GREENBACK CUTTHROAT RECOVERY PROJECT
1985 Progress Report

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INTRODUCTION

This report summarizes the 1985 greenback cutthroat trout (Salmo clarki stomias) recovery efforts in the Northeast region of the state of Colorado.

The greenback cutthroat trout is on the U.S. Fish and Wildlife Service Threatened and Endangered Species List. In 1977, an interagency Greenback Cutthroat Trout Recovery Team was established. The team members include the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, and Colorado Division of Wildlife. The Goal of the recovery team is to remove the greenback trout from the Threatened and Endangered Species List by establishing 20 stable populations within its native range.

In 1985, efforts were directed toward achieving this goal. Two additional streams were reclaimed using rotenone. Age 0+ greenbacks were planted in three greenback streams and in one new site, Zinn Ranch Ponds. East Plum Creek and Hassel Lake were surveyed and recommended as future reclamation sites. Annual surveys were completed for six greenback populations. Elevations, gradient profiles, habitat areas, and habitat lengths were compiled for existing greenback streams. Population stability was defined so it could be quantified. Criteria was established for opening greenback streams to catch and release fishing. Finally, stocking and habitat improvement recommendations were made.

STREAM RECLAMATION PROJECTS

Pennock Creek and Bruno Gulch were the sites of stream restoration efforts in 1985. These two streams were treated with synergized rotenone (2.5%) to remove brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta). Lengths, weights, and population numbers were compiled for future camparisons between the new greenback populations and the replaced brook and brown trout populations (Table 1). 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 released from a 55 gallon drum. Permanganate drained through a gate valve at the base of the drum which was connected to a float valve with a garden hose. The float valve, which maintained a constant head, was placed in a ten gallon tub that had a regulating valve near the bottom. The valve on the bottom of the tub was opened to the correct application rate. The constant head insured a constant flow of permanganate thru the valve.

Table 1. Trout population parameters for Pennock Creek and Bruno Gulch in 1985.

Stream	Date	Site Length m	Site Area m^2	Number Captured	Site Population Estimate	Population Density #/ha	Average Length mm	Length Range mm-mm	Average Weight gm	Weight Range gm-gm	Standing Crop Est. kg/ha
Bruno Gulch (Brook $\geq$1+)	8/28/85	100	200	41	41	2050	141.7	76-225	33.3	4-86	68.3
Bruno Gulch (Brook 0+)	8/28/85	100	200	30	30	-	45.2	4-54	-		-
E.Fk.Pennock (Brook)	8/19/85	50	50	16	-	-	127.5	62-207	39.7	9-90	-
W.Fk.Pennock (Brook)	8/19/85	50	135	14	-	-	131.9	50-226	58.6	19-102	-
Main Pennock (Brown)	8/14/85	61	214	8	8	374	249.4	137-366	227.3	29-580	85.1
Main Pennock (Brook)	8/14/85	61	214	5	6	280	159.2	129-216	159.2	22-135	15.4

Table 2. Concentrations, exposure times, and total amount of rotenone and potassium permanganate used for Pennock Creek and Bruno Gulch fish removal projects.

Stream	Station	Rotenone/ KMNO4 *	Flow (cfs)/ Volume(ft2)	Concen-tration (ppm)	Release Rate (l/hr)	Exposure Time (hours)	Total Released (liters)
Pennock	A	rotenone	0.4	4	0.16	6	1.0
Creek	B	rotenone	2.5	2	0.51	6	3.1
	C	rotenone	0.6	4	0.24	6	1.45
	D	rotenone	0.1	4	0.04	6	0.25
	E	rotenone	0.5	4	0.20	6	1.2
	F	rotenone	0.5	4	0.20	6	1.2
	G	rotenone	1.5	4	0.60	6	3.6
	H	rotenone	0.1	4	0.04	6	0.25
	Detox	KMNO4	3.7	4-5	1.9kg/hr	32	60.8kg
Bruno	A	rotenone	1.2	4	0.50	6	3.0
Gulch	B	rotenone	1.2	4	0.50	6	3.0
	C	rotenone	0.25	4	0.10	6	0.6
	Pond	rotenone	376,000	2			23.5
	Detox	KMNO4	2.65	4	1.1kg/hr	24	26.4kg

* Does not include rotenone used for spraying isolated pools.

Pennock Creek

Pennock Creek is a tributary of the Little South Fork of the Cache la Poudre River in Roosevelt National Forest. Pennock Creek was poisoned on 21 August 1985. Seven toxicant drip stations were placed on the upper tributaries. The upper limits of trout habitat were determined during an earlier survey, and drip stations were located upstream of these limits. An eighth booster station was located just below the confluence of the two main tributaries. The detoxification station was set below the gabion fish barrier (Figure 1)

A block net and live cage were placed 250m downstream from the detoxification station. A second live cage was placed 500m downstream at the U.S. Forest boundary. Ten rainbow trout, 9 to 11 inches, were held in each live cage and regularly checked for stress and mortalities.

Rotenone treatment started between 0830 and 1000 and ended between 1500 and 1600. Permanganate concentration was reduced from 5 to 4ppm at 1400 after fish in the upper holding cage showed signs of stress. Fish in the upper live cage and above the block net continued to be stressed during the treatment period, but only 3 of the 10 fish in the cage died during this time. Fish in the lower fish cage, at the forest boundary, showed minimal effects of the treatment and no mortalities occurred during treatment. The following day tributaries were surveyed and no live fish were found.

Pennock Creek should be surveyed in 1986 to assess the results of the fish removal efforts. If no fish are found, greenback cutthroat trout should be reintroduced in 1986.

Figure 1. Rotenone drip station sites for Pennock Creek.

Bruno Gulch

Bruno Gulch, a tributary of Geneva Creek in Pike National Forest, was poisoned on 28 August 1985 with 2.5 % synergized rotenone to remove the existing brook trout population. Three drip stations were located on each tributary above the upper limits of trout habitat. Bruno Gulch flows through a 0.4ha gravel pit pond. On 19 and 20 August 1985, a wooden fish barrier (Figure 2) was constructed at the pond outlet, raising the pond level one meter and temporarily stopping stream flow as the pond filled. On the day of treatment the pond had filled only to within 15cm of the top edge of the barrier and the stream between the barrier and Geneva Creek remained dry. Below the pond, isolated pools in the dried stream bed and beaver ponds were sprayed with rotenone (Figure 3).

