GREENBACK CUTTHROAT TROUT

RECOVERY PLAN

This is the completed Greenback Cutthroat Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies (and it does not necessarily represent the views of all recovery team members/individuals), who played the key role in preparing this plan. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

Acknowledgements should read as follows:

The Greenback Cutthroat Trout Recovery Plan, dated Oct. 1982, prepared by the U.S. Fish and Wildlife Service in cooperation with the Greenback Cutthroat Trout Recovery Team.

James R. Bennett	Colorado Division of Wildlife
Bruce D. Rosenlund	U.S. Fish and Wildlife Service
Richard Moore	U.S. Forest Service
David R. Stevens	U.S. National Park Service

Additional copies may be obtained from:

Fish and Wildlife Reference Service
Unit i
Denver, Colorado 80205
Telephone: 303/571-4656

Acknowledgement

The Team is grateful to its former members and consultants who aided in the preparation of this Plan. They include:

Robin Knox	Colorado Division of Wildlife
David Langlois	Colorado Division of Wildlife
Rolf B. Nittman	Colorado Division of Wildlife
Robert Behnke	Cooperative Fishery Unit
John Gold	Texas A&M University
Bob Stuber	U.S. Forest Service
James W. Mullan	U.S. Fish and Wildlife Service
Pat Dwyer	U.S. Fish and Wildlife Service
Terry Hickman	U.S. Fish and Wildlife Service
Jane Park	U.S. Fish and Wildlife Service

Preface

This Recovery Plan for the greenback cutthroat trout was developed by the Greenback Cutthroat Trout Recovery Team, an interagency group of scientists operating under the sponsorship of the U.S. Fish and Wildlife Service. The goal of this Plan is to restore the greenback cutthroat to a nonthreatened or endangered status within its native range.

The original greenback Recovery Plan was written in 1978 and is superseded by this Plan. This latest edition contains updated information and recovery objectives completed by researchers since 1978.

The plan is organized into five sections:

1. Introduction - outlining taxonomy, life history, ecology, reproduction, diseases and parasites, food, growth, reasons for decline and distribution;

2. Recovery - detailing the tasks considered vital to the successful recovery of the greenback;

3. Status of recovery plan implementation - an up-to-date tabulation of the status of recovered populations;

4. Implementation schedule - an itinerary of scheduled recovery tasks assigning lead-agency responsibility and estimated costs;

5. Appendix A: Letters of comment.

We sincerely hope that this document will be used by agencies involved with greenback trout management to align and coordinate their efforts to most effectively work toward our common goal.

Revisions of this Plan, especially Sections III (Status of Recovery Plan Implementation) and Section IV (Implementation schedule) will occur as often as is feasible and appropriate.

Literature citation should read:

> Greenback Cutthroat Trout Recovery Team. 1982. Greenback Cutthroat Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Table of Contents

	Page
Acknowledgement	i
Preface	ii
PART I	
Introduction	1
Taxonomy	2
Table 1	3
History	4
Life History and Ecology	5
Habitat Requirements	5
Reproduction	5
Food and Feeding	6
Size	6
Diseases and Parasites	6
Reasons for Decline	7
Distribution	8
Pure Populations	8
Figure 1	9
"B" Populations	10
"C" Populations	10
PART II	
Objective	11
Step-down Outline	11
Narrative	14
Table 2	16
Table 3	21
Literature Cited	27
PART III	
Current Status of Task Implementation	29
PART IV	
Implementation Schedule	32
PART V	
Appendix	
A. Letters of Comment	
B. Wild Trout Policy	

PART I

INTRODUCTION

There were four cutthroat trout subspecies in Colorado when settlers first arrived. The greenback cutthroat trout was the sole salmonid resident in the South Platte River drainage, and it shared the Arkansas River system with the now extinct yellowfin cutthroat. Unfortunately, these four cutthroat trout subspecies proved quite susceptible to the negative influences associated with human "improvement". Land and water exploitation, mining, logging and the wholesale stocking of exotic fish species have all taken their toll on the endemic trout of Rocky Mountain region. Greene (1937) thought the greenback already extinct. Fortunately he was wrong, and three "pure" populations of greenback cutthroat trout have subsequently been discovered.

Efforts to improve the plight of the greenback trout began in 1959, and were shared by Bureau of Land Management, Colorado Cooperative Fishery Unit (CSU), U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service and the Colorado Division of Wildlife. With the enactment of the Endangered Species Act (1973), the greenback was listed as an endangered species. Substantial recovery progress was made throughout the 1970's, which led to the downlisting of the greenback to threatened status in 1978, where it remains today.

Continued recovery is expected, as is the complete delisting of the greenback. At that time, we should know where all the pure historic populations are; and as a result of reintroduction, there should be enough secure, stable populations in the South Platte and Arkansas River systems to ensure natural genetic variability within the greenback genotype; and a realistic, workable management plan should be drafted and in place. Hopefully, the public will continue its support of the greenback recovery effort, and will soon have its patience rewarded when the greenback cutthroat trout regains its stature as a native gamefish species.

BACKGROUND

Taxonomy

The cutthroat trout, *Salmo clarki*, is a prime example of a polytypic species. Trout referred to as *S. clarki* are found in both coastal and inland streams from Alaska to New Mexico, and within this range the species has evolved into numerous subspecies or geographic races. Many subspecies undoubtedly are polyphyletic, having evolved directly from other subspecies rather than (monophyletically) from a centrally localized stem group. This evolutionary pattern, coupled with the declining abundance of "pure" inland trout, and extensive hybridization with introduced species (e.g., *Salmo gairdneri*), has made it very nearly impossible to unravel the myraid systematic problems within inland *S. clarki* (Gold 1977).

The taxonomy of the greenback cutthroat trout (*S. c. stomias*) ("greenback") has been described by Wernsman (1973), Behnke (1973, 1976, 1979) with the following species description from Behnke and Zarn (1976), "Taxonomic criteria for *S. clarki stomias* remain tentative due to the extreme rareness of pure populations and to the scarcity of ancient museum specimens. Even so, scale counts made from available specimens consistently exhibit the highest values of any cutthroat trout, or any trout in the genus *Salmo*. It may be assumed that extremely high scale counts (Table 1) are characteristic of pure populations of *S. c. stomias*, with some suggestion that those populations native to the South Platte Basin may show slightly higher counts than those native to the Arkansas drainage. The greenback cutthroat displays typically lower numbers of pyloric caeca and vertebrae than most other subspecies of *S. clarki* but much overlap occurs in these characters.

Salmo clarki stomias undoubtedly derived via an ancient headwater transfer from waters of the Colorado River basin to the South Platte River drainage (and then to the Arkansas River drainage) and for this reason shares many similarities with the Colorado River cutthroat, *S. c. pleuriticus*. The striking spotting pattern and intense coloration which can develop in mature fish is the most diagnostic field character of the greenback trout. *S. c. stomias* typically displays the largest and most pronounced spots of any cutthroat trout. Round to oblong in shape, they appear concentrated posteriorly on the caudal peduncle area. Coloration, similar to *S. c. pleuriticus*, tends toward blood-red over the lower sides and ventral region, especially in mature males. Although a genetic basis exists to express characteristic color patterns, the actual manifestation of color intensity and pattern depends upon age, sex and diet."

Table 1

Comparison of selected parameters for various Colorado subspecies of *Salmo clarki* and rainbow trout (from Johnson 1976)

	Number vertebrae	Number pyloric ceaca	Number gill-rakers	Number basibranchial teeth	Lateral line scale count (2 rows above lateral line)	Scale count from lateral line to dorsal fin	Spots
	mean (range)	mean (range)	mean (range)	mean (range)	mean (range)	mean (range)	
S. clarki stomias (greenback cutthroat trout)*	60.6 (59-62)	29.4 (24-42)	20.5 (17-22)	usually present (0-15)	195.0 (175-214)	48.0 (46-53)	Large absent from head
S. clarki virginalis (Rio Grande cutthroat trout)*	61.7 (60-63)	46.0 (33-59)	19.5 (18-21)	7.3 (4-12)	164.0 (146-186)	41.9 (39-47)	Med. size, concentrated posteriorly
S. clarki pleuriticus (Colorado cutthroat trout)*	61.2 (60-63)	35.0 (23-46)	19.0 (16-21)	usually present (0-15)	180.0 (159-202)	43.0 (31-51)	Large spots concentrated posteriorly
S. clarki macdonaldi (yellowfin cutthroat trout)*	60.6 (60-61)	42.0 (32-49)	21.3 (20-22)	15.5 (15-16)	161.7 (149-172)	41.3 (38-46)	Spots small, irregular shape
S. clarki lewisi (Yellowstone cutthroat trout)	61.6 (60-63)	41.2 (31-51)	20.6 (18-23)	24.0 (9-46)	179.2 (161-187)	40.6 (37-46)	
S. gairdneri (rainbow trout)	63.0 (62-65)	55.0 (40-70)	19.0 (18-21)	absent	130.0 (120-140)	27.0 (24-30)	Small, equally distributed

*Counts from populations thought to be pure strains and typical of the subspecies. (From Behnke 1973a, 1973b, 1973c; Wernsman 1973)

History

According to Behnke (1979), "There is considerable confusion concerning the name stomias in regards to where the original (type) specimens actually came from. It is possible that the specimens on which the name is based, were not greenback trout taken from the South Platte drainage. Cope (1872), in the same publication in which he names S. pleuriticus, named Salmo stomias from specimens collected from: "The South Platte River at Fort Riley, Kansas." The South Platte River drainage does not enter the State of Kansas. In later publications, Cope stated that the "type locality" of stomias is the Kansas River at Fort Riley, Kansas. The Kansas River, however, has no native trout. The confusion originated with an Army expedition under the command of Lt. F. T. Bryant, traveling from Fort Riley, Kansas, to Fort Bridger, Wyoming, and back again in 1856. A surgeon, Dr. W. R. Hammond, accompanied the expedition and made natural history collections; among his collections were two specimens of cutthroat trout. The expedition traversed parts of the Kansas, North Platte, South Platte and Green River drainages in Kansas, Nebraska, Wyoming and Colorado. Cutthroat trout could have been collected only in the Green River or South Platte drainages. The problem is that all of the specimens collected on the expedition were simply labeled "Fort Riley, Kansas" (the terminus of the expedition) and shipped to the Philadelphia Academy of Sciences, where Cope later saw the cutthroat trout specimens and named Salmo stomias.

Jordan (1891) redefined stomias and limited its use to the cutthroat trout native to the South Platte and Arkansas River drainages. Jordan also appears to be the first person to use the common name "greenback" for this trout in the literature.

Actually, stomias specimens do not have any more green on their backs than do any other subspecies of cutthroat trout.

The fate of the greenback population native to the Twin Lakes essentially parallels the fate of the greenback trout in general. Twin Lakes was noted for its abundance of greenback trout in the nineteenth century. In the 1890's rainbow trout, brook trout, lake trout (Salvelinus namaycush), and Atlantic salmon were introduced. When Juday sampled Twin Lakes in 1902-1903, rainbow trout were dominant (Juday, 1906). Although Juday collected specimens of greenback trout (some of these were identified as hybrids when examining Juday's specimens at the National Museum), he found no "yellowfin" cutthroat trout. The greenback disappeared from Twin Lakes shortly thereafter. Twin Lakes is now primarily noted for its lake trout fishery."

When the Leadville National Fish Hatchery was established in 1889, the greenback cutthroat trout was obtained from waters adjacent to the hatchery and moved by wagon to the hatchery to be used as broodstock. Evidently, the greenback and the yellowfin cutthroat trout did not adapt as well to this hatchery as some other species, such as the brook trout. The availability of other species more adaptable to hatchery rearing, and species such as the Yellowstone cutthroat whose eggs were easily available in large numbers, evidently led to the abandonment of the greenback by early fish culturalists as a source of trout for stocking purposes.

A second attempt to rear greenbacks at the Leadville National Fish Hatchery was attempted in 1957 and 1958, using 50 slightly hybridized greenbacks from Forest Canyon, Rocky Mountain National Park, and 26 pure greenbacks from the now extinct Albion Creek population. This project was abandoned due to fish mortality in the hatchery and asynchronous maturation of the remaining males and females. The project terminated with the stocking of the surviving broodstock into Florence Creek, Uinta and Ouray Indian Reservation, Utah. The greenbacks in Florence Creek had been almost totally displaced by brook trout by 1978.

Life History and Ecology

Habitat Requirements: The habitat requirements of the greenback cutthroat trout appear little different from other species of trout. Bulkley (1959) gathered information on age, growth, food habits and movement of a slightly hybridized population in the headwaters (10,500 ft) of the Big Thompson River, Rocky Mountain National Park (RMNP). Nelson (1972) provided data on age, growth and fecundity of a dense and unexploited, slightly hybridized greenback population in Island Lake, Boulder Creek watershed. Although these studies focus on some aspects of habitat and life history, there is a general lack of detailed information on the subtleties of the greenback's habitat requirements. To date, the most critical requirement documented is the absence of other species of trout. Greenbacks appear to easily hybridize with other spring-spawning species, and are easily displaced by brook trout in subalpine and montane habitats within Colorado.

Reproduction: Although not much detailed information is available on the reproductive aspects of greenback trout in Colorado, there presently is little reason to suspect stomias to be different in spawning activities from other S. clarki subspecies. Spawning occurs from late spring to late summer depending upon water temperature. Greenbacks in Hidden Valley Creek, RMNP, at an elevation of 9,000 ft spawn in mid-June, while greenbacks at an elevation of 11,000 ft in the North Fork, Big Thompson River were still running milt in mid-September. Water temperatures during spawning often are in the 3.8C to 7.2C range. The fecundity of

seven females from Island Lake, averaging 270+ mm in length, had a mean value of 299 eggs per fish (Nelson 1972). Como Creek greenbacks held at the USFWS Fish Cultural Development Center (FCDC) produced 1.5 eggs per gram of female weight for two-year old greenbacks weighing 254 gram and 1.4 eggs per gram of female weight for three-year olds weighing 357 g (Dwyer 1981).

Although Como Creek greenbacks can produce eggs at age two in the hatchery, in small subalpine streams within Colorado females appear to mature after their fourth summer of life at lengths near 180 mm. In Forest Canyon, at an elevation of approximately 10,500 ft, Bulkley (1959) observed fry emerging on August 26.

Food and Feeding: Jordan (1891) mentioned that stomias fed on invertebrates when held in a hatchery and were reluctant to accept fish flesh as food. Bulkley (1959) reported that the slightly hybridized greenbacks in Forest Canyon fed mainly upon terrestrial organisms during the summer, primarily adult Hymenoptera and adult Diptera.

Size: Behnke (1979) stated that, "Historically, it appears that the greenback seldom attained a large size. About 1-2 pounds seems to be typical maximum size given by "old timers". In Twin Lakes, Colorado, during the late 1800's, the greenback did not exceed a foot in length, while the yellowfin cutthroat (now extinct) attained a size of 10-12 pounds." However, in small headwater habitats, the greenback can attain a relatively large size of 356-380 mm as observed in the headwaters of the South Fork, Cache La Poudre River, which is much larger than that attained by most brook trout populations in similar habitat.

Disease and Parasites: The only known data on the pathogens of wild greenbacks was obtained prior to the transfer of 64 Como Creek greenbacks to the USFWS, FCDC in 1977. Fecal material, ovarian fluid and seminal fluid from 78 Como Creek pre- and post-spawning greenbacks failed to show any viral activity when inoculated onto susceptible tissue cultures. One moribund greenback collected from Como Creek on June 22, 1977, was found to have numerous Gyrodactylus spp. and Glossatella spp. covering the body. Internally, this greenback was found to have Hexamita spp. and Crepidostomum farionis within the intestinal tract. Although bacteria were present within the kidney, they were nonobligate to salmonids.

Following the transfer of the Como Creek greenbacks to the FCDC, 11 greenbacks were lost within 6 months. Examination of these fish revealed no viral activity, and no clinical bacterial infection was found although Pseudomonas spp. and Aeromonas hydrophilia was isolated. Fish diagnostics by the USFWS, Fish Disease Control Center.

Reasons for Decline of the Numbers of Pure Populations of Greenback Cutthroat Trout

The most critical factor in the decline of the greenback cutthroat trout has been the introduction of nonnative fish species within the South Platte and Arkansas River drainages. The 1800's saw the greenback cutthroat as the dominant trout in these two drainages, the arrival of the railroad to Colorado, and the emergence of the art of fish culture. The railroad and the fish hatchery combined to make large numbers of fish eggs and fry readily available and easily transported in a relatively short period of time. The greenback's early failure to respond to fish culture, and its limited native distribution, soon led to other fish species being used for stocking throughout the greenback's native range.

The proximate biological reasons for the disappearance of most of the stomias populations appear to be its tendency to hybridize with other species of spring-spawning salmonids and its inability to compete against the fall-spawning brook trout within subalpine and montane habitats.

Greenbacks appear to hybridize readily with rainbow trout and other subspecies of cutthroats, as is evident from the array of intergrades of greenbacks and other spring-spawning salmonids within Colorado. The mechanism by which brook trout displace greenbacks is not thoroughly understood, but probably includes an advantage gained through a one-year earlier sexual maturation by brook trout, and subsequent larger size of brook trout young-of-the-year (YOY). Brook trout emerge from the redds earlier in the first year of life than do greenbacks, and can be 30 mm longer than greenbacks by their first October. In Hidden Valley Creek, RMNP, YOY brook trout (65 mm) and YOY greenbacks (35 mm) are usually found in the shallow stream habitat by October, and appear to compete for food and space during winter minimum flows.

