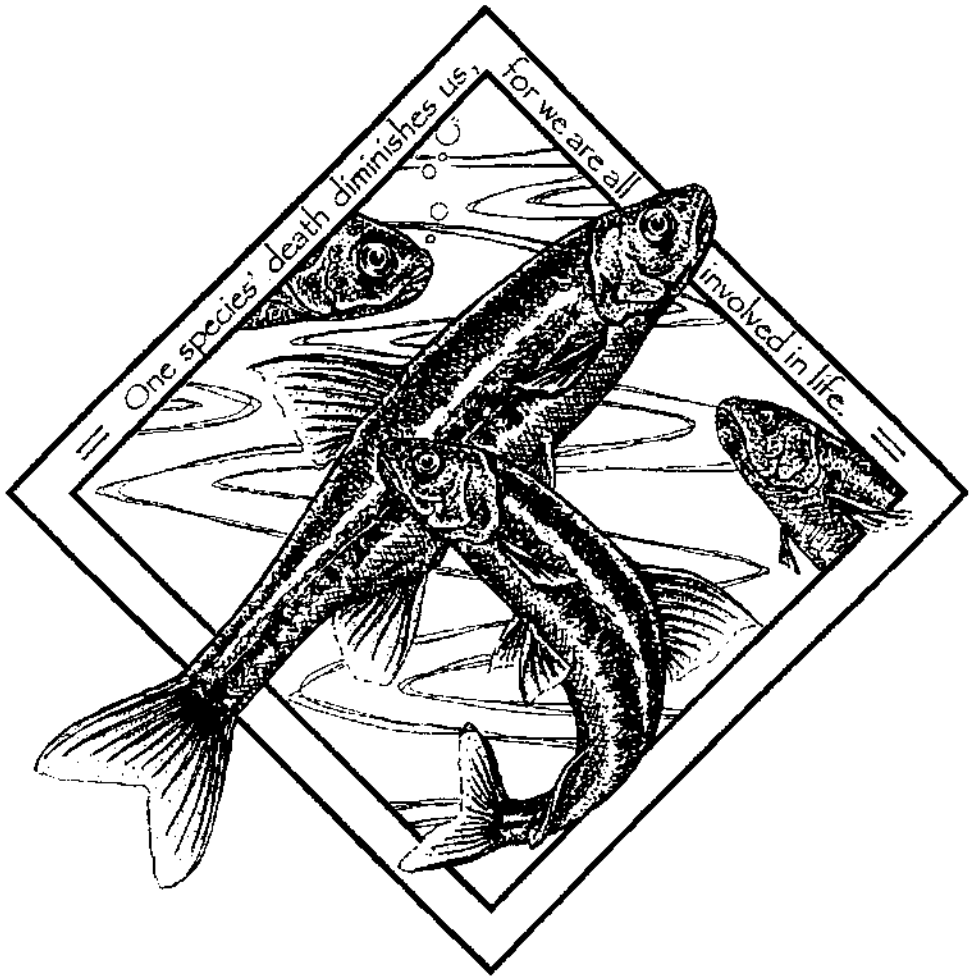

Final Report - March 4, 2002

Little Colorado Spinedace Habitat Survey and Restoration In The East Clear Creek Watershed

Arizona Game and Fish Department
Heritage Fund Program IIPAM
Grant #I99006

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DISCLAIMER

The findings, opinions, and recommendations in this report are those of the investigators who have received partial or full funding from the Arizona Game and Fish Department Heritage Fund. The findings, opinions, and recommendations do not necessarily reflect those of the Arizona Game and Fish Commission or the Department, or necessarily represent official Department policy or management practice. For further information, please contact the Arizona Game and Fish Department.

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INTRODUCTION

The Coconino National Forest was awarded a Heritage Grant (Heritage IIPAM Fund) through the Arizona Game and Fish Department by letter dated September 8, 1999. This Grant funding coupled with Forest Service matching dollars were used to accomplish two objectives within the East Clear Creek (ECC) Watershed specific to the Little Colorado spinedace (*Lepidomeda vittata*) and its habitat. The first objective was to conduct stream habitat inventory surveys to locate and identify occupied spinedace habitat and / or potential future spinedace stocking sites within five major drainages. The second objective was to enhance spinedace habitat through protection of meadow habitat, and associated spring sources, from elk grazing within the headwaters of two drainages.

Both objectives for the work accomplished under the Grant are in accordance with the Little Colorado spinedace Recovery Plan (USDI 1998), and with the 1999 strategy developed to facilitate and guide the recovery of the spinedace and its habitat within the East Clear Creek Watershed (USDA 1999).

The Little Colorado spinedace (spinedace) is an endemic cyprinid to the Little Colorado River Basin (Miller 1963). Declines in population abundance and distribution resulted in the September 16, 1987 (USDI 1987) listing of this minnow as a threatened species under the Endangered Species Act. The designation of critical habitat was made in conjunction with the U.S. Fish and Wildlife Service listing of the Little Colorado spinedace (spinedace). The East Clear Creek (ECC) Watershed forms the southwestern extension of the Little Colorado River Basin. East Clear Creek is one of three drainages, within the basin, identified as critical habitat for this species. "Constituent elements" of the critical habitat, consist of "clean, permanent flowing water, with pools and a fine gravel or silt-mud substrate." (USDI 1987)

As with most aquatic habitats in the southwest, the Little Colorado River Basin contains a variety of aquatic habitat types, and is prone to rather severe seasonal and yearly fluctuations in water quality and quantity. Both mountain streams and lower gradient streams and rivers provide habitat for the spinedace. Residual pools and spring areas are important refuges during periods of normal low water or drought. From these refuges, spinedace are able to quickly recolonize other stream reaches during wetter periods (Minckley and Carufel 1967). Populations seem to appear and disappear over short time frames and this has made specific determinations on status and exact location of populations difficult (Miller 1963, Minckley 1965, Minckley 1973), which led to concerns in the 1960's and 1970's for the species survival.

As would be expected for a species adapted to fluctuating physical conditions, the spinedace is found in a variety of habitats (Blinn and Runck 1990, Miller 1963, Miller and Hubbs 1960, Nisselson and Blinn 1991). Whether occupancy of these habitats reflect the local preferences of the species or its ability to tolerate less than optimal conditions is not clear. Available information indicates that suitable habitat for the Little Colorado spinedace is characterized by clear, flowing pools with slow to moderate currents, moderate depths and gravel substrates (Miller 1963, Minckley and Carufel 1967). Cover provided by undercut banks or large rocks are often a key feature. Spinedace have also been found in pools and flowing water conditions over a variety of substrates, with or without aquatic vegetation, in turbid and clear water (Denova and Abarca 1992, Nisselson and Blinn 1991). Spinedace are mid-water dwellers. During high water events, adult spinedace will utilize the lower end of riffles and the upper ends of pools and are positioned lateral to the current (Minckley 1984). It is during these high water events that recolonization of other areas of the stream can occur.

Spinedace can tolerate sediment, but the upper limit of that tolerance is unknown. Blinn (pers. comm.) suspects that an influx of sediment and increased turbidity into the system in the spring may trigger spawning events, however, fine sediment in the spawning gravels reduces the oxygen content and will kill the eggs. Water quality is important during the breeding season, and where the quality is good, spinedace are larger than in areas of poor water quality.

Aquatic and terrestrial insects form the basis of the spinedace diet (Runck and Blinn 1993), but they will also consume algae and detritus (Blinn and Runck 1990, Minckley and Carufel 1967). Spinedace are opportunistic feeders, using whatever is seasonally available (Runck and Blinn 1993). Foraging may take place both in the water column and on the bottom (Minckley and Carufel 1967).

The critical spawning period for spinedace is from early to mid-May, with some spawning occurring in June or July (Blinn 1993, Blinn and Runck 1990, Miller 1961, Minckley 1973, Minckley and Carufel 1967). The later spawned fish may not survive through the winter, and therefore would not recruit into the population. Gravel substrates are required for spawning.

Water temperature regimes may influence the timing of the spawn. When cold temperatures pushed the spawning back to June, Blinn reported that the adults did not become fertile until temperatures reached about 16° Celsius (C). Fry that emerged late in the year (spawned in June) did not survive the winter. A minimum length of 50-60 millimeters (mm) may be necessary for overwintering.

STUDY / CONSTRUCTION AREAS

Stream Habitat Inventories

Stream habitat inventories were conducted along the entire lengths of Yeager, Kehl, Dane, and Bear Canyons; and along that portion of East Clear Creek upstream from Forest Road 141 (Jones Crossing) (Figure 1). These stream channels drain portions of the East Clear Creek 5th code watershed located above the Mogollon Rim in central Arizona. All inventories were conducted on U.S. Forest Service lands. These five drainages flow north from their headwaters along the Mogollon Rim. Depending on slope aspect, the canyon slopes are dominated by a mixed-conifer and ponderosa pine cover type. The stream channels within the upper reaches of each drainage, cut through the relatively deep loamy soils of the alluvial swales. These headwater swales are usually vegetated with a bluegrass / mountain bunchgrass herbaceous cover. The canyons become more deeply incised in the landscape as they flow north.

The 22.6-kilometer (km) distance of Yeager Canyon empties into ECC 10.5 kilometers downstream of the Blue Ridge Reservoir (BRR). Kehl Canyon flows approximately 6.4 kilometers before draining into ECC at approximately 17.6 kilometers upstream from BRR. The 13.5-kilometer length of Dane Canyon is a main tributary to Barbershop Canyon, which confluences with ECC 4.2 kilometers downstream of BRR. Bear Canyon flows a measured distance of 12.4 kilometers before draining into the southern arm of BRR. That surveyed portion of ECC above Jones Crossing measured 13.7 kilometers. Refer to Appendix A for stream course and reach distances in metric and English measurements.

Elk Exclosures

Three elk exclosures were constructed within the headwater meadows of General Springs Canyon and Merritt Draw. One exclosure was constructed in General Springs Canyon, whereas the other two exclosures were constructed in Merritt Draw. The General Spring Exclosure is located immediately south of the historic General Springs Cabin. The Arizona Trail passes down the west side of the exclosure. General Springs Canyon empties into Bear Canyon at the southern arm to Blue Ridge Reservoir; and Merritt Draw empties into Barbershop Canyon, a major tributary to ECC. These headwater meadows are located at the southern extension of their respective north flowing drainages.

Under the original Grant Agreement, only one exclosure was proposed for construction within Merritt Draw. The original proposal was to protect only Whistling Spring within a single exclosure. Another spring, Merritt Spring, is located down drainage from Whistling Spring at a distance to great to be included within the original exclosure. Therefore, the original exclosure was constructed at slightly more than half its original size, allowing for the construction of a second exclosure (in Merritt Draw) to protect the meadow and spring source at Merritt Spring. This deviation from the original agreement was requested through an amendment to the scope of the agreement documented in the April-June 2000 quarterly report dated July 31, 2000.

METHODS / MATERIALS

Stream Habitat Inventories

Habitat Inventory

The Basinwide Estimation of Habitat and Fish Populations in Streams (Dolloff et.al. 1993) methodology was used to conduct the inventories. This stream survey method provides a statistically valid, accurate, and cost-effective inventory process. Under this inventory process, each of the five target streams was stratified into survey units, commonly referred to as reaches. Breaks between reach segments were based primarily upon 1) confluences with major side channels, and 2) distinct features (influential road crossings, springs). Stream reach breaks were identified prior to the start of the inventory using features shown on 7.5-minute topographic maps. Each reach of each of the five target stream courses was named with its respective stream course name and a Roman numeral (i.e. Yeager I). All inventory surveys began at the further downstream point, and proceeded upstream to the headwaters. Therefore, Roman numeral one (I) was assigned to the first reach extending upstream from its

confluence with the next major drainage. For that portion of East Clear Creek upstream of Blue Ridge Reservoir, reach breaks started at the ECC / Miller Canyon confluence. Reach III of ECC began at Jones Crossing.