Rotenone was pumped from a tank aboard a boat which was slowly driven in a crossing pattern around the pond. A 12 volt pump forced the rotenone through a flexible 3/8 inch clear plastic tube which was attached to a 12 foot long by 1 inch diameter perforated PVC pipe. The pipe was drilled with 1/16 inch holes every 6 inches and a weight tied on one end. The pipe was loosely tied to the side of the boat and the weighted end was allowed to drag on the pond bottom.

The detoxification station was located 250m above the pond. Potassium permanganate was released into the stream from 1500 until 1500 the next day. Detoxified water flowed into the pond turning the water a dull red.

Bruno Gulch should be surveyed in 1986 to assess the results of the fish removal efforts. If no fish are found, greenback cutthroat trout should be introduced in 1986.

Figure 2. Schematic view of fish barrier built on Bruno Gulch.

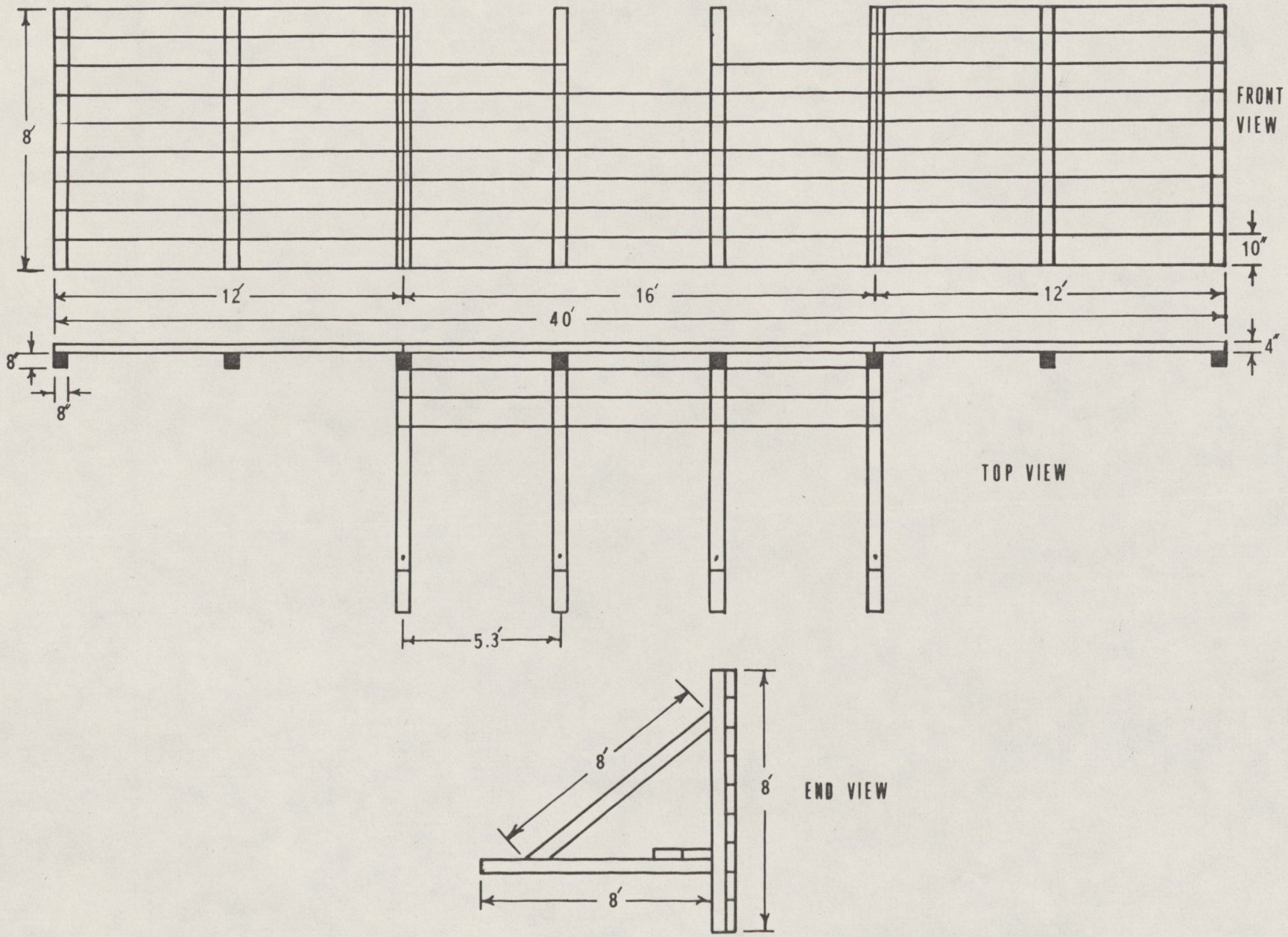


Figure 3. Rotenone drip station sites for Bruno Gulch.

STOCKING OF GREENBACK CUTTHROAT TROUT

Greenback cutthroat trout fry were stocked in Bard Creek, East and West Fork of Sheep Creek, and Zinn Ranch Ponds. Greenback fry raised at the U.S. Fish and Wildlife Service Fish Technology Center in Bozeman, Montana, were transported in a large fish hauling tank to Fort Collins. Upon their early morning arrival on 25 September 1985, fry destined to East and West Fork of Sheep Creek, Bard Creek, and Rocky Mountain National Park were transferred to small holding tanks mounted in pickup truck beds. Water in the holding tanks was aerated with bottled oxygen diffused through a carbon air stone. Fry going to Zinn Ranch Ponds were placed into double-lined plastic bags. Because of extremely cold weather the prior week, ice was added to the water to begin acclimation of the small fish to expected cold stream and pond water (<5 degrees C).