The ability of brook trout to displace a pure greenback population was dramatically demonstrated by events in Black Hollow Creek. Brook trout were removed from this small montane stream in 1967, prior to restocking with 50 pure greenback cutthroat trout which established a reproducing greenback population. However, in 1973, two brook trout were found above the barrier, and by 1977, electrofishing for more than one mi above the barrier produced only brook trout (Behnke 1976, 1979).

Although greenback habitat has been lost due to degradation of aquatic environment through dewatering, timbering, construction, over-grazing and acid mine drainage, extensive amounts of good cutthroat habitat still remain throughout the greenback's native range. Future restoration efforts should stress habitat improvement and protection, along with the reintroduction of pure populations of greenbacks into good trout habitat presently barren or occupied by nonnative species.

Distribution

The historic distribution of the greenback cutthroat trout was the South Platte drainage and the Arkansas River drainage (Fig. 1). Although stomias was present within these drainages, little is known of its exact lake and stream distribution and the range in elevation the species once occupied. The only other trout species thought to have occurred within the greenback's native range was the yellowfin cutthroat trout (S. clarki macdonaldi), collected from Twin Lakes (Arkansas River drainage) in 1889 (Behnke 1979). The yellowfin cutthroat appears to have become extinct by the early 1900's.

At the time of the enactment of the Endangered Species Act in 1973, only two small historic populations of greenback cutthroat trout were known to exist (Como Creek and the South Fork, Cache La Poudre River) that conformed to the meristics of the type specimens, and were thus thought to be pure S. c. stomias. Como Creek and the South Fork, Cache La Poudre River are small headwater streams of the South Platte River drainage and collectively represented 3 mi of stream habitat and probably less than 1,000 greenbacks. In 1977, another population of pure greenbacks was confirmed in Cascade Creek, representing 1.5 mi of headwater stream in the Arkansas River drainage. The present population of greenbacks in Cascade Creek is estimated to be 600 fish.

Based upon surveys and taxonomic analyses by Behnke (1979) and Gold (1978), the following represents the known locations of pre-restoration populations of pure greenback cutthroat trout within Colorado:

South Platte River Drainage
  Como Creek, Boulder County, Roosevelt NF
  South Fork, Cache La Poudre River, Larimer County, Roosevelt NF

Arkansas River Drainage
  Cascade Creek, Huerfano County, San Isabel NF.

Restoration efforts dealing with pure populations of greenbacks date back to 1967. A current list of historic and restoration populations and their current status is shown in Section III of this plan.

As previously mentioned, the greenback cutthroat trout readily hybridizes with other species of trout, therefore, populations range phenotypically from "essentially pure" to obvious hybrids. The Colorado Division of Wildlife (CDOW) has adopted a rating system developed by Binns (1977), as a means of rating population purity. Each population is assigned a letter ranging from "A" (pure) to "F" (obvious hybrids). Since the Endangered Species Act does not protect hybrids, only "A" populations are considered in

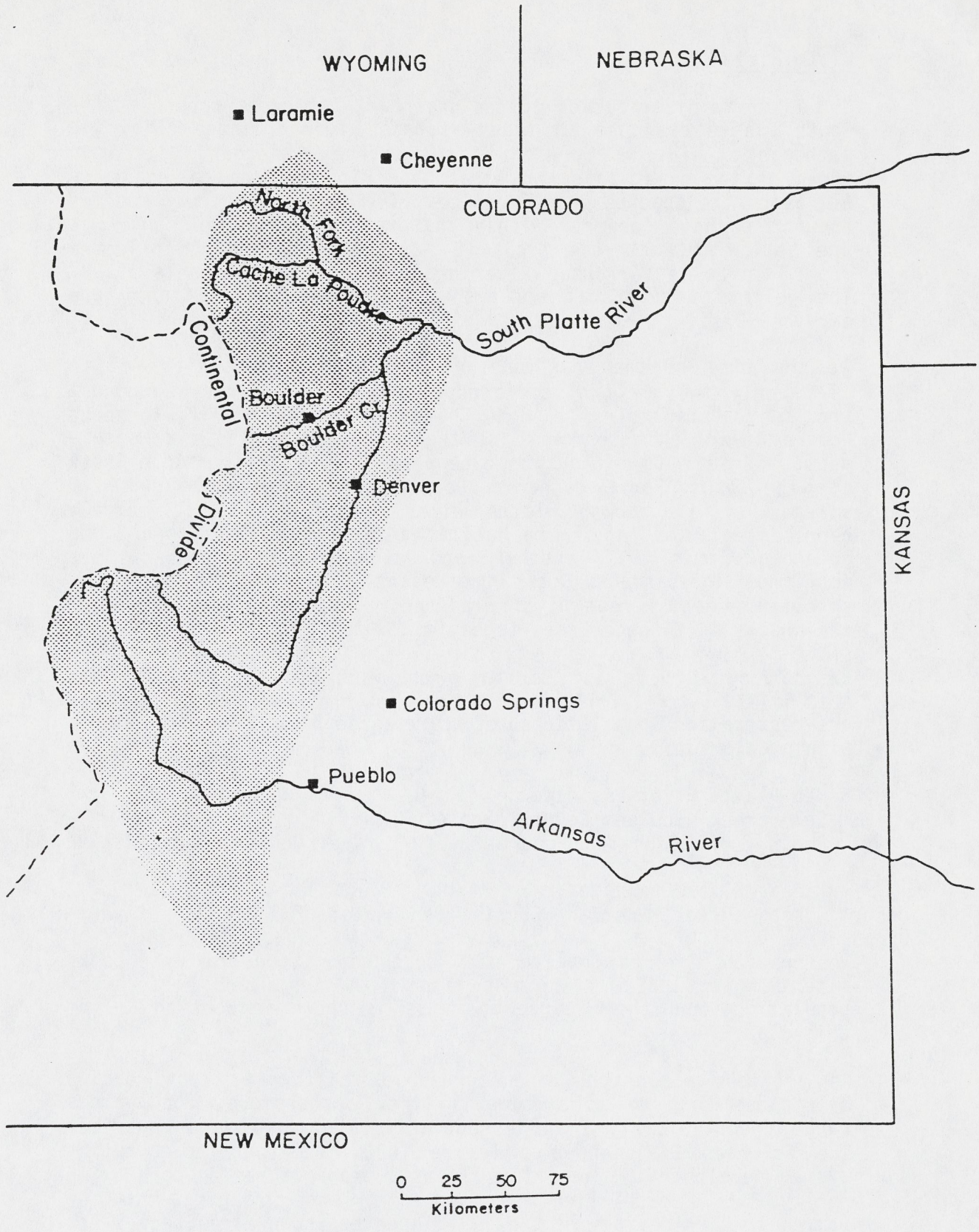


Figure 1. Historic distribution of Salmo clarki stomias (from Behnke and Zarn 1976)

this plan. However, the following list of known "B" and "C" greenback populations is included in hopes that information obtained from research on "A" through "C" populations will be of value in formulating a management plan for recovered cutthroat subspecies.

"B" Populations of Greenbacks: Essentially pure, with a trace of contamination. Known "B" populations are

Arkansas River drainage
- South Fork, Huerfano River (Strawberry Creek, Dutch Creek, Deep Creek)
- South Apache Creek

South Platte drainage
- Island Lake
- Goose Lake
- Forest Canyon, Big Thompson River
- Caddis Lake (transplant of Forest Canyon greenbacks)
- Sawmill Creek
- Roaring Creek

Green River
- Florence Creek (transplant of Forest Canyon and Albion Creek greenbacks).

"C" Populations of Greenbacks: Good representatives of greenback stock but with some contamination from other trout species. Known "C" populations are

South Platte drainage
- Rabbit Creek

North Platte drainage
- Nunn Creek.

PART II

RECOVERY

OBJECTIVE

THE OBJECTIVE OF THE GREENBACK CUTTHROAT TROUT RECOVERY PLAN IS THE REMOVAL OF THIS SUBSPECIES FROM THE USFWS THREATENED AND ENDANGERED SPECIES LIST. THIS SUBSPECIES WILL BE CONSIDERED RECOVERED WHEN 20 STABLE GREENBACK CUTTHROAT TROUT POPULATIONS ARE DOCUMENTED WITHIN ITS NATIVE RANGE. This implies the expansion of the range of pure greenback cutthroat trout to a level where isolated disruptions in population or habitat, and controlled angler harvest of greenbacks will not result in the extinction of the subspecies within its historic range.

To attain this goal, the Greenback Cutthroat Trout Recovery Team deems the following tasks necessary.

STEPDOWN OUTLINE

1. Maintain and enhance historic and stable greenback trout populations and their habitat

    1.1. Conduct population and habitat monitoring

    1.2. Habitat improvement

    1.3. Maintain stream barriers

    1.4. Prevent introduction of nonnative species

    1.5. Promote sound land and water use guidelines

    1.6. Enforce regulations

2. Establish or document the existence of 20 stable populations of pure (type "A") greenback cutthroat trout within the species historic range

    2.1. Conduct surveys for historic populations

    2.2. Prepare and maintain list of potential habitat

        2.21. Identify suitable habitat

        2.22. Survey potential habitat

        2.23. Promote interagency cooperation

2.3. Prepare habitat for reintroduction

2.31. Habitat manipulation

2.32. Construct or improve barriers

2.33. Remove all nonnative salmonids

2.4. Introduce pure (type "A") greenback trout

2.41. Use appropriate stocking rates for fish from wild populations

2.42. Use appropriate stocking rates for larval hatchery fish

2.5. Monitor and document the success of introduction

2.51. Prepare and annually update Table 3

3. Establish hatchery and wild populations of pure (type "A") greenback trout for broodstock

3.1. Establish one lake/stream environment within the South Platte River drainage

3.2. Establish one lake/stream environment within the Arkansas River drainage

3.3. Establish a hatchery propagation program

3.31. Collect and utilize milt from wild populations

3.32. Prepare reports on the status of the hatchery program

3.4. Investigate feasibility of establishing Colorado hatchery propagation of greenback cutthroat trout

4. Document response to angling pressure

4.1. Assess effects of mixed species fishing and special regulations

4.2. Assess effects of mono-species fishing and special regulations

4.3. Study other, or alternative, sites.

5. Conduct information and education (I & E) program

5.1. Maintain a current copy of the Recovery Plan at the Denver Public Library, Fish and Wildlife Reference Service

5.2. Make news worthy activities available to media outlets

5.3. Promote interagency cooperation and understanding

5.4. Present current Recovery Team activities to professional and public meetings

5.5. Encourage agency I & E programs

6. Prepare a long-term management plan and cooperative agreement for the management of greenback cutthroat trout

6.1. Prepare a management plan incorporating information obtained through completion of Recovery Plan tasks

6.2. Prepare cooperative agreement

NARRATIVE

1. Maintain and enhance historic and stable greenback cutthroat trout populations and their habitat

1.1 - Conduct population and habitat monitoring. All streams that contain populations of pure greenback trout should be censused at least once every 3 years. Numbers, age and condition of fish, and condition of the habitat should be evaluated. The presence of any exotic species or habitat degradation should be noted, and steps taken to remedy the situation.

1.2 - Improve habitat. When necessary and appropriate, improve habitat quality that is below its potential through physical manipulation of the damaged habitat using sound land and water management practices.

1.3 - Maintain stream barriers. Stream barriers are essential to prevent invasions of undesirable fish into the habitat of greenback cutthroat trout. Barriers should be inspected periodically for their effectiveness and stability. New barriers should be constructed and maintained where necessary.

1.4 - Prevent the introduction of nonnative species. It is extremely important to prohibit introduction of exotic fish into greenback cutthroat trout habitat. Such introductions foster competition and hybridization.

1.5 - Promote sound land and water use guidelines. Grazing, logging, agricultural and silvicultural techniques that do not adversely affect the greenback cutthroat trout habitat should be supported and promoted. The use of buffer strips along streams should be encouraged to help protect habitat from human and livestock impacts. Proper land use practices (in terms of protecting native trout habitat) should be encouraged in the following areas:

a. Grazing practices
b. Preserving riparian vegetation
c. Silvicultural practices
d. Mining activities
e. Instream flow maintenance
f. Water diversion and reservoirs
g. Road construction
h. Human activity

1.6 - Enforce Regulations. Following the development of special angling regulations, or habitat closures, strict enforcement is necessary to ensure that the populations are protected from abuse.

2. Establish or document the existence of 20 stable populations of pure (type "A") greenback cutthroat trout within the species' historic range. These populations should be reasonably well distributed between the South Platte and Arkansas River drainages. A stable population is defined as a greenback population capable of supporting a "wild trout" fishery as defined by the Colorado Division of Wildlife Policy No. D-6 (1981, Appendix B), and accepted as stable by a majority of the Team Members after a review of the available population and habitat data. It is suggested that a population contain a sustainable 500 individuals over 50 mm in total length prior to being considered as one of the 20 stable populations.

2.1 - Conduct surveys for historic populations. Continue to search systematically for historic populations of greenback cutthroat trout that may still exist within its historic range. Verify such populations by field collections and analysis by qualified taxonomists.

2.2 - Prepare and maintain the List of Candidate Aquatic Habitats, of areas that could, with or without modification, support populations of pure greenback cutthroat trout. The selection of candidate aquatic habitats should be based upon the following criteria, and listed in Section III of this Plan.

2.21 - Identify suitable habitat. Aquatic survey, or review of agency records for headwater lake and streams capable of supporting stable populations of spring-spawning trout.

2.22 - Survey habitats identified in 2.21 for their feasibility of successfully establishing stable or sanctuary greenback populations: presence of barriers, ease of removing nonnative fish species, past stocking records and elevation.

2.23 - Promote interagency cooperation. Consultation with agency(s) responsible for land management. Determine if a greenback cutthroat trout population would be compatible with present and future agency management goals, with the management goal for each candidate water shown in Table 2.

Table 2

Candidate aquatic habitats for the introduction of pure greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Proposed Habitat	(Ft) Elevation	Area[2]	Mang. Goal	Species Present	Year Piscicides	Stock	Agencies
South Platte	South Fork Cache La Poudre	Pennock Creek	8,720 - 10,200	5.0 mi	WTF[1]	Bkt & Bnt	1982	1983-1985	CDOW & FS
South Platte	South Fork Cache La Poudre	South Fork Cache La Poudre	9,800 - 10,800	1.8 mi	Sanctuary	Barren	NA	1985-1987	RMNP & FWS
South Platte	South Fork Cache La Poudre	Willow Creek	10,000 - 10,600	3.5 mi	WTF	Bkt		Dependent upon availability of	RMNP & FWS
South Platte	South Fork Cache La Poudre	Hague Creek	9,800 - 10,800	4.8 mi	WTF	Bkt & Cutt		S. F. Cache La Poudre greenbacks	RMNP & FWS
South Platte	South Fork Cache La Poudre	Mirror Lake & Cascade Cr.	9,800 - 11,040	30.5 S. A. 3.3 mi	WTF	Bkt & Bnt			RMNP & FWS
South Platte	FCDC	Bard Creek	10,000 - 11,200	5.0 mi	WTF	Barren	NA	1982	CDOW & FS
South Platte	FCDC	Leavenworth Creek	10,200 - 11,600	4.0 mi	WTF	Barren	NA	1982	CDOW & FS
South Platte	FCDC	Sheep Creek	8,000 - 10,960	5.0 mi	WTF	Rbt	1980 & 1981	1982, 1983, 1984	CDOW & FS

Table 2 (Continued)

Candidate aquatic habitats for the introduction of pure greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Proposed Habitat	(Ft) Elevation	Area[2]	Mang. Goal	Species Present	Year Piscicides	Stock	Agencies
South Platte	FCDC	Cornelius Creek	7,800 - 8,800	5.0 mi	WTF	Bkt & Bnt	1981	1983, 1984, 1985	CDOW & FS
South Platte	FCDC	George Creek	7,600 - 9,000	5.0 mi	WTF	Bkt & Bnt	1981	1983, 1984, 9185	CDOW & FS
South Platte	FCDC & Hidden Valley	West Creek Below Falls	7,720 - 8,100	1.0 mi	WTF	Bkt	1982	1983, 1984, 1985	CDOW, FS, RMNP & FWS
South Platte	FCDC	Fern Lake & Fern Creek	9,000 - 9,500	9.2 S. A. .9 mi	WTF	Bkt & Cutt	1982	1983, 1984, 1985	RMNP & FWS
South Platte	FCDC	Spruce Lake	9,660	3.7 S. A.	WTF	Rbt	1983	1984, 1985, 1986	RMNP & FWS
South Platte	FCDC	Lost Lake & N.F. Big Thompson	10,000 - 10,710	9.2 S. A. 2.2 mi	WTF	Bkt & Cutt	1984	1985, 1986, 1987	RMNP & FWS
South Platte	FCDC	Hutcheson Lakes	10,600 - 11,200	11.9 S. A. 0.8 mi	WTF	Cutt	1985	1986, 1987, 1988	RMNP & FWS
South Platte	FCDC	Black Lake	10,000 - 10,620	9.2 S. A. 1.1 mi	WTF	Bkt & Cutt	1986	1987, 1988, 1989	RMNP & FWS
South Platte	FCDC	Thunder Lake & Lion Creek	10,300 - 10,800	16.5 S. A. 0.5 mi	WTF	Cutt & Bkt	1987	1988, 1989, 1990	RMNP & FWS

Table 2 (Continued)

Candidate aquatic habitats for the introduction of pure greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Proposed Habitat	(Ft) Elevation	Area[2]	Mang. Goal	Species Present	Year Piscicides	Stock	Agencies
South Platte	FCDC	Lawn Lake	10,987	48.0 S. A. 3.0 mi	WTF	Bkt	1988	1989, 1990, 1991	RMNP & FWS
South Platte	FCDC & Hidden Valley	Cow Creek	7,950 - 8,600	2.0 mi	WTF	Bkt	1989	1990, 1991, 1992	RMNP & FWS
Arkansas	Cascade Creek	Greenhorn Creek	9,100 - 10,800	2.5 mi	WTF	Barren	NA	1983	CDOW & FS
Arkansas	Cascade Creek	Cottonwood Creek	8,800 - 11,500	3.5 mi	WTF	Barren	NA	1983-1984	CDOW & FS
Arkansas	Cascade Creek	Pikes Peak Res. #2	11,100	12.0 S. A.	WTF	Cutt	1983 & 1984	1984-1985	CDOW

[1]WTF = Wild Trout Fishery

[2]Area: Stream miles or surface acres

2.3 - Prepare habitat for reintroduction. Carry out remedial actions necessary and appropriate to make candidate waters suitable for the introduction of pure greenback cutthroat trout. Aquatic habitats selected for the introduction of greenbacks may be lacking in some phase of preferred or essential habitat requirements.