Within each reach, a basic classification system was used to identify three habitat types: pool, run, and riffle (Table 1). A fourth habitat type (complex) was later determined to be useful to describe multiple pool – riffle associations marked by very short distances for each habitat type (i.e. $\leq$ 2 meters/habitat type). An inventory of these four habitat types was made using a preselected set of habitat characteristics. Habitat characteristics included: habitat unit lengths, average widths (meters), and maximum and average depths (centimeters), primary and secondary channel substrates (ocular estimate), large woody debris (ocular estimate), and water temperature (degrees Celsius). Channel substrate size classes and large woody debris (LWD) size classes are displayed in Tables 2 and 3, respectively.

Table 1. Definitions of the habitat types used under the basic classification system for the East Clear Creek (ECC) Watershed stream habitat inventory.

Habitat Types	Definition
Pool	Generally a slow water habitat type where subsurface velocities tend to be slow. Pools are bounded by a head crest (upstream break in slope) and a tail crest (downstream break in slope). This habitat type is generally formed by either a damming feature (large wood debris, boulders, beaver dam), and/or scouring water that carves out a nonuniform depression in the channel bed. Scours are generally formed in association with instream boulders, stream channel meanders, and/or large woody debris.
Run	Typically a fast water habitat that can have deep and fast water with a defined thalweg and little surface agitation. However, as found in the ECC Watershed, runs are typically slow water habitats that resemble the flat water of a pool, but with a defined thalweg and no apparent scour.
Riffle	A fast water habitat unit in which water flows swiftly over completely or partially submerged obstructions to produce surface agitation. Riffles found in the ECC Watershed are low gradient riffles given gradients of less than 4 percent.
Complex	Within the ECC Watershed, this habitat unit identifier was used to describe multiple pool – riffle associations marked by very short distances for each habitat type (i.e. $\leq$ 2 meters/habitat type).

- **The literal translation for "thalweg" is "valley way"; the defining trough of a stream channel, or in other words the line connecting the lowest or deepest points along a streambed.**
- **The basic definition for each habitat type was taken from Overton et al. 1997**

Table 2. Stream channel substrate size classes used during the summer of 2000 habitat inventories of the five target stream courses within the East Clear Creek Watershed.

Substrate Type	Metric Measure (millimeters)
Fines	<2 mm
Gravels	2 – 128 mm
Cobbles	129 – 256
Boulders	> 256 mm
Bedrock	
Embedded	

Table 3. Large Woody Debris size classes used during the summer of 2000 habitat inventories of the five target stream courses within the East Clear Creek Watershed.

	Diameters (centimeters)			
Lengths (meters)	5 to 10	11 to 50	Over 50	Rootwad
1 to 5	Class 1	Class 2	Class 3	
Over 5	Class 4	Class 5	Class 6	Class 7

This table is from Dolloff et al. 1993.

Sampling of the habitat types within a reach is done as a two-step process. First, the sampling team (crew) classified individual habitat units by habitat type and records visual observations of habitat characteristics. Secondly, the sampling team pairs visual observations of surface area with actual measurements taken at a predetermined number of units (at least 10 for each habitat type) to develop a calibration ratio. The team was assigned a sampling fraction of 20% as the number of units in each habitat type they would measure for surface area as a check for their visual observations. The number of measured units is based on the expected number of units in a habitat type and on the expected degree of consistency between visual observations and actual measurements from one unit to the next. If a habitat type is likely to be rare, the team would need to measure most or even all of the units of that type to assure that the number of paired observations meet the recommended minimum of 10.

Before starting the inventory on a particular reach, the team selects a random number to use as the starting point for intervals between habitat units they would measure. For a 20 percent sample, the starting point would be one of the first five units. As an example, if the team randomly selected the 3rd unit for the first set of measurements

(the 3rd pool, 3rd riffle, and 3rd run would be measured in addition to the visually estimated surface area), then their next set would occur on the 8th unit, followed by the 13th, the 18th, and so on until the survey is completed for a particular reach.

The inventory crew (team) consisted of three Northern Arizona University students hired as summer season employees of the Coconino National Forest. Team members included George Christianson, Brian Clark, and Josh Cousins. Except for Kehl Canyon, this team of three physically measured the entire lengths, along the thalweg, of the five surveyed stream courses during the habitat inventory portion of the surveys. The length of the Kehl Canyon was estimated by counting paces as the estimator walked the thalweg of the stream channel.

The team used a Garmin III Plus GPS unit to obtain Latitude / Longitude coordinates for the beginning of each reach and the end point of the last reach. A 50-meter (m) vinyl tape was used to measure the thalweg lengths of each and every habitat unit, and to measure the cross section widths to calculate average widths for the measured habitat units. A 5-meter pocket surveyor's rod was used to measure maximum depths for each and every habitat unit, and to measure cross section transect depths to calculate average depths for the measured habitat units. A Celsius thermometer was used to take water temperatures at only the measured habitats. The crew photographed significant habitat features and fish with a 35 mm camera.

The habitat inventories would begin at the downstream end of each reach and proceed upstream, recording an assigned unique number to each habitat unit (e.g. Pool–1, Riffle-1, Pool-2, Run-1). A single team member was dedicated to the task of estimating the widths for the visual observations on each and every habitat unit. As the team moved upstream the assigned data recorder would log the various habitat characteristics for each visually observed habitat unit (actual taped length of the thalweg, estimated average width, maximum depth measurements, visual estimate on primary and secondary substrate classes, and woody debris classes). The team would continue making and recording visual observations until they arrived at a habitat unit that they designated (random draw) for measurement (to correlate with the visual observations on widths). After visually estimating the width, the team would calculate the mean width from measurements taken at three cross sections perpendicular to the thalweg and at one-quarter, one-half, and three-quarters the distance of the habitat unit's thalweg. The length and widths (visual and actual) were entered into an Excel spreadsheet, which was designed to calculate surface areas, generate calibration ratios, calculate correlation coefficients, variance of the true total surface area for each habitat type within the reach, and reach totals for each habitat type.

Fish Sampling

Following each respective stream's habitat inventory, the crew revisited the watered portions to sample fish from the randomly selected habitat units identified during the habitat inventory. Sampling fish in the randomly selected habitat units deviates from the fish survey method described by Dolloff for the Basinwide Estimation technique. As described, estimated numbers of fish are made through visual observations by divers within a percentage of the total number of measured habitats for a specific habitat type (i.e. pools). Diver counts are then calibrated by electrofishing a sampled subset of the habitat type visited by the divers. Under the survey technique described by Dolloff et.al.(1993), a multiple-pass depletion sampling effort with electrofishing equipment would be used to get a more accurate estimate of the number of fish for use in calibrating the diver visual estimates. For this survey in the East Clear Creek Watershed, at least one sampled habitat type (pool and run) per reach received a three-pass depletion sampling effort. Typically, disturbed sediments within the sampled habitats impaired visibility to the point of precluding any additional electrofishing passes.

Given habitat conditions within our study area, diver counts were substituted by a visual guess (not a count) as to the number of fish in a given habitat unit while walking along the habitat. Fish guesstimates were made in only the pool habitat types. Most all pools received a guesstimate. Guesstimates were for total number of fish in a particular pool. Only those pools that were actually measured were then electrofished to establish some sort of calibration ratio, which was then used to estimate total number of fish per reach. In the time between the habitat inventory and the electrofishing, some of the measured pools dried up; and therefore, were not sampled for fish. In order to keep the sampling numbers as close to the measured habitat numbers, unmeasured pools were sampled for fish. On occasion, larger pools that were not measured during the habitat inventory were also sampled for fish. These larger pools were likely to persist during a drought period, while many of the other pools would be lost as fish habitat.

A Smith-Root Model 12-B backpack electrofisher and two dip nets (1/8 inch mesh) were used to collect fish from pool and run habitats within most reaches of the five stream courses. Fish collected from each sampled habitat were identified to species and enumerated. A subset (1 to 25) of the total number of each species within each habitat's collection were weighed and measured. Both 60 and 300-gram Pesola spring scales were used for weighing the fish. Larger fish were clipped directly to the scale, whereas the smaller fish were weighed in a plastic bag clipped to the scale. Fish total lengths (TL) were measured on a millimeter ruler board. Real-time electrofishing

duration was recorded, as were electrofisher settings and amperage output and water temperature.

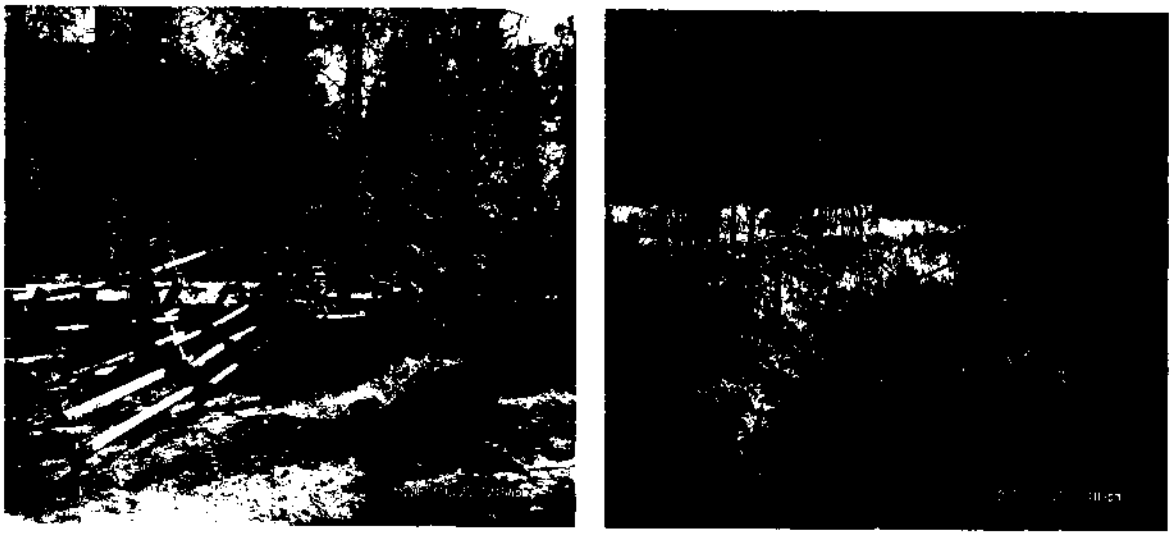
Elk Exclosures

The exclosures were located within portions of the two headwater meadows that are protected from livestock grazing. The addition of these elk exclosures creates three additional elk/livestock paired grazing study areas to the four that currently exist within the Coconino National Forest portion of the watershed.

Each exclosure was constructed to a height of approximately seven feet. Steel pipe posts, two and seven-eighth inches in diameter, were cement into holes spaced approximately 13 feet apart and dug to about three feet in depth. Two ten-foot steel T-posts were driven into the ground at an even spacing between the steel pipe posts. Trees with a diameter of 10 inches or greater were used as inline and corner posts. Pine stays were placed between the trees and the fence wire. Four-foot high hog wire was attached to the posts to form the bottom panel of the fence. Five strands of high-tensile wire were threaded through hex head nuts welded onto the steel pipe posts at a spacing to complete the last three-foot of fencing. All labor was done by hand, except for the use of a small cement mixer.

The north and south ends of the General Springs exclosure were constructed with different materials. Due to the proximity of the exclosure fence to the historic General Springs Cabin, the southern end of the exclosure (within view of the cabin) was constructed in a buck and pole type fence with peeled green cut pine pole size trees (Photo 1). The section of fence along the northern end (downstream of the cabin) was constructed with steel pipe posts and steel sucker rod rails welded to the posts. This pipe and sucker rod fence construction was better suited for the drainage crossing at the downstream end of the exclosure (Photo 2).

Construction began in June 2000 and was completed by September 1, 2000. The number of personnel used to complete the elk exclosures varied between one and six individuals depending on the particular task to be accomplished.



Photos 1 and 2. General Springs Elk Exclosure: Constructed in General Springs Canyon, just north of the historic General Springs Cabin, during June and July 2000; photo taken October 25, 2001. **Left Photo:** View of the buck and pole section of the fence along the southern end of the exclosure. **Right Photo:** View of the steel pipe and sucker rod section of the fence along the northern (downstream) end of the exclosure.

RESULTS AND DISCUSSION

Stream Habitat Inventories

A compilation of the information gathered for each of the several reaches within each of the five surveyed stream courses is presented in four appendices (Appendix A, B, C, D). Information and data pertinent to all five stream courses is summarized in the following "General Summary" narrative. Figure 2 displays a comparison of the total distances for the five stream courses, and their proportional distances for each habitat type. Items of particular interest (i.e. specific habitats, barriers, fish species) pertaining to each stream course and their respective reaches are summarized under the "Reach Summaries" subheading of this section.