Fry planted in East and West Fork of Sheep Creek and Zinn Ranch Ponds were transferred upon arrival at the stream to double-lined, heavy duty clear plastic bags filled with 1/3 water. The ratio of fish to water was approximately 1:20. The remainder of the bag was filled with oxygen and sealed with white castrator bands. Unfortunately, the white bands stretched and many of the plastic bags had to be tied with rope. In the future, only new green castrator bands should be used to seal the plastic bags shut, because of their problem-free performance in the past. The fish were carefully tempered before being distributed into habitat suitable for small fry.

Fry total length ranged between 27 and 42mm and averaged 35.5mm

for the 16 fish measured. Individual weight averaged 0.22gm. Zinn Ranch Ponds were reclaimed in 1984 and stocked for the first time in 1985 with 810 greenback cutthroat trout fry. Bard Creek received 3,243 fry and East and West Fork of Sheep Creek received 6,500 fry.

Approximately 20% of the 6,500 fry planted in East and West Fork of Sheep Creek died. Fry were apparently crushed by the baffle plates in the holding tanks. In the past, baffle plates were not used and transport mortalities were low. Baffles should be secured to prevent crushing of the fish or not used in the future. In some cases, adult trout were observed darting from cover toward the fry shortly after their release. This behavior was probably from predation on the disoriented fry. Small greenbacks should be planted in pools with sufficient cover to protect them from hungry adults or in stream reaches where few or no adult cutthroat are present.

STREAM AND LAKE SURVEYS

Hassel Lake

Hassel Lake, located in Arapahoe National Forest in Clear Creek County was surveyed on 20 September 1985. A small tributary of Woods Creek (<2.0cfs) flows through the small lake. The inlet stream provided 100m2 of trout habitat with spawning gravel covering approximately 25m2 of the stream bottom. Numerous adult brook trout (8" to 12") in spawning condition were observed in the inlet water. Depths on the two hectare lake were estimated from shore. Approximately 75% of the lake appeared to be one meter deep or less

and the remaining 25% was greater than one meter. Bottom substrate was composed of 80% silt and sand, and 20% gravel and rubble. Emergent plants along the shore were the the only aquatic vegetation present. The outlet stream provided an additional 100m2 of trout habitat above impassable cascading waters. Area use is primarily recreational. Fisherman access to Hassel lake is restricted to a long steep trail. Mining activity in the area did not appear to impact water quality of the lake. Rotenone poisoning of brook trout could be done with certainty of a complete kill. The outlet stream flows into Urad Reservoir, a flood control impoundment. A conservation pool is maintained at less than 25% of full capacity until spring runoff. Hassel Lake meets the criteria of a high priority introduction site with good trout habitat, low area use, presence of a fish barrier, and good reclamation potential.

If Hassel Lake is reclaimed, Urad Reservoir and Woods Creek should also be considered for poisoning at the same time. A 1982 survey of Woods Creek rated the trout habitat as marginal because of the moderate gradient. Prior to 1982, as part of a land reclamation project rock-filled gabion baskets were placed in the stream to create plunge pools. Since Urad Reservoir and Woods creek are on private property, cooperation with the land owners would be required.

East Plum Creek

The headwater of East Plum Creek, located in Pike National Forest in Douglas County was surveyed on 17 September 1985. Purpose

of the survey was to determine if late summer flow was adequate to support a trout population. Flow was 1.0cfs and capable of maintaining greenback cutthroat trout. In 1984, trout habitat was evaluated using Binns Habitat Quality Index. Although the stream was barren of fish, the model predicted that 78.1kg of trout could be supported by 0.9ha of stream. Recreation and logging in the area has little impact on the stream, but survival training by the U.S Air Force Academy has damaged the riparian vegetation. Upstream movement of fish into the headwaters is prevented by a series of waterfalls. Bear Creek and Gove Creek, both tributaries of East Plum Creek, are similar to the headwaters of East Plum Creek with respect to watershed size, soil composition, elevation and gradient. These nearby streams are very productive trout waters, supporting cutthroat in Bear Creek and brook trout in Gove Creek. Based on the good trout habitat, low area use, and presence of an impassable waterfall, the headwater of East Plum Creek should be given high priority as a greenback cutthroat trout introduction site.

STATUS OF EXISTING POPULATIONS

Greenback cutthroat trout populations are monitored on an annual basis. The yearly surveys provide valuable information on population size, standing crop, fish condition, recruitment, and survival rates. These population surveys help detect population problems early, so management steps can be taken to protect and improve population conditions.

One or more sites representing a typical reach have been

established on each greenback cutthroat stream. Table 3 lists location and description for each sample site. Each site was sampled twice with a Coeffelt backpack shocker with equal effort on each pass. The Seber-Lecren two-pass population estimation method was used to approximate the number of fish. Lengths and weights were taken for all fish captured and checked for marks when necessary. Greenback cutthroat trout population parameters for streams sampled in 1985 were summarized in Table 4 and length frequencies were tabulated in Table 5. May Creek, East and West Fork of Sheep Creek, and Little South Fork of the Cache la Poudre were not sampled in 1985 because early snow blocked access to these streams.

Table 3. Descriptions of sample sites on existing greenback cutthroat trout streams.