2.31 - Habitat manipulation. If necessary and appropriate, upgrade candidate habitat by the use of good aquatic habitat management practices considering: pool/riffle ratios, riparian vegetation, spawning habitat, water quality and protection from excessive disturbance.

2.32 - Construct or improve barrier(s). Some areas may require the construction or improvement of existing barriers to fish migration.

2.33 - Remove all nonnative salmonids present within the candidate habitat with piscicides. Review project success, and repeat application of piscicides, if necessary. Allow treated habitat to remain barren for a minimum of 6 months, prior to proceeding to Task 2.4.

2.4 - Introduce pure (type "A") greenback cutthroat trout into the candidate waters, using the greenbacks most representative of the drainage being stocked. Greenback cutthroat trout populations established within the South Platte drainage should be founded with trout from: Como Creek or the South Fork of the Cache La Poudre River, their descendants or from sources yet to be determined within the South Platte drainage that are type "A" greenbacks.

Greenback cutthroat trout populations established within the Arkansas drainage should be founded with trout from: Cascade Creek, their descendants or from yet to be determined sources within the Arkansas River drainage that are type "A" greenbacks.

Use of hatchery-reared pure greenbacks or pure (type "A") greenbacks from wild populations will depend upon the management goal of the particular project. However, no more than 15 of the stable populations should be founded from the Bozeman FCDC, Como Creek broodstock.

2.41 - Use appropriate stocking rates for fish from wild populations. Stocking rates for greenbacks from wild populations should be 30 to 60 subadults/adults per site, with 60 being the most

desirable number. Removal of any greenbacks from the three historic pure (type "A") populations will require approval from the responsible management agencies and the Recovery Team.

2.42 - Use appropriate stocking rates for larval hatchery fish. Tentative first-year stocking rates for hatchery fry should be 1,000-25 mm fish per surface acre of lake and 1,000-25 mm fish per mi of stream. Based upon the results from the Ouzel Lake and other projects, these stocking rates and schedules may be amended. Stock areas for 3 consecutive years.

2.5 - Monitor and document the success of each introduction of greenbacks into candidate waters. Projects should be examined annually for the first 3 years following stocking and then semiannually until the candidate water meets its management goal and is considered stable by the Recovery Team. Monitoring and reporting of each project's success will be the responsibility of the lead agency on the project.

2.51 - Prepare and annually update Table 3. Prepare and distribute an annually updated The Status of Greenback Cutthroat Trout, for Section III (Table 3) of this Recovery Plan. This report will be summarized by the Team Leader, based upon status reports of Task 2.5, and Task 1.0.

3. Establish hatchery and wild populations of pure (type "A") greenback cutthroat trout that can be used as broodstock

3.1 - Establish one lake/stream environment within the South Platte River drainage to function as a practical wild broodstock source. This broodstock may constitute one of the 20 stable populations under Task 2.

3.2 - Establish one lake/stream environment within the Arkansas River drainage to function as a practical wild broodstock source. This broodstock may constitute one of 20 stable populations under Task 2.0.

3.3 - Establish a hatchery propagation program. Establish and demonstrate the use of a hatchery propagation program at the USFWS, FCDC at Bozeman, Montana, using pure (type "A") greenback cutthroat trout. Use greenback fry from this source as outlined in Task 2.4.

The present Como Creek broodstock established at the USFWS, FCDC in 1977, should not be used for Task 2.0 past 1990.

Table 3

Status of the greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Habitat	ELEV/AREA (ft/stream mi or surface acre)	Mang. Goal	Year Stocked	Greenback Population	Lead Agency	Status
South Platte	Historic	South Fork Cache La Poudre	9,200 - 9,600 1.0 mi	Sanctuary	Historic	50	CDOW & FS	Population declining due to some angling pressure
South Platte	Historic	Como Creek	8,600 - 9,800 2.0 mi	Sanctuary	Historic	800	CDOW & FS	Stable
South Platte	Como Creek	North Fork Big Thompson River	10,800 - 11,000 0.6 mi	Sanctuary	1970	100	RMNP & FWS	Small population above timberline
South Platte	Como Creek	Hidden Valley Creek	8,800 - 9,300 6 S. A. 1.0 mi stream	Sanctuary & WTF	1973	1000	RMNP & FWS	BKT dominate 6 S. A. of beaver ponds. With BKT removal, greenback dominate the stream
South Platte	FCDC	West Creek above Falls	8,100 8,700 1.5 mi	WTF	1979		RMNP & FWS	Reproduction not documented in 1980. 58 Hidden Valley Creek greenbacks stocked
South Platte	Como Creek	Black Hollow Creek	7,800 - 9,000 2.0 mi	WTF	1967-1980 (stream retreated)	200	CDOW & FS	37 Como Creek greenbacks stocked in 1980 + greenbacks present from 1967 stocking

Table 3 (Continued)

Status of the greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Habitat	ELEV/AREA (ft/stream mi or surface acre)	Mang. Goal	Year Stocked	Greenback Population	Lead Agency	Status
South Platte	Como Creek & FCDC	Bear Lake	9,475/ 11.2 S. A.	Sanctuary	1975 & 1981		RMNP & FWS	Reproduction not documented from the 1975 stocking. Habitat improved
South Platte	Como Creek	May Creek	9,600 - 10,750/ 2.5 mi	WTF	1980			54 Como Creek greenbacks stocked in 1980
South Platte	FCDC	Hourglass Creek	9,000 - 10,500/ 1.25 mi	WTF	1981		CDOW & FS	158 FCDC greenbacks @ 155 mm stocked in 1981
South Platte	FCDC	Williams Gulch	9,200 - 10,000/ 1.9 mi	WTF	1981		CDOW & FS	40 FCDC greenbacks @ 155 mm stocked in 1981
South Platte	FCDC	Ouzel Lake & Ouzel Creek	9,400 - 10,300/ 6.4 S. A. 2.1 mi	WTF	1981		RMNP & FWS	16,570 FCDC fry stocked in 1981
Arkansas	Historic	Cascade Creek	9,600 - 10,800/ 1.5 mi	Sanctuary	Historic	620	CDOW & FS	Stable

Table 3 (Continued)

Status of the greenback cutthroat trout populations, 1982

Drainage	Origin of Greenbacks	Habitat	ELEV/AREA (ft/stream mi or surface acre)	Mang. Goal	Year Stocked	Greenback Population	Lead Agency	Status
Arkansas	Cascade Creek	Mc Alpine Pond	9,300/ 0.3 S. A.	Broodstock	1980	20-24	CDOW	25 Cascade Creek greenbacks stocked 1980. Eggs taken in 1982
Arkansas	Cascade Creek	Lytle	6,200/ 0.5 S. A. 0.1 mi	Broodstock	1981		FWS & Ft. Carson	40 Cascade Creel greenbacks stocked in 1981

Movement of greenback fry and milt between Bozeman FCDC and Colorado will be in accordance with current State and Federal fish disease policies and good fisheries management practices.

3.31 - Collect and utilize milt from wild populations. Collect and utilize milt from wild populations of pure (type "A") greenbacks to fertilize hatchery ova, to retard genetic drift within the hatchery.

3.32 - Prepare reports on the status of the hatchery program. The Bozeman FCDC should report annually to the Team Leader the status of the greenback hatchery project, and prepare a section for Task 6 of the Recovery Plan detailing hatchery aspects of S. c. stomias.

3.4 - Investigate feasibility of establishing Colorado hatchery propagation of greenback cutthroat trout. Preferably this program will use South Fork, Cache La Poudre River greenbacks.

4. Document response to angler pressure. Prior to delisting, at least one population of pure greenback cutthroat trout will be open to angling, using special regulations, over a period of years to adequately document the species' response to angling pressure. Based upon restoration projects completed to date, the following areas appear to be the best study areas.

4.1 - Assess effects of mixed species fishing and special regulations. Document the response of a mixed brook trout-greenback fishery within the beaver pond habitat of Hidden Valley Creek, RMNP, to artificial lure catch-and-kill angling for brook trout and catch-and-release angling for greenbacks. Presently, brook trout are displacing greenbacks here. The objective of these angling regulations will be to give a competitive advantage to the greenbacks, while providing a recreational fisheries.

4.2 - Assess effects of mono-species fishing and special regulations. Assuming that greenback cutthroat trout fry stocked into Ouzel Lake, RMNP, in 1981, 1982 and 1983 grow as expected, open Ouzel Lake to catch-and-release angling by August 1, 1984. Maintain August 1 opening date until successful reproduction is documented, then open to season long catch-and-release, or limited catch-and-kill, depending upon population size and angler use.

4.3 - Study other, or alternative, sites. Likely study sites include Bard and Leavenworth creeks (Arapaho National Forest), and Fern Lake (RMNP).

5. Conduct an information and education program (I & E) explaining the goal, objectives and recovery activities for the greenback cutthroat trout.

5.1 - Maintain a current Recovery Plan including an updated Section III of the Recovery Plan at the Denver Public Fish and Wildlife Reference Service.

5.2 - Make newsworthy activities available to media outlets. The Recovery Team should make newsworthy activities available to media outlets, particularly when these activities mark the completion of objectives of the Recovery Plan.

5.3 - Promote interagency cooperation and understanding of Recovery Team activities whenever possible.

5.4 - Present current Team recovery activities to professional and public meetings as agency time and funds permit.

5.5 - Encourage agency I & E programs. Public understanding and support of Tasks 2, 3 and 4 of this Plan can promote recovery efforts.

6. Prepare a long-term management plan and cooperative agreement for the management of greenback cutthroat trout. Prior to delisting, prepare a long-term management plan, and cooperative agreement for the management of greenback cutthroat trout, that will be acceptable to all participating agencies having proprietorship over the populations of greenbacks.

6.1 - Prepare a management plan that will incorporate all the information obtained through the completion of the objectives of the Recovery Plan tasks. Lead agencies will maintain records on their recovery activities so as to be able to address the following topics in the final management plan:

a. Habitat requirements

b. Reproduction

c. Food preference

d. Methods for habitat improvement and maintenance

e. Methods for removing nonnative fish species

f. Hatchery maintenance of greenback cutthroat trout broodstock and any hatchery disease problems.

g. Stocking rates for greenback hatchery fry

h. Angling regulations for and sport fisheries management of greenback cutthroat trout

i. List of populations of greenback cutthroat trout, their status and management goals

j. List of possible future restoration sites

k. Recommendations.

6.2 - Prepare a cooperative agreement. Cooperative agreements should be prepared or existing agreements amended to define management agencies' roles in maintaining the populations of pure greenback cutthroat trout. If needed, the status of the subspecies can be reviewed at interagency coordination meetings.

Literature Cited

* Behnke, R. J. 1973. The greenback cutthroat trout Salmo clarki stomias. Status report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA.

* Behnke, R. J. and M. Zarn. 1976. Biology and management of threatened and endangered western trout. USDA Forest Service, General Technical Report RM-28.

Behnke, R. J. 1979. Monograph of the native trouts of the genus Salmo of western North America. U.S. Fish and Wildlife Service, Denver, Colorado, USA.

Binns, N. A. 1977. Present status of indigenous populations of cutthroat trout, Salmo clarki in southwest Wyoming. Wyoming Game and Fish Department Fish Technical Bulletin 5.

* Bulkley, R. V. 1959. Report on 1958 fishery studies in Rocky Mountain National Park. Bureau of Sport Fisheries and Wildlife, Logan, Utah, USA.

Cope, E. D. 1872. Report on the reptiles and fishes obtained by the naturalists of the expedition. U.S. Geological Survey Wyoming : 432-442

* Dwyer, W. P. 1981. Greenback cutthroat trout broodstock annual report for 1981. USFWS, Fish Cultural Development Center, Bozeman, Montana, USA.

Gold, J. R. 1978. Proposal for the morphological analysis of S. c. stomias and S. c. pleuriticus populations. Texas A&M University, College Station, Texas, USA.

* Green, W. S. 1937. Colorado trout. Colorado Museum of Natural History Popular Series No. 2.

* Johnson, J. E. 1976. Status of endangered and threatened fish species in Colorado. USDI, BLM Technical Note 280.

Jordan, D. S. 1891. Report on explorations in Colorado and Utah during the summer of 1889, with an account of the fishes found in each of the river basins examined. Bulletin U.S. Fish Commission, 9:1-40.

Juday, Co. 1907. A study of Twin Lakes, Colorado, with especial consideration of the trouts. Bulletin U.S. Bureau of Fisheries, 26:147-178.

* Nelson, W. S. 1972. An unexploited population of greenback trout. Colorado Division of Wildlife, Fort Collins, Colorado, USA.

Wernsman, G. 1973. Systematics of native Colorado trout. Master's thesis. Colorado State University, Fort Collins, Colorado, USA.

PART III

CURRENT STATUS OF TASK IMPLEMENTATION OF THE GREENBACK CUTTHROAT TROUT RECOVERY PLAN

Task 1. Maintain and enhance existing greenback cutthroat trout populations and their habitat.

The closure of Como Creek road in 1978, appears to have decreased the amount of abuse the area was suffering when vehicles could be easily driven to the stream. Como Creek will be evaluated for stream improvement in 1982.

The small number of greenbacks in the South Fork of the Cache La Poudre River are highly vulnerable to angler harvest. Although angler use here is probably only sporatic, the angler use and the harsh habitat severely limit the size of the population. As soon as this population is capable of sustaining a transplant, greenbacks from this source should be moved to better habitats.

The Cascade Creek greenback population appears to be stable, probably because of its remote location.

In an attempt to improve the status of the greenback cutthroat trout within the beaver ponds of Hidden Valley Creek, a special angling program will be initiated on August 1, 1982, as outlined in Part II, Task 4 of this Plan.

Task 2. Establish or document the existence of 20 stable population of pure (type "A") greenback cutthroat trout.

To date, the search for pure populations of greenback cutthroat trout has documented three historic populations: Como Creek, South Fork of the Cache La Poudre River and Cascade Creek. Total habitat of the three historic sites is approximately 4.5 mi of stream with a total estimated population of 1,470 fish (Table 3).

Through 1981, pure greenback cutthroat trout have been introduced into 11 new aquatic habitats, representing 13.75 mi of stream and 24.4 surface acres of beaver ponds, lakes and reservoirs (Table 3). None of these 11 sites has achieved a stable wild trout fisheries status. Of the 11 sites, only seven appear to have the potential of becoming wild trout fisheries. The management goal for the other four sites include two broodstock lakes and two sanctuaries.

A list of candidate aquatic habitats for the introduction of pure greenback cutthroat trout has been compiled (Table 2). A total of 22 sites have been proposed, distributed through the historic range and utilizing the three known pure historic populations of greenbacks. These sites have the potential of constituting 20 stable greenback populations.

Task 3. Establish hatchery and wild broodstock populations.

A suitable wild broodstock population for the South Platte River drainage has not been established, nor a candidate site identified through 1981.

Wild broodstock populations for the Arkansas River drainage have been established at McAlpine Pond (1980) and Lytle Spring Pond (1981) using Cascade Creek greenbacks. About 3,000 eggs were taken from McAlpine Pond stock (June 1982), and were incubated *in situ*.

A hatchery broodstock was established in 1977, with the movement of 64 Como Creek greenbacks to the USFWS, FCDC. Initial problems with acceptance of food and asynchronous maturation of the sexes in 1978, were solved. In 1981, 865 greenbacks at a length of 155 mm (from the 1980 spawn) and 16,570 fry from the 1981 spawn were stocked into rehabilitated habitats. A total of 200 greenback broodstock remain at the FCDC, representing the original Como Creek greenbacks and their 1978 and 1979 progeny. It is anticipated that between 20,000-30,000 fry should be available for stocking in 1982.

In June 1982, milt from Hidden Valley Creek type "A" wild greenbacks successfully fertilized about 20,000 ova, after being air-freighted from RMNP to Bozeman, FCDC.

Task 4. Document the greenback cutthroat trout's response to angling pressure.

The removal of brook trout from Hidden Valley Creek was not a complete success. Como Creek greenbacks stocked here in 1973, have established a good reproducing population in the stream habitat below the beaver ponds, due to the annual removal of brook trout by electrofishing. However, within the beaver ponds--where electrofishing and netting is not effective--brook trout are displacing the greenbacks. An experimental catch-and-kill for brook trout and catch-and-release angling program for greenbacks within the beaver ponds of Hidden Valley Creek was opened on August 1, 1982.

