reaches B and C.

Habitat improvements in reach A are largely contingent upon increasing stream flows in the dewatered section.

Culverts could be replaced with structures that provide passage to upstream spawning riffles.

The elimination of rock dams in upper and lower sections of reach A would reduce stream base level and allow the stream to reclaim channel features that now underlie flat, wide and sediment filled pools. This would reduce channel width and restore habitat diversity.

Ginoff Creek

Results
Ginoff Creek drains the south portion of Kleinschmidt Flat and flows 2.6 miles before joining Rock Creek just above the highway 200 bridge.

The stream habitat survey consisted of 1 reach and 44 samples taken at the 50% intensity.

Glide and riffle habitat types were evenly represented, each comprising 36 percent of the sample; pools comprised 27 percent of the sample. For all habitat types, the average length of unit was 67.2 meters. This represents a 23 meter increase over the mean length of Rock Creek units. Average width was 9.2 meters and mean depth was 41.2 centimeters. Glides comprised 53% of the stream surface area; pools and riffles averaged 28% and 19% of the sampled stream surface area respectively. Compared to Rock Creek, the survey indicates Ginoff Creek to a significant reduction in the amount of stream surface area covered by riffles.

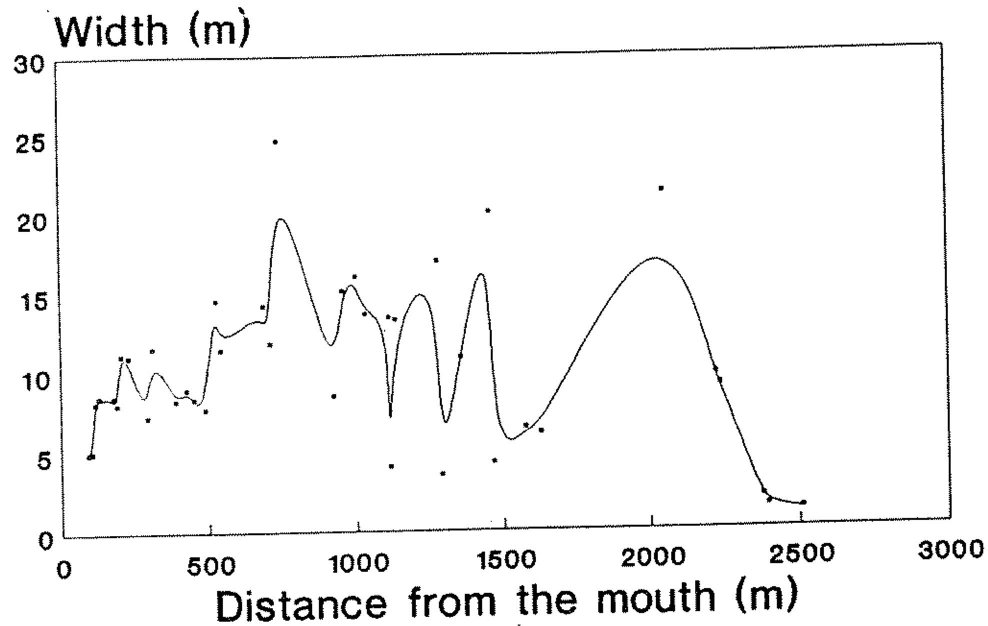


Figure 5 Stream width for sampled habitat units of Ginoff Creek.

Fifty percent of the sampled pools were trench pools. Boulder dams formed 42 percent of the pools, and 6% formed from lateral scour. All pools were associated with some type of structure. Trench pools were associated largely with culverts; dammed pools largely with boulders. Less common structural devices associated with pools included enhancement structures and stream bends. Low-gradient gravel comprised 63% of the sampled riffles; low gradient cobble were found in 37% of the samples. Nineteen percent of the sampled riffles had structural associations. Structural associations were about evenly distributed among the two riffle types. Pocket water, enhancement structures and stream bends were structure associated with riffles.

Substrates for all habitat units were comprised mostly of fine material, primarily gravel, sand and silt. Substrates comprise of fine sediment ranged from 22% in riffles to 47% in glide habitats, and averaged 37% of the substratum. Compared to Rock Creek, Ginoff Creek had about three times the fine sediment in riffle substrates. Levels of fine sediment increase upstream. Likewise, percent mean surface fines were higher in all habitat types when compared to Rock Creek.

Meadow-type vegetation comprised 82% of the riparian community, while willow shrublands and willow meadowlands each comprised 9 percent of the sampled shoreline. Willows were dead or eaten back by livestock to the point where regeneration of woody vegetation was no longer occurring. All successional stages were classified as overmature due to the decline and lack of regeneration.

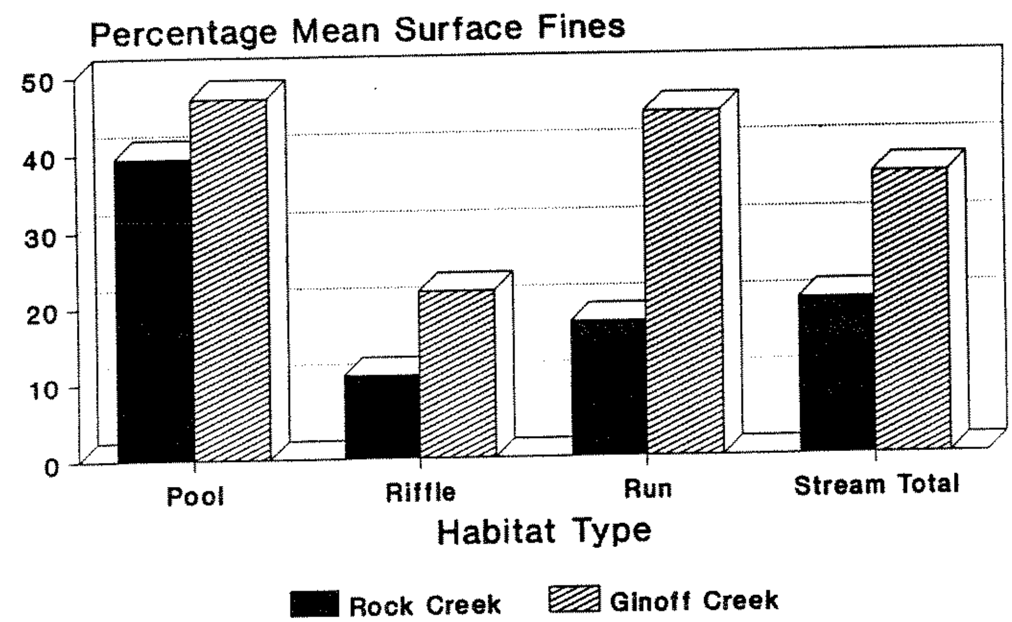


Figure 6 Comparison of mean surface fines for Rock and Ginoff Creeks.

The mean unit length for pools and glides is 70 meters. For a unit of this length, the stream averages 1.5 pieces of active debris and 0.0 pieces of inactive debris per unit length. Pools had about half (1.2 per 100 m) the amount of active woody debris as glide habitats (2.3 per 100 m). Potential woody debris for both banks is 2.7 per habitat unit or 4.7 per 100 meters of stream.

For pools and glides: aquatic vegetation covered 21% of the sampled area; overhead bank cover was a low 4.5%; overhanging bank vegetation covered 58% of the sampled stream banks; undercut banks were reported for 7 percent of the streambanks; eroding banks averaged 16% of the sampled shorelines; instream cover was measured at 21%.

The surveys indicate 35% of all sampled units had road encroachment. The left bank had 25% encroachment; the right bank had 45%. Half of the habitat types with encroachment were classified as having a high degree of encroachment with existing roads within 5 meters of the stream.

Discussion

The habitat trend in Ginoff Creek was reported as deteriorating.

Woody vegetation along the banks is much reduced compared to Rock creek. The poor quality of stream habitat results from the elimination of bank vegetation, instream woody debris, undercut banks and instream cover.

Increased sediment further degrades stream habitat. Roads encroachment and livestock trampled banks are suspected to be primary causes of erosion. Rock dams result in excessive deposition of sediment. Rock dams have raised the stream base level to form a stair-stepped stream appearance. The dams increase stream elevation to form flat, wide and low diversity glide and pool habitats. Rock dams increase the length and width of affected habitat units, and tend to reduce habitat diversity upstream. Increased fine sediment behind the dams probably influence the growth of aquatic plants in Ginoff Creek.