Stream	Location	Elev.	Substrate	Vegetation	Comments
Bard Creek	T3S R74W sec.31 SE1/4	9280	boulder,rubble, gravel	pine,alder, aspen,willow	Beaver activity, mod. gradient
Black Hollow upper	T8N R74W sec.2 NE1/4	7640	rubble,boulder, gravel	alder,aspen, pine	heavily shaded, mod. gradient
Black Hollow lower	T8N R74 sec.11 NE1/4	8200	rubble,boulder, gravel	alder,aspen, pine	heavily shaded, few pools
Bruno Gulch	T6S R75W sec.14 NW1/4	9920	rubble,gravel, sand,silt	pine,aspen, willow	riparian damage from recreation
Como Creek site A	T1N R73W sec.25 SW1/4	8800	silt,sand, gravel,rubble	pine	heavily shaded, heavy siltation
Como Creek site B	T1N R73W sec.25 SW1/4	8920	sand,silt, gravel,rubble	pine,aspen, alder	old mine near site, log check dams in 1985
Como Creek site C	T1N R73W sec.25 NW1/4	9000	sand,silt, gravel,rubble	pine,aspen, alder	mod. shaded log check dams in 1983
Como Creek site D	T1N R73W sec.23 SE1/4	9320	rubble,gravel,	pine,aspen,	heavily shaded
Cornelius	T11N R73W sec.28 SW1/4	8020	silt,sand	pine,alder,	heavy siltation from grazing
George Creek	T11N R73W sec.19 E1/2	8440	silt,sand, gravel,rubble	alder,grass	thru open meadow eroding banks
Little S. Fk. Poudre	T7N R73W sec.29 NW1/4	9240	boulder,rubble, gravel	pine,aspen, alder	heavily shaded, many log jams
May Creek	T7N R75W sec.2 SE1/4	10360	boulder,rubble, gravel	willow,pine, aspen	mod. gradient, flows thru open wet meadow
Pennock Creek	T7N R73W sec.23 NW1/4	8600	boulder,rubble, gravel,sand	pine,aspen, alder	log check dams in 1985
E. Fork Sheep Creek	T8N R74W sec.19 NW1/4	9480	gravel,rubble, sand,silt	willow,pine, aspen	beaver activity, large pools
W. Fork Sheep Creek	T8N R75W sec.24 NE1/4	9480	gravel,sand, silt	grass	sloughing banks, little cover
Williams Gulch upper	T9N R75W sec.27 NE1/4	9680	silt,gravel, sand	willow,grass	meanders thru open meadow, heavily grazed
Williams Gulch lower	T9N R75W sec.27 NE1/4	9560	rubble,gravel, silt	pine,aspen	heavily shaded, mod. gradient

Table 4. Greenback cutthroat trout population parameters for 1985.

Stream	Date	Site Length m	Site Area m^2	Number Captured	Site Population Estimate	Population Density #/ha	Average Length mm	Length Range mm-mm	Average Weight gm	Weight Range gm-gm	Standing Crop Est. kg/ha
Bard Creek	9/20/85	100	310	29	34	1097	151.6	102-205	38.4	10-90	42.1
Black Hollow Creek (lower site)	7/18/85	100	310	27	31	1000	161.9	117-212	48.8	17-98	48.8
Black Hollow Creek (upper site)	7/18/85	100	280	19	22	786	111.4	60-182	17.4	2-66	13.7
Black Hollow Creek (combined)	7/18/85	200	590	46	53	898	141.0	60-212	35.8	2-98	32.2
Como Creek (site B)	7/24/85	100	210	29	35	1667	131.8	57-232	43.1	1-150	71.8
Como Creek (site C)	7/24/85	100	203	47	51	2512	134.8	60-245	34.0	1-154	85.4
Como Creek (site D)	7/24/85	100	161	60	68	4224	132.5	52-220	31.3	1-105	132.2
Como Creek (combined)	7/24/85	300	574	136	154	2683	133.2	52-245	34.8	1-154	96.5
Cornelius Creek	7/29/85	100	180	14	14	778	163.4	135-183	44.0	22-67	34.2
George Creek	7/29/85	750	1500	181	181	1207	166.4	131-230	46.1	20-110	55.6
Williams Gulch (upper site)	7/19/85	50	70	33	34	4857	131.6	49-202	24.0	8-68	116.6
Williams Gulch (lower site)	7/19/85	50	70	18	19	2714	127.4	62-230	29.8	2-100	80.9
Williams Gulch (combined)	7/19/85	100	140	51	53	3786	130.1	49-230	25.8	2-100	98.8

Table 5. Length frequencies of greenback cutthroat trout collected in 1985.

Length cm	Bard Creek	Black Hollow (lower)	Black Hollow (upper)	Como Creek (site B)	Como Creek (site C)	Como Creek (site D)	Cornelius Creek	George Creek	Williams Gulch (lower)	Williams Gulch (upper)
5					1					1
6			2	4	9	6			1	
7			2	3	5	2			2	
8			1	2						
9			1	1	1				1	1
10	1		2		3	6			1	5
11	2		1		1	2			1	4
12	2	2	1		2	4			4	3
13	2	2	4	3	5	2	2	5	1	1
14	4	1	2	1	3	4	3	7	7	
15	3	6	2	2	5	4	1	32	4	
16	7	4	1	1	5	5	3	33	2	4
17	2	1		2	9	3	5	19		
18	3	6	1	1	4	1		3	1	1
19	1	1		4	3	4		5		1
20	1	2		1	1			10	1	1
21	1	1		1	2	2		6		
22					1			4		
23				2		1		2	1	
24										
25						1				

Bard Creek

Bard Creek was a barren stream first stocked in 1982 with greenback cutthroat. Estimated standing crop has increased from 5.6kg/ha in 1984, to 42.1kg/ha in 1985, a 7.5-fold increase. The U.S. Forest Service installed log check dams this year, including several in the sample site. The increase in biomass over last year can not be attributed to the increased cover created by the logs. Few fish were found in the newly created pools because of the recent construction activity. Starting next year, a second sample site should be located upstream from an abandoned mine, where mine tailings are a potential source of pollution. Many other streams in Clear Creek County are contaminated with acid runoff from mine tailings. Data from an upper site would provide a better picture of the total population condition in Bard Creek. Comparative data between the two sites would help document the effect, if any, of mine tailing runoff on the greenbacks.

Black Hollow Creek

Average standing crop in Black Hollow Creek has remained steady since 1982, ranging from 28.4 to 32.2kg/ha. The standing crop estimate was 48.8kg/ha for the lower site and exceeded the HQI predicted standing crop of 46.2kg/ha for the same site. Log check dams would be very beneficial to this population.

Como Creek

Average standing crop, in Como Creek, increased 54% from 62.6kg/ha in 1982, to 96.5kg/ha in 1985. This increase may be partly attributed to deep pools created by log check dams constructed in 1983 and 1984. For combined sites C and D, average length increased only 5mm and average weight increased only 5gm between 1982 and 1985, but density increased significantly from 2846 fish/ha to 3269 fish/ha, a 15% increase. Greenbacks at sites C and D appeared to have gained the most benefit from the 1983 habitat improvement structures.

