NOTES ON 1978 FIELD COLLECTIONS OF CUTTHROAT TROUT FROM SELECTED NORTH FORK WATERS, GLACIER NATIONAL PARK

Grace Lake

Native fish apparently never ascended above the falls located one-half mile below the outlet of Grace Lake. The population of cutthroat trout found in this water descended from a 1925 stocking of 101,000 cutthroat eggs. These trout resemble Yellowstone cutthroats, but the spots appear larger and somewhat more irregular than those typically found on the Yellowstone subspecies. Tissue samples from these trout are available for electrophoresis studies, but the specimens were too large for preservation in the field with available storage facilities. This lake will be sampled again next season, and trout will be preserved for morphomeristic character analyses.

Logging Lake

The Logging Lake specimens were collected from the shallow bay at the head of the lake. Cutthroat trout in this lake could be mildly influenced by Yellowstone cutthroat trout from Grace Lake situated 1.5 miles upstream, since fry could survive the 60-foot waterfalls between Grace and Logging lakes. The Logging Lake cutthroat population has also been exposed to about 202,000 Yellowstone cutthroat fingerlings planted between 1934 and 1944.

Cerulean Lake

This is the remote headwaters lake of the Quartz Creek drainage. Since the upper 7 miles of the drainage lacks trails, the aquatic system is unimpaired and probably represents the most ecologically intact lake/stream complex on the North Fork.

Cutthroat trout and bull trout are present in Cerulean Lake. Native suckers and whitefish could also be present, but none were collected or observed. Normally, they are visible in lakes of this type when present. The cutthroat trout collected from Cerulean Lake exhibited a deep cyan-blue coloration along the entire dorsal surface. This trait was more pronounced than anything seen on cutthroats elsewhere in Glacier Park. The color faded rapidly, however, in preserved fish.

Cerulean Lake has never been stocked, but there is unrestricted passage between Cerulean and Quartz lakes. The extent of population exchange between these lakes is unknown. These cutthroats may be the best representation of the indigenous westslope cutthroat surviving in Glacier National Park.

Quartz Lake

Quartz Lake is one of the least disturbed waters on the North Fork. A single stocking of 8,500 cutthroat trout fry occurred in 1940; no doubt these were Yellowstone cutthroats. The sample obtained for the present study comprised trout taken from both the upper and lower ends of the lake and, hence, should represent the existing population well. It may be noteworthy that the cutthroats caught from this lake exhibited a striking blue cast along the dorsal surface. These trout appear to be excellent representations of the native cutthroat.

Evangeline Lake

This small lake near the headwaters of the Camas Creek drainage appears to have been naturally barren of fish life. Physical barriers downstream effectively blocked fish movements. Today the lake contains a population of Yellowstone cutthroat which descended from stockings in 1925 and 1935 of about 90,000 eggs and fry. The lake appears to be marginally productive; hence, it is not surprising that many of these trout were found in poor condition. Evidently, they have sustained a viable population only because of the absence of competitive pressures.

Arrow Lake

Native salmonids have historically occupied the Camas Creek drainage upstream as far as Arrow Lake. A series of small waterfalls and cascades above Arrow evidently prevented fish from invading the headwaters. "Dolly Varden" (bull trout) were reported from Arrow Lake during the park's 1964 creel census, but none were collected or reported this past summer. Indeed, only cutthroat trout were observed. Possibly the log jam at the foot of Trout Lake (immediately downstream) created by the 1964 flood could be blocking upstream movements of migratory species. If this is the case, the Arrow Lake cutthroat population could be reproductively isolated from the North Fork cutthroat trout fishery.

Of 33 cutthroat trout collected from Arrow Lake, 30 appeared to be native westslope trout. However, three fingerlings captured in the outlet stream by electrofishing were obviously Yellowstone cutthroats. Curiously, no adults of the latter subspecies were collected. The small Yellowstone cutthroats probably washed down from Camas or Evangeline lakes in the headwaters of this drainage where exotic Yellowstone trout were established half a century ago.

Approximately 122,000 Yellowstone cutthroat eggs and fingerlings were planted in Arrow Lake during the 1920s and 1930s; conceivably, these introductions have influenced the native cutthroat population in that lake. However, this does not account for the juvenile Yellowstone cutthroats collected recently since these fish did not appear to be hybrids.

Evaluation of Recent Collections of

Cutthroat Trout in Colorado

Prepared for Colorado Division of Wildlife

Robert J. Behnke
June 1977

Introduction

Examination, analysis and comparisons were made of 5 samples of 48 specimens from the South Platte and Arkansas river drainages (suspected *Salmo clarki stomias*) and 8 samples of 49 specimens from the Colorado River basin (suspected *S. c. pleuriticus*).

The most significant conclusion concerns the identification of trout from South Huerfano and Cascade creeks (Arkansas drainage) as *S. c. stomias* (no indication of hybrid influence in any specimen).

Most of the samples from the Colorado basin are obvious hybrids. The most "hopeful" *pleuriticus* sample is from Rocky Fork Creek (Frying Pan R.), but only 6 specimens were available for study.

Further data and discussion of other Colorado River basin collections not previously reported on are included in this report.

No Rio Grande basin specimens were examined during the present study but a synthesis of information on Rio Grande cutthroat trout from a report by David Propst is included in relation to the status of this trout in Colorado.

A strong correlation appears to exist between rainbow trout hybrid influence on native trout populations and the development of basibranchial teeth, which suggests a rapid method of screening large numbers of samples for purity evaluation.

The potential application of computer analysis of taxonomic characters to better quantify the diagnostic characters of the native subspecies is discussed.

Collections from the South Platte and Arkansas Drainages

South Huefano and Cascade Creeks

Division of Wildlife collections from the South Huerfano River, above and below Dutch Creek, and its tributary. Cascade Creek "above rapids", made on September 12, 1976, are the most significant specimens examined in this study. I can find no evidence of non-native trout influence in any character in any of these specimens; the spotting pattern is uniformly typical of the greenback cutthroat trout. I judge these two samples to represent pure, or virtually pure, populations of *Salmo clarki stomias*. There are no significant differences, except for the number of basibranchial teeth ($\bar{x}$ 9.3 for Cascade Creek and 5.9 for South Huerfano fish), in any character between the two samples. Every specimen has at least one basibranchial tooth. Previously, I examined a sample from the South Huerfano River, above the confluence with Dutch Creek, collected in 1963. I judged them to be the best representative of *S. c. stomias* known from the Arkansas River basin (Behnke 1976a). I had reservations of the purity of the 1963 collection because 1 of 10 specimens lacked basibranchial teeth and the average number of teeth was low (3.0). The long history of stocking rainbow trout and probably non-native cutthroat trout in the South Huerfano drainage, also argued against persistence of a pure population without physical isolation. The present collection of 15 specimens collected 13 years later in the same stream section, differs from the 1963 collection in more basibranchial teeth (100% occurrence and a mean value of 5.9) and slightly higher scale numbers (191.2 vs 185.0). The suggestion is that since rainbow trout stocking has been discontinued, at least in the upper part of South Huerfano Creek, the native genotype is better adapted to the environmental conditions and rainbow trout genes have been selectively lost to the population. If this is the case, it is the first known instance of a greenback trout population resisting the effects of hybridization (genetic swamping). If, indeed, rainbow trout genes were in the population at low levels in 1963, it is not reasonable to believe that every non-native gene has been lost and qualify the South Huefano sample as "virtually pure". There is no possible technique that can absolutely determine the purity of any population as *S. c. stomias*, but because the appearance and all characters are completely typical of the greenback trout, I consider the populations from which these samples were drawn to be *Salmo clarki stomias*.

It would now be important to examine the degree, if any, of isolation of this population. Are there rainbow trout or obvious hybrids in the drainage downstream? If so, what prevents free movement and mixing?

Only the number of basibranchial teeth (9.3 vs 5.9) indicates that the Cascade Creek sample and the South Huerfano sample were not drawn from a single interbreeding population. They appear identical. The notation with the sample that the Cascade Creek fish were taken "above rapids", suggests a partial barrier to free gene flow between the two populations. If this is true, and rainbow trout or hybrids are found in the lower sections of South Huerfano Creek without barriers preventing upstream invasion, then Cascade Creek should be favored as a source of greenback trout for re-introductions in the Arkansas basin. D.O.W. stocking records for the upper South Huefano and for Cascade Creek should be examined.

Because of the significance of the South Huefano and Cascade Creek samples as the only known populations of S. c. stomias in the Arkansas basin, a total of 28 morphological and meristic characters were recorded on all specimens for computer analysis in an attempt to set quantitative limits on the diagnosis of this subspecies. This matter is discussed in a later section.

Long Draw Collection

In a previous report on greenback trout (Behnke 1976a), I called attention to a population of trout in a very small, unnamed tributary of Long Draw Reservoir (headwaters Poudre R.), which could possibly be S. c. stomias. Six specimens collected in 1968, all have basibranchial teeth, high scale counts (197.8) and low pyloric caeca counts (29.5), along with large, round spots on the body. Last October, Mr. Terry Hickman and I went to this creek to obtain a larger sample. An improved road had been constructed to Long Draw Reservoir and a recreation area established. This resulted in increased angler use of the small stream and we found it to be almost barren of catchable-size trout - vividly demonstrating the vulnerability of cutthroat trout to anglers in stream situations. Only two specimens were taken and the data from these two are presented in Table 1 with data from the 1968 sample.

It would seem doubtful that a pure stomias population could have persisted here because of the stream's connection to Long Draw Reservoir and the Grand Ditch which could have allowed entry of Colorado River cutthroat and introduced non-native cutthroat into this population.

It can only be said that this population in this miniscule habitat, based on the relatively few specimens available for study, does have the typical appearance and diagnostic characters of stomias.

Rocky Mountain Park Collection

Dave Stevens collected 8 specimens from Pear Reservoir Creek (St. Vrain drainage of RMP), last October for evaluation of purity. There is no doubt that the Pear Reservoir Creek trout represent hybrids between rainbow trout and probably more than one subspecies of cutthroat trout. They are predominantly cutthroat trout and the bright coloration suggests the native greenback influence. The absence of basibranchial teeth in 5 of the 8 specimens and irregular shaped, profuse spots are the result of rainbow trout influence.

Pond in South St. Vrain Drainage Collection

I had heard of and received a specimen from an isolated pond in the South St. Vrain drainage several years ago. The specimen was brightly colored and had large, round spots. It resembled stomias and wasn't a typical hybrid. In June, 1976, I arranged to visit this pond. With Mr. Keith Bilby of Longmont, we obtained three additional specimens. The living appearance of these trout are similar to stomias, with large, round spots and orange color suffusing the ventral region. Examination of specimens, however, causes me to reject these trout as pure stomias. One of 4 lacks basibranchial teeth and the lateral series scale counts are low for greenback trout (171.7).

This pond and the origin of its trout are of interest, however. The pond is shown (unnamed) on the Ward topo map at an elevation of slightly over 10,000 ft., off the Brainard Lake Trail and about one mile from the South St. Vrain River. The pond is about four acres in size and shallow, except for a deep shaft, evidently from mining exploration (an old drainage cut can be observed). Without the deep, man-made shaft, the pond would undoubtedly winter-kill. The physical isolation also makes it clear that trout could not have been native here. A small, inlet stream debouches directly from a boulder field into the lake with only a silt-sand bottom. Natural reproduction does not appear likely and no young fish were observed around the shoreline of the lake.

Besides cutthroat trout, the pond has large brook trout. Mr. Bilby caught a 14 in. and 19 in. (3.75 lb.) brook trout during our visit. Rolf Nittman told me he has no records of stocking this pond, but mentioned the possibility that trout fry supplied to the Boulder Sportsmen's Club may be the source of the present population. Mr. Bilby told me cutthroat trout to 25 in. have been caught from this pond.

The Non-Game section should be aware of this pond because future reports of "greenback" trout are likely to originate here.

Colorado River Basin Collections

None of the 8 samples examined from the Colorado River basin are judged pure, but a final opinion on the purity of the trout in Rocky Fork Creek (Frying Pan R.) is reserved until study of a larger sample is completed.

Walt Burkhard collected 7 samples totalling 43 specimens. No data except for creek names accompanied these collections, but I believe they are from the White and Yampa river drainages. These specimens were poorly preserved - partially decomposed and stuffed through the neck of small containers so they preserved in a coiled, twisted manner. They were difficult to analyze. Fortunately basibranchial teeth are not affected by such treatment and I believe a valid judgement on their relative purity has been made. All of Mr. Burkhard's collections represent rainbow x cutthroat hybrids. Most specimens lack basibranchial teeth and have lower scale counts than expected for _S_. _c_. _pleuriticus_ (Table 1). However, the scale counts, caecal counts and spotting pattern do reveal that these populations, although obviously hybridized, have a predominantly cutthroat trout genotype.

The one sample I would point out as the "best _pleuriticus_" (least hybrid influence) is Soldier Creek. Four of the five specimens have basibranchial teeth and these four have scale counts typical of _pleuriticus_ (182-194). The fifth specimen lacks basibranchial teeth, has 152 scales and a more typical hybrid spotting pattern. If it is possible that this hybrid specimen was from another locality and inadvertantly mixed with the Soldier Creek collection, then this population would warrant further collection and study and observations on its degree of isolation.

It is of interest to note that a hybrid influence of rainbow trout does not influence all characters uniformly. The 7 specimens from Big Beaver Creek have the typical scale counts of pleuriticus (180-195), although 3 of the 7 lack basibranchial teeth. The diagnostic characters of this sample are almost identical to a sample of 15 specimens I examined in 1971 from a Beaver Creek on BLM lands near the Utah border in Colorado. BLM personnel believed they had found a pure population of pleuriticus at that time because of the remoteness of the habitat. Although I did find an average of 183 scales in the sample, typical of pleuriticus, 7 of 15 specimens lacked basibranchial teeth and stocking records revealed that 1000 rainbow trout and 1000 "natives" were stocked as recently as 1969.

I also examined 12 specimens collected in 1971 from a Canyon Creek, tributary to Piceance Creek. I do not believe that the 3 specimens collected in 1976 from "Canyon Creek" by Burkhard could be the same locality. The 1971 specimens all have basibranchial teeth and characters very similar to Trappers Lake cutthroat trout, which had likely been stocked. The 1976 sample from Canyon Creek is obviously hybridized.

From talks I have given to Trout Unlimited chapters in the Denver area on native trout, some T. U. members have developed an intense interest in finding pure populations of native trout. In May, 1977, Mr. Bob Steenrod and Mr. Charles Winters took me to an isolated tributary of the Frying Pan River - Rocky Fork Creek, to obtain specimens of a reputed pure population of S. c. pleuriticus. The Rocky Fork Creek watershed possesses all of the ideal factors for the stream to hold an uncontaminated population. The lower one mile of stream bed, before joining the Frying Pan River immediately below Ruedi Dam, runs underground through a steep canyon and undoubtably has served as a complete barrier to upstream migration for a considerable time. Above the canyon, the stream forms a series of beaver dams in a large meadow area. No lakes are tributary to the drainage. During our visit on May 14, we encountered blizzard conditions and a water temperature of 36^{o} F. Trout were difficult to catch and only six specimens were preserved for examination. The living colors of the largest specimens, preparing to spawn, were typical of pleuriticus, with orange and golden tints developing on the body. The spotting pattern is typical of pleuriticus with no indication of hybrid influence. Evaluation of character analysis of the six specimens, calls for a delay on the final judgement of this population until more specimens are available for study. One of the six specimens lacks basibranchial teeth (at least 90% occurrence is expected in pure pleuriticus). The scale counts are at the lower range expected of pleuriticus (40-45 above [43.8] and 167-199 [181.3] in lateral series), but highly accurate counts are impossible on these specimens due to thick epidermal covering of scales and these counts must be considered only as the "best estimate".

Another trip is planned this summer to obtain a larger series of trout from Rocky Fork Creek. DOW stocking records should be checked for any recorded introductions into this stream.

Thus, the situation regarding the status of S. c. pleuriticus in Colorado remains unchanged. The best (purest) representative known in the state is in Northwater Creek (Behnke 1976b), which, although having a long history of introductions, including rainbow trout, 41 specimens collected in recent years from Northwater Creek, all ideally conform to the diagnosis of S. c. pleuriticus. All 41 specimens from Northwater Creek have basibranchial teeth. The "second best" pleuriticus known from Colorado is from the Cunningham Creek population (Frying Pan drainage) with average scale counts of about 190 and 18 of 19 specimens with basibranchial teeth.

I would classify both the Northwater Creek and Cunningham Creek populations as Salmo clarki pleuriticus because the hybrid influence, if any, is insignificant and not detectable.

It should be recognized that somewhere in the broad geographical region comprising the Colorado River drainage of Colorado, some completely isolated populations of pure pleuriticus must exist in waters that have never been stocked with non-native trout. However, such populations must certainly be rare. During the past several years I have examined numerous samples from remote cutthroat trout populations in the basin and with the exception of Northwater Creek, Cunningham Creek and possibly Rocky Fork Creek, almost all have shown definite signs of hybridization.

An exception to this statement concerns collections made by Clee Sealing in 1973. All of Sealing's collections had obvious hybrid influence with the exception of 10 specimens from Nickleson Creek, a tributary in the Roaring Fork drainage, near Aspen (tributary of Snowmass Creek). The character analysis of Nickleson Creek specimens is included in Table 1. All have basibranchial teeth, and other characters are typical of pleuriticus including the vertebral counts (60-62 [61.2]). I have no indication that Nickleson Creek is isolated from hybrid populations found in the Snowmass-Roaring Fork drainage. A further look at the Nickleson Creek population is warranted.

The stock of cutthroat trout in Kremmling Reservoir has been used for the propagation of "native" trout (at least in 1972-73). This reservoir was considered a good possibility for pure pleuriticus by George Kidd because it is on land closed to the public and there are no stocking records for the stream above. I received 24 specimens of trout from Kremmling Reservoir in 1972 and 73. Their character analysis has not been made available before and is included in Table 1. I am confident that the Kremmling Reservoir trout are not pure pleuriticus, although they are predominantly pleuriticus. I believe that an influence is present from at least one other non-native cutthroat (probably Yellowstone Lake), and a very slight influence from rainbow trout (lower scale counts, 1 of 24 specimens without basibranchial teeth and occasional high caecal counts).

Also included in Table 1 are comparisons of Trapper's Lake cutthroat trout from Trapper's Lake, collected in 1971 and examined by me, and Trapper's Lake cutthroat originating from a plant into Williamson Lake, California in 1930 and collected in 1976 (examined by John Gold).

It can be noted that the values of meristic characters are virtually identical. There has been a general belief that the massive stocking of Yellowstone Lake cutthroat trout into Trapper's Lake in the 1950's, signficantly altered the native genotype. This is not true. No real differences are apparent between the present Trapper's Lake cutthroat and its early derivative in Williamson Lake. John Gold told me he has written a paper on this matter for publication in California Fish and Game.

Rio Grande Cutthroat Trout

As mentioned above, no specimens of Rio Grande basin trout were examined in the present study. Propst (1977) completed a report based on his study of Rio Grande trout in New Mexico. Of particular relevance to the status of native trout in Colorado, are the collections made by Propst from the Canadian River basin.

I had pointed out previously (Behnke 1976c) that no authentic records exist to document the native occurrence of trout in the Canadian River. If trout are native to the Canadian drainage they could have had their origin from headwater stream transfer from either the Arkansas basin (greenback trout) or from the Rio Grande basin (Rio Grande cutthroat). The specimens I examined in 1976 from Ricardo Creek, Costilla Co., Colorado, a headwater tributary in the Canadian drainage, are Rio Grande cutthroat trout. Propst collected specimens from several Canadian River drainage tributaries including lower Ricardo Creek, in New Mexico, and found that although the influence of past hybridization with rainbow trout is apparent in all his samples, the cutthroat trout ancestor here is the Rio Grande cutthroat and not the greenback. Propst's sample from lower Ricardo Creek, has a more obvious rainbow trout influence than the specimens I examined from this stream in Colorado (17 of 21 without basibranchial teeth, some high caecal and low scale counts). He mentioned a geological uplift near the border through which Ricardo Creek flows, which may act as a barrier to free movement and which could serve to maintain a higher degree of purity in the trout on the Colorado side of the border. Except for the lack of basibranchial teeth in half of the specimens I examined from Ricardo Creek, I found them quite typical of *S. c. virginalis*.

Propst found, as have all previous studies, that pure populations of Rio Grande cutthroat trout are very rare. Although 33 sites were sampled by Propst, most in remote localities, only one stream was judged to probably contain a pure population of S. c. virginalis. I would expect comparable results from comparable sampling in the Rio Grande basin of Colorado.

Discussion and Suggestions

It is apparent that all of the subspecies of cutthroat trout native to Colorado are certainly rare as pure populations. With the tremendous area encompassed by headwater streams in the state, it must be recognized that only a relatively small area has been adequately sampled for the occurrence of native trout, and that usually not in a systematic manner.

It would be virtually prohibitive in manpower and money to sample and examine specimens from every stream in the state with fish resembling cutthroat trout. Sampling can be selective to concentrate on isolated areas or areas where reliable evidence suggests the possible occurrence of native trout. A screening system can be devised for sampling and examination to greatly speed-up this process. In the field, an experienced person can recognize obvious external hybrid influence in coloration and spotting pattern, and when these indicators are observed in a population, there would be no need to preserve specimens for examination. The spotting patterns of hybrid and native (greenback, Colorado River and Rio Grande cutthroat trouts), specimens becomes more uniquely typical of a particular genotype with increase in size. Decisions on "typical" spotting patterns of native subspecies and hybrids should be based on specimens of about 200 mm or more.

If no obvious external indication of hybridization is apparent in a population, then at least 10 specimens can be preserved for examination. For evaluation of S. c. stomias and S. c. pleuriticus, there is a strong correlation between rainbow trout hybridization and the absence of basibranchial teeth, so that several samples may be screened by first examining the basibranchial teeth. Only those samples in which 90% of the specimens have these teeth, would examination continue to include the time-consuming counting and measuring of several other characters. There is a natural tendency in Rio Grande cutthroat trout to have a more feeble development of basibranchial teeth and a level of 80% might be used with Rio Grande samples.

To assist in future studies of native trout, any DOW project funded by such agencies as BLM, USFS or Bureau of Reclamation which may include areas possessing native trout, should have specific direction for sampling and evaluation of purity of populations. If this is done, progress toward a better determination of the status of Colorado's native trouts would be advanced and situations such as Cunningham Creek and its pleuriticus population could be recognized before and not after the fact of development.

As mentioned above, there is no character and no technique that can be used to absolutely determine the purity of any of the native subspecies of cutthroat trout. This is not surprising if the evolutionary development of subspecies of cutthroat trout is considered in the various drainage basins. Being an inhabitant of headwater streams, natural geological events provide opportunity for transfer of trout and gene flow between basins. This prevents the long and complete isolation needed to evolve unique genetic differences not shared by the populations in neighboring basins. Thus, there is no known gene (as observed by analysis of the gene product - the protein), unique to stomias, pleuriticus, or virginalis, nor is one likely to be found. With the present state of knowledge and techniques, biochemical analysis of native trout may be interesting, but essentially a waste of time and money in relation to determining relative purity of stocks. The same can be said of investigation into karyotypes.

One modern technique does offer some interesting potential to better quantify the diagnostic characters of subspecies of cutthroat trout and perhaps define acceptable limits of variation in "pure" populations. This is computer analysis of data.

I have experimented with computer aided techniques for handling taxonomic data for several years (Legendre, Schreck and Behnke 1972), but in recent years several new programs have been devised to analyze data and group specimens in many ways. An inherent danger must be recognized when interpreting the computer print-out, and that concerns artifacts from environmental (non-genetic) influence. For example, if three lots of trout, all from the same parents, were raised in three distinctly different environments such as a small stream, a lake and a hatchery, their growth rates would likely produce consistent differences in morphology. A quantitative morphological description of each population based on morphometric measurements, when fed into the computer would yield three distinct clusters, leading an uninformed observer to believe they represent three different species. Thus, the major criteria for computer-aided diagnosis should be meristic characters (essentially genetic based), and then find morphological characters that correlate with the meristic data. Hickman (1977) used a principal component analysis which is a discriminant function analysis setting out the best set of diagnostic characters on a horizontal axis and the next best set of characters on a verticle axis to produce a two-dimensional print-out with a centroid (or "mean of means"), for each sample or group of samples in a particular geographical area. Each specimen, represented by a number, is grouped around the centroid. The print-out reveals the "goodness" of the analysis by "predicted group membership". That is, what are the chances of classifying an unknown specimen into its correct group (subspecies or geographical region of subspecies), by the characters used?

Hickman's results on Bonneville basin cutthroat trout lend encouragement that similar or better results might be obtained to quantify the taxonomic consistency and variability of stomias, pleuriticus and virginalis, if sufficient samples of pure populations were available for analysis.

Mike Prewitt also used this computer technique to analyze taxonomic data from bluehead, white and flannelmouth suckers and their hybrids for his MS thesis. Because, in this case, the suckers have species-specific, non-overlapping differences, and all hybrids appear to be F_1's (evidently sterile), the predicted assignment of an unknown specimen to its correct group is 100%.

On the other hand I have seen this program used in an analysis of trout from Chitty Creek, Arizona (a study of the pollution sources and their effect on the aquatic habitat of Eagle Creek watershed, Apache-Sitgraves National Forest, Arizona. B. E. Kynard. 1976. Univ. Ariz.), which led the author to believe that an undescribed subspecies of *S. apache* inhabits Chitty Creek (my opinion is that they are *S. gilae* x *S. gairdneri* hybrid). In the above-mentioned study *S. gairdneri* was represented by hatchery-reared fish. It lacked proper understanding of trout taxonomy.

It will take some experimentation with characters and techniques, and the computer can not create real (genetic), uniqueness that isn't in nature, but, I believe, useful information will result from such a study on the native trout of Colorado, if carried out by persons with a basic understanding and familiarity of trout taxonomy.

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Call Blanke
CSU 491-5320
H 482-1078

COLORADO RIVER CUTTHROAT

TROUT INVENTORY

RCE
Aug '83

Endangered Wildlife Investigations
Performance Report

State of Colorado
Department of Natural Resources
Division of Wildlife
711 Independent Avenue
Grand Junction, Colorado 81505

February, 1983

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ACKNOWLEDGEMENTS

Thanks to all the Division of Wildlife and U. S. Forest Service personnel that helped us in our search for the cutthroat. Thanks also goes to Steve Culver for his help with the computer analysis and Darrel Snyder for the use of the Colorado State University Larval fish laboratory.

JOB PROGRESS REPORT

State of: Colorado

Project No.: ______________ : Endangered Fish

Work Plan No.: ______________ : Job No.

Job Title: Colorado River Cutthroat Trout Inventory.

Period Covered: April 1, 1982 through August 31, 1982.

Personnel: Larry Wyckoff, Jim Nankervis, Tom Lytle, and John Ellenberger.

Temp Employ [illegible]

[illegible] Jul 82

- [illegible]

- [illegible] Lytle [illegible]

- [illegible] delisting criteria because there were so many streams identified w/ cutthroats

- need to be self sustaining

ABSTRACT

From April 1, 1982 through July 30, 1982, a total of 30 waters was sampled for presence and identification of pure populations of Colorado River cutthroat trout (Salmo clarki pleuriticus). Observations were made of 30 streams in relation to their suitability as S. c. pleuriticus habitat and as potential sites for restoration of species into its native waters.

- limitations of fishing needs to be qualified

- may or may not be needed

COLORADO RIVER CUTTHROAT TROUT INVENTORY

1982

Michael R. Grode, Larry C. Wyckoff, and Jim Nankervis

INTRODUCTION

History

The Colorado River cutthroat trout, _Salmo clarki pleuriticus_, was first described by Cope in 1872 as a result of Hayden's geological survey of Wyoming. In 1891, Jordan gave a more complete description of scale counts, spotting patterns and coloration. Present day diagnosis of population purity is based upon these data (Wernsman 1973).

The former range _S. c. pleuriticus_ extended from the headwaters of the Colorado River basin downstream to the Dirty Devil River, Utah, on the west and to the San Juan drainage of Colorado, New Mexico, and Arizona, on the east (Behnke and Zarn 1976). Presently, however, pure populations of _S. c. pleuriticus_ are rare. Figure 1 shows the past and present distribution of _S. c. pleuriticus_ (reprinted with permission, Behnke and Benson 1980).

Habitat loss and changes, as well as the introduction of non-native trouts, have caused the decline. Brown trout (_Salmo trutta_) and rainbow trout (_S. gairdneri_) have completely displaced _S. c. pleuriticus_ in the larger rivers, and brook trout (_Salvelinus fontinalis_), have invaded many of the smaller headwater streams (Behnke and Zarn 1976). Wernsman (1973) reported finding only three populations of relatively pure _S. c. pleuriticus_ in tributaries of the main Colorado River: Cunningham Creek, tributary to the Frying Pan River, Pitkin

County, Colorado; Northwater Creek, tributary to Parachute Creek, Garfield County, Colorado; and the very headwater source of the Colorado River, Rocky Mountain National Park, Colorado. This latter population was not isolated from non-native trouts and is now extinct for all practical purposes (Behnke and Zarn 1976). Additionally, Behnke's (1978) analysis of collections made in Wyoming determined that four streams in the Little Snake River drainage have virtually pure S. c. pleuriticus and also found that specimens from Lead Creek of the upper Green River drainage are pure.

In 1980, under the direction of Tom Lytle, nongame biologist for the northwest region of Colorado, an inventory project discovered 13 pure populations of S. c. pleuriticus in Colorado. Seventeen other populations were predominantly S. c. pleuriticus, but showed evidence of hybridization with rainbow trout and other non-native cutthroat trout.

Presently, Salmo clarki pleuriticus is recognized as threatened by the Colorado Wildlife Commission. The Utah Fish Committee of the American Fisheries Society's bonneville Chapter lists S. c. pleuriticus as endangered (Behnke and Zarn 1976). Miller (1972) also included S. c. pleuriticus in his list of threatened freshwater fishes of the United States.

OBJECTIVES

1. To determine if and where populations of Salmo clarki pleuriticus exist.
2. To assess the purity of existing populations.
3. To reintroduce S. c. pleuriticus into suitable streams and lakes within its historic range.
4. To monitor and protect known populations of S. c. pleuriticus.

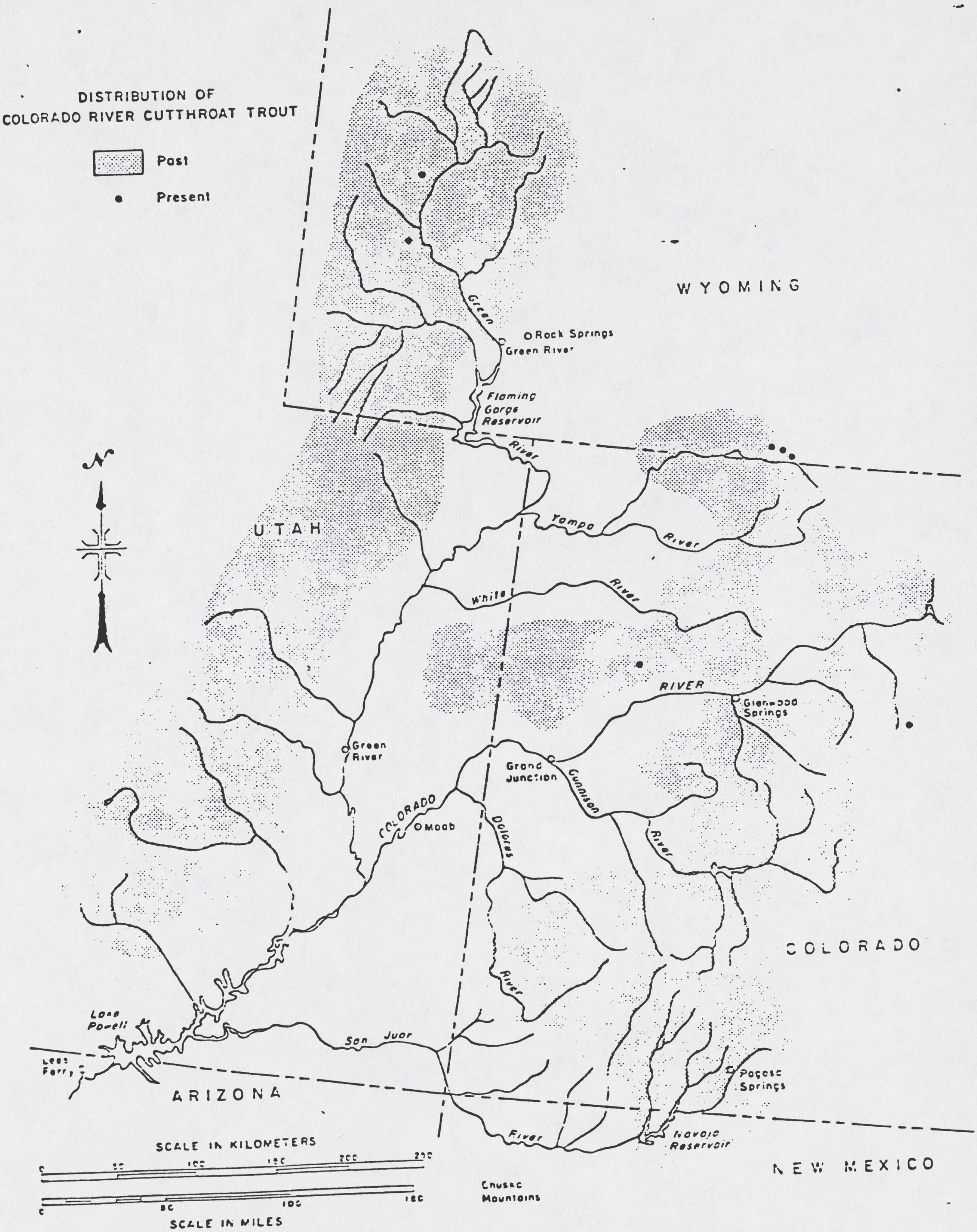


Figure 1. Past and present distribution of Colorado River cutthroat trout.

METHODS AND MATERIALS

FIELD

Candidate waters for the 1982 inventory were restricted to streams because they were believed to have better potential as habitat for pure or relict populations. Last year's inventory revealed only one pure population from lacustrine habitat.

Selection of streams was based on computerized stream inventory data for waters that were shown to have a "known history of cutthroat". In most cases, the chosen streams were cross-referenced with stocking records and eliminated if rainbow trout had been introduced. Streams supposedly containing cutthroat were not eliminated if non-native species other than rainbow had been reported in a previous survey.

Several streams were surveyed on the recommendation of various CDOW and Forest Service (F.S.) field personnel. In the interest of efficiency and optimal utilization of collection time, their suggestions were used to further discriminate against poor or unlikely candidate waters. Suggestions from some local fishermen were used similarly.

Actual sampling was usually accomplished using a Coffelt BP-2 backpack electroshocker. In situations that involved extensive hiking, sampling was augmented by angling. The samples were taken as close to headwaters as possible since this is the most likely location for pure populations of *S. c. pleuriticus* (Behnke 1976, Langlois et al. 1978). Whenever possible, sampling was done above barrier falls which would prevent the upward migration of exotics. An adequate barrier falls is considered to be one greater than three feet in height (Langlois et al. 1978). Beaver dams were encountered on many streams and they function as effective temporary barriers in some situations.

Critical habitat may need to be preserved by upgrading certain beaver structures with permanent ones. A CDOW stream survey sheet was completed for each stream sampled and additional notes were taken on habitat appraisal and general stream characteristics.

The fish were preserved in ten percent formalin with 0.4 percent borax used as a buffer (Wernsman 1973), and placed in one gallon Nalgene bottles. The bottles were initially stored in a horizontal position to allow the specimens to stiffen without curling. A small (less than one inch) ventral incision was made in each fish anterior to the vent to facilitate penetration of the formalin. A minimum size requirement of 75 mm was placed on each specimen at Dr. Behnke's suggestion. This is the size at which basibranchial teeth are fully developed.

Ten specimens are considered an adequate sample for determining statistical significance (Behnke and Zarn 1976). Those samples of less than 10 were a result of sparse populations or various extenuating circumstances. The samples that could not be immersed in formalin quickly were injected with formalin at several points throughout the body until they could be properly preserved. Each sample was photographed to record color and spotting patterns before being preserved. A standard collection card was filled out for each sample which described location and characteristics of the particular stream and was included in the sample. Maps were color-coded for those streams sampled and the location of barrier falls as was done in the 1981 survey.

TAXONOMIC ANALYSIS

The purity of S. c. pleuriticus was assessed by analysis of various meristic characteristics and spotting patterns. The first adequate description of S. c. pleuriticus was published in the work of Behnke and Zarn (1976). The Colorado River cutthroat trout is characterized by high scale counts, (170-200+) in the lateral series and (38-48) above the lateral line, low pyloric caeca counts (25-45), 17-21 gillrakers, and basibranchial teeth present in at least 90 percent of the populations (but low in number). The spotting pattern is variable according to geographic locality, and S. c. pleuriticus has a genetic basis to develop brilliant bright red, orange, and golden-yellow colors, especially in mature males (Behnke and Zarn 1976, Behnke 1979).

Morphological measurements were performed according to the procedures described by Hubbs and Lagler (1958). Alizarin was used to stain both the first arch gillrakers and basibranchial teeth by soaking cheesecloth in the dye and placing a small swab in the mouth of the fish overnight. This procedure facilitated the counting of both the gillrakers and the basibranchial teeth. Scale definition was enhanced by the use of malachite green dye applied directly to the scales after the epidermis had been scraped away. Scale counts in the lateral series were made by counting the scales two rows above the lateral line (scale counts of the pored scales are similar in many species). Pyloric caeca counts were made by pulling every complete tip loose from the intestine. When possible, all counts and measurements were made on the left side of the fish.

PURITY RATING

Hybridization is one major problem that has led to the demise of pure S. c. pleuriticus populations. The introduction of non-native trouts to the Colorado River drainage has resulted in all degrees of hybridization and thus renders taxonomic evaluation of pure S. c. pleuriticus population difficult. Hybridization between Salmo species and subspecies is detectable by analysis of genotypic and phenotypic characters. Populations of supposed endemic S. c. pleuriticus are given a purity rating taken from a matrix evaluation of the characteristics analyzed.

Hybridization with rainbow trout is usually detected by an absence of basibranchial teeth, lower scale counts, higher pyloric caeca counts and a profusion of spots. Hybridization with other subspecies of cutthroat is not usually determined by a single character, rather a combination of meristic characters will usually distinguish S. c. pleuriticus from most other non-native cutthroats.

In the process of determining the purity of S. c. pleuriticus, the guidelines established by Binns (1977), in which the letters A through F designated various degrees of hybridization, were followed. The rating scheme is presented here:

- A - Pure S. c. pleuriticus.
- B - Essentially pure, but with a trace of contamination from other Salmo (sub) species.
- C - Good representative of S. c. pleuriticus stock, but some hybridization is evident.
- D - Definite evidence of hybridization, but external characters suggest that it is still representative of S. c. pleuriticus.

E - Populations not examined by a taxonomist.

F - Obvious hybrid and poor representatives of _S. c. pleuriticus_.

Questions arise, however: What defines "essentially"? "Some"? In an attempt to quantify our purity assessment, we have developed a prioritized character matrix:

1 - the number of scales two rows above the lateral line

2 - pyloric caeca

3 - basibranchial teeth

4 - spotting pattern

This will help to remove some of the subjective judgments involved, although intuitively an experienced taxonomist can judge purity fairly accurately.

One limitation that should be pointed out is that spotting descriptions are still somewhat subjective. However, almost anyone can recognize variability. The greater the variability in size, shape, and position of the spots, the greater the rainbow trout and/or non-native cutthroat trout influence (Behnke 1978).

Shown below is the character matrix (Table 1) used to determine the purity of a population. Gillrakers and scales above the lateral line have similar values for pure _S. c. pleuriticus_ and rainbow trout, so these were not used. Typical _S. c. pleuriticus_ values were taken from Behnke and Zarn (1976) and the obvious hybrid values that define the end of the spectrum were taken from rainbow trout character described in Behnke's (1979) monograph. The range of values given for scales and caeca represent mean values.

TABLE 1

Strain Purity of S. c. pleuriticus Using Meristic Characters

	A (1)	B (2)	C (3)	D (4)	F (5)
Number of scales two rows above lateral line	180+	168-179	155-167	142-154	120-142
Number of pyloric caeca	40.9	41.0-44.5	44.6-48.5	48.6-53.0	53.1+
Percent of spec. lacking basi-branchial teeth	10%	10-20%	20-40%	50-75%	75-100%
Spotting variability	Uniform no variability	Slight variability	Same vari-ability yet still typical pleuriticus	Quite vari-able yet still pleuriticus	Obvious hybrid spotting

(After Behnke and Zarn 1976)

This matrix works well for S. c. pleuriticus and non-native hybrids. Genetic influence from subspecies such as the Yellowstone cutthroat (S. c. bouvieri) can be seen in the spotting variability which will result in B or C purity grades. Yellowstone cutthroat typically have a lower number of scales in the lateral series (165-180), somewhat higher gillraker counts (18-23) and many more basibranchial teeth (average of 22) (Behnke 1979).