The cumulative impacts of rock dams, limited instream cover and poor riparian management impact the stream habitat quality and severely limit the amount of spawning, rearing and adult fish that can inhabit and/or reproduce in the system. Unlike the lower reach of Rock Creek, 1989 fishery surveys near the mouth of Ginoff Creek collected no rainbow trout in the sample. Brown trout redd counts in Ginoff Creek indicate that spawning activity is currently limited to about 100 meters of riffle habitat near the mouth of Ginoff Creek. Most riffle habitats lack structural association that could provide protective cover for spawning migratory fish.

Corrective Measures

The removal of rock dams would eliminate base-level controls, and allow the stream to reclaim channel features that now underlie wide, flat and sediment filled pools. The recovery of stream habitats should then allow spawning riffles and gravels to recover. This could improve spawning opportunity for resident and migratory fish.

Livestock could be managed to improve bank stability, reduce erosion and allow bank vegetation to recover. The recovery of woody bank vegetation would provide habitat diversity, woody debris recruitment, bank stability and protective-cover for fish. Large woody debris installed in the channel would provide habitat diversity and protective-cover in the interim.

Buffer strips would provide a degree of security against sediment that erodes from roads that have encroached the stream.

In the middle and upper sections of Ginoff Creek, better riparian management could improve the quality of shoreline habitats. However, pool habitat development may not occur if left to natural recovery due to low banks, wide and shallow channel features and the lack of channel maintenance stream flows.

Better riparian management along with the removal of rock dams could improve the amount and quality of spawning and rearing habitat in Ginoff Creek. Improved stream habitat quality and diversity may attract rainbow trout and/or native fish use and provide increase recruitment to the North Fork of the Blackfoot River.

Nevada Spring Creek

Unlike Rock and Ginoff Creeks, Nevada Spring Creek surfaces from an artesian aquifer in morainal foothills adjacent to the Nevada Valley. Groundwater at 11 cfs flows from the source with a constant summertime temperature of 44-45 degrees F. Of the 11 cfs, 4 cfs is diverted at the source to pasturelands in the valley or into Wasson Creek. Wasson Creek then returns water back to the spring creek 200 feet below its source. The remaining 7 cfs flows over a 200 foot section of stony hillslope where water flows with a moderate gradient under a dense mat of grasses and water cress. 200 feet below the source of the spring, the foothills join the flat alluvial plains of the lower Nevada Valley. Wasson Creek enters the spring creek channel at this junction. Stream gradient quickly drops to 1%. Unlike the gravelly plains of Kleinschmidt Flat, Nevada Spring Creek flows through flat alluvial silt plains which support hay and pasturelands. Nevada Spring Creek joins Nevada Creek 3.1 miles below the source. Nevada Creek then flows 6 miles to its confluence with the Blackfoot River.

Results

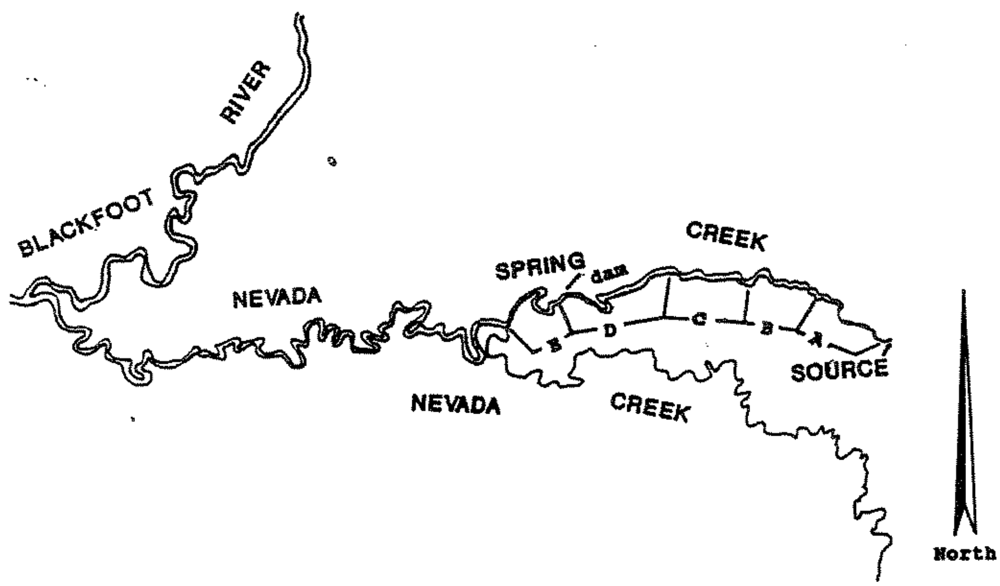


Figure 7 Map of Nevada Spring Creek.

Nevada Spring Creek was divided into 5 reaches and studied at the 50% intensity. The survey extended from the mouth of Wasson Creek 3.1 miles downstream to the confluence of Nevada Creek. A total of 60 samples were taken: 17 in reach A (0.40 miles); 12 in reach B (0.56 miles); 8 in reach C (0.56 miles); 11 in reach D (0.88 miles); and 12 in reach E (0.68 miles).

42 pools were sampled, 18 glides and no riffles. Pools comprised 51% of the stream surface area and glides 49%.

Pools comprised about 12% of the stream surface area in reach A and increased to 100% of sampled stream surface area in lower reaches. Pools were associated with structure in 29% of the sampled units. Forty of the 42 sampled pools were trench pools associated with stream bends and point bars. The remaining 2 pools were created from dams. Twenty five percent of the pools were associated with enhancement devices or culverts.

Substrates were comprised primarily of sand and silt (Fig. 8). Sand and silt increased from a mean of 79% in reach A to 99-100% in downstream reaches. Substrates in Reaches B and C were estimated to be 100% sand and silt. Beginning in Reach B, depth of sediment increased downstream to reach D where a rock dam and culvert structure that is situated above stream base level. The device impounds water and causes sediment deposition upstream. Sediment covers the stream bottom to a depth ranging from 25-90 cm upstream of the culvert at the end of reach D (Pierce and Peters 1990). The amount of boulders and rubble increases slightly in lower reaches to 1-2% of the substrate composition in reach E. Percent mean surface fines for sand and silt covered a minimum of 47% of the sampled substrate. The habitat crew noted coverage was actually higher because aquatic vegetation covering the substrate resulted in low readings.

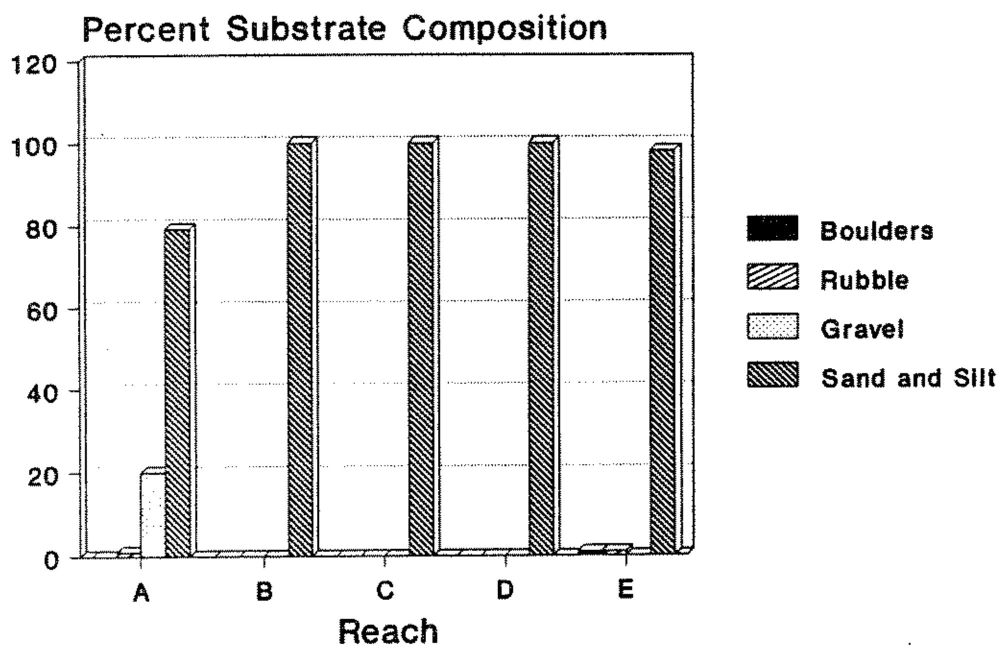


Figure 8 Percent substrate composition for 5 reaches of Nevada Spring Creek.

Meadow vegetation lined 100% of the sampled shoreline for the entire stream. Plant community development was reported to be in the very early stages of succession due to the near complete lack of woody riparian species.

The stream supports a high amount of aquatic vegetation; coverage was 63% of the total sampled area. The percent area covered by aquatic vegetation increased from 28% below the spring source to as much as much as 91% in downstream reaches.