General Summary

The lack of a winter snow pack, spring rains, and very late summer monsoonal rains resulted in severe impacts to the fish and their habitat within the East Clear Creek Watershed. Between the time of the habitat inventory and the fish sampling of a particular stream, smaller pool, runs, and any connecting riffles were found to have dried up. Aside from the occasional deep pool ($\geq$ 1 meter), all other habitats (pool, run, riffle) were shallow and waning as the summer progressed. Where riffle habitat

existed, the flows were typically so narrow and shallow that discharge measurements were not made. Habitats classified as "runs" were, in many cases, isolated pools of flat water within sections of a reach that would normally exist as part of a riffle during peak and base flows.

This dry summer provided a much-needed opportunity to inventory habitat conditions during extremely dry conditions. As it happened, the inventory planned for potential / historic spinedace habitat coincided with one of the drier years. The inventory during the dry summer of 2000 allowed the opportunity to locate pool habitat that is most likely to persist during a drought period.

Habitat inventories began with Yeager Canyon on May 30 followed by the completion of the fish sampling by June 20. This habitat / fish survey method continued for each of the other four stream course in the following order: Kehl, Dane, Bear, and East Clear Creek. As would be expected, the inventory crew became more efficient with the survey technique and equipment as the summer progressed. Also, as the summer progressed, stream courses dried up, resulting in lengthy dry stretches, fewer habitat units to inventory and sample for fish. For those habitats that received a fish survey and that were subjected to drying, sampling of the concentrated fish became extremely efficient.

Spinedace were not collected in any fish survey within any of the five stream courses. All fish collected during the sampling surveys were returned to the habitats from which they were collected. Obvious, but infrequent mortalities on fish were noted on the electrofishing data sheets. Despite collecting permit allowances for stomach content analysis on any and all trout collected, none were made and all trout were returned to their respective habitats.

Crayfish (*Orconectes virilis*) are typically abundant within East Clear Creek downstream of Blue Ridge Reservoir and in Barbershop Canyon. Barbershop Canyon is one of the main tributaries to East Clear Creek, and Dane Canyon is a main tributary to Barbershop Canyon. Despite this abundance, not one crayfish was observed in any of the five surveyed stream courses until the upstream end of Reach V in ECC. Reach V was the last to be surveyed (August 10), and contained the greatest percentage of dry stream channel. The upper end of Reach V is approximately one kilometer downstream of Potato Lake, which is known for its crayfish infestation. If crayfish did exist within the watered portions of the surveyed streams, they were so rare they were not observed. Certainly, the long, expansive dry stretches of stream channel are likely providing a barrier to upstream movement by crayfish.

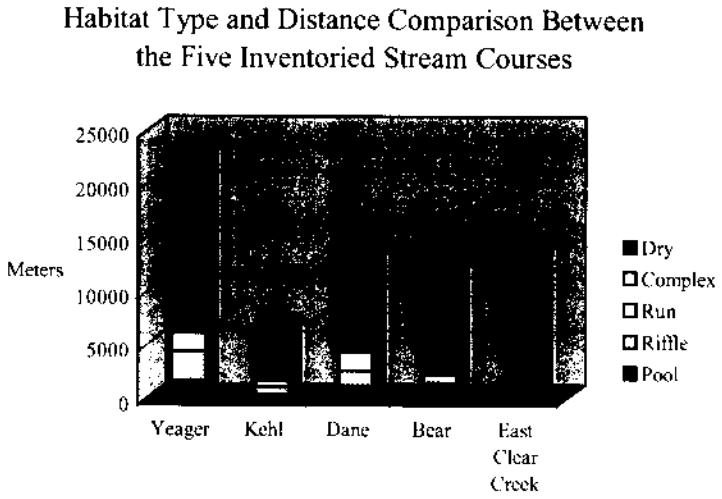


Figure 2. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the five inventoried stream courses.

The Basinwide stream survey technique works best within systems containing perennial water with enough habitats to achieve at least 10 visually estimated / actual measured inventory pairs per habitat type. Even at a 20 percent sampling of each habitat type, the long dry stretches and relatively sparse habitats made it difficult to obtain the data needed for a suitable statistical analysis. This was particularly the case for arriving at an estimated fish population associated with habitat inventoried within each reach. Any correlation that could be made would only provide a "snapshot in time" of the correlation of numbers of fish to habitat for the day fish were sampled. Habitats were drying so quickly that fish losses would result in very different correlations the next day or week.

Reach Summaries

Yeager Canyon

Yeager Canyon was divided into four reaches (I, II, III, IV). Habitat inventories began May 30, 2000 at the Yeager Canyon / East Clear Creek confluence, and ended on June 15th near the headwaters at the upstream end of Reach IV. Reach break coordinates (uncorrected latitude / longitude) are listed in Appendix B. The total length of the canyon measured 22.6 kilometers (14 miles); where Reach III contributed the greatest length (8.8 kms) and Reach IV the least (1.7 kms). Seventy-two percent (72%) of

Yeager Canyon was measured as having a dry streambed. Of the twenty-eight percent (28%) of the canyon occupied by water, Reach I contained the greatest wetted distance (3847 meters) with an estimated 8,004 square meters of surface area (95% confidence interval of 7,247 m^2 to 8,761 m^2). Reach I and III are the only reaches, of all the five target stream courses, where the "complex" habitat type was used. The first three reaches would be characterized as perennial interrupted to intermittent, whereas the fourth reach (headwater reach) would best be classified as an ephemeral drainage.

Figure 3 illustrates the combined distances for each habitat type and dry stream channel found in each of Yeager Canyon's four reaches. Given the scale used in Figure 3, pool and riffle habitat distances within Reach IV are so minimal that the representative bars for their numbers are not visible. Appendix C displays reach summations for total distance, and for the sum total distance of each habitat type. Appendix C also shows the estimated wetted surface areas and calculated 95% confidence intervals for each reach.

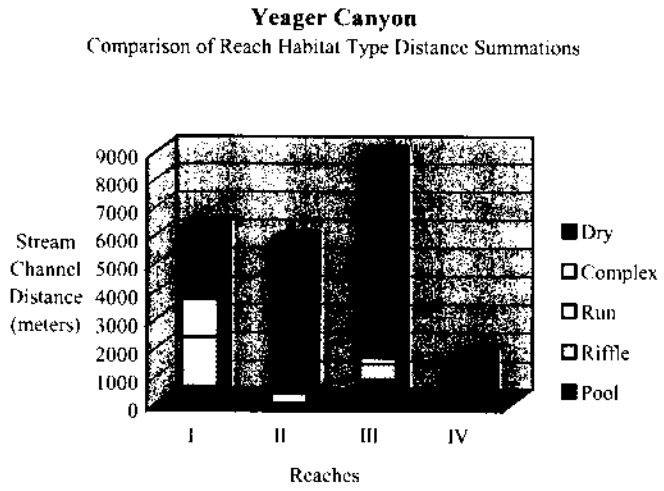


Figure 3. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the four reaches identified in Yeager Canyon.

Yeager I

Reach I extends upstream from the Yeager Canyon/ECC confluence to the downstream end of the culvert at the 95 Road crossing. The majority of the 2,409 meters (m) of dry streambed were found within the first 1,894 meters of stream

channel. Interspersed within this dry stretch were several isolated small pools ranging in size from .9 m long by 1.1m wide to 5.7 m long by .9 m wide. Two large woody debris dams exist at the 773 m and 1,894 m distance. The first debris pile measured eight (8) meters in length by seven (7) meters wide, while the second measured eight (8) meters long with a ten-meter width. These debris dams are composed of Class 2 and 6 sized logs. Three bedrock shelves, spanning the width of the stream channel, were encounter along a 190-meter stream channel distance. The first shelf measured 1.2 meters in height at the 1,744-metered channel distance; the second is 1.5 meters high at the 1,844-meter distance (Photo 3), and the third is nine-tenths (.9) meter in height at the 1,933-metered distance. A latitude / longitude coordinate (uncorrected) of N34° 33' 13" / W111° 08' 15" was taken at the second bedrock shelf. The first two shelves may provide an effective barrier to upstream movement of fish from East Clear Creek. The wetted portions of this reach began upstream of the 1,894 metered debris dam (Photo 4).

Photo 3. The second of three bedrock "barriers" is found at the 1,844-metered distance along the first reach in Yeager Canyon. This "barrier" measured 1.5 meters in height. Brian Clark provides scale to this instream feature located at GPS coordinates of N34° 33' 13" / W111° 08' 15".

Photo 4. View of the upstream side of the second of two large woody debris dams within the first reach of Yeager Canyon. The one pictured above is located at the 1,894-metered distance from the ECC / Yeager Canyon confluence. This pile of woody debris spans the width of the stream channel with a width of 10 meters and covering eight (8) meters of the stream channel. The height is estimated at three (3) meters.

All substrate classes, except for "fines", were well represented throughout the reach. Water temperatures ranged from 11° to 25°C. Several relatively sizable pools retained their crest depth throughout the summer. These pools feature instream cover by either a large boulder, or an undercut / overhang associated with a rock wall or outcropping.

Thirty-eight (38) nonnative rainbow trout (*Oncorhynchus mykiss*), or hybrids thereof, were collected from 11 pools and one run sampled in this first reach of Yeager Canyon (Photo 5). These trout ranged in size from 95 mm to 210 mm. Trout were the **only fish species** found during the surveys in Yeager Canyon. The results of the fish surveys in Yeager Canyon match those reported by Dorum et al. (1996) and White and Mongomery (1995). Refer to Appendix D for a listing of the numbers of fish collected by species by sampled habitat type for each reach. This appendix also displays number of habitats sampled, electrofishing effort, sample dates, and range of water temperatures. The electrofisher settings used during the fish sampling included

an output voltage of 300 to 400, and a standard pulse width of 60 Hertz (Hz) with a pulse frequency of 6 milliseconds (ms).

Photo 5. Inventory crew electrofishing Pool 41 in Yeager 1 on June 19, 2000. A 119-second fishing effort netted eight (8) rainbow trout ranging in size from 101 to 200 mm in 16° C water. Latitude / Longitude coordinates for Pool 41 is N34° 32.603' / W111° 07.797.

Yeager II

Reach II extends from the 95 Road crossing over Yeager Canyon to Schneider Spring. The habitat inventory of this 5.8-kilometer reach was surveyed between June 7 and June 8. A 1327-meter dry stretch occupied the first portion of this reach, as did a 3603-meter section of dry streambed near the end of the reach. Six pools, nine riffles, and 10 run habitats were intermixed between and above these long dry sections. Three large wood debris dams, with Class 1, 4, and 5 logs, were reported along this reach. Gravels dominated the channel substrates, and were intermixed with an equal proportion of cobbles and boulders.

Fish collections recorded for Reach II occurred within two pools and one run located immediately downstream of the point at which flow from Schneider Spring (a mere trickle) enters Yeager Canyon. As with Reach I, these three habitats produced only rainbow trout. Thirteen trout ranging in size from 97 mm to 232 mm were collected and released on September 7. Weights ranged from nine to 110 grams. Electrofisher setting were the same as reported for Reach I, except voltage outputs of 400 and 500 were used.

Yeager III

Reach III extends from Schneider Spring to the confluence with an unnamed second order stream channel north of Holder Cabin. Class 1 and/or Class 4 pieces of LWD were associated with 13 of the 100 pools. Gravel and cobble substrates dominated the stream channels of the run, riffles, and complex habitat types; whereas, the pool habitats were lined with a mixture of gravels and fine sediments. A rock barrier at the 15,574-meter mark (from the ECC/Yeager confluence) has a height of 2.4 meters. A fish survey was not conducted in this reach.

Yeager IV

Reach IV extends from the confluence with an unnamed second order stream channel north of Holder Cabin to the confluence with a first order stream near the headwaters (reference Appendix B for Lat./Long. coordinates). As would be expected of a headwater reach, this reach had the highest gradient (2.2%) for the shortest metered distance (1,695 m). Twelve pools and 2 riffles were found along this reach. Fine substrates (soil sediment) dominated 50% of the pool habitats. A major channel headcut and bank sloughing contribute to the sediment loading of the pooled habitats. LWD was noted as being associated with only one of the pools. A fish survey was not conducted in this reach.