Cornelius Creek

Greenbacks captured in Cornelius Creek showed significant growth in one year. Average length increased from 115mm to 163mm and average weight increased from 15gm to 44gm. Greenbacks stocked in 1984 were not captured. Unfortunately, two brook trout averaging 119mm and 16gm were found at the site. Small brook trout age 0+ and 1+ were also found in two stream sections above the sample site. Both sites were located just below large beaver ponds. Only two greenbacks averaging 185mm and 69gm were captured at a fourth sample section near the confluence with George Creek.

George Creek

Between 1984 and 1985, average size of greenbacks collected in George Creek increased from 123mm to 166mm and from 20gm to 46gm. Sodium cyanide was used to sample this site because the electroshocking equipment had malfunctioned. Brook trout were not collected at the sample site, but were collected in two other sections sampled upstream. Like Cornelius Creek, greenbacks stocked in 1984 were not collected at the sample site. Fry stocked in 1984 were planted approximately 2000m upstream from the sample sites in both George and Cornelius Creek. There are several possible reasons for not recovering any of the 1984 fry. The fry may not have migrated into the sample sites, larger fish preyed on the smaller fish or high handling mortalities shortly after stocking.

Williams Gulch

Two sites were sampled on Williams Gulch in 1985. At the upper site, density increased from 81.3kg/ha in 1984 to 116.6kg/ha in 1985. Average length increased only 7mm and average weight increased only 2gm. Many of the larger fish appeared to be thin. Their poor condition may be due to overstocking, which increased competition for resources. Greenbacks collected in the lower site were in good condition.

STOCKING AGE 0+ FISH VS. AGE 1+ FISH

In 1983, greenback fingerlings produced at the USFWS Fish Technology Center in Bozeman, Montana were stocked at age 0+ into reintroduction streams. A number of fish were, however, held at the hatchery until early 1984. These age 1+ fish were then marked with an adipose clip and stocked into Bard Creek, Black Hollow Creek, Williams Gulch, Cornelius Creek, and George Creek to test the effectiveness of stocking yearling trout. These same streams had also been stocked with age 0+ in 1983. Numbers, lengths, and weights of marked greenbacks recovered in 1985 are compiled in Table 6.

A total of 36 marked trout were recovered in 1985, of which 30 were from George Creek. In the collections from George Creek, 151 fish from the 1983 plant (3620) were also captured. These fish averaged 155mm in length and 37g in weight. Assuming a 25% first year mortality on the 1983 plant, there should have been about 2715 fish from that plant present when the 200 age 1+ fish were stocked in 1984. If mortality of the two plants then remained constant until 1985, 13 (7%) of the 181 fish sampled should have been from the 1984 plant. In fact, 30 (16.6%) were marked, and one could assume that the survival of fish stocked at age 1+ was over twice as high as that for fish stocked at age 0+. Marked fish averaged 200mm and 76g, which was 55mm longer and twice as heavy as the average unmarked fish.

In summary, age 0+ fish are easier to transport in large numbers, however there are at least some indications that age 1+ may survive better. Better survival may be a result of a competitive advantage due the larger size they attained while held in the hatchery. The added costs of the age 1+ fish may also be a factor worth considering. A more controlled evaluation would be necessary to better understand the advantages and disadvantages of stocking advanced yearlings.

Table 6. Summary of length, weight, and number of greenback cutthroat trout stocked at age 1+ in 1984.

Stream	Clip *	No.Stocked 1984	Marked Fish in Caught 1985	Length mm	Length Range mm-mm	Weight gm	Weight Range gm-gm
Bard Creek	Adipose	400	4	184.0	160-205	68.8	43-90
Black Hollow	Adipose	75	0	-	-	-	-
Williams Gulch	Adipose	230	2	182.5	182-183	52.5	46-59
Cornelius	Adipose	310	0	-	-	-	-
George	Adipose	200	30	200.4	156-230	76.0	37-110

* Average length of greenback cutthroat with adipose clip was 140mm in 1984.

COMPARISON OF STREAM HABITAT

Habitat area, elevation, and gradient profile of the 10 existing populations and two future streams were compiled from USGS topographic maps and illustrated in figure 4. Average widths were compiled from past habitat surveys and stream flow transects. Limits of greenback cutthroat trout habitat were based on past population surveys. Stream lengths, average widths and total trout habitat are listed in Table 7.

Table 7. Estimated average width, total length, and area of present greenback cutthroat trout stream habitat.

Stream	Average width meters	Total Length meters	Estimated Area hectares
Bard Creek	3.1	6093	1.89
Black Hollow Creek	3.1	5196	0.52
Bruno Gulch	2.5	3047	0.76
Como Creek	2.0	2894	0.58
Cornelius Creek	1.8	6931	1.25
George Creek	2.0	12720	2.54
May Creek	2.3	1676	0.39
Pennock Creek	2.8	8760	2.45
Little S. Fork of Poudre	4.6	1676	0.77
East Fork of Sheep Creek	3.9	5332	2.08
West Fork of Sheep Creek	4.2	5941	2.50
Williams Gulch	1.4	3199	0.48
Total			16.21

Figure 4. Gradient profiles and elevation ranges for present greenback cutthroat trout stream habitat.