Bank erosion was high in upstream reaches compared to lower reaches. Twenty six percent of the banks in reach A were recorded as eroding compared to 37% in reach B. Reaches C, D and E had less than 3% eroding banks.

Overhead cover was measured at only 1%. Banks with overhanging vegetation comprised 78% of the sample.

Active woody debris was limited to reach A and Reach E. The average habitat unit in reach A was 41 meters in length. A habitat unit of this length maintained only 0.1 pieces of active woody debris, 0.0 pieces of inactive woody debris, and 0.2 pieces of potential woody debris. Middle reaches, B and C, lacked all forms of woody debris. Reach D had 0.2 pieces of active woody debris for mean habitat unit length for 98 m, thus showing an equally low amount of active woody debris as compared to reach A.

Road encroachment occurred in 5% of the samples. Only in downstream reaches was encroachment considered high.

Discussion

The stream habitat trend is reported as deteriorating. Rock dams coupled with damaged riparian result in severe stream habitat degradation. Except for a few patches of willow and aspen near the source, nearly all woody riparian vegetation has been eliminated. The low-gradient stream becomes wide, shallow and heavily silted due to unstable and eroding banks in upper reaches and rock dams that trap sediment in lower reaches and lack of maintenance flows. In reach A the habitat crew noted inadequate pools, excessive silt and high turbidity. Pools have little overhanging vegetation and cover. Substrate quality was poor due to excessive sediment except immediately below the spring source.

The habitat crew noted at the beginning of reach B that livestock grazing, stream sediment deposition and turbidity all increase. Trampled and raw banks appear to be primary sources of eroded material in upper reaches; whereas, rock dams and culverts are primary causes of sediment deposition in lower reaches. Culverts located above stream grade in reach D causes sediment deposition and habitat degradation. From B through E, limiting factors include lack of spawning areas, adequate pools, inadequate riffles and inadequate undercut banks. A culvert at the beginning of reach E forms an upstream fish passage barrier. The stream receives direct sunlight over its entire length. The lack of shade and dark mud bottom cause elevated water temperatures. Maximum water temperatures were recorded at 75 degrees F two miles below the spring source. This represents a 30 degree increase in water temperature from the spring source to the middle section of reach E. Increased temperatures, elevated nutrient levels and heavy sediment increase the ability of the stream to grow large amounts aquatic vegetation. Studies show stream temperatures and nutrient levels increase downstream while trout habitat quality and the ability of Nevada Spring Creek to sustain a trout fishery progressively decreases (Pierce and Peters 1991).

Fishery surveys indicate poor quality stream habitats severely limit reproduction, recruitment and the number of adult fish able to inhabit the stream under current conditions. Near the spring source, densities of brown trout were estimated at a low 13 (± 1) fish per 1000 feet of stream. All size classes were present but poorly represented. The capture of YOY brown trout indicates successful reproduction in the upper spring creek system or closely adjoining water. A few cutthroat were sampled to which no juveniles were found.

Corrective Measures

Nevada Spring Creek has high potential for improved fisheries through better riparian management and stream habitat restoration.

In spring 1990 a habitat restoration pilot project was developed for a one-half mile section (reach A) of stream near the source. The project included: 1) fencing the stream corridor to restrict livestock impacts; 2) willow plantings that will stabilize banks, provide much needed protective-cover and shade to the stream; 3) installation of logs and woody debris to enhance protective-cover for both adult and juvenile fish until natural vegetation is reestablished; and, 4) reintroduction of juvenile westslope cutthroat trout. This project will protect and transfer cold and clean water downstream, and improve crucial spawning habitat for resident and possibly migratory trout as the stream recovers.

Habitat restoration in reaches B through E requires better riparian management. Regeneration of shrubs would shade and stabilize stream banks and eventually lead to the development of undercut banks. A shaded stream would eventually transfer clean, cold water downstream. To this end, corrective measures in downstream reaches could include: 1) stream-side management zones that protect stream corridors; 2) grazing strategies, like rest-rotation, would help protect sensitive riparian areas; 3) stream rehabilitation projects similar to the pilot project; 4) removal of the culvert and rock dams are crucial components to any restoration project. The removal of dams and culverts would: lower the streams base level; eliminate a fish passage barrier; help tighten and stabilize stream banks; remove sediment from the system; while increasing habitat diversity and habitat quality.

Gold Creek

The basin divide, Clearwater River and lower Blackfoot River separate a small mountainous region in the western section of the Blackfoot Basin. These Belt rock mountains have approximately 4,500 feet local relief. Streams flow south through subalpine forests, montane woodlands and vast tracts of clearcut commercial timber lands. Stream valleys drains this region through both glacial U-shaped and unglaciated V-shaped valleys. These steep perennial streams briefly cut into high river terraces just before entering the lower Blackfoot River.

Gold Creek, a 3rd-order stream, is the largest tributary to the Blackfoot River below the Clearwater River junction. From a cirque basin (elev. 6490 ft.), Gold Creek flows south through a till-covered glacial valley over most of its 18.2 mile length. The upper basin lies within the Rattlesnake Wilderness and Recreation Area. From there it flows through primarily USFS and Champion International commercial forest lands, before entering the Blackfoot River at river mile 13.5 (elev. 3440). Discharge was recorded at 24.3 cfs near the mouth on 9/6/89.

Results

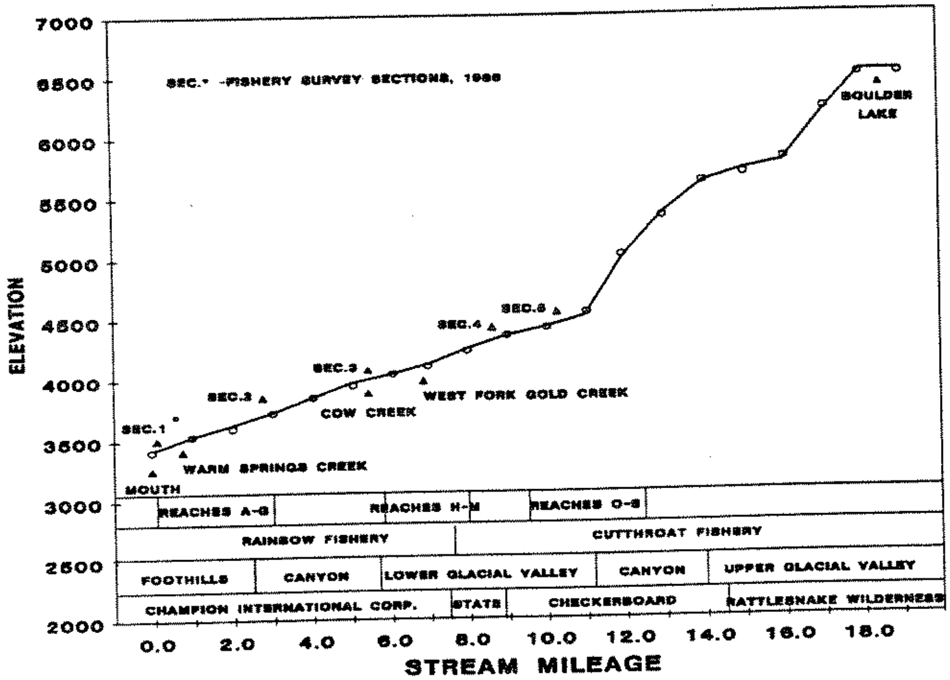


Figure 9 Reach location and profile of the Gold Creek Channel.

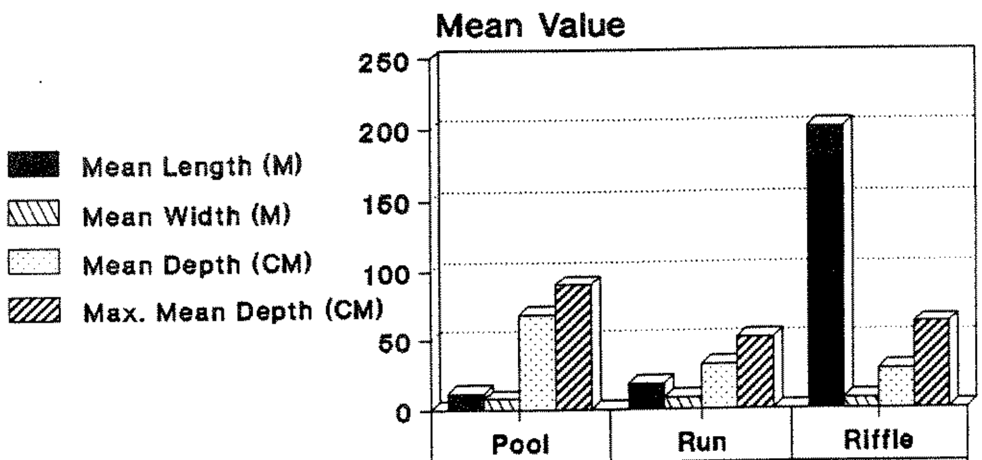
Three segments of Gold Creek, (stream mileage 0.0 to 3.0, 5.8 to 8.0, and 9.5 to 12.5), were divided into 18 stream reaches and sampled at the 10% intensity. The first segment was broken into 7 reaches (A-G), the second into 6 reaches (H-M) and the third segment had 5 reaches (O-S). A total of 47 pools, 57 riffle and 8 glides were measured for a total of 112 habitat units.