It is obvious that standardization of the purity rating system is necessary in order to ensure consistent application. This scheme has worked well for the 1982 collection. Further refinement may be needed if complications or contra-dictions arise in the future.

INVENTORY RESULTS

The following list comprises all those streams sampled in 1982. Table 2 provides a summary of every stream sampled, its location, species sampled and number of specimens taken.

The standard CDOW abbreviations for species sampled are used and consist of the following: CRN = *S. c. pleuriticus*, B = *Salvelinus fontinalis* (brook trout), R = *Salmo gairdneri* (rainbow trout), MTS = *Cottus bairdi* (mottled sculpin), BHS = *Catostomus discobolus* (Bluehead sucker), and SD = *Rhinichtys osculus* (Colorado speckled dace).

Table 3 presents data from five meristic characters analyzed in this study. Ranges are given for each character and mean values are provided within the parentheses. Legal site descriptions and sample size (*n*) are also included.

Hubbs and Hubbs diagrams Figures 2-5 are included here to present the data in a more graphic manner. The diagrams illustrate the mean (centerpoint), standard deviation (outer limits of the open rectangle), and sample range (basal line).

Table 4 lists the purity grade rating for those streams sampled in 1982. Following Table 4 is a narrative describing each streams' location, physical characteristics, and species present. The purity grade for cutthroat populations is discussed and management recommendations are added here also. None of the streams or lakes found to contain cutthroat trout should be stocked with non-native trouts such as rainbow trout or brook trout. Non-native subspecies of cutthroat trout should not be stocked either, in order to preserve the genetic integrity of populations of S. c. pleuriticus.

To use this system:

1. Compare the data gathered from the population with the ranges in the matrix and determine which letter grade each character merits.
2. Convert the letter grades to numbers shown to the right of each letter (i.e. C - 3).
3. Sum the numbers for the four characters.
4. Compare the sum with the table below for a final purity rating.

A - 4-5

B - 6-7

C - 8-10

D - 11-13

F - 13+

Pluses and minuses are assigned depending upon where in the range the sum falls, or if other variable outside the matrix (such as pelvic rays) indicate a greater or lesser purity. For example, Lost Creek fish have an average of 188.4 scales, 37.20 caeca, 2.40 teeth and typical S. c. pleuriticus spotting. Therefore, using the matrix:

Scales	-	A - 1
Caeca	-	A - 1
Teeth	-	A - 1
Spotting	-	A - 1
		4

Comparing '4' with the table shows that Lost Creek is an A" population, but teeth counts are on the low side, so a (-) is appropriate. Thus, the purity of Lost Creek is an "A-".

Table 2. Summary of streams examined in northwestern Colorado that contained populations of *Salmo clarki pleuriticus*, 1982.

LOCALITY	LEGAL DESCRIPTION	COUNTY	SPECIES SAMPLED	SAMPLE SIZE
Black Gore Creek	5S 80W Sec 12	Summit	CRN, B	10
Bobtail Creek	3S 76W Sec 33	Grand	CRN, B	10
Butler Creek	3S 92W Sec 31	Rio Blanco	CRN	10
Cabin Creek	1S 75W Sec 2	Grand	CRN	10
Cattle Creek	7S 86W Sec 15	Eagle	CRN, B	10
Corral Creek	6S 79W Sec 22	Summit	CRN, B	10
Cross Creek 7S 82W sec 12	7S 81W Sec 11	Eagle	CRN	10
West Cross Creek 7S 82W sec 11	7S 81W Sec 11	Eagle	CRN	10
Hahn Creek	1N 90W Sec 34, 35	Rio Blanco	CRN	10
Hat Creek	6S 83W Sec 27	Eagle	CRN, B	10
JQS Gulch	5S 94W Sec 26	Garfield	CRN, B	10
Fawn Creek	1N 90W Sec 34	Rio Blanco	--	--
Lost Creek	2N 90W Sec 35	Rio Blanco	CRN	10
Lost Trail Creek	11S 87W Sec 20, 21	Pitkin	CRN	10
East Meadow Creek	4S 81W Sec 11	Eagle	CRN, B	6
Miller Creek	5S 79W Sec 20	Summit	CRN, B	8
Mitchell Creek	6S 89W Sec 27	Garfield	CRN, B	10
Nickelson Creek	9S 87W Sec 36	Pitkin	CRN	10
Nolan Creek	6S 83W Sec 25	Eagle	CRN, B	10
Northwater Creek	5S 95W Sec 13	Garfield	CRN, B	10
South Fork-Ranch Creek	1S 75W Sec 35	Grand	CRN, B	10
Snell Creek	2N 89W Sec 24	Rio Blanco	CRN	10
North Creek-Swan Creek	6S 76W Sec 19	Summit	CRN	10

TABLE 3

Taxonomic character analysis summary for trout collected in the Colorado River drainage in 1982.

Stream	Standard Length	Gill-rakers Total	Scales above Lateral Line	Scales in Lateral Series	Pyloric Caeca	Basi-branchial Teeth
Black Bone Creek						
mean	167.80	19.67	43.50	174.00	34.83	5.33
s.d		1.37	1.76	21.88	2.64	6.77
range		18-22	41-45	163-200	31-38	0-18
Bobtail Creek						
mean	157.17	19.67	39.20	202.66	35.00	13.33
s.d.		1.03	1.48	19.98	1.58	5.50
range		18-21	39-41	164-220	33-37	6-20
Butler Creek						
mean	188.10	18.30	42.70	180.80	32.40	3.10
s.d.		0.82	2.00	9.50	1.50	2.64
range		17-19	41-47	165-199	30-35	0-8
Cabin Creek						
mean	147.80	18.77	44.17	192.00	33.16	4.17
s.d.		0.75	2.23	8.41	1.83	1.33
range		17-19	40-46	184-208	31-35	2-6
Cattle Creek						
mean	167.00	18.10	42.20	177.80	31.70	3.60
s.d.		1.20	1.87	13.29	4.66	3.98
range		17-20	42-45	180-195	30-34	0-9
Corral Creek						
mean	145.75	19.63	39.14	198.88	33.75	7.13
s.d.		1.51	2.27	7.32	4.13	3.14
range		18-22	35-42	188-206	29-39	4-12
Cross Creek						
mean	181.20	20.00	42.80	186.50	38.00	9.70
s.d.		1.05	2.66	13.73	2.55	4.95
range		19-22	39-45	158-207	33-41	3-18
West Cross Creek						
mean	169.50	20.00	40.80	174.30	33.10	6.70
s.d.		1.33	0.79	15.14	2.13	3.74
range		17-21	40-42	152-202	30-37	1-13
Hahn Creek						
mean	160.60	18.80	39.90	190.30	30.80	3.70
s.d.		1.23	2.47	14.40	1.93	2.36
range		17-21	36-45	174-224	28-34	0-8
Hat Creek						
mean	187.40	19.00	43.75	188.50	35.00	8.63
s.d.		1.31	3.60	6.05	2.16	3.96
range		17-21	39-49	177-197	32-37	4-16
JQS Gulch						
mean	171.10	18.00	42.10	189.70	31.30	2.60
s.d.		0.67	1.66	8.04	1.16	2.01
range		17-19	41-45	176-205	30-33	0-6

Table 3 Continued:

Taxonomic character analysis summary for trout collected in the Colorado River drainage in 1982. (cont.)

Stream	Standard Length	Gill-rakers Total	Scales above Lateral Line	Scales in Lateral Series	Pyloric Caeca	Basi-branchial Teeth
Lost Creek						
mean	168.00	19.80	45.50	188.40	37.20	2.40
s.d.		0.92	1.43	9.29	2.57	1.35
range		18-21	43-48	180-205	32-40	0-4
Lost Trail Creek						
mean	164.70	18.00	39.10	196.78	26.70	6.80
s.d.		1.56	2.81	6.70	4.64	3.49
range		16-21	34-42	189-210	18-32	0-12
East Meadow Creek						
mean	170.10	19.60	44.60	220.60	33.90	18.30
s.d.		1.58	2.46	9.44	2.13	6.25
range		17-23	40-47	206-234	30-36	8-27
Miller Creek						
mean	156.50	18.70	41.00	192.33	31.40	7.20
s.d.		1.42	1.41	7.62	1.65	4.61
range		16-21	39-43	193-200	29-34	2-18
Mitchell Creek						
mean	172.22	18.44	42.33	204.78	32.11	13.11
s.d.		1.51	2.45	11.49	2.76	3.79
range		15-20	39-47	194-227	27-36	8-19
Nickelson Creek						
mean	165.90	18.90	45.60	184.20	36.10	3.40
s.d.		0.74	3.03	12.42	5.49	2.01
range		18-20	41-51	160-196	28-48	0-7
Nolan Creek						
mean	170.60	18.20	42.50	198.80	29.60	2.70
s.d.		0.92	2.22	4.49	2.27	2.67
range		17-20	40-47	192-206	26-32	0-7
Northwater Creek						
mean	146.90	18.60	43.70	188.00	32.30	4.40
s.d.		0.84	1.16	4.94	1.64	2.67
range		17-20	42-45	180-195	30-34	0-9
South Fork Ranch Creek						
mean	163.50	19.44	42.22	205.10	34.20	10.00
s.d.		1.07	3.56	7.58	3.08	4.32
range		18-21	38-48	195-216	29-40	6-17
Snell Creek						
mean	163.00	18.10	45.88	188.10	37.13	7.40
s.d.		0.99	2.47	5.26	3.87	2.59
range		17-20	42-49	182-196	31-43	3-13
North Fork Swan Creek						
mean	157.50	18.30	42.90	200.10	30.50	8.60
s.d.		0.95	2.73	11.77	1.65	5.68
range		17-20	40-48	184-223	29-33	2-16

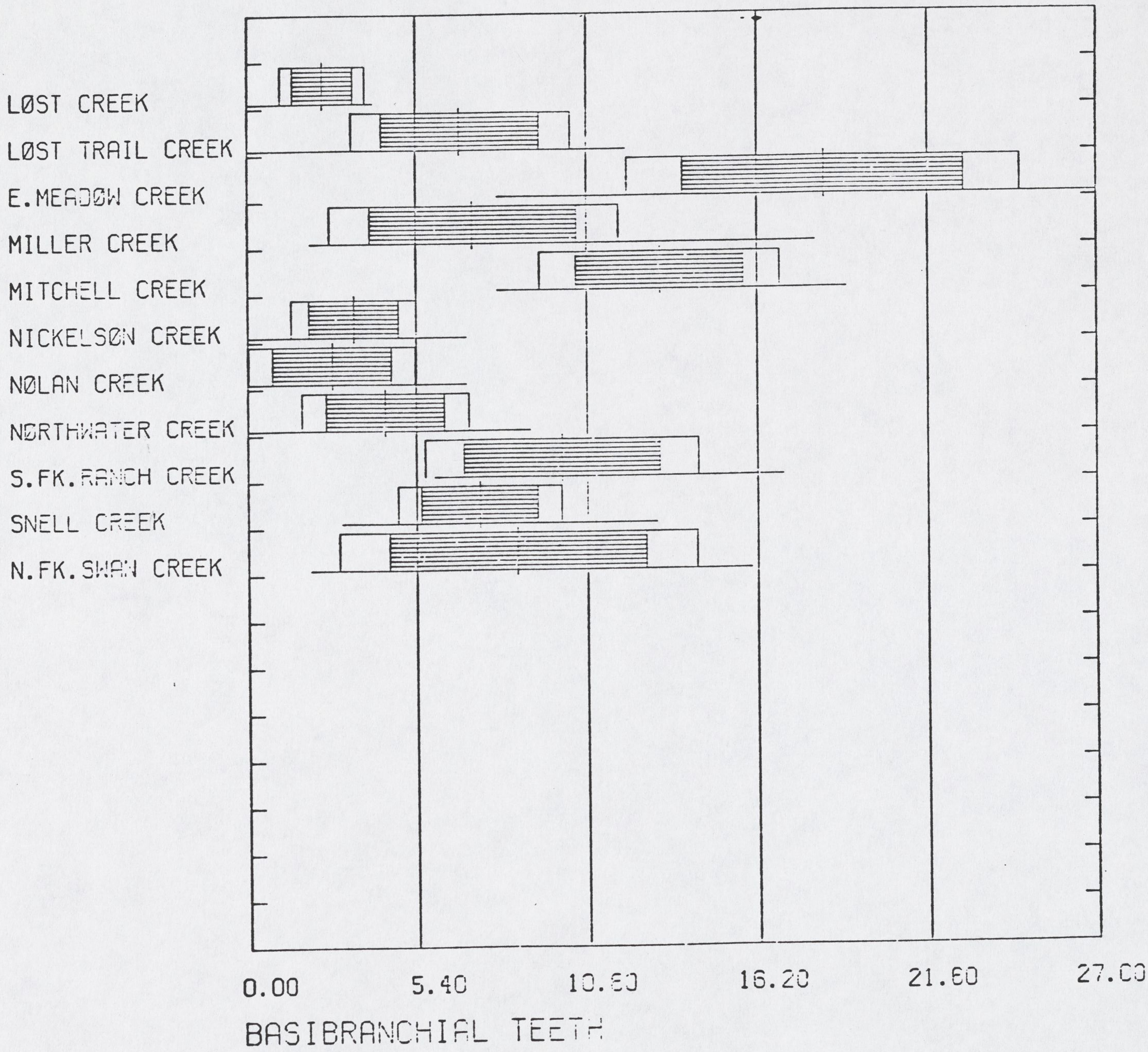
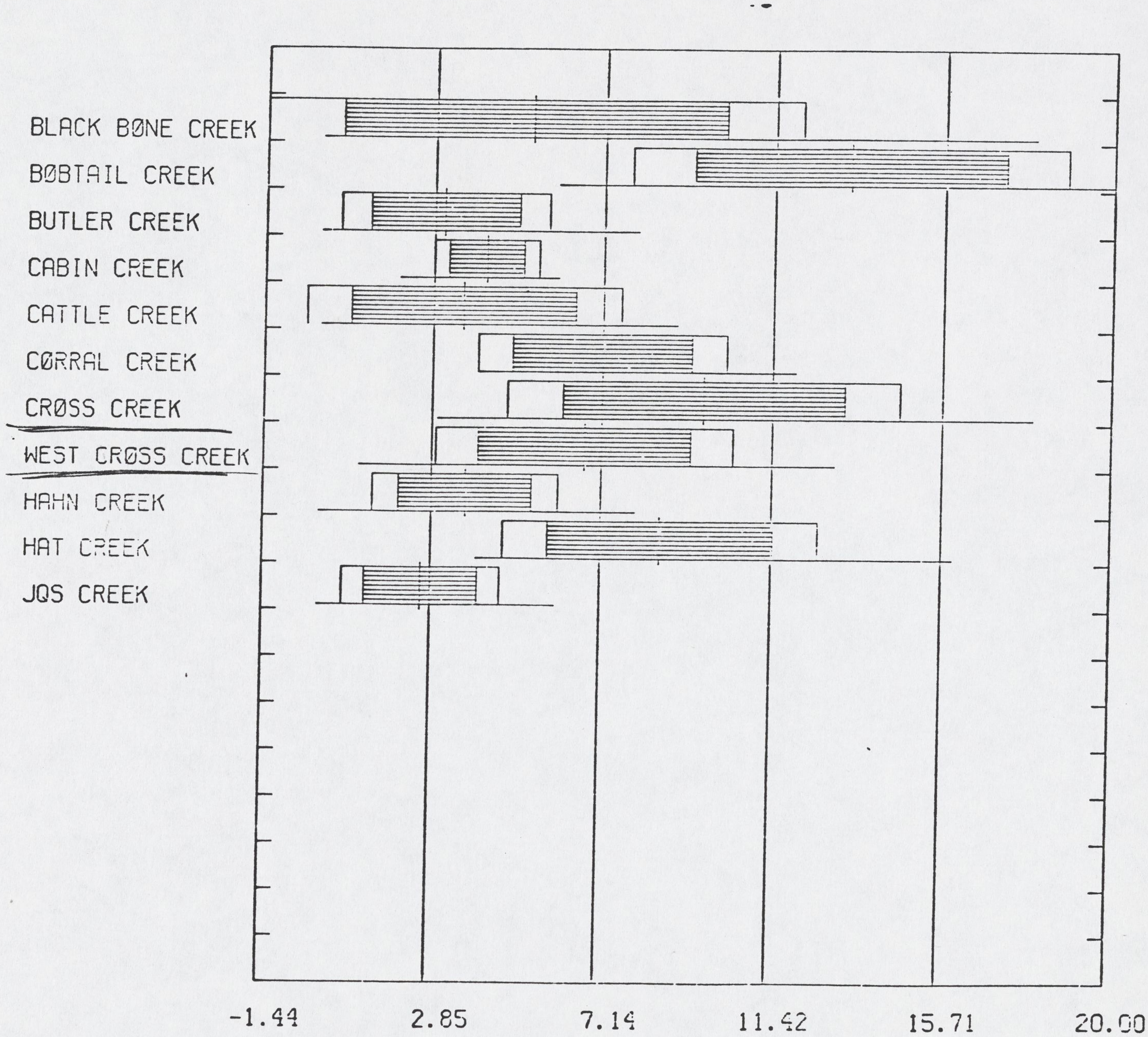


Figure 2. Basibranchial teeth, Hubbs and Hubbs diagram.



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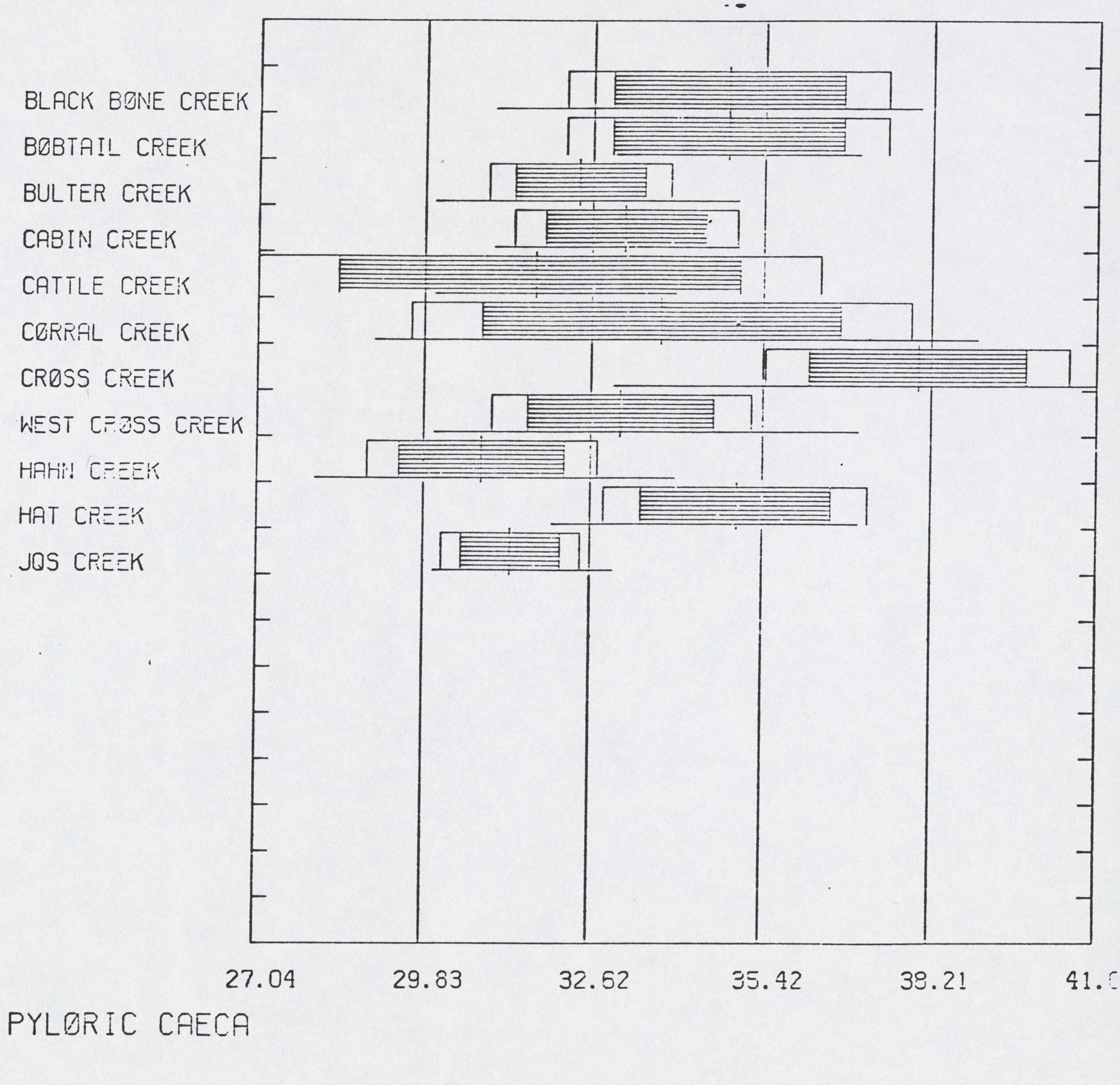
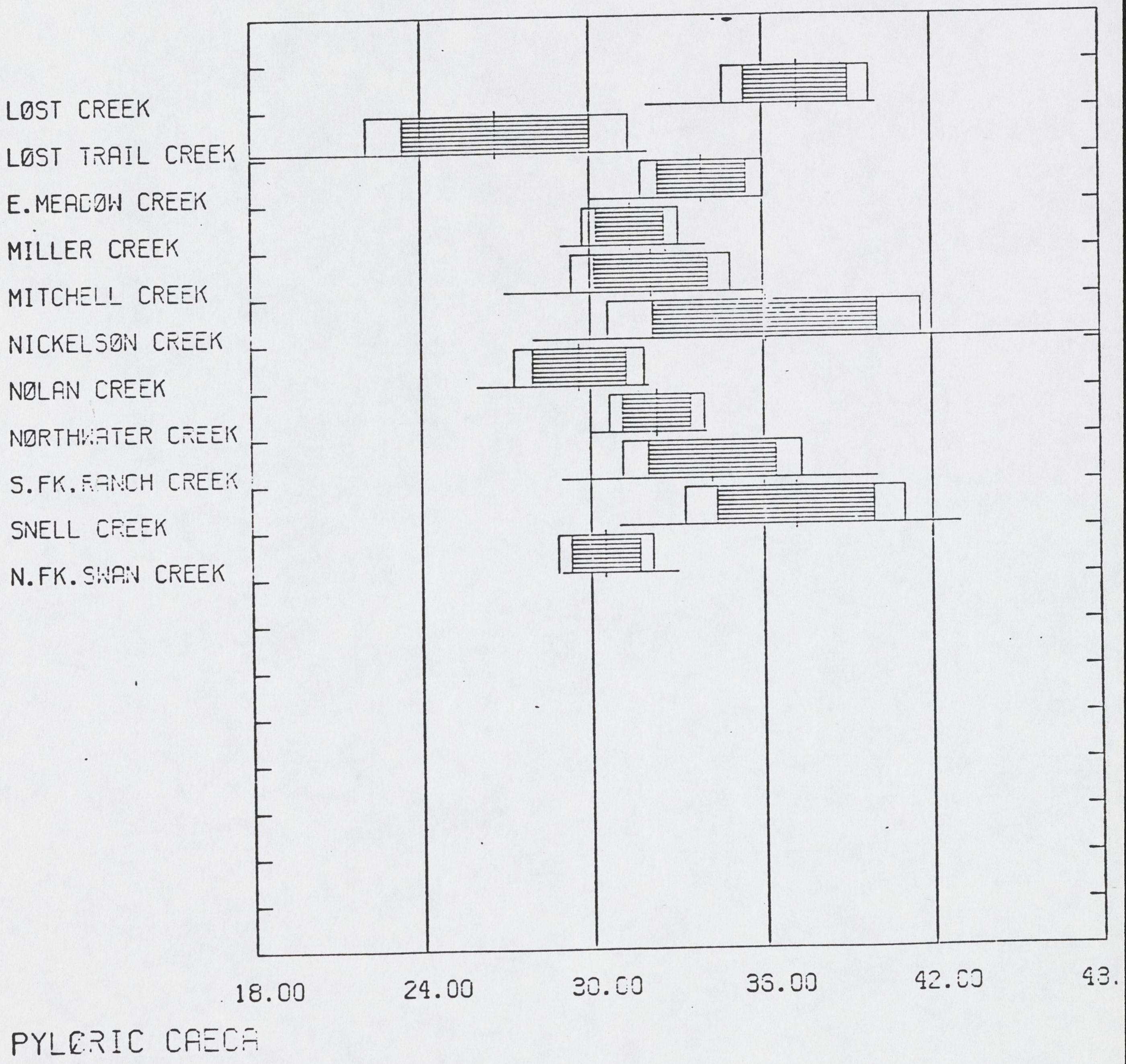


Figure 3. Pyloric caeca, Hubbs and Hubbs diagram.



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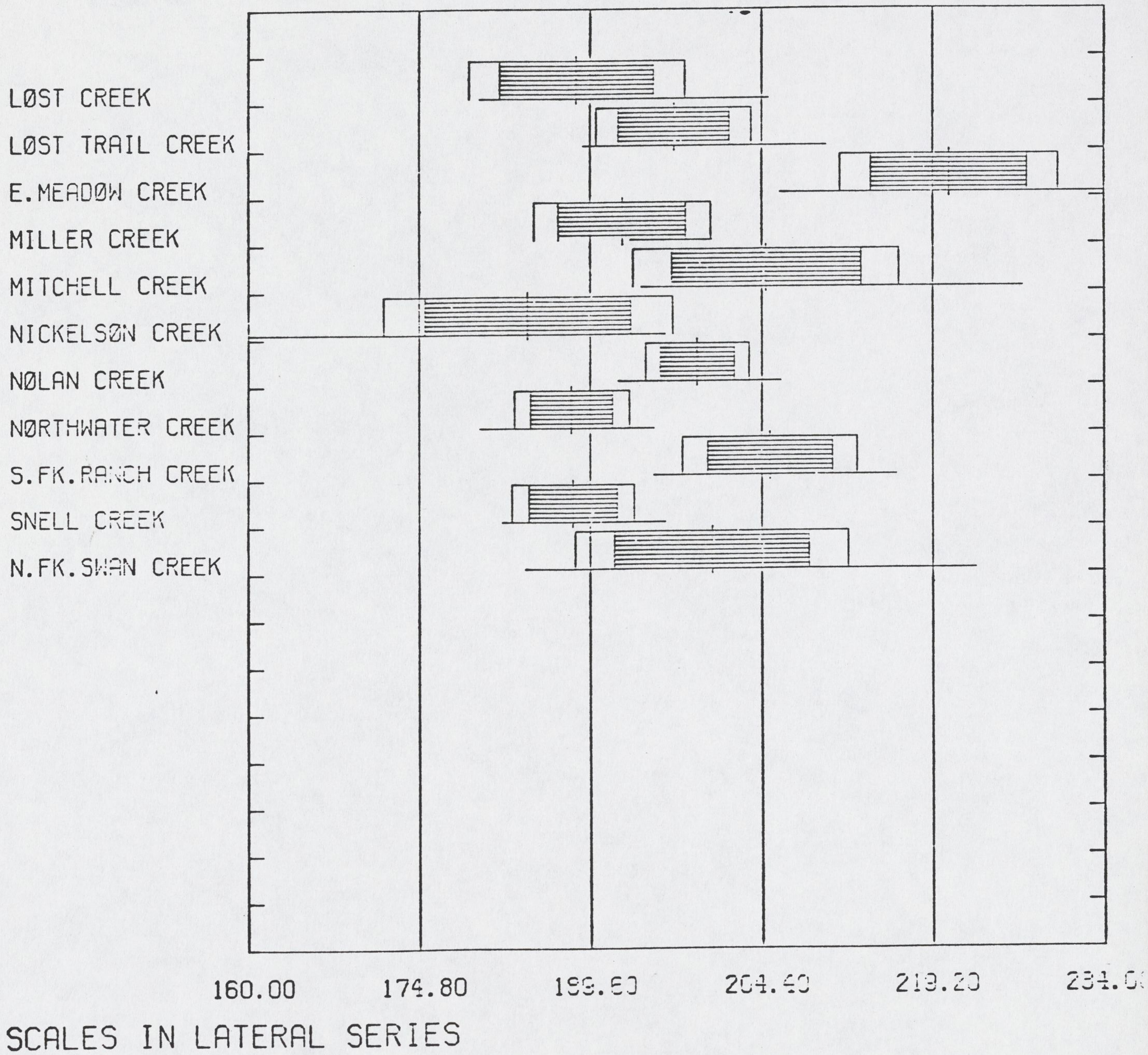
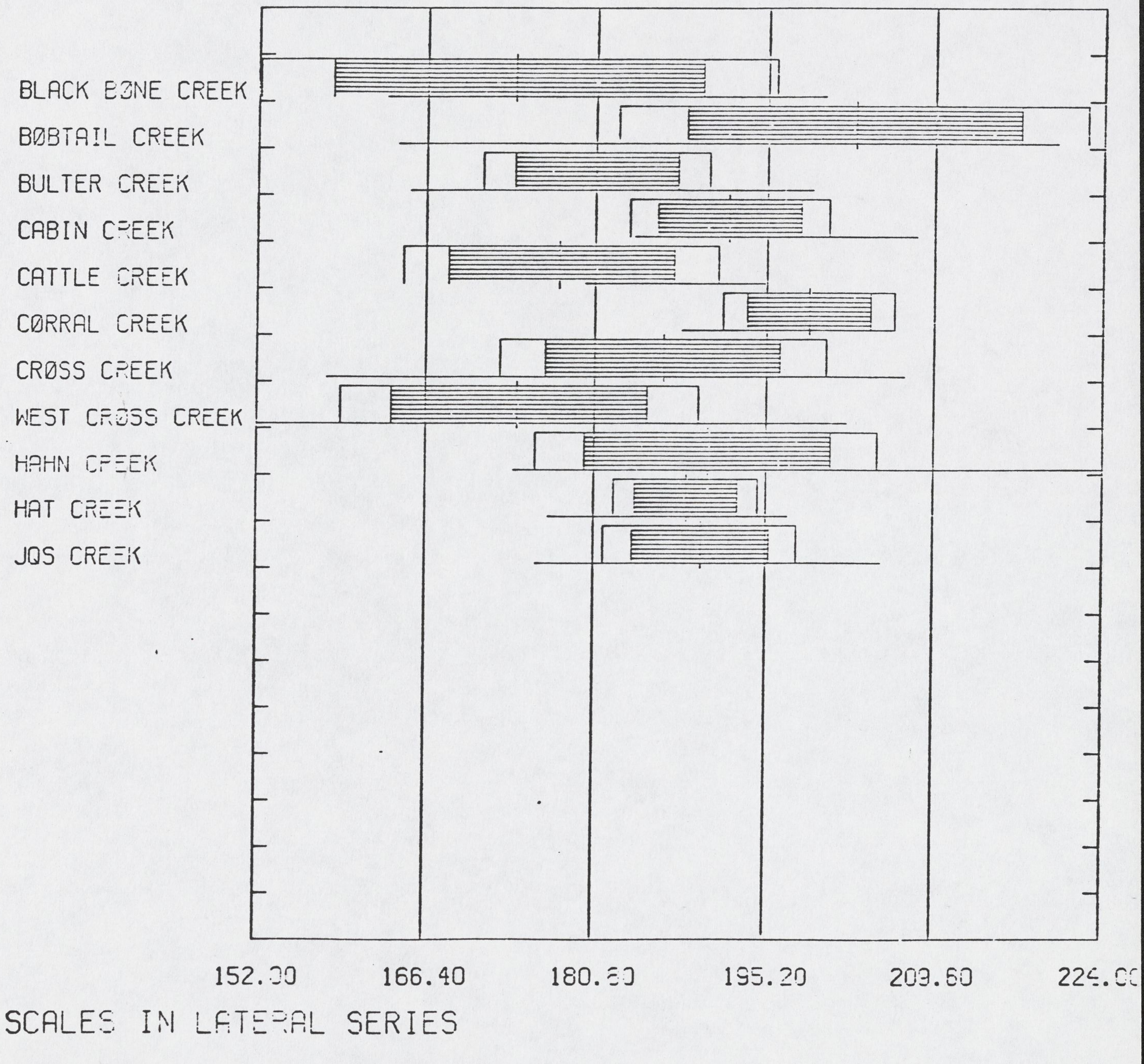


Figure 4. Scales in lateral series, Hubbs and Hubbs diagram.



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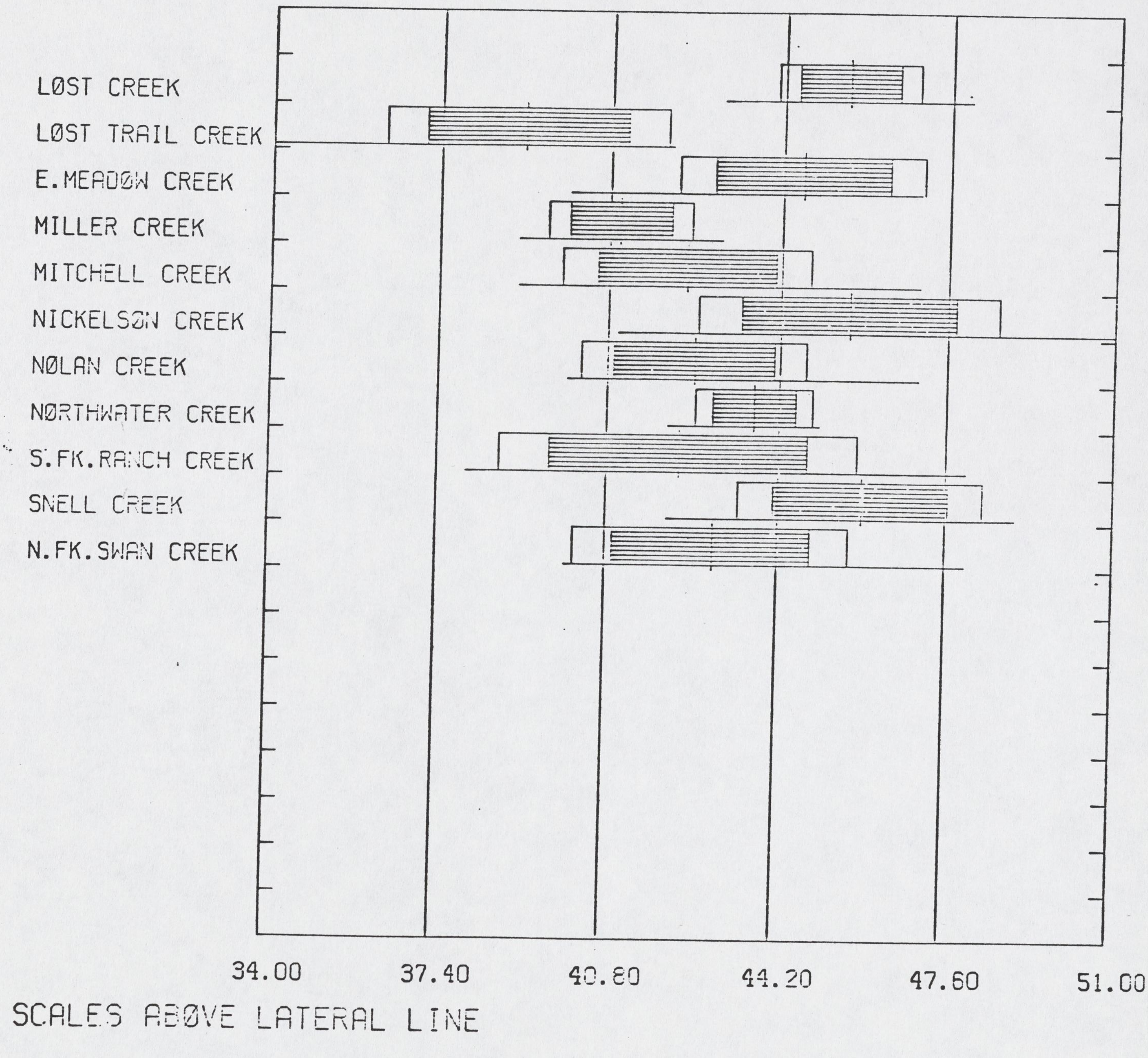
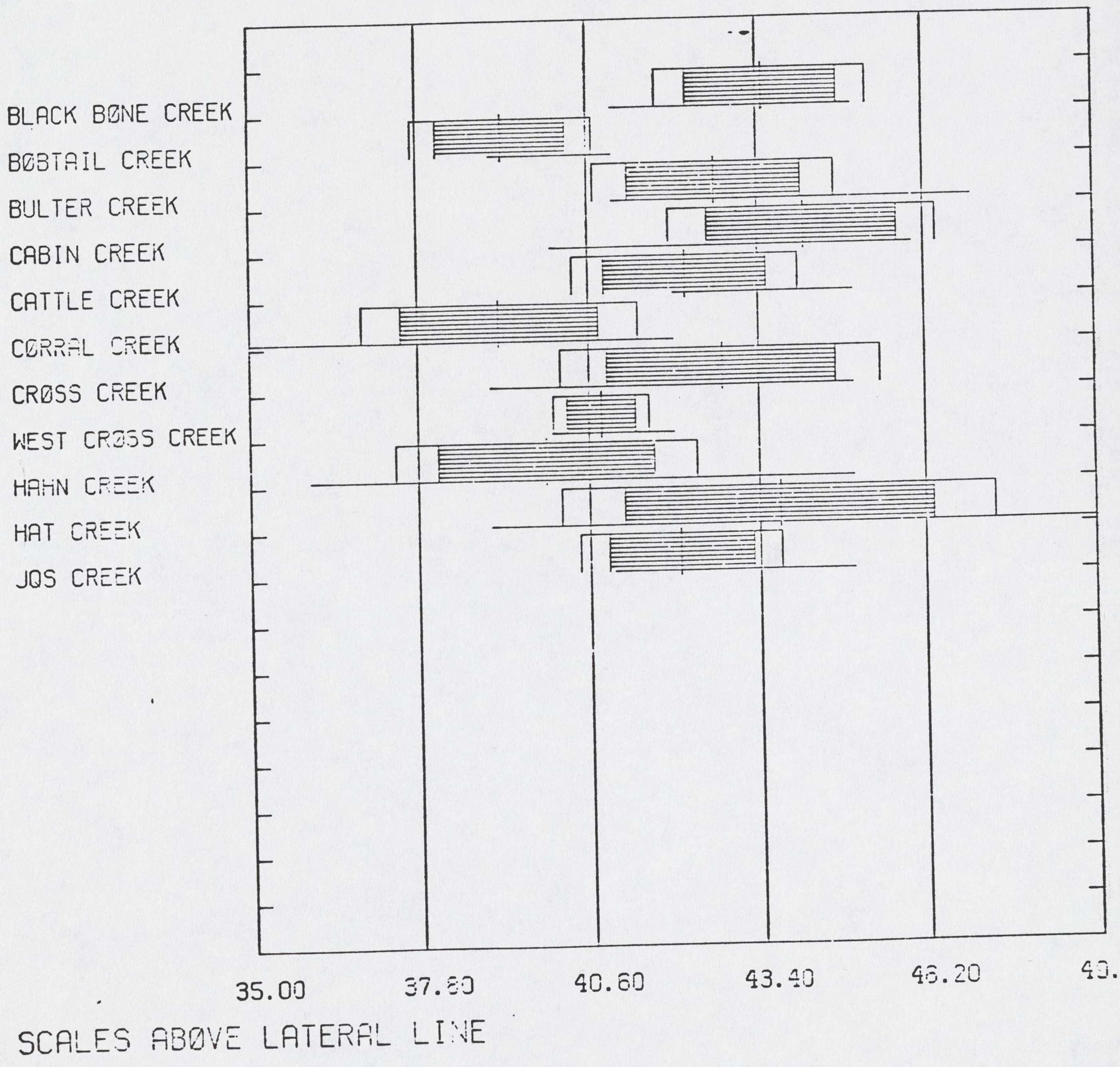


Figure 5. Scales above lateral line, Hubbs and Hubbs diagram.