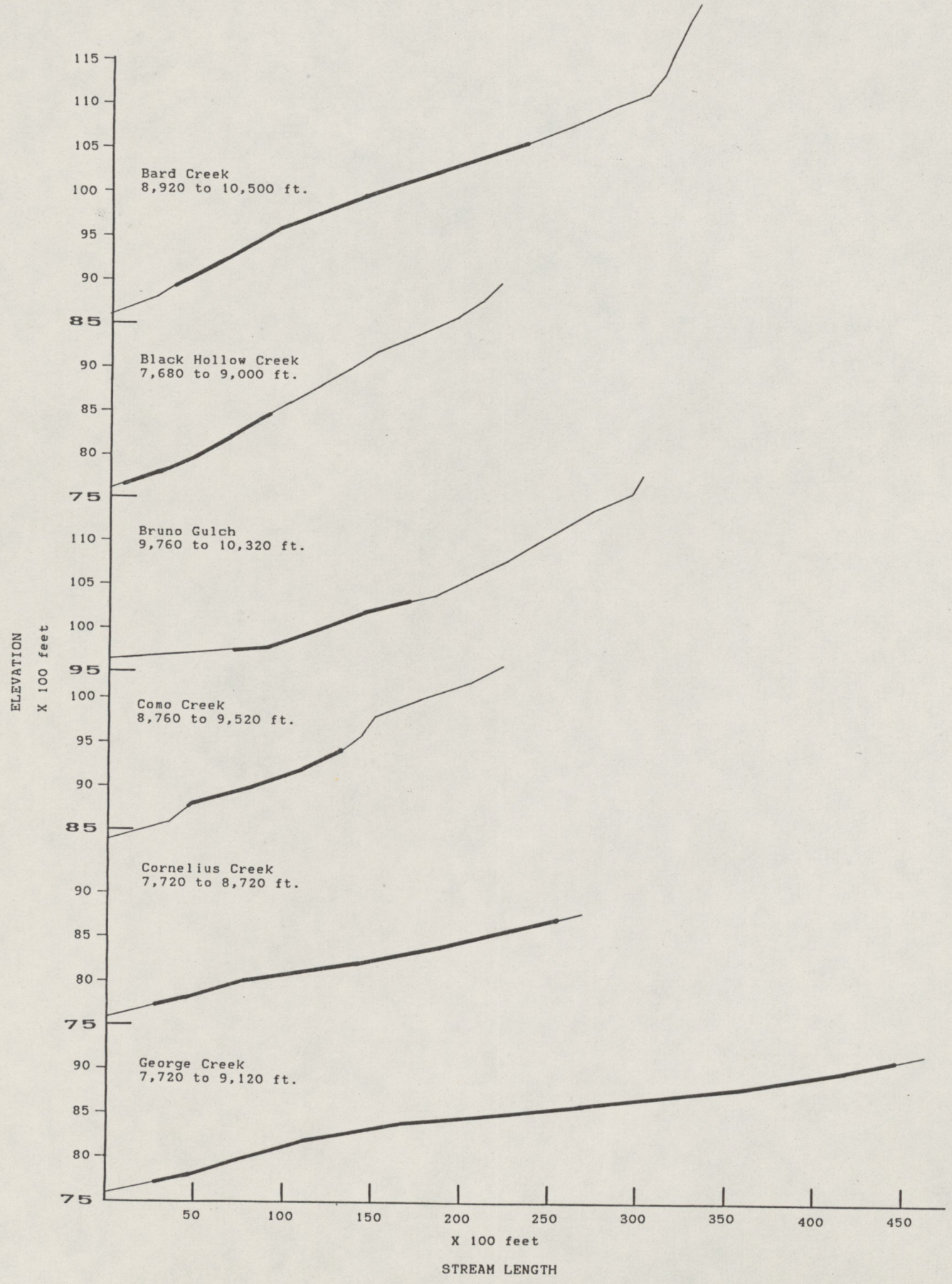
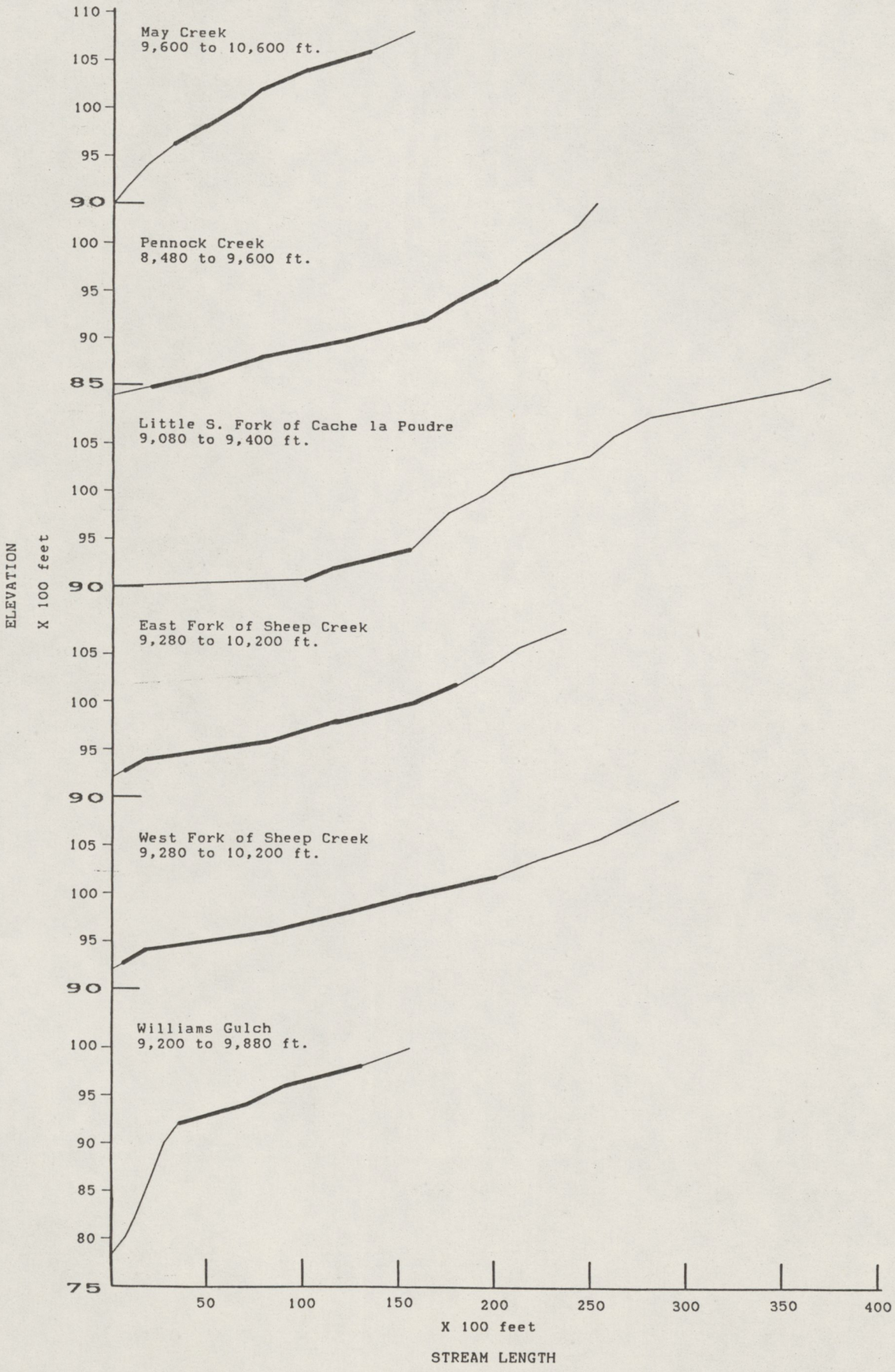


Figure 4. continued.