The lower segment comprised 40% of the sampled stream length yet provided only 19% of the sampled individual habitat types.

Middle reaches, H through M, comprised 38% of the sampled stream length and 50% of the individual habitat types. The upstream segment was 22% of the total sampled stream length, and comprised 32% of the habitat types.

Riffles comprised 51% of the entire sample and 86% of the stream surface area. The disproportionate areal coverage by riffles is due to riffles with a mean length of 201.5 meters, compared to the average pool length of 12.1 meters. Of the 57 sampled riffles: 28 were classified as low-gradient cobble; 17 were low-gradient boulder; 10 were cascades; and 2 were low-gradient gravel.

In lower reaches, stream habitat diversity was low. The section was dominated by long, low-gradient bouldery riffles and small pocket water habitats. Riffle habitat types extended up to 809 meters in length. In the middle stream segment, riffle diversity increased, length of riffle habitats decreased and low-gradient cobbles become the dominant riffle type. A lower percentage of boulder and gravel riffle types occurred in these middle stream segments. Separated by a higher frequency of pools, low-gradient cobble riffles continued into the upper stream segment. In the uppermost reaches, cascades become the dominant riffle type.



	Pool	Run	Riffle
Mean Length (M)	12.1	18	201.5
Mean Width (M)	7.8	8.3	7.7
Mean Depth (CM)	68.4	32.2	28.3
Max. Mean Depth (CM)	90.1	51.4	61.7

Figure 10 Mean length, width and depths for Gold Creek habitat types.

Forty two percent of the all habitat units were pools. Pools comprised however only 5% of the sampled surface area. Eight runs comprise the remaining 7% of the sampled units, and covered 8% of the sampled area. Of the 47 sampled pools there were 14 trench pools, 11 plunge pools, 8 lateral scour pools, 7 dammed pools and 7 back water pools. Like riffle types, pool diversity and frequency was highest in middle to upper reaches (fig. 11)

All sampled pools were associated with structure. Large woody debris provided 53% of pool structure, followed by stream bends (15%) and boulders (11%). Pocket water, dams, waterfalls and other structural forms provided pools with smaller amounts of structure.

Ninety six percent of riffle habitats had structural associations. Structural associations for riffles were 89% pocket water followed by boulders at 7% and other forms (4%).

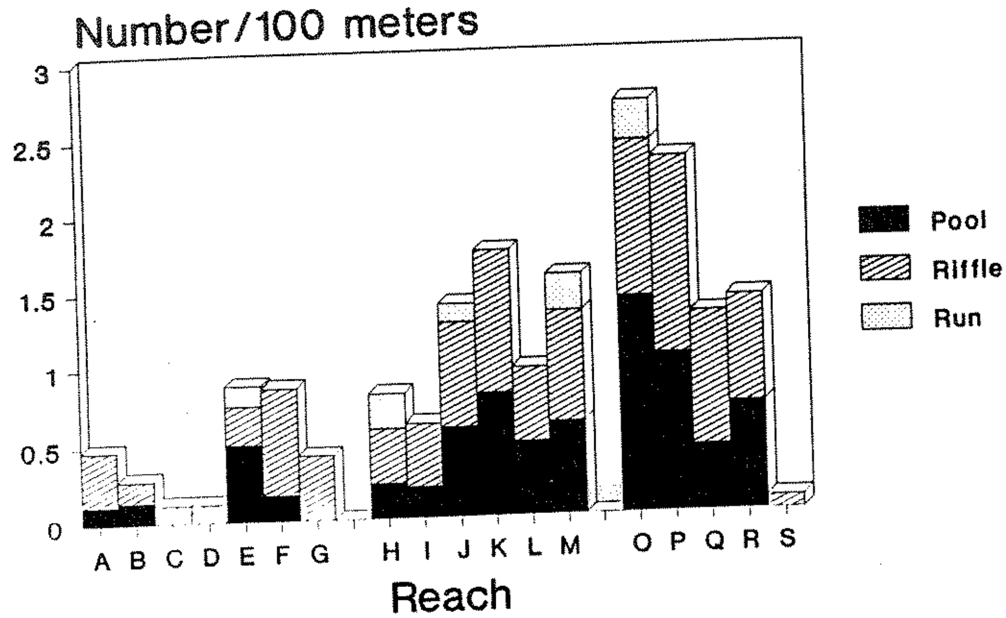


Figure 11 Sampled frequency of stream habitat types for Gold Creek stream reaches.

Substrate composition was sampled at 10 sites. The composition for all reaches and all habitats types was 41% gravel, 34% cobble, 14% boulders, and 11% sand and silt. Overall, gravel comprised over 25% of riffle substratum. Sand and silt comprised less than 10% of riffle substrates. Surface fines covered 7.5% of the substrate and ranged between 0.6% in glides to 17.7% in pools.

Road encroachment was recorded in 15% of the samples. Based on the sample, road encroachment was isolated to reaches E and F where encroachment was considered to occur at a low degree (roads 10-30 meters from the stream).

For individual reaches, overhead bank cover ranged from 0.0 to 9.6% with a mean value of 2.5% for all banks sampled. Overhanging vegetation lined from 2% to 50% of the banks. Overhanging vegetation averaged 8.8 % of all sampled banks. Instream cover ranged for 0 to 33% and averaged 18.6 % of the stream channel area. Undercut banks occurred in 3 of 5 samples. On average 6% of the stream banks were recorded as undercut. Ten percent of the sampled stream banks were classified as eroding.

The survey indicates a high degree of bank erosion in middle reaches J and K.

The dominant riparian community in upper reaches is a spruce forest above an alder shrub layer. Moving downstream, the community atenuates to a lodgepole pine/alder community before becoming a Douglas fir/alder community in lower reaches. Succession ranges from very early stages, non-stocked, less than 10% crown cover in spruce dominated upstream communities to a mature Doug fir woodland in lower reaches. Based on all samples, the combined riparian vegetation appears in the immature stages of community development.

The average length of pools and glides sampled for woody debris is 12.3 meters. There were: 2 pieces of woody debris; 0.8 pieces of inactive woody debris; and about 3.2 pieces of potential woody debris. The left bank was reported to have about double the amount of potential woody debris as the right bank.

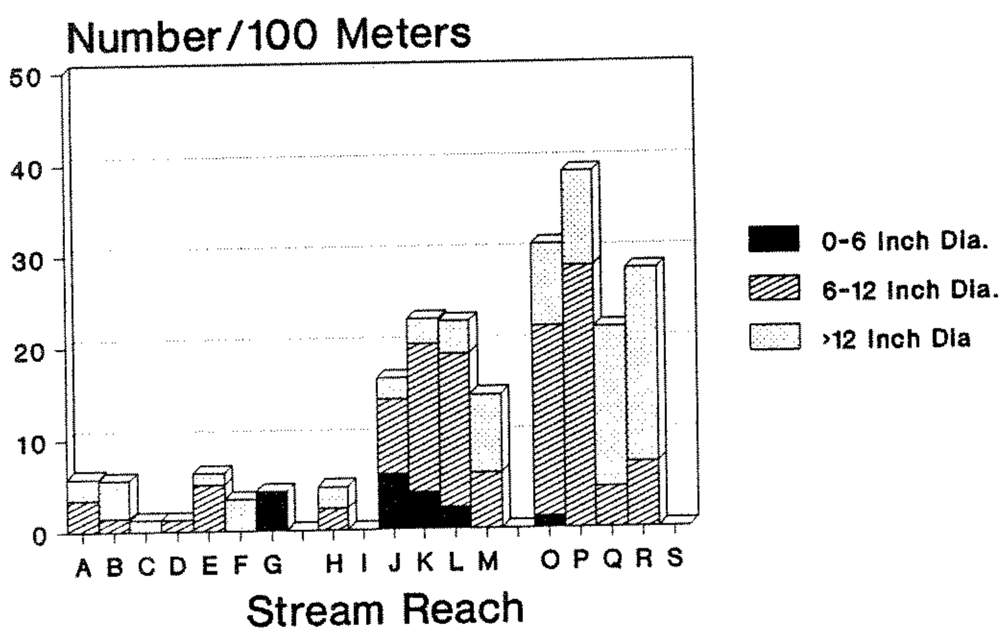


Figure 12 Amount of Organic debris for Gold Creek stream reaches.