Initial results from a Butler Borgeson creel census ran from August 1 through August 8, 1982, indicates that greenbacks are extremely susceptible to angling pressure. Although brook dominate the beaver ponds, 730 angler hours in eight days resulted in 630 greenbacks and 295 brook trout being landed. Approximately 50 percent of both species landed, were landed on opening day. Anglers released 60 percent of the brook trout and 99.99 percent of the greenbacks landed.

PART IV

IMPLEMENTATION SCHEDULE

Definition of Priorities

Priority 1 - All actions that are absolutely essential to prevent the extinction of the species.

Priority 2 - All actions necessary to maintain the species current population status.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Abbreviations Used in Priorities and Tables

Bkt	Brook trout
Bnt	Brown trout
CDOW	Colorado Division of Wildlife
Cutt	Cutthroat trout
FCDC	USFWS, Fish Cultural Development Center
FS	U.S. Forest Service
FWS	U.S. Fish and Wildlife Service
mi	Stream miles
Rbt	Rainbow trout
RMNP	Rocky Mountain National Park
S. A.	Surface acres
WTF	Wild trout fisheries

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY FWS REGION (6)	RESPONSIBLE AGENCY FWS PROGRAM (6a)	RESPONSIBLE AGENCY OTHER (7)	FISCAL YEAR COSTS (EST.) FY-83 (8)	FY-84	FY-85	COMMENTS/NOTES (9)
I1	Conduct population and habitat monitoring	1.1	1	continuous	6	SE	CDOW FS RMNP	1,000 150 500 1,000	1,000	1,200 150	
M3	Habitat Improvement	1.2	2	on-going 3-5 years			CDOW FS	3,000 5,500	3,000 5,700	3,200 5,900	
M3	Maintain Stream Barriers	1.3	1	continuous			CDOW FS	2,000	2,000	2,200	
M4	Prevent/control introduction of nonnative species	1.4	1	on-going continuous			CDOW	1,000	1,000	1,200	
M3	Promote sound land and water use guidelines	1.5	2	continuous			CDOW FS	500 150	500 150	500 150	

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS/NOTES
					FWS		OTHER	FY-83	FY-84	FY-85	
					REGION	PROGRAM					
(1)	(2)	(3)	(4)	(5)	(6)	(6a)	(7)	(8)			(9)
03	Enforce regulations	1.6	1	continuous			CDOW	500	500	500	
							FS	150		150	
							RMNP	2,000	4,000	4,000	
I1	Conduct surveys for historic populations	2.1	3				CDOW	500	500	500	
							FS	500			
					6	SE		2,000	2,000	2,500	
I14	Prepare and maintain list of potential habitats	2.2	3	on-going			CDOW	2,500	3,000	3,200	
		2.21					FS	150	150	150	
		2.22					RMNP	2,000	2,000	2,000	
		2.23			6	SE		4,000	3,000	3,000	
M3	Prepare habitat for reintroduction	2.3	3	on-going			CDOW	2,000	2,500	2,700	
		2.31					FS	2,350	2,650	2,550	
		2.32					RMNP	5,000	7,000	10,000	
		2.33			6	SE		4,000	4,000	4,000	
M2	Introduce pure greenback trout into candidate waters	2.4	3	on-going			CDOW	1,500	2,000	2,200	
		2.41									
		2.42					RMNP	1,500	2,000	2,000	
					6	SE		1,000	1,500	1,800	

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS/NOTES
					FWS		OTHER	FY-83	FY-84	FY-85	
					REGION	PROGRAM					
(1)	(2)	(3)	(4)	(5)	(6)	(6a)	(7)	(8)			(9)
I13	Monitor and document success of introduction	2.5	3	on-going			CDOW	1,500	2,000	2,200	
							FS		150		
							RMNP	2.000	4,000	4,000	
					6	SE		4,500	7,300	8,000	
M7	Establish and maintain broodstock within South Platte River drainage	3.1	3	on-going			CSOW	6,000	6,000	6,200	
M7	... Within the Arkansas River drainage	3.2	3	on-going			CDOW	4,500	4,500	4,700	
							FS	200	200	100	
							USArmy	1,000	1,000	1,000	
					6	SE		2,000	2,000	2,500	
M1	Establish a hatchery propagation program	3.3 3.31 3.32	3	on-going	6	HFR	FCDC	3,000	3,000	3,200	FCDC (Fish Cultural Development Center, Bozeman, MT)
I7	Investigate feasibility of establishing Colorado hatchery propagation	3.4	3	1 year			CDOW	1,000			

United States Department of the Interior
FISH AND WILDLIFE SERVICE
COLORADO FIELD OFFICE
330 S. GARRISON ST.
LAKEWOOD, COLORADO 80226

IN REPLY REFER TO:

10/12/02

Dr. Behnke
CSO

Dear Dr. Behnke,

Thanks for the copy of your repat. Enclosed is the final draft of the Greenback Cutthroat Trout Recovery Plan. Any comments would be appreciated.

I haven't done too much this year with the Air Force Academy Snake River program. However, spot creel census at Ft. Carson and the Academy where we are using catchable Snake Rivers tend to show larger fish and less boom and bust in the catchrate. We will be gill netting in about 2 weeks to determine carry-over compared to other years when we used only RBT.

- over -

We checked Bear lake yesterday, and found YOY IN the INlet. Not many and only about 180-200 mm IN length, but at least another good development For Bear lake. We Found no Fish IN the outlet.

I am enclosing some extra greenback slides For you From Bear lake and Fort Carson.

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS/NOTES
					FWS		OTHER	FY-83	FY-84	FY-85	
					REGION	PROGRAM					
(1)	(2)	(3)	(4)	(5)	(6)	(6a)	(7)	(8)			(9)
I4	Access effects of mixed species fishing and special regulations-Hidden Valley, brook trout fisheries	4.1	3	3-5 years	6	SE	RMNP	1,000 1,000	1,000 1,000	1,000 1,000	
L4	Access effects of mono species fishing and special regulations, Ouzel Lake, RMNP	4.2	3	3-5 years	6	SE	RMNP		10,000 1,000	10,000 1,000	
I4	Study other alternative sites	4.3	3	3-5 years			USFS	------	-----	-----	Funding in FY-86
01	Maintain current Recovery Plan at Denver Public Library	5.1	3	continuous	6	SE	CDOW	------	-----	-----	
01	Inform media of activities	5.2	3	continuous	6	SE	CDOW	100 100	200 200	200 200	

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST.)			COMMENTS/NOTES
					FWS		OTHER				
					REGION	PROGRAM		FY-83	FY-84	FY-85	
(1)	(2)	(3)	(4)	(5)	(6)	(6a)	(7)	(8)			(9)
04	Promote Interagency Cooperation	5.3	3	continuous	6	SE	CDOW FS RMNP	200 150	300 300	300 150	
01	Present current activities to professional/public meetings	5.4	3		6	SE	CDOW	200 200	300 200	300 200	
01	Encourage agency I & E programs	5.5	3		6	I&E	CDOW FS RMNP	150	150	150	Task 5.5 handled by most Agencies present I&E programs
04	Prepare Management Plan	6.1	3	1 year	6	SE	CDOW FS	2,500 250	2,600 250	2,800 250	No involvement through 1985
	Prepare Cooperative Agreement	6.2	3	3-6 months	6	SE	CDOW FS	2,500 50	2,600 50	2,800 50	No involvement through 1985

APPENDIX

Appendices will be included when the plan is printed.

STATE OF COLORADO
WILDLIFE COMMISSION

POLICY NO. D-6 August 1, 1981

SUBJECT: WILD TROUT

I. WILD TROUT POLICY

WHEREAS

The state of Colorado has a very limited mileage of biologically productive streams capable of supporting all life stages of Wild Trout and whereas Wild Trout hatch, grow and provide sport fishing at a very low management cost and Wild Trout populations are most successful when not augmented with catchable sized hatchery fish.

THEREFORE;

It is the policy of the Wildlife Commission to provide an opportunity for Colorado anglers to observe, or fish for, wild trout in the most natural, aesthetically pleasing, aquatic environment possible. Designated wild trout waters will be protected and managed so they will forever support optimum and viable self-sustaining wild trout populations.

II. DEFINITION

A. Wild trout complete their entire life cycle in the natural environment.

B. A wild trout water is a lake or stream that normally supports a naturally reproducing and self-sustaining trout population without artificial stocking by the Division of Wildlife.

III. WILD TROUT MANAGEMENT GOALS

A. Protection and Enhancement of Wild Trout Habitat

1. Aquatic and terrestrial habitat will be actively protected, rehabilitated, and enhanced through cooperation with State and Federal, public and private agencies.

2. Every effort will be made to seek out and enhance or rehabilitate stream and lake resources that have the potential for management as wild trout waters.

B. Management of Wild Trout Waters

1. Wild trout waters will be managed through the use of fishing regulations designed to protect and enhance wild trout populations. Special regulations may include: size limits, species limits, bag limits, terminal tackle restrictions, season closures, and catch and release regulations.

2. There will be no stocking of hatchery fish in waters designated as wild trout waters.

3. In the event of a natural or environmental calamity trout introductions from hatchery or wild stock may be made by Division of Wildlife fishery personnel with prior approval of the Wildlife Commission.

C. Classification of Wild Trout Waters

1. A stream or selected stream section that does not have the potential to produce 20 pounds/acre standing crop of wild trout cannot be designated as a wild trout water unless it provides spawning and nursery areas essential for support of wild trout populations in adjoining standing waters.

2. A stream or selected stream section with standing crops ranging between 20 and 100 pounds/acre of wild trout that may be at maximum production is eligible for classification as wild trout water by the Wildlife Commission.

3. A stream or selected stream sections with standing crops in excess of 100 pounds/acre of wild trout are automatically eligible for classification as wild trout waters and if so classified by the Commission can not be stocked with hatchery fish.

4. All bodies of water with self-sustaining cutthroat trout populations endemic to the state of Colorado will be eligible for classification as a wild trout water.

5. Standing bodies of water may be designated as wild trout waters if the trout population can sustain a fishery through natural reproduction.

D. The Division will provide recommendations for the classification and management of all wild trout waters to the Wildlife Commission for their consideration and approval.

Greenback Cutthroat Trout Recovery Project

1982 Progress Report

Steven R. Culver

Kevin R. Bestgen

State of Colorado

Department of Natural Resources

Division of Wildlife

Nongame Program Management

6060 Broadway

Denver, Colorado 80216

July, 1983

Table of Contents

Acknowledgement.....ii.

List of tables.....iii.

List of figures.....iv.

I. Introduction.....1.

II. Status of existing populations.....2.

III. Establishment of new populations.....7.

IV. Stream restoration projects.....7.

V. Habitat evaluation.....11.

VI. Stream surveys.....31.

VII. Discussion and Recommendations.....41.

References.....45.

Appendix A (Proposed Research).....46.

Appendix B (Field Forms).....59.

Appendix C (Transect Data Summary).....63.

Appendix D (Cover Data Summary).....74.

Acknowledgement

Special thanks to Frank Howe, who volunteered many hours of his time to the greenback cutthroat recovery project. Without his much appreciated help most of the field data would not have been collected. Frank made our field work more enjoyable and tolerable.

List of Tables

Table — Page

1. Existing greenback cutthroat trout populations.....2.
2. Concentrations, exposure times, and total amount of rotenone and potassium permanganate used for George and Cornelius Creeks fish removal projects....9.
3. Fish population and physical parameters measured and analyzed for Como Creek and Black Hollow Creek.....17.
4. Greenback cutthroat trout data summary for Como Creek.....18.
5. Habitat and greenback cutthroat trout population data summary for Como Creek.....20.
6. Greenback cutthroat trout population data summary for Black Hollow Creek.....27.
7. Physical data and greenback cutthroat trout population data summary for station B on Black Hollow Creek.....28.
8. Revised list of streams to be evaluated for greenback cutthroat trout introduction.....33.
9. Flow data collected during high flow in 1982.....34.
10. Bard and Leavenworth Creek water quality analysis results.....37.

List of Figures

Figure — Page

1. Greenback cutthroat trout distribution map for the South Platte drainage.....3.
2. Map of George and Cornelius Creek.....10.
3. Map of Como Creek.....16.
4. Greenback cutthroat trout length frequency distribution of pool fish versus riffle fish in Como Creek.....20.
5. Greenback cutthroat trout length frequency distribution in Como Creek.....21.
6. Map of Black Hollow Creek.....26.
7. Greenback cutthroat trout length frequency distribution of pool fish versus riffle fish in Black Hollow Creek.....29.
8. Greenback cutthroat trout length frequency distribution in Black Hollow Creek.....30.

Abstract

In 1982, five of six greenback cutthroat trout (Salmo clarki stomias) inhabited streams, currently managed by the Colorado Division of Wildlife, were monitored to determine the status of the populations. Additional fish from the Federal research hatchery in Bozeman Montana were stocked in Black Hollow Creek, Hourglass Creek, May Creek and Williams Gulch Creek. Two new greenback cutthroat trout populations were established in East and West Fork of Sheep Creek and Bard Creek. Brook trout (Salvelinus fontinalis) were removed from George and Cornelius Creeks using rotenone. Stream habitat and population assessments were completed for Como Creek and Black Hollow Creek. An estimated 1,450 fish inhabit 3000m of Como Creek. Estimated standing crop of greenback cutthroat trout in Como Creek was 36.1kg. Estimated standing crop for upper reaches of Black Hollow Creek was 1.4kg. Nine streams were surveyed for possible reintroduction of greenback cutthroat trout. Bruno Gulch and Scott Gomer Creek were considered high priority streams for reclamation.

I. Introduction

This report summarizes the 1982 greenback cutthroat trout recovery effort in the North East Region for the state of Colorado.

In 1977, the greenback cutthroat recovery team set a goal of restoring stable, self-sustaining populations of greenback cutthroat trout (*Salmo clarki stomias*) until said populations have reached a point where their survival is assured. To meet this goal, three objectives were established:

1) Determine if and where additional greenback cutthroat trout populations still exist.

2) Reintroduce greenback cutthroat trout into suitable habitat in the historic range.

3) Monitor and protect known populations.

This years efforts were directed toward achieving the second and third objectives. In 1982, two new greenback cutthroat trout populations were established in East and West Fork of Sheep Creek and Bard Creek. A total of nine streams were surveyed for potential reclamation sites for greenback cutthroat trout reintroduction. Nonnative trout species were removed from two sites scheduled for greenback trout introduction. These sites included George Creek and Cornelius Creek. In an effort to evaluate greenback cutthroat trout habitat requirements, a methodology for quantifying stream habitat was developed.

II. Status of Existing Populations.

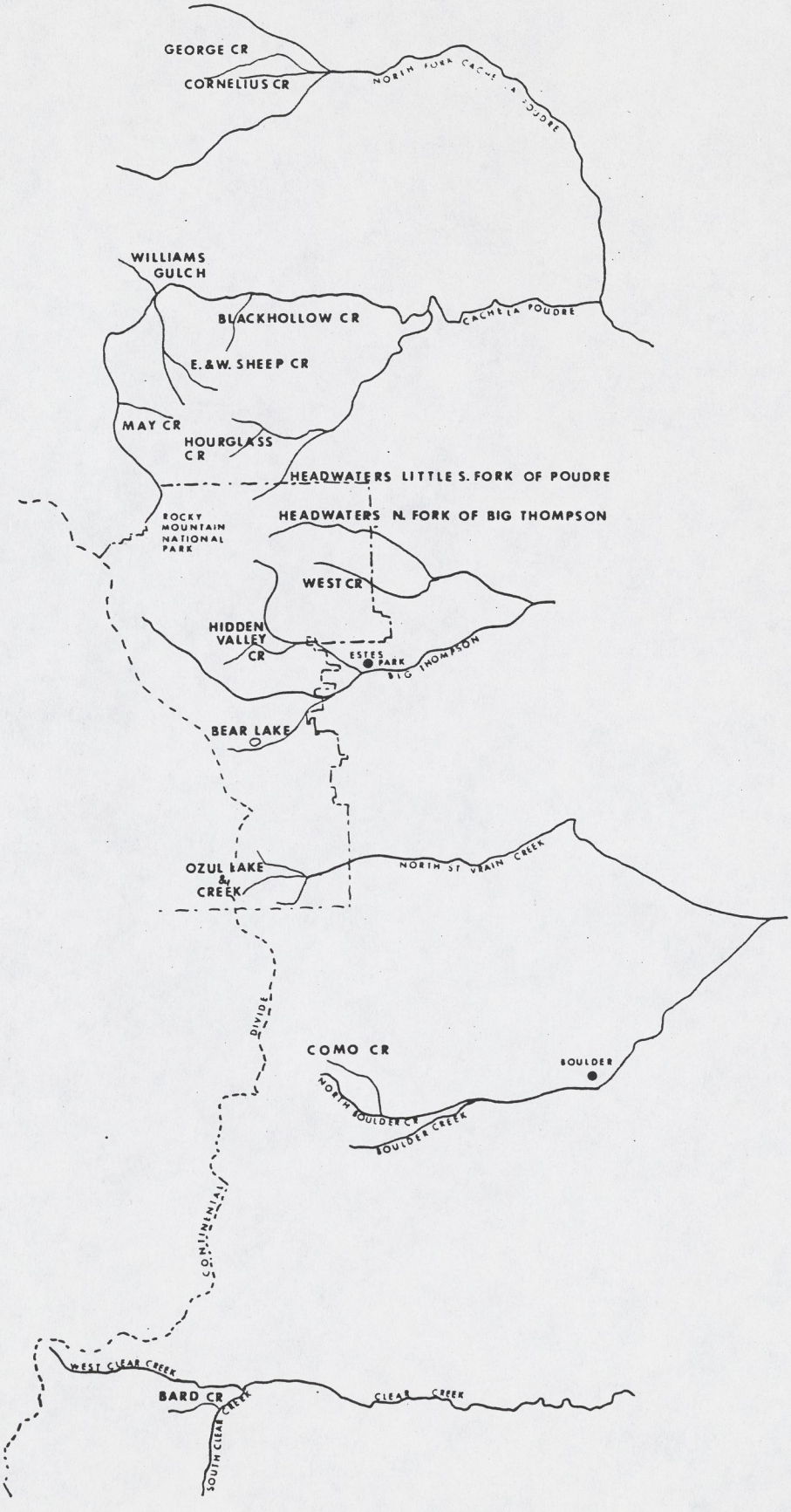
Six populations of greenback cutthroat trout are presently managed in the North East region (Table 1 and Figure 1). Greenback cutthroat trout were released into four streams with existing populations of greenback cutthroat trout. Fish were transported from Bozeman, Montana by the U.S. Fish and Wildlife Service to Fort Collins. From there fish were transferred to holding tanks and then transported to the stocking sites. Fish not stocked on the first day were held in a 100 gallon aquarium until they were stocked the following day. A subsample of the Bozeman hatchery fish were weighed and measured. The average length of 50 fish was 45mm, ranging from 32mm to 63mm. Average weight for the same 50 fish was 0.97g.