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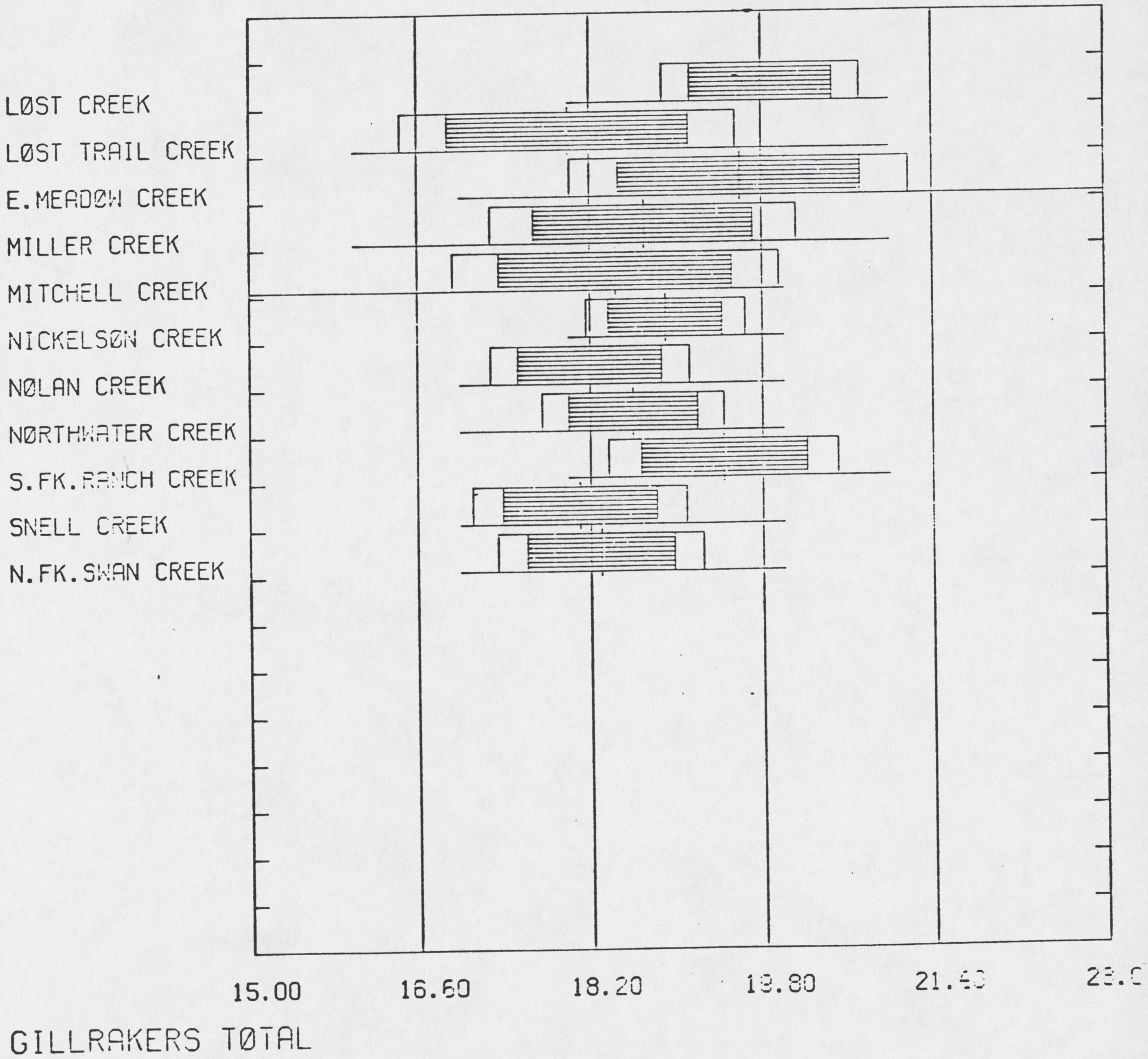

Figure 6. Gillrakers total, Hubbs and Hubbs diagram,

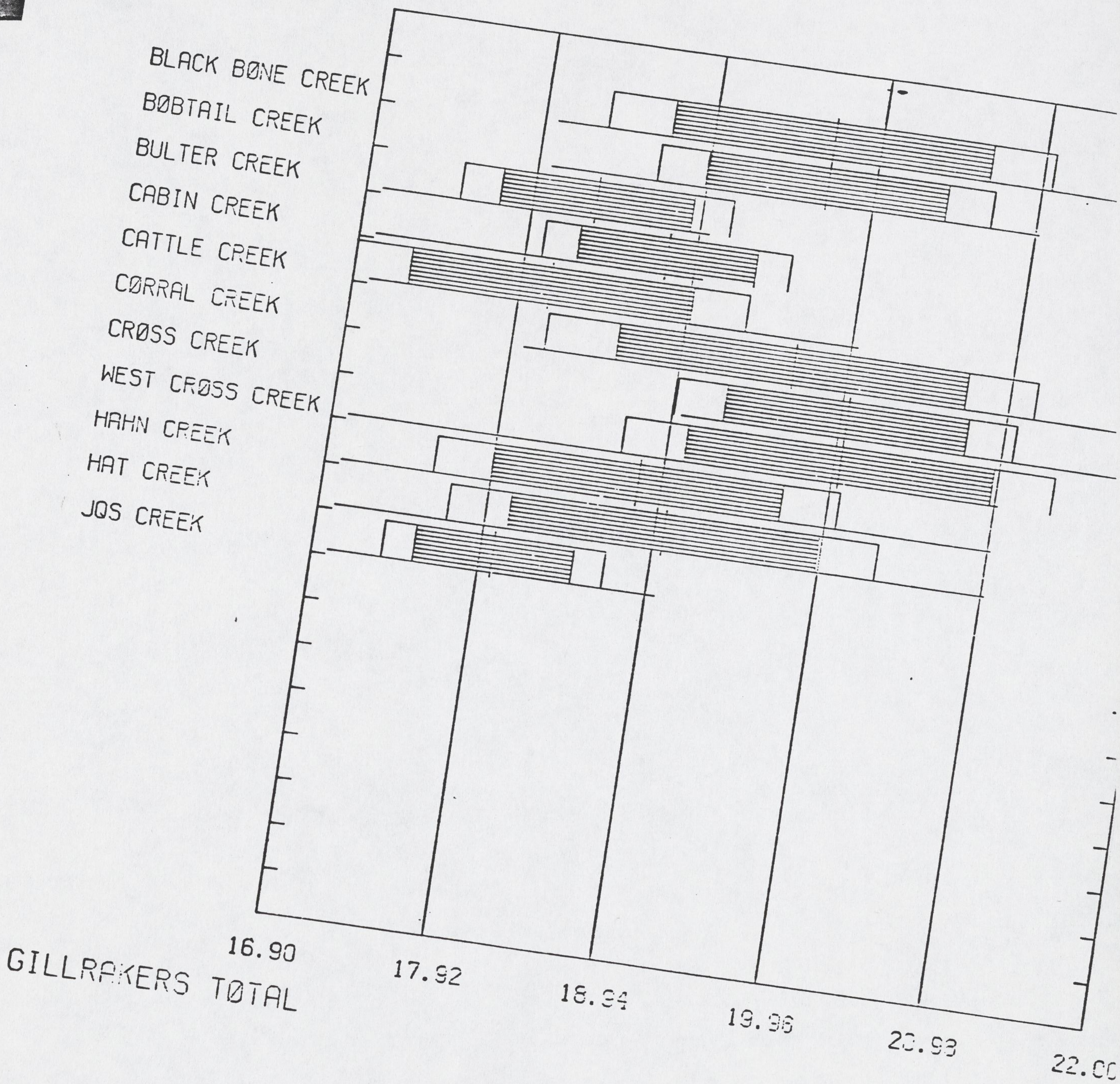

Figure 6 (Continued)

Table 4. Purity grade rating for Colorado River cutthroat habitats sampled in 1982.

Black Gore Creek	C
Bobtail Creek	A-
Butler Creek	B+
Cabin Creek	A-
Cattle Creek	A+
Corral Creek	B
Cross Creek	A+
East Meadow Creek	A+
Hahn Creek	A-
Hat Creek	A+
JQS Gulch	A+
Lost Creek	C
Lost Trail Creek	A-
Miller Creek	A
Mitchell Creek	A+
Nickelson Creek	A-
Nolan Creek	A
North Fork Swan Creek	A-
Northwater Creek	A
Snell Creek	B
South Fork Ranch Creek	A
West Cross Creek	A+

Ratings A+ → C

(7) A+'s of 20 streams

both Cross & West Cross are A+

<u>Black Gore Creek</u>: This stream has poor potential for cutthroat projects due to its high usage by fishermen from Vail.

<u>Bobtail Creek</u>: This stream appears to be excellent habitat and lies just south of Jones Pass. The access is solely by four wheel drive road.

<u>Butler Creek</u>: This stream has a great amount of cutthroats but the stream bottom is not very good due to high usage by cattle.

<u>Cabin Creek</u>: This stream has a good population of <u>fish</u> but is used a lot by area fishermen. Restrictions on fishing would have to be enforced for a restoration project.

<u>Cattle Creek</u>: This stream has a pure <u>S</u>. <u>c</u>. <u>pleuriticus</u> population. A 50 foot falls lies about three miles up the valley from the end of the road. Habitat is excellent, with many pools and good cover. The abundant population may provide a good stocking source.

<u>Corral Creek</u>: This is an extremely small stream but yielded a good cutthroat population. It is not a good stream for restoration due to its small size and disturbance by I-70 over Vail Pass.

<u>Cross Creek</u>: This stream has excellent management potential with a good stream bottom and cover. A very good population of cutthroats exist here with a very good size variability. This stream should be watched very closely due to the possible water diversion sites.

Used by fisherman

<u>West Cross Creek</u>: This stream is very much like Cross Creek and should be monitored closely.

<u>Hahn Creek</u>: This headwater stream was highly productive and yielded a variety of age groups. It is a good candidate for reintroduction of native cutthroats.

Hat Creek: This stream provides excellent habitat for its existing population of natives, lots of cover, log jams, overhanging trees and a good meander. This population should be monitored due to the possible Adams Rib Ski Area. Fish taken from here were 2" to 18", therefore, it is a viable reproducing population.

JQS Gulch: This is a hard stream to find; it is on U.S. Naval property and there are no good maps on the area. The stream has a good population of native cutthroats, and good cover and substrate.

Lost Creek: This creek is located just south of Lost Park in the Flattops Wilderness Area. It is extremely hard to get to and requires dry weather for access across the Sleepy Cat trail. The stream is considered to have poor management potential.

Lost Trail Creek: Directly south of Forest Service Road 315, the creek runs along it. Very good four wheel drive road. It is a straight fast stream with poor management potential.

East Meadow Creek: North of Vail on USFS 410, there is a good road with a ¼-mile hike to the stream. Rubble and gravel bottom with many pools and cover. Very good management potential.

Miller Creek: This creek is just north of I-70 from the east Vail service road. It is a paved road until it dead ends. There is poor management potential due to construction of highways and very steep gradients.

Mitchell Creek: Just north of the Glenwood Fish Hatchery. It has great management potential being so close to the hatchery and has good paved access.

Nickelson Creek: The headwaters of Nickelson Creek consist largely of beaver ponds located in meadows and/or private property. It is not a good choice for restoration due to heavy cattle damage and its location on private property.

Talbe 1 continued

Locality	Gillrakers	Pyloric caeca	Scales above lat. line and in lat. series	Basibranchial Teeth
Bear Park N=9	17-21(18.8)	37-52(42.0)	36-42(39.1) 163-183(174.4)	5 of 9 no teeth 4 w/ 2-6 (3.5)
Black Sulpher Crk N=6	16-20(17.3)	rotted	38-47(43.8) 166-186(176.8)	5 of 6 no teeth 1 w/2
Brush Crk. N=1	20	34	34 158	no teeth
E. Douglas Crk. N=12	17-20(18.6)	29-36(32.)	38-45(41.5) 155-186(167.5)	3 of 12 no teeth
Big Beaver Crk. N=7	19-21(19.9)	39-45(41.7)	40-49(46.6) 180-195(188.1)	9 w/2-4(2.8) 3 of 7 no teeth
Nickleson Crk. (Roaring Fk.) 1973 N=10	18-21(19.2)	33-45(38.7)	43-49(44.2) 165-198(188.9)	4 w/2-3(2.7) 1-12(4.9)
Kremmling Res. 1972-73 N=24	17-22(20.1)	30-54(39.1)	35-43(37.7) 160-193(176.6)	1 of 24 no teeth 23 w/ 1-21(8.2)
Trappers L. 1971 N=24	18-22(20.1)	35-63(42.7)	39-47(42.7) 165-220(191.1)	2-16(9.6)
Trappers L. stock in Williamson L. Calif. N=21	18-22(20.4)	30-45(38.8)	173-209(188.9)	2-25(12.5)

Table 1. Character analysis of Colorado trout samples.

Locality	Gillrakers	Pyloric caeca	Scales above lat. line and in lat. series	Basibranchial Teeth
Arkansas Drainage				
So. Huefano Crk. 1976 N=15	17-22(19.4)	30-48(38.4)	39-49(43.9) 163-210(191.2)	1-13(5.9)
Cascade Crk. 1976 N=15	17-21(19.0)	30-48(39.2)	42-49(44.5) 179-207(193.6)	4-21(9.3)
So. Platte Drainage Pear Res. Crk. 1976 N=8	18-21(19.4)	34-46(40.8)	39-44(41.3) 174-189(180.1)	5 of 8 no teeth 3 w/ 1-7 (4.7)
Pond, So. St. Vrain	17-19(18.0)	32-39(35.5)	37.43(40.0) 165-178(171.7)	1 of 4 no teeth 3 w/ 4-10 (5.7)
Trib. Long Draw Res. 1976 N=2	19,19	31,35	48.49 188,197	5,8
Do. 1968 N=6	19-21(20.8)	26-33(29.5)	47-51(48.8) 190-208(197.8)	2-15(8.4)
Colorado R. Basin				
Rocky Fork Crk. 1976 N=6	18-20(18.8)	26-39(32.8)	40-45(43.8) 167-199(181.3)	1 of 6 no teeth 5 w/ 4-11 (6.5)
Burkhard's collections				
Canyon Crk. N=3	16-19(17.7)	37-39(37.7)	34-38(36.0) 165-171(168.0)	2 of 3 no teeth 1 w/ 6
Soldier Crk. N=5	17-20(18.2)	28-42(35.4)	39-47(44.0) 152-194 (179.8)	1 of 5 no teeth 4 w/2-7(4.3)

Nolan Creek: Ten fish were taken from Nolan Creek just above Fulford. The stream is a good candidate for restoration due to its easy accessibility and remoteness. The stream goes underground 1.5 miles below Fulford so there is no chance for migration of other fish.

Northwater Creek: This is an extremely productive population. We sampled only one pool and shocked about 75 fish. This has been the population that was considered an ideal representation of pure *S. c. pleuriticus* (Behnke 1976).

South Fork Ranch Creek: The lower end of this creek contained a large number of brook trout, but these gave way to cutthroat further upstream. It is a good population but very sparse.

Snell Creek: A good population of fish, but due to the remoteness and inaccessibility, this would not be a good restoration sight.

North Fork Swan Creek: This stream provides excellent habitat for cutthroat, yet the population was sparse. Access is extremely good which may be the reason for not many fish. It is likely to be a highly used fishing spot for Dillon and Breckenridge.

DISCUSSION AND CONCLUSION

In general, all 23 populations sampled should be considered as *Salmo clarki pleuriticus*. Purity grades ranged from 'A' to 'B', although only two populations could be considered A+. These two are JQS Gulch, a small tributary to Parachute Creek within the Naval Oil Shale Reserve in Garfield County and Cattle Creek, tributary to the Roaring Fork River, Eagle County.

Table 5. List of sites for introduction of _Salmo_ _clarki_ _pleuriticus_ in Colorado based on 1981 inventory data.

First Priority: Streams that are barren of fish and have natural barriers.

Management Action: Stock with pure _Salmo_ _clarki_ _pleuriticus_.

- Arapahoe Creek (Wheeler Basin)
- Bruin Creek and upper Difficult Creek
- Crystal Creek (above the Mohawk Lake road)
- Jim Creek
- Spruce Creek (Tributary to Woody Creek)

Second Priority: Streams with a rock barrier over three feet and exotic fish species present.

Management Action: Treat with reotenone above falls to remove exotics restock with pure _S_. _c_. _pleuriticus_.

- East Fork Parachute Creek
- Fish Creek
- Game Creek
- North Fork Crystal River
- South Fork Crystal River
- Yule Creek

Third Priority: Streams with a beaver dam barriers and exotic fish species present.

Management Action: Treat with rotenone above the dam to remove exotics and restock with pure _S_. _c_. _pleuriticus_.

- Circle Creek
- King Solomon Creek
- Stafford Creek

As evidenced by this report, pure populations of Salmo clarki pleuriticus are indeed rare. Table 6 contains a list of 67 streams and lakes in Colorado with 'A', 'B', or 'C' grade S. c. pleuriticus. Of these waters presently known to contain S. c. pleuriticus, only 28 are pure ('A+', 'A', 'A-' populations). Undoubtedly there are yet undiscovered but probably very few. Some unsampled lakes may contain pure populations of Trappers Lake stock. However, hybridization with Yellowstone Lake cutthroat, which were commonly stocked in mountain lakes from 1905 to 1955 (Behnke 1979), has often diluted the genetic purity of S. c. pleuriticus. Behnke also mentions in last year's S. c. pleuriticus inventory report that Colorado lakes have had several other stocking sources that have affected purity, such as the Haypress Lake stock, which was a mixture of several subspecies of cutthroat and a slight rainbow influence.

The frailty of the remaining populations has also been evidence in this project. Trappers Creek, tributary to Parachute Creek, was sampled in 1976 and considered to be relatively pure (Behnke 1976). When it was sampled again in 1981, analysis revealed some hybrid influence as half of the specimens lack basibranchial teeth and spotting was variable.

Northwater Creek, also in the Parachute drainage, was also a pure population despite 1,500 rainbow trout that were stocked in 1976 (Behnke 1976). This year's collection contained one fish (120 mm) that lacked basibranchial teeth. The alizarin did not stain well so the small teeth may have been broken off during analysis, if they existed. No teeth were seen, however, so it was recorded as having none. The other characters show the trout to be typical S. c. pleuriticus and no other evidenced of hybridization can be found and is still considered as an 'A' population.

Both Northwater Creek and Trappers Creek have barriers, yet Trappers Creek has some evidence of hybridization and Northwater is still relatively pure, despite rainbow stocking. It is possible that the barrier that isolates Trappers Creek from East Middle Fork Parachute Creek is not big enough to stop upstream migration. Another explanation is that Trappers Creek was mistaken for Northwater Creek when rainbow were stocked (Behnke 1976).

What lies in the future for the wild native trout of the Colorado River Basin? Management suggestions have been made for each stream sampled in 1982 and a summary list of purity grade ratings is provided in Table 6. There are over 90 streams with history of cutthroat yet to be inventoried, but many of these contain exotic trouts or have already been taken over by brook trout. Further management activities should follow the guidelines within the "Narrative Task Description" in the draft Colorado River Cutthroat Trout Recovery Plan.

Hopefully, the present range of *S. c. pleuriticus* will be expanded to secure pure and productive populations so that *S. c. pleuriticus* will no longer be listed as a threatened subspecies in Colorado.

FUTURE PLANS

It is the intent during the 1983-84 field season, that work to determine the population stability of the identified A populations will be accomplished. Inventory work on new streams and development of management plans for pure populations of *S. c. pleuriticus* will continue.

Table 6 (Continued)

Purity	Date of Survey	Water
B	1981	Crystal Creek?
		Difficult Creek
		No. Fork Elliot Creek
		No. Fork Thompson Creek
		Spruce Creek
	1982	Snell Creek
		Corral Creek
B-	1980	Lake of the Crags
		East Fork Red Dirt Cree
		West Fork Red Dirt Cree
	1981	First Creek
C+	1981	Middle Fork Thompson Cr
		East Fork Parachute Crk
		Yule Creek
C	1980	Carter Lake
	1980, 1982	Lost Creek
		Lost Dog Creek
		Possum Creek
	1981	Big Park Creek
		East Middle Fk. Parachu Creek
		Roaring Fork Creek
		Trappers Creek
D	1981	North Fork Wallace Cree

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COLORADO RIVER CUTTHROAT
TROUT INVENTORY

Endangered Wildlife Investigations
Performance Report
SE-3-3

State of Colorado
Department of Natural Resources
Division of Wildlife
711 Independent Avenue
Grand Junction, Colorado 81501

May, 1981

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Direction and guidance were provided by Dr. Bob Behnke, Colorado State University.

JOB PROGRESS REPORT

State of Colorado

Project No. SE-3-3 : Endangered Fishes

Work Plan No. I : Job No. 5

Job Title: Colorado River Cutthroat Trout Inventory

Period Covered: 1 July 1979 through 31 December 1980

Personnel: Tom Lytle, Tom Bohanon, Bill Boydstun, Eric Wagner, and Steve Culver.

ABSTRACT

From July 1, 1979 through December 31, 1980, a total of 46 streams and 20 lakes was sampled for identification of pure populations of Colorado River Cutthroat Trout (*Salmo clarki pleuriticus*). Analysis of genetic purity based on meristic characters was performed on 318 fish from 30 of the waters. Observations were made of streams and lakes in relation to their suitability a *S. c. pleuriticus* habitat and as potential sites for restoration of the species into its native waters.

COLORADO RIVER CUTTHROAT TROUT INVENTORY

Tom Bohanon, Bill Boydstun, Tom Lytle, and Eric Wagner

PROGRAM NARRATIVE OBJECTIVES

To determine if and where Colorado River trout populations exist, make Colorado River trout available for transplant into historic habitat, and monitor and protect known populations.

INTRODUCTION

The former range of *S. c. pleuriticus* extended from the headwaters of the Colorado River basin downstream to the Dirty Devil River in Utah on the west, and to the San Juan drainage of Colorado, New Mexico, and Arizona on the east (Behnke 1979). The fish is currently considered a threatened species in Colorado, and the confirmed presence of pure populations is quite rare. The decline of the species' genetic purity is largely due to indiscriminate stocking of *Salmo gairdneri* (rainbow trout) and numerous non-native subspecies of *S. clarki* in *S. c. pleuriticus* waters by a variety of public and private agencies. This stocking has in turn led to hybridization of Colorado River cutthroats with non-native species, and has seriously diluted the gene pool. In addition, *Salmo trutta* (brown trout) in the large rivers and *Salvelinus fontinalis* (brook trout) have displaced *S. c. pleuriticus* from its native waters through competition for food and habitat (Hickman 1979, Behnke et.al. 1976).

Materials and Methods

Stream and lake selection for sampling was largely based on data recovered from computer files in the Colorado Division of Wildlife's Denver headquarters. Streams whose survey indicated the presence of cutthroat trout were considered as candidates for this survey. The presence of rainbow trout at any time in the history of the water in question automatically eliminated it from consideration. Streams containing cutthroat trout were not eliminated if previous surveys reported non-native species other than rainbow trout, nor were they eliminated if the record indicated stocking with cutthroat trout, although they were given less priority in sampling.

Lakes were selected from similar computer files based on concurrent presence of cutthroat trout and lack of rainbows. The computer files contained stocking data from 1973 to the present, and all streams and lakes which showed no stocking record prior to 1973 were inspected for stocking on old Division records which date back to 1951. Lakes which had been stocked with cutthroat trout were further selected based on the average size of trout found during earlier high lake surveys. Stocked lakes were surveyed in this study only if the average size of cutthroats taken on previous surveys was 9.0 inches or less, based on the assumption that a small average size would indicate reproduction (Sealing 1980).

In addition, several streams and lakes were surveyed based on recommendations from field personnel of both the Colorado Division of Wildlife and the Bureau of Land Management. These waters were not reported in previously mentioned stocking records or survey reports, but were considered to be important potential sites for pure populations of _S_. _c_. _pleuriticus_ based on historical knowledge of the water in question. Streams and lakes to be surveyed were color coded on U. S. Forest Service maps to indicate stocking and survey history, and the source of the information. These maps have been duplicated for the 1981 _S_. _c_. _pleuriticus_ survey, and indicate waters which were surveyed in 1980. Known locations of barrier falls are also marked on these maps.

The vast majority of streams were sampled with a Coffelt BP-2 electro-shocker, although some were sampled by angling where distance and rugged terrain prohibited transporting the shocker to the sample site. An effort was made to sample streams as close as possible to their headwaters, as this is the most likely location for pure populations of _S_. _c_. _pleuriticus_ (Behnke 1976, Langlois 1978, 1980). Whenever possible, samples were taken above barrier falls which would prevent the upstream migration of rainbow trout or non-native cutthroat trout. An adequate barrier falls is considered to be one greater than three feet in height (Langlois 1978). Standard Division of Wildlife stream survey forms were completed for each stream, and a general impression of stream and lake suitability as _S_. _c_. _pleuriticus_ habitat was obtained.

Lakes were surveyed by means of gill nets which were set with a small rubber raft in the evening and left in place for a minimum of ten hours. Two to three gill nets were set in each lake; at least one 50 foot variable mesh (.25-1.25 inch) monofilament net and one 50 foot large mesh (2.5 inch) net were set to obtain a representative sample of the population. When possible, two variable mesh nets and one large mesh net were set, as this combination consistently produced the best sample.

Cutthroat trout obtained were preserved in one gallon Nalgene containers with ten percent formalin, and 0.4 percent borax was added as a buffer

(Wernsman 1973). These bottles were stored in a horizontal position to prevent curling and facilitate lateral line scale series counts. Samples were put in the formalin-borax solution after placing a .25-.50 inch slit in each fish anterior to the vent. A minimum size restriction of 4.5 inches was placed on each fish kept, which is .5 inch in excess of the size at which basi branchial teeth are fully developed (Behnke 1980, Nehring et.al. 1978, Wernsman 1973). In all but four samples, ten or more fish were preserved so that significant mean values of meristic characters could be obtained (Behnke et.al. 1976, Behnke 1980). Samples of less than ten were taken due to sparse trout numbers and various difficulties encountered in obtaining the samples. If preservation was not possible within one hour of collection, the fish were injected with ten percent formalin and wrapped in formalin soaked paper towels until they could be properly preserved (Behnke et.al. 1976). Color slides were taken of each sample before preservation to record color and spotting patterns, and a collection card was included in each sample describing various physical characteristics of the water in question. Only two cutthroat samples were kept from waters which also produced rainbow trout.

Inventory

Table 1 lists every stream and lake sampled in 1980, and includes a variety of descriptive information. The standard Colorado Division of Wildlife abbreviations for species sampled are used and consist of the following: CRN = potential *S. c. pleuriticus*, B = *Salvelinus fontinalis* (brook trout), M = *Salvelinus namaycush* (lake trout), R = *Salmo gairdneri* (rainbow trout), L = *Salmo trutta* (brown trout), MOS = *Catostomus platyrhynchus* (mountain sucker) and MTS = *Cottus bairdi* (mottled sculpin). Knowledge of the definite presence or absence of a barrier falls below the sampling location is indicated by "yes" or "no", but a slash ("-") indicates only that none was observed on this survey. A barrier falls is defined as a three foot permanent natural structure (cliff, underground stream) which prohibits upstream migration from the stream into which the water in question drains (Langlois et.al. 1978). The flow of streams was estimated as accurately as possible in cubic feet per second, and lake acreage was taken from Kelley (1975). Stocking history is based on Division of Wildlife stocking records which date from 1951 to the present. If a stream is known to have been stocked with cutthroat trout, the most recent year of the stocking is given. "NS" indicates the stream has not been stocked, at least since 1951, and "UNK" indicates the stocking history is unknown.

An impression of waters as present or future S. c. pleuriticus habitat is based on physical characteristics, remoteness, potential for reintroduction of pure strains, and the possibility of natural or artificial contamination with non-native sub-species of cutthroat trout and/or rainbow trout. This impression is indicated in Table 1 as either "excellent", "fair", or "poor". A detailed description of streams and lakes from which samples were obtained follows under Discussion, as well as some waters which did not yield samples. Specific impressions and recommendations for individual waters can be found in these descriptions. Any stream or lake found to contain pure S. c. pleuriticus following meristic analysis should be immediately given top priority regardless of its relative quality or these impressions. Actions should include protection from both fishermen and exotic salmonids, as well as transplanting members of the population to waters from which spawn can be taken, providing that the impact of this action will not endanger perpetuation of the existing population.

Table 1. Summary of streams and lakes in northwestern Colorado examined for presence of Colorado River Cutthroat Trout (<u>Salmo clarki pleuriticus</u>), 1980.

LOCALITY	LEGAL DESCRIPTION OF SAMPLE SITE	COUNTY	SPECIES SAMPLED	SAMPLE SIZE	STOCKING HISTORY	BARRIER FALLS	ESTIMATED FLOW/ACREAGE	MANAGEMENT POTENTIAL
Yampa Drainage - Streams								
Beaver Creek	S23 T10N R85W	Routt	MTS,WS,B	--	1976	No	10 cfs	Poor
Elk River, North Fork	S23 T10N R84W	Routt	MTS,R,L,B,CRN	--	NS	No	30 cfs	Poor
Elk River, North Fork	S10 T10N R83W	Routt	CRN	--	NS	Yes	10 cfs	Excellent
English Creek	S36 T10N R84W	Routt	B	--	NS	--	2 cfs	Poor
Lost Dog Creek	S26 T10N R84W	Routt	CRN-B	--	NS	--	3 cfs	Fair
Lost Dog Creek	S24 T10N R84W	Routt	CRN-B	10	NS	--	1.5 cfs	Fair
Mad Creek, North Fork	S28 T8N R83W	Routt	CRN	--	NS	--	4 cfs	Poor
Mandall Creek	S13 T1N R87W	Garfield	CRN-B	13	1976	--	7 cfs	Excellent
Porcupine Creek	S33 T8N R83W	Routt	CRN-B	--	NS	--	2 cfs	Fair
Sand Creek	S24 T2N R86W	Rio Blanco	B	--	NS	--	2 cfs	Poor
Lakes								
Big Creek Lake	S17 T8N R83W	Routt	CRN	--	1977	--	8 acres	Poor
Crater Lake	S14 T2N R87W	Rio Blanco	--	--	1976-B	Yes	5 acres	Poor
Fishhawk Lake	S26 T8N R84W	Routt	B	--	NS	--	9 acres	Poor
Lake of the Crags	S21 T8N R83W	Routt	CRN	11	1977	Yes	6 acres	Excellent
Lake Diana	S4 T10N R83W	Routt	CRN	11	1977	Yes	10 acres	Excellent
Lake Margaret	S26 T8N R84W	Routt	CRN	--	1977	--	40 acres	Fair
Luna Lake	S21 T8N R83W	Routt	CRN	10	1971	No	38 acres	Poor
Porcupine Lake	S33 T8N R83W	Routt	CRN	10	1977	Yes	6 acres	Excellent
Snowstorm Lake	S25 T8N R84W	Routt	CRN-B	--	1952	No	11 acres	Poor
Colorado Drainage - Streams								
Tributary to Eagle River								
Abrams Creek	S20 T5S R84W	Eagle	CRN	10	NS	--	3 cfs	Fair-Good
Black Gore Creek	S9 T6S R79W	Eagle	CRN,R,B	--	1974-R	No	10 cfs	Poor
Hat Creek	S27 T6S R83W	Eagle	CRN	11	NS	--	7 cfs	Excellent
Indian Creek	S23 T4S R81W	Eagle	CRN	15	NS	No	2 cfs	Poor
Miller Creek	S20 T5S R79W	Eagle	CRN	10	NS	Yes	2 cfs	Fair
Nolan Creek	S25 T6S R83W	Eagle	CRN-B	5	NS	--	7 cfs	Fair-Excellen
Pitkin Creek	S1 T5S R80W	Eagle	CRN	10	NS	Yes	1 cfs	Fair
Polk Creek	S28 T5S R79W	Eagle	CRN	11	NS	--	4 cfs	Fair

Table 1. continued

LOCALITY	LEGAL DESCRIPTION OF SAMPLE SITE	COUNTY	SPECIES SAMPLED	SAMPLE SIZE	STOCKING HISTORY	BARRIER FALLS	ESTIMATED FLOW/ACREAGE	MANAGEMENT POTENTIAL
Red Sandstone Creek	S25 T4S R80W	Eagle	CRN,B,R	--	NS	--	5 cfs	Poor
Resolution Creek	S1 T6S R80W	Eagle	--	--	NS	--	3 cfs	Excellent
Resolution Creek	S2 T7S R80W	Eagle	B	--	NS	--	3 cfs	Excellent
Lakes								
Brady Lake	S12 T8S R82W	Eagle	CRN	--	1977	Yes	15 acres	Fair
Paradise Lake #1	S18 T8S R81W	Pitkin	B	--	1977	Yes	20 acres	Poor
Paradise Lake #3	S13 T8S R82W	Pitkin	B	--	NS	Yes	2 acres	Poor
Sopris Lake	S12 T8S R82W	Eagle	--	--	NS	--	10 acres	Poor
Colorado Drainage - Streams Tributary to Roaring Fork River								
Capitol Creek	S34 T9S R87W	Pitkin	B	--	1978-R	--	40 cfs	Poor
Carter Creek	S3 T8S R82W	Pitkin-Eagle	CRN	--	NS	Yes	5 cfs	Excellent
Cunningham Creek	S20 T8S R82W	Pitkin	L-B	--	NS	--	20 cfs	Fair
Fourmile Creek	S36 T7S R89W	Garfield	CRN,R,MTS	--	1954-R	Yes	1 cfs	Poor
Frying Pan River	S26 T9S R82W	Eagle-Pitkin	CRN,R,B	--	1965-R	--	20 cfs	Poor
Frying Pan River	S11 T9S R82W	Eagle-Pitkin	CRN	--	1965-R	--	10 cfs	Poor
Frying Pan River-North Fork	S19 T8S R83W	Pitkin	CRN-B	--	NS	--	20 cfs	Poor
Frying Pan River-North Fork	S15 T8S R82W	Pitkin	B	--	NS	--	10 cfs	Poor
Frying Pan River-South Fork	S29 T9S R82W	Pitkin	CRN	--	NS	--	70 cfs	Poor
Lost Trail Creek	S30 T11S R87W	Gunnison	--	--	Unk	Yes	5 cfs	Poor
Lost Trail Creek	S21 T11S R87W	Gunnison	CRN	6	Unk	Yes	50 cfs	Poor
Lost Trail Creek-North Fork	S19 T11S R87W	Gunnison	--	--	Unk	No	30 cfs	Poor
Marten Creek	S26 T9S R82W	Pitkin	B	--	NS	No	50 cfs	Poor
Marten Creek	S3 T10S R82W	Pitkin	B	--	NS	--	30 cfs	Poor
Nickelson Creek	S36 T9S R87W	Pitkin	CRN	8	NS	--	9 cfs	Poor
Mormon Creek	S15 T8S R82W	Pitkin	B	--	NS	--	5 cfs	Poor
Thomas Creek	S25 T85 R88W	Pitkin	CRN-R	--	1978-R	--	10 cfs	Poor
Lakes								
Carter Lake	S10 T8S R82W	Eagle	CRN-R	15	NS	Yes	8 acres	Excellent
Frying Pan Lake #2&3	S11 T10S R82W	Pitkin	CRN	13	(2)-NS (3)-1959	--	(2)-5 acres (3)-6 acres	Excellent
Independence Lake	S28 T10S R82W	Pitkin	B	--	NS	Yes	9 acres	Excellent

Table 1. continued

LOCALITY	LEGAL DESCRIPTION OF SAMPLE SITE	COUNTY	SPECIES SAMPLED	SAMPLE SIZE	STOCKING HISTORY	BARRIER FALLS	ESTIMATED FLOW/ACREAGE	MANAGEMENT POTENTIAL
Colorado Drainage - Streams Tributary to Blue River								
Corral Creek	S22 T6S R79W	Summit	CRN-R	12	NS	No	1 cfs	Poor
Colorado Drainage - Streams Tributary to Colorado River								
Canyon Creek - East	S13 T5S R90W	Garfield	B	--	NS	Yes	29 cfs	Poor
Deadman Gulch	S5 T1N R83W	Routt	CRN	10	NS	No	0.2 cfs	Poor
Derby Creek	S11 T2S R86W	Eagle	R-B	--	NS	--	5 cfs	Poor
Dickson Creek	S16,21 T4S R81W	Eagle	R	--	NS	--	5 cfs	Poor
Meadow Creek	S3 T4S R81W	Eagle	--	--	NS	--	3 cfs	Poor-Fair
Meadow Creek-East Fork	S10 T4S R81W	Eagle	CRN	10	NS	--	3 cfs	Poor-Fair
Mitchell Creek	S27 T5S R89W	Garfield	CRN-B	10	NS	Yes	7 cfs	Excellent
Moniger Creek	S8 T4S R81W	Eagle	--	--	NS	--	0.5 cfs	Poor
Piney River-South Fork	S7 T4S R81W	Eagle	--	--	NS	Yes	4 cfs	Excellent
Possum Creek	S20 T5S R89W	Garfield	CRN	10	NS	Yes	5 cfs	Fair
Red Dirt Creek-East Fork	S27 T2S R86W	Eagle	CRN	10	NS	Yes	6 cfs	Excellent
Red Dirt Creek-West Fork	S34 T2S R86W	Eagle	CRN	10	NS	Yes	8 cfs	Excellent
Lakes								
Bowen Lake	S31 T4S R88W	Garfield	B	--	NS	Yes	2 acres	Poor
Hack Lake	S3 T3S R87W	Garfield	CRN	10	1978	Yes	1 acre	Excellent
White River Drainage - Streams								
Fawn Creek	S7 T1N R90W	Rio Blanco	CRN,MOS,MTS	12	NS	--	4 cfs	Fair
Hahn Creek	S34 T2N R90W	Rio Blanco	CRN,MTS	14	NS	--	3 cfs	Fair
Lost Creek	S15 T1N R90W	Rio Blanco	CRN,MOS,MTS	9	NS	--	4 cfs	Fair
Lakes								
Little Skinny Fish Lake	S19 T1N R87W	Garfield	CRN	10	NS	Yes	5 acres	Excellent
Skinny Fish Lake	S24 T1N R88W	Garfield	CRN,B,R	12	1978	Yes	10 acres	Fair

Table 5. List of streams and lakes in Colorado known to contain _Salmo clarki pleuriticus_ as of 1981.

Purity	Date of Survey	Water
A+	1969	Cross Creek
	1972	Cunningham Creek
	1980	E. Meadow Creek
		Mitchell Creek
	1981	JQS Gulch
		Cattle Creek
A	1971	Trappers Lake
	1976	Timber Lake
		Timber Creek
	1980	Hack Lake
		Hat Creek
		Nolan Creek
		Miller Creek
	1981	Northwater Creek
		S. Fk. Ranch Creek
A-	1980	Abrams Creek
		Corral Creek
		Fawn Creek
		Frying Pan Lakes #2,3
		Nickelson Creek
		Hahn Creek
		Lost Trail Creek
	1981	Bobtail Creek
		Little Green Creek
		N. Fk. Swan River

Taxonomic character analysis summary for trout collected in the Colorado River drainage in 1982.

Stream	Standard Length	Gill-rakers Total	Scales above Lateral Line	Scales in Lateral Series	Pyloric Caeca	Basi-branchial Teeth
Black Bone Creek						
mean	167.80	19.67	43.50	174.00	34.83	5.33
s.d		1.37	1.76	21.88	2.64	6.77
range		18-22	41-45	163-200	31-38	0-18
Bobtail Creek						
mean	157.17	19.67	39.20	202.66	35.00	13.33
s.d.		1.03	1.48	19.98	1.58	5.50
range		18-21	39-41	164-220	33-37	6-20
Butler Creek						
mean	188.10	18.30	42.70	180.80	32.40	3.10
s.d.		0.82	2.00	9.50	1.50	2.64
range		17-19	41-47	165-199	30-35	0-8
Cabin Creek						
mean	147.80	18.77	44.17	192.00	33.16	4.17
s.d.		0.75	2.23	8.41	1.83	1.33
range		17-19	40-46	184-208	31-35	2-6
Cattle Creek						
mean	167.00	18.10	42.20	177.80	31.70	3.60
s.d.		1.20	1.87	13.29	4.66	3.98
range		17-20	42-45	180-195	30-34	0-9
Corral Creek						
mean	145.75	19.63	39.14	198.88	33.75	7.13
s.d.		1.51	2.27	7.32	4.13	3.14
range		18-22	35-42	188-206	29-39	4-12
Cross Creek						
mean	181.20	20.00	42.80	186.50	38.00	9.70
s.d.		1.05	2.66	13.73	2.55	4.95
range		19-22	39-45	158-207	33-41	3-18
West Cross Creek						
mean	169.50	20.00	40.80	174.30	33.10	6.70
s.d.		1.33	0.79	15.14	2.13	3.74
range		17-21	40-42	152-202	30-37	1-13
Hahn Creek						
mean	160.60	18.80	39.90	190.30	30.80	3.70
s.d.		1.23	2.47	14.40	1.93	2.36
range		17-21	36-45	174-224	28-34	0-8
Hat Creek						
mean	187.40	19.00	43.75	188.50	35.00	8.63
s.d.		1.31	3.60	6.05	2.16	3.96
range		17-21	39-49	177-197	32-37	4-16
JQS Gulch						
mean	171.10	18.00	42.10	189.70	31.30	2.60
s.d.		0.67	1.66	8.04	1.16	2.01
range		17-19	41-45	176-205	30-33	0-6

Taxonomic character analysis summary for trout collected in the Colorado River drainage in 1982. (cont.)