Kehl Canyon

Kehl Canyon was divided into three reaches (I, II, III). Habitat inventories began June 21, 2000 at the Kehl Canyon / East Clear Creek confluence, and ended on June 22 at the end of the defined channel near Kehl Springs at Kehl Campground. Reach break coordinates (uncorrected latitude / longitude) are listed in Appendix B. The total length of the canyon measured 6.4 kilometers (4.0 miles); where Reach II contributed the greatest length (3.3 kms) and Reach I the least (1.0 kms). Seventy-four percent (74%) of Kehl Canyon was measured as having a dry streambed. Of the twenty-six percent (26%) of the canyon occupied by water, Reach II contained the greatest wetted

distance (1632 meters) with an estimated 3,478 square meters of surface area (95% confidence interval of 3,154 m^2 to 3,802 m^2). The first two reaches would be characterized as perennial interrupted to intermittent; whereas the third reach (headwater reach) would best be classified as an ephemeral drainage.

Figure 4 illustrates the combined distances for each habitat type and dry stream channel found in each of Kehl Canyon's three reaches. Given the scale used in Figure 4, pool and run habitat distances within Reach I and III are so minimal that the representative bars for their numbers are not visible. Appendix C displays reach summations for total distance and for the sum total distance of each habitat type. Appendix C also shows the estimated wetted surface areas and calculated 95% confidence intervals for each reach.

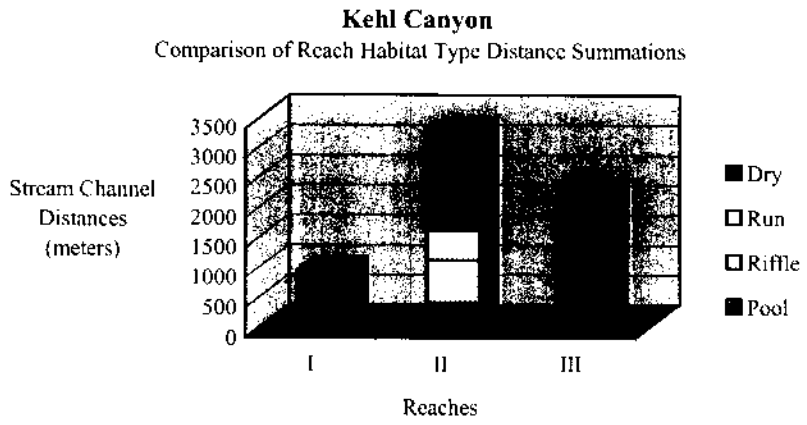


Figure 4. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the three reaches identified in Kehl Canyon.

Dorum et al. (1996) surveyed the entire length of Kehl Canyon in 1995. They reported the collection of only rainbow trout. Fish surveys conducted under this inventory collected trout, speckled dace (*Rhinichthys osculus*), and one fathead minnow (*Pimephales promelas*).

Kehl I

Kehl I extends from its confluence with ECC to its upstream confluence with West Kehl Canyon. The watered portions of this reach were just upstream of its confluence with ECC. The sampling of two pools netted 48 speckled dace.

Kehl II

Kehl II extends from its confluence with West Kehl Canyon to Middle Kehl Canyon. For all habitat types, gravels and cobbles dominated the channel substrate. There was 695 m of dry channel from West Kehl to the first reliable water. From there the water flow was intermittent with some continuity between several habitats. The more permanent water continued to show until 632 m below the Middle Kehl confluence. A "barrier" consisting of LWD piled against a large boulder was located at the 1428.4-meter mark, at the upstream end of Pool 21 (Photo 6). Gravel and cobble sized rubble has filled in behind the "barrier", which measured one plus meters in height, 12 meters in width, and a length of 10 meters (channel distance upstream of the debris dam). LWD size classes were dominated by 4's and 5's; where 13 of 37 pools, seven (7) of 37 riffles, and 10 of 23 runs were associated with LWD.

One of the 63 trout collected from this reach measured 300 mm and weighed 215 grams. This trout came from Pool 19 (one of 12 sampled pools), which had a maximum depth of 53 centimeters (cm). Eleven (11) (or 17%) of the 63 trout collected measured $\geq$ 200 mm. The range of size classes and number of trout in this reach is certainly indicative of sustained water over the years and a self-sustaining trout fishery. One fathead minnow (25 mm) and 16 speckled dace (70 to 110 mm) were also collected in this reach.

Photo 6. Pool 21 in Kehl II below boulder and large woody debris structure. Although this pool maintained water through the summer, pool depth was approximately 36 cm below crest depth on June 22, 2000, as evidenced by the light/dark striping on the rock outcrop (left bank) as seen in the middle ground. A 260-second electrofishing effort on June 26, 2000 netted six (6) rainbow trout ranging in size from 135 to 220 mm. Water temperature was 12° C. Pictured are inventory crewmembers Josh Cousins (foreground) and Brian Clark (background).

Kehl III

Kehl III extends from its confluence with Middle Kehl Canyon to a point just downstream of Kehl Spring. Four pools for 19 m and one run of 14 m were the only habitats present within this reach. Numerous logs lie across the channel. A LWD dam exists in the upper portion of the reach. As reported by Dorum et al. (1996), the flow produced by Kehl Spring was only a trickle. A fish survey was not conducted in this reach.

Dane Canyon

Dane Canyon was divided into five reaches (I, II, III, IV, V). Habitat inventories began June 28, 2000 at the Dane Canyon / Barbershop Canyon confluence, and ended on July 13 at a point near the headwaters. Reach break coordinates (uncorrected latitude / longitude) are listed in Appendix B. The total length of the canyon measured 13.5 kilometers (8.4 miles); where Reach I contributed the greatest length (3.5 kms) and Reach III the least (1.3 kms). Sixty-seven percent (67%) of Dane Canyon was measured as having a dry streambed. Of the thirty-three percent (33%) of the canyon occupied by water, Reach I contained the greatest wetted distance (1,913 meters) with an estimated 7,277 square meters of surface area (95% confidence interval of 5,971 m^2 to 8,582 m^2). The first four reaches would be characterized as perennial interrupted, whereas the fifth reach (headwater reach) would best be classified as an intermittent drainage. Dane Canyon remains a very confined drainage from its confluence with Barbershop Canyon to a point near the headwaters where the drainage opens around the headwater meadows.

Figure 5 illustrates the combined distances for each habitat type and dry stream channel found in each of Dane Canyon's five reaches. Given the scale used in Figure 5, pool, riffle, and run habitat distances within Reach V are so minimal that the representative bars for their numbers are not visible. Appendix C displays reach summations for total distance and for the sum total distance of each habitat type. Appendix C also shows the estimated wetted surface areas and calculated 95% confidence intervals for each reach.

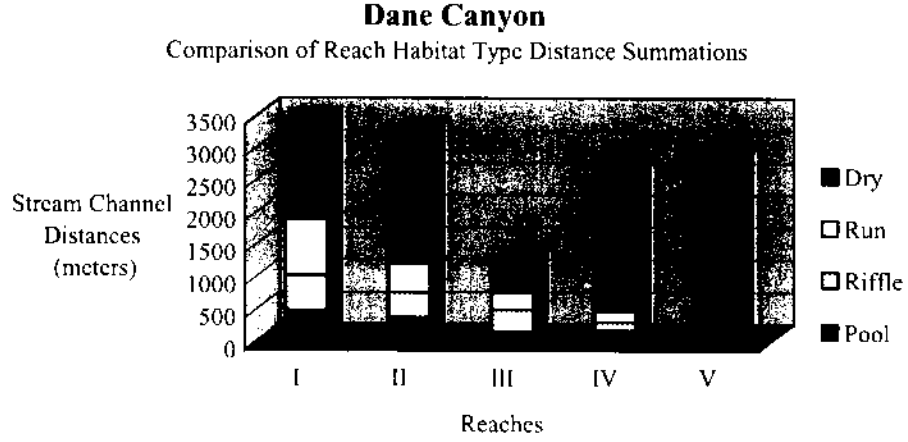


Figure 5. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the five reaches identified in Dane Canyon.

Dane I

Dane I extends from its confluence with Barbershop Canyon upstream to its confluence with Moonshine Draw. Three pools, number 3, 16, and 21, had measured depths of 1.5 m, 1.3 m, and 1.6 m, respectively. Fish sampling collected speckled dace, bluehead suckers (*Catostomus discobolus discobolus*), and rainbow trout throughout this reach. Pool 16 produced a 145 mm bluehead sucker weighing 40 grams.

Dane II

Dane II extends from its confluence with Moonshine Draw upstream to its confluence with an unnamed tributary, which receives a slight flow from Dane Spring. Water levels were very low and many habitats were stagnant. Water temperatures ranged from 12 to 25° C. High numbers of minnows were observed in each habitat; so much so, that this reach produced the highest number of fish collected (2109 fish) of all sampled reaches. In Pool 19, 1013 fish (1 trout, 7 bluehead suckers, 1005 speckled dace) were collected during a two-pass electrofishing effort totaling 1472 seconds. This two-pass effort resulted in a caught per unit effort (CPUE) of .68 fish per second (or 41.3 fish/minute). The first pass collected 756 fish, and the second pass collected 257 fish. A small flow of water from a spring off the left bank (facing upstream) enters this reach at the lower end of Riffle 15 (2941-meter mark).

Dane III

Dane III extends from its confluence with an unnamed tributary, which receives a flow from Dane Spring upstream to its confluence with McClintock Draw. Pool 5 (378 metered distance) had a depth greater than one meter (Photo 7). Spring flow at the 605 metered distance contributes enough flow to the upstream end of Riffle 12 to maintain a sustained flow for a distance downstream. There was no stream flow upstream of where the spring entered the stream channel.

Photo 7. Pool 5 in Dane III on July 6, 2000. This pool measured 41 meters in length, had an average width of 5.8 meters, and had a maximum depth of greater than a meter. Substrates were comprised of silt, gravels, and cobbles. Electrofishing of Pool 5 on July 19, 2000 for 827 seconds netted 239 total fish. Fish species included speckled dace, bluehead suckers, and rainbow trout. Water temperature was 22° C.

Dane IV

Dane IV extends from its confluence with McClintock Draw upstream to its confluence with an unnamed north flowing tributary (T12N, R11 ½ E, Section 10, NE ¼). A considerable amount of Class 5 LWD was associated with Pool 5. Speckled

dace and bluehead suckers made up the fish collections in this reach, where numerous juvenile suckers were collected in the shallow portions of the four (4) sampled pools. The total CPUE (99.2 fish per minute) for this reach was the highest of all sampled reaches within all inventoried stream courses. The high CPUE is certainly a result of conducting multiple-pass depletion electrofishing efforts in restricted habitats that concentrate fish numbers.

Dane V

Dane V extends from its confluence with an unnamed north flowing tributary (T12N, R11 ½ E, Section 10, NE ¼) upstream to a point near the headwaters (reference Appendix B for Lat./Long. coordinates). Of the 2,899-metered distance for the reach, a mere 39.8 m contained water in 5 habitats (3 pools, 1 riffle, 1 run). Pool 1 had a measured depth of 1.1 m. Pool 1 produced 95 fish (84 speckled dace, 11 bluehead suckers.

Bear Canyon

Bear Canyon was divided into four reaches (I, II, III, IV). Bear Canyon habitat inventories began July 24, 2000 at its confluence with the high water mark of Blue Ridge Reservoir, and ended on July 27 at a point near the headwaters. Reach break coordinates (uncorrected latitude / longitude) are listed in Appendix B. The total length of the canyon measured 12.4 kilometers (7.7 miles); where Reach II contributed the greatest length (7.0 kms) and Reach III the least (1.0 kms). Eight-one percent (81%) of Bear Canyon was measured as having a dry streambed. Of the nineteen percent (19%) of the canyon occupied by water, Reach II contained the greatest wetted distance (1,559 meters) with an estimated 4,569 square meters of surface area (95% confidence interval of 4,007 m^2 to 5,131 m^2). The first three reaches would be characterized as perennial interrupted, whereas the fourth reach (headwater reach) would best be classified as an intermittent drainage.