Table 1. Existing greenback cutthroat trout populations. *

County	Stream	Drainage
Boulder	Como Creek	Boulder Creek
Larimer	Black Hollow	Poudre River
	Hourglass	Poudre River
	Little South Fork of Poudre River	Poudre River
	May Creek	Poudre River
	Williams Gulch	Poudre River

* Populations of greenback cutthroat inside Rocky Mountain National Park are not included.

Figure 1. Greenback cutthroat trout distribution map for the South Platte drainage.



Como Creek

Cutthroat trout habitat and the population status were evaluated in 1982. The analysis of data collected is presented in the habitat evaluation chapter. Habitat degradation is still a problem confronting the Como Creek population. The lack of adequate gates blocking the roads entering the area allows access to on and off road vehicles. Erosion from existing roads and areas of damaged riparian vegetation significantly increases the silt load in the lower reaches of Como Creek. Human activity, which includes dam and bridge building and other unnecessary destruction of vegetation, which is essential for the protection of bank soil, also contributes to the silt load. Silt build up in the stream is a limiting factor to both reproductive success and food production. Fishing pressure may be a factor limiting this population. Although no anglers were encountered, there was evidence of fishing.

Blackhollow Creek

The habitat and population status was evaluated in 1982. The results are presented in the habitat section. Approximately 1000 greenback cutthroat were stocked in the lower reaches on 6 October 1982. An electrofishing survey found the upper limits of the greenback population to reach the base of a 1m high waterfall located approximately 300m above the first natural waterfall fish barrier. Approximately 500m of stream was electroshocked above the upper waterfall. Although no fish were collected and the habitat was marginal, additional greenback cutthroat trout should be transferred from the lower reaches to this upper section after the population

has stablized. This would provide additional refuge in case of brook trout reintroduction. The population has been slowly recovering since the initial stocking in 1980. An electroshocking survey in the lower reaches recovered very few adult fish and a moderate number of juveniles. Electroshocking is very difficult in the lower reaches because of dense overhanging vegetation. Because the lower reaches are so difficult to electroshock our sampling results do not give a clear picture of the population. The use of fry traps may give a better anaylsis of the population.

Little South Fork of the Poudre

No attempt was made to collect any fish from this area during 1982 field season.

May Creek

May Creek was sampled again in 1982 to determine the status of greenback cutthroat stocked in 1980. Two sampling attempts did not recover any fish in 1981, but approximately five fish were recovered in 1982. There was no evidence of reproduction since all fish collected were adults. Approximately 2000 fish were stocked on 5 October 1982.

Hourglass Creek

During July and August, Hourglass Creek was examined to determine if fish were present from the 1980 and 1981 stockings. The upper reaches of suitable habitat were electroshocked in mid-August, but only five fish were recovered. The temperature of the water was

42 degrees F at 1:00 PM. The fish collected seemed to lack body flexibility. This may be due to electroshocking, but we had not found this effect on cutthroat trout we collected in other streams. The first introduction of greenbacks into hourglass was done by the Colorado Cooperative Fishery Unit in 1965 (Li 1968). Later surveys showed that the original 56 trout did not survive. From this past failure plus the poor condition of the present greenback population we conclude that survival of the present greenback population is doubtful. On 5 October 1982, approximately 1500 greenbacks were planted to increase the number of the existing population. These fish were transported from a fish hauling truck to the stocking site in twelve plastic bags (approximately 125 fish per bag) by horseback. All fish were acclimated to the stream temperature and released. No mortalities were observed. The success of the Hourglass population surviving is doubtful.

Williams Gulch

An electroshocking survey recovered nine of the 40 greenback cutthroat trout planted in 1981 in good condition. The largest fish was 200mm long. Individual fish were plump from eating the abundant aquatic invertebrate population observed. Water temperature was high because of flow thru a open meadow and exposure to the sun. Approximately 2000 fish were stocked on 6 October 1982. Additional fish should be stocked in 1983 if available.

III. Establishment of New Populations

Two new populations were established in 1982. East and West Fork of Sheep Creek, tributary of the Cache La Poudre River, in Larimer County was stocked with approximately 7200 greenbacks on 5 October 1982. These fish were transplanted from a fish hauling truck to the stocking site in six plastic bags (approximately 1200 fish per bag) by horseback. All fish were acclimated to the stream water conditions and released. Approximately 5% mortality was observed. Mortalities were due to transportation in the fish hauling tank. In July, Sheep Creek was surveyed to evaluate the 1981 fish removal efforts. No fish were recovered.

Bard Creek, tributary of Clear Creek in Clear Creek County was stocked on 5 October 1982 with approximately 7200 greenbacks and on 11 November 1982 with another 1100 fish Greenbacks were transported from Bozeman, Montana by the U.S. Fish and Wildlife Service to Fort Collins. From there fish were transferred to holding tanks and then transferred to the various stocking sites. Fish not stocked on the first day were held in a 100 gallon aquarium until they were planted the following day.

IV. Stream Restoration Projects

George Creek and Cornelius Creek were the sites of stream restoration efforts in 1982. These streams were treated in 1981 with synergized rotenone (2.5%) to remove nonnative trout species. Unfortunately brook trout (Salvelinus fontinalis) were found in the upper reaches of George Creek and a lone brook trout was recovered

from a beaver dam pond on Cornelius Creek. The reason for finding numerous brook trout in the upper reaches George Creek is uncertain. One possible explanation may be due to an oxidizing element present in the stream substrate or from mine tailing runoff.

These two streams were again treated with synergized rotenone (2.5%) to remove nonnative trout species for a second time in 1982. Potassium permanganate was used to detoxify the rotenone. Concentrations, exposure times, and total amount of rotenone and potassium permanganate are listed in table 2. Rotenone was released into the streams using modified small animal waterers. A 1/16 inch hole was drilled into the trough of the waterers. A constant head of water in the trough created a steady flow through the hole. Rotenone was applied to isolated and low flow pools using insecticide sprayers. Potassium permanganate was applied using a constant flow device which regulated the rate of permanganate siphoned from two 50 gallon drums. A toilet bowl valve and float were connected to the siphon hose. The valve and float were placed in a five gallon bucket which had a regulating valve near the bottom. The toilet valve regulated the incoming permanganate to maintain a constant head. The valve on the bottom of the bucket was opened to the correct application rate. The constant head insured a constant flow thru the valve.

George and Cornelius Creeks were poisoned on 24 August 1982. The seven toxicant drip stations were placed equal distances apart, with three on Cornelius Creek and four on George Creek (Figure 2). The detoxification station was located below the gabion fish barrier. Live cages with four to six brook trout were placed upstream of each

drip station and the detoxifiction station to test whether flow through beaver ponds was adequate to kill fish.

Many dead fish were observed between stations 1 and 2 on George Creek and no fish were recovered from Cornelius Creek. All fish in the live cages were dead within four hours of the initial release of rotenone.

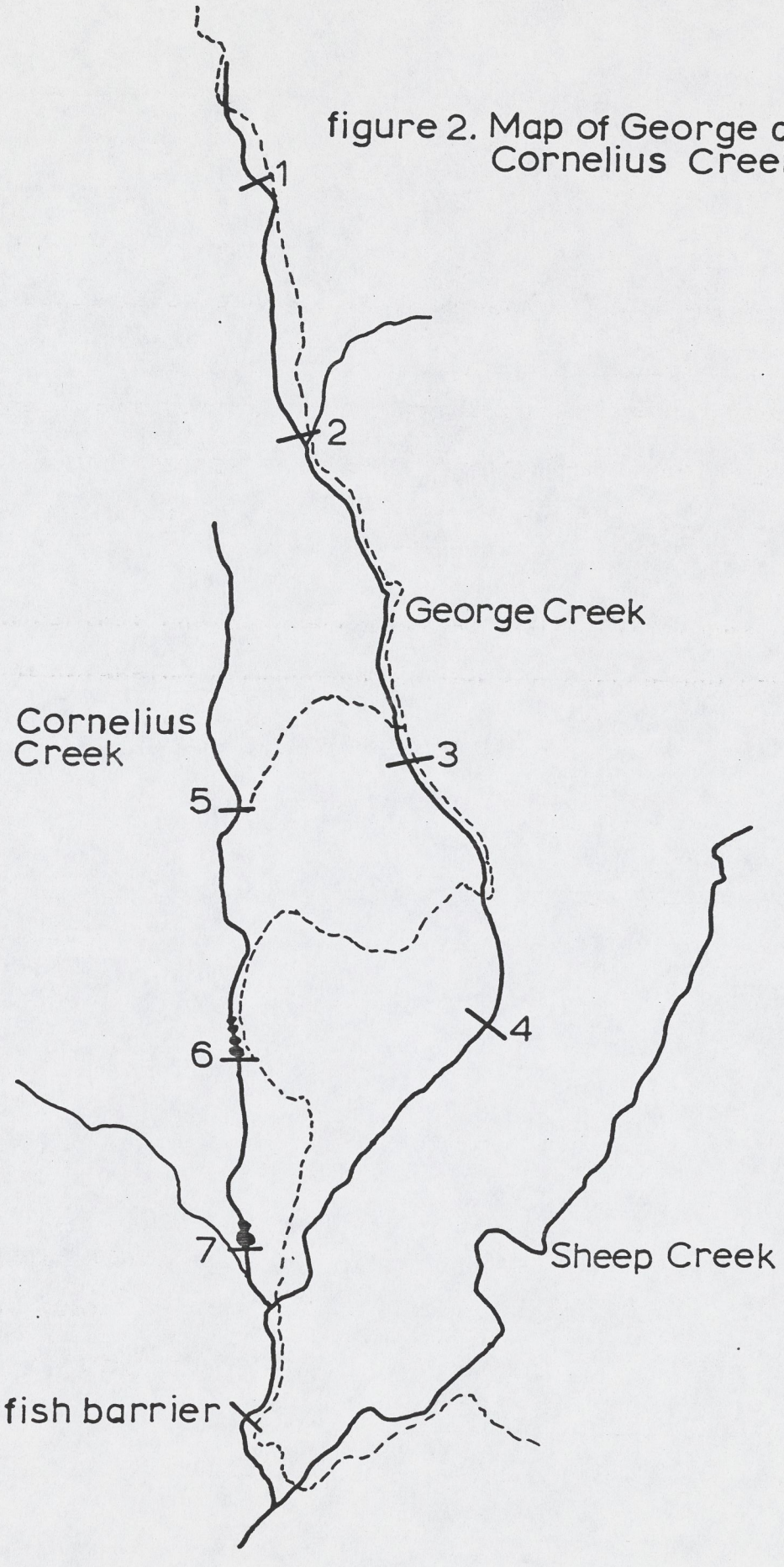
George and Cornelius Creeks should be surveyed in 1983 to assess the results of the 1982 fish removal efforts. If no fish are found, greenback cutthroat trout should be reintroduced in 1983.

Table 2. Concentrations, exposure times, and total amount of rotenone and potassium permanganate used for George and Cornelius Creeks fish removal projects.

	Station							
	1	2	3	4	5	6	7	total
discharge (cfs)	1.5	1.5	1.75	1.75	1.0	1.0	1.0	2.75
rotenone								
concentration (ppm)	6	6	4	4	6	6	4	6
total used (liters) *	7.4	7.4	5.7	5.7	4.9	4.9	3.3	39.3
exposure time (hours)	8	8	8	8	8	8	8	8
potassium permanganate								
concentration (ppm)								3
total used (kg)								40.0
exposure time (hours)								48

* Does not include rotenone used for spraying isolated pools.

figure 2. Map of George and Cornelius Creek.



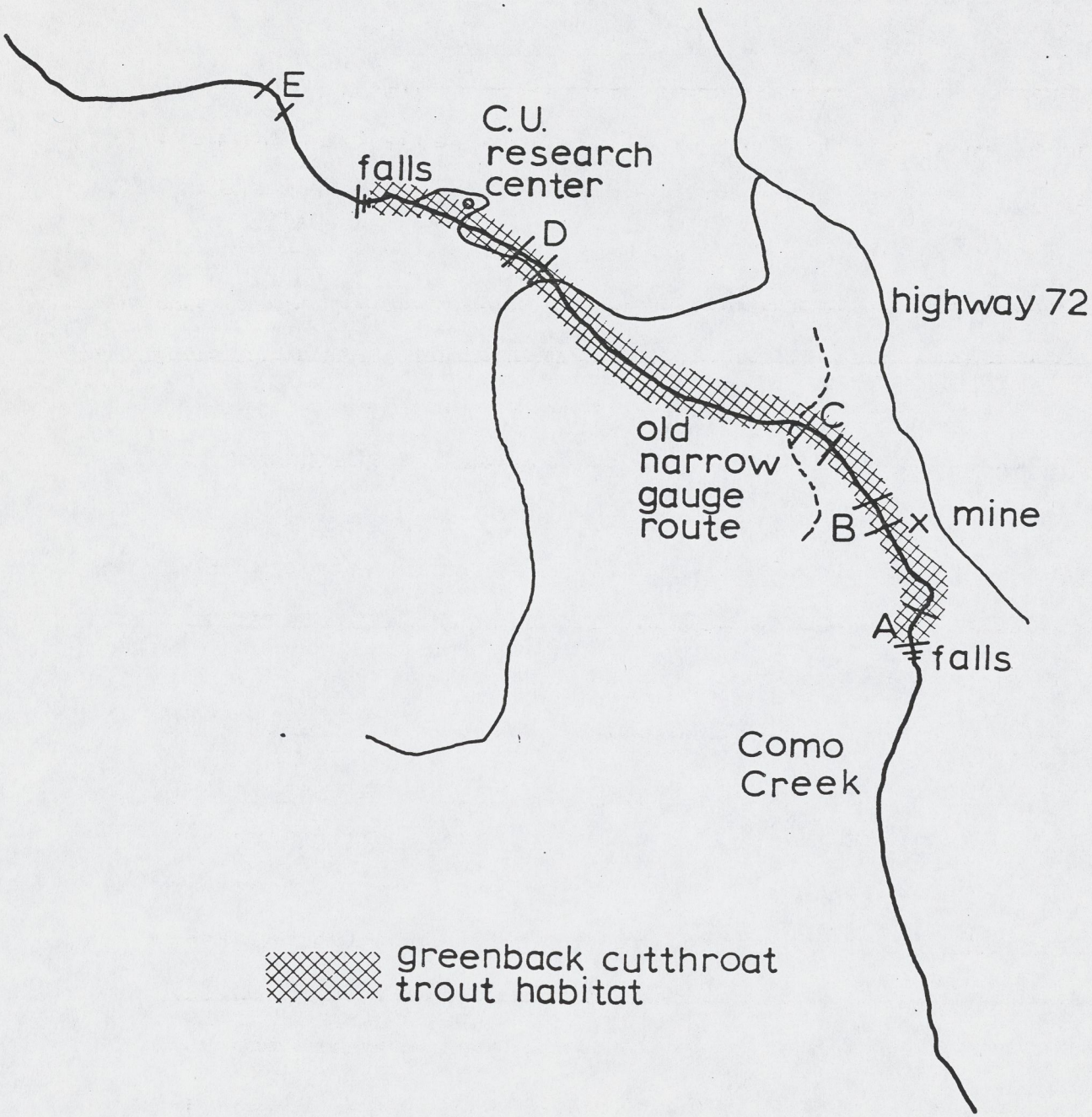
V. Habitat Evaluation

A. Como Creek Habitat Analysis

The objectives of this study were to quantify greenback cutthroat trout habitat in Como Creek and compare the results with various population parameters. The results from this study will be used in the future to compare habitat analysis of other greenback inhabitated streams. This study and future studies will help us determine what constitutes suitable habitat for supporting a stable population of greenback cutthroat trout. Statistical models developed from the Como Creek study will predict response of the Como Creek greenback population to habitat improvements.