Stream	Standard Length	Gill-rakers Total	Scales above Lateral Line	Scales in Lateral Series	Pyloric Caeca	Basi-branchial Teeth
Lost Creek						
mean	168.00	19.80	45.50	188.40	37.20	2.40
s.d.		0.92	1.43	9.29	2.57	1.35
range		18-21	43-48	180-205	32-40	0-4
Lost Trail Creek						
mean	164.70	18.00	39.10	196.78	26.70	6.80
s.d.		1.56	2.81	6.70	4.64	3.49
range		16-21	34-42	189-210	18-32	0-12
East Meadow Creek						
mean	170.10	19.60	44.60	220.60	33.90	18.30
s.d.		1.58	2.46	9.44	2.13	6.25
range		17-23	40-47	206-234	30-36	8-27
Miller Creek						
mean	156.50	18.70	41.00	192.33	31.40	7.20
s.d.		1.42	1.41	7.62	1.65	4.61
range		16-21	39-43	193-200	29-34	2-18
Mitchell Creek						
mean	172.22	18.44	42.33	204.78	32.11	13.11
s.d.		1.51	2.45	11.49	2.76	3.79
range		15-20	39-47	194-227	27-36	8-19
Nickelson Creek						
mean	165.90	18.90	45.60	184.20	36.10	3.40
s.d.		0.74	3.03	12.42	5.49	2.01
range		18-20	41-51	160-196	28-48	0-7
Nolan Creek						
mean	170.60	18.20	42.50	198.80	29.60	2.70
s.d.		0.92	2.22	4.49	2.27	2.67
range		17-20	40-47	192-206	26-32	0-7
Northwater Creek						
mean	146.90	18.60	43.70	188.00	32.30	4.40
s.d.		0.84	1.16	4.94	1.64	2.67
range		17-20	42-45	180-195	30-34	0-9
South Fork Ranch Creek						
mean	163.50	19.44	42.22	205.10	34.20	10.00
s.d.		1.07	3.56	7.58	3.08	4.32
range		18-21	38-48	195-216	29-40	6-17
Snell Creek						
mean	163.00	18.10	45.88	188.10	37.13	7.40
s.d.		0.99	2.47	5.26	3.87	2.59
range		17-20	42-49	182-196	31-43	3-13
North Fork Swan Creek						
mean	157.50	18.30	42.90	200.10	30.50	8.60
s.d.		0.95	2.73	11.77	1.65	5.68
range		17-20	40-48	184-223	29-33	2-16

Summary of information on the status of the
greenback cutthroat trout, *Salmo clarki stomias*

Prepared for

U.S. Fish and Wildlife Service
Salt Lake City Area Office

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June, 1976

Introduction

This report summarizes the current knowledge regarding the status, distribution and taxonomy of the greenback cutthroat trout. It includes the analysis of several samples of specimens not included in previous reports or theses and a comparison of the specimens of the same genotype (Big Thompson River in Forest Canyon of Rocky Mountain National Park) after establishment in new environments (Caddis Lake, RMP and Florence Creek, Utah), to evaluate the magnitude of non-genetic (environmental) influence on some of the taxonomic characters and reveal what changes might occur in transplanted populations.

The possibility that the greenback cutthroat trout of the Arkansas River system effected a headwater transfer to the Canadian River basin is discussed.

The objectives of this report are to provide a compendium of information and recommendations for protection and restoration basic to a meaningful recovery program, leading to a change in federal status from endangered to threatened.

Historical Review

The greenback cutthroat trout is an example of how the actual survival status of a fish can become confused with its taxonomic status.

As a basic starting point, there is no doubt that a cutthroat trout is indigenous to the headwaters of the South Platte and Arkansas river basins and that this cutthroat trout is given the common name of greenback trout (Jordan, 1891). This trout has suffered a rapid decline in distribution and abundance to the point of extreme rarity as pure populations and is presently classed as endangered on the federal list of endangered and threatened species (Behnke and Zarn, 1976).

The confused taxonomy of the greenback trout is related to the original description and to the degree of differentiation between *S. c. stomias* and other subspecies of cutthroat trout (how readily and with what consistency can specimens of *S. c. stomias* be separated from other subspecies).

The taxonomic confusion surrounding the name *stomias* began with an 1856 Army expedition under the command of Lt. F. T. Bryant from Fort Riley, Kansas to Fort Bridger, Wyoming and return. Dr. W. R. Hammond, an Army surgeon, accompanied the expedition, and as was a common practice at that time, made some natural history collections. The route of the expedition traversed parts of the Kansas, North Platte, South Platte and Green River drainages of Kansas, Nebraska, Colorado and Wyoming. All of the fish specimens collected were simply labeled "Fort Riley, Kansas" and shipped to the Philadelphia Academy of Sciences. Many of these specimens, including two specimens of cutthroat trout, were destined to be described as new species from "Fort Riley, Kansas". Cross and Oland (1961) discussed the confusion this collection has caused to fish taxonomy.

All we know is that Dr. Hammond collected, preserved and shipped at least two specimens of cutthroat trout from Fort Riley, Kansas to the Philadelphia Academy in 1856. Because no trout were known to be indigenous to the Kansas, Republican or North Platte systems, these specimens must have been taken from the South Platte or Green River basins.

Cope (1865) first mentioned these specimens as "Trutta lewisi" from the Kansas River. Later, he described a new species, Salmo stomias, on Dr. Hammond's specimens and gave the locality as the "South Platte River, Fort Riley, Kansas" (Cope, 1872). The diagnostic criteria used by Cope for stomias was "a large mouth" (not diagnostic from other cutthroat trout) and "42 scales above the lateral line" (erroneous for South Platte native trout, in which I typically count 45-55 scales above the lateral line).

Cope and Yarrow (1875) changed the type locality of stomias from the South Platte River to the Kansas River, Fort Riley and in later publications Cope considered the cutthroat trout native to the South Platte basin as "S. pleuriticus" (pleuriticus is the currently accepted name of the Colorado River cutthroat trout).

The original specimens (type specimens) of stomias are in the collection of the Philadelphia Academy of Natural Science (7825 and 7826). I have not seen these specimens but Dr. R. R. Miller, Museum of Zoology, University of Michigan, has examined them and related that although the specimens are in poor condition and accurate scale counts are impossible, he estimated only about 150 scales in the lateral series (about 40 fewer than expected for native South Platte cutthroat trout). It is possible that Cope mixed specimens and #7825 and 7826 are actually specimens of Rio Grande cutthroat trout. It seems apparent from an article by Fowler (1912) that Cope also assigned the name stomias to Rio Grande cutthroat trout specimens collected from Ute Creek, Fort Garland, Colorado.

Thus, we have a situation where we do not know the origin of the type specimens bearing the name stomias (South Platte or Green River if they were collected by Dr. Hammond in 1856 - or possibly the Rio Grande drainage if Cope mixed specimens during his studies), and the original describer (Cope) claimed stomias was not the native trout of the South Platte basin.

Our present concept of the taxon stomias is attributed to David Starr Jordan who qualifies as the "first reviser" of the name (makes current use "legitimate"). Jordan (1891) stated that trout were not native to Kansas and assigned the name stomias to the cutthroat trout native to the South Platte and Arkansas basins of Colorado. Jordan also associated the common name of greenback trout with stomias.

Jordan and Evermann (1896:489) mistakenly assumed that the native cutthroat trout of the South Platte and Arkansas rivers were derived from an ancestor moving downstream from the upper Missouri basin and in turn gave rise to the Colorado River cutthroat trout. The more probable sequence is reversed. If cutthroat trout ever migrated down the Missouri River to become established in the South Platte, it would be expected that populations would have become established in the Black Hills of Wyoming and South Dakota and in the North Platte drainage of Nebraska, Wyoming and Colorado - areas barren of trout until introduced by man. Based on the best evaluation of historical data and examination of specimens, I conclude that the cutthroat trout of the upper Missouri basin were derived from two separate crossings of the Continental Divide. The original distribution of cutthroat trout in the upper Missouri River proper did not extend much below Great Falls, Montana. In the Yellowstone River drainage native trout extended downstream to the Tongue River and the two forms of cutthroat trout (upper Missouri and Yellowstone) never came in contact and never existed as permanent populations below the junction of the Yellowstone with the Missouri. Thus, the origin of cutthroat trout in the South Platte basin can be attributed to a headwater transfer from the Colorado River system, a later transfer from the South Platte established them in the Arkansas River basin.

Jordan and Evermann (1896) reduced stomias to subspecific status, first as Salmo mykiss stomias and later to the presently accepted, S. clarki stomias (Jordan and Evermann, 1898).

No published work, however, presented adequate diagnostic criteria for stomias and sporadic attempts to do something for the protection and transplant of any remnant populations were stymied by the question: how is stomias to be recognized if it is found?

The early decline of the greenback cutthroat trout can be attributed to loss and degradation of habitat from mining, logging, grazing and irrigation projects - already well underway when Jordan visited Colorado in 1889.

The final squeeze, forcing the native cutthroat trout to the point of extinction was the introduction of non-native trouts. Brown trout replaced it in larger rivers, brook trout replaced it in smaller tributaries, rainbow trout hybridized with the native cutthroat and typically replaced it in streams of intermediate size and elevation between the brook trout and brown trout zones. The indiscriminant mixing of various subspecies of cutthroat trout such as the greenback, Colorado River and Yellowstone Lake cutthroat in fish propagation and their subsequent distribution throughout headwater tributaries and mountain lakes created the present situation where a tremendous diversity of cutthroat trout populations can be found in the South Platte and Arkansas river basins, but few closely resemble the original native trout.

Dieffenbach (1964) attempted to find pure populations of stomias but he was hampered by a lack of diagnostic criteria useful for comparison with specimens he collected. Dieffenbach was misled by Jordan's (1891) statement that stomias has about 140 scales in the lateral line. Most cutthroat (and rainbow and almost all species of the genus Salmo) have about 120-125 scales in the lateral line (number of pores). Occasionally I have found small, isolated populations of cutthroat trout with 130-140 or more lateral line pores - but it is a character exhibiting local variability and not useful in subspecific diagnosis. I examined museum specimens of stomias collected by Jordan in 1889 and found none approaching 140 scales in the lateral line.

When Dieffenbach found a population of cutthroat trout inhabiting Black Hollow Creek, a small tributary of the Poudre River with an average of 137 scales in the lateral line (I counted an average of 133 pored scales to the end of the vertebral column in these specimens), he decided that the Black Hollow Creek cutthroat trout was the best known representative of stomias.

After re-examining Dieffenbach's data and specimens and finding that the cutthroat trout in Black Hollow Creek were not physically isolated from rainbow trout in the Main Poudre River, I concluded that the Black Hollow Creek cutthroat trout was not a pure population of stomias, but was a "good phenotypic" representative of stomias. A photograph of the original Black Hollow Creek cutthroat appears on the cover of a BLM publication (Johnson, 1976). The large, pronounced spotting pattern typical of stomias can be observed. Character values of the Black Hollow Creek cutthroat are presented in Table 1.

The discovery of the Black Hollow Creek trout stimulated a resurgence of interest in stomias restoration, but the original Black Hollow Creek population was probably lost as a result. In October 1966, 54 cutthroat trout from Black Hollow Creek were transported and stocked into the headwaters of Hourglass Creek (tributary of Little South Poudre River). This section of Hourglass Creek provided about two miles of stream above barrier falls, barren of fish. Evidently no trout remained above the barriers to spawn in Hourglass Creek. In a 1975 survey, Rolf Nittmann, Colorado Division of Wildlife, found no fish above the barriers but reported sighting one large cutthroat trout downstream where brook trout are also found.

In 1967 a cooperative project of the Colorado Cooperative Fishery Unit, the U.S. Forest Service and the Colorado Division of Wildlife constructed a barrier to upstream migration in Black Hollow Creek. About 25 cutthroat trout were removed and held in a small spring seep while rotenone was administered to the creek to eradicate the brook trout. The cutthroat trout were to be placed back into Black Hollow Creek the next day, but they were found to be dead or dying. Electrofishing in 1968 and 1969 found no evidence of survival and in September 1969, the last 10 specimens of cutthroat trout found in Albion Creek (Boulder Creek watershed), which I had judged to be pure <u>stomias</u>, were transported to Black Hollow Creek. Forty trout from Como Creek, a small stream in the Boulder Creek drainage with a trout virtually identical to the Albion Creek greenback, were stocked into Black Hollow Creek in 1970. Natural reproduction was observed in 1971 and 1972.

The lack of taxonomic information concerning <u>stomias</u> was also responsible for the abandonment of an earlier effort to restore native trout into waters of Rocky Mountain National Park.

In the 1950's a cutthroat trout population was found in the headwaters of the Big Thompson River in Forest Canyon of Rocky Mountain National Park. At that time it was commonly assumed that stomias was extinct, because of the statement to that effect made by Greene (1937) in his booklet on Colorado trout. Much interest was generated by the Forest Canyon trout as a possible pure population of stomias. Specimens were sent to Dr. R. R. Miller at the University of Michigan, some life history studies were made (Bulkley, 1959) and a transplant was made into the barren Fay Lakes of Rocky Mountain Park in 1959 in a cooperative restoration project between the U.S. Fish and Wildlife Service and the National Park Service.

This bubble of excitement was burst by the finding of records in Park Service files relating the stocking of cutthroat trout into Forest Canyon in 1922 and 1923. In 1922, 140,000 "spotted native" trout were stocked into Forest Canyon by the Estes Park Sportsman Association. This was followed in 1923 by a stocking of 130,000. The trout were obtained from the Estes Park State Fish Hatchery but almost certainly originated from eggs of Yellowstone Lake cutthroat. Also, Dr. Miller wrote that he could not determine the identity of specimens as stomias because insufficient taxonomic data on stomias existed and he pointed out the confusion surrounding the name stomias. Thus the first "official" restoration efforts for the native trout of the South Platte and Arkansas drainages came to an unhappy termination. The original transplant into Fay Lakes did not perpetuate in Fay Lakes but some individuals must have migrated downstream to establish a self-sustaining population in Caddis Lake, where they were discovered by James Mullan (U.S. Fish and Wildlife Service) in 1972.

The above episodes emphasize the point that adequate taxonomic information is basic to any recovery or restoration plan for cutthroat trout subspecies.

My interests in cutthroat trout taxonomy formally began in 1957 for my M.A. thesis research on cutthroat trout. To establish some baseline data on the characteristics of several subspecies, including _stomias_, I examined museum specimens, collected mainly during the period of 1870-1900. I noted that although most of the described subspecies of _S. clarki_ lacked clear-cut differences (unique characters), differences in mean values of several characters could be used to separate specimens from different major drainage basins. The native cutthroat trout of the South Platte and Arkansas drainages were characterized by high scale counts, large spots and a tendency for lower numbers of vertebrae and pyloric caeca than most other subspecies of cutthroat trout.

The cutthroat trout native to Yellowstone Lake was the major source of cutthroat trout used in propagation and stocking from a period of about 1900 to 1950. Large series of Yellowstone Lake cutthroat trout were analyzed to detect differences from other subspecies and to evaluate effects of past hybridization between a native cutthroat trout and the introduced Yellowstone cutthroat. A series of characters were also evaluated to detect the effects of hybridization between native cutthroat trout and introduced rainbow trout. Finally, a series of samples representing known parental sources and derived populations established in new environments were compared to evaluate the direct environmental influence (non-genetic) on the taxonomic characters.

With this information, I determined that the Forest Canyon cutthroat trout did not represent an introduced population of Yellowstone Lake cutthroat trout. Although not pure, the Forest Canyon trout are a good representative of _stomias_. A project initiated by the Colorado Cooperative Fishery Unit in 1964 took Forest Canyon trout to the Leadville National Fish Hatchery for an attempt at artificial propagation. Males and females did not mature synchronously and the remaining fish were transported and stocked in a small, barren stream (Florence Creek) on the Uinta and Ouray Indian Reservation, Utah in 1967. These fish reproduced and became established in Florence Creek where James Mullan collected a sample of specimens in 1975. The character values of samples from the Big Thompson River in Forest Canyon and the derived populations in Caddis Lake and Florence Creek are presented in Table 1.

The status of S. c. stomias to 1973 was discussed by Wernsman (1973) and Behnke (1973). After evaluating all of the evidence from character analysis we decided that two populations were probably pure and were the best known living representatives of stomias. These were the populations in Como Creek, a tributary of North Boulder Creek, Boulder County, Colorado and in the very headwaters of the Little South Poudre River, Larimer County, Colorado. Both of these sites are completely isolated from invasion by introduced trout and have no known stocking records.

Because of accessibility, the Como Creek trout has been used for introductions into Black Hollow Creek and into Rocky Mountain Park.

Taxonomy

Table 1 presents the data from character analysis of collections of cutthroat trout from the South Platte and Arkansas river basins. Included are data from ancient museum collections and samples from Yellowstone Lake and the headwaters of the Colorado River for comparisons and discussion. Because of the proximity to Colorado State University, the Poudre River drainage is best represented. Every known cutthroat trout population in the Poudre drainage has been sampled. Ideally, for a complete analysis of the present status of S. c. stomias, all major subdrainages of the South Platte and Arkansas basins should be surveyed and cutthroat trout populations sampled comparable to the Poudre drainage collections. Interpretation of the data from the Poudre drainage samples suggest how this might be accomplished with minimal time and effort and maximal production of useful information. This matter is discussed in the "Recommendations" section.

Most of the old museum specimens were collected from Twin Lakes (Arkansas River drainage) and little information is available on the original range of variability of the taxonomic characters of S. c. stomias. The specimens from the headwaters of the Little South Poudre River were judged pure because of the large, pronounced spots, the extremely high scale counts (higher than any trout of the genus Salmo), bright coloration and the remoteness and isolation of the site. They do have slightly higher values for vertebrae, pyloric caeca and gillrakers than might be expected of a hypothetical "typical" stomias, but it is not likely that these values were influenced by past hybridization with either non-native cutthroat trout or rainbow trout without affecting the scale counts, coloration and spotting pattern also.

The meristic characters of the Como Creek trout may approximate more closely the "typical" original greenback cutthroat. They have the large, pronounced spotting pattern, characteristic of stomias, although one of the 18 specimens examined lacks basibranchial teeth. Basibranchial teeth are not invariably present in all pure cutthroat trout and in most instances I would hesitate to invoke rainbow trout hybridization as an explanation for the absence of these teeth in less than 10% of the population, particularly in a small population where genetic drift may operate.

The best diagnosis at present for the recognition of stomias is as follows: Spotting pattern of large, roundish spots (largest spots noticeably larger than pupil of eye); the largest and most numerous spots on caudal peduncle area; coloration bright in adults (red, gold and orange colors predominate in sexually mature fish); mean values for vertebrae, 60-62; pyloric caeca, 28-36; scales above lateral line, 45-55+; lateral series, 185-215+; basibranchial teeth present in at least 90% of population.

Examination of the data in Table 1 demonstrates that most of the cutthroat trout populations of the Poudre drainage have a large measure of greenback cutthroat ancestry determining their characters. None are typical Yellowstone Lake cutthroat and none are obvious rainbow x cutthroat hybrids. Closer analysis of the data, however, revealing the amount of variability between the populations demonstrates that almost all of these populations have a recognizeable influence by past introductions of both rainbow trout and non-native cutthroat trout. Of all the samples from the Poudre drainage, only the population in the headwaters of the Little South Poudre is judged pure. Roaring Creek and the original Black Hollow populations are "good representatives" of stomias. The spotting pattern on most of the specimens in the other samples (small, erratic, more profuse) also indicates past hybridization. One sample, however, of 6 specimens collected in 1968 from a tiny unnamed tributary to Long Draw Reservoir (headwaters of Big South Poudre) merits further attention. These fish had not been examined prior to this report. The spotting pattern of these trout is not as distinctive as that found on Como Creek or Little South Poudre specimens, but the scale counts and caecal counts are indicative of stomias and the number of gillrakers are similar to the Little South Poudre sample. Because of barrier falls on the Big South Poudre, it is possible that trout were not native to the headwater areas, but early introductions from nearby waters may have originally established native trout here.

If the present population in the tributary to Long Draw Reservoir represents a population introduced by man, they may not be Poudre River greenback trout (stomias) but Colorado River cutthroat trout (pleuriticus). Long Draw Reservoir is only a few miles from the very headwaters of the Colorado River. The data from a sample of cutthroat trout found in the headwaters of the Colorado River are presented in Table 1. Note that the meristic characters of this sample is quite typical of stomias. The spots on these Colorado River specimens are relatively smaller than the spots of the Como Creek or Little South Poudre specimens, but it must be assumed that originally there were local populations of S. c. pleuriticus on one side of the Continental Divide in the headwaters of the Colorado River, with "larger than average" spots and populations of S. c. stomias on the other side in the headwaters of the South Platte basins with "smaller than average" spots and both with essentially similar meristic values, thus obliterating any distinction between the two subspecies.

In my taxonomic analysis of S. c. pleuriticus, I found some slight, average differences between pleuriticus of the upper Green River basin and stomias of the South Platte and Arkansas systems, but as more specimens were examined from the Yampa and Colorado River drainages a trend for larger spots and higher scale counts blurred the taxonomic distinctions of pleuriticus and stomias. This is not unexpected because, almost certainly, stomias was derived from pleuriticus by headwater transfer from the Colorado to the South Platte basin. Because of the degree of isolation of trout populations between the upper Green River and the headwaters of the Colorado River (historically the main Green River was not salmonid habitat below the town of Green River), the genetic affinities between pleuriticus of the upper Colorado basin and stomias may be closer than the affinities between pleuriticus of the Upper Colorado and pleuriticus of the Upper Green River.

This matter concerns the point of taxonomic validity raised in the introduction. With the present information, modern ichthyologists would not likely describe the South Platte (and Arkansas) cutthroat trout as a subspecies distinct from the Colorado River cutthroat trout. However, the names for the two subspecies are long established and are useful to associate native trout with specific geographical areas. Ultimately, the assignment of a native cutthroat trout to the subspecies stomias or pleuriticus rests on the site of origin (South Platte - Arkansas drainages or the Colorado River basin).

Comparison of specimens of the parent population in Forest Canyon with derived populations in Caddis Lake and Florence Creek revealed a high degree of consistency. Aside from the more striking coloration developed in Caddis Lake fish, the only character undergoing recognizeable change is the diminuition of basibranchial teeth in Florence Creek specimens. Three of 15 specimens over 100 mm S.L. (and 2 of 7 less than 100 mm) from Florence Creek lacked teeth. Of the original specimens from Forest Canyon, basibranchial teeth were found in 37 of 40 fish. Also, the teeth are more feebly developed in Florence Creek specimens in comparison with Forest Canyon fish. In similar comparisons of parental and derived populations of cutthroat trout, Wernsman (1973) found basibranchial teeth number to be a stable character. The most likely explanation for a change in basibranchial teeth in the Florence Creek sample is the "Founder's Principle", whereby a new population is founded on a relatively few individuals and these individuals possess modal gene frequencies for some characters different from the modes of the parent population.

This is an indication of what can be expected for other transplants - that the new populations may not be identical to the parents in every character.

Distribution

The original distribution of the greenback cutthroat included the upper parts of the South Platte and Arkansas river systems. Precise details of the distribution are not known, but permanent populations probably did not extend much below the foothill region of the Rocky Mountains (above the city of Pueblo on the Arkansas and to the city of Greeley on the South Platte). Except for a small area in southeast Wyoming (headwaters of Dale and Boxelder creeks) all of the original native trout distribution in the South Platte and Arkansas basins is in Colorado.

A thesis by Stork (1975) and a report by Stork and Behnke (1975) on the native cutthroat trout of the Rio Grande and Pecos basins, discussed the possibility that *S. c. stomias* may be native to the Canadian River basin via a headwater transfer from the Arkansas basin. This speculation was based on examination of specimens of cutthroat trout from the headwaters of the Pecos basin, New Mexico. Some of the populations of Pecos cutthroat trout exhibited a striking similarity to greenback cutthroat in their spotting pattern and were recognizeably different from typical Rio Grande cutthroat trout, *S. c. virginalis*. Stork and I suggested that perhaps the native trout of the upper Pecos basin were derived from headwater transfer from the Canadian River basin under the assumption that the Canadian River basin had native trout from a previous headwater transfer from the Arkansas River drainage (greenback trout).

Admittedly these speculations on the origin of Pecos and Canadian River cutthroat lack firm supportive evidence, particularly in view of the fact that no documented evidence exists that trout are native to the Canadian River basin (no museum collections of Canadian River basin trout were made prior to introductions).

A recent collection of cutthroat trout was made from Ricardo Creek, a headwater tributary of the Canadian River system, Costilla County, Colorado. After thorough examination and comparisons I identified the Ricardo Creek trout as Rio Grande cutthroat, S. c. virginalis (Behnke, 1976). It is possible that prospectors or sheepherders could have transplanted trout into Ricardo Creek from a headwater tributary of the Rio Grande, which lies only a few miles to the northwest of Ricardo Creek.

I anticipate further information on Canadian River cutthroat trout (Are they native? If so, are they derived from S. c. stomias or S. c. virginalis?) from the thesis research of C.S.U. student, David Propst, who initiated a study of native cutthroat trout in New Mexico this year.

The present known distribution of pure stomias populations in the South Platte drainage consists of the small stocks in Como Creek and in the headwaters of the Little South Poudre and of transplanted Como Creek trout in Black Hollow Creek and two transplants in Rocky Mountain Park - Hidden Valley Creek and Bear Lake. No pure populations have been identified from the Arkansas River basin (but Arkansas basin collections are few). The best representative Arkansas drainage greenback trout, is the sample from the headwaters of the South Huerfano River.

Life History and Ecology

I can add nothing to my previous remarks on the life history and ecology of greenback trout (Behnke, 1973), that very little information is available. Behnke and Zarn (1976) stressed the point that ecological and life history attributes of trout are highly variable and mainly under direct environmental (non-genetic) influence. Previous data developed by Bulkley (1959) and Nelson (1972) on predominant greenback cutthroat populations (Forest Canyon and Island Lake) could apply to any species of trout living under similar circumstances.

From all of the information pertaining to the decline of the greenback trout from its native range, the most cogent point for future restoration programs is that the greenback cutthroat is not likely to coexist with other species of trout. Because the greenback once lived in virtually all of the present trout habitat on the eastern slopes of the Rocky Mountains in Colorado, it can be assumed that re-introductions of greenback cutthroat trout will be successful in streams or lakes now holding introduced trouts if all of the non-native fish are eliminated and prevented from reinvasion. This being the case, detailed habitat studies are not a necessary prerequisite for future transplants, as was demonstrated by the successful establishment of Como Creek greenback trout in Hidden Valley of Rocky Mountain Park, a typical beaver pond - brook trout habitat when the brook trout were eradicated.

Protective Measures

As discussed above, the first greenback restoration projects used the slightly hybridized populations of Forest Canyon and Black Hollow Creek. These efforts did establish the Forest Canyon trout in Caddis Lake in Rocky Mountain Park and in Florence Creek, Utah and created a greenback trout sanctuary area in Black Hollow Creek by the construction of a barrier and elimination of brook trout (although the original Black Hollow Creek population was probably lost). Introductions of 10 Albion Creek trout in 1969 and 40 trout from Como Creek in 1970 did establish a thriving population of greenback trout in Black Hollow Creek by 1972. A survey of Black Hollow Creek in 1975 found that brook trout were again established above the barrier falls (probably from angler introductions). A decision on a future course of action for Black Hollow Creek is one of the current matters facing the Greenback Recovery Team.

In 1971, 40 trout from Como Creek were helicoptered into a barren headwater tributary of the Big Thompson River in Rocky Mountain Park. Evidently, due to severe winter conditions, all of these fish migrated downstream over a barrier falls and have little chance of perpetuating themselves in the dense population of brook trout found there.

In 1973, 80 trout from Como Creek were stocked into Hidden Valley Creek of Rocky Mountain Park after treatment with antimycin to eliminate brook trout. Surveys of Hidden Valley in 1974 and 1975 revealed successful reproduction in both years and no evidence of brook trout survival. The habitat of Hidden Valley Creek consists of about 15 surface acres of water, mostly in beaver ponds which should support several thousand greenback trout when the population expands to carrying capacity (1978-1980).

In 1975, Bear Lake, an 11.2 acre body of water in Rocky Mountain Park, was treated with antimycin to eradicate brook trout and 65 greenback cutthroat trout from Como Creek were transplanted into it. If the inlet and outlet areas of Bear Lake can be modified to induce natural reproduction and the aggregation of spawning fish, it should provide an excellent situation for spawn taking operations providing eggs for an expanded restoration program.

S. c. stomias is listed in the federal register as an "endangered species" under the 1973 Endangered Species Act (PL 93-205) and is endowed with certain protections such as from threats to habitat from any federal or federally-funded project. A Greenback Trout Recovery Team has been established whose mission is to enhance the survival status of the greenback trout so it is no longer "endangered". The members of the Greenback Recovery Team (1976) are: Mr. Dave Langlois, Colorado Division of Wildlife (replacement for Rolf Nittmann); Mr. Richard Moore, U.S. Forest Service; Mr. Dave Stevens, National Park Service; and Mr. James Mullan, U.S. Fish and Wildlife Service. I (Robert Behnke) serve as Technical Consultant to the team.

In February, 1976, a first draft of a greenback trout recovery plan was written by the team and submitted to the U.S. Fish and Wildlife Service. With the plan, a request was made to declassify S. c. stomias from endangered to threatened. The Recovery Team's reasons for requesting a change in status was based on the fact that the greenback cutthroat trout is not now in imminent danger of extinction because of the recognition and protection of the two indigenous populations in Como Creek and in the headwaters of the Little South Poudre River and the introduced populations in Rocky Mountain Park where the watersheds are completely protected against degradation.

It was also pointed out by the Recovery Team that the endangered status, by prohibiting angling (or any "taking"), inhibited more transplants of greenback trout into public waters because such action would force closure of these waters to anglers, thus alienating fishermen.

Understandably, the Fish and Wildlife Service has a cautious approach to the evaluation of requests for change of status. A reply from Mr. Harvey Willoughby, Director, Region 6, U.S. Fish and Wildlife Service to Mr. Nittmann (April 12, 1976), commented on the recovery plan and a request for a change in status. Mr. Willoughby pointed out the need for continued, long term monitoring and of statements of achievable and quantifiable objectives calling for specific actions and schedules to be carried out. A problem here is that to the present, no funding has been available specifically to carry out projects on greenback trout. All work to date has been done on a piecemeal, sporadic and part-time basis or ancillary to other projects. For example, I have previously pointed out that we know little of the status of native trout in the Arkansas River drainage because of the paucity of collections. As part of an ongoing D-J project on stream surveys (F-32-D) in the Arkansas drainage, Mr. Don Wurm, regional biologist, Colorado Division of Wildlife, agreed to give special emphasis to collections of potential native trout populations. Colorado Division of Wildlife has obligated funds to handle the identification of collections made in 1976.

The Colorado Division of Wildlife classifies *S. c. stomias* as "threatened". This classification gives the management responsibility of *stomias* to the non-game section of the Division. The non-game aquatic biologist of the Colorado Division of Wildlife is Mr. Dave Langlois.

Recommendations

The delegation of administrative authority for endangered and threatened species to the non-game section of the Colorado Division of Wildlife has the advantage of centralizing projects and responsibilities on species whose distribution overlaps into more than one of the administrative regions of the state. Anticipating the eventual granting of matching federal funds for endangered and threatened species programs to the state, the non-game section should draft a proposal for funding a project on the greenback cutthroat trout (or all of the native cutthroat trout of the state). The ultimate goal would be to re-introduce pure greenback trout into several waters until it was no longer endangered or threatened and again comes under the jurisdiction of fish management. Basic to such a project is the inventory, collection and taxonomic analysis of cutthroat trout populations in the South Platte and Arkansas river basins, comparable to what has been accomplished in the Poudre River drainage of the South Platte basin.

To make most effective use of funds and time, collections should be planned from those areas with the greatest potential for the persistence of native trout. Such areas will be remote and isolated headwater situations. Streams with some physical barrier to prevent upstream migration of non-native trout and the watershed above the barrier being sufficiently small or remote so that previous introductions of non-native trout were unlikely. Particular attention should be given to the location of lakes on a watershed. Most mountain headwater lakes have a long history of non-native trout introductions, resulting in hybrid mixtures throughout all parts of a continuous drainage not physically isolated. Consultation with Division employees familiar with a specific drainage or region may provide leads to the location of potential native trout populations. The South Platte and Arkansas basins can be partitioned into sub-drainages and a plan of collection sites noted from topographic maps.

For drafting a proposal, sections 4 (documentation and reporting) and 13 (research and surveys) of the U.S. Fish and Wildlife Service's Federal Aid Manual should be consulted. Objectives should be stated in quantifiable and measureable terms. For example, three months of summer field work will collect a minimum of 30 designated sites and preserve 300-500 specimens for analysis.

Until funding is available to initiate an inventory specifically devoted to greenback trout, the personnel of the non-game section of Colorado Division of Wildlife should capitalize on opportunities whereby federal agencies such as the Bureau of Reclamation, Bureau of Land Management and the U.S. Forest Service, preparing environmental assessments, analysis or impact statements, could make a contribution toward the inventory and collection of cutthroat trout populations in the South Platte and Arkansas basins.

I note that the possible occurrence of native cutthroat trout was not even considered in the final environmental impact statements for timber management (1975) for the Rio Grande, Routt, Uncompahgre, Gunnison and Arapaho National Forests in Colorado.

In Rocky Mountain National Park, the schedule and plans for 1976 and 1977 for green back trout restoration in the Park developed by Park Biologist, Dave Stevens and U.S. Fish and Wildlife Service Biologist, James Mullan, should be formalized and carried out. This includes monitoring the introduced greenback populations in Hidden Valley and Bear Lake, the creation of spawning habitat in Bear Lake, elimination of brook trout and introduction of greenback trout in about 4 miles of West Creek, above a natural barrier, and in 2¼ miles of Cow Creek (construction of a barrier will be necessary). A cutthroat trout population of unknown origin occurs in Pear Reservoir Creek in Rocky Mountain Park. This population should be identified and the habitat assessed. If the present population represents a typical hybrid mixture of non-native trout, the site can be considered for greenback introduction.

In 1975, while obtaining trout from Como Creek for transplant into Bear Lake, members of the Recovery Team made a brief reconnaissance of the Como Creek watershed. An isolated headwater section of the stream above the University of Colorado's Arctic and Alpine Research Station was found to be barren of trout. The habitat appeared to be suitable and it is recommended that an introduction be made in 1976 to extend the range of the trout in Como Creek. The downstream limits of greenback trout in Como Creek has not yet been established. This should be accomplished in 1976 as well as observing any potential threats to the downstream area - for example, the possibility of construction of ponds on private property in the watershed where rainbow trout could possibly gain access to the stream.

The headwaters of the Little South Poudre River should be surveyed in greater detail to estimate population size (evidently small) and to assess the potential for extending the distribution of this trout by introductions into a presently barren western tributary, joining the Little South Poudre just north of the boundary of Rocky Mountain Park. An objective should be scheduled to introduce fish from the Little South Poudre population into the headwaters of Hourglass Creek in an attempt to establish a new population. The original stocking of Hourglass Creek with cutthroat trout from Black Hollow Creek was made in October. The tendency for downstream movement of trout is increased by cold or decreasing temperatures (data reviewed by Behnke and Zarn, 1976) and the prospects for successful establishment in Hourglass Creek should be improved by transplants made during the early-mid summer period.

An excellent site for the establishment of a future brood stock of greenback trout is at the sources of the South Branch Boxelder Creek on the property of Colorado State University's Maxwell Ranch, Larimer County, Colorado. Two series of springs, about one-half mile apart at an elevation of approximately 7200 ft, create the origin of the South Branch and join together about one-half mile downstream, just above the county road crossing. The springs provide a constant source of good quality water (water quality and invertebrate fauna has been studied by graduate student Richard Botorff, Department of Zoology). The flows are less than one c.f.s., but presently support a dense population of small brook trout. This section of the watershed is in excellent condition and is not subjected to flooding or erosion. A construction of a barrier, perhaps just below the junction of the two forks, and eradication of the brook trout would provide an excellent opportunity to restore greenback trout. Boxelder Creek is a tributary of the Poudre River and although no records of cutthroat trout from this drainage are known, it is assumed that the greenback trout occurred throughout Boxelder Creek before replacement by brook trout. The creation of a small pond by a barrier dam would provide habitat for rapid growth and relatively large adult fish resulting in a source of readily obtainable spawners for future propagation. The area is accessible by a good gravel road, open year-round.

Mr. E. J. F. Early, Manager of the Maxwell Ranch, has expressed interest on the part of Colorado State University for an endangered species refuge on the Ranch. He has pointed out, however, that the University has no funds available to contribute to the project. The major expense would be in the construction of a barrier dam. Possible construction assistance might be available from Army Reserve Units as part of their training requirements.

A greenback restoration project designed for brood stock maintenance on the Maxwell Ranch definitely deserves serious consideration by the Greenback Recovery Team and the non-game section of the Colorado Division of Wildlife.

The following areas are high priority sites for collection of specimens for identification: 1. The headwaters of South Huefano Creek (The 1963 collection was made "above confluence with Dutch Creek"). This sample represents best known greenback population in the Arkansas River drainage. Do cutthroat trout still exist there? Are they isolated? Are there isolated tributaries which may hold pure populations of native trout? 2. The very headwaters of the Purgatoire River near Purgatoire Peak. I know of no records of native trout in the Purgatoire drainage (tributary to the Arkansas River near Las Animas, Colorado). If greenback trout ever gained access to the Canadian River basin, the transfer would most likely have occurred in the Purgatoire Peak area - if the greenback was native to the Purgatoire drainage. I discussed this matter in a report on the cutthroat trout found in Ricardo Creek, a headwater tributary of the Canadian River basin (Behnke, 1976). 3. The headwaters of the Apishapa River (the drainage between the Huefano River and the Purgatoire River) is also an important site. 4. A larger collection should be made from the unnamed tributary of Long Draw Reservoir (headwaters of Big South Poudre drainage), for detailed analysis as a pure population and evaluate relationships to *stomias* and *pleuriticus*.

The Recovery Team should set a goal by 1978 to present documented evidence that the status of *S. c. stomias* clearly warrants a change from endangered to threatened. This would include: (1) current data on the indigenous populations in Como Creek and the Little South Poudre River and the introduced populations in Hidden Valley Creek, Bear Lake and Black Hollow Creek; (2) verification that brook trout have not re-appeared in Hidden Valley or Bear Lake and a decision on a course of action for Black Hollow Creek regarding treatment for elimination of brook trout; (3) additional transplants to establish new populations such as in Hourglass Creek, Cow Creek, West Creek, Boxelder Creek and extending the distribution into presently isolated, barren sections of Como Creek and the Little South Poudre; (4) update on status of *stomias* in South Platte and Arkansas basins based on collections made in 1976-77.

Finally, a successful greenback recovery program should emphasize the values of the greenback trout in fisheries management to stimulate more widespread introductions as a fisheries management option to replace stunted brook trout populations with a more desirable trout. In the Yellowstone River, Wyoming and in the St. Joe River, Idaho, special regulation fisheries for native cutthroat trout have been enthusiastically endorsed by fishermen (Behnke and Zarn, 1976). Future data comparing the population structure, size and growth rate of the greenback trout introduced into

Hidden Valley and into Bear Lake with the brook trout populations existing there at the time of treatment will be most valuable for predicting the expected results of replacing brook trout with greenback trout in small stream and mountain lake environments (Dave Stevens and James Mullan recorded data from the brook trout populations in Hidden Valley and in Bear Lake immediately after treatment).

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Table 1. Character analysis.

