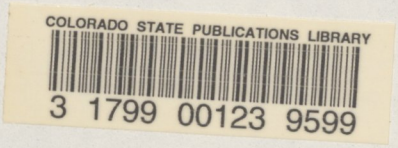

GREENBACK CUTTHROAT TROUT RECOVERY PROJECT
1987 PROGRESS REPORT

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INTRODUCTION

The greenback cutthroat trout (Salmo clarki stomias) was one of two native salmonids present east of the Continental Divide in Colorado when European settlers arrived. The range of the greenback, along with that of the yellowfin cutthroat (S. clarki macdonaldi), gradually decreased as habitat loss from mining activities combined with the fishes inability to compete with non-native salmonids. The yellowfin was driven to extinction by the early 1900's. The greenback steadily lost ground and hybridized with introduced rainbow and other subspecies of cutthroat until only three genetically pure populations existed. Historical populations of greenbacks occurred in Como Creek in Boulder County,the Little South Fork of the Poudre in Larimer County, (both tributaries of the South Platte River) and Huerfano Creek in the Arkansas River drainage.

In 1977, the Greenback Cutthroat Trout Recovery team was organized with personnel from the U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Park Service and Colorado Division of Wildlife. The goal of the team is to remove the greenback from the USFWS threatened and endangered list. To accomplish this 20 stable populations must be established within the species historical range.

Efforts in 1987 toward achieving this goal in the DOW Northeast Region consisted of annual population surveys of the seven populations and evaluating the potential of each creek using the Habitat Quality Index model (Binns 1982), and evaluating the success of 1986 stocking in Pennock Creek. Fry from Bozeman, Montana were stocked in four creeks in late September

In 1988, four of the greenback streams will be opened to catch and release fishing. The stability of these populations is discussed as are the fishability and accessability of the streams.

METHODS

Population sampling was conducted at the same sites as those used in 1986 (Appendix Figures 2-7) with the exception of Sheep Creek where 1987 sampling occurred approximately 100m downstream from the previous years sites. An additional 100m section was sampled on Black Hollow and May Creek for reasons mentioned in the text. Population was estimated using the Seber-LeCren two pass depletion method. A block net were set at the lower terminus of each section to prevent fish from leaving or entering the section.

Thermographs were placed in Black Hollow Creek in both the upper and lower stations, to provide baseline information regarding

proposed USFS activities in that drainage.

Habitat Quality Index measurements were taken and predicted biomass calculated for all sites. Results were questionable in 1987 and recommendations are made to make the model more useful in the future.

STATUS OF EXISTING POPULATIONS

Black Hollow Creek

Restoration efforts in Black Hollow Creek began in 1962, when a barrier was constructed. Brook and brown trout were erradicated and greenback cutthroat reintroduced. During a 1978 population survey in this drainage brook trout were found to have reinvaded the reaches above the barrier. In 1979, a second attempt was made to remove brook trout from the system. Since that time no non-native salmonids have been found in the Black Hollow Creek drainage upstream of the barrier.

Thirty-seven greenback cutthroat adults from the Como Creek stock were transferred to Black Hollow Creek in 1980, and fry and fingerlings from the Bozeman, Montana hatchery were stocked in 1983 and 1984.

Since 1985, two sites have been sampled annually to determine the status of the existing cutthroat population. The lower station is located immediately above the barrier; the upper station is located approximately 2.4 kilometers further upstream. In addition a short section (61m) was sampled immediately upstream of the lower site. Biomass estimates were slightly higher in this section suggesting repeated sampling at sites may in fact deplete the population. Standing crop estimates (Table. 1) for the two stations combined have fluctuated from 32.2 kg/ha in 1985 to a high of 47.5 kg/ha in 1986. Standing crop in 1987 was within the 1985-1986 range averaging 37.7 kg/ha. The 1987 standing crop estimate for the lower station declined from the previous years estimate,which may in part be attributed to the time of sampling. The Black Hollow population was sampled July 6 and 7,1987 (sampling occured in mid August or later the two previous years) due to a low water year. Earlier sampling reflects less annual growth. Length frequency analysis (Table. 2) of this population indicates natural reproduction has occurred in 1985 and 1986, evidenced by the presence of individuals in the <90mm length class. Black Hollow Creek was revisited on August 19, 1987 to collect data for Habitat Quality Index (HQI) habitat assessment (refer to HQI section of this report). At this time young-of-the-year greenback cutthroat trout (30-35mm) were

observed in low numbers in the limited shallow quiet water habitats. Population structure has remained stable throughout the last three years. Black Hollow was supplementally stocked with approximately 2000 fry (1100/lb) on September 16, 1987. Thermographs were placed in the lower section on June 26, 1987 and in the upper section August 7, 1987 and were retrieved September 22, 1987. The purpose being; to provide baseline thermal regime information with regard to proposed Forest Service activities in the drainage (Appendix Figure. 1).

Black Hollow Creek is one of four greenback cutthroat trout streams scheduled to open for catch and release angling in 1988. Population stability was a primary concern prior to opening any greenback stream to fishing. Bestgen and Culver (1985) reported that Black Hollow Creek supported a greenback population that met their criteria for a potential fishery. Results of the following two years sampling would confirm this claim. Although population numbers and biomass estimates have fluctuated from year to year we believe the Black Hollow greenback age structure has remained stable. As result of the new management practices on Black Hollow Creek creel surveys will be included in the 1988 work plan to evaluate angler use and deter exploitation of the resource.

Although the Black Hollow population is not located far from a major highway (Colorado HWY 14), the dense woody riparian growth should preclude heavy angler use. A final consideration with regard to Black Hollow Creek as a public fishery, is access to the stream. The land surrounding the confluence of Black Hollow Creek and the Poudre River is privately owned. Access will be restricted to the upper drainage, via Crown Point Road, unless arrangements can be made with the current landowners.

We recommend some form of habitat improvement for Black Hollow Creek. This creek is characterized by steep gradients, large sized substrates and a prepoderance of swift water habitats. Both sections sampled contain two or three steep sided plunge pools (1.2 - 1.5 meters deep) which provide the majority of cover in these areas. Shallow, slack water areas for juveniles are limited. Log drop structures would create rearing areas and possibly increase spawning habitat at the head of the resulting pools while increasing the plunge pool refuges for older fish. Habitat improvements should be concentrated but not restricted to the lower portion of the basin as the temperatures there favor natural reproduction.

East and West Forks of Sheep Creek

Sheep Creek is a tributary of the mainstem Poudre River. A

natural waterfall located downstream of the confluence of the East and West Forks acts as a barrier to upstream fish migrations. Non-native salmonids were poisoned from the drainage above the waterfall in 1981. Greenback cutthroat fry and fingerlings were stocked in both forks from 1982 through 1985 and in 1987.

Standing crop estimates have remained stable from 1986 (37.8 kg/ha in the East Fork; 52.6 kg/ha in the West Fork) to 1987 (37.5 kg/ha in the East Fork; 49.8 kg/ha in the West Fork) in the absence of artificial stocking. These estimates indicate an increase of 60% in the East Fork population and 450% in the West Fork population since 1984. Length frequency analysis of the fish collected in the East Fork in 1987 indicates natural reproduction has likely taken place. Results from the West Fork samples do not indicate the same likelihood of instream reproduction.