DISCUSSION AND RECOMMENDATIONS

George and Cornelius Creek

George and Cornelius Creek were both poisoned with rotenone in 1981 and 1982. In 1983, both streams were intensively sampled with sodium cyanide, and no fish were captured. Confident that George and Cornelius Creeks were barren, greenbacks were introduced in 1983. The 1984 survey found only greenback cutthroat and additional fish were stocked. Unfortunately, brook trout were found throughout Cornelius Creek and in the upper reaches of George Creek during this years survey. These fish were in the 0+ and 1+ age group, the product of adults or eggs which were missed by the poison. The greatest number of small brook trout were found near beaver ponds. We suspect some brook trout survived the rotenone in these ponds.

Management alternatives for George and Cornelius Creek include: 1) no action 2) poison both streams again with rotenone 3) use NaCN to remove greenback cutthroat and transport to Pennock Creek then poison both streams. The no action alternative would allow brook trout to survive and eventually take over the streams. The second alternative would result in the unnecessary loss of many adult greenback cutthroat trout. The third alternative would be the most desirable. Very few of the adult greenbacks would be lost and the introduction of adult greenbacks into Pennock Creek would push the reclamation schedule ahead. Outlined below is a method for implementing alternative 3 for recovering the greenbacks from George and Cornelius Creeks.

Organize enough personnel to collect fish, transport fresh water, transfer fish from stream to a holding tank, drive vehicles, and transfer fish from holding tank to Pennock Creek. After slowly dissolving 1 to 2 NaCN pellets into the stream, follow the dissolved cyanide downstream and transfer incapacitated greenbacks to freshwater. Transfer the fish to a truck mounted holding tank filled with well oxygenated water. The tank should be large enough to hold 100 to 150kg of fish. Care should be taken not to contaminate the holding tank water with NaCN. Add NaCN pellets to the stream as the cyanide dissipates from the water. Extreme care and patience will be required to avoid high concentrations of cyanide, especially in large pools where flow is very slow. Greenbacks should be transported to Pennock Creek and released as quickly as possible. Transfer of greenback cutthroat from George and Cornelius Creeks should be done on separate days in late July or early August.

After transfer of the adult greenback cutthroat to Pennock Creek, both George and Cornelius Creeks should be poisoned again with rotenone. Rotenone application methods need to be changed in order to avoid repeating past mistakes. The past method of only one person with a handheld insecticide sprayer spraying rotenone on the surface of the beaver ponds was inadequate. Poor mixing, upwelling freshwater, or insufficient coverage are a few possible reasons for failure. Dense willow growth and downed vegetation made access to the ponds difficult. Future rotenone treatment of these two streams and others should concentrate on thorough application of poison to beaver ponds.

Greenback Cutthroat Trout Population Stability

The phrase "stable population" has often been used to describe greenback populations in past management goals, plans and reports. The definition of a stable greenback cutthroat population and how to quantify stability has caused some confusion and question among biologists. The stability of a population is a measure of fluctuation in the total number of individuals in that population. The amplitude of fluctuation in any population of animals is a function of survival and fertility, which are influenced by extrinsic (physical) and intrinsic (predation, disease, etc.) factors. Stability varies between species and within species. In many cases, this variation has been shown to be directly correlated with environmental stability (Odum 1971, Elseth and Baumgardner 1981). As biologist, managing greenback populations, we are concerned with those populations that fluctuate so that recruitment dips to zero some years making population survival doubtful. We are also concerned with environmental forces, competition with other species, disease, predation and other factors influencing population stability and how these factors affect stability.

The following definition of a stable population should help make future management decisions easier. A greenback cutthroat trout population is considered stable when intrinsic and extrinsic factors, excluding major natural catastrophes, will not affect any life stage such that annual reproduction is not successful. Major natural catastophes would include rare events such as droughts and bottom scouring floods. With this definition we can now quantify

stability by categorizing populations using age and growth data. For management purposes we need to know if a greenback population is stable, unstable, or borderline between stable and unstable. By aging fish from otoliths or scales and using length frequency information we can now fit most greenback populations into one of the following population stability categories.

Category	Definition
Unstable	One or more age classes are missing from the population between age 0+ and age at sexual maturity and the proportion in each age class is not constant from year to year.
Limited Stable	All age classes are present between age 0+ and age at sexual maturity, but the number of individuals in one or more age classes is less than the number of individuals in the next older age class and the proportion in each age class is not constant from year to year.
Stable	All age classes are present between age 0+ and age at sexual maturity, and the proportion in each age class remains constant year after year.

In the future, these population stability guidelines should be refined as more is learned about greenback cutthroat trout

populations.

Como Creek was considered a stable population because all age classes are present, between age 0+ and age 3+. In general, greenbacks in Como Creek are sexually mature at age 2+. From the fact that length frequencies have fluctuated very little, since 1981, we can infer that age class proportions have remained constant since then.

Little South Fork of the Poudre is an example of an unstable population. Age classes between 0+ and 3+ have often been missing from past population survey data. A comparison of length frequency tables from past data, for different years, shows that the proportion of fish in each size category fluctuates from year to year. From this we infer that the proportion of fish in each age category does not remain constant from year to year.

Black Hollow Creek was also considered a stable population because all age classes are present and age category proportions have remained constant. The stability of all other greenback cutthroat trout populations are presently unknown due to lack of age and growth data or successful reproduction has not been documented.