Locality	Vertebrae	Gillrakers	Pyloric caeca	Scales above lat. line and in lat. ser.	Basibranchial teeth
South Platte Basin Poudre R. drainage Headwaters Little So. Poudre,1965, 1970 n = 18	60-63 (61.9)	19-23 (21.3)	27-50 (35.2)	53-60 (56.7) 205-236(216.5)	~~7 (1)~~ ~~(mean of 50)~~ 2-17 (11.1)
Black Hollow Crk. 1963 n = 40	60-63 (61.9)	-	37 (1) (mean of 50)	41-48 (44.2) 175-216(193.5)	7 (1) (mean of 50)
Roaring Crk. 1962 n = 30	60-62 (60.9)	-	31.2(1) (mean of 30)	41-50 (45.7) 173-209(190.4)	10.3(1) (mean of 30)
Hague Crk. 1967 n = 8	61-63 (61.9)	19-22 (20.4)	23-43 (34.4)	41-48 (44.5) 160-195(179.4)	2-14 (8.9)
Trap Crk. 1967 n = 10	59-63 (61.1)	17-21 (18.7)	31-41 (35.5)	40-49 (45.6) 165-201(186.6)	1 w/o teeth 9 w/ 1-10(5.1)
Neota Crk. 1967 n = 10	61-63 (61.3)	20-22 (20.7)	25-36 (30.7)	37-56 (46.3) 167-201(186.7)	1 w/o teeth 9 w/ 1-10(5.1)
Willow Crk. (above Long Draw Res.) 1969 n = 10	61-64 (62.2)	18-21 (19.5)	24-41 (30.9)	43-49 (45.9) 179-204(187.7)	4 w/o teeth 6 w/ 3-6(4)
Willow Crk. (below Long Draw Res.) 1969 n = 7	60-63 (61.3)	20-22 (20.7)	25-36 (30.7)	37-56 (46.3) 167-201(186.7)	3-7 (5.0)
Corral Crk. 1967 n = 22	61-63 (61.9)	18-20 (18.7)	32-49 (38.8)	42-47 (44.2) 156-193(180.3)	2-20 (8.5)

Locality	Vertebrae	Gillrakers	Pyloric caeca	Scales above lat. line and in lat. ser.	Basibranchial teeth
Trib. Long Draw Res. 1968 n = 6	-	19-21 (20.8)	26-33 (29.5)	47-51 (48.8) 190-208(197.8)	2-15 (8.4)
Thompson R. drainage Forest Canyon 1959-1967 n = 40	59-62 (60.7)	18-22 (19.1)	29-46 (35.9)	44-54 (49.6) 187-204(192.4)	3 of 40 w/o teeth 37 w/ 1-13(7.1)
Caddis L. (introduced frm. Forest Canyon) 1972 n = 6	-	16-22 (19.0)	31-39 (35.3)	46-49 (48.1) 186-202(191.3)	2-13 (8.2)
Florence Crk. (introduced frm. Forest Canyon) 1975 n = 15	-	16-21 (19.0)	26-43 (34.0)	43-51 (47.7) 182-208(190.8)	3 of 15 w/o teeth 12 w/ 1-8(4.4)
Boulder Crk. drainage Como Crk. 1969 n = 18	59-62 (60.2)	17-21 (19.0)	24-42 (29.4)	46-53 (48.4) 174-205(189.3)	1 of 18 w/o teeth 17 w/ 3-12(6.0)
Albion Crk. 1955-1963 n = 22	58-62 (60.1)	17-20 (18.5)	29-46 (34.1)	41-47 (44.6) 168-203(189.3)	1-23 (8.0) n = 12
Island L.(2) (City Boulder Wa~~t~~tershed) 1963 n = 50	59-62 (60.4)	-	36.6(1) (mean of 50)	41-50 (45.0) 167-196(179.8)	7.9(1) (mean of 50)
Bear Crk.(Morrison) 1889 n = 1	59	19	-	44 195	3
Arkansas R. Basin Twin Lakes 1889-1903 n = 20	59-62 (61.3)	18-21 (19.2)	33 (n = 1)	46-53 (46.2) 170-202(186.0)	1 of 14 w/o teeth 13 w/ 6-14(11.0)
Arkansas R. 1889 n = 2	60,62	20,22	31 (n = 1)	46,49 191,213	2,12

good - rainbow - quest.

#1, (2, 3), 5 | 8, 10 | #4 (low scales)

7, 11, 12 | (6) | #9. low scales 2 'rainbows'

13, 15 | (18) | 14 - hi teeth

(19) N=4 | 16. - 17

(16) - hi teeth - hi scales = 190 | 23 | (21) | (20) - hi teeth post. rakers low

22, 24 | (27) N=4

(25) - hi teeth
28 | 26 clear Riilundo | 29

30

Analysis of spots

W. 9k Alewites N = 4

M. 7k. N = 18

E. 7k N = 10

OFFICE MEMO

TO: Date

FROM:

SUBJECT:

REMARKS:

+ 2 brwn trt. Fowler Canyon, Taos Co.

**

1 "W. Fk." Rita la Presa . | Taos Co. w/o teeth 1/15 (58mm) (brown)

wyprobranded 2(3) Rito la Presa 2/23 (brown)

4 Rito del Medio Taos 2/10 several <100mm - aberrant jaw

5 Jaroso Canyon " 10 all - aberrant snout

(22) - 6 W. Fk. Luna Crk Mora Co. 3/9 brown

7 E. Fk. Alamitos Crk. Taos 10 all dorsal hump

8 W. Latir Crk " 16 of 16 w/ teeth pred. rainbow obvious hybrid.

9 Rito Pimero " all 17 w/ teeth but 2 (102) rainbow-like.

(30) - 10 El Rito Crk. - Rio Arriba Co. 10/23

11 Lake Fk. Crk. . Taos all 17

12 Bitter Crk. . Taos 2/21 ** 5 PA aberration

* 13 Salaz Canyon Crk. . " " all 7 (1 brown - may have been incl.)

same locol. 14 San Cristobal Crk. " hi counts all of 11 roundworm in caecum

15 Tienditas Crk. " 18/19

16 San Cristobal " S32 " all hi of 10

- 17 San Cristobal Crk. S 31 . " all lower of 21

18 Bitter Crk. " 6/15

19 "E. Fk." Rito la Presa Mora Co. 1/4

20 Columbia Crk. . Taos Co. all hi 15

21 Rito la Presa Taos Co. 4/13 - browns

22 W. Fk. Alamitos Crk. " all of 4

23 Sawmill Crk. " (all 1) 5/12 - more rainbow -

24 Palo ciento Crk. " all of 22 - aberrant D A fin

25 S. Fk. Rio Hondo " all 13

26 " " " all 7

(6) - 27 W. Fk. Luna Crk. " 3/5 browns

28 Mid. Fk. Alamitos " 1/18

29 E. Fk. Luna Mora Co. 1/6

(10) - 30 El Rito Crk. - Rio Arriba 12/24 sucker, dace-

		rakers	pos P. x̄	lat. ser.		caeca teeth
N=15	#1	17-19 (18.4)	(7.1)	169	(39)	5 (1/15)
N=24	2(3)	17-21 (19.0)	(5.5)	172	(39)	5.6 (2/23)
N=16	4	18-23 (19.7)	(1.6)	147	(32)	3.8 (2/16)
10	5	17-20 (18.8)	(5.7)	179	(36)	8.3
9	6	17-20 (18.4)	(3.4)	162	(38)	2.4 (3/9)
10	7	18-20 (18.5)	(3.3)	188	(38)	5.7
16	8	17-21 (19.4)	(0.18)	134	(43)	0.1 (15/16)
17	9	17-20 (18.4)	(1.4)	154	(41)	7.0
22	10	17-20 (18.4)	(6.2)	158	(42)	1.6 (10/23)
17	11	17-22 (19.2)	(5.6)	188	(38)	8.8
21	12	16-20 (18.0)	(4.3)	157	(39)	3.3 (2/21)
8	13	17-20 (18.3)	(3.4)	163	(38)	4 ~~3~~.6
21	14	18-22 (19.7)	(3.3)	181	(41)	12.4
15	15	16-20 (18.3)	(2.1)	171	(39)	(3.6) (1/19)
?	16	.	.	.		.
21	17	16-21 (18.9)	(2.3)	190	(41)	(7.0)
15	18	16-20 (18.3)	(6.4)	162	(39)	1.1 (6/15)
14	19	17-19 (18.0)	(4.8)	165	(36)	3.5 (1/14)
15	20	17-21 (19.4)	(0.9)	180	(44)	12.7
15	21	17-20 (18.3)	(4.8)	156	(44)	2.0 (4/13)
4	22	18-20 (19.0)	(3.5)	171	(33)	5.3
12	23	16-21 (19.3)	(0.08)	124	(43)	0.4 (5/12)
22	24	17-21 (18.7)	(.9)	175	(37)	5.0
13	25	17-22 (19.3)	(2.3)	182	(41)	9.0
7	26	17-19 (18.3)	(2.0)	172	(38)	8.4
4	27	17-19 (18.3)	(6.0)	164	(36)	3.8 (3/5)
18	28	16-20 (18.6)	(2.7)	182	(37)	6.8 (1/18)
6	29	17-20 (18.3)	(8.5)	153	(38)	2.0 (1/6)
24	30	17-22 (18.8)	(5.5)	159	(36)	1.8 (12/24)

Population #

		Pop Size
1	- "West Fork" of Rito la Presa	N = 17
2	- Rito la Presa Jar 1 } S 4+9	N = 13
3.	- Rito la Presa Jar 2 }	N = 19
4	- Rito del Medio	N = 16
5.	- Jaroso Canyon ("creek")	N = 10
6	West Fork of Luna Creek at forest boundary	N = 12
7	("East Fork") Alamitos Creek	N = 10
8	West Latir Creek (obvious hybrid)	N = 16
9	Rito Primero	N = 17
10	El Rito Creek S10 vs.	N = 23
11	Lake Fork ("Creek") (Pure Cutts)	N = 17
12	Bitter Creek (between S16 + S21)	N = 21
13	Saloz Canyon Creek	N = 8
14	San Cristobal Creek S32	N = 11
15	Tienditas Creek	N = 19
16	San Cristobal Creek S32	N = 10
17	San Cristobal Creek S31	N = 21
18	Bitter Creek (S15)	N = 15
19	("East Fork") Rito la Presa	N = 4
20	Columbine Creek	N = 15
21	Rito la Presa S17	N = 17
22	("west Fork) Alamitos Creek	N = 4
23	Sawmill Creek at Sawmill Pk.	N = 12
24	Palociento Creek	N = 22
25	South Fork of Rio Hondo S17	N = 13
26	South Fork of Rio Hondo S20	N = 7
27	West Fork of Luna Creek	N = 11
28	("middle Fork") of Alamitos Creek	N = 18

29 - East Fork Luna Creek N= 9

30 El Rito Creek S 35 N=27

cutognatis spot chgs

pect - petv
belw b.l.
- no spots

Taos - Palocieuto Crk. T 23 N, R 14 E, S 3 T very good
typical *virginalis*

Taos - Sawmill Crk. at Sawmill Park, T 27 N R 15 E S 17
overwhelmingly rainbow trout > 75%.

Taos Tienditas Crk. T 24 N R15E S8, - good,
typical virginalis - 1 spec. Pecos-like

Taos Bitter Crk. T29N R15E S15 - cutts, but
spots small, 'pinhead-like' anterior - but quite uniform

Taos San Cristobal Crk. T28N R 13E S 32. - good-very good.
typical *virginalis*

Taos Rito Primero T 29N R13E S 3 - predom. with mainly cutts
but hybrid infl. a 2 speci. quite typical rainbow trout.

Rio Arriba Co. · El Rito Crk. T 27 N R 6 E S 10 good *virginalis*

Mora - E. Fk. Luna · T 23 N R 15 E S 16 - 6 cutts, 3 brown
cutts typical *virginalis*.

Taos - Middle Fk. Alamitos Crk. · T 21 N R13E S 19 - Pecos-like
virginalis

Taos - W. Fk Latir Crk - T 30 N, R13 E S15 predominant > 75% rainbow -

Rio Arriba Co. - El Rito Crk - T27N R6E S 35 dace (Rhinich.)
wh. sucker, good - typical *virginalis*.

- So. Fk. Rio Hondo - T 27 N R14E SW 1/4 17 - very good
virginalis - large, old spec - no spots ant.

Taos - 2nd # San Cristobal - T 28 N, R13E, S 31 very good *virginalis*

Mora Co. - W. Fk. Rito de Prosa · T 23 N, R19 E S 24. 4 small spec
no indicat. hybrid -

Mora - W. Fk. Luna T 23 N R15E S 21, S16 at F.S. boundary
1 brown - cutts appear typical *virginalis*

* C

4. Rito del Medio T30N R13E, S34

T205 Co. larger, Pecos-like spotting on larger specim - some w/ ventral spots
4 smaller specimen w/ rainbow-like influence - spots smaller,
profuse, ventral.

18 T205 Co. Bitter Crk. T29N R15E S29 - Predominantly virginalis
but several specimen definite rainbow influence - smaller, profuse, ventrally
* on top of head - - large, plump specimen.

T205 Co. Rito la Presa T22N R14E S17 - predominant
native, but definite rainbow influen. - spots ventral, dorsal, top head.

" T22N R14E S 4&9 4 brown, 13 cut
No indication hybrids - + 3rd bottle 50/50 brown-cutts - cutts look good.

T205 - Jarosa Canyon T23N, R13E, S25
no hybrid inflo. - 1 pughead -

Mora Co. - W. Fk. Rito la Presa - T23N R14E, S25, 23 - browns
cutt - but more even distrib. spots over body - atypical.

T205 Co. L. Fk. Crk. - T29N R14E S8 - typical Pecos-like
spots - large, sparse - but variable - some w/ spots (large) and
all over body. are ventral spots -

Mora - W. Fk. Luna Crk. - T23N R15E S8 1 brown - 9 small
1 (100mm) cutt - no indication hybrid - but not enough
spec - 100-200mm.,

T205 - Fowler Canyon T23N R13E S19 - only 2 brown.

T205 - W. Fk. Alimitos - T21N R14E S17. 4 spec. - 2 small
2 med. - no indication but sample too small.

T205 - Columbine - T28N, R13E, S25 * very good -
typical virginalis - large specimens.

T2c1 E. Fk. Alamitas T21N, R13E S24 - good, typical virginalis.

*Carson N.F. - heavy use - many campgrounds (stocking?)

T20s S. Fk. Rio Hondo T26N R13E S20 - very good - !

T20s Salaz Canyon Crk. T23N, R13E, S25. 1 brown good, typical virginalis.

trib. Red R.

T20s - Bitter Crk. T29N R15E interface between S16, S21
- as other Bitter Crk. sample - small spots, but uniform -
- but S27 - rainbow spots

- Best virginalis (phenotype)

Red R. (?) very good -
Columbine Crk. - 28N 13E

Palociento Crk. - T23N, R14E, S.

direct trib. Rio Grande - above Hondo
San Cristobal Crk. - T28N R13E S32, + S31 - very good.

2 coll. headwater trib Rio T20s

Tpendites Crk. - T24N R15E (1 pecos-like)

El Rito - T27N R6E

E. Luna T23N 15E - 8 browns - Trib. Mora - Canad.

T29N R15E - Trib. Red R.
- geotenic spots
Bitter Crk. - good - uniform - but small, pinhead-like spots anteriorly

El Rito - 27N 6E - dace, sucker.

Jarosa Canyon 23N, 13E no hybrid infl.

S. Fk. Rio Hondo, 27N 14E - very good.

W. Fk. - 4 spec. small
- headwaters Rio Pueblo / → Mora ↓ Pecos
Mid Fk. - Alamitos Crk. 21N 13E - Pecos-like

W. Fk. Luna 23N 15E S16 + S8 - no indication - Mora - Canad.

del Medio 30N 13E - Pecos-like - smaller w/ ventral variability - spots - Trib. Rio Grande N. Red R.

Trib Red R. above Cabresto L.

- Lake Fk. - 29N 14E - large spots - atypical

- trib. Rio Pueblo

4 no indication
W. Fk. Rito la Presa 23N 14E S24 -
W. Fk. - 23, 14 - atypical spots
22 14 17 - predom. native, but some hybrid
22 14 4+9 - several browns - 15 cutts - look good.

Red. R. > native > native

Rito Primero T29 R13E - 2 rainbow-like) Bitter Crk - rainbow inflo.

Most rainbow

Sawmill Crk. - T27N R15E

W. Fk. Latir Crk. 30N R13E

Jarosa Canyon
Sala Canyon

(A)

Rio Grande del Rancho
↑
Rio Pueblo

(5) Jarosa Canyon N=10

(7) Alamitos - E. Fk. - N=10
(22) Pecos-like spots W. Fk. - N=4 trib Rio Pueblo w/ Rito la Presa.
(28) Mid Fk - N=18

(13) Saloz Canyon N=7 - locality as w/ Jarosa Canyon

(17) (14+16) San Cristobal N=21 - direct Rio Grande - but high teeth -

(20) Colombine N=15 Red. R. (?) - - large excellent

(24) Palociento - locatio as w/ Jarosa - Saloz.

(25-26) S. Fk. Rio Hondo 2 sites - very good - but heavy use area.

(15) A-/B+ Trenditas Crk. 1/19 - headwater Rio Taos - some variable spotting -

(B)

(12, 18) B+ (12) Bitter Crk. *1 N=21 pinhead > small aut spots

B - (18) " " *2 N=15
*3 ?

* Bitter Crk - L. Fk. teeth trib Red R. - but very dif spots -

(4) Rito del Medio - N. of Red R. Pecos-like - - variable

(8) (6-27) (29) (W) E Fk. Luna - * Pecos

(30) - El Rito *1 *2 -

(11) L. Fk. all w/ teeth but larger, variable spots prob. non-native cutt -

B: Rito (21) la Presa - 3-4 coll. - * near Rio Alamitos -
E Fk. - (19) N=4
C (2) N=24 (C)

+ Rito Primero → Red R. all teeth but 2 very rainbow like.
(if stocking cease may upgrade - revert - strong selection for cutts

Medio

(F)

Sawmill

Latir

+ Fowler Canyon - only browns

	post.	D	A	Peak V.	D of m L.	peak depth
Latir	0-1	11.1	9.9	14.8	.257	.128
Sawmill.		10.1	9.6	14.1	.248	.128
(A) Alam.	3.3	9.1	8.9	13.1	.195	.119
Salaz		9.6	8.9	13.0	.221	.124
San Crist.	(1)	9.1	9.2	13.7	.220	.119
	(2)	9.7	8.7	14.0	.237	.118
Palucianto		9.6	9.2	13.2	.227	.120
Rio Llano	(1)	9.3	9.3	13.1	.205	.118
	(2)	9.6	9.3	13.1	.193	.123
Rimero			9.6/9.2	13.6	.241	.127

	L/B	P
Bn. - sawmill	11.5/10.5	9.7
Latir	11.5/10.7	10.1
	9.5-10/8.7-9.5	9

A. W. Fk. Rito la Presa N=15 (all 14 w/ teeth) = B

B. Rito la Presa #1 N=24 (20 of 23) = B

C. del Medio N=16 20 of 10 0.27 = B vari. spots

D Jaresa Canyon — - A

E W. Fk. Luna - — B

F E. Fk. Alamitos — A

G Latir 7

H Primero C

I El Rito #1 N=22 B

J Lake Fk. B

K Bitter #1 N=21 B+

L Salaz Canyon A

M San Cristobal #1 N=21 A

N Tienditas A-/B+

O San Cristobal #2 N=21 A

P Bitter #2 N=15 B-

Q E Fk. Rito Presa N=4 B

R.	Columbine N=15	– A
S	Rito Presa #2 N=12	B/C
T	Alamitos N=4	A
U	Sawmill	F
V	Palociento	A
W	S. Fk. Rio Hondo #1	A
X	" " #2	A
Y	W. Fk. Luna #2	B
Z	M. Fk. Alamitos	A
Ø	E Fk. Luna	B
1	El Rito #2 N=24	B

give $\bar{x}$
size
– other sp.
– notes –
– oddities.

A – pure, cutthroats ... no ...
B – phenotypically as virgin but ...
C – hybrid ... more ... but >50% ...
D – hybrid predom. >50%
F – overwhelm. hyb >75% –

Alamitos Crk. – Rito la Presa both trib. – Rio Pueblo

Bitter Crk – L. Fk. – Trib. Red R. – very dif. spots –

– 3 Bitter Crks – 2 good, 1 (S 29) hybrid – + Columbine Crk –

Rio Primero – (all Red R.) – – large hatchery –

W. Fk. Rito la Presa 22, 14, 24
23, 14, ~~17~~ atypical spots
22, 14, 4.9
– spots more evenly distrib. – atypical

W. Fk. Rito la Presa

※1 B. N = 15 ~~18~~, 14 all > 100 mm teeth 1–9 (5.0)

N = 24
C. – Rito la Presa – 22. 14, 17 – rainbow spots – ventral – head –
site 1 – ~~12~~ of 23 w/o teeth.
0–23 (5.6) –

B B ~~RN~~: N = 12 site 2 3 of 12 0–6 (2.5)
22 14 4.9 – look good

N = 16
C B Rito del Medio low scales, 2 of 10 w/o, Pecos-like – ...

N = 10
A? Jaroso Canyon – 4–17 (8.3) headwater trib. Rio Grande del Ranchos? if ↑N – if S. to Rio Pueblo ?

N = 9 ① 3 of 9 → Mira → Canada. ✗ high posterior
B W. Fk. Luna . 0–9 (2.4)
3 C
B N = 4 ② 2 of 4 – ~~3 of 5~~ 0–6 (3.8)
B E. Fk. N = 6 1 of 6 0–4 (1.4)
high scales – Pecos-ish spots –

Alz. & Fk
A? E. Fk. Alamitos N = 10 2–10 (5.7) – low branch. – 9.1, 9.5

N = 16
~~F~~ – Latir Crk.

C* – Rito Primero N = 17 – 15 good 2 rainb. all – 1–17 (7.0) – odd Yellowstone – branch. 10.7 – 11.5 10.6 – 11.1

N = 22 ①
B El Rito 10 of 22 w/o 0–6 (1.6) – but – spots typical, lower scales, – 9.7, 10.4
N = 24 ② .12 of 24 0–9 (2.5)

N = 17
B L. Fork all 6–14 (8.8) – but spots large – variable 9.6 – 10.1
pure cutt – but influence – spots

N=21 site 1 — 2 of 21 — scales 156 — neotenic

(B+) Bitter Crk. 0-9 (3.3) - small, uniform spots.

(B) Bitter site 2 — 6 of 15 — 0-5 (1.1) — pinhead-spots

N=7

(A)? Saloz Canyon — As Jarosa Cany 23-13 it N.↑ it ↓5. — 2-9 (4.1) — 5.6-9.0

N=21 — direct Rio Grande trib above

(A)? San Cristobal ① 5-21 (12.4) high scales. - but spots look excellent-

A? smaller spec. N=21 ② 4-12 (7.1) high scales-

N=19 — 1 of 19

(A-/B) Tienditas Crk. 0-8 (3.6) - some spotting unusual-

similar

N=4

(B) E. Fk. Rito la Presa ① 1 of 4 0-7 (3.5)

~~N=12 ② 0-6 (2.5)~~

scales, rakers

(A?) Columbine Crk. N=15 — low post. rakers — high scales — 7-26 (12.7) - but look very good.!

Ala.

(N=4.) N=4 w. ~~FR~~

Alamitos 3-8 (5.3) look good

(A)

N=12

(?) - Sawmill

N=22

(A) Palociento Crk. 1-11 (5.0) low post. rakers - good — A Rio Grande del Rancho ↓S Presa (Pueblo)-

N=13 ①

(A) both — S. Fk. Rio Hondo 2-15 (9.0) very good - but campground - heavy use

N=7 ② 3-15 (8.4)

N=18 — 1 of 18 — Pecos-like

(A)? - Mid Fk. Alamitos Crk. 0-13 (3.5)

E

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Red band LOCALITY CA, Sheepheaven Crk.

COLLECTED BY R. Smith DATE

Cat. # Measurements by Eric Wagner DATE

Specimen #	1	2	3					
Total L.	148	160	132					
Standard L.	125	137	110					
Body D								
Head L								
Orbit L								
Upper Jaw L	19	22	16					
Dors. Orig. to Snt. tip	66	68	58					
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	6	7	7					
(lower)	10	10	10					
(total)	16	17	17					
Branchiostegal rays right	9	9	9					
(left)	9	9	10					
Dorsal rays	9B	9B	9B					
Anal rays	10B	9B	10B					
Pectoral fin rays	13	12	13					
Scales in lateral line								
Scales above lateral line	33	36	32					
Scales 2 rows above lat.	150	185	141					
Pelvic fin rays	9	10	9					
Pyloric caeca	34	38	30					
Dentition	0	0	0					

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat Trout LOCALITY Ypsilon L., RMNP

COLLECTED BY Bruce Rosenlund DATE 1979

Cat. # ______ Measurements by Eric Wagner DATE ______

Specimen #	1	2	3	4	5	6	7	8
Total L.	283	277	289	286	295	293	251	281
Standard L.	245	237	253	249	256	256	222	243
Body D								
Head L								
Orbit L								
Upper Jaw L	32	35	32	32	39	40	33	31
Dors. Orig. to Snt. tip	127	122	130	119	132	123	112	118
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7	6	7	7	7	8	8 5	8 5
(lower)	12	13	14	13	11	13	13	13 8
(total)	19	19	21	20	18	21	21	21
Branchiostegal rays right	11	11	12	12	11	12	11	11
(left)	11	11	13	13	11	12	12	11
Dorsal rays	10B	9B	10B	9B	10B	10B	10B	10B
Anal rays	11B	9B	11B	12B	10B	11B	11B	11B
Pectoral fin rays	13	13	14	14	14	14	14	15
Scales in lateral line								
Scales above lateral line	46	44	45	51	45	47	46	51
Scales 2 rows above lat.	198	194	213	198	198	200	195	204
Pelvic fin rays	10	9	11	10	9	10	10	10
Pyloric caeca	36	40	40	48	40	36	44	36
Dentition	7	1	7	3	6	0	4	7

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

(Introd. 1959 fm. Forest Canyon)

SPECIES Cutthroat Trout LOCALITY RMP, Co Caddis Lake

COLLECTED BY Bruce Rosenlund FWS DATE 1979

Cat. # ______ Measurements by ______ DATE 9/4/79

Specimen #

	1	2	3	4	5	6		
Total L.	214	184	257	230	240	227		
Standard L.	184	159	221	197	206	191		
Body D								
Head L								
Orbit L								
Upper Jaw L	25	24	35	29	33	29		
Dors. Orig. to Snt. tip	92	78	118	99	108	97		
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	6	7	7	8	8	6		
(lower)	10	11	11	12	14	12		
(total)	16	18	18	20	22	18		
Branchiostegal rays right	10	11	10	11	10	11		
(left)	11	11	11	11	10	11		
Dorsal rays	9B	9B	10B	10B	9B	10B		
Anal rays	10B	9B	10B	10B	10B	9B		
Pectoral fin rays	13	13	13	14	14	13		
Scales in lateral line								
Scales above lateral line	44	48	45	45	46	48		
Scales 2 rows above lat.	189	198	175	190	208	205		
Pelvic fin rays	9	9	9	9	9	10		
Pyloric caeca	32	30	36	36	34	30		
Dentition					4			

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

(Introd. 1959 fm. Forest Canyon)

SPECIES Cutthroat Trout LOCALITY RMP, CO Caddis Lake

COLLECTED BY Bruce Rosenland FWS DATE 1979

Cat. # ______ Measurements by ______ DATE ______

Specimen #	7	8	9	10	11	12	13	
Total L.	207	185	250	195	239	261	235	
Standard L.	177	159	216	168	204	221	203	
Body D								
Head L								
Orbit L								
Upper Jaw L	28	24	34	22	29	40	33	
Dors. Orig. to Snt. tip	88	80	112	84	104	120	101	
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7	7	7	7	7	6	6	
(lower)	11	12	12	11	11	10	10	
(total)	18	19	19	18	18	16	16	
Branchiostegal rays right	10	10	11	11	10	10	9	
(left)	11	9	11	11	10	10	10	
Dorsal rays	9B	10B	10B	9B	9B	10B	10B	
Anal rays	9B	10B	9B	10B	9B	9B	9B	
Pectoral fin rays	14	13	14	14	14	13	13	
Scales in lateral line								
Scales above lateral line								
Scales 2 rows above lat.								
Pelvic fin rays	9	9	9	9	9	9	9	
Pyloric caeca	32	30	30	33	36	32	32	
Dentition	6	8	5	6	6	0	5	

5:50

3:35

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cuttr. LOCALITY Fraser Expt'l Forest Grand Co. Lake in Iron Ck. Drainage CO

COLLECTED BY D. Pettus & D. Marvin DATE 22 Aug 79

Cat. # ______ Measurements by EW DATE 1/23/80

Specimen #	1	2	3	4	5	6	7	8
Total L.	211	291	279	284	247	304	167	256
Standard L.	181	245	244	250	214	263	141	219
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L	35	48	49	43	40	49	25	40
Adip. fin depressed L								
Caudal peduncle D	19	27	27	26	24	28	14	25
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7 / 4	7 / 1	7 / 3	5 / 4	7 / 0	7 / 2	7 / 0	7 / 0
(lower)	13 / 6	11 / 3	11 / 7	11 / 5	13 / 2	12 / 0	14 / 1	14 / 0
(total)	20	18	18	16	20	19	21	21
Branchiostegal rays right	10	9	11	10	10	10	10	10
(left)	13	10	10	10	10	11	10	11
Dorsal rays	9B	9B	9B	9B	9B	9B	9B	9B
Anal rays	9B	9B	9B	10B	9B	10B	10B	10B
Pectoral fin rays	14	13	13	14	15	12	14	13
Scales in lateral line								
Scales above lateral line	48	49	46	42	46	52	41	46
Scales 2 rows above lat.	177	194	189	196	178	191	176	197
Pelvic fin rays	10	9	9	10	9	9	9	10
Pyloric caeca	39	35	-	43	36	34	39	33
Dentition	3	11	11	31	12	10	4	7

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat LOCALITY N FK. Little Belt Cr. (Baldy Cr) Cascade Co. Belt, Montana

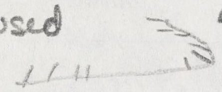
COLLECTED BY Ed Nevala DATE 18 Oct 1980

Cat. # ______ Measurements by Eric Wagner DATE 21 Jan 1981

Specimen #	1	2	3	4	5	6	7	8	9
Total L.	212	166	178	177	154	159	146	154	146
Standard L.	177	138	147	146	127	131	120	127	116
Body D									
Head L									
Orbit L									
Upper Jaw L									
Dors. Orig. to Snt. tip									
Dorsal fin basal L									
Dorsal fin depressed L									
Adip. fin depressed L									
Caudal peduncle D									
Caudal peduncle L									
Vertebrae									
1st Arch gillrakers (up)	8/1	8/2	6/2	7/1	8/1	7/3	7/1	7/1	7/2
(lower)	*9/0	11/0	*11/0	10/0	12/0	11/0	11/0	11/0	11/1
(total)	17	19	17	17	20	18	18	18	18
Branchiostegal rays right	10	11	12	11	12	10	10	10	11
(left)	10	11	12	11	11	11	10	11	11
Dorsal rays									
Anal rays	9B	9B	8B	8B	8B	7B	9B	8B	9B
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line	38	43	43	42	41	36	39	42	45
Scales 2 rows above lat.	178	177	188	188	176	173	177	166	183
Pelvic fin rays	9	9	9	9	9	10	9	9	9
Pyloric caeca	31	36	34	30	33	33	28±2	30	37
Dentition	2	0	0	0	4	0	2	5	3
						*			

1 * lower arch missing some rakers but looks smooth

3 * 2 lower rakers fused



10
132
109

6 • lateral line irregular

8/1
11/0
19

11
10

10B

38
178
9
35
0

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat LOCALITY N. Fk. of Dry Fk. (Deep Cr.) of Smith R. T15N R5E S20 MT

COLLECTED BY Wipperman, Nevala ~~Hatton~~ Peek DATE 1 Oct 1980

Cat. # ______ Measurements by Eric Wagner DATE 23 Jan 1980

Specimen #	1	2	3	4	5	6		
Total L.	173	165	177	150	152	152		
Standard L.	146	138	146	125	125	126		
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	8/1	7/0	8/0	8/0	7/0	7/1		
(lower)	12/0	12/0	11/0	12/0	12/0	10/0		
(total)	20	19	19	20	19	17		
Branchiostegal rays right	9	11	10	10	9	10		
(left)	10	11	10	10	10	11		
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	41	47	41	46	44	43		
Scales 2 rows above lat.	175	193	194	190	174	195		
Pelvic fin rays	9	9	9	9	8	9		
Pyloric caeca	28	29	28	32	26	26		
Dentition	7	1	7	5	11	7		

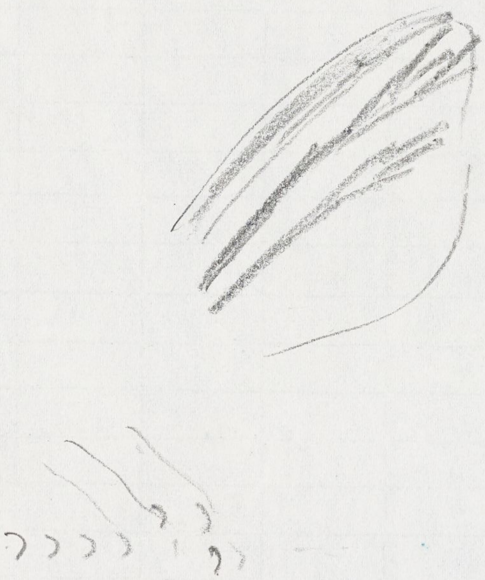
CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat LOCALITY N. FK. of Dry FK (Deep Cr.) of Smith River T 15N, R 5E, S20

COLLECTED BY Wipperman, Nevala, Holton, Peek DATE

Cat. # Measurements by Er DATE

Specimen #	1	2	3	4	5			
Total L.	196	173	134	152	175			
Standard L.	164	146	129	127	146			
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/1	8/1	7/0	8/1	8/1			
(lower)	10/0	13/0	11/0	11/2	12/0			
(total)	17	21	18	19	20			
Branchiostegal rays right	9	9	9	10	10			
(left)	10	11	11	11	10			
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	40	49	44	46				
Scales 2 rows above lat.	169	186	211	154				
Pelvic fin rays	9	9	9	9				
Pyloric caeca	29	32	38	29				
Dentition	11	9	7	6				



CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat LOCALITY Hall Creek, Montana

COLLECTED BY Hadley DATE 23 Sept 1980

Cat. # Measurements by Eric Wagner DATE 22 Jan 1981

Specimen #	1	2	3	4	5	6	7	
Total L.	171	197	124	124	102	102	92	
Standard L.	145	166	102	102	84	83	76	
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/0	7/1	7/1	6/	6/0	7/0	7/0	
(lower)	12/1	11/0	12/0	13/	11/0	12/0	12/0	
(total)	19	18	19	19	17	19	19	
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	42	44	45	44	42	45	38	
Scales 2 rows above lat.	180	187	178	197	184	182	179	
Pelvic fin rays	9	9	9	9	9	9	9	
Pyloric caeca	37	32	27	31	27	29	27	
Dentition	4	3	3	4	2	1	3	
			*	*				

3. caudal fin clipped or broken

4. dorsal fin clipped

~~Eagle~~ Locality ~~E.K.R.~~ Drainage (cont.)	Gillrakers	Scales above lat. line and Lat. Series	Basibranchial teeth	Pyloric Caeca	Pelvic Rays
HAT CRK N=10 T6S R83W	16-22 (19.3)	42-52 (48.8) 171-206 (191.8)	2-16 (9.4)	29-46 (36.9)	9-9 (9)
Colorado River Drainage					
Routt Co. Deadman Gulch N=10 T1N R83W S5	18-22 (19.8)	38-51 (44.6) 172-198 (184.8)	0-12 (2.6)	33-52 (41.0)	9-10 (9.3)
Eagle Co. E. Fork Red Dirt Crk N=10 T2S R86W S28	17-20 (18.8)	40-52 (47.3) 159-203 (189.8)	0-7 (1.8)	26-46 (38.2)	8-10 (9.1)
W. Fork Red Dirt Crk N=10 T2S R86W S34	17-22 (19.5)	46-51 (47.8) 171-219 (190.5)	0-16 (4.0)		9-10 (9.1)
E. Meadow Crk N=10 T4S R81W S11	19-22 (19.6)	48-59 (54.6) 198-223 (207.8)	4-12 (7.3)	27-39 (35.6)	9-9 (9)
Garfield Co. Possum Crk N=10 T5S R89W S20	15-21 (19.0)	35-45 (42.1) 166-200 (186.7)	0-16 (5.2)	32-66 (43.2)	9-10 (9.7)
Mitchell Crk N=10 above Glenwood Hatchery T5S R89W S27	16-20 (18.4)	44-50 (48.1) 179-205 (194.0)	5-15 (8.1)	32-38 (34.8)	9-9 (9)
Hack Lake N=10 T3S R87W S3	18-21 (19.4)	42-56 (47.0) 167-190 (181.8)	2-18 (9.8)	28-42 (33.8)	6-9 (8.4)
Roaring Fork Drainage					
Frying Pan Lakes #2+3 N=13	18-21 (19.3)	41-51 (45.6) 184-214 (195.5)	3-14 (9.3)	36-48 (41.4)	9-9 (9)
Lost Trail Crk N=6 T11S R87W S19	18-21 (19.2)	44-50 (48) 174-198 (191.5)	0-11 (3.7)	27-43 (33.2)	9-9 (9)
Nickelson Crk N=8 T9S R87W S36	18-21 (19.1)	40-52 (45.9) 173-212 (192.1)	2-10 (6.13)	26-42 (33.4)	8-9 (8.9)

S.W. 1-5 (3.1)

Fawn
little sk. R.
skray R.
Mandall Cr.

Fryingpan lake
coordinates

<40
>180
^ 90% Bb. teeth

1980 Pleuriticus collection

Locality	Gillrakers	scales above lat. line and lat. series	Basibranchial teeth	Pyloric caeca	Pelvic rays
Elk R. Drainage					
~~T10N R84W S24~~					
Lost Dog Crk N=10	18-21 (19.1)	35-42 (39.0) 135-193 (160.7)	0-3 (1.5)	32-35 (41.3)	9-10 (9.3)
T10N R84W S24					
Porcupine Lake N=10	18-21 (19.6)	40-46 (43.7) 155-186 (174.3)	1-23 (7.8)	37-44 (39.8)	9-10 (9.2)
T8N R83W S33					
Luna Lake N=11	18-22 (20.0)	43-50 (46.3) 171-208 (190.0)	0-7 (3.91)	36-44 (40.9)	9-9 (9)
T8N R83W S28					
Lake Diana N=11	16-21 (18.9)	39-47 (42.6) 166-199 (182.6)	* 10-25 (15.1)	35-55 (45.8)	9-10 (9.4)
T10N R83W S4					
Lake of the Crags N=10	18-22 (19.6)	39-46 (42.3) 169-200 (183.9)	3-43 (15.4)	38-46 (41.5)	8-10 (8.9)
T8N R83W S21					
Eagle R. Drainage					
Indian Creek N=15	18-21 (19.6)	39-47 (43.5) 176-206 (192.8)	0-6 (1.9)	33-46 (39.4)	8-10 (8.9)
T4S R81W S23					
Pitkin Crk. N=10	19-21 (20.0)	42-54 (47.9) 165-201	3-19 (10.1)	33-48 (40.4)	9-10 (9.2)
T5S R80W S1					
Carter Lake N=15	—	—	0-4 (2.0)	—	—
T8S R82W S10					
Nolan Crk. N=5	16-20 (17.6)	45-49 (47.0) 194-205 (198.0)	0-6 (3.4)	32-41 (34.6)	9-9 (9)
T6S R83W S25					
Abrams Crk. N=9	16-19 (17.3)	44-56 (49.8) 180-211 (198.2)	2-7 (4.1)	37-57 (45.2)	9-9 (9)
T15S R84W S19					
Miller Creek N=10	18-21 (19.1)	42-54 (48.9) 182-215 (198.9)	2-14 (9.1)	26-42 (37.0)	8-9 (8.9)
T5S R79W S20					
Polk Crk N=11	17-21 (18.9)	39-48 (43.7) 159-186 (172.8)	0-7 (3)	26-48 (38.1)	9-10 (9.1)
T5S R79W S28					

①

Table 1. Character analysis of 1980 collections of Colorado River cutthroat trout (*Salmo clarki pleuriticus*) from the Upper Colorado River Drainage in Colorado.