Sampling sites (both forks) are located in the forested area upstream of a large open meadow (former reservoir basin). In this low gradient area the creeks meander extensively before joining at the downstream boundary of the meadow. It was assumed this meadow stretch of the East and West Forks provided more favorable habitat for spawning, YOY and juvenile greenbacks than the areas sampled. To determine this, Sheep Creek (as it flows through this reservoir basin) was sampled again on September 9, 1987. Young of the year greenbacks were observed in Sheep Creek mainstem and in the lower East and West Forks. It was assumed these fry had recently emerged (within the past 1-2 weeks) based on their size (25-30mm). An estimated emergence period of the last week of August to the first week of September is late, especially when considering 1987 was a low water year when incubation would be accelerated. The Sheep Creek population may be reproducing on a limited basis during normal flow years.

Both forks of Sheep Creek will open to catch and release angling on January 1, 1988. A creel survey clerk will visit the creek on a periodic basis in 1987 to assess fishing pressure. Accessibility (3.2 kilometer hike) should limit the amount of angler use. Regulations for the Sheep Creek fishery should be posted from the lower terminus of the reservoir basin to a point two miles upstream to insure public awareness. Fishability in Sheep Creek is excellent throughout the reservoir basin and good in the forested areas upstream.

George and Cornelius Creeks

George and Cornelius Creeks are tributaries of Sheep Creek (not the same Sheep Ck. previously referred to) in the North Fork of the Poudre River drainage. Greenback populations are isolated from downstream non-native salmonid populations by a man-made

barrier on George Creek (located 0.8km below the George/Cornelius confluence). These creeks were sites of restoration in 1981 and 1982. An incomplete removal of the dominant species, brook trout, in 1981 made it necessary for a second application of rotenone the following year. Greenback fry and fingerlings were reintroduced in 1983 and 1984.

In 1985, brook trout were again found throughout Cornelius Creek and in the headwaters of George Creek. Population sampling in 1986 confirmed the presence of brook trout in Cornelius Ck. however none were collected in the 100 meter study site on George Creek. In 1987 an intensive effort was made to electrofish a substantial portion of both drainages to determine the range and concentration of brook trout. Juvenile and YOY brook trout were found while conducting a population estimate on Cornelius Creek (a 100 meter site located approx. 1.2 km above the George/Cornelius confluence). Brook trout were also observed and four adults were collected with hook and line in beaver dam ponds in the upper reaches of this drainage. Although greenback cutthroat still largely out number brook trout in Cornelius Creek, this species composition could be reversed within 10 years. This potential shift is due to the brook trout's competitive advantage and the fact that age 0+, 1+ and adult brook trout are present in the system. Three brown trout were also collected in Cornelius Creek in the stretch below our study site.

Standing crop estimates of the greenback cutthroat population in Cornelius Creek increased from 34.2 kg/ha in 1985 to 75 kg/ha in 1986, and remained high in 1987 at 63.7 kg/ha. Young-of-the-year greenbacks were also observed July 30, 1987.

Similar drainage wide sampling in George Creek yielded greenbacks exclusively. Approximately 3.0 kilometers of stream were electrofished above the confluence however no sampling was done in the beaver dam ponds near the headwaters (a likely refuge for non-native salmonids). Although brook trout were found in the upper reaches of George Creek in 1985, the density of this population does not appear as great as that found in Cornelius Creek. Presently, we must assume that some unquantified contingent of brook trout still exists in George Creek. With unobstructed flows between George and Cornelius Creeks the non-native salmonid abundance will likely increase.

The greenback population in George Creek is strong. The standing crop estimate for 1987 is 72.1 kg/ha, which represents a slight decline from 1986 (92 kg/ha) however sampling was conducted several weeks earlier this year. It was encouraging to observe many YOY and to collect (15) 1+ greenbacks in our 100 meter sampling station. From the population structure standpoint George Creek supports the most stable greenback populations in the Northeast Region.

George and Cornelius Creeks will open to public fishing on January 1, 1988. Regulations will serve a dual purpose in these

fisheries. First, catch and release fishing will act to preserve the endangered greenback cutthroat, the more abundant species in these creeks. Second, catch and creel (8 brook or brown trout bag limit / day) will hopefully help control the non-native salmonids. This management practice has been in use in Rocky Mountain National Park on Hidden Valley Creek for several years. The distinctive characteristics of each species lend themselves to easy recognition, which should reduce confusion on the part of the most anglers. Creel clerks and posted information should provide the necessary information regarding these distinguishing characteristics.

Both creeks offer areas of fairly fishable stream habitat, and extremely fishable beaver dam ponds. During August, 1987 several members of the crew fished for brook trout in these ponds with limited success (four brook trout caught). However they caught and released cutthroat trout at a rate of 50-60 fish / hour. The cutthroat trout is very suseptible to angling. The repeated hooking and handling will undoubtedly cause some mortality on all the creeks where fishing is permitted. It will be necessary for both the biologist and creel clerks to evaluate this mortality. Fishermen access to George and Cornelius Creeks is limited to hiking or four wheel drive vehicle via the Acme Road.

Williams Gulch

Williams Gulch, which was formerly barren, was stocked with 48 (127mm) fish in 1981, 200 fry in 1982, 400 fry in 1983 and 1400 fry and 230 marked fingerlings (140mm) in 1984. Two marked fingerlings were recoverd in 1985, none in 1986 and 1987.

The lower termini of the three sites sampled were located 2.5, 2.8 and 3.5km downstream from the point where the Green Ridge Trail meets the creek. The lower site had a moderate gradient, slight to moderate shading, and boulder, cobble and sand substrate. There were no substantial pools and few undercut banks. The middle section was located in a small clearing, shaded slightly by pines. Gradient was low and substrate was predominantly sand and gravel. There was moderate undercutting throughout this intermediate section. The upper sampling station meandered extensively through an open meadow with a tribuatry entering from the south at the section mid-point. Habitat was primarily slow-flowing runs broken up with short riffles; substrate was fine sediments and gravel.

In 1987, standing crop was estimated at 30.6 kg/ha in the lower station, 54.0 kg/ha in the middle and 55.8 kg/ha at the upper station. These figures represent a stable biomass at the lower and intermediate sites when compared to 1986 results; 29 kg/ha

and 59 kg/ha respectively. However, a significant decrease was observed at the upper site where biomass was estimated at 84 kg/ha in 1986.

Average length of fish (130mm) has remained constant throughout Williams Gulch for the past three years and yet the average weight has increased steadily from 25.8 g in 1985 to 30 g in 1987. In 1985, Culver and Bestgen noticed an abundance of fish in poor condition which was attributed to an aggressive stocking schedule while the population was being established. Apparently the Williams Gulch population has now reached a more healthy density.