Como Creek is the site of one of the three remnant greenback cutthroat trout populations. Como Creek is located in Boulder County, Colorado and is a tributary of North Boulder Creek. The section of stream studied is located between a waterfall, which acts as a fish barrier, located near the Caribou Ranch property boundary and a waterfall barrier located above the University of Colorado Alpine Research Center. Below the lower waterfall only brook trout were collected. Above the upper waterfall only one adult greenback was found in 1982. Surveys in the upper reaches during the past four years indicate the greenback population in the higher reaches is declining and no reproduction has occured. The analysis that follows includes only the 3000m of suitable habitat, which supports a reproducing population of greenbacks, between the lower and upper waterfall (Figure 3).

figure 3. Map of Como Creek



Methods and Materials

Methods and materials are outlined in Appendix A (Proposed Research). Specifics and variations of the methods and variations are as follows: Five 100m stream reaches were marked and labeled A thru E (Figure 3). All fish were weighed and measured and this information recorded for the fish from each coded pool and riffle. All parameters measured are listed in table 3. Field forms used for recording data are in appendix B.

Results and Discussion

Transect data for Como Creek is summarized in appendix C. Note that average pool or riffle length, surface area, and volume are incorrect at the section and stream level due to computer control statement error. Cover data summary is in appendix D. Fish data summary is in table 4. The estimated number of greenback cutthroat trout 40mm long and above in the 3000m study section of Como Creek was 1,450 fish. The estimated number of trout greater than 150mm in Como Creek was 420 fish. Station B data was not included in the fish production estimates because habitat measurements were not completed. Station E data was not included in the analysis because only one fish 147mm long and 27g was collected. Standing crop for Como Creek was 62.56kg/ha or 58.48g/cu.m. Productivity of the study sections decreass continously downstream. The reason for this is unclear, there was no correlation between the habitat parameters and standing crop. We suspect increased pertubation of riparian habitat

Table 3. Fish population and physical parameters measured and analyzed for Como Creek and Black Hollow Creek.

fish population	transect	cover
number of fish	average depth	% bank cover
average length	maximum depth	% instream cover
average weight	area	% undercut bank cover
total weight	volume	% overhanging vegetation
	% boulder substrate	% surface turbulence
	% rubble substrate	% debris cover
	% gravel substrate	% rock cover
	% sand substrate	% log cover
	% silt substrate	% vegetation cover
	% vegetation substrate	area of cover
	% debris substrate	depth of cover
		volume covered
		average size of cover
		average volume covered
		cover area/total area ratio
		volume covered/total vol.ratio

Table 4. Greenback cutthroat trout data summary for Como Creek.

Station A											
	pools						**riffles**				
code	fish total	ave. length	ave. weight	total weight	max. length	code	fish total	ave. length	ave. weight	total weight	max. length
1	0	-	-	-	-	1	5	56.8	5.0	25	89
2	5	169.3	60.3	181	236	2	5	35.0	5.0	25	35
3	7	127.6	27.6	193	184	3	2	115.0	15.0	30	141
4	0	-	-	-	-	4	4	122.8	15.5	102	190
5	2	145.5	30.0	60	165	5	3	128.7	21.0	63	148
6	3	118.7	24.0	72	184	6	1	85.0	5.0	5	85
7	4	93.8	16.0	64	152	7	1	77.0	5.0	5	77
8	2	106.0	12.5	25	124						
9	3	76.6	31.3	94	150						
total	26	145.0	26.5	689	236	total	21	82.3	12.1	255	190
Station B											
1	4	98.3	8.8	35	131	1	0	-	-	-	-
2	2	140.5	23.5	47	146	2	0	-	-	-	-
3	0	-	-	-	-	3	6	99.7	10.0	60	137
4	1	115.0	12.0	12	115	4	0	-	-	-	-
5	3	124.3	31.7	95	192	5	1	86.0	5.0	5	86
6	0	-	-	-	-	6	2	167.0	52.0	104	186
7	2	134.0	31.5	63	176	7	4	-	-	-	-
8	1	81.0	5.0	5	81	8	1	77.0	5.0	5	77
9	4	102.5	16.3	65	186						
10	2	146.0	28.5	40	157						
11	2	120.0	20.0	40	157						
12	1	188.0	68.0	68	188						
total	22	120.1	26.8	590	192	total	14	109.5	17.4	174	186
Station C											
1	9	127.6	29.3	264	219	1	5	96.0	10.0	50	149
2	1	78.0	5.0	5	78	2	0	-	-	-	-
3	3	161.3	50.7	152	196	3	6	123.5	17.8	107	155
4	2	165.0	44.0	88	177	4	2	90.5	7.5	15	106
5	2	156.5	42.5	85	176	5	5	110.6	21.0	105	189
6	6	176.0	69.8	419	241						
7	1	83.0	5.0	5	83						
total	24	145.5	42.4	1018	241	total	18	108.6	15.4	277	189

Table 4. (cont.)

Station D

pools						riffles					
code	fish total	ave. length	ave. weight	total weight	max. length	code	fish total	ave. length	ave. weight	total weight	max. length
1	6	124.8	23.0	138	173	1	0	-	-	-	-
2	3	176.0	62.3	187	186	2	1	146.0	28.0	28	146
3	2	131.0	20.0	40	141	3	0	-	-	-	-
4	2	98.5	10.0	20	121	4	1	138.0	20.0	20	138
5	1	125.0	15.0	15	125	5	0	-	-	-	-
6	8	97.8	11.4	91	144	6	3	107.7	14.3	43	141
7	6	113.8	17.2	103	161	7	0	-	-	-	-
8	8	141.3	33.4	301	212						
9	0	-	-	-	-						
10	2	154.5	34.0	68	160						
11	5	119.0	14.4	72	143						
12	8	145.8	30.6	245	190						
total	51	128.0	25.1	1280	212	total	5	121.4	18.2	91	146
grand total	123	133.6	29.1	3577	241	grand total	58	100.4	13.7	797	190

in the lower reaches increase stream silt loads. Fine particles fill substrate interstitial spaces thus reducing stream invertebrate production. Observations of stream bottom surfaces was the basis for substrate analysis. Future habitat measurements should include subsurface substrate analysis or invertebrate production analysis.

Pools support significantly more fish biomass than riffles. Pool productivity significantly decreases progressively downstream, but riffle productivity significantly increases downstream. There was no correlation between fish production and pool classification. Pools were classified using Habitat Evalution Procedure (HEP) criteria. No first class pools exist in Como Creek. Thirty-six percent of the pools were second class pools and 64% were third class pools. The average trout found in pools were significantly larger than trout found in riffles (Table 5).

Length frequency distribution (Figure 4) of pool fish versus riffle fish illustrates that pool fish size class distribution had a wider range than the riffle fish size class distribution. Figure 5 illustrates length frequency distribution of all fish collected in the stream. Note that percentages used for the graphs were rounded to the nearest whole percent.

A simple least square regression and scatterplots were generated between dependent variables (average length, average weight, total weight, and maximum length) and the independent variables (Table 3). A total of 28 analyses were completed. Analysis showed no correlation between the independent and dependent variables. There was a very slight correlation between average weight and average depth (R-squared=.28), total weight and average depth

Table 5. Habitat and greenback cutthroat trout population data summary for Como Creek.

	Station A	Station C	Station D	Total	Estimate for Como Creek *
date hab. sampled	9/9/82	10/14/82	10/12/82		
elevation (m)	2682	2743	2834		
length (m)	103.8	98.0	100.9	302.6	3000 (+-100)
ave width (m)	2.44	2.03	1.61	2.03	2.03
ave depth (m)	.11	.14	.12	.12	.12
total area (sq.m)	232.9	191.1	153.3	577.3	5773.0
total volume (cu.m)	23.26	22.75	15.72	61.73	617.3
flow (cu.m/sec)	0.030	0.027	0.026	0.028	0.028
flow (c.f.s.)	1.05	0.96	0.92	0.98	0.98
velocity (m/sec)	0.13	0.12	0.17	0.14	0.14
date fish sampled	9/7/82	9/8/82	9/8/82		
shocking time (min)	47	28	63	138	
number of fish	47	42	56	145	1450
fish > 150mm	12	15	15	42	420
fish biomass (g)	944	1295	1371	3610	36.1kg
fish production					
g/sq.m	4.05	6.78	8.94	6.26	6.26
kg/ha	40.53	67.76	89.45	62.56	62.56
g/cu.m	40.58	56.92	87.21	58.48	58.48
pool volume (cu.m)	14.86	11.77	10.14	36.77	367.7
pool area (sq.m)	114.61	62.09	72.22	248.92	2489.2
1st class pools (%)	0.0	0.0	0.0	0.0	0.0
2nd class pools (%)	44.2	83.7	15.1	36.2	36.2
3rd class pools (%)	55.8	16.3	84.9	63.8	63.8
pool biomass (g)	689	1018	1280	2987	29.87kg
production (g/cu.m)	46.37	86.49	126.23	81.23	81.23
riffle volume (cu.m)	8.40	10.98	5.58	24.96	249.6
riffle area (sq.m)	118.32	129.01	81.05	328.38	3283.8
riffle biomass (g)	255	277	91	623	6.23kg
production (g/cu.m)	30.36	25.23	16.31	24.96	24.96
pool/riffle (area)	.97	.48	.89	.76	.76
pool/riffle (vol.)	1.77	1.07	1.82	1.47	1.47

* Estimates are for all suitable habitat which will support a reproducing population of greenback cutthroat trout in Como Creek.

Figure 4. Greenback cutthroat trout length frequency distribution of pool fish versus riffle fish in Como Creek.

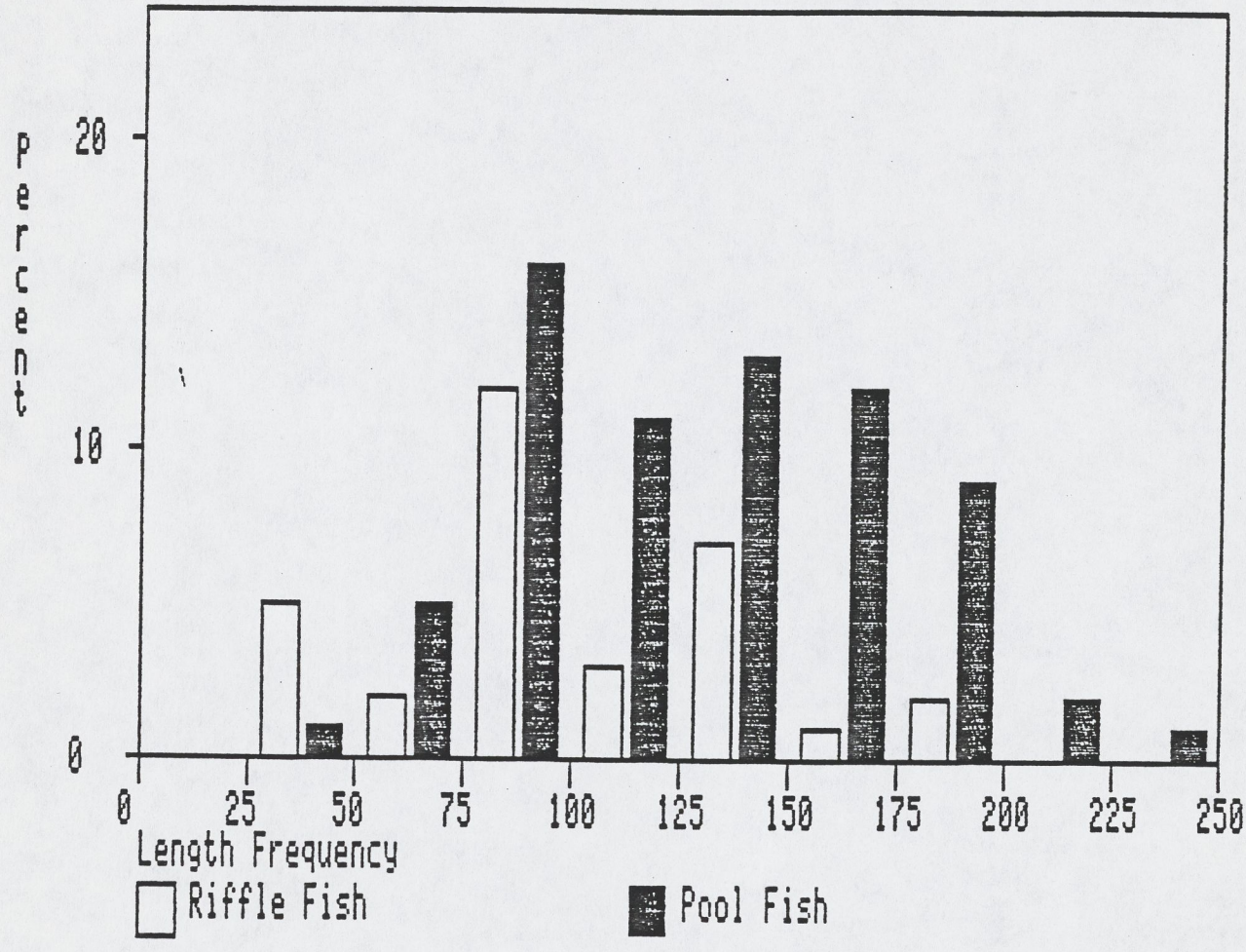
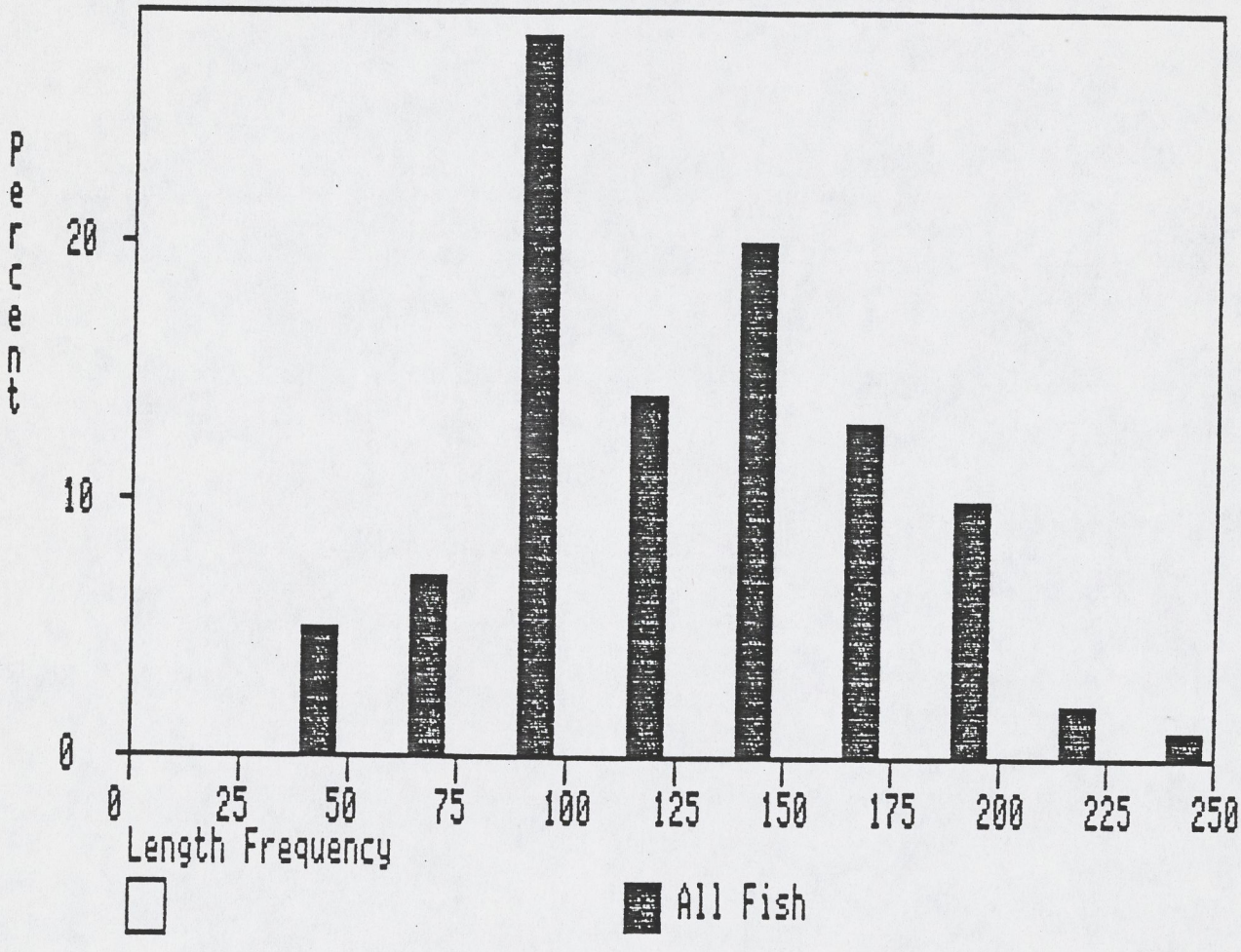


Figure 5. Greenback cutthroat trout length frequency distribution for Como Creek.



(R-squared=.24), and total weight and volume (R-squared=.28).

Multiple stepwise regression analysis using the dependent variables (average length, average weight, total weight, and maximum weight) and independent variables listed in table 3 were computed using different variable inclusion levels and F to remove and enter levels. The independent variables were included in the models in different order, variables were also grouped or seperated based on relative importance of the independent variables. The overall test for a variable to be included in the model used statistical inference procedures to test the null hypothesis that the multiple correlation is zero in the population which the sample was drawn. The test statistics employed for the overall test was a F-test. Numerous analyses were completed to find the most useful models for predicting the different dependent variables. Data analyzed using regression analysis was not classified as pool or riffle. Each pool or riffle was treated as a homogeneous reach of habitat within a habitat continum, which ranged from a shallow riffle to a deep first class pool.

Numerous models were generated, but only one model which predicts trout biomass, is presented in this report. All other models had low correlation coefficients and were of little use.