Locality	Gillrakers	Scales above lat. line and lat. series	Basibranchial teeth	Pyloric caeca	~~Quality~~ Purity Grade	Comments
Yampa Drainage						
Lost Dog Creek N=10 T10N R84W S24	18-21 (19.1)	35-42 (39.0) 135-193 (160.7)	4 w/o teeth 6 with 2-3 (2.5)	32-55 ~~35-42~~ (41.3)	C	Hybrid characteristics
Porcupine Lake N=10 T8N R83W S33	18-21 (19.6)	40-46 (43.7) 155-186 (174.3)	1-23 (7.8)	37-44 (39.8)	B	Probable mixture Yellowstone and Trappers L. stocks.
Luna Lake N=11 T8N R83W S28	18-22 (20.0)	43-50 (46.3) 171-208 (190.0)	1 w/o teeth 10 with 1-7 (4.3)	36-44 (40.9)	B+	Spotting variable, spots large.
Lake Diana N=11 T10N R83W S4	16-21 (18.9)	39-47 (42.6) 166-199 (182.6)	10-25 (15.1)	35-55 (45.8)	B	Definite yellowstone ~~stock~~ influence. Perhaps stocking from Haypress L. origin.
Lake of the Crags N=10 T8N R83W S21	18-22 (19.6)	39-46 (42.3) 169-200 (183.9)	3-43 (15.4)	38-46 (41.5)	B-	Spotting erratic, indicates diverse parentage, probably Yellowstone and Trappers Lake stocks mixed.
Mandall Creek ① N=14 T11N R87W S13	18-20 (19.1)	41-53 (46.3) 161-198 (178.8)	1-10 (4.4)	29-48 39.1	B+	Spotting variability indicates hybrid influence
White River Drainage						
Fawn Creek N=12 T1N R90W S7	19-22 (20.4)	45-52 (47.3) 178-202 (189.4)	1 w/o teeth 11 with 1-8 (3.4)	30-46 (37.4)	A-	Relatively uniform, typical ~~Good spotting~~ pleuriticus spotting
Lost Creek N=9 T1N R90W S15	18-21 (19.3)	41-52 (47.8) 132-200 (178.4)	3 w/o teeth 6 with 2-11 (5.7)	32-62 (40.6)	C	Hybrid spotting
~~Skinnyfish Lake N=12~~ ~~T?S R87W~~ omit	~~16-21 (18.9)~~	~~25-48 (37.?)~~ ~~137-205 (167.0)~~	~~6 w/o teeth~~ ~~6 with 4-12 (7.8)~~		~~D~~	~~hybrid spotting~~ omit

footnote ① The label describes the creek as being in Garfield Co., but date and township indicate it as being in Routt Co. and tributary to the Yampa River.

2

Locality	Gillrakers	Scales above Lat. line and Lat. Series	Basibranchial teeth	Pyloric caeca	~~Quality~~ Purity Grade	Comments
Little Skinnyfish Lake N=10 T1N R87W S19	18-21 (19.1)	40-50 (43.6) 175-199 (187.1)	3 w/o teeth 7 with 1-11 (4.1)	30-44 (36.6)	B	Predominantly pleuriticus, large spots, some slight non-native influence.
Hahn Creek N=14 T2N R90W S34	18-22 (19.2)	42-49 (46.7) 173-204 (186.7)	1 w/o teeth 13 with 1-6 (3.5)	32-44 (37.1)	A⁻	Relatively uniform, typical pleuriticus spotting.
Colorado River Drainage Trib. to Eagle River Indian Creek N=15 T4S R81W S23	18-21 (19.6)	39-47 (43.5) 176-206 (192.8)	5 w/o teeth 10 with 1-6 (2.8)	33-46 (39.4)	B+	Basibranchial teeth indicate hybridiz. influence, but spotting is uniform. Spots relatively large.
Pitkin Creek N=10 T5S R80W S1	19-21 (20.0)	42-54 (47.9) 165-201 (181.4)	3-19 (10.1)	33-48 (40.4)	B	Considerable variation in spotting.
Carter Lake N=15 T8S R82W S10	—	—	3 w/o teeth 12 with 1-4 (2.5)	—	C	Obvious rainbow Hybrid spotting
Nolan Creek N=5 T6S R83W S25	16-20 (17.6)	45-49 (47.0) 194-205 (198.0)	1 w/o teeth 4 with 2-6 (4.2)	32-41 (34.6)	A(?)	Meristic characters ideal pleuriticus but spotting lacks uniformity.
Abrams Creek N=9 T15S R84W S19	16-19 (17.3)	44-56 (49.8) 180-211 (198.2)	2-7 (4.1)	37-57 (45.2)	A⁻	Uniform, typical pleuriticus spotting pattern.
Miller Creek N=10 T5S R79W S20	18-21 (19.1)	42-54 (48.9) 182-215 (198.9)	2-14 (9.1)	26-42 (37.0)	A(?)	Spots more evenly distributed over body, similar to Trappers Lake stock.
Polk Creek N=11 T5S R79W S28	17-21 (18.9)	39-48 (43.7) 159-186 (172.8)	1 w/o teeth 10 with 1-7 (3.3)	26-48 (38.1)	B+	Hybrid influence in spotting pattern
HAT Creek N=10 T6S R83W	16-22 (19.3)	42-~~5~~52 (48.8) 171-206 (191.8)	2-16 (9.4)	29-46 (36.9)	A(?)	Spotting variation. Some specimens typical pleuriticus; some typical of stomias.

3

Locality	Gillrakers	Scales above Lat. series	Basibranchial teeth	Pyloric Caeca	~~Quality~~ Purity Grade	Comments
Trib. to Roaring Fork Frying Pan Lakes #2+3 N=13 elev. 11,000 ft	18-21 (19.3)	41-51 (45.6) 184-214 (195.5)	3-14 (9.3)	36-48 (41.4)	A−	Relatively large, but somewhat uniform spotting. May be natural variability.
Lost Trail Creek N=6 T 11S R 87W S 19	18-21 (19.2)	44-50 (48) 174-198 (191.5)	1 w/o teeth 5 with 1-11 (4.4)	27-43 (33.2)	A−	Some inconsistancy in spotting.
Nickelson Creek N=8 T 9S R 87 W S36	18-21 (19.1)	40-52 (45.9) 173-212 (192.1)	2-10 (6.13)	26-42 (33.4)	A−	Meristic characters typical pleuriticus but considerable variation in spotting.
Trib. to Colorado River Deadman Gulch N=10 T 1N R83W S5	18-22 (19.8)	38-51 (44.6) 172-198 (184.8)	2 w/o teeth 8 with 1-12 (3.2)	33-52 (41.0)	B+	some ~~pl~~ rainbow hybrid influence, but generally ~~un~~iform pleuriticus spotting
East Fork Red Dirt Creek N=10 T 2S R86W S28	17-20 (18.8)	40-52 (47.3) 159-203 (189.8)	5 w/o teeth 5 with 1-7 (3.6)	26-46 (38.2)	B−	~~characters indicate rainbow hybrid influence, but~~ Spotting is definitely cutthroat with some large spots and pleuriticus spotting.
West Fork Red Dirt Creek N=10 T 2S R86W S34	17-22 (19.5)	46-51 (47.8) 171-219 (190.5)	3 w/o teeth 7 with 1-16 (5.7)	33-52 (42.4)	B−	Some rainbow hybridi~~zation~~ influence in teeth and ceaca, but 7 specimens with typical pleuriticus spotting.
East Meadow Creek N=10 T4S R81W S11	19-22 (19.6)	48-59 (54.6) 198-223 (207.8)	4-12 (7.3)	27-39 (35.6)	A+	Uniform, typical pleuriticus spotting.

4

Locality	Gillrakers	Scales above Lateral ser.	Basibranchial teeth	Pyloric caeca	~~Quality~~ Purity Grade	
Possum Creek N=10 T5S R89W S20	15-21(19.0)	35-45(42.1) 166-200(186.7)	1 w/o teeth 9 with 2-16 (5.8)	32-66 (43.2)	C	Obvious rainbow hybrid spotting
Mitchell Creek N=10 between barrier falls above Glenwood Hatchery T5S R89W S27	16-20(18.4)	44-50(48.1) 179-205(194.0)	5-15(8.1)	32-38(34.8)	A+	Typical pleuriticus spotting
Hack Lake N=10 T3S R87W S3	18-21(19.4)	42-56 (47.0) 167-190 (181.8)	2-18(9.8)	28-42(33.8)	A(?) +	Large, sparse spotting; lower anterior spotting
Trib to Blue River Corral Creek N=11 T6S R79W S15	17-20(19.3)	40-49(45.3) 172-214(188.3)	3-12(6.9)	36-51 (43.3)	~~B+~~ A-	Although caeca count somewhat high, spotting pattern is uniform and typical of pleuriticus

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY E. Meadow Creek

COLLECTED BY ____________ DATE ____________

Cat. # ____________ Measurements by S. CULVER B. ANDERSON DATE 13 Nov 1980

Specimen #

	1	2	3	4	5	6	7	8
Total L.	138	141	112	108	110	108	113	173
Standard L.	115	122	93	91	91	92	94	144
Body D	27	27	22	20	23	21	21	37
Head L	28	29	23	22	23	22	21	37
Orbit L	7	6	6	5	5	6	6	9
Upper Jaw L	15	15	8	7	12	7	12	21
Dors. Orig. to Snt. tip	57	60	47	43	45	47	47	74
Dorsal fin basal L	15	16	12	12	12	13	12	18
Dorsal fin depressed L	24	25	20	19	17	18	19	29
Adip. fin depressed L	9	11	8	6	7	7	9	12
Caudal peduncle D	12	12	10	9	10	10	10	16
Caudal peduncle L	20	19	16	17	15	15	17	24
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	46	38	37	44	40	42	35	44
Scales 2 rows above lat.	204	201	180	192	183	187	165	203
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES SALMO CLARKI LOCALITY E. MEADOW CREEK

COLLECTED BY DATE

Cat. # Measurements by S. CULVER B. ANDERSON DATE 13 NOV 1980

Specimen #	9	10						
Total L.	200	209						
Standard L.	166	174						
Body D	45	44						
Head L	46	48						
Orbit L	10	11						
Upper Jaw L	27	28						
Dors. Orig. to Snt. tip	86	92						
Dorsal fin basal L	25	21						
Dorsal fin depressed L	36	35						
Adip. fin depressed L	19	17						
Caudal peduncle D	19	19						
Caudal peduncle L	29	28						
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	43	~40 (scales missing below dorsal fin)						
Scales 2 rows above lat.	205	207						
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY Miller Creek Eagle Co. T5S R79W S20

COLLECTED BY Bohamon + Boydstun DATE 8/15/80

Cat. # ______ Measurements by Anderson + Culver DATE 11/18/80

Specimen #

	1	2	3	4	5	6	7	8
Total L.	182	180	151	163	157	187	149	129
Standard L.	152	148	124	132	130	155	120	117
Body D	37	42	32	31	30	38	131	23
Head L	40	43	34	37	37	45	34	26
Orbit L	9	9	8	9	9	10	9	7
Upper Jaw L	22	26	19	21	22	28	20	14
Dors. Orig. to Snt. tip	78	81	67	67	67	83	65	53
Dorsal fin basal L	23	19	17	17	19	18	18	15
Dorsal fin depressed L	34	32	31	31	30	33	29	26
Adip. fin depressed L	16	17	13	14	15	15	12	11
Caudal peduncle D	16	19	14	15	14	17	14	12
Caudal peduncle L	27	25	22	24	20	25	20	17
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	42	~40 missing	40	38	36	38	43	40
Scales 2 rows above lat.	187	177	189	168	165	166	170	190
Pelvic fin rays								
Pyloric caeca								
Dentition								

DEADMAN GULCH 8/9/80 11/24/80

ROUTT Co T1N, R83W, SEC. 5

BOHANON-BOYDSTUN

1	2	3	4	5	6	7	8	9	10
123	138	133	143	150	110	134	149	116	149
101	116	112	120	124	93	113	124	96	122
25	26	28	32	28	20	28	30	24	31
27	DEF. 28	30	33	34	23	28	30 DEF	26	36
6	7	6	7	8	6	7	8	8	7
15	15	17	17	19	12	16	17	14	20
52	59	57	64	67	47	60	64	50	67
13	16	15	17	17	12	15	17	13	15
23	24	21	24	24	18	21	26	20	26
11	10	9	11	13	9	10	10	7	12
12	12	12	15	14	10	12	13	10	13
16	19	19	21	21	16	18	21	16	19
44	45	42	45	43	38	40	40	44	42
191	198	179	176	194	175	181	177	186	174

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

2-42

SPECIES Salmo clarki LOCALITY Miller Creek Eagle Co. T5S R79W Sec. 20

COLLECTED BY Bohamon + Boydstun DATE 8/19/80

Cat. # ______ Measurements by Anderson + Culver DATE 11/18/80

Specimen #

	9	10						
Total L.	158	157						
Standard L.	130	131						
Body D	31	35						
Head L	35	37						
Orbit L	9	9						
Upper Jaw L	20	21						
Dors. Orig. to Snt. tip	66	68						
Dorsal fin basal L	16	17						
Dorsal fin depressed L	27	32						
Adip. fin depressed L	12	15						
Caudal peduncle D	15	15						
Caudal peduncle L	24	22						
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	43	43						
Scales 2 rows above lat.	192	187						
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo Clarki LOCALITY GARFIELD Co T1N, R87W, SEC. 19 Little Skinnyfish Lake

COLLECTED BY ______ DATE ______

Cat. # ______ Measurements by Culver + Anderson DATE ______

Specimen #	1	2	3	4	5	6	7	8
Total L.	227	202	195	200	197	217	265	200
Standard L.	192	171	165	170	166	190	225	171
Body D	47	41	41	41	36	47	57	39
Head L	43	40	39	41	36	45	56	39
Orbit L	10	9	9	8	8	10	11	9
Upper Jaw L	20	23	21	22	20	25	30	21
Dors. Orig. to Snt. tip	92	86	76	87	83	95	116	84
Dorsal fin basal L	25	27	22	22	18	23	30	23
Dorsal fin depressed L	36	30	31	29	28	35	43	34
Adip. fin depressed L	17	13	16	14	9	16	22	13
Caudal peduncle D	19	18	18	18	17	20	25	17
Caudal peduncle L	39	30	30	28	28	31	38	27
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	39	40	41	39	41	43	41	40
Scales 2 rows above lat.	175	185	192	181	183	183	189	186
Pelvic fin rays								
Pyloric caeca								
Dentition								

ABRAMS CR. 8/24/80 11/25/80

EAGLE CO T5S, R84W, SEC 19

BOHANON - O'MEARA

1	2	3	4	5	6	7	8	9	10
160	123	115	115	116	150	147	105	168	211
132	102	96	96	97	126	122	87	140	178
38	26	25	23	23	34	33	21	39	49
34	26	25	23	23	32	33	22	39	49
9	6	6	6	7	8	8	6	9	11
19	14	13	12	14	18	18	12	21	32
67	51	47	45	48	65	62	41	72	93
20	14	13	14	13	18	17	13	19	26
30	23	21	21	22	27	28	20	31	42
11	9	9	8	9	10	11	7	12	16
16	12	11	10	11	14	14	9	17	21
22	17	16	15	16	20	20	13	25	29
46	44	42	44	38	46	44	41	46	43
187	185	188	199	174	203	180	177	206	181

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY LITTLE SKINNYFISH LAKE
GARFIELD CO. T1N, R87W, SEC. 19

COLLECTED BY DATE

Cat. # Measurements by CULVER + ANDERSON DATE 17 NOV. 1980

Specimen #

	9	10						
Total L.	230	224						
Standard L.	196	192						
Body D	48	47						
Head L	48	47						
Orbit L	9	9						
Upper Jaw L	27	26						
Dors. Orig. to Snt. tip	11	100						
Dorsal fin basal L	20	25						
Dorsal fin depressed L	34	38						
Adip. fin depressed L	18	17						
Caudal peduncle D	21	22						
Caudal peduncle L	32	34						
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	40	39						
Scales 2 rows above lat.	192	180						
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo Clarki LOCALITY Abrams Cr. Eagle Co. T5S, R84W, sec 19

COLLECTED BY Bohanon O'meara DATE 8/24/80

Cat. # ______ Measurements by ______ DATE ______

Specimen #	1	2	3	4	5	6	7	8	9	10
Total L.	160	123	115	115	116	150	147	105	168	211
Standard L.	132	102	96	96	97	126	122	87	140	178
Body D	39	26	25	23	23	34	33	21	39	49
Head L	34	26	25	23	23	32	33	22	39	49
Orbit L	9	6	6	6	7	8	8	6	9	11
Upper Jaw L	19	14	13	12	14	18	18	12	21	32
Dors. Orig. to Snt. tip	67	51	47	45	48	65	62	41	72	93
Dorsal fin basal L	20	14	13	14	13	19	17	13	19	26
Dorsal fin depressed L	30	23	21	21	22	27	28	20	31	42
Adip. fin depressed L	11	9	9	8	9	10	11	7	12	16
Caudal peduncle D	16	12	11	10	11	14	14	9	17	21
Caudal peduncle L	22	17	16	15	16	20	20	13	25	29
Vertebrae										
1st Arch gillrakers (up)										
(lower)										
(total)										
Branchiostegal rays right										
(left)										
Dorsal rays										
Anal rays										
Pectoral fin rays										
Scales in lateral line										
Scales above lateral line	46	44	42	44	38	46	44	41	46	43
Scales 2 rows above lat.	187	185	188	199	174	203	180	177	206	181
Pelvic fin rays										
Pyloric caeca										
Dentition										

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES SALMO CLARKI LOCALITY E. RED DIRT CRK. T2S, R86W, S28 EAGLE Co.

COLLECTED BY BOHANON - O'MEARA DATE 8/25/80

Cat. # Measurements by CULVER + ANDERSON DATE 11/19/80

Specimen #

	1	2	3	4	5	6	7	8	9	10
Total L.	136	144	130	167	122	171	134	173	178	199
Standard L.	113	123	109	140	102	145	113	145	147	163
Body D	29	36	32	37	23	42	30	38	43	45
Head L	32	33	30	37	25	40	31	38	42	43
Orbit L	8	8	8	8	6	8	8	8	9	9
Upper Jaw L	16	18	16	20	14	23	14	20	23	24
Dors. Orig. to Snt. tip	57	66	55	71	51	75	55	70	75	90
Dorsal fin basal L	20	17	17	21	14	20	17	23	23	22
Dorsal fin depressed L	31	27	27	32	21	33	26	36	36	35
Adip. fin depressed L	11	12	12	13	9	14	8	13	13	15
Caudal peduncle D	13	15	14	15	10	17	14	16	18	19
Caudal peduncle L	18	21	19	23	18	24	21	25	25	27
Vertebrae										
1st Arch gillrakers (up)										
(lower)										
(total)										
Branchiostegal rays right										
(left)										
Dorsal rays										
Anal rays										
Pectoral fin rays										
Scales in lateral line										
Scales above lateral line	39	39	41	42	39	40	38	40	42	43
Scales 2 rows above lat.	160	171	168	185	182	184	155	180	178	183
Pelvic fin rays										
Pyloric caeca										
Dentition										

LOST CREEK T1N, R90W, SEC 15 RIO BLANCO CO.

COLL: BOYDSTUN 8-12-80

11-20-80

	1	2	3	4	5	6	7	8	RBT 9
1	190	132	138	142	177	115	178	167	226
2	158	118	115	122	150	94	151	140	189
3	40	27	25	26	35	23	39	34	55
4	42	29	28	28	36	24	39	35	50
5	9	7	6	7	8	6	8	8	11
6	23	16	15	16	19	13	22	19	26
7	78	54	56	55	72	46	74	69	94
8	21	15	14	16	20	13	20	18	27
9	35	25	24	27	31	22	30	29	42
10	14	11	8	8	13	8	12	12	16
11	17	13	12	13	16	11	17	16	27
12	26	19	18	22	25	17	23	23	34
SCALE S	45	44	45	46	45	40	45	46	35
	185	168	179	176	184	156	184	174	122

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY Lost Creek Rio Blanco Co T1N, R90N, Sect. 15

COLLECTED BY Boyd Stun DATE 8/12/80

Cat. # ____ Measurements by Culver-Anderson DATE 11/20/80

Specimen #

	1	2	3	4	5	6	7	8	9
Total L.	190	132	138	142	177	115	178	167	226
Standard L.	158	118	115	122	150	94	151	140	189
Body D	40	27	25	26	35	23	39	34	55
Head L	42	29	28	28	36	24	39	35	50
Orbit L	9	7	6	7	8	6	8	8	11
Upper Jaw L	23	16	15	16	19	13	22	19	26
Dors. Orig. to Snt. tip	78	54	56	55	72	46	74	69	94
Dorsal fin basal L	21	15	14	16	20	13	20	18	27
Dorsal fin depressed L	35	25	24	27	31	22	30	29	42
Adip. fin depressed L	14	11	8	8	13	8	12	12	16
Caudal peduncle D	17	13	12	13	16	11	17	16	27
Caudal peduncle L	26	19	18	22	25	17	23	23	34
Vertebrae									
1st Arch gillrakers (up)									
(lower)									
(total)									
Branchiostegal rays right									
(left)									
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line	45	44	45	46	45	40	45	46	35
Scales 2 rows above lat.	185	168	179	176	184	156	184	174	122
Pelvic fin rays									
Pyloric caeca									
Dentition									

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY Nickelson Creek Pitkin CO. T9S R87W S36

COLLECTED BY Bohanon Boydston DATE 7/10/80

Cat. # ________ Measurements by Culver Anderson DATE 12/2/80

Specimen #

	1	2	3	4	5	6	7	8
Total L.	250	235	229	224	275	232	292	183
Standard L.	214	200	196	193	235	195	252	155
Body D	54	50	47	45	56	46	62	40
Head L	54	51	47	48	62	47	61	38 Def
Orbit L	11	10	10	10	11	10	11	8
Upper Jaw L	31	27	25	21	33	28	31	24
Dors. Orig. to Snt. tip	114	105	100	98	118	96	123	78
Dorsal fin basal L	27	25	25	27	32	27	34	19
Dorsal fin depressed L	43	41	36	38	58	40	52	31
Adip. fin depressed L	17	13	14	13	21	15	22	13
Caudal peduncle D	23	21	21	20	26	21	27	17
Caudal peduncle L	37	33	32	31	40	33	43	29
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	43	46	46	42	41	44	44	42
Scales 2 rows above lat.	192	208	190	188	176	181	187	182
Pelvic fin rays								
Pyloric caeca								
Dentition								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat (Stomias Hybrid) LOCALITY Pikes Peak Res #5

COLLECTED BY ______ DATE 6-27-80

Cat. # ______ Measurements by Anderson + Culver DATE 11-12-80

Specimen #	1	2	3	4	5 DEFORMED GILL COVER	6 DEFORMED	7	8
Total L.	258	226	241	258	251	275	263	255
Standard L.	212	205	202	210	210	235	220	210
Body D	55	48	51	52	48	54	41	50
Head L	55	56	55	59	58	79	57	55
Orbit L	10	10	10	11	14	15	10	10
Upper Jaw L	32	29	31	33	31	44	30	31
Dors. Orig. to Snt. tip	109	109	100	115	111	138	105	110
Dorsal fin basal L	30	24	27	33	28	36	30	28
Dorsal fin depressed L	44	42	42	49	44	60	143	43
Adip. fin depressed L	18	15	14	18	19	23	16	18
Caudal peduncle D	25	24	24	26	22	23	22	24
Caudal peduncle L	33	33	29	33	33	22	39	33
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	42	39	44	43	41	39	40	42
Scales 2 rows above lat.	195	189	186	179	182	188	188	183
Pelvic fin rays								
Pyloric caeca								
Dentition								

SPECIES Cutthroat LOCALITY Pikes Peak Res. #5

COLLECTED BY ______________ DATE 6-27-80

Cat. # ________ Measurements by Anderson + Culver DATE 11-12-80

Specimen #

	9	10	11					
Total L.	245	257	225					
Standard L.	205	218	185					
Body D	46	48	42					
Head L	53	56	50					
Orbit L	10	11	10					
Upper Jaw L	30	31	27					
Dors. Orig. to Snt. tip	97	109	93					
Dorsal fin basal L	31	27	25					
Dorsal fin depressed L	44	39	38					
Adip. fin depressed L	20	17	16					
Caudal peduncle D	23	22	20					
Caudal peduncle L	38	36	30					
Vertebrae								
1st Arch gillrakers (up)								
(lower)								
(total)								
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	40	43	39					
Scales 2 rows above lat.	192	200	187					
Pelvic fin rays								
Pyloric caeca								
Dentition								

TAXONOMIC ANALYSIS OF CUTTHROAT TROUT FROM ROCKY MOUNTAIN NATIONAL PARK

prepared for the U.S. Fish and Wildlife
Service, Lakewood, Colorado

by Eric J. Wagner

December 1982

INTRODUCTION

Due to habitat degradation and hybridization with non-native trout, Colorado's native cutthroat trout now occupy only a small fraction of their former range. The greenback cutthroat trout, Salmo clarki stomias, native to the Arkansas and South Platte River drainages, and the Colorado River cutthroat, native to the Colorado River drainage, are presently being managed. Efforts by a wide variety of government and private organizations have initiated the recovery of the native cutthroat, with the ultimate goal of establishing several stable cutthroat trout populations within their former range.

Wernsman(1973) and Behnke(1973) describe the status of cutthroat trout. These were updated later by Behnke(1976,1979), Behnke and Zarn(1976), Wagner and Chapal(1982), and the Greenback Cutthroat Trout Recovery Team(1982).

The purpose of this study is to determine the purity and taxonomy of cutthroat trout sampled from Rocky Mountain National Park (RMNP), Colorado. Bruce Rosenlund, of the U.S. Fish and Wildlife Service, collected cutthroat trout from Paradise Creek, downstream from Adams Lake (R74W,T3N,S31 Grand Co., CO) and from Boundary Lake (R74W,T2N,S5 Grand Co.) at the head of Paradise Creek. From the South Platte River drainage he sampled at four different points along the Big Thompson River in Forest Canyon. Specimens were taken from Rasberry Park (R74W,T5N,s28 Larimer Co., CO), 500 feet below the Gorge Creek-Big Thompson River junction, at the Gorge Creek junction, and at 10,500 feet.

METHODS

Cutthroat trout were recieved preserved with formalin, wrapped with successive layers of plastic bags and aluminum foil. Meristic and morphological measurements were made according to the procedures described by Hubbs and Lagler(1958). Basibranchial teeth and gillrakers were stained with Alizarin to facilitate counting. Scale counts were made by counting the number of scales in the lateral series two rows above the lateral line. Pyloric caeca were counted by pulling each complete tip loose from the intestine. Where applicable, all counts and measurements were made on the left side of the fish.

RESULTS AND DISCUSSION

Table 1 presents the statistical summary of the cutthroat trout taxonomic analysis for each of the sampled populations. All of the cutthroat trout (9) from Paradise Creek, tributary to Grand Lake, display the typical spotting pattern of *Salmo clarki pleuritucus* and spotting is uniform between specimens. The high lateral scale counts ($\bar{x}$=200.6) and low pyloric caeca counts ($\bar{x}$=39.4) are typical of *Salmo clarki pleuriticus* (Behnke 1979). Basibranchial teeth are present in each fish, also indicating a pure population.

The *pleuriticus* of Paradise Creek are probably decendents of Trapper's Lake stock. The relatively high number of basibranchial teeth ($\bar{x}$=9.8) is typical of Trapper's Lake cutthroat,

Table 1. Statistical summary of taxonomic characters from cutthroat trout sampled from Rocky Mountain National Park.

Locality	Standard Length(mm) Range / $\bar{x}$	Total Gillrakers Range / $\bar{x}$	Lateral Scales Range / $\bar{x}$	Pyloric Caeca Range / $\bar{x}$	Basibranchial Teeth Range / $\bar{x}$
Colo. R. drainage					
Paradise Creek N=9	147-218 172.6	17-20 19.0	182-212 200.6	31-47 39.4	4-20 9.8
Boundary Lake N=4	163-254 186.2	19-22 20.5	176-203 183.8	32-51 39.2	7-14 11.0
South Platte R. drainage					
Big Thompson River					
at Rasberry Park	101-210 161.4	17-22 19.9	178-209 192.9	29-45 31.8	0-15 7.1
500 ft below Gorge Cr junction	165-180 170.3	19-21 20.2	180-211 192.8	31-47 37.0	0-15 7.0
at Gorge Cr. jct.	116-172 150.4	17-22 19.4	183-208 194.0	28-52 38.1	0-14 8.1
at 10,500 feet	100-203 152.9	17-20 18.4	181-205 192.6	29-43 32.0	2-12 7.1

although the total gillraker count ($\bar{x}$=19.0) is slightly lower than that reported for Trapper's Lake (Wernsman 1973). The higher number and greater development of the posterior gillrakers on the first arch is also indicative of Trappers Lake origin (Behnke pers. comm.). Based on the taxonomic characters, it appears that the trout of Paradise Creek are decendents of Trapper's Lake-endemic native crosses. Thus being of pure lineage (Behnke 1979), the <u>pleuriticus</u> of Paradise Creek are pure and should be managed as an"A" population as described by the alphabetic grading system developed by Binns (1977).

At the headwaters of Paradise Creek lies Boundary Lake. Once again, the higher number of gillrakers ($\bar{x}$=20.5) and basibranchial teeth ($\bar{x}$=11.0) indicate Trapper's Lake genotypes. Although one specimen had 51 pyloric caeca, the spotting and meristic characters all indicate pure <u>pleuriticus</u> and constitute an "A" population.

In the South Platte River drainage, cutthroat trout from the Big Thompson River were examined to determine if any non-native genes had infiltrated the greenback population. Samples from Rasberry Park, the sample site furthest downstream, show only a very slight non-native trout influence upon the taxomomic characters. Only one specimen (SL=117mm) of 14 lacks basibranchial teeth. There is some slight variability in spotting, but spotting is typical of <u>S. c. stomias</u>. The high scale counts ($\bar{x}$=192.9) and caeca counts are indicative of pure <u>stomias</u> (Behnke 1979).

Further upstream, 500 feet below the Gorge Creek Junction, six more greenbacks were sampled. Examination of these specimens proved them to be relatively pure stomias as well. One specimen (SL=180mm) lacked basibranchial teeth, but spotting and meristic characters are all typical of greenback trout.

Nine trout from the Gorge Creek-Big Thompson River junction were analyzed. One trout (SL=172mm) lacked basibranchial teeth, yet all other characters are typical of stomias.

At the 10,500 foot mark, the sample site furthest upstream in these 1980 collections, 14 greenback trout were collected. All of the specimens have uniform spotting that is typical of stomias and all have basibranchial teeth. Scale counts, gillrakers, and caeca are all typical stomias.

Overall, there appears to be little or no difference between the greenback trout in the upper and lower portions of Forest Canyon. The only evidence of greater purity further upstream is the fact that at the 10,500 foot elevation site, all fish had basibranchial teeth, slightly fewer gillrakers($\bar{x}$=18.4), and greater uniformity in spotting between specimens. The difference, however, is insignificant.

The data presented here differs little from the results reported by Behnke(1976). He reported three of 40 specimens without basibranchial teeth, and there are three of 43 without teeth in this sample. The average lateral scale and pyloric caeca counts are nearly identical with gillraker totals also being comparable. In Behnke's (1976) analysis, he determined the Forest Canyon trout to be 'good representative' stomias, despite the 1922 and 1923 stocking of 'spotted native' trout into Forest Canyon. Since the data from this study shows that nothing has changed since 1976, Forest Canyon greenback trout can still be considered 'good representative' stomias.

SUMMARY

Cutthroat trout sampled from Paradise Creek, tributary to Grand Lake, are pure Salmo clarki pleuriticus and probably are decendents of Trapper's Lake-endemic native cutthroat crosses. Boundary Lake also contains pure S. c. pleuriticus of Trappers Lake origin. In the Big Thompson River, evaluation of samples from four points within Forest Canyon showed little or no taxonomic differences between sites. No significant difference was found between the 1982 and 1976 taxonomic evaluations of Forest Canyon greenback trout.

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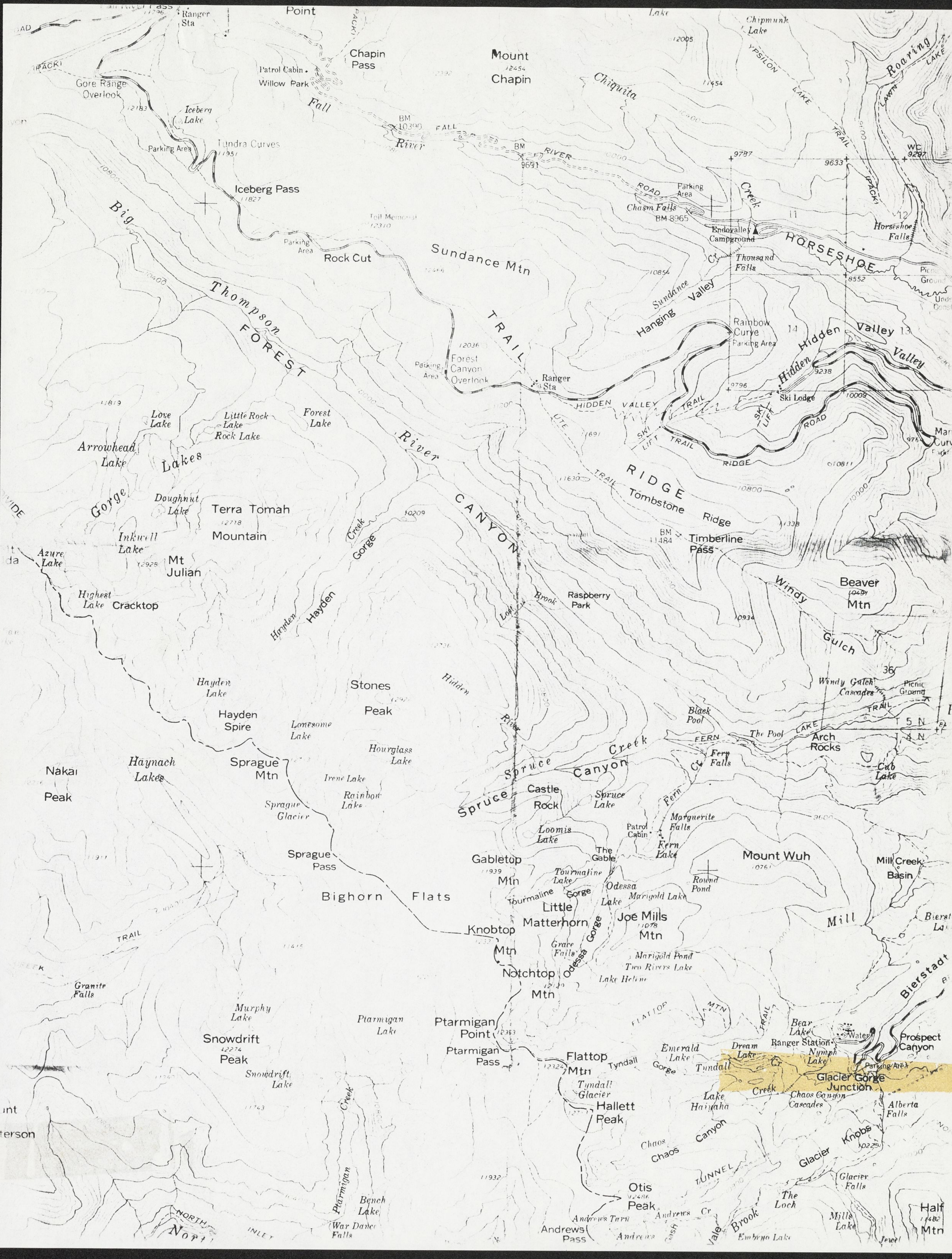
Figure 1. Sample sites on the Big Thompson River, Rocky Mountain National Park, CO.



Ranger Sta
Point
Chapin Pass
Mount Chapin
Patrol Cabin
Willow Park
Chipmunk Lake
Gore Range Overlook
Iceberg Lake
Fall River
Chiquita
Tundra Curves
Parking Area
Iceberg Pass
Roaring
Chasm Falls
Endovalley Campground
Horseshoe Falls
HORSESHOE
Big Thompson
FOREST
Rock Cut
Sundance Mtn
TRAIL
Thousand Falls
Hanging Valley
Rainbow Curve
Parking Area
Hidden Valley
Forest Canyon Overlook
Ranger Sta
Ski Lodge
HIDDEN VALLEY
RIDGE
ROAD
Love Lake
Little Rock Lake
Rock Lake
Forest Lake
Arrowhead Lake
Lakes
River
RIDGE
Tombstone Ridge
Gorge
Doughnut Lake
Terra Tomah Mountain
CANYON
Timberline Pass
Inkwell Lake
Mt Julian
Azure Lake
Hayden Gorge
Windy
Beaver Mtn
Raspberry Park
Highest Lake
Cracktop
Gulch
Windy Gulch Cascades
Picnic Ground
Hayden Lake
Stones Peak
Black Pool
Hayden Spire
Lonesome Lake
The Pool
Arch Rocks
Hourglass Lake
Fern Falls
Cub Lake
Nakai Peak
Haynach Lakes
Sprague Mtn
Irene Lake
Spruce Canyon
Castle Rock
Spruce Lake
Rainbow Lake
Sprague Glacier
Marguerite Falls
Loomis Lake
Patrol Cabin
Fern Lake
Sprague Pass
Gabletop Mtn
The Gable
Mount Wuh
Mill Creek Basin
Tourmaline Lake
Round Pond
Bighorn Flats
Odessa Lake
Marigold Lake
Little Matterhorn
Joe Mills Mtn
Mill
Knobtop Mtn
Grace Falls
Marigold Pond
Two Rivers Lake
Notchtop Mtn
Lake Helene
Granite Falls
Murphy Lake
Ptarmigan Lake
Ptarmigan Point
Bierstadt
Snowdrift Peak
Bear Lake
Ranger Station
Prospect Canyon
Ptarmigan Pass
Flattop Mtn
Emerald Lake
Dream Lake
Nymph Lake
Tyndall Gorge
Parking Area
Snowdrift Lake
Tyndall Glacier
Glacier Gorge Junction
Chaos Canyon Cascades
Hallett Peak
Lake Haiyaha
Alberta Falls
Chaos Canyon
Glacier Knobs
Glacier Falls
Otis Peak
The Loch
Bench Lake
War Dance Falls
Andrews Tarn
Andrews Pass
Mills Lake
Half Mtn

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BX82NVR            BBBBBBBBBBB   X          X   8888888888    2222222222   NN        NN  VV        VV  RRRRRRRRRRR
                   BBBBBBBBBBBB  XX        XX  888888888888  222222222222  NNN       NN  VV        VV  RRRRRRRRRRRR
                   BB        BB  XX        XX  88        88  22        22  NNNN      NN  VV        VV  RR        RR
                   BB        BB   XX      XX   88        88            22  NN NN     NN   VV      VV   RR        RR
                   BB        BB    XX    XX    88        88            22  NN  NN    NN   VV      VV   RR        RR
                   BB        BB     XX  XX     88        88            22  NN   NN   NN   VV      VV   RR        RR
                   BB        BB      XXXX      88        88            22  NN    NN  NN    VV    VV    RR        RR
                   BBBBBBBBBBBB       XX        8888888888       2222222   NN     NN NN    VV    VV    RRRRRRRRRRRR
                   BBBBBBBBBBB        XX        8888888888      2222222    NN      NNNN    VV    VV    RRRRRRRRRRR
                   BB        BB      XXXX      88        88    22          NN       NNN     VV  VV     RR  RR
                   BB        BB     XX  XX     88        88   22           NN        NN     VV  VV     RR   RR
                   BB        BB    XX    XX    88        88  22            NN        NN     VV  VV     RR    RR
                   BB        BB   XX      XX   88        88  22            NN        NN      V  V      RR     RR
                   BB        BB  XX        XX  88        88  22            NN        NN      VVVV      RR      RR
                   BBBBBBBBBBBB  XX        XX  888888888888  222222222222  NN        NN      VVVV      RR       RR
                   BBBBBBBBBBB   X          X   8888888888   222222222222  NN        NN       VV       RR        RR


                                                                           CSU
                                                                     COMPUTER CENTER

                                                                      NOS 1.4-508
                                                          C S U   G R E E N   M A C H I N E.
                                                CREATOR FAMILY, USER NUMBER = GREEN      FUGZ
                                                                JOBCARD NAME = BX82

                                                                      UNCLE SITE A2

                                                                     TIME:  13.56.16.
                                                                     DATE:  81/03/24.

         1         2         3         4         5         6         7         8         9        10        11        12        13
123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012

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1980 *Pleuriticus* collection

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                                                                81/03/24.    13.47.23.     PAGE    1
UNIVERSITY COMPUTING CENTER
COLORADO STATE UNIV.