Bear Canyon is a much larger canyon, with less confinement, than the other tributaries to East Clear Creek. There was very little running water when the survey was conducted. Pool habitats, throughout Bear Canyon, were found to contain substantial depth. Five pools contained depths of over 1.0 meter. Stretches of Bear Canyon appeared to persist in a dry condition. These dry stretches have suffered such extensive bank erosion that even alders are not present. Mostly silt and gravels dominate the channel substrates within the pools. The channel substrates within an occasional run were found embedded with silt.

Figure 6 illustrates the combined distances for each habitat type and dry stream channel found in each of Bear Canyon's four reaches. Given the scale used in Figure 6, pool, riffle, and run habitat distances within Reach III and IV are so minimal that the representative bars for their numbers are not visible. Appendix C displays reach summations for total distance and for the sum total distance of each habitat type. Appendix C also shows the estimated wetted surface areas and calculated 95% confidence intervals for each reach.

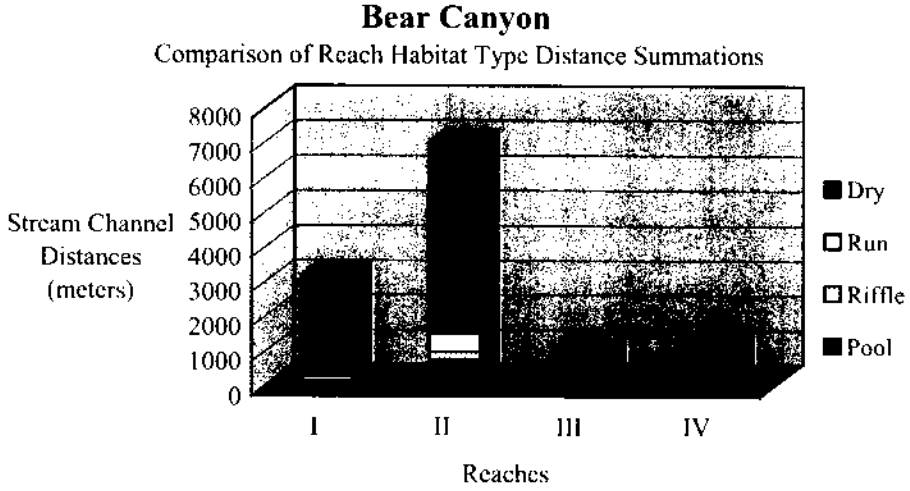


Figure 6. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the four reaches identified in Bear Canyon.

Bear I

Bear I begins at the high water mark of the south arm of the Blue Ridge Reservoir, and continues upstream to the culvert at the 95 Road crossing. The length of the culvert was included as part of the overall length of this reach. A wide channel with relatively deep sand and gravel depositions characterizes the majority of this reach. Near the end of the reach, the channel becomes more confined and showing more water. Pool 6 (2,586 metered distance) was noted as having a depth of greater than 2.0 meters. Fish sampling collected speckled dace and bluehead suckers. A large number of young-of-the-year fish were observed in this reach. The fish sampling strategy had to be altered for this reach due to the drying of habitat units between the end of the habitat inventory (July 24) and the fish sampling, which was conducted on July 31.

Bear II

Bear II extends from the upstream side of the 95 Road crossing upstream to the Bear Canyon / East Bear Canyon confluence. Large pools were typically found at the bends in the stream channel, and in association with sandstone outcroppings. Long stretches of dry streambed were found in the center of the reach. An occasional deep pool would exist within these dry stretches. Significant amounts of Class 4, 5, and 6 pieces of LWD were not only found in association with pools and runs, but also found in debris piles ("log jams") along portions of the dry streambed. Fish sampling was conducted in only five pools; the depth of some pools precluded the sampling with the electrofisher. Two dip nets were used for five minutes to sample Pool 5 (11.4 m by 1.6 m, maximum depth 28 cm, average. depth 9 cm, temperature 24°C). The five minutes of dip netting in Pool 5 yielded 197 fish (193 speckled dace, 4 bluehead suckers). In addition to speckled dace and suckers, fathead minnows and rainbow trout were also collected from other sampled habitats along this reach. Neither White and Mongomery (1995) nor Dorum et al. (1996) reported collecting fathead minnows.

Bear III

Bear III extends between its confluences with East and West Bear Canyon. This reach has a lot of silt associated with it. The stream channel meanders through bluegrass/pine bunchgrass openings where it has cut down to bedrock in places. Given the erosion of the stream channel to bedrock, these portions of the reach were found to be drying rapidly during the survey. Pool habitats were full of silt, which when disturbed during electrofishing, allowed for only a one pass sampling effort. Class 4 and 5 woody debris were found in association with the pools. Speckled dace continued to be present in large numbers, whereas suckers were less frequent.

Bear IV

Bear IV extends from its confluence with West Bear Canyon to the headwaters of Bear Canyon (reference Appendix B for Lat./Long. coordinates). Water existed for only a very short distance upstream of the confluence with West Bear; the remaining length of the reach was dry. There were only 5.4 m of pool, 6.5 m of run, and 1,177.5 m of dry. Given the lack of water, and the fact that speckled dace were observed dying in the drying habitats; this reach was not sampled for fish.

East Clear Creek

East Clear Creek was divided into three reaches (III, IV, V). Five reach breaks were made for the portion of East Clear Creek upstream from Blue Ridge Reservoir. The three reaches surveyed under this inventory (Summer 2000) are upstream of the 141 Forest Road crossing (Jones Crossing). Reaches I and II are downstream of Jones Crossing, and were surveyed as part of the Summer 2001 habitat inventories. For future reference, reach breaks could/should be made at locations different from those used for the 2000 and 2001 inventories.

East Clear Creek habitat inventories began August 7, 2000 at Jones Crossing, and ended on August 8 at the confluence with Potato Lake Draw. Reach break coordinates (uncorrected latitude / longitude) are listed in Appendix B. The total length of the surveyed portion of East Clear Creek measured 13.7 kilometers (8.5 miles); where Reach IV contributed the greatest length (5.0 kms) and Reach III the least (4.3 kms). Ninety-seven percent (97%) of the survey portion of East Clear Creek was measured as having a dry streambed. Of the three percent (3%) of the canyon occupied by water, Reach IV contained the greatest wetted distance (223 meters) with an estimated 274 square meters of surface area (95% confidence interval of 88 m^2 to 460 m^2). The first reach (ECC III) would be characterized as intermittent, whereas Reach IV and V would best be classified as perennial interrupted drainages.

Figure 7 illustrates the combined distances for each habitat type and dry stream channel found in each of the three inventoried reaches. Given the scale used in Figure 7, all pool, riffle, and run habitat distances within all three reaches are so minimal that the representative bars for their numbers are not very visible. Appendix C displays reach summations for total distance and for the sum total distance of each habitat type. Appendix C also shows the estimated wetted surface areas and calculated 95% confidence intervals for each reach.

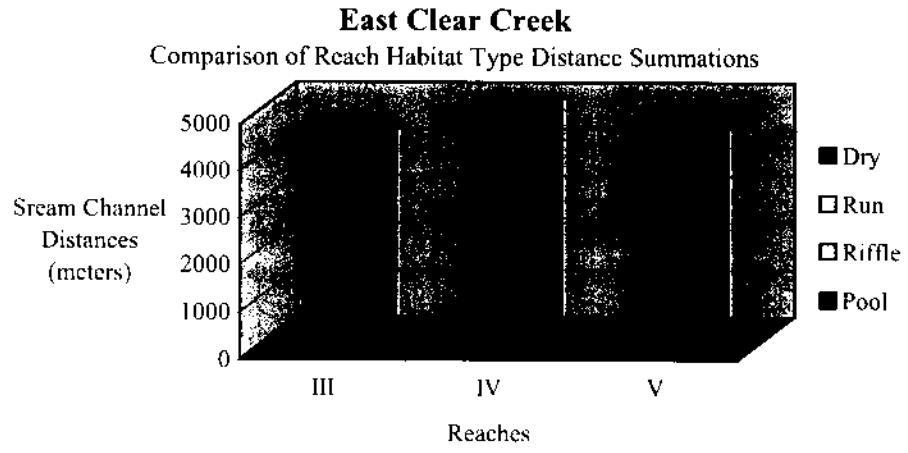


Figure 7. Comparisons of the sum total stream channel distance (in meters) occupied by each habitat type and dry streambed for the three reaches identified in East Clear Creek.

ECC III

ECC III extends from the upstream side of the 141 Road crossing (Jones Crossing) to its confluence with an unnamed north flowing tributary in T13N, R10E, Section 21, NE ¼. This reach contained 37.3 m of side channel pools, and 4309.2 m of dry streambed in a relatively wide channel. There are two nice scours in the channel, but both lacked water. Large woody debris was not found along this reach. The electrofisher was used to sample only the first of three pools; dip net hauls were made on the other two pools. Twenty-one (21) dead speckled dace were counted in Pool 5 prior to sampling with dip nets. A total of 164 minnows were netted in Pool 5, 155 speckled dace and nine (9) fathead minnows. Speckled dace and fathead minnows were the only species collected in this reach.

ECC IV

ECC IV extends from its confluence with an unnamed north flowing tributary in T13N, R10E, Section 21, NE ¼ to its confluence with Kehl Canyon. Reach IV contained 143.2 m of pools, 18.2 m of riffles, 62.1 m of runs, and 4762.4 m of dry streambed in a channel that begins to be a bit more confined. Pool 13 is the result of a scour associated with a large rock outcropping near the end of the reach. This pool had a maximum depth greater than 69 cm. Only one piece of LWD (Class 4) was found in this reach, and it was associated with Pool 1.

Thirteen (13) pool habitats were recorded along this reach. Pools 4 and 9 were the only two pools to be sampled for fish. On August 7th, Pool 4 measured 4.4 m long, 1.2 m wide, and 31 cm maximum depth, with a sand / gravel bottom (Photo 8). Given the water conditions (low oxygen levels) and so as not to create additional stress to the fish from electrofishing, the sampling of Pool 4 was done with dip nets. Three passes with two dip nets collected a total of 385 fish from Pool 4. Each pass collections were as follows: pass 1 – 294 fish, pass 2 – 72 fish, and pass 3 – 19 fish. Of the 385 fish collected from Pool 4, there were 331 speckled dace, 53 fathead minnows, and one Little Colorado sucker (Catostomus sp.) (138 mm). Electrofishing of Pool 9 halted after a 20-second effort resulted in visible stress to the fish. Dip nets were used to finish the sampling of Pool 9. A total of 199 fish were collected from Pool 9, which included 181 speckled dace (37 – 112 mm), seven (7) Little Colorado suckers (72 – 250 mm), six (6) bluehead suckers (≤ 112 mm), and five (5) fathead minnows.

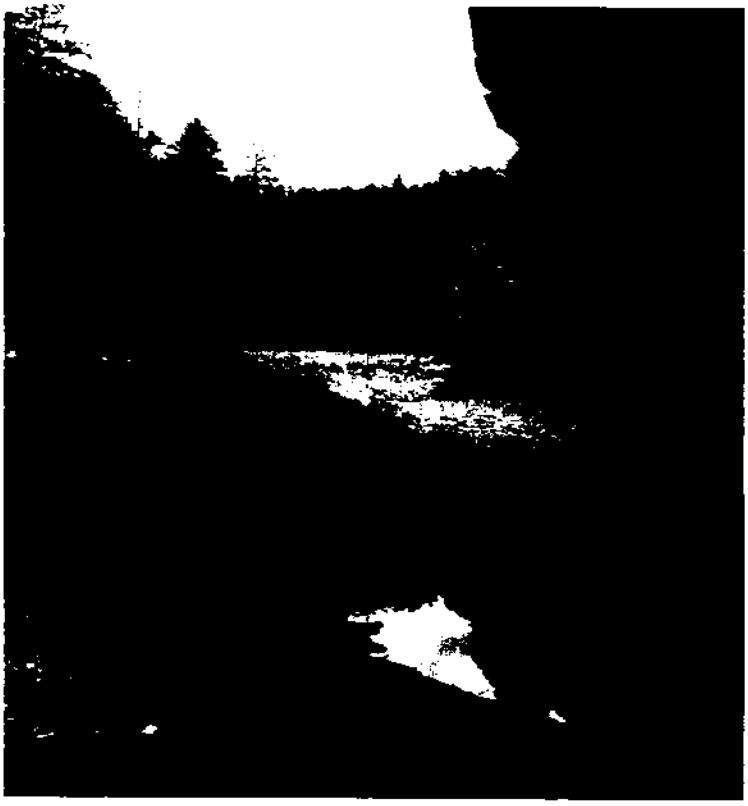


Photo 8. Pool 4 is show in this downstream view of ECC IV. Note the rock outcrops and gravel aggradations in the stream channel. A three-pass depletion sampling effort produces 385 total fish. Pool 4 lost water volume between the time of habitat inventory and fish survey.