Four physical habitat variables were included in a linear model which predicted fish biomass. Variations between all models were due to different inclusion levels, F to include and remove levels, and removal of outliers. Variables which were used in the final model were almost always in the other models generated. Four pool and riffle data set outliers were removed from the data because the

difference between predicted biomass and actual biomass was greater than two standard deviations. The final model included the following parameters: Volume, average volume covered, total area of pool or riffle, and total volume covered. These four parameters explained 81.4% of the variation in fish biomass. Volume accounted for 47.5% of the variation, average volume covered accounted for 14.3%, total area of pool or riffle accounted for 8.7%, and total volume covered accounted for 10.9%. The final model for predicting fish biomass in a homogeneous reach of Como Creek is:

Total Trout Biomass (g) = 0.0902 x (volume (cu.m)) + 2.4815 x (average volume covered (cu.m)) - 0.4879 x (total volume covered (cu.m)) - 0.00407 x (area (sq.m)) - 5.935

Area and total volume covered are negative components in the model. The negative area component is an adjustment for average depth of the habitat section. In other words, a deep pool with high volume and low relative total surface area is more productive than a riffle area with the same volume but greater surface area. The negative total volume covered component adjusts for the total number of covered areas. Thus, a few large covered areas are more productive than many small covered areas. This aspect of the model is flawed. According to the model it is possible for cover to have a negative impact on trout production in Como Creek. This model applies only to Como Creek. This model will be useful in deciding what habitat improvements will be the most beneficial in increasing standing crop in Como Creek.

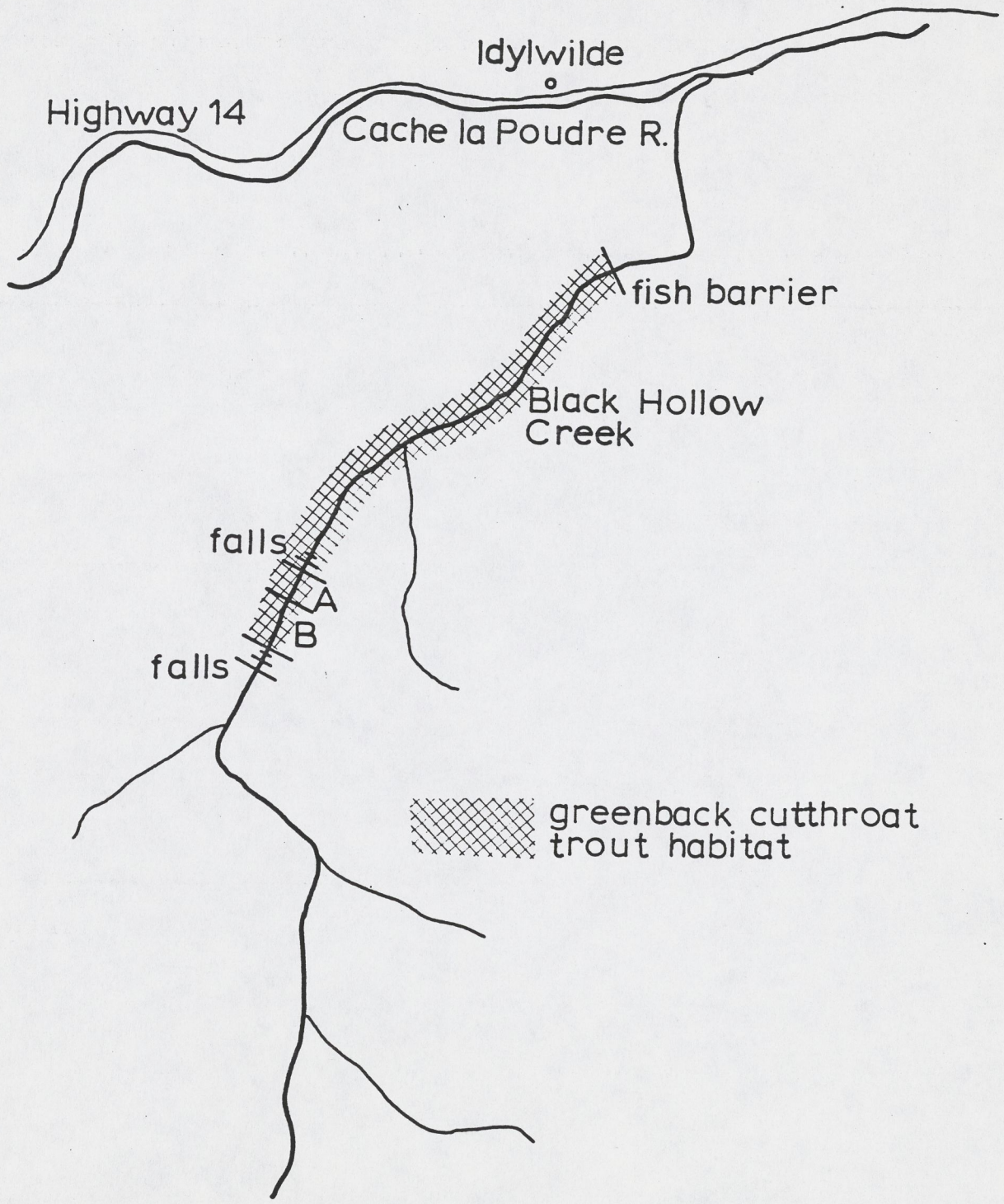
B. Black Hollow Creek Habitat Analysis

The objectives of this study were to quantify greenback cutthroat trout habitat in Black Hollow Creek and relate the results to various population parameters. The results from this study will help us determine what constitutes suitable habitat for supporting a stable population of greenback cutthroat trout.

Black Hollow Creek was poisoned in 1979 to remove brook trout found above the manmade fish barrier. The section poisoned was between the lower natural waterfall and the fish barrier. In 1978, greenback cutthroat trout collected from the section to be poisoned were transported above the lower natural waterfall. The section between the lower waterfall and the next impassable waterfall was the site for our population and habitat analysis (Figure 6). An electroshocking survey above the upper falls did not find any fish. The study area represents the upper limits of greenback cutthroat in Black Hollow Creek. The section below the lower natural waterfall was not included in this study because greenback trout were stocked in 1980 and 1982. The population in this section of stream is not representative of a natural reproducing greenback population.

Blackhollow Creek is located in Larimer County, Colorado and is a tributary of the Cache la Poudre River. The shaded area in figure 6 represents approximately 2000m of suitable cutthroat trout habitat.

figure6. Map of Black Hollow Creek.



Methods and Materials

Methods and materials are outlined in Appendix A (proposed research). The following descibes specifics and variations to the methods and materials in Appendix A. Two stream reaches 100m and 160m long were marked and labeled station A and station B (Figure 6). All fish were weighed and measured and this information recorded for the fish from each coded pool and riffle. All parameters measured are listed in table 3. Stepwise regression analysis was not completed for Black Hollow Creek, but will be completed at a later date.

Results and Discussion

Transect data for Black Hollow Creek is summarized in appendix C. Note that average pool or riffle length, surface area, and volume are incorrect at the section and stream level due to computer control statement error. Cover analysis data is summarized in appendix D. Trout measurements are summarized in table 6. The total number of 30mm and larger greenback cutthroat trout in the 260m study section was 25 fish (Table 7). Habitat analysis was not completed for station A. Instantaneous trout biomass production for station B was 28.43kg/ha or 24.56g/cu.m. A series of pools located just below the upper waterfall supported the greatest number and largest trout in the study section. Pools supported significantly more fish biomass than riffles. This can be attributed to the high stream gradient of 9.0% in the riffle areas. A high amount of

Table 6. Greenback cutthroat trout population data summary for Black Hollow Creek.

Station A

pools						riffles					
code	fish total	ave. length	ave. weight	total weight	max. length	code	fish total	ave. length	ave. weight	total weight	max. length
1	2	65	-	-	65	1	0	-	-	-	-
2	1	65	-	-	65	2	1	65.0	-	-	65
3	1	65	-	-	65	3	3	90.3	-	-	108
total	4	65	-	-	65	total	4	84.0	-	-	108

Station B

pools						riffles					
1	1	235.0	130.0	130	235	1	0	-	-	-	-
2	1	236.0	135.0	135	236	2	0	-	-	-	-
3	6	177.7	59.8	359	258	3	0	-	-	-	-
4	1	166.0	50.0	50	166	4	1	193.0	55.0	55	193
5	2	183.5	56.5	113	192						
6	1	280.0	245.0	245	280						
7	1	172.0	53.0	53	172						
8	1	170.0	52.0	52	170						
9	2	232.5	112.5	225	251						
total	16	197.33	85.1	1362	280	total	1	193.0	55.0	55	193
grand total	20	170.86	-	-	280	grand total	5	105.8	-	-	193

Table 7. Physical data and greenback cutthroat trout population data summary for station B on Blackhollow Creek.

	Station B
date habitat sampled	8/18/82
elevation (m)	2560
length (m)	160.0
average width (m)	3.28
average depth (m)	0.14
total area (sq.m)	498.48
total volume (cu.m)	57.69
flow (cu.m/sec)	0.106
flow (c.f.s.)	3.76
velocity (m/sec)	0.30
gradient (%)	9.0
date fish sampled	10/18/82
number of fish	17
fish biomass (g)	1417
fish production (g/sq.m)	2.84
(Kg/ha)	28.43
(g/cu.m)	24.56
pool volume (cu.m)	13.41
pool area (sq.m)	74.40
pool biomass (g)	1362
pool production (g/cu.m)	101.57
riffle volume (cu.m)	44.28
riffle area (sq.m)	424.09
riffle biomass (g)	55
riffle production (g/cu.m)	1.24
pool/riffle (area)	0.18
pool/riffle (volume)	0.30

energy is required for trout to maintain themselves in riffle areas with high water velocity. Figure 7 illustrates the length frequency distribution of pool and riffle fish. Figure 8 illustrates length frequency distribution for all fish collected in the study section. Although reproduction was evident as illustrated in figure 8, this type of size distribution is typical of an unstable population with many adults and few young fish and missing age classes. The reason for few young fish is likely due to drifting of the fry downstream below the waterfall barrier. Since the fish collected were not aged using a bony structure, population stability analysis was not completed.

Figure 7. Greenback cutthroat trout length frequency distribution of pool fish versus riffle fish.

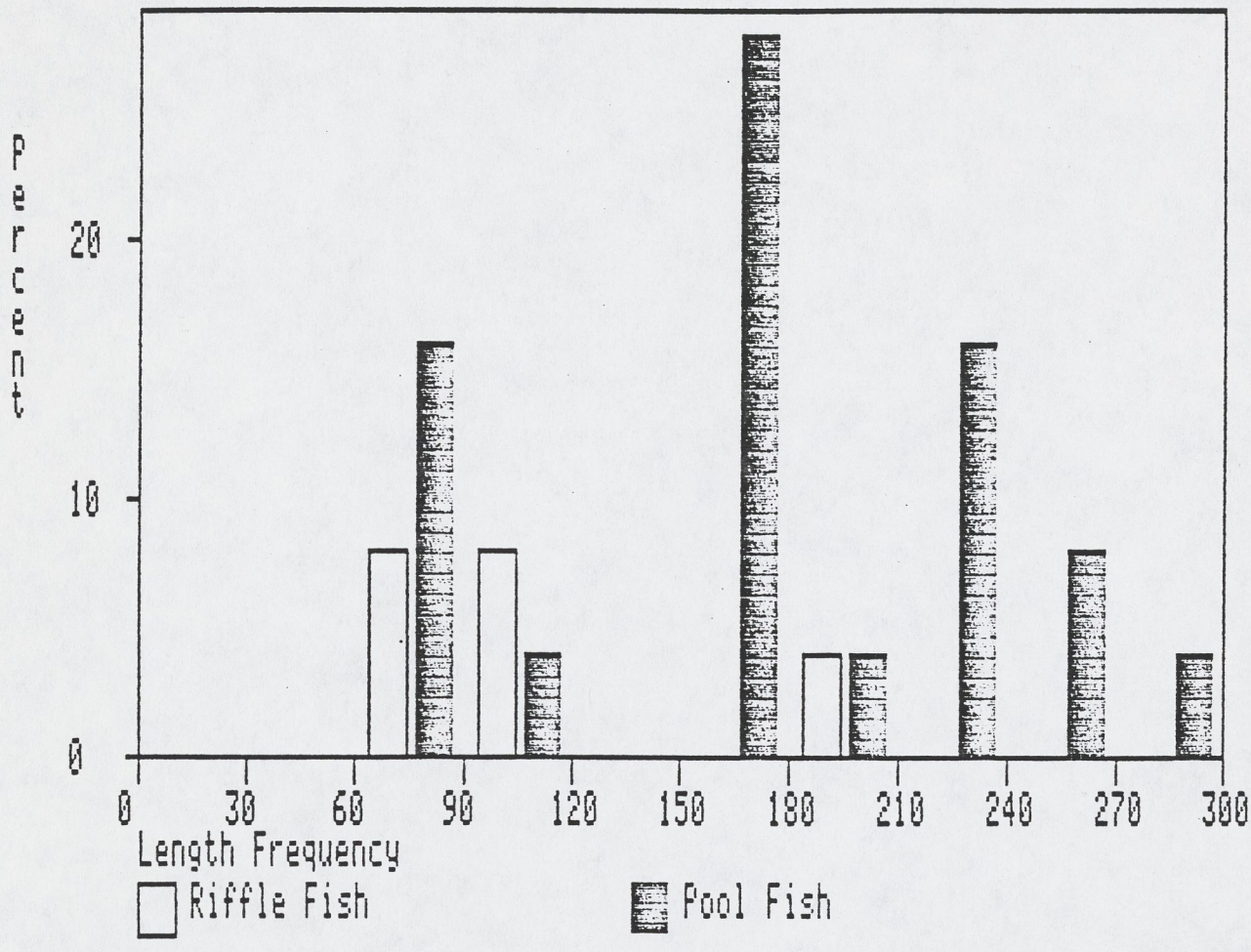
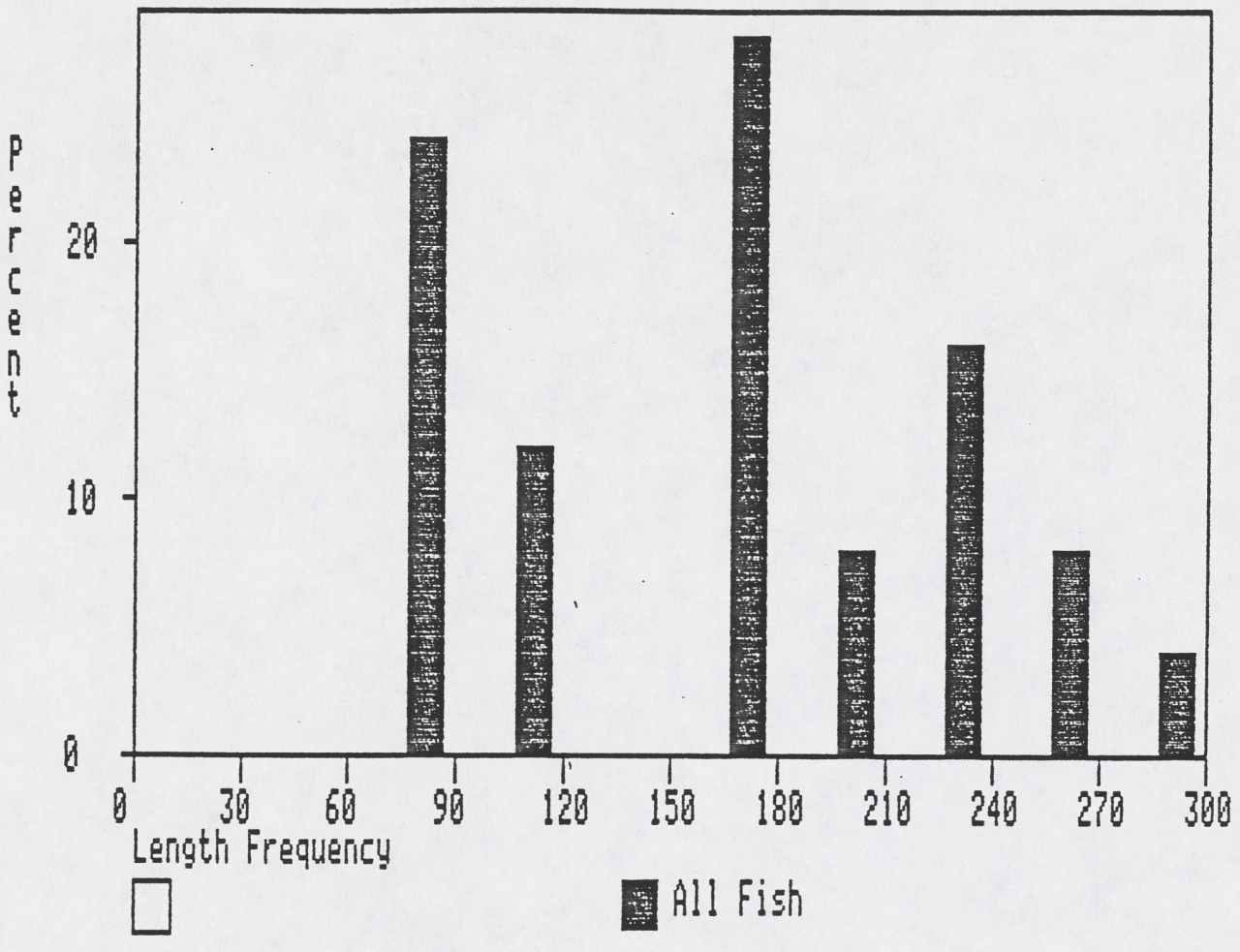


Figure 8. Greenback cutthroat trout length frequency distribution for Black Hollow Creek.