Length frequency analysis in 1987 indicates a strong year class (50-70mm) of 1986 recruits, and YOY (25-35mm) were observed at all stations when the creek was revisited on August 21 and 24, 1987. The greenback population in the lower and intermediate portions of the Williams Gulch drainage appears to be stable and in good condition. The fish in the upper portion are apparently reflecting continued habitat degradation. Cattle grazing in the open meadow has decreased bank stability and increased siltation of the stream bed to the detriment of cutthroats in that region. Biologists with the Arapahoe-Roosevelt Forest are currently assessing the extent of grazing caused habitat damage in the drainage and plan to implement measures to remedy this situation in the near future (John Bustos (USFS), personal communication).

May Creek

May Creek was barren when stocked in 1980 with 54 adult greenbacks from Como Creek. Subsequent stockings included, 2000 fry in 1982, 700 fry in 1983 and 1400 fry and 90 fingerlings in 1984 and 2000 fry on September 16, 1987.

The greenback population and biomass estimates for the 100m section sampled declined significantly from 1986 to 1987; 41 individuals / 61.9 kg/ha in 1986 to 17 individuals / 29.9 kg/ha in 1987. To determine if our sampling practices (i.e. shocking and handling) were partly responsible for this decline, we sampled an additional 100m section located 200m upstream. Apparently sampling had had little effect an this population as the second site yielded nearly identical information as the first (Table 1). Average length and weight of the fish has increased consistently from 1984 to 1987.

When comparing length frequency data from 1986 and 1987 it appears the population was thinned at all ages. In 1987, young of the year were not observed at the time of population sampling,

when the creek was measured for HQI estimation or when fish from Bozeman, Montana were stocked in September.

The fish collected this year appeared healthy and free of disease. There was evidence of successful past instream reproduction (70-90mm individuals). May Creek is the highest restoration site in the Northeast region at an elevation of 10,360 feet. Gradient was estimated at 8% throughout the drainage (Bestgen and Culver 1985) which is relatively steep in comparison to other greenback streams. The section sampled contains several small plunge pools and one large log jam. Habitat throughout a 2.5 km stretch of May Creek downstream of the sampled site was found to be monotonous, dominated by long stretches of riffles. Overwintering habitat may be limiting the May Creek population, and habitat improvement may benefit it. As is the case with Black Hollow Creek, log drops or felled trees would likely be the structure of choice as these populations are fairly remote.

May Creek biomass was reduced by half from 1986 to 1987. It will be necessary to closely monitor this population to see if it continues to decline or levels off as did the Williams Gulch population. We feel that May Creek may require supplemental stockings of Bozeman fry on a bi-annual basis. A final decision should be drawn from the next two years of population sampling.

Little South Fork of the Poudre

This is an historical population of greenback cutthroat trout which has received no stocking. The section sampled is located approximately 2.5 km southwest of the Pingree Park campus (above private land). The lower terminus was 50m downstream of a tributary entering from the west. The gradient was low to moderate throughout and the substrate was cobble/gravel. Three log jams provided the majority of cover found in this section.

The 1987 standing crop estimate of 28.5 kg/ha was again (as in 1986) the lowest of the greenback streams we sample. Although the biomass estimate has remained constant from 1986 to 1987 it appears this population is comprised of older fish that have not successfully reproduced in several years. No YOY were observed again this year, despite efforts to locate them in August and September. A specific effort should be made in 1988 to locate 0+ or 1+ fish. If none are found, DOW and USFWS (Bruce Rosenlund in particular) personnel should determine if habitat improvement would benefit this population.

On going efforts have tried to establish a hatchery stock of

Little So. Fk Poudre fish, however it has been difficult to collect sufficient numbers of fish at the proper time of year. Supplemental stocking of offspring from indigenous parental stock would certainly help this population. In spite of the fact that this population has sustained itself through time, results of surveys indicate that the slightest illegal exploitation or even significant natural disturbance (flooding heavy enough to dislodge the log jam) could cause this population to crash.

Pennock Creek

Pennock Creek was chosen for reintroduction of greenback cutthroats in 1984 and non-natives were removed in 1985. Once it was determined that the creek was barren, the three year restocking program was started. Pennock Creek received its first stocking in 1986 and received approximately 6000-7000 fry from the Bozeman, Montana stock on September 16, 1987.

Pennock Creek was sampled on July 8, 1987 to determine the condition of YOY greenbacks stocked last September. The crew shocked (5) 100m sections throughout a 2.5 km stretch beginning immediately above the fish barrier. We found good concentrations of 60mm fish in the areas they were stocked, however they had not ranged far from the location they were planted. The fry had apparently over wintered well nearly doubling their size by the following July. No other species were observed while electrofishing.

Habitat Quality Index (HQI) - Prediction of Standing Crop

The HQI is a model developed on Wyoming streams which involves rating physical and biotic components of a stream and its drainage (Binns 1982). These ratings are then plugged into a logarithmic function which yields an estimate of standing crop (lb/ac) in the absence of fishing pressure or other factors that might decrease biomass. The Binns HQI was calculated for all greenback sampling sites from August 19 through August 28,1987.

Our rating criteria followed those outlined in the HQI manual (Binns 1982). Several of the attributes (rated from 1-4; with 4 being optimum) are straightforward (stream width, nitrate

nitrogen as determined by qualified personnel, eroding banks, water velocity and substrate) while others require a certain amount of subjectivity (critical period flow, annual stream flow variation, cover). The substrate attribute is based on the presence of submerged aquatic vegetation and number of invertebrates per sq. ft. Submerged aquatic vegetation was generally lacking from our sampling sites therefore we relied on the average count of invertebrates from two surber samples. The maximum summer temperature attribute is one which is weighted heavily in the final HQI equation. The warmest temperature recorded during our visits to the streams or from thermograph data (Black Hollow Creed) was used since temperature records were not available.

While our final HQI predicted biomass was considered credible for some of the streams, in several instances we feel the model grossly underestimated the potential of the streams (all Williams Gulch sites, Cornelius Creek, Pennock Creek, Little So.Fk. Poudre and May Creek) (Table. 3). Davis and Culver (1984) estimated more realistic values when they calculated HQIs on several of the same greenback streams, however they encountered similar difficulties with the Williams Gulch estimate.

The HQIs should be repeated in 1988, with the following recommendations. If possible place a thermograph in each creek (at an intermediate location on those creeks with more than one site) or at least make an effort to visit all creeks in late July or early August to better estimate the summer maximum temperature. As mentioned this attribute is an important one and should not be misrepresented. Review 1984 and 1987 measurements and calculate percent cover while at the site. Being less critical of what is considered cover in small headwater streams may aid in estimating the potential of these streams. Several of the attributes were rated the same by both crews; it may prove helpful to have these values on the first HQIs in 1988. We feel 1987 nitrate nitrogen ratings are accurate as the water samples were fixed with sulfuric acid and kept cool until delivered to the Water Quality Lab at CSU, in Fort Collins where the analysis was done and may not need to be repeated.

Stocking Greenback Cutthroat Fry: 1987

Originally only Pennock Creek was scheduled to receive fry stockings in 1987. An overabundance of hatchery fish made it possible to include Black Hollow, May Creek, and the East and West Forks of Sheep Creek to the list. The remaining greenback streams in our region were not stocked primarily due to logistical difficulties.