ECC V

ECC V extends from its confluences with Kehl Canyon upstream to its confluence with Potato Lake Draw at the downstream end of the culvert under the 147 Road. This reach had very little water, which was rapidly drying up. There were 70.5 m of pools, 28 m of riffles, 51 m of runs, and 4228.8 m of dry streambed. Small spots of water (< 2 m) were found scattered along the long dry stretch near the upstream end of the reach. These spots of water were the result of recent rain showers. One (1) run and five (5) pools were found in association with Class 3, 4, and 5 LWD. Large boulders and several logs created a change in streambed elevation near the middle of the reach. A willow is growing out of the center of the "log jam".

A large number of young-of-the-year fish were observed in the pools just above the confluence with Kehl Canyon. There were a large number of fathead minnows in this reach as well as speckled dace. Fish were not observed upstream of the Forest Road 308 crossing. A total of 155 fish were collected with dip nets from two (2) pools (Pools 2 & 9). Pool 2 measured nine (9) by two (2) meters with a maximum depth of 31 cm. Pool 9 measured three (3) by one and seven tenth (1.7) meters with a maximum depth of 10 cm and an average depth of four (4) cm. A three-pass depletion sample netted a total of 102 fish from Pool 2. Fish collected during each of the three passes were as follows: pass 1 – 64 fish, pass 2 – 21 fish, and pass 3 – 17 fish. Species composition found in Pool 2 included 101 speckled dace (34 – 61 mm) and one (1) fathead minnow (55 mm). A single pass on Pool 9 netted a total of 53 fish, which included 49 fathead minnows (39 – 60 mm) and four (4) speckled dace (51 mm).

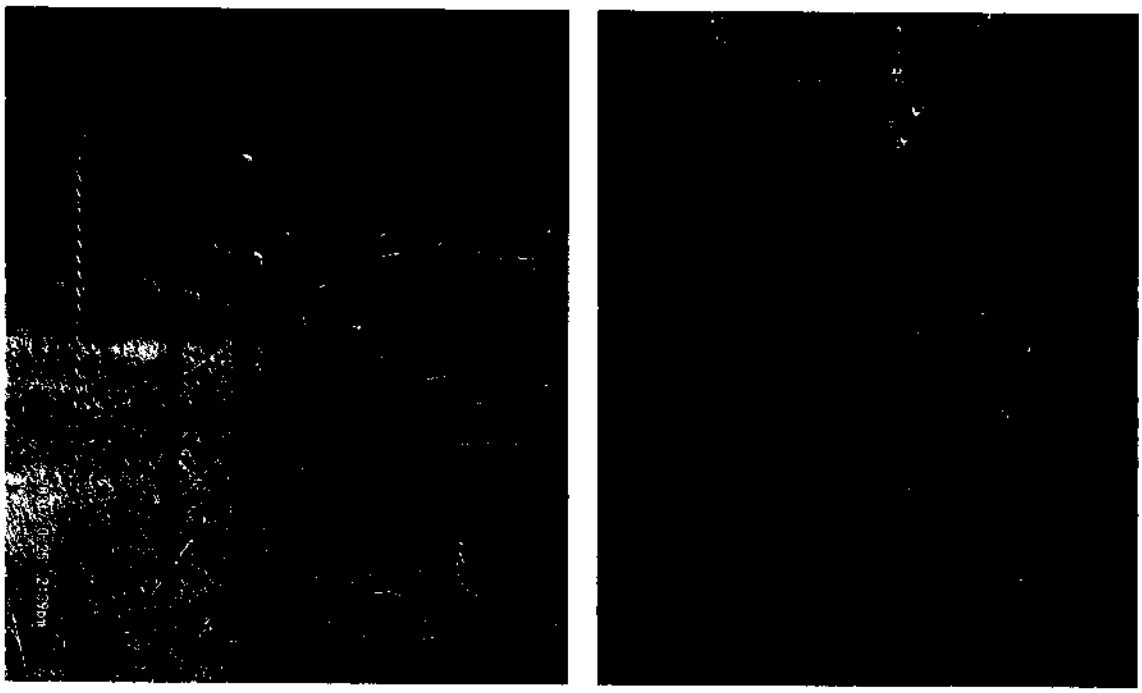
A dead crayfish found near the upstream end of this reach was the only crayfish observed in any of the five inventoried stream courses.

Elk Exclosures

The exclosure associated with Whistling Spring has a perimeter of 496.4 meters (1628.5 feet) and encompasses approximately one and six-tenths (1.6) acres of Merritt Draw. Protection of Merritt Spring and approximately one (1) acre of Merritt Draw is provided by the elk exclosure that has a perimeter of 321-meters (1053 feet). The General Springs exclosure encompasses approximately two (2) acres within a 573.3-meter (1881 feet) perimeter.

These exclosures have been in place for one full growing season (2001). The results from protecting these small patches of meadow and spring habitats are truly

phenomenal. Herbaceous production within the exclosures is sharply contrasted by that which remains accessible to grazing by elk (Photos 9, 10, and 11).



Photos 9 and 10. Merritt Springs Elk Exclosure: Constructed in Merritt Draw during August 2000; photo taken October 25, 2001. Both photos illustrate the fence line contrast along the south end of the exclosure. **Left Photo:** The left side of photo is within the elk exclosure that includes Merritt Springs. The right side is outside the exclosure, but within a livestock exclosure that protects Merritt Draw from livestock use. **Right Photo:** View looking into the elk exclosure. Photo point is within the livestock excluded portion of Merritt Draw with a view of the southern end of the meadow area excluded to elk use. Grass, sedge, forb production behind the fence (middle ground) is the result of one growing season (2001) rest from elk. The 80 to 90 percent utilization of the meadow outside the elk exclosure (foreground) is strictly a result of elk grazing. Elk droppings are seen in the foreground.

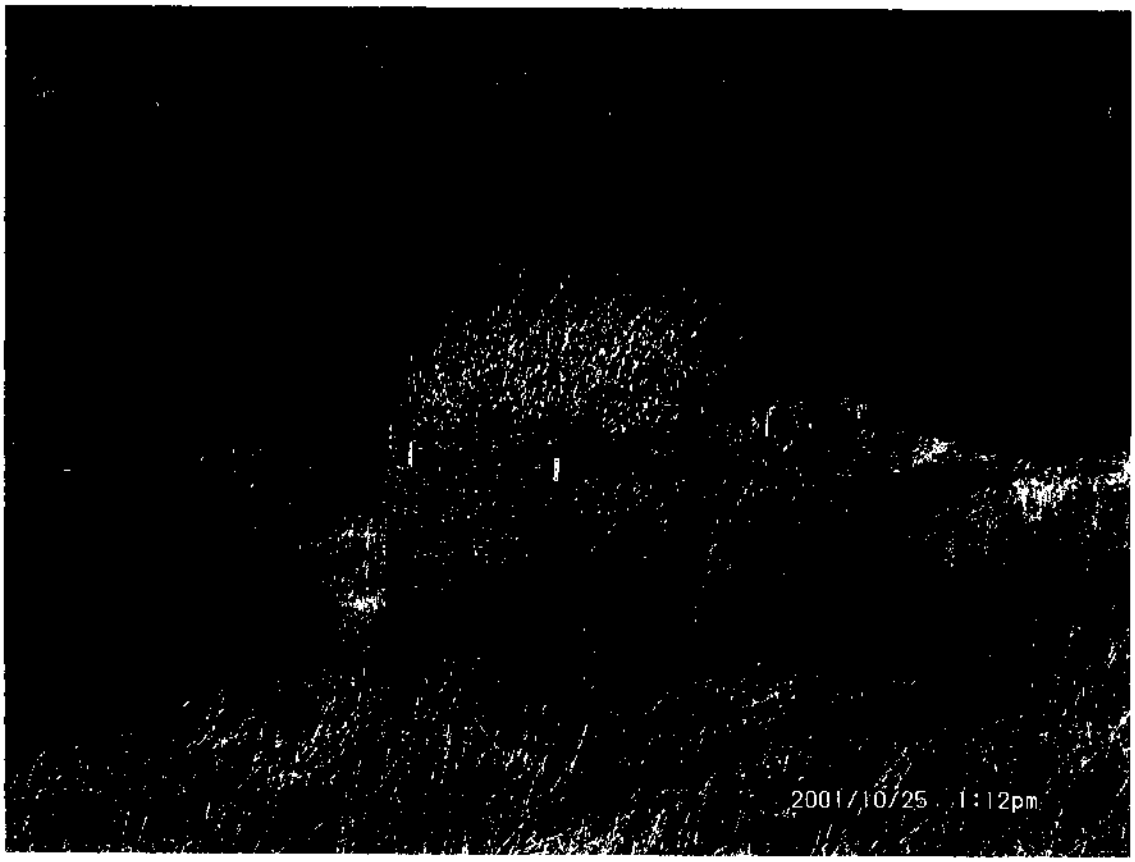


Photo 11. A view of the drainage that runs along the east side of the meadow protected by the General Springs exclosure. Included within the perimeter of the larger elk exclosure is a willow that had received protection on a much smaller scale. All the leader growth above the height of the four-foot fence is the result of protection from elk browsing during the 2001 growing season. Note the density and production of the herbaceous vegetation covering the drainage bottom.

CONCLUSION

Results from the stream habitat inventories and elk exclosure constructions met the intended objectives. The elk exclosures have demonstrated improved meadow conditions after only one year of protection. Protection of the springs and meadows are expected to add a certain increase in water storage and release down drainage, but the amount will not be enough to improve flows down drainage. Based on results from these new exclosures and those of the older ones, additional fencing to connect the three exclosures (2 new & 1 old) in Merritt Draw could possibly produce a flow down drainage.

Despite not collecting spinedace from the available habitats within the five inventoried stream courses, several observations were made that could be useful in recovering spinedace to the western portion of the East Clear Creek Watershed. Most of the observations are not new, but they do substantiate those recorded in previous survey reports and papers. This survey found:

- all five stream courses contain relatively large, deep pools associated with large boulders, LWD, and/or rock outcrop overhangs that provide good cover; all of which could provide refuge to spinedace during dry years.
- Yeager Canyon contained the greatest watered distance, whereas Dane Canyon contained the greater estimated surface area of water, indicating Dane Canyon's habitats are larger than Yeager Canyon.
- the lower reach of Yeager Canyon contains the highest quality water throughout the dry summer, most of which exists over fairly clean gravel and cobble substrates.
- that within specified reaches of Yeager, Dane, and Kehl Canyons, pooled habitats are connected to graveled riffles and runs suitable for spawning.
- that although trout were found to persist in all but ECC, Yeager and Kehl Canyons tend to support the best self-sustaining populations; and if so desired, electrofishing the relatively small habitats could effectively reduced trout number.
- that instream barriers (bedrock shelves, LWD piles, long sections of dry stream channel) exist within all five canyons. Given that the "barriers" in Yeager Canyon occur closest to the nonnative salmonid source populations in ECC, means the potential ability to protect a repatriated population of spinedace over a greater distance; thus allowing for a higher number of habitats available to a successful reintroduction of spinedace.
- lack of water and high silt loading of the habitats that may exist make for reduced habitat conditions within the headwater reaches of Yeager, Dane, and Bear Canyons.
- Blue Ridge Reservoir has drastically altered habitat condition within the first reach of Bear Canyon through channel aggradations.
- that crayfish were absence, or virtually nonexistent within all five surveyed stream courses during the dry summer of 2000.
- that a backpack electrofisher can be an effective tool in capturing a high percentage of fish in all but the deepest pools.