S P S S - - STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES

VERSION 8.0 -- JUNE 18, 1979


                VARIABLE LIST  C1 TO C13
                COMPUTE        C14=C7+C8
                INPUT MEDIUM   TAPE
                N OF CASES     UNKNOWN
                INPUT FORMAT   FIXED(F2.0,3X,12F5.0)
                READ INPUT DATA

                ACCORDING TO YOUR INPUT FORMAT, VARIABLES ARE TO BE READ AS FOLLOWS

                VARIABLE  FORMAT  RECORD    COLUMNS

                C1         F 2. 0     1       1-   2
                C2         F 5. 0     1       6-  10
                C3         F 5. 0     1      11-  15
                C4         F 5. 0     1      16-  20
                C5         F 5. 0     1      21-  25
                C6         F 5. 0     1      26-  30
                C7         F 5. 0     1      31-  35
                C8         F 5. 0     1      36-  40
                C9         F 5. 0     1      41-  45
                C10        F 5. 0     1      46-  50
                C11        F 5. 0     1      51-  55
                C12        F 5. 0     1      56-  60
                C13        F 5. 0     1      61-  65

THE INPUT FORMAT PROVIDES FOR  13 VARIABLES.   13 WILL BE READ.
IT PROVIDES FOR  1 RECORDS (*CARDS*) PER CASE.
A MAXIMUM OF    65 *COLUMNS* ARE USED ON A RECORD.

END OF FILE ON FILE PLEUR
AFTER READING    316 CASES FROM SUBFILE NONAME

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                                                                81/03/24.    13.47.23.     PAGE    2

CPU TIME REQUIRED..      1.8780 SECONDS

                VALUE LABELS     C1 (1)MILLER CREEK (2)E. MEADOW CREEK
                                (3)POSSUM CREEK
                                (4)HAHN CREEK
                                (5)CORRAL CREEK (6)HAT CREEK (7)W.FORK RED DIRT CR.
                                (8)E.FORK RED DIRT CR. (9)MITCHELL CREEK
                                (10)POLK CREEK (11)LITTLE SKINNYFISH L.
                                (12)NICKELSON CREEK (13)MANDALL CREEK
                                (14)LOST DOG CREEK (15)FAWN CREEK
                                (16)PITKIN CREEK (17)DEADMAN GULCH
                                (18)SKINNYFISH LAKE (19)LOST CREEK
                                (20)ABRAMS CREEK (21)NOLAN CREEK
                                (22)PORCUPINE LAKE (23)LUNA LAKE
                                (24)LAKE OF THE CRAGS (25)HACK LAKE
                                (26)LOST TRAIL CREEK (27)FRYING PAN LAKES 2,3
                                (28)LAKE DIANA (29)INDIAN CREEK (30)CARTER LAKE/
                REPORT          FORMAT=HDSPACE(2)/
                                VARS=C3 "STANDARD" "LENGTH" "  (MM)  " (8)
                                C4 "GILL-" "RAKERS" "UPPER" (6)
                                C5 "GILL-" "RAKERS" "LOWER" (6)
                                C6 "GILL-" "RAKERS" "TOTAL" (6)
                                C7 "POSTE-" "RIOR" "GILL-" "RAKERS" "UPPER" (6)
                                C8 "POSTE-" "RIOR" "GILL-" "RAKERS" "LOWER" (6)
                                C14 "POSTE-" "RIOR" "GILL-" "RAKERS" "TOTAL" (6)
                                C9 "SCALES" "ABOVE" "LATERAL" "LINE" (7)
                                C10 "SCALES" "  IN  " "LATERAL" "SERIES" (8)
                                C13 "BASI-" "BRANCHIAL" "TEETH" (9)
                                C12 "PYLORIC" "CAECA" (7)
                                C11 "PELVIC" "FIN" "RAYS" (6)/
                                MISSING=VAR/
                                CHEAD="COLORADO WEST SLOPE TROUT COLLECTION"
                                      "        CHARACTER ANALYSIS SUMMARY       "/
                                LHEAD="PREPARED ON )DATE"/
                                RHEAD="COLLECTION PERIOD  7/9/80 TO 9/9/80"/
                                BREAK= C1 "COLLECTION SITE" (LABEL)/
                                SUMMARY=VALIDN "  SAMPLE SIZE" MEAN "  MEAN"
                                            MIN "  MINIMUM" MAX "  MAXIMUM"
                                            STDEV "  STANDARD DEVIATION"
                                (C3 C4(2) C5(2) C6(2) C7(2) C8(2) C14(2) C9(2)
                                C10(2) C13(2) C12(2) C11(2))

      00055500 CM NEEDED FOR REPORT
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PREPARED ON 81/03/24. | COLORADO WEST SLOPE TROUT COLLECTION | COLLECTION PERIOD 7/9/80 TO 9/9/80

CHARACTER ANALYSIS SUMMARY

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	POSTERIOR GILL-RAKERS TOTAL	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASI-BRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
MILLER CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	133.90	7.30	11.80	19.10	3.30	7.80	11.10	48.90	198.90	9.10	37.00	8.90
MINIMUM	106	7	11	18	3	7	10	42	182	2	26	8
MAXIMUM	156	8	13	21	4	10	13	54	215	14	42	9
STANDARD DEVIATION	15.50	.48	.79	.99	.48	1.03	1.20	3.96	9.96	3.63	5.14	.32
E. MEADOW CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	117.50	7.20	12.40	19.60	.40	1.50	1.90	54.60	207.80	7.30	35.60	9.00
MINIMUM	90	7	12	19	0	0	0	48	198	4	27	9
MAXIMUM	173	8	14	22	1	3	4	59	223	12	39	9
STANDARD DEVIATION	32.85	.42	.70	.97	.52	1.08	1.37	3.24	7.45	3.06	3.34	0
POSSUM CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	186.00	6.60	12.40	19.00	2.20	3.10	5.30	37.90	186.70	5.20	43.20	9.70
MINIMUM	110	5	10	15	0	1	1	-0	166	0	32	9
MAXIMUM	229	8	14	21	3	8	11	45	200	16	66	10
STANDARD DEVIATION	41.59	.97	1.17	1.83	1.03	2.18	2.83	13.66	10.92	4.92	9.24	.48
HAHN CREEK												
SAMPLE SIZE	14	14	14	14	14	14	14	14	14	14	14	14
MEAN	126.43	7.14	12.07	19.21	2.64	5.43	8.07	46.71	186.71	3.21	37.07	9.14
MINIMUM	91	6	11	18	1	2	3	42	173	0	32	9
MAXIMUM	153	8	14	22	6	9	13	49	204	6	44	10
STANDARD DEVIATION	18.69	.53	1.00	1.12	1.39	2.34	3.34	1.64	8.21	1.63	3.58	.36
CORRAL CREEK												
SAMPLE SIZE	11	11	11	11	11	11	11	11	11	11	11	11
MEAN	120.55	7.55	11.73	19.27	2.36	6.18	8.55	45.27	188.27	6.91	43.27	8.82
MINIMUM	94	7	10	17	2	2	4	40	172	3	36	8
MAXIMUM	162	8	12	20	4	10	12	49	214	12	51	9
STANDARD DEVIATION	27.97	.52	.65	.90	.67	2.27	2.46	2.45	13.33	3.18	4.03	.40

PREPARED ON 81/03/24.

COLORADO WEST SLOPE TROUT COLLECTION
CHARACTER ANALYSIS SUMMARY

COLLECTION PERIOD 7/9/80 TO 9/9/80

C1

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	~~POSTERIOR GILL-RAKERS TOTAL~~	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASI-BRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
HAT CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	163.40	7.20	12.10	19.30	4.20	6.00	10.20	43.90	191.80	9.40	36.90	9.00
MINIMUM	109	6	10	16	2	2	4	-0	171	2	29	9
MAXIMUM	206	8	14	22	6	9	15	52	206	16	46	9
STANDARD DEVIATION	35.73	.63	1.29	1.83	1.23	2.40	3.29	15.76	10.32	4.43	4.48	0
W.FORK RED DIRT CR.												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	175.40	7.20	12.30	19.50	3.00	5.40	8.40	47.80	190.50	4.00	39.40	9.10
MINIMUM	117	6	11	17	2	0	3	46	171	0	10	9
MAXIMUM	206	8	14	22	5	9	14	51	219	16	52	10
STANDARD DEVIATION	25.14	.63	1.06	1.65	.94	3.03	3.34	1.75	13.61	5.73	12.10	.32
E.FORK RED DIRT CR.												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	129.50	7.10	11.70	18.80	2.00	4.00	6.00	47.30	189.80	1.80	38.20	9.10
MINIMUM	99	6	11	17	1	1	3	40	159	0	26	8
MAXIMUM	169	8	12	20	3	7	9	52	203	7	46	10
STANDARD DEVIATION	22.00	.74	.48	.92	.47	2.05	2.26	3.47	13.22	2.39	6.89	.57
MITCHELL CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	164.80	6.80	11.60	18.40	3.20	7.30	10.50	38.50	194.00	8.10	34.80	9.00
MINIMUM	114	5	11	16	2	4	7	-0	179	5	32	9
MAXIMUM	191	8	12	20	5	9	14	50	205	15	38	9
STANDARD DEVIATION	23.68	.92	.52	1.26	.92	1.42	1.84	20.36	10.25	2.92	2.15	0
POLK CREEK												
SAMPLE SIZE	11	11	11	11	11	11	11	11	11	11	11	11
MEAN	124.73	6.91	12.00	18.91	3.09	4.82	7.91	43.73	172.82	3.00	38.09	9.09
MINIMUM	96	6	11	17	2	2	5	39	159	0	26	9
MAXIMUM	150	8	13	21	6	9	13	48	186	7	48	10
STANDARD DEVIATION	16.06	.54	.77	1.14	1.14	2.23	2.88	3.00	8.61	2.00	6.16	.30

PREPARED ON 81/03/24. COLORADO WEST SLOPE TROUT COLLECTION COLLECTION PERIOD 7/9/80 TO 9/9/80

CHARACTER ANALYSIS SUMMARY

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	POSTERIOR GILL-RAKERS TOTAL	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASI-BRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
LITTLE SKINNYFISH L.												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	184.30	7.00	12.10	19.10	2.50	7.60	10.10	43.60	187.10	2.90	36.60	9.00
MINIMUM	167	7	11	18	2	5	7	40	175	0	30	9
MAXIMUM	225	7	14	21	3	9	12	50	199	11	44	9
STANDARD DEVIATION	18.61	0	.88	.88	.53	1.17	1.52	3.10	7.56	3.35	4.58	0
NICKELSON CREEK												
SAMPLE SIZE	8	8	8	8	8	8	8	8	8	8	8	8
MEAN	204.75	7.13	12.00	19.12	2.38	5.13	7.50	45.88	192.12	6.13	33.37	8.88
MINIMUM	154	6	11	18	1	2	3	40	173	2	26	8
MAXIMUM	251	8	13	21	3	9	12	52	212	10	42	9
STANDARD DEVIATION	29.33	.64	.53	.99	.92	2.36	3.07	4.02	13.26	3.18	4.96	.35
MANDALL CREEK												
SAMPLE SIZE	14	14	14	14	14	14	14	14	14	14	14	14
MEAN	147.29	6.93	12.14	19.07	2.86	5.14	8.00	43.00	178.79	4.43	36.29	8.86
MINIMUM	106	6	11	18	1	1	2	-0	161	1	-0	8
MAXIMUM	185	8	14	20	6	10	16	53	198	10	48	9
STANDARD DEVIATION	25.47	.62	.77	.62	1.35	2.66	3.66	12.87	11.23	3.01	11.46	.36
LOST DOG CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	123.30	7.30	11.70	19.10	1.60	1.70	3.30	39.00	160.70	1.50	41.30	9.30
MINIMUM	111	7	11	18	0	0	0	35	135	0	32	9
MAXIMUM	132	9	13	21	3	3	5	42	193	3	55	10
STANDARD DEVIATION	5.77	.67	.82	1.20	1.07	.95	1.64	2.36	18.64	1.35	7.57	.48
FAWN CREEK												
SAMPLE SIZE	12	12	12	12	12	12	12	12	12	12	12	12
MEAN	151.58	7.58	12.83	20.42	2.92	5.25	8.17	47.33	189.42	3.25	37.42	9.08
MINIMUM	118	7	12	19	1	2	3	45	178	0	30	8
MAXIMUM	209	9	14	22	5	9	12	52	202	8	46	10
STANDARD DEVIATION	26.74	.67	.83	1.24	1.24	2.18	2.69	2.42	7.97	2.05	4.21	.51

PREPARED ON 81/03/24. COLORADO WEST SLOPE TROUT COLLECTION COLLECTION PERIOD 7/9/80 TO 9/9/80

CHARACTER ANALYSIS SUMMARY

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	POSTERIOR GILL-RAKERS TOTAL	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASIBRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
PITKIN CREEK												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	146.10	7.50	12.40	20.00	2.70	4.90	7.60	47.90	174.20	10.10	40.40	9.20
MINIMUM	114	7	11	19	0	1	2	42	108	3	33	9
MAXIMUM	192	8	14	21	4	9	12	54	201	19	48	10
STANDARD DEVIATION	27.00	.53	.97	.82	1.25	2.77	3.63	3.93	26.96	4.75	4.35	.42
DEADMAN GULCH												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	112.10	7.60	12.30	19.80	1.20	2.60	3.80	44.60	184.80	2.60	41.00	9.30
MINIMUM	93	6	12	18	0	0	0	38	172	0	33	9
MAXIMUM	125	10	13	22	2	4	5	51	198	12	52	10
STANDARD DEVIATION	11.66	1.17	.48	1.23	.79	1.51	1.99	4.17	8.50	3.47	5.44	.48
SKINNYFISH LAKE												
SAMPLE SIZE	12	12	12	12	12	12	12	12	12	12	12	12
MEAN	133.92	6.67	12.17	18.92	1.67	3.25	4.92	37.17	167.00	3.92	42.92	9.42
MINIMUM	115	4	11	16	0	0	0	25	137	0	0	9
MAXIMUM	153	9	13	21	5	10	14	48	205	12	91	11
STANDARD DEVIATION	12.27	1.37	.58	1.56	1.87	3.72	5.37	8.66	24.39	4.72	26.89	.67
LOST CREEK												
SAMPLE SIZE	9	9	9	9	9	9	9	9	9	9	9	9
MEAN	136.33	7.00	12.33	19.33	2.44	6.44	8.89	47.78	178.44	3.78	36.11	9.22
MINIMUM	95	7	11	18	0	0	0	41	132	0	0	9
MAXIMUM	189	7	14	21	4	10	13	52	200	11	62	10
STANDARD DEVIATION	29.09	0	.87	.87	1.13	3.09	3.92	3.19	19.33	4.18	16.39	.44
ABRAMS CREEK												
SAMPLE SIZE	9	9	9	9	9	9	9	9	9	9	9	9
MEAN	117.33	6.11	11.22	17.33	1.44	4.00	5.44	49.78	198.22	4.11	45.22	9.00
MINIMUM	88	5	10	16	0	2	3	44	180	2	37	9
MAXIMUM	177	7	13	19	3	8	10	56	211	7	57	9
STANDARD DEVIATION	29.42	.60	.83	1.00	.88	1.80	2.24	4.12	10.52	1.62	6.24	0

PREPARED ON 81/03/24. COLORADO WEST SLOPE TROUT COLLECTION COLLECTION PERIOD 7/9/80 TO 9/9/80

CHARACTER ANALYSIS SUMMARY

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	POSTERIOR GILL-RAKERS TOTAL	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASI-BRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
NOLAN CREEK												
SAMPLE SIZE	5	5	5	5	5	5	5	5	5	5	5	5
MEAN	139.20	6.40	11.20	17.60	1.80	4.60	6.40	47.00	198.00	3.40	34.60	9.00
MINIMUM	112	6	9	16	0	2	2	45	194	0	32	9
MAXIMUM	173	7	13	20	3	7	10	49	205	6	41	9
STANDARD DEVIATION	23.40	.55	1.48	1.52	1.30	1.95	3.05	2.00	4.36	2.61	3.65	0
PORCUPINE LAKE												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	147.50	7.50	12.20	19.60	3.10	6.20	9.30	43.70	174.30	7.80	39.80	9.20
MINIMUM	123	7	11	18	0	2	2	40	155	1	37	9
MAXIMUM	171	9	13	21	6	11	15	46	186	23	44	10
STANDARD DEVIATION	20.42	.71	.63	.84	1.66	2.74	4.06	2.26	9.73	6.46	2.66	.42
LUNA LAKE												
SAMPLE SIZE	11	11	11	11	11	11	11	11	11	11	11	11
MEAN	148.91	7.45	12.55	20.00	4.64	6.73	11.36	46.27	190.00	3.91	40.91	9.00
MINIMUM	113	6	11	18	3	4	8	43	171	0	36	9
MAXIMUM	267	9	14	22	10	9	14	50	208	7	44	9
STANDARD DEVIATION	44.20	.82	1.04	1.55	1.86	1.90	2.01	2.87	11.57	2.21	2.81	0
LAKE OF THE CRAGS												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	168.60	7.50	12.10	19.60	3.40	4.80	8.20	42.30	183.90	15.40	41.50	8.90
MINIMUM	114	7	11	18	2	0	3	39	169	3	38	8
MAXIMUM	230	9	13	22	5	10	14	46	200	43	46	10
STANDARD DEVIATION	31.43	.71	.74	1.26	.84	3.08	3.61	2.00	9.98	12.55	2.59	.57
HACK LAKE												
SAMPLE SIZE	10	10	10	10	10	10	10	10	10	10	10	10
MEAN	142.70	7.20	12.20	19.40	3.90	5.20	9.10	47.00	181.80	9.80	33.80	8.40
MINIMUM	96	6	11	18	2	2	5	42	167	2	28	6
MAXIMUM	208	8	13	21	6	9	15	56	190	18	42	9
STANDARD DEVIATION	34.99	.79	.63	1.07	1.20	2.74	3.73	4.24	7.70	4.83	4.26	.97

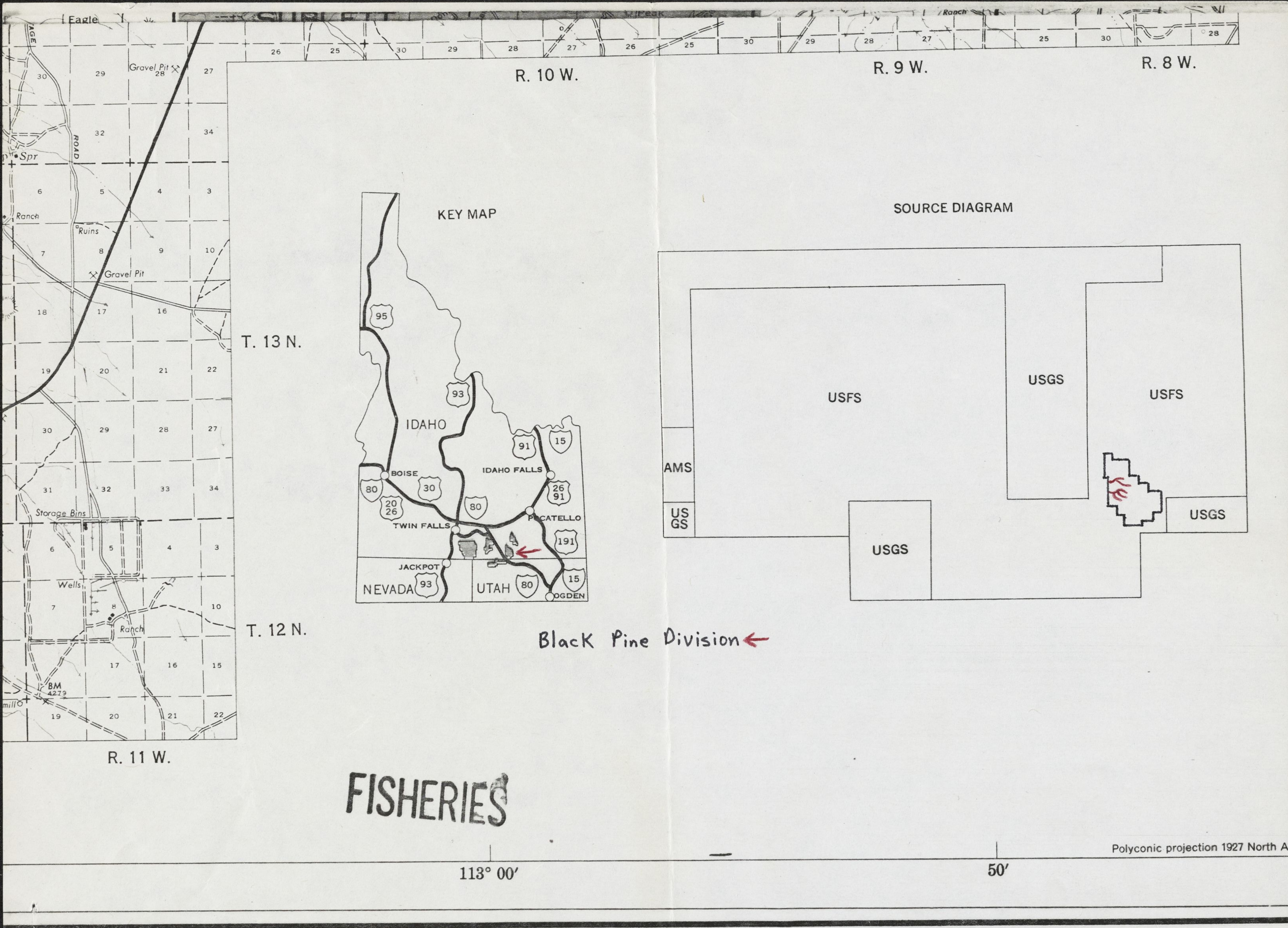
PREPARED ON 81/03/24. COLORADO WEST SLOPE TROUT COLLECTION COLLECTION PERIOD 7/9/80 TO 9/9/80

CHARACTER ANALYSIS SUMMARY

COLLECTION SITE	STANDARD LENGTH (MM)	GILL-RAKERS UPPER	GILL-RAKERS LOWER	GILL-RAKERS TOTAL	POSTERIOR GILL-RAKERS UPPER	POSTERIOR GILL-RAKERS LOWER	POSTERIOR GILL-RAKERS TOTAL	SCALES ABOVE LATERAL LINE	SCALES IN LATERAL SERIES	BASI-BRANCHIAL TEETH	PYLORIC CAECA	PELVIC FIN RAYS
LOST TRAIL CREEK												
SAMPLE SIZE	6	6	6	6	6	6	6	6	6	6	6	6
MEAN	177.33	7.00	12.17	19.17	3.17	6.33	9.50	48.00	191.50	3.67	22.17	9.00
MINIMUM	107	6	11	18	2	3	5	44	174	0	-0	9
MAXIMUM	225	8	13	21	4	10	13	50	198	11	43	9
STANDARD DEVIATION	46.06	.89	.75	1.17	.75	2.88	3.27	2.28	8.78	4.13	18.04	0
FRYING PAN LAKES 2,3												
SAMPLE SIZE	13	13	13	13	13	13	13	13	13	13	13	13
MEAN	189.77	6.85	12.46	19.31	3.92	6.77	10.69	31.54	150.38	9.31	31.85	6.92
MINIMUM	151	5	11	18	2	0	3	-0	-0	3	-0	-0
MAXIMUM	236	8	14	21	5	10	15	51	214	14	48	9
STANDARD DEVIATION	30.28	.69	.97	.95	.95	2.77	3.30	22.01	86.13	3.22	18.41	3.95
LAKE DIANA												
SAMPLE SIZE	11	11	11	11	11	11	11	11	11	11	11	11
MEAN	215.18	7.27	11.64	18.91	2.27	3.00	5.27	42.55	182.64	15.09	45.82	9.36
MINIMUM	188	6	10	16	0	0	0	39	166	10	35	9
MAXIMUM	260	9	14	21	6	6	11	47	199	25	55	10
STANDARD DEVIATION	25.29	.90	1.21	1.70	1.85	1.84	3.47	2.66	11.60	4.53	6.06	.50
INDIAN CREEK												
SAMPLE SIZE	15	15	15	15	15	15	15	15	15	15	15	15
MEAN	144.33	7.47	12.13	19.60	2.87	6.80	9.67	43.53	192.80	1.87	39.40	5.93
MINIMUM	95	7	11	18	1	3	4	39	176	0	33	-0
MAXIMUM	197	9	14	21	4	10	13	47	206	6	46	10
STANDARD DEVIATION	27.81	.64	.92	.99	.74	2.34	2.89	2.20	10.49	1.85	3.92	4.37
CARTER LAKE												
SAMPLE SIZE	15	15	15	15	15	15	15	15	15	15	15	15
MEAN	171.80	0	0	0	0	0	0	0	0	2.00	0	0
MINIMUM	132	-0	-0	-0	-0	-0	0	-0	-0	0	-0	-0
MAXIMUM	250	-0	-0	-0	-0	-0	0	-0	-0	4	-0	-0
STANDARD DEVIATION	25.20	0	0	0	0	0	0	0	0	1.51	0	0

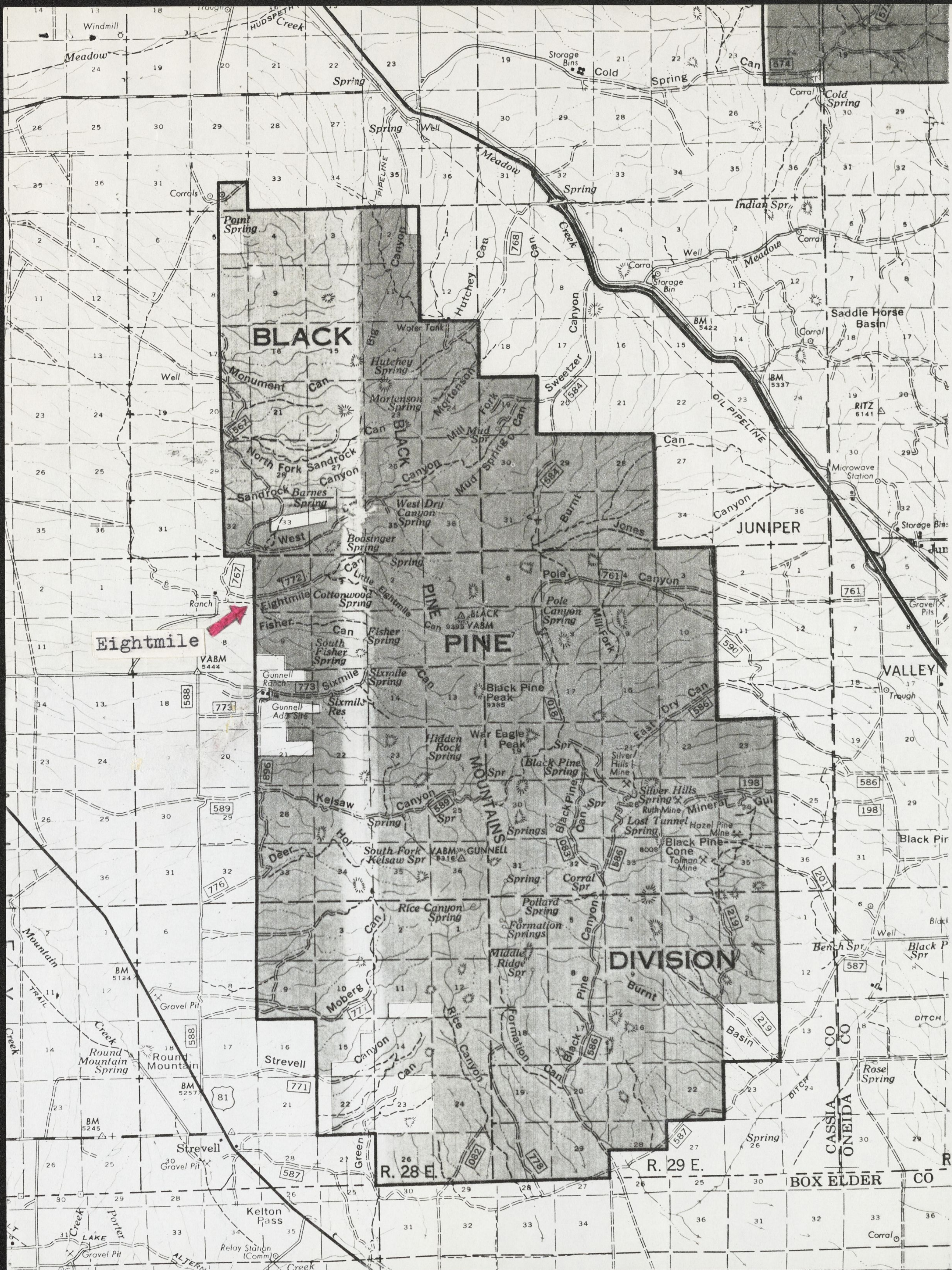
```
CPU TIME REQUIRED..     13.5260 SECONDS

                    FINISH

TOTAL CPU TIME USED..     15.9940 SECONDS


RUN COMPLETED

NUMBER OF CONTROL CARDS READ  46
NUMBER OF ERRORS DETECTED      0
```

```
 BX82NVR. 81/03/24.C S U   G R E E N   M A C H I N E.

13.47.15.BX82,T64,PR75.CULVER
13.47.15.USER,FUGZJQ3,.
13.47.15.ATTACH(SPSS/UN=LIBRARY)
13.47.16.GET,PLEUR,PREPORT.
13.47.18.SPSS(D=PLEUR,I=PREPORT)
13.47.29.** FILE RETURNED ** PLEUR
13.50.23.END SPSS
13.50.23.REWIND,OUTPUT.
13.50.23.COPYEI,OUTPUT,TEST.
13.50.24. EOI ENCOUNTERED.
13.50.24.REPLACE,TEST.
13.50.25.GOTO,DAYFILE.
13.50.25.DAYFILE,DF.
13.50.25. USER DAYFILE DUMPED.
13.50.25.REPLACE,DF.
13.50.26.UEAD,       0.001KUNS.
13.50.26.UEPF,       0.070KUNS.
13.50.26.UEMS,       5.380KUNS.
13.50.26.UECP,      16.373SECS.
13.50.26.AESR,      26.879UNTS.

 BX82NVR      11 PAGES PRINTED.
?>#JOB.SEPARATOR#<?
```



Black Pine Division

FISHERIES


BLACK
PINE
DIVISION
BLACK PINE MOUNTAINS
Eightmile
JUNIPER
VALLEY
R. 28 E.
R. 29 E.
CASSIA CO
ONEIDA CO
BOX ELDER CO
Point Spring
Monument Can
North Fork Sandrock
Sandrock Canyon
Barnes Spring
Big Canyon
Hutchey Spring
Hutchey Can
Mortenson Spring
Mortenson
Mill Fork
Mud Spr
Mud Spring Can
Black Canyon
West Dry Canyon Spring
Boosinger Spring
Cottonwood Spring
Little Eightmile
Eightmile Can
Fisher Can
Fisher Spring
South Fisher Spring
Sixmile Spring
Sixmile Can
Sixmile Res
Gunnell Ranch
Gunnell Adm Site
Black Pine Peak
9385
Pole Canyon Spring
Pole Canyon
Mill Fork
Burnt Can
Jones
East Dry Can
Hidden Rock Spring
War Eagle Peak
Black Pine Spring
Silver Hills Mine
Silver Hills Spring
Ruth Mine
Mineral Gul
Lost Tunnel Spring
Hazel Pine Mine
Black Pine Cone
Tolman Mine
Kelsaw Canyon
Kelsaw Spring
South Fork Kelsaw Spr
VABM GUNNELL
Deer Hol
Springs
Corral Spr
Pollard Spring
Formation Springs
Middle Ridge Spr
Rice Canyon Spring
Rice Canyon
Moberg Can
Formation Can
Black Pine Can
Basin
Strevell
Round Mountain
Round Mountain Spring
Kelton Pass
Relay Station (Comm)
Gravel Pit
Hudspeth Creek
Meadow Creek
Cold Spring
Storage Bins
Sweetzer Canyon
Indian Spr
Saddle Horse Basin
RITZ
6141
Microwave Station
OIL PIPELINE
PIPELINE
Mountain Creek
TRAIL
Bench Spr
Black Pine Spr
Rose Spring
Corral
Well
Windmill
Trough
Ranch
VABM
5444
81

UNITED STATES DEPARTMENT OF AGRICULTURE

PURCHASE ORDER

THIS NUMBER MUST APPEAR ON ALL INVOICES, PACKAGES AND PAPERS RELATING TO THIS ORDER

PAGE NUMBER	CONTRACT NUMBER	ORDER DATE	ORDER NUMBER	SUB.
1 OF 1	OM	07 16 84	43-0267-4-268	

CHECK ONE

X Purchase Order (See Reverse)

☐ Delivery Order

TO: (Seller)

Dr. Robert Behnke
Dept. of Fish & Wildlife Biology
Colorado State University
Fort Collins. Colorado 80523

SHIP TO: (Consignee and Destination)

Sawtooth National Forest
Attn: Harv Forsgren
P.O. Box 925
Hailey, Idaho 83333

LINE ITEM	ACT. CODE	DESCRIPTION	QUANTITY	UNIT ISSUE	UNIT PRICE	AMOUNT
01		Provide Cutthroat trout identification for eleven specimens collected from Eightmile Canyon, Black Pine Mtn., Cassia County, Idaho. Please made identification of variety of cu cutthroat enclosed with written report detailing the methods used and the results of the analysis. Federal Acquisition Regulations are referenced on the attached copy of "Purchase Order Terms and Conditions."	1	JOB	Est. $300.00	$300 00

SELLER'S ORIGINAL

FOB POINT	DISCOUNT TERMS		TOTAL
Destination	Net 30 days	0	$300 00

TIME FOR DELIVERY	SHIP VIA
August 3, 1984	

BILLING INSTRUCTIONS:

Furnish invoice with our ORDER NUMBER to:

U.S. DEPARTMENT OF AGRICULTURE
~~National Finance Center~~
~~P.O. Box 60075~~
~~New Orleans, Louisiana 70160~~
Sawtooth National Forest
Attn: Harv Forsgren
P.O. Box. 925, Hailey, Idaho 83333

DO NOT SHIP ORDER TO THIS ADDRESS (Ship to Consignee Address Above)

FAILURE TO SHOW OUR PURCHASE ORDER NUMBER ON INVOICE WILL DELAY PAYMENT

FREIGHT CHARGE OVER $100 REQUIRES BILL OF LADING

ISSUING OFFICE NAME AND ADDRESS

Sawtooth National Forest
1525 Addison Avenue East
Twin Falls, Idaho 83301

ORDERED BY (Name and Title)

Margaret Rude, Purchasing Agent

PHONE (Area Code and Number)

(208) 733 3698 FTS 554 6571

AUTHORIZED SIGNATURE Margaret Rude

FORM AD-838-9 (3/80)

SELLER'S ORIGINAL

UNITED STATES DEPARTMENT OF AGRICULTURE
Terms and Conditions of Purchase Order

The following terms and conditions apply to purchase orders only. When "Purchase Order" is checked on the front of this form, supplies or services shall be furnished in accordance with the terms specified on both sides of this order and on the attached sheets, if any.

1. INSPECTION AND ACCEPTANCE. - Inspection and acceptance will be at destination, unless otherwise provided. Until delivery and acceptance, and after any rejections, risk of loss will be on the Contractor unless loss results from negligence of the Government.

2. VARIATION IN QUANTITY. - No variation in the quantity of any item called for by this contract will be accepted unless such variation has been caused by conditions of loading, shipping, or packing, or allowances in manufacturing processes, and then only to the extent, if any, specified elsewhere in this contract.

3. DISCOUNTS. - Discount time will be computed from date of delivery at place of acceptance or from receipt of correct invoice at the office specified by the Government, whichever is later. Payment is made, for discount purposes, when check is mailed.

4. DISPUTES. — (a) This contract is subject to the Contract Disputes Act of 1978 (Pub. L. 95-563).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved in accordance with this clause.

(c) (i) As used herein, "claim" means a written demand or assertion by one of the parties seeking, as a legal right, the payment of money, adjustment or interpretation of contract terms, or other relief, arising under or relating to this contract.

(ii) A voucher, invoice, or request for payment that is not in dispute when submitted is not a claim for the purposes of the Act. However, where such submission is subsequently not acted upon in a reasonable time, or disputed either as to liability or amount, it may be converted to a claim pursuant to the Act.

(iii) A claim by the contractor shall be made in writing and submitted to the contracting officer for decision. A claim by the Government against the contractor shall be subject to a decision by the Contracting Officer.

(d) For contractor claims of more than $50,000, the contractor shall submit with the claim a certification that the claim is made in good faith; the supporting data are accurate and complete to the best of the contractor's knowledge and belief; and the amount requested accurately reflects the contract adjustment for which the contractor believes the Government is liable. The certification shall be executed by the contractor if an individual. When the contractor is not an individual, the certification shall be executed by a senior company official in charge at the contractor's plant or location involved, or by an officer or general partner of the contractor having overall responsibility for the conduct of the contractor's affairs.

(e) For contractor claims of $50,000 or less, the Contracting Officer must render a decision within 60 days. For contractor claims in excess of $50,000, the Contracting Officer must decide the claim within 60 days or notify the contractor of the date when the decision will be made.

(f) The Contracting Officer's decision shall be final unless the contractor appeals or files a suit as provided in the Act.

(g) The authority of the Contracting Officer under the Act does not extend to claims or disputes which by statute or regulation other agencies are expressly authorized to decide.

(h) Interest on the amount found due on a contractor claim shall be paid from the date the claim is received by the Contracting Officer until the date of payment.

(i) Except as the parties may otherwise agree, pending final resolution of a claim by the contractor arising under the contract, the contractor shall proceed diligently with the performance of the contract in accordance with the contracting officer's decision.

5. FOREIGN SUPPLIES. - This contract is subject to the Buy American Act (41 U.S.C. 10 a-d) as implemented by Executive Order 10582 of December 17, 1954, and any restrictions in appropriation acts on the procurement of foreign supplies.

6. CONVICT LABOR. - In connection with the performance of work under this contract, the Contractor agrees not to employ any person undergoing sentence of imprisonment except as provided by Public Law 89-176, September 10, 1965 (18 U.S.C. 4082(c) (2) and Executive Order 11755, December 29, 1973.

7. OFFICIALS NOT TO BENEFIT. - No member of or Delegate to Congress or resident commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

8. COVENANT AGAINST CONTINGENT FEES. - The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fees, excepting bonafide employees or bonafide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty the Government shall have the right to annul this contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fees.

9. FEDERAL, STATE, AND LOCAL TAXES. - Except as may be otherwise provided in this contract, the contract price includes all applicable Federal, State and local taxes and duties in effect on the date of this contract but does not include any taxes from which the Government, the Contractor or this transaction is exempt. Upon request of the Contractor, the Government shall furnish a tax exemption certificate or similar evidence of exemption with respect to any such tax not included in the contract price pursuant to this clause. For the purpose of this clause, the term "date of contract" means the date of the contractor's quotation or, if no quotation, the date of this purchase order.

10. SERVICE CONTRACT ACT OF 1965. - *(applies only to contracts for services unless exempted by the regulations of the Department of Labor)* - Except to the extent that an exemption, variation, or tolerance would apply pursuant to 29 CFR 4-6 if this were a contract in excess of $2500, the contractor and any subcontractor hereunder shall pay all his employees engaged in performing work on the contract not less than the minimum wage specified under section 6(a)(1) of the Fair Labor Standards Act of 1938, as amended. All regulations and interpretations of the Service Contract Act of 1965 expressed in 29 CFR Part 4 are hereby incorporated by reference in this contract.

11. CHANGES. - The Contracting Officer may at any time by a written order, and without notice to the sureties, make changes within the general scope of this contract, in any one or more of the following: (i) *for supplies;* (a) drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (b) method of shipment or packing; and (c) place of delivery; (ii) *for services, including but not limited to the following:* (a) specifications (including drawings and designs); (b) method or manner of performance of the work; (c) Government-furnished facilities, equipment, materials, services, or site; or (d) directing acceleration in the performance of the work. If any such change causes an increase or decrease in the cost of, or the time required for, the performance of any part of the work under this contract, whether changed or not changed by any such order, an equitable adjustment shall be made in the contract price or delivery schedule, or both, and the contract shall be modified in writing accordingly. Any claim by the Contractor for adjustment under this clause must be asserted within 30 days from the date of receipt by the Contractor of the notification of change. *Provided, however,* that the Contracting Officer, if he decides that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this contract. Where the cost of property made obsolete or excess as a result of a change is included in the Contractor's claim for adjustment, the Contracting Officer shall have the right to prescribe the manner of disposition of such property. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes." However, nothing in this clause shall excuse the Contractor from proceeding with the contract as changed.

12. TERMINATION FOR DEFAULT. - The Contracting Officer, by written notice, may terminate the contract, in whole or in part, for failure of the Contractor to perform any of the provisions hereof. In such event the Contractor shall be liable for damages, including the excess cost of reprocuring similar supplies or services, provided that if (i) it is determined for any reason that the Contractor was not in default or (ii) the Contractor's failure to perform is without his and his subcontractor's control, fault or negligence the termination shall be a termination for convenience under Paragraph 13.