Trends in the organic debris sample show a reduced amount of organic debris in lower stream reaches. The amount of organic debris increased significantly in the middle and upper stream segments (fig. 12). The amount of organic debris in Gold Creek shows high degree of similarity with the frequency of habitat units in the Gold creek channel.

Discussion

The habitat trend was reported as static for all the sampled reaches in the Gold Creek surveys.

Habitat features in the high-gradient, uppermost stream sections are characterized by swift currents, cascading turbulent water over exposed rocks. Organic debris increases habitat diversity below the cascades. The middle section supports a higher diversity and frequency of pool and riffle habitats. In lower sections, water flows swiftly over submerged and partially submerged cobble and boulder riffle units.

Stream diversity decreases in lower reaches. Reduced diversity of stream habitats may be attributed to a reduction in organic debris in the lower Gold Creek channel. Lower reaches lack slow-moving deep water, cover and habitat diversity. Without instream woody debris, boulder-laden riffles and pocket water habitats form the characteristic physical features of lower Gold Creek.

Bouldery riffles and lack of instream debris in lower stream reaches are important when considering Gold Creek fisheries. Gold Creek provides spawning opportunity for migratory bull, brown, rainbow and possibly cutthroat trout from the Blackfoot River. Lower Gold Creek reaches provide very little holding pools and protective cover. The lack of quality pool habitats probably limits the adult resident fishery. Small boulder and pocket-water habitats however seem to provide quality juvenile fish habitat. Trout captured in lower Gold Creek during 1989 showed that adult fish were poorly represented (fig. 13); yet, catch-rates of rainbow trout YOY in lower Gold Creek reaches were the highest of any tributary sampled during the 1989 field season (Peters 1990). Good densities of juvenile rainbow trout in the Johnsrud section of the Blackfoot River may be a result of Gold Creek's ability to produce and rear rainbow trout.

In middle to upper reaches, stream habitat diversity increases. Above the rainbow/cutthroat trout transition zone at stream mile 7, Gold Creek supports resident cutthroat trout dominated fisheries and a wider distribution of size classes (Peters 1990).

Several factors limit stream habitat diversity and quality in lower stream reaches. These include: low amount of woody debris, high flow fluctuations, inadequate pools, lack of undercut banks and damaged riparian. In lower to middle reaches, the habitat crew noted bedload movement, the continual lack of both undercut banks and bank cover, bank erosion and a heavy amount of sediment deposited in pools. To some degree the riparian and stream habitat conditions were attributed to livestock use and past logging practices in the riparian.

In middle reaches, the survey noted excessive riparian damage due to logging of the riparian zone, including blowdown and slash debris within the channel and sediment deposition in pools.

Incised eroding channels occur in mid to lower stream reaches.

This channel type occurs in areas where stream base level has declined, rapidly causing downward cutting of the channel. The loss of large woody debris in the Gold Creek channel and/or changes in stream discharge may have been responsible.

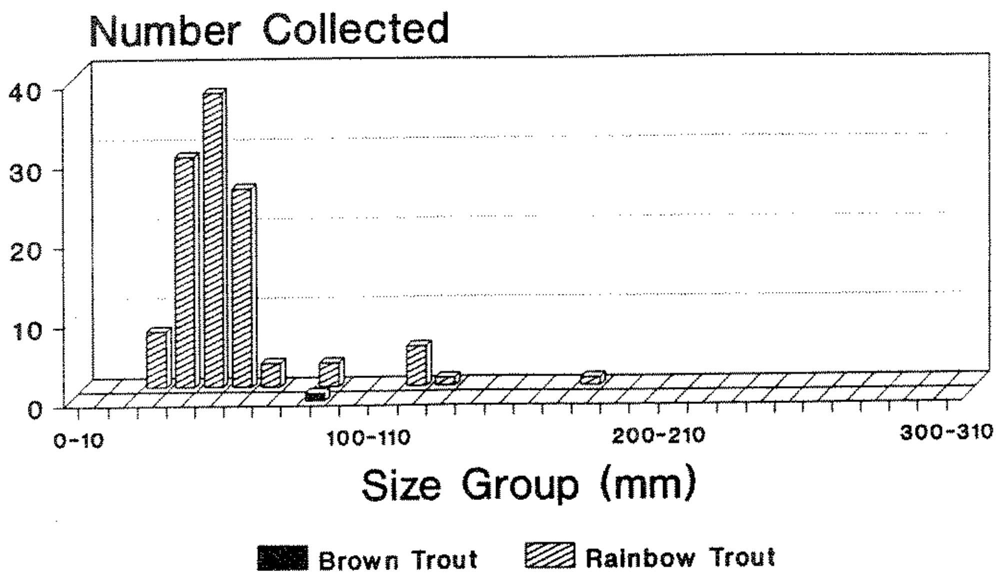


Figure 13 Length-frequency for all trout species collected at mile 0.1, September 1989.

Woody debris or lack of woody debris is important. For fisheries, the continual incorporation of woody debris into the channel helps create, diversify and maintain quality stream habitats, particularly adult fish habitat through the formation of pools and protective cover. Woody debris also helps dissipate stream energy. The reduction of large conifers from the riparian reduces future energy barriers and may subject the stream to long-term channel erosion.

Sediment buildup combined with the lack of undercut banks and poor pool development may be related to channel scour, livestock overuse, extensive timber harvest in the basin, the loss of large woody debris recruitment to the channel and road encroachment in middle stream reaches.

Corrective measures

High flow fluctuations, stream erosion, damaged riparian and reduced habitat diversity in lower reaches are primary concerns. Factors that reduce the overall habitat quality and limit the fishery may require long-term corrective measures.

High flow fluctuations may be associated with the elimination of forest cover. A significant reduction in forest cover can disrupt the hydrologic regime by decreasing evapotranspiration and interception rates. Both factors increase the amount of water available for stream runoff. Hydrologic studies in the upper and middle section of Gold Creek basin estimated Gold Creek flows have increased by roughly 10% above natural levels (Bill Schultz, pers. comm. 1991). If large scale reduction in the forest canopy influences stream fluctuations and channel erosion, it may take a degree of forest regeneration and recruitment of woody debris to balance forces of erosion and deposition within the channel.

Measures that protect riparian areas could help mitigate high streamflow fluctuations. Better riparian management would allow regeneration and maturation of the current immature riparian community; and reduced timber harvest along stream corridors where future woody debris recruitment is a concern. Regeneration of the conifer overstory and recruitment of large woody debris would help dissipate excessive stream energy, and protect the stream from bank erosion in middle to lower reaches. Increased woody debris in lower reaches would provide cover, and facilitate the scour action needed to develop pools in a stream segment that lacks high quality pools and large fish habitat. In the interim, large woody debris secured in the channel would diversify habitat, benefit the resident and migratory fisheries and help dissipate excessive stream energy.

Wales and Chamberlain Creeks: Small streams of the Garnet Mountains

The Nevada Valley, Ovando Valley and the lower river canyon separate and form a semicircular, mountainous region in the southern portion of the Blackfoot Basin. Unlike the ice-scoured mountains to the north, the Garnet Mountains have unglaciated mountains with rounded summits, lower local relief (approximately 3000 feet) and V-shaped canyons with small streams. These small second and third-order montane basins produce base flows less than 5 c.f.s. All streams in this region flow north; some become underfit in lower stream reaches. Except for a band of glacial deposits along the northern periphery, streams run directly from the mountains into the Blackfoot River, located adjacent to the foothills of this region.