Of the five stream courses inventoried during the summer of 2000, Yeager and Dane Canyons are thought to provide the best situations for successful spinedace reintroductions. In fact, based in part on the findings of the summer 2000 inventory

work, actions toward spinedace reintroductions into Yeager Canyon were undertaken in 2001.

Yeager Canyon appeared to possess a number of aspects favorable to spinedace reintroduction. Two LWD "dams", three bedrock shelves, and dry stream channel nearly two kilometer long stand in the way of upstream movement of nonnative rainbow and brown trout (*Salmo trutta*) from East Clear Creek. Given that both rainbow and brown trout exist in East Clear Creek, and that only rainbows occupied the watered section of reach I (above the barriers), provides a good indication that the barriers are effective in preventing upstream movement from East Clear Creek. Yeager Canyon contained only rainbow trout in relatively small habitats. An initial mechanical "renovation" of Yeager Canyon would be fairly easy and successful. Monitoring and maintenance of a reintroduced spinedace population to Yeager Canyon would also be a fairly effortless task. And, Yeager Canyon does not contain crayfish.

Dane Canyon's overall length of watered stream course, relatively small habitats, and low relative number of nonnative fish would seem to provide for the ease of mechanical treatment and ample habitat for wide spread dissemination of reintroduced spinedace.

Steep canyon walls and a narrow drainage keeps the middle reach of Kehl Canyon colder than the other five stream courses. This colder condition seems favorable to the sizeable trout population found in that reach, but may not suit spinedace existence.

Bear Canyon would require an artificial barrier to prevent upstream movement of trout from the Blue Ridge Reservoir. A renovation of the isolated deep pools found in the lower reaches of Bear Canyon would likely fail without a barrier near its flow into the reservoir. Reach I of the Bear Canyon consists of a broad channel for much of its distance. The installation of a barrier would be a major undertaking.

Fish habitat in the upper three reaches of East Clear Creek is so limited that this drainage may be the best location for a quick mechanical removal on fathead minnows and reintroduction of spinedace. On the other hand, existence of the habitats may be so tentative that spinedace would surely be wasted if introduced to this portion of East Clear Creek.

FINANCIAL STATEMENT

Table 4 summarizes the Heritage Grant and Forest Service funding and expenditures. The actual total expenditure of Grant dollars was $37,063.29. The Department has paid the Forest Service $35,145.00 as a 90% payment of the $39,050.00 Grant amount. Pending approval of this report, the Department will be billed for $1,918.29.

Table 4. Financial accounting of the Heritage Grant and Forest Service funding and expenditures for Project No. I99006.

BUDGET CATEGORY	TOTAL GRANT BUDGET	ACTUAL EXPENSES-GRANT (A)	TOTAL FOREST SERVICE MATCH	ACTUAL EXPENSES-FOREST SERVICE (B)	TOTAL ACTUAL EXPENSES (A+B)
Pre-agreement			$17,145.00	**$17,145.00**	**$17,145.00**
Development	$10,350.00	**$10,140.63**	0		**$10,140.63**
Personnel	$24,000.00	**$22,348.53**	$29,350.00	**$29,748.00**	**$52,096.53**
Miscellaneous (Travel & Supplies)	$4,700.00	**$4,574.13**	$2,285.00	**$5,707.00**	**$10,281.13**
TOTAL	$39,050.00	**$37,063.29**	$48,780.00	**$52,600.00**	**$89,663.29**

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Appendix A

Reach Distances, Elevations, and Gradients

East Clear Creek Watershed

Stream Habitat Inventory

Summer 2000

Stream	Reach #	Reach Distance (meters)	Reach Distance (feet)	Reach Distance (kilometers)	Reach Distance (miles)	Elevation Downstream (meters)	Elevaton Upstream (meters)	Elevation Downstream (feet)	Elevation Upstream (feet)	Elevational Change (meters)	Elevational Change (feet)	Gradient (%)
Yeager	I	6256	20520	6.3	3.9	1957	2098	6420	6880	140	460	2.2
	II	5803	19034	5.8	3.6	2098	2183	6880	7160	85	280	1.5
	III	8,822	28,936	8.8	5.5	2,183	2,268	7,160	7,440	85	280	1.0
	IV	1,695	5,560	1.7	1.1	2,268	2,305	7,440	7,560	37	120	2.2
TOTALS		22,576	74,068	22.6	14.0							
Kehl	I	951	3,119	1.0	0.6	2,122	2,134	6,960	7,000	12	40	1.3
	II	3,267	10,716	3.3	2.0	2,134	2,183	7,000	7,160	49	160	1.5
	III	2,221	7,285	2.2	1.4	2,183	2,268	7,160	7,440	85	280	3.8
TOTALS		6,439	21,125	6.4	4.0							
Dane	I	3,452	11,323	3.5	2.1	2,085	2,134	6,840	7,000	49	160	1.4
	II	3,248	10,653	3.2	2.0	2,134	2,183	7,000	7,160	49	160	1.5
	III	1,254	4,113	1.3	0.8	2,183	2,195	7,160	7,200	12	40	1.0
	IV	2,656	8,712	2.7	1.6	2,195	2,244	7,200	7,360	49	160	1.8
	V	2,899	9,509	2.9	1.8	2,244	2,293	7,360	7,520	49	160	1.7
TOTALS		13,509	44,321	13.5	8.4							

Appendix A

Reach Distances, Elevations, and Gradients
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

Stream	Reach #	Reach Distance (meters)	Reach Distance (feet)	Reach Distance (kilometers)	Reach Distance (miles)	Elevation Downstream (meters)	Elevaton Upstream (meters)	Elevation Downstream (feet)	Elevation Upstream (feet)	Elevational Change (meters)	Elevational Change (feet)	Gradient (%)
Bear	I	3,200	10,496	3.2	2.0	2,049	2,085	6,720	6,840	37	120	1.1
	II	7,019	23,022	7.0	4.4	2,085	2,159	6,840	7,080	73	240	1.0
	III	989	3,244	1.0	0.6	2,159	2,171	7,080	7,120	12	40	1.2
	IV	1,189	3,900	1.2	0.7	2,171	2,195	7,120	7,200	24	80	2.1
TOTALS		12,397	40,673	12.4	7.7							
ECC	III	4,346	14,255	4.3	2.7	2,091	2,110	6,860	6,920	18	60	0.4
	IV	4,985	16,351	5.0	3.1	2,110	2,122	6,920	6,960	12	40	0.2
	V	4,379	14,363	4.4	2.7	2,122	2,183	6,960	7,160	61	200	1.4
TOTALS		13,710	44,980	13.7	8.5							
GRAND TOTALS		68,631	225,167	68.6	42.6							

Appendix B

Stream Reach Coordinates
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

STREAM REACH	REACH END PT.	LATITUDE	LONGITUDE	DESCRIPTION
Yeager I	DS	N 34° 33.972'	W111° 08.563'	Mouth of Yeager Canyon (ECC / Yeager Canyon confluence to FR 96
	US	N 34° 31.771'	W111° 07.731'	
Yeager II	DS	N34° 31.771'	W111° 07.731'	FR 96 to Schneider Spring confluence
	US	N34° 29.302'	W111° 07.917'	
Yeager III	DS	N34° 29.302'	W111° 07.917'	Schneider Spring to unnamed canyon below holder cabin.
	US	N34° 25.531'	W111° 09.425'	
Yeager IV	DS	N34° 25.531'	W111° 09.425'	Unnamed canyon below Holder Cabin to headwaters of Yeager.
	US	N34° 24.879'	W111° 09.999'	
Kehl I	DS	N34° 29.217'	W111° 18.849'	Mouth of Kehl Canyon to mouth of West Kehl Canyon
	US	N34° 28.896'	W111° 18.638'	
Kehl II	DS	N34° 28.896'	W111° 18.638'	West Kehl Canyon to mouth of middle Kehl
	US	N34° 27.296'	W111° 18.646'	
Kehl III	DS	N34° 27.296'	W111° 18.646'	Mouth of middle Kehl to headwaters of Kehl. (Kehl Spring)
	US	N34° 26.133'	W111° 18.87'	
Dane I	DS	N34° 30.478'	W111° 09.142'	Mouth of Dane Canyon to mouth of Moonshine Draw.
	US	N34° 29.264'	W111° 08.768'	

Appendix B

Stream Reach Coordinates
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

STREAM REACH	REACH END PT.	LATITUDE	LONGITUDE	DESCRIPTION
Dane II	DS	N34°29.264'	W111° 08.768'	Mouth of Moonshine Draw to confluence of Dane Spring
	US	N34°28.099'	W111° 09.092'	
Dane III	DS	N34° 28.099'	W111° 09.092'	Dane Spring confluence to Mouth of McClintock draw
	US	N34° 27.622'	W111° 09.409'	
Dane IV	DS	N34° 27.622'	W111° 09.409'	Mouth of McClintock Draw to unnamed canyon
	US	N34° 26.537'	W111° 10.209'	
Dane V	DS	N34° 26.537'	W111° 10.209'	Mouth of unnamed canyon to headwaters of Dane Canyon
	US	N34° 25.363'	W111° 10.982'	
Bear I	DS	N34° 32.213'	W111° 12.218'	Mouth of Bear Canyon to Forest Road 95
	US	N34° 30.533'	W111° 12.062'	
Bear II	DS	N34° 30.533'	W111° 12.062'	Forest Rd. 95 to mouth of East Bear Canyon
	US	N34° 27.774'	W111° 12.551'	
Bear III	DS	N34° 27.774'	W111° 12.551'	Mouth of East Bear Canyon to mouth of West Bear Canyon
	US	N34° 27.493'	W111° 12.941'	
Bear IV	DS	N34° 27.493'	W111° 12.941'	Mouth of West Bear Canyon to headwaters of Bear Canyon
	US	N34° 26.936'	W111° 13.350'	

Appendix B

Stream Reach Coordinates
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

STREAM REACH	REACH END PT.	LATITUDE	LONGITUDE	DESCRIPTION
ECC III	DS	N34° 31.734'	W111° 17.050'	Jones Crossing to unnamed canyon at T13N, R10E, S.21, NE ¼, NE ¼
	US	N34° 30.305'	W111° 17.351'	
ECC IV	DS	N34° 30.305'	W111° 17.351'	Unnamed canyon to Kehl Canyon
	US	N34° 29.217'	W111° 18.840'	
ECC V	DS	N34° 29.217'	W111° 18.840'	Kehl Canyon to Potato Lake Draw.
	US	N34° 27.950'	W111° 20.250'	

Latitude / Longitude coordinates for the downstream and upstream ends of stream reaches inventoried during the summer of 2000. Coordinates are uncorrected locations marked with a Garmin III Plus GPS unit.

DS: coordinate for the **DownStream** end of the reach.
US: coordinate for the **UpStream** end of the reach.