13. TERMINATION FOR CONVENIENCE. - The Contracting Officer, by written notice, may terminate this contract, in whole or in part, when it is in the best interest of the Government. If this contract is for supplies and is so terminated, the Contractor shall be compensated in accordance with Part 1-8 of the Federal Procurement Regulations (41 CFR 1-8), in effect on this contract's date. To the extent that this contract is for services and is so terminated, the Government shall be liable only for payment in accordance with the payment provisions of this contract for services rendered prior to the effective date of termination.

14. ASSIGNMENT OF CLAIMS. - Claims for monies due or to become due under this contract shall be assigned only pursuant to the Assignment of Claims Act of 1940, as amended (31 U.S.C. 203-41 U.S.C. 15). This purchase order may not be assigned unless or until the supplier has been requested to and has accepted this order by executing an Acceptance hereon.

15. CLAUSES INCORPORATED BY REFERENCE. - If the amount of this purchase order exceeds $2,500, the following clauses form a part of the purchase order and are hereby incorporated by reference. Citations refer to the Federal Procurement Regulations. Text of the clauses may be obtained from the Contracting Officer:

Employment of the Handicapped (1-12.1304)
Contract Work Hours and Safety Standards Act (1-12.303)
Service Contract Act of 1965 (1-12.904-1)(when applicable this clause takes precedence over paragraph 10 above).

U.S. DEPARTMENT OF AGRICULTURE
PURCHASE ORDER TERMS AND CONDITIONS

The following terms and conditions as well as those on the obverse and on attached sheets, if any, apply when "Purchase Order" is checked on the front of this form. (A delivery order is subject to the terms and conditions of the referenced contract and the front of this form.)

52.252-2 Clauses Incorporated by Reference (APR 1984). This contract incorporates the following clauses by reference, with the same full force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

I. Federal Acquisition Regulation (48 CFR Chapter 1) Clauses

II. Agriculture Acquisition Regulation (48 CFR Chapter 4) Clauses

52.252-6 Authorized Deviations In Clauses (APR 1984).

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(Deviation)" after the date of the clause.

(b) The use in this solicitation or contract of any Agriculture Acquisition Regulation (48 CFR Chapter 4) with an authorized deviation is indicated by the addition of "(Deviation)" after the name of the regulation.

GENERAL. The following terms and conditions apply to all purchase orders (unless otherwise indicated):

52.202-1	Definitions (APR 1984)
52.203-1	Officials Not to Benefit (APR 1984)
52.203-3	Gratuities (APR 1984)
52.203-5	Covenant Against Contingent Fees (APR 1984)
52.212-9	Variation in Quantity (APR 1984) (Permissible variations, if any, are stated on the obverse or attached sheets)
52.222-3	Convict Labor (APR 1984) (Unless precluded by FAR Subpart 22.2)
52.232-8	Discounts for Prompt Payment (APR 1984)
52.232-11	Extras (APR 1984)

52.232-23	Assignment of Claims (APR 1984) Inapplicable to orders less than $1,000)
52.233-1	Disputes (APR 1984)
52.246-1	Contractor Inspection Requirements (APR 1984)
52.247-34	F.O.B. Destination (APR 1984)
452.232-70	Interest on Overdue Payments (APR 1984)
452.232-71	Payment Due Date (APR 1984)
452.232-71	Payment Due Date -- Alternate I (APR 1984) (applicable) when clause at 52.213-2 is appropriate)
452.232-72	Invoices (APR 1984) (The clause at 52.213-2 Invoices (APR 1984) shall supersede this clause when purchase orders authorize advance payment under 31 U.S.C.530 for subscriptions or other publications)

Additional terms and conditions applicable to purchase orders exceeding $2500:

52.222-4	Contract Work Hours and Safety Standards Act -- Overtime Compensation -- General (APR 1984) (Unless precluded by FAR Subpart 22.3)
52.222-36	Affirmative Action for Handicapped Workers (APR 1984)

Additional terms and conditions applicable to purchase orders exceeding $10,000:

52.215-01	Examination of Records by Comptroller General (APR 1984)
52.222-26	Equal Opportunity (APR 1984)
52.222-35	Affirmative Action for Special Disabled and Vietnam Era Veterans (APR 1984)
52.249-08	Default (Fixed Price Supply and Service) (APR 1984)

SUPPLIES. Additional terms and conditions applicable to all purchase orders for supplies:

52.210-5	New Material (APR 1984)

52.225-3	Buy American Act -- Supplies (APR 1984)
52.243-1	Changes -- Fixed Price (APR 1984)
52.249-1	Termination for Convenience of the Government (Fixed Price) (Short Form) (APR 1984)

SUPPLIES. Additional terms and conditions applicable to purchase orders for supplies exceeding $10,000:

52.222-20	Walsh-Healy Public Contracts Act (APR 1984) (Unless exempted by Statute or regulation)

SERVICES. Additional terms and conditions applicable to purchase orders for services:

52.243-1	Changes -- Fixed Price (APR 1984) -- Alternate I (APR 1984)
52.222-40	Service Contract Act of 1965 -- Contracts of $2500 or less (APR 1984)
52.222-41	Service Contract Act of 1965 (APR 1984) (Applicable to purchase orders exceeding $2500)
52.222-42	Statement of Equivalent Federal Wage Rate (APR 1984) (Applicable equivalent rates are stated on the obverse or attached sheets.)
52.249-4	Termination for Convenience of the Government (Services) (Short Form) (APR 1984)

OPTIONAL. The following terms and conditions are applicable when required and appropriate:

52.202-1	Definitions (APR 1984) -- Alternate I (APR 1984)
52.219-8	Utilization of Small Business Concerns & Small Business Disadvantaged Business Concerns (APR 1984)
52.219-13	Utilization of Women-Owned Small Businesses (APR 1984)
52.225-5	Buy American Act -- Construction Materials - (APR 1984)
52.232-1	Payments (APR 1984)
52.232-3	Payments under Personal Services Contracts (APR 1984)
52.246-2	Inspection of Supplies--Fixed-Price (APR 1984)
52.246-4	Inspection of Services--Fixed-Price (APR 1984)
52.247-29	F.O.B. Origin (APR 1984)

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES S. c. bouvieri LOCALITY Idaho, Cassia Co, Eightmile Canyon, Raft R drainage

COLLECTED BY USFS, Sawtooth N.F. DATE June 1984

Cat. # ______ Measurements by ______ DATE ______

Specimen #	1	2	3	4	5	6	7	8	
Total L.	199	201	194	171	171	156	192	171	
Standard L.									
Body D									
Head L									
Orbit L									
Upper Jaw L									
Dors. Orig. to Snt. tip									
Dorsal fin basal L									
Dorsal fin depressed L									
Adip. fin depressed L									
Caudal peduncle D									
Caudal peduncle L									
Vertebrae		tiny							
1st Arch gillrakers (up)	7 2	6 3	6 2	6	7	8	7	6	
(lower)	11	11	12	11	10	11	12	12	17-19
(total)	18	17	18	17	17	19	19	18	17.8
Branchiostegal rays right									
(left)									
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line	41	39	40	44	37	42	37	38	39.8
Scales 2 rows above lat.	182	167	162	175	180	168	158	183	171.5
Pelvic fin rays	9	9	9	9	9	8	9	9	8-9
Pyloric caeca	45	38	43	37	35	48	40	37	40.3
Dentition	4	3	6	3	4	7	2	5	4.2

T.L.			
	95	111	117
	7/11	6/11	6/12
teeth	4	6	3
fin	9	9	9

Juno

I	II	III	IV
2nd growin	1[illegible]-160	170-190	
95-117 mm		160-190	180-220

UNITED STATES DEPARTMENT OF AGRICULTURE
PURCHASE ORDER

PAGE NUMBER	CONTRACT NUMBER	ORDER DATE	ORDER NUMBER (THIS NUMBER MUST APPEAR ON ALL INVOICES, PACKAGES AND PAPERS RELATING TO THIS ORDER)	SUB
1 OF 1	OM	102980	43-8490-1-63	

CHECK ONE	TO: (Seller)	SHIP TO: (Consignee and Destination)
[X] Purchase Order (See Reverse) [ ] Delivery Order	Colorado State University Dept. of Fish & Wildlife Biology Dr. Robert H. Behnke Fort Collins, CO 80523	Wasatch National Forest 8226 Federal Building 125 South State Street Salt Lake City, UT 84138

LINE ITEM	ACT. CODE	DESCRIPTION	QUANTITY	UNIT ISSUE	UNIT PRICE	AMOUNT
01		Analysis of Cutthroat trout to determine if they are pure strain Utah Cutthroat trout; fish from Cater Creek and Mill Creek, Evanston Ranger Distict,,Wasatch National Forest Cost Not to Exceed $500.00	1	job	500.00	500 00

SELLER'S ORIGINAL

FOB POINT	DISCOUNT TERMS	TOTAL
N/A	Net	500 00
TIME FOR DELIVERY	**SHIP VIA**	
11-3-80	N/A	

BILLING INSTRUCTIONS:

DO NOT SHIP ORDER TO THIS ADDRESS (Ship to Consignee Address Above)

Furnish invoice with our ORDER NUMBER to:

WASATCH NATL. FOREST
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

FAILURE TO SHOW OUR PURCHASE ORDER NUMBER ON INVOICE WILL DELAY PAYMENT

FREIGHT CHARGE OVER $25 REQUIRES BILL OF LADING

ISSUING OFFICE NAME AND ADDRESS	ORDERED BY (Name and Title)
Wasatch National Forest 8226 Federal Building 125 south State Streett Salt Lake City, UT 84138	KAREN JACKSON Purchasing Agent **PHONE (Area Code and Number)** (801)524-5101 FTS 588-5101 **AUTHORIZED SIGNATURE** Karen Jackson

FORM AD - 838 - 9 (5/78)

SELLER'S ORIGINAL

UNITED STATES DEPARTMENT OF AGRICULTURE

Terms and Conditions of Purchase Order

The following terms and conditions apply to purchase orders only. When "Purchase Order" is checked on the front of this form, supplies or services shall be furnished in accordance with the terms specified on both sides of this order and on the attached sheets, if any.

1. INSPECTION AND ACCEPTANCE. - Inspection and acceptance will be at destination, unless otherwise provided. Until delivery and acceptance, and after any rejections, risk of loss will be on the Contractor unless loss results from negligence of the Government.

2. VARIATION IN QUANTITY. - No variation in the quantity of any item called for by this contract will be accepted unless such variation has been caused by conditions of loading, shipping, or packing, or allowances in manufacturing processes, and then only to the extent, if any, specified elsewhere in this contract.

3. DISCOUNTS. - Discount time will be computed from date of delivery at place of acceptance or from receipt of correct invoice at the office specified by the Government, whichever is later. Payment is made, for discount purposes, when check is mailed.

4. DISPUTES. - (a) Except as otherwise provided in this contract any dispute concerning a question of fact arising under this contract which is not disposed of by agreement shall be decided by the Contracting Officer, who shall mail or otherwise furnish a copy thereof to the Contractor. This decision shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the Contractor mails or otherwise furnishes to the Contracting Officer a written appeal addressed to the Head of the Agency. The decision of the Head of the Agency or his duly authorized representative for the determination of such appeals shall be final and conclusive unless determined by a court of competent jurisdiction to have been fraudulent or capricious, or arbitrary, or so grossly erroneous as necessarily to imply bad faith, or not supported by substantial evidence. In connection with any appeal proceedings under this clause, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of his appeal. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the contract and in accordance with the Contracting Officer's decision. (b) This "Disputes" clause does not preclude consideration of law questions in connection with decisions provided for in (a) above: provided, that nothing in this contract shall be construed as making final the decision of any administrative official, representative or board on a question of law.

5. FOREIGN SUPPLIES. - This contract is subject to the Buy American Act (41 U.S.C. 10 a-d) as implemented by Executive Order 10582 of December 17, 1954, and any restrictions in appropriation acts on the procurement of foreign supplies.

6. CONVICT LABOR. - In connection with the performance of work under this contract, the Contractor agrees not to employ any person undergoing sentence of imprisonment except as provided by Public Law 89-176, September 10, 1965 (18 U.S.C. 4082(c) (2) and Executive Order 11755, December 29, 1973.

7. OFFICIALS NOT TO BENEFIT. - No member of or Delegate to Congress or resident commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

8. COVENANT AGAINST CONTINGENT FEES. - The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fees, excepting bonafide employees or bonafide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty the Government shall have the right to annul this contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fees.

9. FEDERAL, STATE, AND LOCAL TAXES. - Except as may be otherwise provided in this contract, the contract price includes all applicable Federal, State and local taxes and duties in effect on the date of this contract but does not include any taxes from which the Government, the Contractor or this transaction is exempt. Upon request of the Contractor, the Government shall furnish a tax exemption certificate or similar evidence of exemption with respect to any such tax not included in the contract price pursuant to this clause. For the purpose of this clause, the term "date of contract" means the date of the contractor's quotation or, if no quotation, the date of this purchase order.

10. SERVICE CONTRACT ACT OF 1965. - *(applies only to contracts for services unless exempted by the regulations of the Department of Labor)* - Except to the extent that an exemption, variation, or tolerance would apply pursuant to 29 CFR 4-6 if this were a contract in excess of $2500, the contractor and any subcontractor hereunder shall pay all his employees engaged in performing work on the contract not less than the minimum wage specified under section 6(a)(1) of the Fair Labor Standards Act of 1938, as amended. All regulations and interpretations of the Service Contract Act of 1965 expressed in 29 CFR Part 4 are hereby incorporated by reference in this contract.

11. CHANGES. - The Contracting Officer may at any time, by a written order, and without notice to the sureties, make changes within the general scope of this contract, in any one or more of the following: (i) *for supplies:* (a) drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (b) method of shipment or packing; and (c) place of delivery; (ii) *for services, including but not limited to the following:* (a) specifications (including drawings and designs);(b) method or manner of performance of the work; (c) Government-furnished facilities, equipment, materials, services, or site; or (d) directing acceleration in the performance of the work. If any such change causes an increase or decrease in the cost of, or the time required for, the performance of any part of the work under this contract, whether changed or not changed by any such order, an equitable adjustment shall be made in the contract price or delivery schedule, or both, and the contract shall be modified in writing accordingly. Any claim by the Contractor for adjustment under this clause must be asserted within 30 days from the date of receipt by the Contractor of the notification of change. *Provided, however,* that the Contracting Officer, if he decides that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this contract. Where the cost of property made obsolete or excess as a result of a change is included in the Contractor's claim for adjustment, the Contracting Officer shall have the right to prescribe the manner of disposition of such property. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes." However, nothing in this clause shall excuse the Contractor from proceeding with the contract as changed.

12. TERMINATION FOR DEFAULT. - The Contracting Officer, by written notice, may terminate the contract, in whole or in part, for failure of the Contractor to perform any of the provisions hereof. In such event the Contractor shall be liable for damages, including the excess cost of reprocuring similar supplies or services, provided that if (i) it is determined for any reason that the Contractor was not in default or (ii) the Contractor's failure to perform is without his and his subcontractor's control, fault or negligence the termination shall be a termination for convenience under paragraph 13.

13. TERMINATION FOR CONVENIENCE. - The Contracting Officer, by written notice, may terminate this contract, in whole or in part, when it is in the best interest of the Government. If this contract is for supplies and is so terminated, the Contractor shall be compensated in accordance with Part 1-8 of the Federal Procurement Regulations (41 CFR 1-8), in effect on this contract's date. To the extent that this contract is for services and is so terminated, the Government shall be liable only for payment in accordance with the payment provisions of this contract for services rendered prior to the effective date of termination.

14. ASSIGNMENT OF CLAIMS. - Claims for monies due or to become due under this contract shall be assigned only pursuant to the Assignment of Claims Act of 1940, as amended (31 U.S.C. 203, 41 U.S.C. 15). This purchase order may not be assigned unless or until the supplier has been requested to and has accepted this order by executing an Acceptance hereon.

15. CLAUSES INCORPORATED BY REFERENCE. - If the amount of this purchase order exceeds $2,500, the following clauses form a part of the purchase order and are hereby incorporated by reference. Citations refer to the Federal Procurement Regulations. Text of the clauses may be obtained from the Contracting Officer:

Employment of the Handicapped (1-12.1304)
Contract Work Hours and Safety Standards Act (1-12.303)
Service Contract Act of 1965 (1-12.904-1)(when applicable this clause takes precedence over paragraph 10 above).

FORM AD-838-10(5/78)

Disputes

(a) This contract is subject to the Contract Disputes Act of 1978 (41 U.S.C. 601, et. seq.). If a dispute arises relating to the contract, the contractor may submit a claim to the Contracting Officer who shall issue a written decision on the dispute in the manner specified in DAR 1-314 (FPR 1-1.318).

(b) "Claim" means

(1) a written request submitted to the Contracting Officer;

(2) for payment of money, adjustment of contract terms, or other relief;

(3) which is in dispute or remains unresolved after a reasonable time for its review and disposition by the Government; and

(4) for which a Contracting Officer's decision is demanded.

(c) In the case of disputed requests or amendments to such requests for payment exceeding $50,000, or with any amendment causing the total request in dispute to exceed $50,000, the Contractor shall certify, at the time of submission as a claim, as follows:

> I certify that the claim is made in good faith, that the supporting data are accurate and complete to the best of my knowledge and belief; and that the amount requested accurately reflects the contract adjustment for which the contractor believes the Government is liable.

(Contractor's Name)

(Title)

(d) The Government shall pay the contractor interest

(1) on the amount found due on claims submitted under this clause;

(2) at the rates fixed by the Secretary of the Treasury, under the Renegotiation Act, Public Law 92-41;

(3) from the date the Contracting Officer receives the claim, until the Government makes payment.

(e) The decision of the Contracting Officer shall be final and conclusive and not subject to review by any forum, tribunal, or Government agency unless an appeal or action is timely commenced within the times specified by the Contract Disputes Act of 1978.

(f) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal or action related to the contract, and comply with any decision of the Contracting Officer.

(END OF CLAUSE)

III. Regulatory Coverage - Section 5 of Public Law 95-563

The Federal Procurement Regulations are amended by adding the following new section 1-1.328:

1-1.328 Fraudulent Claims

(a) Section 5 of the Contract Disputes Act of 1978 (41 U.S.C. 601, 604) provides that if a contractor is unable to support any part of

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
WASATCH NATIONAL FOREST
8226 FEDERAL BUILDING, 125 SOUTH STATE ST.
SALT LAKE CITY, UTAH 84138

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

SALT LAKE CITY
OCT 30
UTAH

U.S. OFFICIAL MAIL
U.S. POSTAGE

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF AGRICULTURE
AGR 101

U.S.MAIL

S503177

21

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977—229-822 19328

REQUISITION FOR SUPPLIES, EQUIPMENT, OR SERVICES

INSTRUCTIONS: Agencies must provide entries in unshaded areas. See reverse.

MAIL TO: *(Purchasing Activity)*

1 REQUISITIONING OFFICE

2 RECEIVING OFFICE NO.	3 CONTRACT NUMBER	4 ORDER DATE	5 SF-37	6 UNIT CODE	7 FUND CODE	8 PURCHASE/DELIVERY ORDER NUMBER	9 SUB.

1A REQUISITION NO. (Document Control No.)

1B REQUISITION DATE

CHECK ONE: ☐ Purchase Order ☐ Delivery Order

10 TO: (Seller)
Dr. Robert J. Behnke
Dept. of Fish & Wildlife Biology
Colorado State University
Fort Collins, Colo. 80523
8-327-0111
→ 491-5320.

11 SHIP TO (Consignee and Destination)

☐ INSIDE DELIVERY REQUESTED

12 LINE ITEM	13 ACT. CODE	14 DESCRIPTION	15 BUDGET OBJECT	16 ACC. LINE	17 QUANTITY	18 UNIT ISSUE	19 UNIT PRICE	20 AMOUNT
1.		Identification of cutthroat trout from Carter Creek and Mill Creek- D-4, as to their purity as Bonneville Cutthroat trout.					Not to Exceed $500.00	Approx. 500 00

For additional information, please contact:

TECHNICAL CONTACT — TELEPHONE NO.

21 FOB POINT | 22 DISCOUNT TERMS | Sub-Total ▶ 25 500 00

23 REQUIRED DELIVERY (Do not use ASAP) | 23A NEGOTIATED DELIVERY | 24 SHIP VIA | 26 ESTIMATED FREIGHT | TOTAL ▶ 27 500 00

28 ACC LINE	29 ACCOUNTING CLASSIFICATION A	B	C		D	E	30 DISTRIBUTION	31 AMOUNT
2	5	10	5	3	4	1 — 4 — 1 — 2	2	
						250		

SOURCES OF SUPPLY: (If necessary, use attachment)

I certify that the above items are necessary for use in the public service.

TITLE
Fisheries Biologist

SIGNATURE OF AUTHORIZED REPRESENTATIVE
Mark A. Shaw.

INSTRUCTIONS FOR REQUISITIONING ACTIVITIES

Do not make entries in shaded areas *(blocks numbered 4, 5, 6, 8, 9, 10, 13, 21, 22, 23A, 24, 26, 27 and Purchase Delivery Order block).* These spaces are provided for procurement personnel.

Block 1. REQUISITIONING OFFICE. Enter the office that prepares the requisition.

Block 1A. REQUISITION NUMBER. Enter appropriate Document Control Number.

Block 1B. REQUISITION DATE. Enter date the requisition is prepared.

Block 2. RECEIVING OFFICE NUMBER. Enter last four positions of the GSA FEDSTRIP Requisition Number of the office responsible for answering inquiries concerning receipt of the order.

Block 3. CONTRACT NUMBER. If this is a delivery order on a GSA contract, enter contract number, if known. Otherwise, leave blank.

Block 6. UNIT CODE. For Forest Service only; enter the code of the unit whose funds are to be charged.

Block 7. FUND CODE. Enter appropriate Fund Code for agency and accounting station, as assigned by National Finance Center (NFC).

Block 11. SHIP TO. Enter complete destination address to include zip code. Check "Inside Delivery Requested" box if applicable.

Block 12. LINE ITEM. Each separately priced item must be assigned a number, beginning with 1 and continuing consecutively.

Block 14. DESCRIPTION. Provide complete description of the item(s). Enter details of the order, e.g., special delivery instructions, subscription renewal numbers, GSA Catalog stock numbers, etc.

Block 15. BUDGET OBJECT. Enter NFC assigned Budget Object Classification Code *(4 positions)*, incorporating agency assigned subobject codes *(3rd and 4th positions)* as applicable.

Block 16. ACCOUNTING LINE. Enter the number from Block 28 that identifies the accounting classification to be charged. Enter an "X" if the line item is to be charged to more than one accounting classification.

Block 17. QUANTITY. Enter quantity required, consistent with unit of issue.

Block 18. UNIT ISSUE. Unit of issue must be consistent with unit of shipment/billing by the source of supply, e.g.; DZ, EA, JOB, PK, etc. When ordering GSA stock numbered items, use unit of issue in the GSA Supply Catalog.

Block 19. UNIT PRICE. Enter price per unit of issue. Up to four decimal places may be used, e.g., .0625.

Block 20. AMOUNT. Enter the extended value *(Quantity x Unit Price)*. Round off to two decimal places.

Block 23. REQUIRED DELIVERY. Enter required delivery date.

Block 25. SUB-TOTAL. Enter on the last page of the order the cumulative total of Block 20 "Amount".

Block 28. ACCOUNTING LINE. This block identifies the appropriate account(s) to be charged. The identifying numbers in Block 28 are used also in Block 16 to relate the line item(s) with the appropriate accounting classification(s). Starting with "1" and continuing consecutively, enter a number for each line of accounting classification.

Block 29. ACCOUNTING CLASSIFICATION. Enter the appropriate accounting data for each accounting line number entered in Block 28. Use format prescribed by your agency.

Block 30. DISTRIBUTION. If an "X" has been entered in Block 16, enter in Block 30 the percentages of the amount to be charged the applicable accounting classifications. The percentages must total 100.

If sources of supply are known, enter name and full address.

REQUISITION FOR SUPPLIES, EQUIPMENT, OR SERVICES

INSTRUCTIONS: Agencies must provide entries in unshaded areas. See reverse.

MAIL TO: *(Purchasing Activity)*

1 REQUISITIONING OFFICE

2 RECEIVING OFFICE NO.	3 CONTRACT NUMBER	4 ORDER DATE	5 SF-37	6 UNIT CODE	7 FUND CODE	8 PURCHASE/DELIVERY ORDER NUMBER	9 SUB.

1A REQUISITION NO. (Document Control No.)

1B REQUISITION DATE

CHECK ONE
☐ Purchase Order
☐ Delivery Order

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Dr. Robert J. Behnke
Dept. of Fish & Wildlife Biology
Colorado State University
Fort Collins, Colo. 80523
8-327-0111
→ 491-5320.

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☐ INSIDE DELIVERY REQUESTED

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For additional information, please contact:

TECHNICAL CONTACT TELEPHONE NO.

21 FOB POINT

22 DISCOUNT TERMS

25 Sub-Total ▶ 500 00

23 REQUIRED DELIVERY (Do not use ASAP)

23A NEGOTIATED DELIVERY

24 SHIP VIA

26 ESTIMATED FREIGHT

27 TOTAL ▶ 500 00

28 ACC. LINE	29 ACCOUNTING CLASSIFICATION A	B	C	D	E	30 DISTRIBUTION	31 AMOUNT
—2—	—5—	—10—	—5— —3—	—4—	—1— —4— —1— —2—	—2—	
					250		

SOURCES OF SUPPLY (If necessary, use attachment)

I certify that the above items are necessary for use in the public service.

TITLE
Fisheries Biologist

SIGNATURE OF AUTHORIZED REPRESENTATIVE
Mark A. Shaw.

☆ U.S. GOVERNMENT PRINTING OFFICE 1977—229-822 19328

REQUISITION FOR SUPPLIES, EQUIPMENT, OR SERVICES

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2 RECEIVING OFFICE NO.	3 CONTRACT NUMBER	4 ORDER DATE	5 SF-37	6 UNIT CODE	7 FUND CODE	8 PURCHASE/DELIVERY ORDER NUMBER	9 SUB.	1A REQUISITION NO. (Document Control No.)
								1B REQUISITION DATE

CHECK ONE: ☐ Purchase Order ☐ Delivery Order

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Dept. of Fish & Wildlife Biology
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Fort Collins, Colo. 80523

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8-327-0111
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For additional information, please contact:

TECHNICAL CONTACT | TELEPHONE NO.

21 FOB POINT | 22 DISCOUNT TERMS | Sub-Total ▶ 25 500 00

23 REQUIRED DELIVERY (Do not use ASAP) | 23A NEGOTIATED DELIVERY | 24 SHIP VIA | 26 ESTIMATED FREIGHT | TOTAL ▶ 27 500 00

28 ACC LINE —2—	29 ACCOUNTING CLASSIFICATION A —5—	B —10—	C —5— —3—	D —4—	E 1 —4— 1 —2—	30 DISTRIBUTION —2—	31 AMOUNT
					2 50		

SOURCES OF SUPPLY (If necessary, use attachment)

I certify that the above items are necessary for use in the public service.

TITLE: Fisheries Biologist

SIGNATURE OF AUTHORIZED REPRESENTATIVE: Mark A Shaw

AD-700 (7-76)

☆ U.S. GOVERNMENT PRINTING OFFICE 1977—229-822 19328

REQUISITION FOR SUPPLIES, EQUIPMENT, OR SERVICES

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MAIL TO: *(Purchasing Activity)*

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TECHNICAL CONTACT — TELEPHONE NO.

21 FOB POINT	22 DISCOUNT TERMS	Sub-Total ▶	25 500.00
23 REQUIRED DELIVERY (Do not use ASAP) / 23A NEGOTIATED DELIVERY / 24 SHIP VIA / 26 ESTIMATED FREIGHT		TOTAL ▶	27 500.00

28 ACC. LINE -2-	29 ACCOUNTING CLASSIFICATION A -5-	B -10-	C -5- -3-	D -4-	E -1- -4- -1- -2-	30 DISTRIBUTION -2-	31 AMOUNT
					250		

SOURCES OF SUPPLY (If necessary, use attachment)

[illegible]

I certify that the above items are necessary for use in the public service.

TITLE
Fisheries Biologist

SIGNATURE OF AUTHORIZED REPRESENTATIVE
[illegible signature]

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat S. c. ? utah LOCALITY Mill Creek Wasatch N.F. D-4 Trib to Bear River

COLLECTED BY DATE 9/30/80

Cat. # Measurements by Eric Wagner DATE 17 Nov 1980

Specimen # Bonneville

	1	2	3	4	5	6	7	8
Total L.	160	161	287	215	142	158	149	239
Standard L.	141	135	246	183	119	132	124	203
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	8/0	7/1	7/0	7/0	7/0	7/0	8/1	8/0
(lower)	13/0	13/1	13/0	13/0	12/1	12/0	13/0	12/0
(total)	21	20	20	20	19	19	21	20
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	44	40	42	45	40	40	43	44
Scales 2 rows above lat.	206 196	174	182	189 179	174	197 187	184	172
Pelvic fin rays	9	8	9	9	9	9	9	9
Pyloric caeca	42	42	39	39	35	39	37	—
Dentition	4	5	4	3	6	3	0	7

* stream has been stocked with yellowstone cutthroat and rainbow.

16-21 (19.2)

34-53 (41.8) caeca

37-45 (41.0) spots as Carter Ck

157-190 (179.8) — largest looks good

2 w/o teeth — one w/ spots on head.

30 w/ 1-7 (3.3)

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat (s.c. ? utah) LOCALITY Mill Creek Wasatch N.F. D-4 Trib. to Bear River

COLLECTED BY ______ DATE 9-30-80

Cat. # ______ Measurements by Eric Wagner DATE 17 Nov 1980

Specimen #	9	10	11	12	13	14	15	16
Total L.	211	171	154	110	103	144	135	96
Standard L.	183	144	129	91	86	121	113	80
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	6/0	7/0	6/0	7/1	7/0	7/1	7/0	7/1
(lower)	13/2	13/2	11/0	12/1	11/0	14/0	13/1	13/0
(total)	19	20	17	19	18	21	20	20
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	46	44	37	41	40	41	43	42
Scales 2 rows above lat.	188 178	186	186 176	176	177	191 181	190	184
Pelvic fin rays	9	9	9	9	9	9	9	9
Pyloric caeca	46	52	47	38	42	53	48	45
Dentition	2	4	3	4	3	5	6	1

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES cutthroat (S.C. utah) ?

LOCALITY Mill Creek Wasatch N.F. D-4
Trib to Bear River

COLLECTED BY

DATE 9-30-80

Cat. #

Measurements by Eric Wagner

DATE 19 Nov 1980

Specimen #	17	18	19	*20	21	22	23	24
Total L.	101	93	128	95	189	119	166	104
Standard L.	84	77	108	78	161	90	143	87
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/0	6/0	5/0	7/0	8/0	7/0	7/0	6/0
(lower)	12/1	12/0	11/0	11/0	11/2	13/0	13/0	14/0
(total)	19	18	16	18	19	20	20	20
Branchiostegal rays right								
" (left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	44	40	37	37	40	41	41	40
Scales 2 rows above lat.	173	170	194 184	160	164	177	177	190
Pelvic fin rays	9	9	9	9	9	9	9	9
Pyloric caeca	49	40	47	39	41	46	46	34
Dentition	3	3	7	2	1	4	3	5

#20 - white tip on dorsal fin by not on pelvics

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat (S.c. ? utah) LOCALITY Mill Creek Wasatch N.F D-4 Trib to Bear River

COLLECTED BY ____________ DATE 9-30-80

Cat. # ____________ Measurements by Eric Wagner DATE 20-Nov 80

Specimen #	25	26	27	28	29	30	31	32
Total L.	89	89	98	86	91	94	94	89
Standard L.	74	75	82	71	75	78	79	73
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/0	6/1	6/0	6/0	6/0	6/1	7/0	6/0
(lower)	13/0	12/0	12/0	11/0	12/0	11/1	14/0	12/0
(total)	20	18	18	17	18	17	21	18
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	39	40	40	38	41	42	42	37
Scales 2 rows above lat.	168	176	183 173	172	182	188 178	174	172
Pelvic fin rays	9	9	8	9	9	9	9	9
Pyloric caeca	42	45	44	42	41	51	40	46
Dentition	3	2	1	1	0	4	2	2

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat S. c. utah

LOCALITY Carter Creek Wasatch N.F. D-4
Trib to Mill Creek + Bear River

COLLECTED BY ____________ DATE 9/30/80

Cat. # ____________ Measurements by Eric Wagner DATE 15 Nov 1980

Specimen # Bonneville

Specimen #	1	2	3	4	5	6	7	8
Total L.	233	179	134	173	118	83	75	71
Standard L.	198	153	111	145	98	72	61	59
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/0	6/0	7/0	7/0	7/0	7/1		
(lower)	14/0	13/1	11/0	12/0	14/0	12/0		
(total)	21	19	18	19	21	19		
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	42	40	45	42	44	33		
Scales 2 rows above lat.	186	189 179	176	185 175	184	175		
Pelvic fin rays	9	9	9	9	9	9		
Pyloric caeca	48	53	46	49	46	44		
Dentition	8	11	5	13	10	8		
	*							
	on back							

1 - 63 mm cutthroat in mouth of specimen; head of prey pointed toward stomach.

all w/ teeth 2-13 (7.1)

39-55 caeca (46.4)

35-45 (40.7)

162-188 (177.5)

18-21 (19.3)

spots variable

largest w/ on top head

some typical of Thomas Pk.

some smaller more profuse

but no typical hybrid

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Cutthroat LOCALITY Carter Creek Wasatch NF D-4 Trib to Mill Creek + Bear River

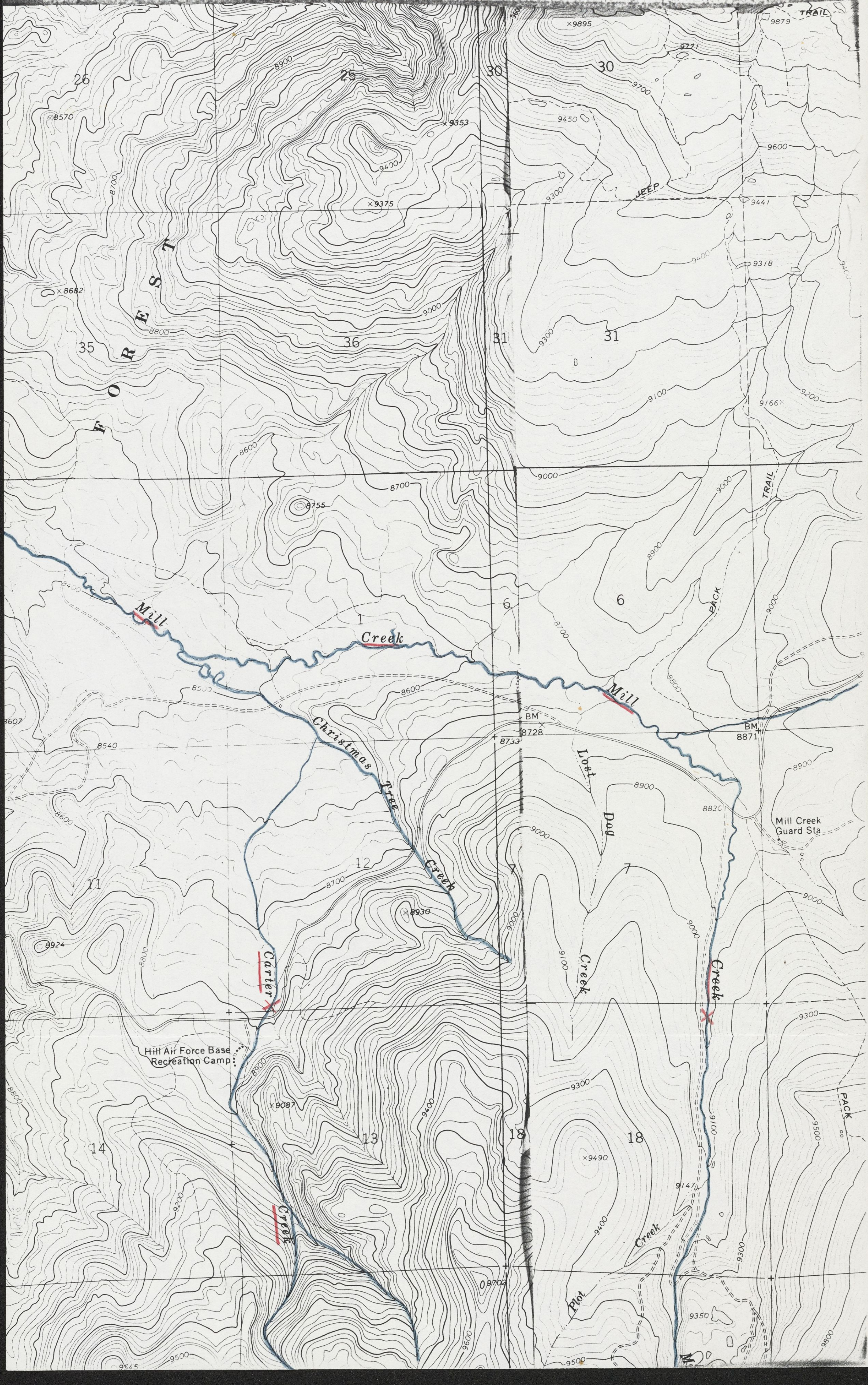
COLLECTED BY ______ DATE 9/30/80

Cat. # ______ Measurements by Eric Wagner DATE 17 Nov 1980

Specimen #	9	10	11	12	13	14	15	16	17
Total L.	113	125	122	182	98	150	83	79	69
Standard L.	94	106	102	151	81	125	68	68	57
Body D									
Head L									
Orbit L									
Upper Jaw L									
Dors. Orig. to Snt. tip									
Dorsal fin basal L									
Dorsal fin depressed L									
Adip. fin depressed L									
Caudal peduncle D									
Caudal peduncle L									
Vertebrae									
1st Arch gillrakers (up)	7 / 1	7 / 0	8 / 1	7 / 0	5 / 0	7 / 2	7 / 0	6 / 0	
(lower)	12 / 0	12 / 1	13 / 1	11 / 0	13 / 0	14 / 3	13 / 0	12 / 0	
(total)	19	19	21	18	18	21	20	18	
Branchiostegal rays right									
(left)									
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line	39	41	46	38	40	40	40	40	
Scales 2 rows above lat.	174	176	181	162	193 183	173	188 178	183	
Pelvic fin rays	9	9	9	9	9	9	9	9	
Pyloric caeca	48	39	39	55	47	42	54	39	
Dentition	6	10	8	3	5	2	5	5	

18	19	20	21	22
74	70	75	80	78
61	59	61	66	65

Deadman Mnt. Quad.   Elizabeth Mnt. Quad.



UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Wasatch National Forest
8226 Federal Bldg., 125 So. State
Salt Lake City, Utah 84138

2630

October 30, 1980

Dr. Robert Benhke
Department of Fish and Wildlife Management
Colorado State University
Fort Collins, Colorado 80523

Dear Dr. Behnke:

Enclosed please find a copy of two quad maps showing the location of the two sites from which the Cutthroat Trout were taken. The fish are to be shipped out today, and the requisition for payment will follow shortly. The following is a brief description of the two creeks from which the fish were taken.

Carter Creek is a small tributary to Mill Creek which then flows into the Bear River. It ranges in elevation from 9880 feet to its confluence at 8530 feet. It is four miles long, of which 2.6 miles lie within the Forest boundary. It is a small stream, with flows ranging from approximately 100 CFS to low flows of less than one CFS. The upper half of the stream is very steep, with gradients greater than ten percent, and lower gradients of four to six percent. One third of the creek runs through meadow, and willow complexes, with the rest running through conifer forest. Dexter Pitman, Northern Region Fisheries Biologist, Utah D.W.R., said that historically the stream has never been stocked, because of its small size; but it has no natural barriers between itself and Mill Creek which has been stocked with Yellowstone Cutthroat Trout and Rainbow Trout. He believes that the rainbow do not survive the harsh winter environment because they are vulnerable hatchery stock. Both Carter Creek and Mill Creek have active beaver dam complexes.

Mill Creek is 22 miles in length from its headwaters to its confluences with the Bear River. Four miles of the stream lie within the Forest Boundary. On the Forest, the gradient varies from greater than ten percent in the headwaters to four percent in the lower meadows. Almost the entire stream is lined with a meadow, grass-forb, or willow complex. The flows vary from 150 CFS to two or three CFS. The lower reaches have extensive beaver dam complexes. The stream is stocked yearly with catchable Rainbow Trout and was stocked with Yellowstone Cutthroat Trout. It receives moderate fishing pressure, and has high esthethic appeal because of its willow bottoms, meadows, and background scenery. Mill Creek is 8.5 miles, and Carter Creek, 6 miles from the Bear River Ranger Station.

If you have any questions, please call me at (801) 524-5107. Thank you.

Sincerely,

Mark A. Shaw

MARK A. SHAW
Aquatic Habitat Biologist

Enclosure