Chamberlain Creek

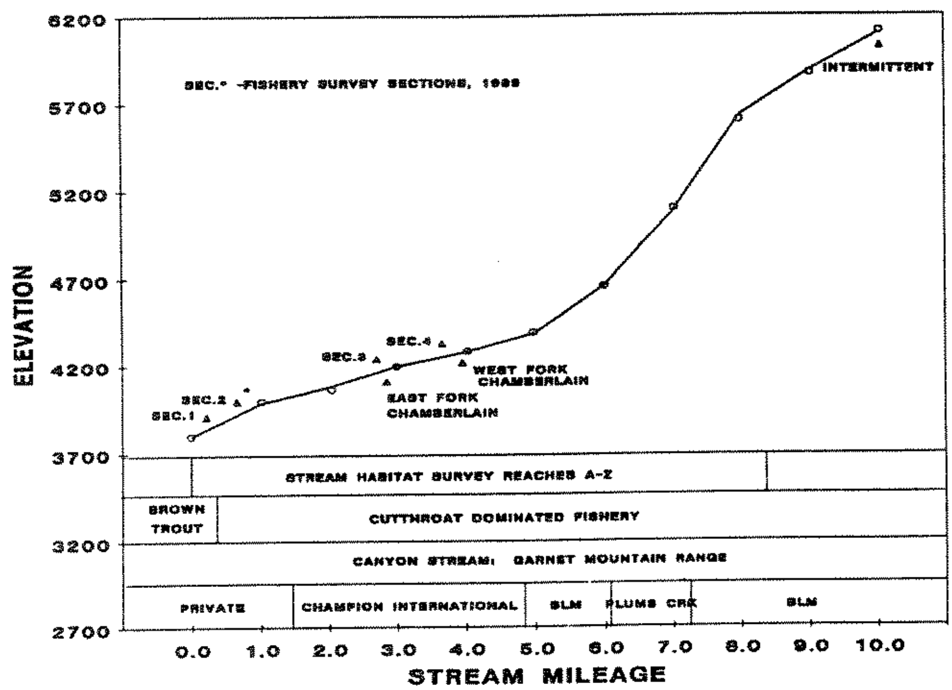


Figure 14 Survey location and profile of the Chamberlain Creek channel.

Chamberlain Creek, a small 2nd-order stream, originates and flows north from Chamberlain Meadows (elev. 6080). The stream flows through a V-shaped canyon in upper reaches, becomes underfit in mid to lower reaches before finally entering glacial deposits near the mouth. Gradient increases and the stream becomes entrenched in glacial deposits just before entering the river. This small cutthroat dominated stream enters the rainbow dominated section of the Blackfoot River at river mile 43.9 (elev. 3790). Discharge was 2.1 c.f.s., September 1989.

Results

Chamberlain Creek was divided into 25 reaches and surveyed at the

10% intensity. A total of 349 samples were taken. The habitat crew measured 116 pools, 165 riffles and 68 glides. Riffles comprised 74% of mean stream surface area, compared to 16% and 9% for glides and pools respectively. The frequency of occurrence for all habitat types per unit stream length was highest near the mouth (fig. 15).

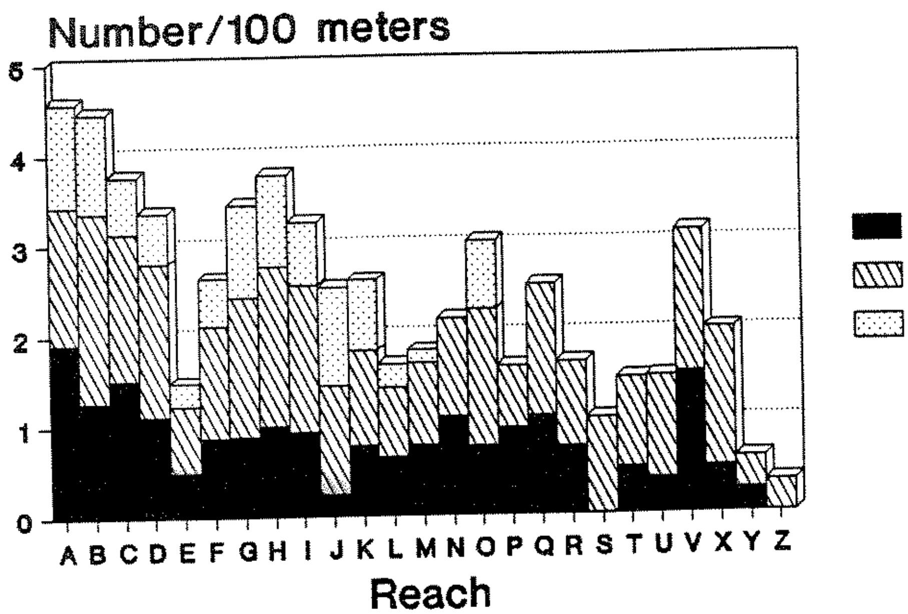


Figure 15 Frequency of habitat types for sampled reaches of Chamberlain Creek.

Of 116 pools: 40% were backwater pools; followed by 28% plunge pools; 15% trench pools; 9% dammed pools; 8% lateral scour pools; and 1% secondary channel pools. Backwater pools were common throughout the stream. Dammed and lateral scour produce pools near the mouth. Plunge pools were common above reach C. Trench pools were common in middle and upper reaches.

Ninety seven of the pools had structural associations. Boulders form the primary associations in mid to upper reaches. Woody debris form the primary pool associations in middle reaches. Bars provide pool structure in lower reaches B through I. Stream bends form some pool structure in lower reaches A through D. Waterfalls, beaver dams, culverts and other forms of structure were less common.

In riffle habitats, boulders comprised the bulk of structure in upstream reaches. Large woody debris is the dominant structure forming component in middle reaches. Bars become a dominant structure forming component in mid to lower reaches.

Riffles were by far the longest habitat type in Chamberlain Creek with a mean length of 70 meters. The type of riffle habitat varied with stream reach. In lower to middle reaches, low gradient gravel and cobble riffles comprised the bulk of the riffle types. In upper reaches cascades abruptly become the characteristic riffle type. A few Low-gradient bouldery riffles were recorded over the streams length above reach D.

Forty one percent of the sampled riffles had structural associations. Pocket water formed almost all the riffle associations. The amount of pocket-water structure increased upstream from the mouth. In middle to upper reaches almost 100 percent of the sample had pocket water associated with cascading riffles.

Runs comprised 15-25% of the stream surface area in lower reaches. With increasing gradient the surface area covered by runs decreased in middle reaches. Runs eventually disappear, replaced by cascading riffles as well as plunge and backwater pools. The amount of pool surface area also decreases upstream. Riffle surface area increases upstream. Mean width decreases slightly upstream. Stream depths remains static throughout Chamberlain Creek.

Substrate composition was diverse for all habitat types. Small amounts of bedrock were found in some pools and runs. Boulders comprised the highest percentage of the substrate in pools while gravel comprised the highest percentage of the substrate in runs. Rubble and gravel comprised an equal amount of the substrate in riffles. Sand and silt comprise 8% of the riffle substrate.

Surface sediment fines covered 14% of the measured pools, followed by 9% of the runs and 2.5% of the riffles. Fine sediment accumulation was heavy in lower and middle reaches A,D,F, and J.

Bank conditions and stream cover were sampled in 18 locations. For the entire sample: aquatic vegetation covered 1.3% of the sampled channel area; bank cover was less than 1%; overhanging vegetation lined 10% of the of the stream. Instream cover was 16%. Twenty eight percent of the stream banks were reported as eroding; Four percent of the stream banks were undercut.

Riparian vegetation is diverse in lower stream reaches with woodland, shrubland, parkland and meadow cover-types represented. Willow, alder, Douglas fir, were all dominant overstory species while alder, dogwood willow comprise the shrub layer. Upstream of reach H, spruce become the dominant overstory species with either alder, dogwood in undergrowth shrub layers. The successional stages of the riparian plant communities range from a pole dominated woodland in the early successional stages, to an overmature, poorly stock woodland.

The length of the average pool and glide sampled for woody debris was 14 meters in length. A unit of this length had: a mean of 3.2 pieces of active woody debris; and 0.8 pieces of inactive woody debris. For both banks this unit supported 4.4 pieces of potential woody debris: 2.7 on the left bank, and 1.7 on the right bank.

The amount of organic debris for individual stream reaches was highest in between reaches J and S (fig. 16).

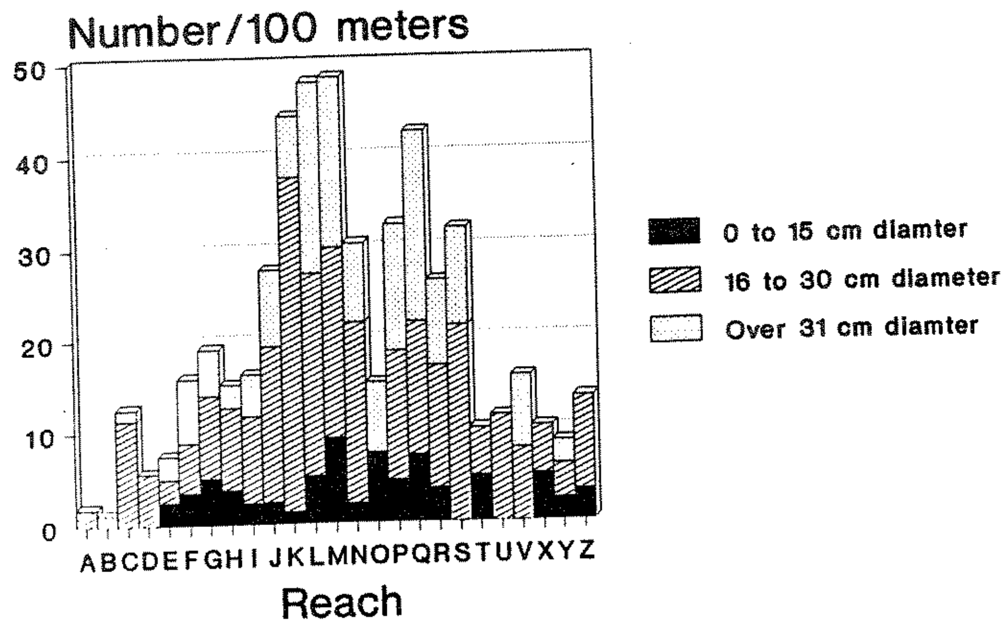


Figure 16 Amount of organic debris for individual stream reaches of Chamberlain Creek.