Greenback cutthroat fry (1100/lb) were trucked to Fort Collins, Colorado from the National Fish Hatchery at Bozeman, Montana on September 16, 1987. Fry were transferred to our hauling tanks, iced down and trucked to the various trailheads where the predetermined number of fish (Table. 4) were placed in double plastic bags containing approx. 2-3 gallons of water. The remaining space in the bags was then inflated with oxygen and sealed with castrator bands. The fry were thoroughly tempered to stream temperatures prior to being release.

We incurred approximately 30% mortality early in the day, most occurred before fish were loaded in our tanks. Minimal mortality occurred as fish were transported to their stocking destination (which took as long as one hour in some cases).

Table. 4. Summary of quantity and biomass of greenback cutthroat fry (1100 / lb) stocked at four restoration sites in 1987.

STREAM	PROPOSED STOCKING QUANTITY	NUMBER STOCKED 9\16\87	POUNDS STOCKED	STOCK LOCAT
Blk. Hollow	3000	2000	1.8	half of tot. released at at each upper and lower sample sites
Sheep E.FK.	3000	2000	1.8	both forks stocked at upper end of old res.
Sheep W.Fk.	3000	2000	1.8	
May	3000	2000	1.8	approx. 0.8km below study site
Pennock	10500	8400	9.5	dispersed through a 3.2 km stretch

Summary of Management Recommendations for 1988

1. Repeat population estimates on all streams.
    - try to determine the survival of fry stocked in 1987 in Black Hollow, East and West Forks of Sheep Creek, and May Creek.

2. Prepare and place signs clearly indicating the catch and release regulations for those streams open to greenback fishing. Post signs throughout the entire greenback range.
    - signs to be placed on the George and Cornelius Creeks fisheries will also have to provide information distinguishing the GBT from brook and brown trout and delineate the species specific regulations.

3. Repeat HQI measurements for all GBT sites:
    - place thermograph in each creek in early July.
    - review 1987 cover measurements; calculate % cover while in field.
    - review ratings from 1984 and 1987 HQIs, do not repeat attributes if not necessary
    - use nitrate nitrogen ratings from the 1987 survey

4. Consult Forest Service personnel: Don Virgovic and John Bustos as to possible Habitat Improvement on:
    - Black Hollow Creek, concentrate in lower drainage
    - May Creek, concentrate on stretch below sampling site
    - Little South Fork of Poudre (consult with Bruce Rosenlund (USFWS)).

5. Stocking GBT fry:
    - Pennock Creek should receive its final stocking (8-10 lbs)
    - consider the impact catch and release fishing has had on those streams opened in 1988. If necessary supplement those populations with light stocking.

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TABLE 1. Greenback Cutthroat Trout Population Parameters, 1987.

STREAM	DATE	SITE LENGTH (m)	SITE AREA (m)	NO. CAPTURED	SITE POP. EST.	POP. DENSITY (#/ha)	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	STANDING CROP EST. (kg/ha)
Black Hollow Lower	7/6/87	100	312	19	20	641	164	80-219	50.6	5-105	32.4
Black Hollow Middle	7/15/87	60.6	193	11	11	569	190	150-220	74.2	28-120	42.2
Black Hollow Upper	7/7/87	100	317	18	24	757	163	109-206	44.3	14-78	33.5
Black Hollow Combined		260.6	822	48	55	669	172.3	80-220	56.4	5-120	37.7
Cornelius Greenbacks	7/30/87	100	125	11	12	960	193.9	141-230	66.4	30-105	63.7
Cornelius Brook Trout	7/30/87	100	125	8	8	640	86.3	51-142	10.6	3-30	6.8
Cornelius Species Combined	7/30/87	100	125	19	19	1520	148.6	57-230	42.9	3-105	65.2
George	7/30/87	100	193	34	34	1762	148.7	82-237	40.9	6-110	72.1
Little So. Fork Poudre	8/12/87	100	571	9	12	210	219	172-285	135.6	55-305	28.5
May Lower	8/10/87	100	253	15	17	672	157.1	83-200	44.5	5-85	29.9
May Upper	8/10/87	100	253	16	16	632	154.6	73-210	50.3	4-105	31.8
May Combined		200	506	31	33	652	155.8	73-210	47.4	4-105	30.9
Sheep E. Fork	7/14/87	90.9	341	34	36	1056	152.7	90-238	35.5	6-112	37.5
Sheep W. Fork	7/13/87	90.9	341	34	34	997	175.2	154-207	49.9	153-207	49.8
Sheep Combined		181.8	682	68	70	1026	164	90-207	42.7	6-207	43.8
Williams Gulch Lower	7/16/87	90.9	180	16	16	889	140.9	59-223	34.4	1-84	30.6
Williams Gulch Middle	7/27/87	100	177	53	54	3050	111.6	60-195	17.7	3-58	54.0
Williams Gulch Upper	7/27/87	100	149	30	31	2081	136.3	72-205	26.8	3-71	55.8
Williams Gulch Combined		290.9	506	99	101	2007	129.6	59-223	30.8	1-84	46.8

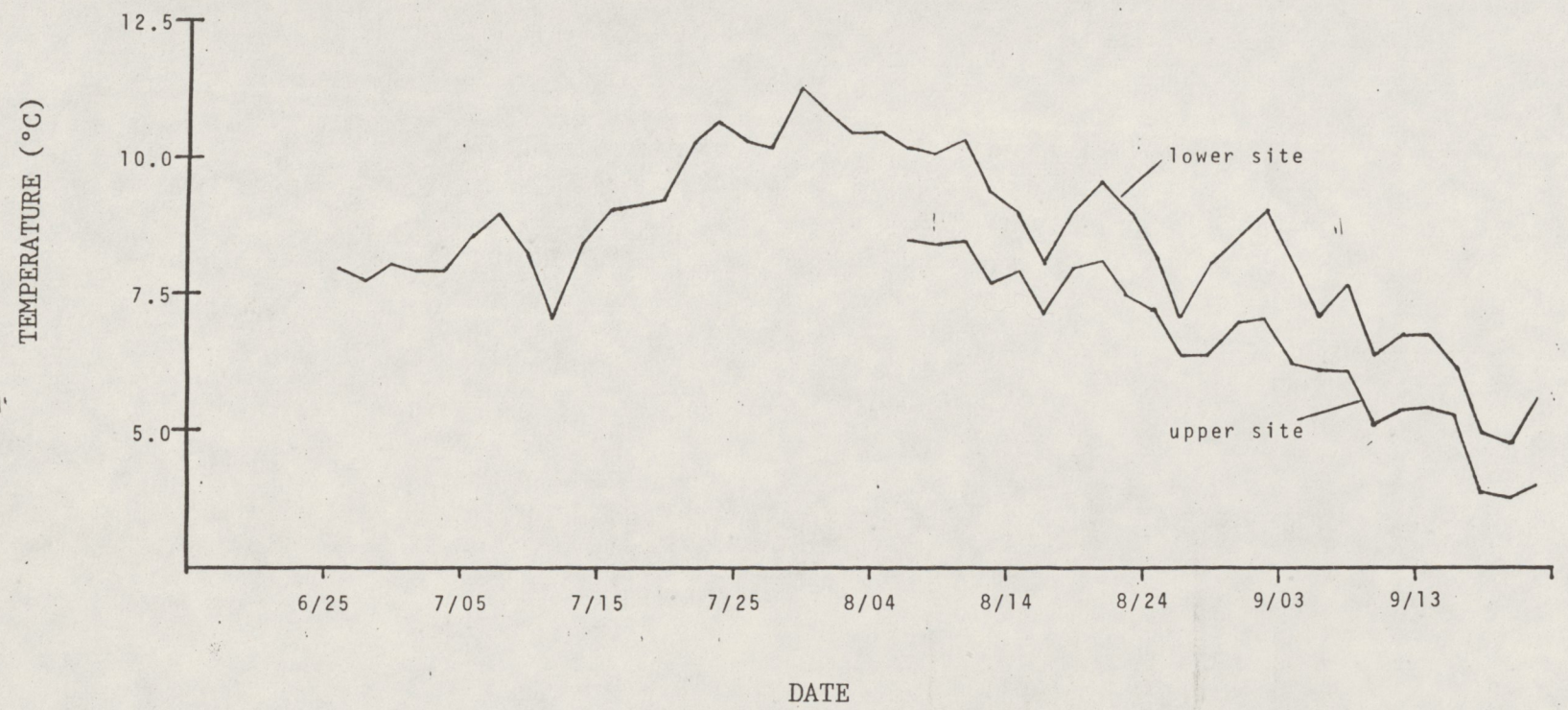
Table 2. Length Frequencies of Greenback Cutthroat Trout Collected in 1987. * Indicates fish were captured but not enumerated.