Appendix C

Stream Habitat Type Summary and Estimated Wetted Surface Area by Reach

East Clear Creek Watershed

Summer 2000

Reach Names	Total Distance (m)	Pool (m)	Riffle (m)	Run (m)	Complex (m)	Dry (m)	Percent Wet	Percent Dry	Est. Wet Surf. Area (m^2)	Confid. Int. Value (m^2)	95% C.I. high (m^2)	95% C.I. low (m^2)	Wetted Surf. Area Per Km
Yeager I	6,256	657	1,741	1,327	122	2,409	61.5	38.5	8,004	757	8,761	7,247	1,279.4
Yeager II	5,803	58	377	149	0	5,220	10.0	90.0	1,129	377	1,506	752	194.5
Yeager III	8,822	921	544	234	27	7,097	19.6	80.4	2,968	178	3,146	2,790	336.4
Yeager IV	1,695	133	25	0	0	1,538	9.3	90.7	178	54	232	124	105.0
TOTALS	22,577	1,769	2,686	1,709	149	16,264			12,279	1,366	13,645	10,913	543.9
Yeager Canyon - % Dry:		**72.0**											
Kehl I	951	19	0	15	0	917	3.6	96.4	30	0	30	30	31.6
Kehl II	3,267	431	700	501	0	1,635	50.0	50.0	3,478	324	3,802	3,154	1,064.6
Kehl III	2,221	19	0	14	0	2,188	1.5	98.5	0	0	0	0	0.0
TOTALS	6,439	469	700	530	0	4,740			3,508	324	3,832	3,184	544.8
Kehl Canyon - % Dry:		**73.6**											
Dane I	3,452	491	545	877	0	1,539	55.4	44.6	7,277	1,306	8,582	5,971	2,108.1
Dane II	3,248	393	385	448	0	2,022	37.7	62.3	3,214	333	3,547	2,881	989.7
Dane III	1,254	172	341	264	0	477	62.0	38.0	1,636	402	2,037	1,234	1,304.4
Dane IV	2,656	199	122	172	0	2,163	18.6	81.4	972	37	1,009	934	366.0
Dane V	2,899	19	6	15	0	2,859	1.4	98.6	0	0	0	0	0.0
TOTALS	13,509	1,274	1,399	1,776	0	9,060			13,099	2,078	15,175	11,020	969.7
Dane Canyon - % Dry:		**67.**											

Appendix C

Stream Habitat Type Summary and Estimated Wetted Surface Area by Reach
East Clear Creek Watershed
Summer 2000

Reach Names	Total Distance (m)	Pool (m)	Riffle (m)	Run (m)	Complex (m)	Dry (m)	Percent Wet	Percent Dry	Est. Wet Surf. Area (m^2)	Confid. Int. Value (m^2)	95% C.I. high (m^2)	95% C.I. low (m^2)	Wetted Surf. Area Per Km
Bear I	3,200	107	81	141	0	2,871	10.3	89.7	911	590	1,500	321	284.7
Bear II	7,019	785	239	535	0	5,460	22.2	77.8	4,569	562	5,131	4,007	650.9
Bear III	989	326	22	72	0	569	42.5	57.5	4,068	4,075	8,143	(6)	4,113.2
Bear IV	1,189	5	0	7	0	1,178	1.0	99.0	0	0	0	0	0.0
TOTALS	12,397	1,223	342	755	0	10,078			9,548	5,227	14,774	4,322	770.2
Bear Canyon - % Dry:		**81.3**											
ECC III	4,346	37	0	0	0	4,309	0.9	99.1	80	111	191	(31)	18.4
ECC IV	4,985	143	18	62	0	4,762	4.5	95.5	274	186	460	88	54.9
ECC V	4,379	71	28	51	0	4,229	3.4	96.6	124	112	236	12	28.3
TOTALS	13,710	251	46	113	0	13,300			478	409	887	69	34.8
ECC - % Dry:		**97.0**											

Total Surveyed Distance for the Summer of 2000

Meters	Kilometers	Feet	Miles
68,632	68.63	225,111	42.6

That segment of ECC downstream of the Blue Ridge Reservoir dam was the only stream to maintain the greatest volume of water, and maintained a continual flow all summer. Therefore, speculation is that the water in the reservoir kept the lower reaches of ECC watered, while all other stream channels dried up.

Appendix D

Fish Collection Summary

East Clear Creek Watershed

Number of Fish by Species by Habitat Type by Stream Reach

Summer 2000

Stream Reach	Habitat Unit		Fish Species RHOS	CADI	CAsp	PIPR	ONMY	# Sampled Habitats	Effort (sec)	Fish / Unit Effort (sec)	Fish / Unit Effort (min)	Collection Dates	Water Temp. (°C)
Yeager I													
	pool						31	11	2949				
	run						7	1	376				
	TOTALS						38		3325			6/19/2000	
TOTAL FISH - all spp:		38								0.01	0.7	6/20/2000	14-18
Yeager II (Schneider Spring)													
	pool						12	2	309				
	run						1	1	86				
	TOTALS						13		395				
TOTAL FISH - all spp:		13								0.03	2.0	9/7/2000	15
Dane I													
	pool		205	19			4	5	3842				
	run		196	12			6	4	2445				
	TOTALS		401	31			10		6287			7/11/2000	
TOTAL FISH - all spp:		1,478								0.24	14.1	7/17/2000	11°-21°

RHOS count is just for the weighed and measured fish. "TOTAL FISH" equals combined total of measured and unmeasured fish.

Appendix D

Fish Collection Summary
East Clear Creek Watershed
Number of Fish by Species by Habitat Type by Stream Reach
Summer 2000

Stream	Habitat		Fish Species					# Sampled	Effort	Fish / Unit	Fish / Unit	Collection	Water
Reach	Unit		RHOS	CADI	CAsp	PIPR	ONMY	Habitats	(sec)	Effort (sec)	Effort (min)	Dates	Temp. (°C)
Dane II													
	pool		201	20			3	6	2652				
	run		31					2	54				
	TOTALS		232	20	0	0	3	8	2706			7/17/2000	
	TOTAL FISH - all spp:	**=**	**2,109**							0.78	46.8	7/19/2000	12°-25°
	(RHOS count is just for the weighed and measured fish)							"TOTAL FISH" equals combined total of measured and unmeasured fish.					
Dane III													
	pool		46	12			4	3	1053				
	run												
	TOTALS		46	12	0	0	4	3	1053				
	TOTAL FISH - all spp:	**=**	**462**							0.44	26.3	7/19/2000	17-22
	(RHOS count is just for the weighed and measured fish)												
Dane IV													
	pool		585	164				4	453				
	run												
	TOTALS		585	164					453				
	TOTAL FISH - all spp:	**=**	**749**							1.65	99.2	7/20/2000	14-19
Dane V													
	pool		84	11				1	480				
	run												
	TOTALS		84	11					480				
	TOTAL FISH - all spp:	**=**	**95**							0.20	11.9	7/20/2000	15

Appendix D

Fish Collection Summary
East Clear Creek Watershed
Number of Fish by Species by Habitat Type by Stream Reach
Summer 2000

Stream Reach	Habitat Unit		Fish Species RHOS	CADI	CAsp	PIPR	ONMY	# Sampled Habitats	Effort (sec)	Fish / Unit Effort (sec)	Fish / Unit Effort (min)	Collection Dates	Water Temp. (°C)
Kehl I													
	pool		48					2	96				
	run												
	TOTALS		48						96				
TOTAL FISH - all spp:		48								0.50	30.0	6/27/2000	18-24
Kehl II													
	pool		16			1	57	12	2034				
	run						6	4	749				
	TOTALS		16			1	63		2783				
TOTAL FISH - all spp:		80								0.03	1.7	6/26/2000	15-20
Bear I													
	pool		469	28		4		2	1298				
	run		194	8				1	260				
	TOTALS		663	36		4			1558				
TOTAL FISH - all spp:		703								0.45	27.1	7/31/2000	16-18
plus 24 fry - unk spp													
Bear II													
	pool		1394	99		12	1	5	1313				
	run												
	TOTALS		1394	99		12	1		1313			7/31/2000	
TOTAL FISH - all spp:		1,500								1.15	68.8	8/1/2000	17-21
(In addition to electrofishing) (dipnet hauls: 2 for 5 min.)													

Appendix D

Fish Collection Summary
East Clear Creek Watershed
Number of Fish by Species by Habitat Type by Stream Reach
Summer 2000

Stream	Habitat		Fish Species					# Sampled	Effort	Fish / Unit	Fish / Unit	Collection	Water
Reach	Unit		RHOS	CADI	CAsp	PIPR	ONMY	Habitats	(sec)	Effort (sec)	Effort (min)	Dates	Temp. (°C)
Bear III													
	pool		339	74				1	1210				
	run												
	TOTALS		339	74					1210				
TOTAL FISH - all spp:		**413**								0.34	20.5	8/3/2000	15-17
			(one pool with three past sample)										
ECC III													
	pool		213			16		3	132				
	run												
	TOTALS		213			16			132				
TOTAL FISH - all spp:		**229**								1.73	104.1	8/9/2000	17-19
			(2 pools sampled w/ dipnets)										
			(21 morts counted - not due to sampling)										
ECC IV													
	pool		512	6	8	58		2	20				
	run												
	TOTALS		512	6	8	58			20				
TOTAL FISH - all spp:		**584**										8/9/2000	15-19
			(shocking effort in one pool, other netted)										

Appendix D

Fish Collection Summary
East Clear Creek Watershed
Number of Fish by Species by Habitat Type by Stream Reach
Summer 2000

Stream	Habitat		Fish Species					# Sampled	Effort	Fish / Unit	Fish / Unit	Collection	Water
Reach	Unit		RHOS	CADI	CAsp	PIPR	ONMY	Habitats	(sec)	Effort (sec)	Effort (min)	Dates	Temp. (°C)
ECC V													
	pool		105			50		2	0				
	run												
	TOTALS		105			50			0				
TOTAL FISH - all spp:		**155**										8/10/2000	18

(all sampling by dipnet)

Fish Species:

RHOS:	Rhinichthys osculus	speckled dace
CADI:	Catostomus discobolus	bluehead sucker
Casp:	Catostomus sp.	Little Colorado sucker
PIPR:	Pimephales promelas	fathead minnow
ONMY:	Oncorhynchus mykiss	rainbow trout

NOTES: Bear II: P5 dipnetted for a total of 197 fish. P10 electrofished, but effort not recorded for a total of 505 fish. Recorded total effort of 1313 second is for all other sampled habitats. The "Fish/Unit Effort" has been adjusted accordingly.

Appendix E

Significant Habitat Features
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

Stream	Reach #	Habitat Type	Stream Channel Feature	Distance (m)	Maximum Depth/Height (cm)	Length (m)	Remarks
Yeager	I		rock barrier	1,744	120.0		Distance from confluence with East Clear Creek
	I		rock barrier	1,844	155.0		Distance from confluence with East Clear Creek
	I		rock barrier	1,933	91.0		Distance from confluence with East Clear Creek
	I	pool 16		2,235	55.0	26.6	Distance from confluence with East Clear Creek
	I	pool 21		2,365	90.0	19.2	Distance from confluence with East Clear Creek
	I	pool 31		2,908	47.0	8.0	Distance from confluence with East Clear Creek
	I	pool 34		3,211	115.0	15.0	Distance from confluence with East Clear Creek
	I	pool 36		3,522	71.0	17.5	Distance from confluence with East Clear Creek
	I	pool 39		3,866	103.0	6.4	Distance from confluence with East Clear Creek
	III	pool 3		11,711	43.0	15.0	Distance from confluence with East Clear Creek
	III		rock barrier	15,563	243.8		Distance from confluence with East Clear Creek
Kehl	II	pool 17		1,277	55.0	3.5	Distance from beginning of Reach II
	II	pool 19		1,319	53.0	11.0	Distance from beginning of Reach II
	II	pool 21		1,420	100.0	8.5	Distance from beginning of Reach II
	II		debris barrier	1,428			Distance from beginning of Reach II
	II	pool 22		1,508	60.0	11.0	Distance from beginning of Reach II
	II	pool 31		2,200	80.0	20.0	Distance from beginning of Reach II
Bear	I	pool 6		2,586	200.0	41.4	Distance from beginning of Reach I (Blue Ridge Reservior)
	II	pool 9		839	90.0	21.9	Distance from beginning of Reach II
	II	pool 25		2,783	150.0	24.0	Distance from beginning of Reach II
	II	pool 30		2,981	130.0	30.4	Distance from beginning of Reach II

Appendix E

Significant Habitat Features
East Clear Creek Watershed
Stream Habitat Inventory
Summer 2000

Stream	Reach #	Habitat Type	Stream Channel Feature	Distance (m)	Maximum Depth/Height (cm)	Length (m)	Remarks
Bear	II	pool 32		3,177	130.0	49.3	Distance from beginning of Reach II
	II	pool 37		4,299	140.0	21.6	Distance from beginning of Reach II
Dane	I	pool 3		503	150	36.7	Distance from confluence with Barbershop Canyon
	I	pool 16		2327	130	14.8	Distance from confluence with Barbershop Canyon
	I	pool 21		2599	160	19.5	Distance from confluence with Barbershop Canyon
	II	riffle 15		2941			Distance from confluence with Barbershop Canyon;
							small spring on LB @ lower end of riffle, very low flow
	III	pool 5		378	100	41	Distance from beginning of Reach III
	III	riffle 12		605			Distance from beginning of Reach III;
							nice spring off RB @ upper end of riffle 12,
	V	pool 1		22	110	9.3	Distance from beginning of Reach V
ECC	II	pool 13		476	69	29.3	Distance from beginning of Reach II