Thirty percent of the combined stream units were encroached by roads: 48% on the east bank and 12% on the west bank. Most samples recorded a high degree of encroachment.

Discussion

Chamberlain Creek is diverse not only because of its physical stream features but also due to a diversity of limiting factors. The diversity of physical habitat features probably contribute to its high fishery value. Chamberlain Creek held the highest trout densities of 20 tributaries sampled in 1989 (Peters 1990). The sample was taken at mile 3.8, reach H, located just below the confluence of the West Fork. The population survey revealed a westslope cutthroat trout density of 967 (±107) fish per 1000 feet of stream and much lower densities of brook and brown trout. Of 20 tributaries sampled for YOY during 1989, Chamberlain Creek had 2.9 YOY cutthroat trout per 10 foot stream section. For cutthroat trout, this density is nearly three times that of the next highest ranking stream. Based on the habitat survey, Reach H where the fish population survey was taken had highly diverse habitats and few limiting factors compared to up and downstream reaches (Fig. 17). Fishery surveys in downstream reaches A and B revealed a significant decline in catch-rates. The fisheries crew attributed declining catch-rates of cutthroat trout to channel alterations, diversions, dewatering and excessive sediment. A population survey in reach A, September 1991, estimated juvenile brown trout densities at 116 (±3) per 1000 feet of stream.

The habitat trend in 44% of the stream reaches is reported as static. The static trend exist in lower and upper reaches. All middle reaches, G through S, or 56% of the total were recorded as deteriorating.

Domestic stock was reported to cause pollution and habitat destruction over lower and middle stream reaches. Stream bank erosion is excessive in lower and middle reaches. Elevated sediment levels in mid to upper reaches are suspected to be a result of poor logging and road building practices.

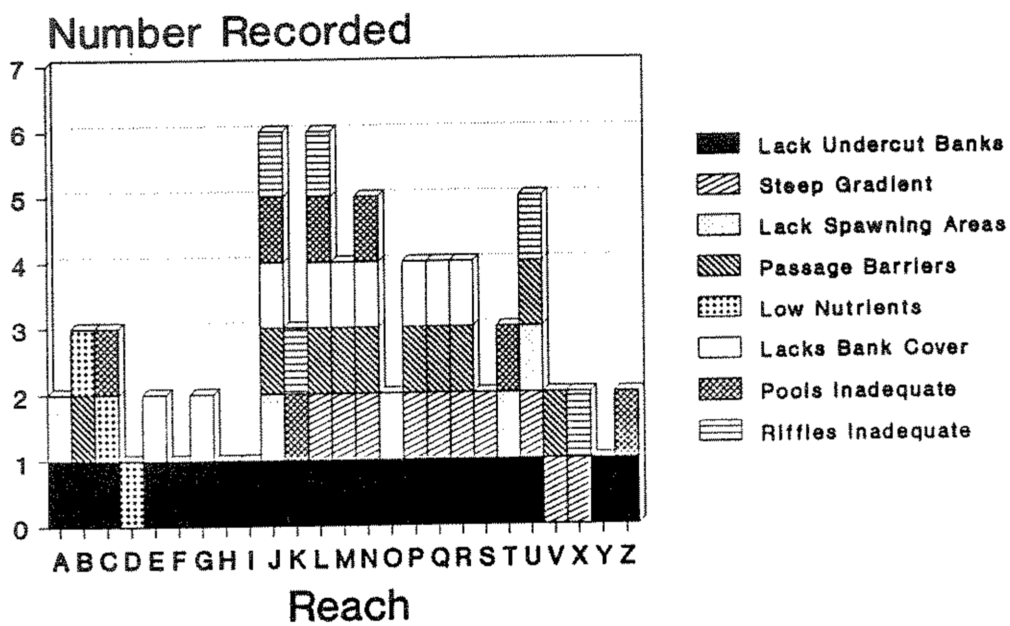


Figure 17 Physical and biological limiting factors for Chamberlain Creek Reaches.

The highest frequency of limiting factors were recorded in the mid to upper stream reaches. Chamberlain Creek lacks undercut banks in 88% of the reaches. Bank cover is lacking in most middle reaches. Pools were recorded as inadequate in 28% of the reaches. Riffles were inadequate in 16% of the stream reaches. Culverts, beaver dams and diversions may hinder up and downstream fish movement near the mouth. Passage barriers are mostly natural in mid to upper reaches.

Road encroachment and channel alterations has eliminated a large amount of potential woody debris along the east bank of middle stream reaches.

Corrective measures

Chamberlain Creek supports high resident populations of westslope cutthroat trout and a good population of juvenile brown trout near the mouth. High populations indicate Chamberlain Creek has high potential for providing the Blackfoot River with recruitment of cutthroat trout and brown trout. Chamberlain Creek's high fishery values warrant better management of the stream and riparian corridor.

Passage problems near the mouth should be corrected. Barriers include a series of beaver dams, two stream diversions and a culvert. By restricting up and downstream movement, these barriers tend to reduce spawning success and recruitment of the fish into river populations.

Culverts can restrict upstream movement of cutthroat trout because migrations occur during spring runoff when stream velocities increase. Culverts restricting upstream movement should be replaced by devices that permit passage. Stream diversions near the mouth inhibit up and downstream fish passage. Barriers restrict spawning activity to the lower one-half mile of stream during base flow periods. Large numbers of juvenile cutthroat trout were observed in irrigation ditches below the upstream diversion during stream surveys October 1991. Incremental diversion closure over a three day period should protect a segment of cutthroat trout that move into irrigation ditches during base flow periods. A beaver control program coupled with better diversion management near the mouth would allow better tributary access and increase the amount the amount of stream available for fall spawning brown trout and their offspring.

Potential woody debris has been reduced along the east bank. The elimination of large woody debris may reduce stream structure, security-cover and will gradually reduce stream habitat diversity through time. This reduction in potential woody debris could be reversed by allowing the growth and regeneration of conifers through riparian management that recognizes the value of riparian woodlands to the maintenance of stream habitat.

Domestic livestock negatively effects habitat quality in lower to middle stream reaches. Alteration of the grazing system could improve riparian conditions.

Logging practices and sediment impact the quality of stream habitat in Chamberlain Creek. Stream side management zones with a distance of 25 to 50 feet for Chamberlain Creek and its tributaries would provide a buffer against land disturbance, and reduce the amount of sediment entering the stream. In 1990, the West Fork of Chamberlain Creek was identified as significant contributor or sediment into lower Chamberlain Creek (Peters 1990). An erosion control program combined with better stream side management could mitigate logging impacts and help maintain and improve habitat and fishery resources.

Wales Creek

Wales Creek, a 2nd-order tributary to the middle section of the Blackfoot River, flows northeast 9 miles from Chamberlain Meadows and joins the Blackfoot River at river mile 60.4. Wales Creek drains montane woodlands and prairie parkland cover-types with decreasing elevation. The upper stream flows through a v-shaped canyon incised in granitic rock-types before entering Wales Creek Reservoir and morainal foothills located in the lower basin. The upper basin is public land administered by the Bureau of Land Management. At about mile 5.0, Wales Creek enters private land. Public land in the upper basin is under special management wilderness study designation. Livestock ranching, timber harvest and irrigated farmland dominate land usage in the lower basin. Below the reservoir, Wales Creek is regulated via both outlet flows and diversionary withdrawal. Discharge for Wales Creek was 1.4 cfs at the mouth on 9/19/89.