LENGTH (mm)	BLACK-HOLLOW LOWER	BLACK-HOLLOW MIDDLE	BLACK-HOLLOW UPPER	CORNELIUS	GEORGE	LITTLE SO. FRK POUDRE	MAY LOWER	MAY UPPER	SHEEP E. FORK	SHEEP W. FORK	WILLIAMS GULCH LOWER	WILLIAMS GULCH MIDDLE	WILLIAMS GULCH UPPER
20									*	*			
30	*			*	*						*	*	*
40													
50											1		
60											2		
70					7			1				28	7
80	2				8		1	1					
90									1				
100			1						1		2		1
110			2						2		2		
120	1								3				1
130	1		1				1		4		1	5	2
140	1			1			2	2	3			5	5
150	2	1	2				4	4	8	4	2	6	4
160			4	1			4	4	4	7	1	3	7
170	4		2	1	2	2	1	1	4	10		2	1
180	4	3	3		6			1	1	9	2	2	1
190	3	3		3	5	1	1	1	1	2		2	
200		3	3	2	3	1	1			2	1		1
210	1			2	1	1		1			1		
220		1				1					1		
230				1	2				1				
240						1							
250						1							
260													
270													
280						1							

Table 3. Habitat Quality Index (HQI) predictions of standing crop (kg/ha), HQI attributes for Greenback Cutthroat populations from 1984 and 1987.

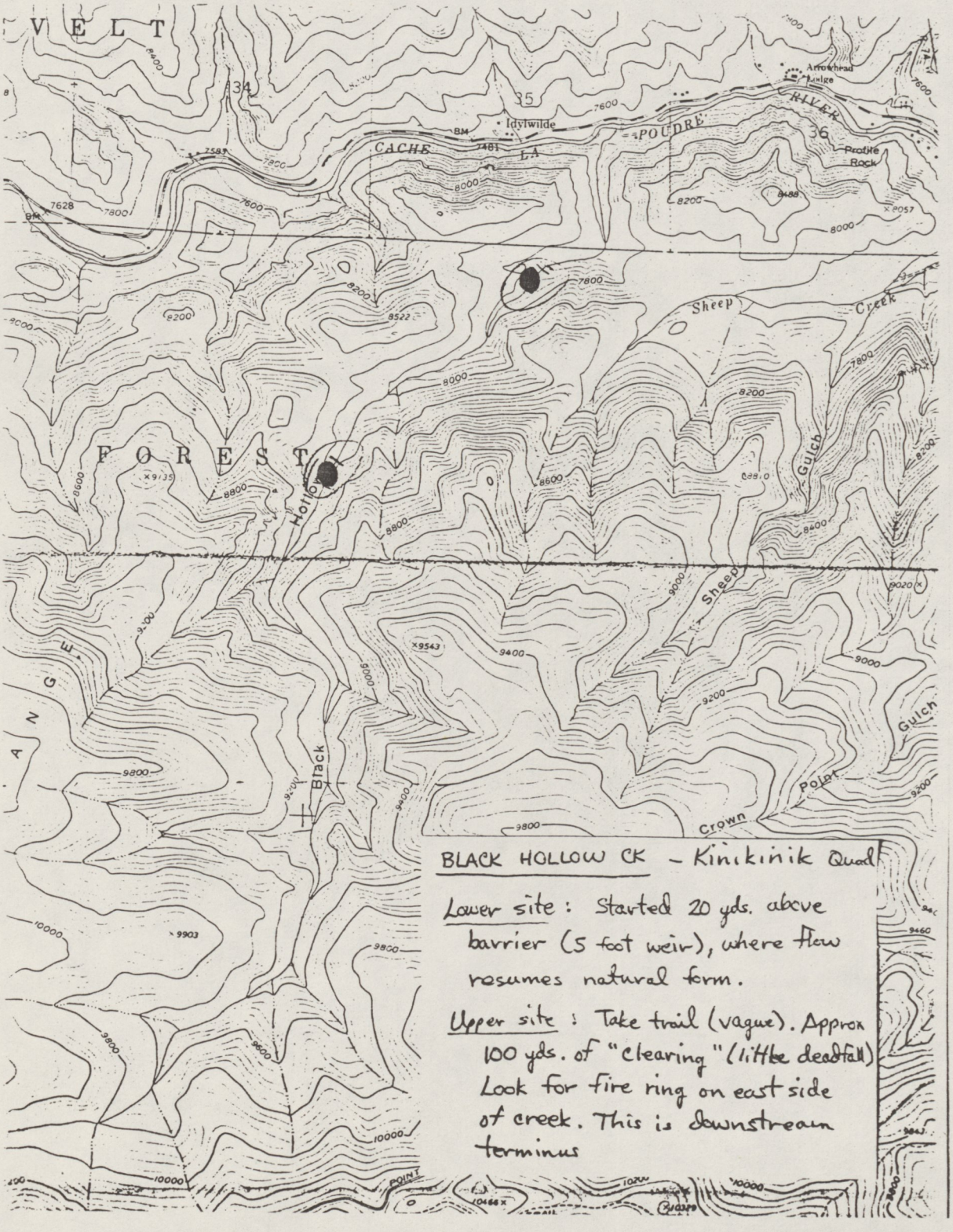
STREAMS/YEAR OF SURVEY	PERIOD FLOW (CPF)	ANNUAL STRM. FLOW VARIATION (ASFV)	MAXIMUM SUMMER TEMPERATURE	NITRATE NITROGEN	LOVER	ERODING BANK	STREAM WIDTH	WATER VELOCITY	SUBSTRATE	DEDICATED STANDING CROP kg/ha
Black Hollow Lower 1987	3	2	4	2	1	4	2	2	1	58.12
Black Hollow Upper 1987	3	2	4	2	0	4	2	2	2	38.96
Black Hollow 1984	4	2	3	3	0	4	2	2	1	46.7
Cornelius 1987	2	2	4	2	0	2	1	1	1	25.96
Cornelius 1984	3	2	4	4	2	4	2	1	1	81.0
George 1977	3	3	4	2	0	1	1	1	2	62.9
George 1984	4	2	4	4	2	4	1	1	1	82.2
Little So. Fk. Poudre 1987	4	3	2	3	0	4	3	4	0	5.59
May 1987	3	3	1	2	0	4	1	2	2	8.27
May 1984	4	2	2	3	0	4	2	2	1	24.8
Pennock 1987	4	3	2	2	0	4	3	2	1	14.5,100.5 '84
Sheep East Fork 1987	2	2	3	2	0	3	3	2	1	23.7
Sheep East Fork 1984	4	2	3	3	2	4	3	2	1	84.4
Sheep West Fork 1987	2	2	3	2	0	2	3	2	1	23.7
Sheep West Fork 1984	4	2	3	2	2	3	3	1	1	42.4
Williams Gulch Lower 1984	3	3	3	2	0	3	2	0	1	7.99
Williams Gulch Mid 1987	3	3	3	2	0	2	1	0	0	7.99
Williams Gulch Upper 1987	4	3	3	2	1	1	1	0	0	9.74
Williams Gulch 1984	4	2	4	2	3	4	1	0	2	14.5