VI. Stream Surveys

A list of possible streams for reintroduction of greenback trout was established after examination of U.S. Service , U.S. Geological survey maps and stream surveys files on all streams in N.E. region. In 1981, the 692 potential streams were narrowed down to a list of 173 streams and revised in 1982 to 123 streams (Table 8) by using the following criteria:

1) Streams must be in the headwaters of either the Arkansas or South Platte River drainages.

2) The headwaters of the streams must be protected from invasion of on-native trout by a waterfall, steep cascade, other impassable barriers, or have a suitable site for a manmade barrier.

3) The stream must be in a low-use area.

4) The stream must have suitable habitat to support a reproducing population of greenback cutthroat trout.

A rating system based on species present, habitat, impassable fish barrier or potential for construction of a fish barrier, accessability and potential for eradication of nonnative species was set up as follows:

rating	criteria
A	Pure greenback cutthroat trout are present.
B	Hybrid greenback cutthroat trout are present.
C	1) Fish barrier present. 2) Good trout habitat. 3) Low fisherman acess. 4) Ready for greenback cutthroat trout introduction.
D	1) Barrier or barrier site present. 2) Good to marginal trout habitat. 3) Marginal fisherman acess. 4) Good reclamation potential. 5) Work required before introduction.
E	1) No fish barrier or barrier site present. 2) Poor or marginal habitat. 3) High fishing pressure. 4) Poor reclamation potential. 5) Not recommended for introduction of greenback cutthroat trout.

Nine of the 123 potential D-rated streams were surveyed in 1982. Surveyed streams were evaluted based on the potential for greenback cutthroat reintroduction. High, moderate, and low priorities were assigned to each stream surveyed as follows:

High priority - should be considered for greenback cutthroat trout reintroduction.

Moderate priority - should be considered if no high priority streams are available.

Low priority - should not be considered for greenback cutthroat trout reintroduction and given a E-rating.

Streams which were surveyed and had good habitat but need to be looked at again were not given a priority rating.

Flow data collected during high flow in 1982 is summarzed in table 9.

Table 8. Revised list of streams to be evaluated for Greenback Cutthroat Trout introduction.

Boulder	Clear Creek	Douglas	Jefferson
Antelope Creek	Barbour Fork	Bear Creek	Bear Creek
Arapahoe Creek	Bear Track Creek	Camp Creek	Bear Gulch
Bell Gulch	Beaver Dam Creek	Cook Creek	Beaver Creek
Beaver Creek	Cottonwood Gulch	Dry Gulch	Brush Creek
S.Fk.Mid. Boulder	Devils Canyon	Eagle Creek	Cabin Creek
Buck Gulch	Ethel Creek	Fourmile Creek	Deer Creek
Cave Creek	Indian Creek	Garber Creek	Elk Creek
Central Gulch	Lake Fork Creek	Middle Garber Creek	Field Creek
Chipmunk Gulch	Lost Creek	North Garber Creek	Freeman Creek
Colorado Creek	Melvine Creek	South Garber Creek	Green Mountain Creek
Coulson Creek	Nott Creek	Gove Creek	Gunbarrel Creek
Dry St. Vrain	Ralston Creek	Jenny Gulch	McCurdy Creek
Ellsworth Creek	Rose Creek	Metz Canyon	Morrison Creek
Hawkins Gulch	Ruby Creek	Pine Creek	Redskin Creek
Jasper Creek	Soda Creek	East Plum Creek	Rolling Creek
Keystone Gulch	Steel Creek	Spring Gulch	North Rolling Creek
Mammoth Gulch	Truesdale Creek	Star Canyon	Tanglewood Creek
Mitchell Creek	Tumbling Creek	Trout Creek	Tramway Creek
Park Creek	Vance Creek	Turkey Creek	Wigwam Creek
Pennsylvania Gulch	Warren Gulch	Little Turkey Creek	
Rattlesnake Gulch	Watrous Gulch	Watson Park Creek	
	West Fork Creek	Wild Cat Creek	
	Woods Creek		

Gilpin	Larimer	Park
Arbuckle Gulch	Box Elder Creek	Bluestern Draw
Cottonwood Gulch	Cedar Creek	Camp Creek
Elk Creek	Dry Creek	Craig Creek
Elk Creek	Fall Creek	Deep Gulch
Jenny Creek	Fall Creek	Deer Creek
Macy Gulch	Fox Creek	North Elk Creek
Pecks Gulch	Lewstone Creek	N. Fork Elk Creek
	Montgomery Creek	Francis Creek
	Poverty Gulch	Gibson Gulch
	Skin Gulch	Holmes Gulch
	Swamp Creek	Jefferson Creek
	Willow Creek	Jefferson Lake Fork
		Kenosha Creek
		Lake Fork
		Mill Gulch
		Sawmill Gulch
		Shutetown Creek
		Slaughterhouse Gulch
		Threemile Creek

Table 9. Flow data collected during high flow in 1982.

Stream	date	flow (cfs)	velocity (ft/sec)
Williams Gulch	7/25/82	0.4	-
May Creek	7/20/82	4.2	-
Sheep Creek East Fork	7/30/82	56.0	2.86
West Fork	7/30/82	52.1	2.86
Leavenworth Creek	7/24/82	58.0	-
West Creek	7/23/82	40.2	2.22
Little S. Fk. of Poudre	7/22/82	57.7	3.85
Hourglass Creek	7/22/82	23.2	2.50
Black Hollow Creek	7/21/82	17.8	3.70

The following is an annotated list of streams which were inventoried during 1982. Streams are listed by county.

Clear Creek County

Bard Creek(tributary of Clear Creek)

Surveyed on 24 June 1982. Water quality was tested and a sample collected to be analyzed for heavy metals. Results of water quality analysis indicated no lethal concentrations of heavy metals were present in the water samples collected. (Table 10).

Chicago Creek(tributary of Clear Creek)

Surveyed on 23 September 1982. Habitat was marginal in the upper reaches below lower Chicago Lake. Flow was good (3.0cfs), water temperature was 47 degrees F, gradient was moderate, and bank willows provided some cover. RainbowXcutthroat trout were the only fish collected. All fish were less than 10cm in length. Habitat in lower reaches (above Idaho Springs Reservoir) was good with large pools, good cover, and high flow (7.0cfs). Water temperature was 47 degrees F. Bottom substrate above the reservoir provided excellent spawning areas. Only rainbowXcutthroat trout (3-9") were collected. Spawning habitat was very good for cutthroat trout above Idaho Springs reservoir. The drain pipe in the reservoir is an effective fish barrier. Lower Chicago Lake, located at the headwaters of Chicago creek was approximately 15 acres and the water temperature was 47 degrees F. No attempt was made to collect fish from the lake. The city of Idaho Springs should be contacted about the possiblity

of reclaiming Idaho Springs Reservoir for greenback cutthroat reintroduction. All stocking records should be checked to determine the origin of the trout species now present. This would be a difficult restoration project but we feel that this area would provide both lake and stream habitat and a brood lake. This is a potential high priority area.

Leavenworth Creek (tributary of South Clear Creek)

Surveyed on 24 June 1982. Water quality was tested and several water samples were collected to be analyzed for heavy metals. Five sites were sampled. A water sample analyzed in the lab was collected at each site. The locations and results of water quality analysis are listed in table 10. The results of a water quality and invertebrate anlysis conducted by David Propst and Bob Stuber for the U.S. Forest Service indicated that cutthroat trout would probably not survive in Leavenworth Creek. Unless further studies indicate otherwise, no greenback cutthroat trout should be stocked in Leavenworth Creek.

Table 10. Bard and Leavenworth Creek water quality analysis results.

	Bard		Leavenworth				
			Sites				
	1	2	1	2	3	4	5
date	6/24/82	5/20/82	6/24/82	6/24/82	6/24/82	6/24/82	5/20/82
location							
township	T2S	T2S	T4S	T4S	T4S	T3S	T4S
range	R74W	R74W	R75W	R75W	R75W	R75W	R75W
section	31	31	10	2	2	36	19
temperature (deg.C)	4.4	2.2	1.1	2.8	4.4	4.4	3.3
Ph	7.2	7.6	6.9	7.0	7.0	7.4	7.5
hardness (mg/l)	51.3	85.5	51.3	85.5	85.5	85.5	153.9
alkalinity (mg/l)	51.3	136.0			68.4	68.4	136.0
Cadmium (ppb)	<0.25	<0.25	<0.25	<0.25	0.27	0.27	0.37
Copper (ppb)	<2.0	<2.0	<2.0	<2.0	4.2	3.6	3.6
Lead (ppb)	<1.0	<1.0	<1.0	<1.0	1.8	1.4	<1.0
Silver (ppb)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc (ppb)	<0.5	<0.5	<0.5	<0.5	14.0	12.0	15.0

Larimer County

Fish Creek (tributary of Beaver Creek)

Surveyed on 8 July 1982. Trout habitat was good with good flow (4.0cfs), deep pools and sufficient cover. Numerous brook trout were collected. Many beaver dams in the upper reaches would make the stream difficult to poison. No fish barrier was found. Access to the stream is limited due to private land located near the mouth of the stream. This is a moderate priority stream.

Park County

Beaver Creek (Tributary of North Fork of the South Platte)

Surveyed on 22 September 1982. Habitat was marginal in the upper reaches with low flow (1.0cfs), numerous beaver ponds, and low water temperatures (42 degrees F). Brook trout was the only species collected. Habitat in lower reaches was marginal with moderate gradient, many plunge pools and moderate flow (3.0cfs). No waterfall fish barrier was found, but potential barrier sites were located in the lower reaches. Brook trout (2-10") was the only species collected in a 100m section during an electroshocking survey. This stream would be difficult to reclaim because of the numerous beaver dams located in the upper reaches. This is a moderate priority stream.

Bruno Gulch (Tributary of Geneva Creek)

Surveyed on 20 September 1982. Bruno Gulch was first surveyed in 1981 and considered a good stream for greenback reintroduction. The

upper reaches were surveyed to determine the feasability of removing brook trout from the stream and to access the fish population for the whole stream. The upper north fork of Bruno Gulch was examined 100m above the confluence with the south fork. There were adequate pools, cover and flows, but no fish were collected. We suspect poor water quality based on low Ph (6.0) and the following observations: the bottom substrate was covered with filamentous algae, very few invertebrates were found, and the water was cloudy. The upper south fork was surveyed above the confluence with the north fork. Fish habitat was good with deep plunge pools, good cover, and moderate flow. Water temperature was 38 degrees F. Several brook trout (3-9") were collected. The upper section approximately 150m below the confluence of the upper forks was surveyed. Habitat was good with deep pools, undercut banks and moderate flow (5.0cfs). Several beaver dams were found in this section, but none appeared to have been active. Steep gradients and several falls were found in the middle reaches of Bruno Gulch. These falls may be potential fish barriers. A gravel pit pond was located in the lower section. Bruno gulch flows thru the pond which was approximately 1 acre in size. The Ph was 7.5. A fish barrier could easily be built using gabion baskets just above the confluence with Geneva Creek. Rock of adequate size could be taken from a gravel hill located near the pond. Poor water quality of the north fork appears to have no effect on trout, since there was a healthy population of brook trout living in lower reaches of Bruno Gulch. This is a high priority stream. Reclamation of this stream is highly recommended. The U.S. Forest Service will prepare an environmental assessment report.

French Creek(tributary of Michigan Creek)

Surveyed on 22 September 1982. Habitat was good in the lower reaches with good cover, fair pools, and moderate flow (5.0cfs). A 50m section of stream was electroshocked. Brook trout (2-7") was the only species collected. Habitat was poor in the upper reaches with little cover, steep gradient, and low flow (2.0cfs). Water temperature was 44 degrees F. An electroshocking survey of the upper reaches produced no fish. No natural fish barrier or potential barrier site was found. This is a moderate priority stream.

Scott Gomer Creek(tributary of Geneva Creek).

Surveyed on 20 September 1982. Habitat was excellent with large deep pools, high flow (15.0cfs), and good cover area. Riparian area was in good shape despite moderate recreational use and cattle grazing. Water temperature was 48 degrees F. Temperatures were artificially low because of high runoff from recent snowfall. A natural waterfall barrier is located just above the Geneva Creek road. Although our survey was incomplete we feel this is a high priority stream. A more intense study of the area in 1983 should be done to determine the feasability of removing nonnative trout species in the Scott Gomer drainage.

North Fork of the South Platte

Surveyed on 22 September 1982. Habitat was poor due to low Ph (5.25). The Ph reading was taken above the confluence of Beaver Creek. An electroshocking survey was not conducted. This is a low priority stream.

VII. Dicussion and Recommendations

The recovery efforts of the state and federal agencies have expanded to include reclamation of more and substantially larger habitats than ever before. Unfortunately, projected hatchery production will probably not meet the demands that newly renovated habitats have for fish. Establishing additional in-state broodstock would not only provide addtional fish for stocking but would also eliminate some transportation costs, interstate shipping problems (disease introduction, etc.) and provide a reserve population in case an unforseeable catastrophy decimates the Bozeman hatchery stock.

The Bellvue research hatchery has expressed past interest in raising pure strain greenback cutthroat trout. The hatchery is currently raising class B greenbacks from spawn taken from the Boulder watershed lakes. There may also be opportunities to raise additional broodstock in natural environments, but seveal criteria must first be met. Access must be controlled to prevent introduction of other salmonids and reduce opportunity for illegal harvest from fishing. The brood pond must be of appropriate size to permit efficient collection of adults and justify time/expense factors. Other considerations include ease of reclamation, accessability, production potential and presence of inlet or outlet streams. A lease or other binding agreement witha private landowner, municipality or government agency would provide a relatively secure and long term facility.

Despite the rather restrictive prerequisites, careful

consideration of available alternatives may provide a workable solution. Many of the gravel pit ponds in the local area may provide suitable environment for trout. Municipal water supplies such as the Idaho Springs reservoir are another option to be investigated. The success of the small pond in the southeast region amply demonstrates the feasibility and value of this kind of endeavor.

One of the criteria that must be met before the greenback cutthroat trout is delisted states that a given number of stable populations shall exist in a specified number of drainages across its native range. Annual monitoring will provide an assessment of general population well being and will give insights into the long term dynamics of headwater trout streams. A database like this may yield information necessary for early recognition of possible impacts on greenback populations, and may also influence future reintroduction and delistment efforts. At present, Como Creek is the only stream capable of providing meaningful data on the dynamic aspects of greenback populations. Streams such as May, Hourglass, and Williams Gulch Creeks may be particularly helpful in establishing reintroduction guidelines. The former two previously barren streams are high in elevation (9,800-10,000ft) and subsequently have short growing seasons and very low mean annual and maximum temperatures. It is doubtful that enough degree days are accumulated in a growing season to ensure that fry develop enough to overwinter and recruit to the population. Li (1969) reported that Hourglass Creek was first stocked in 1965. Several subsequent stockings have failed to produce a viable population so continued addition of fish to this population is not recommended. Sufficient

time has not yet lapsed to determine the fate of the May Creek population but numbers and growth rates appear low. Williams Gulch, another previously fishless stream appears to be a suitable environment for greenback cutthroat trout. Although high in elevation (9,800ft), this stream is small, has a low gradient headwater and recieves much direct insolation, hence temperature regimes are probably adequate for trout growth and reproduction. Future evaluation of barren streams should include documentation of adequate temperature regimes, a qualitative invertebrate assessment and where appropriate, heavy metals and water chemistry analyses.

The habitat evaluation techniques developed and tested in the 1982 field season generated interesting albeit limited and for the most part, previously known information on trout in headwater stream environments. Essentially, the analysis demonstrated that deep pool habitat with some large cover areas are important to trout populations in small streams. Because of the extreme amount of time necessary for this type of evaluation and its inherent limitations, future assessments of this type are not recommended. A qualitative evaluation of the demonstrated important habitat parameters and determination of trout population levels present in the stream should be effective in establishing reintroduction guidelines.

Although the habitat evaluation demonstrated that trout prefer pool habitat, careful interpretation of the results is necessary when recommending habitat improvements for the greenback cutthroat trout. The classic studies of Hunt (1971, 1974) demonstrate that habitat improvements may increase standing crops and mean size of trout, but also suggests that any given stream has a production

potential that cannot be improved upon regardless of the alterations made. In this particular study, population and production levels markedly increased in the improved section of stream due primarily to increased overwinter survival of older (age II+) fish, but overall stream production remained essentially the same. Unmodified stream sections exhibited concurrent declines in productivity, suggesting that production along a stream continuum is highly dependent on the sum total of the parts. At present, the efforts of the recovery team have not progressed to where provision of a quality stream sport fishery is necessary or is in the best interest of the resource. Increasing pool area and numbers of large fish may actually be counter productive by encouraging illegal fishing and harvest of this rare salmonid.

References

Hunt, R.L. 1971. Response of a brook trout population to habitat development in Lawerence Creek. Tech. Bull. No. 48, Wisc. Dept. Nat. Res., 35pp.

Hunt, R.L. 1974. Annual production by brook trout in Lawerence Creek during eleven sucessive years. Tech. Bull. No. 82, Wisc. Dept. Nat. Res., 29pp.

Li, H.W. 1969. Fishes of the South Platte Basin. M.S. Thesis, Colorado State Univ. Fort Collins, Co., 67pp.

Appendix A: Proposed Research