Results

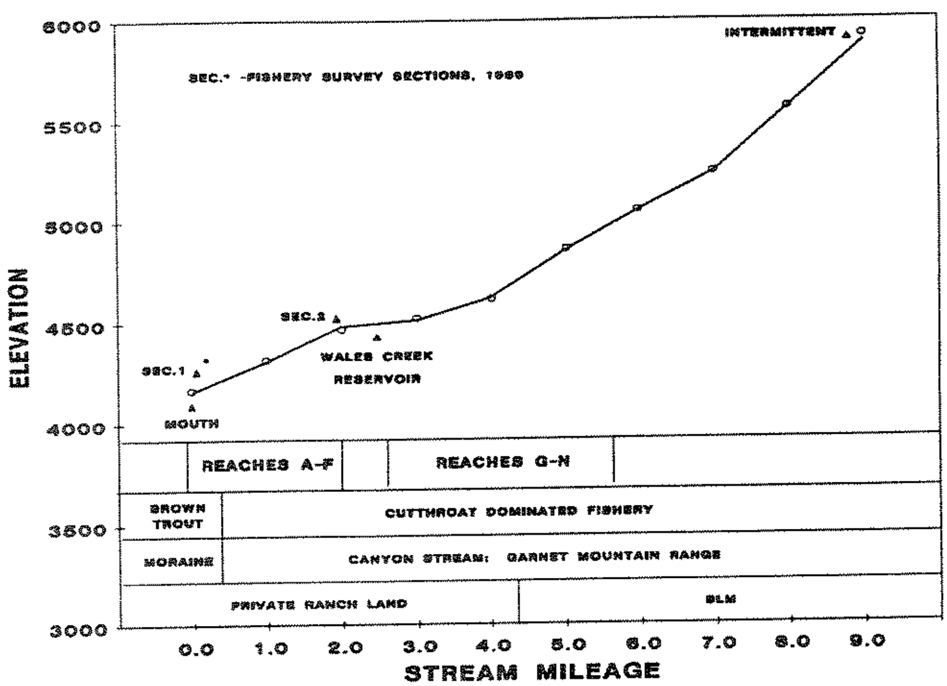


Figure 18 Reach location and profile for Wales Creek.

Wales Creek was divided into two main segments of which 14 reaches were surveyed at the 10% intensity. The lower segment, reach A, begins at the confluence with the Blackfoot River and extends 2.0 miles upstream to the reservoir outlet at reach F. Reaches G begins at the reservoir inlet and ends approximately 3.2 miles upstream at reach N.

The stream habitat survey measured 103 habitat units: 51 riffles, 36 runs and 16 pools. Mean riffle length was 143 meters compared to 24 and 6 meters for runs and pools. Based on the mean lengths and widths, riffles comprised 80% of the stream surface area followed the 16% and 4% for runs and pools.

Of the pools, backwater areas were most common, followed closely by lateral scour pools. Secondary channels and dammed pools were sampled at lower frequencies.

Lower gradient gravel riffles was the most frequently sampled habitat type, followed by low gradient gravel, cascades, low gradient boulder and riffles associated with secondary channels.

All surveyed pools had structural associations, compared to 24% of sampled riffles. Of the riffles cascades had the highest percentage of structural association; while low-gradient gravel riffles had the lowest percentage of structure associations.

Riffles and glides were the only habitat types sampled for substrate composition. Fine sediment, sand and silt, comprised the 57% of the sampled substrate. Sample substrates had 36% mean surface fines. This represents the highest levels of fine sediment of the three basin fed streams.

Road encroachment was recorded at 25% with an even amount of encroachment for both banks.

Meadow vegetation comprised the bulk of the riparian in lower stream reaches. In upstream reaches spruce parkland and Lodgepole pine/alder brush were the communities reported. Riparian plant communities ranged early successional stages in lower reaches to mature riparian communities in upper reaches. The overall level of community development was in early successional stages.

The average unit had a mean length of 11.0 meters. This unit averaged 1.7 pieces of active woody debris, 0.3 piece of inactive debris and 2.8 pieces of potential woody debris. The left bank had 3.3 pieces of potential woody debris, compared to 2.3 on the right bank.

Bank erosion occurred along 41% of the sample banks recorded as eroding. Four percent of the sampled banks were undercut.

Discussion

Unlike the Chamberlain Creek survey, the Wales Creek Survey did not produce well defined patterns of habitat variability. This may be due to a small sample size and/or habitat heterogeneity.

The habitat was recorded as deteriorating in 9 of the 14 reaches, (A through I). In upstream reaches the habitat trend was reported as static. Domestic livestock was reported to impact stream habitat in reaches A through J. Cattle impacts include bank erosion, riparian damage and bank instability. Domestic livestock excrement was recorded as frequent sources of pollution in reaches B through H.

The stream segment below the reservoir had a higher number of stream impacts compared to the segment above the reservoir. Negative impacts below the reservoir include: inadequate pools, reduced instream and potential woody debris; excessive flow fluctuations; dewatered stream sections; elevated stream temperatures; lack of undercut banks; lack of spawning areas; and elevated sediment levels.

Fishery surveys were undertaken in two locations in the downstream section below the reservoir, September 1989. The first survey sampled a 420 foot section beginning at the mouth. The second survey electrofished 150 feet of stream just below the reservoir outlet. The downstream section sampled mostly juvenile brown trout and a few cutthroat trout. Of 20 tributaries sampled for YOY in 1989, the mouth section of Wales Creek had the 3rd highest densities of brown trout YOY with 0.38 fish per 10 foot of stream (Peters 1990). Below the reservoir cutthroat trout were the only fish species collected. Densities of YOY were relatively high compared to most sampled streams with cutthroat YOY. However, the Wales Creek survey collected only 37% of the numbers collected at Chamberlain Creek per unit of stream length (Peters 1990).

Reaches above the reservoir were reported to: lack bank cover; lack undercut banks and maintain inadequate pools. The granitic rock types in upstream reaches probably are a major factor in high sediment loading in upper reaches. The habitat crew reported unstable banks were due to erosive rock types and steep slopes.

Corrective measures

Small streams in the Garnet mountains like Wales and Chamberlain Creek have potential to support high fish densities and provide increased recruitment to the middle section of the Blackfoot River.

Below the reservoir, cattle impacts and dewatering are two sources of stream degradation that if corrected could benefit water quality and fisheries. The fishery could benefit if the reservoir and diversions were regulated to maintain minimum instream flows.

Stream degradation in lower reaches could be reversed with grazing strategies that limit the time when cattle are permitted into the riparian zone. Future management of the upper basin that causes land disturbance should be cognizant of naturally erosive and unstable steep granitic slopes and existing high sediment levels.

The lowest gamefish densities in the Blackfoot River occur in the river section where Wales Creek enters. Extremely low numbers of adult trout in the middle Blackfoot River is tied to low recruitment. Poor recruitment is tied in large part to a limited amount of spawning habitat, poor quality habitats and barriers to tributary spawning sites. Improved habitat quality in these tiny north flowing tributaries could improve not only resident cutthroat and brown trout fisheries but also provide increased recruitment to a recruitment-limited section of the Blackfoot River.

Conclusion

Blackfoot River fisheries depend upon quality tributary habitats. Depending upon basin and riparian usage, the condition of tributaries range from pristine in some upper basins to severely degraded. Trout species are very sensitive to environmental change. Few trout in a stream that once produced abundant numbers, may be a result of recent land use activities. Uncontrolled grazing on agricultural lands and poor logging practices in mountain riparian areas are two primary land use practices that cause stream habitat degradation and depressed fisheries. Poor riparian management leads to elevated stream temperature regimes, uncontrolled erosion, sedimentation of streams and lose of protective-cover for salmonids. Stream habitat degradation not only impairs the capability of tributary streams to produce and maintain populations of fish species, but also reduces habitat quality and fishery values in downstream river reaches. Despite existing damage, riparian zones, streams and many fisheries are resilient and have the potential to respond dramatically to improved management.

Solving problems is favorable only if interdisciplinary efforts and cooperation occurs. All parties, timber interests, livestock operators, state and federal land management agencies could better promote properly managed land-use practices adjacent to streams and correct existing damage. Parties must recognize that stream zones require special management. Implementation of management practices should be designed to meet clearly stated habitat objectives to protect and/or improve the zones. Trout habitat protection may be easier and more cost effective than trout habitat restoration. When restoration is warranted, improvements of riparian corridors should be tailored to meet conditions, problems, site potential, objectives, livestock and/or logging considerations on a site-specific basis. This does not mean that resolution relies on the elimination of traditional practices, but rather management should conform with other recognized uses of riparian areas. Through cooperative efforts, reasonable approaches that improve and maintain habitat for fish and wildlife can be developed. When properly implemented and supervised, compatible grazing and timber harvest techniques could become important management tools benefiting fish and wildlife in riparian habitats.

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