Figure 1. Temperature pattern of Black Hollow Creek as determined from thermographs placed at the upper and lower population sampling site in 1987.



APPENDIX I

Sampling sites on greenback cutthroat trout streams.



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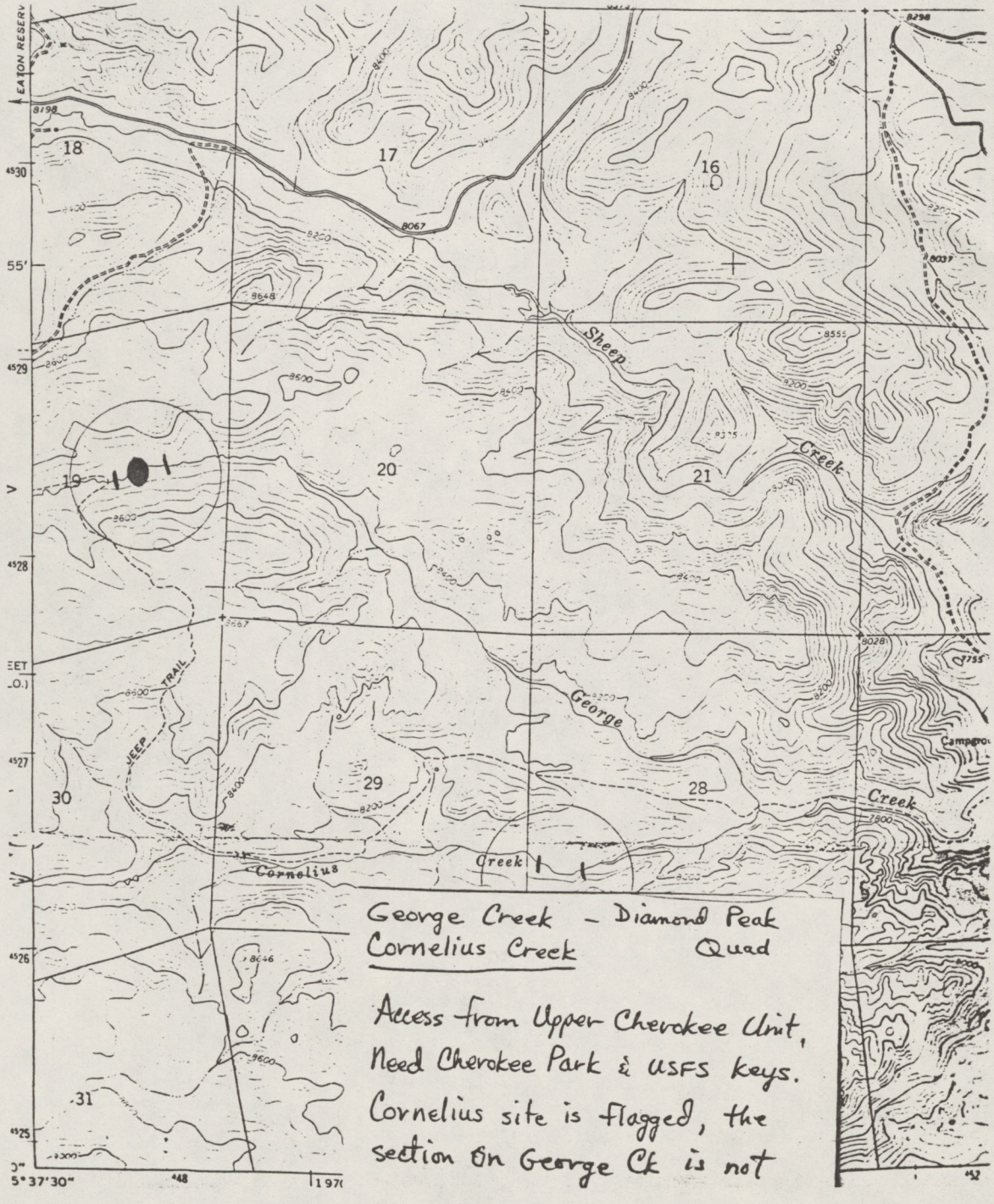
Sampling sites on greenback cutthroat trout streams.