Opening Greenback Streams and Lakes to Fishing

As Colorado's population has grown so has the value of Colorado's fisheries. Fisherman and biologist have expressed concern over the increasing number of streams closed to fishing because of reclamation of habitat for greenback cutthroat introduction. They are worried that fisheries will continue to be destroyed for the benefit of the greenback without replacement of those fisheries. To mitigate the impact of these closures, some greenback streams should be opened again to fishing. Opening streams to catch and release fishing would be beneficial to both the fisherman and the recovery project. The quality of Colorado high mountain stream fisheries could be enhanced by providing the unique opportunity to capture the colorful and aggressive greenback cutthroat trout whose large size is significantly greater than the brook trout, the most common trout now found in Colorado's high mountain streams. Opening greenback streams would also help resolve any public conflicts involving future stream or lake closures.

There is now a total of 16.21ha of greenback cutthroat trout stream habitat in the South Platte Drainage outside of Rocky Mountain National Park. Of this total, 1.35ha was historic greenback habitat, 2.76ha was barren habitat, and 12.1ha of stream supported brook, brown or rainbow trout. To mitigate the loss of 12.1ha of fisheries, reclaimed greenback lakes and streams should be opened to catch and release fishing, only if they meet the following five criteria:

1. The greenback population is not a historic population.
2. The greenback population is stable.
3. Estimated standing crop is greater than the lower 95% confidence limit of predicted standing crop. Predicted standing crop should be based on population data gathered prior to reclamation or a habitat model like HQI.
4. Potential fishing pressure will not affect population stability. Predicted fishing pressure should be based on stream or lake accessibility and fishability.
5. Possibility of introduction of nonnative trout is low.

To date, only Black Hollow Creek meets these five criteria. This is not a historic population. Standing crop estimate of 48.8kg/ha exceeds the predicted value of 46.7kg/ha. The population is considered stable because all age classes are present and age class proportions have remained constant. Potential fishing pressure will be low because accessibility is restricted by lack of improved trails and private property blocking access. Fishability is extremely poor because of dense woody vegetation growing on the banks. Therefore, hooking mortalities should not impact population stability. Possibility of reintroduction of nonnative trout by fisherman is high because brook, brown, and rainbow trout are present in the stream just below the barrier. This high ranking could be changed to low by sending letters and posting signs educating fisherman and nearby landowners not to release nonnative trout above the barrier.

The remaining streams do not meet the above criteria or data is lacking to determine if they meet the criteria (Table 8).

Table 8. Catch and release fishing status of existing greenback cutthroat trout streams.

Stream	Predicted Standing Crop kg/ha	Estimated Standing Crop kg/ha	Stability	Access-ibility	Fish-ability	Possibility of Reintro-duction	Esti-mated Year Open
Bard Creek	58.4	42.1	unknown	moderate	average	low	1988
Bruno Gulch	68.3	0.0	unknown	high	average	low	1990
Black Hollow	46.2	48.8	stable	low	poor	high	1986
Cornelius Ck.	81.0	34.2	unstable	moderate	average	moderate	1991
George Creek	82.2	55.6	unstable	moderate	average	moderate	1991
May Creek	24.8	unknown	unknown	low	average	low	1987
Pennock Creek	100.5	0.0	unknown	moderate	average	high	1990
E.Fk.Sheep Ck	84.4	unknown	unknown	moderate	average	low	1987
W.Fk.Sheep Ck	42.4	unknown	unknown	moderate	good	low	1987
Williams Gulch	82.1	98.8	unknown	low	moderate	low	1987
Zinn Ranch Pds	unknown	minimum	unknown	high	good	high	never

Habitat Improvements

In recent years, The U.S. Forest Service has placed numerous log check dams in many Colorado mountain streams to increase trout production. These structures provide additional pool and cover habitat for trout and stabilize the stream habitat. Log check dams placed in Como Creek, by the Forest Service in 1983 and 1984, have increased standing crop 54% from 62.6kg/ha to 96.5kg/ha. Additional pools and cover are needed in Black Hollow Creek, May Creek, and Little South Fork of the Poudre. In 1984, both Black Hollow and May Creek had an HQI cover rating of zero. Although Binns' HQI model was not used to evaluate the Little South Fork of the Poudre, the trout habitat in this stream is very unstable, reflecting the unstable greenback population. Floods frequently blowout log jams, which provide the majority of the pool and cover habitat. In 1986, log check dams should be placed into these three streams to provide the needed pools, cover, and stability.

Stocking Recommendations

Bard Creek, May Creek and Williams Gulch are streams which were once barren and now support greenback cutthroat trout populations. The success of these populations has encouraged the continued search for additional barren streams suitable for reclamation. Barren streams are very desirable as reintroduction sites because there is no need to eliminate an existing fisheries and reclamation costs are low. Two barren streams, East Plum Creek in Pike National Forest and

Boston Peak Creek (maps do not show any name for this creek, it is located, just west of Boston Peak R74W T9N sec. 33,34,35) should be stocked with greenback cutthroat trout from the Little South Fork of the Poudre when they are available. These streams would provide additional refuge for the taxonomically unique greenbacks now found only in the Little South Fork of the Poudre. Boston Peak Creek was surveyed in 1981 and habitat, similar to Williams Gulch, was considered marginal. At that time it was recommended that Boston Peak Creek be considered as a introduction site only if reclamation of Williams Gulch was successful.

REFERENCES

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APPENDIX

Tentative Schedule for 1986 Field Season

- Transplant greenback cutthroat from George and Cornelius creek to Pennock Creek.
- Poison George and Cornelius Creek.
- Poison Wigwam Creek.
- Poison Hassel Lake (if approved).
- Install log check dams in Little South Fork of Poudre, Black Hollow Creek, and May Creek.
- Plant willow cuttings along the bank of West Fork of Sheep Creek.
- Complete annual population assessment of existing populations.
- Stock greenbacks into Bard Creek, Pennock Creek, Bruno Gulch, Zinn Ranch Ponds, East Plum Creek, and Boston Peak Creek (if approved).
- Compile list of lakes for possible reintroduction of greenbacks.
- From this list assess lake habitat and fisheries.