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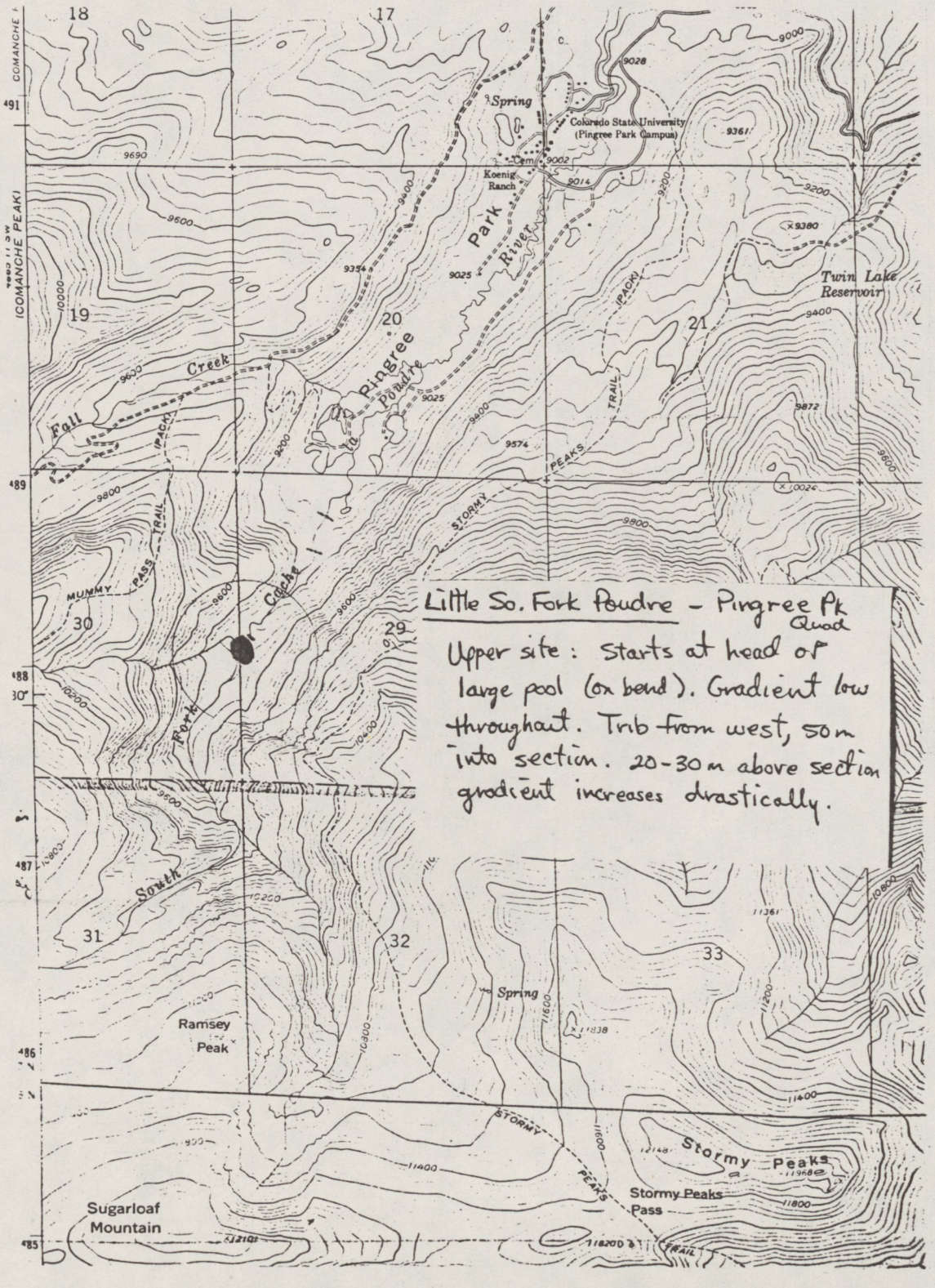
Sampling sites on greenback cutthroat trout streams.



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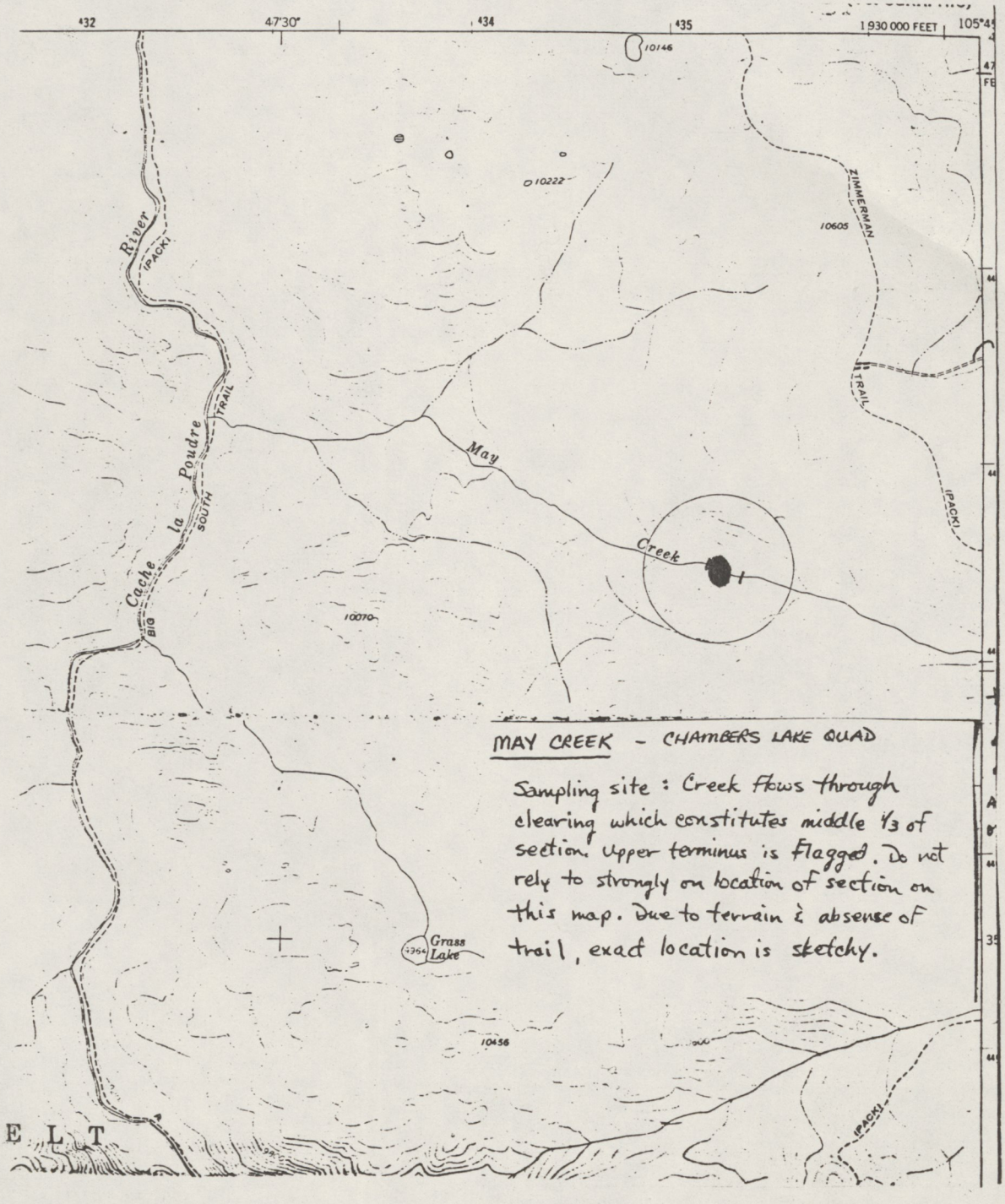
Sampling sites on greenback cutthroat trout streams.



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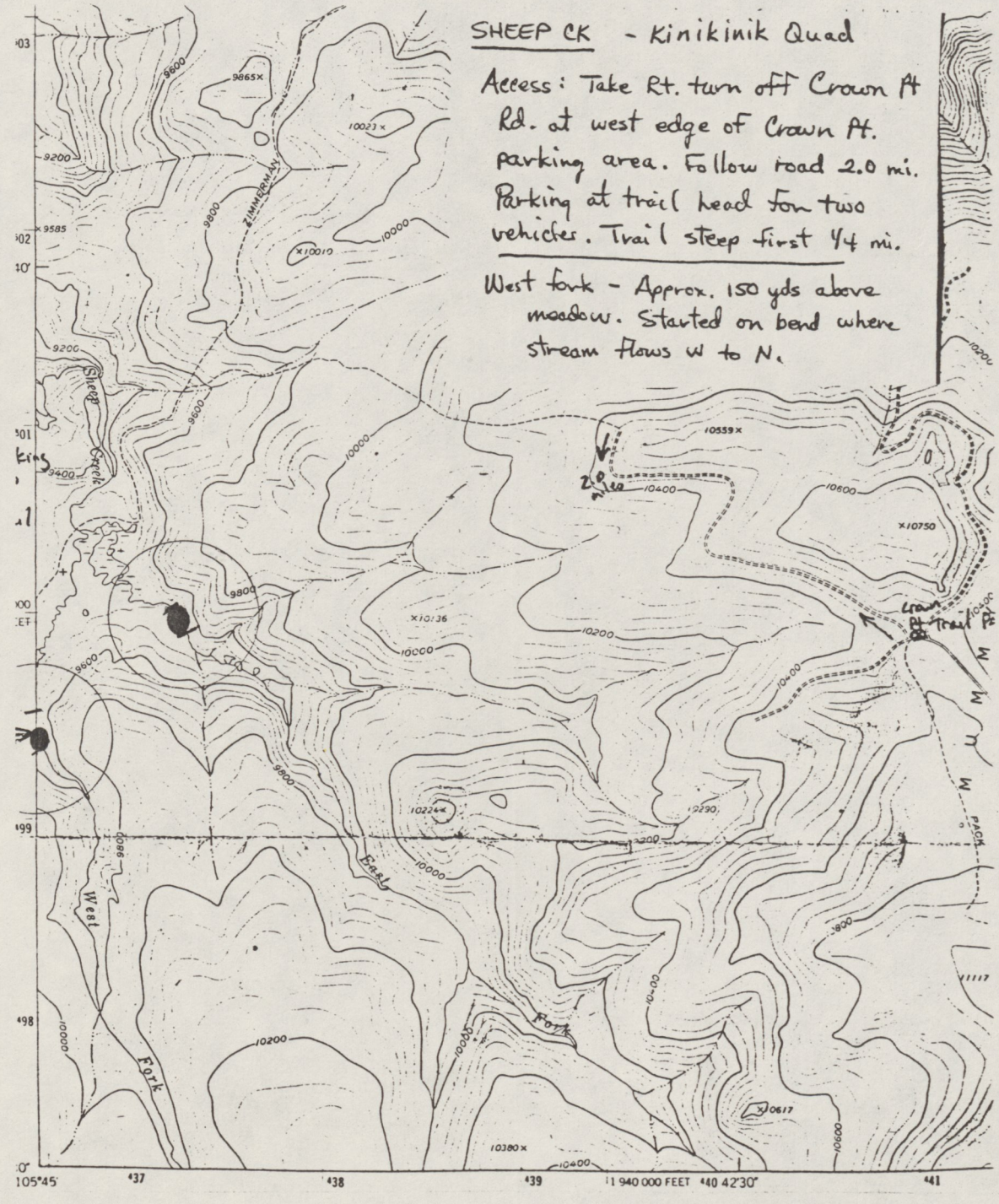

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Sampling sites on greenback cutthroat trout streams.

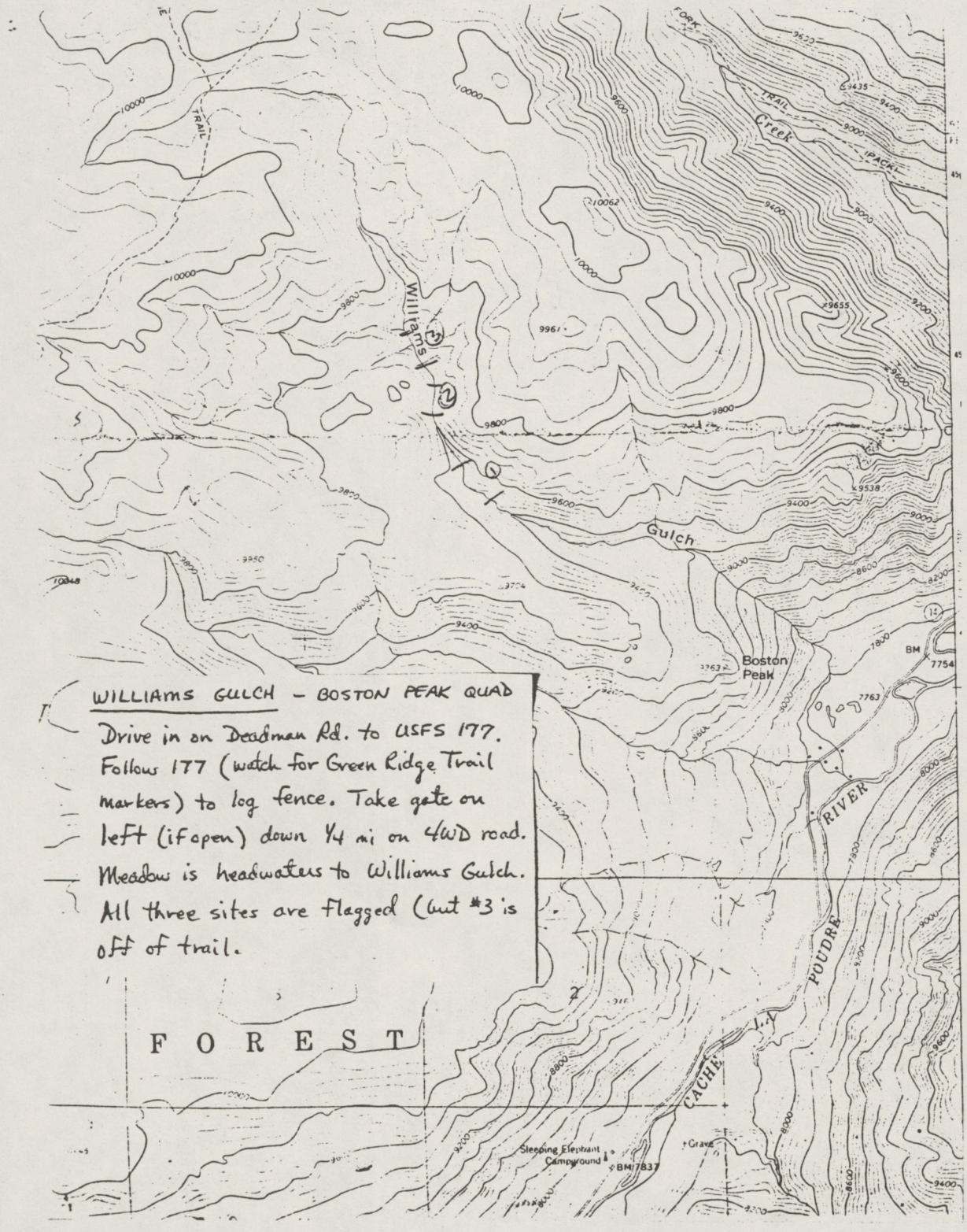

Figure 1. Temperature pattern of Black Hollow Creek as determined from thermographs placed at the upper and lower population sampling site in 1987.

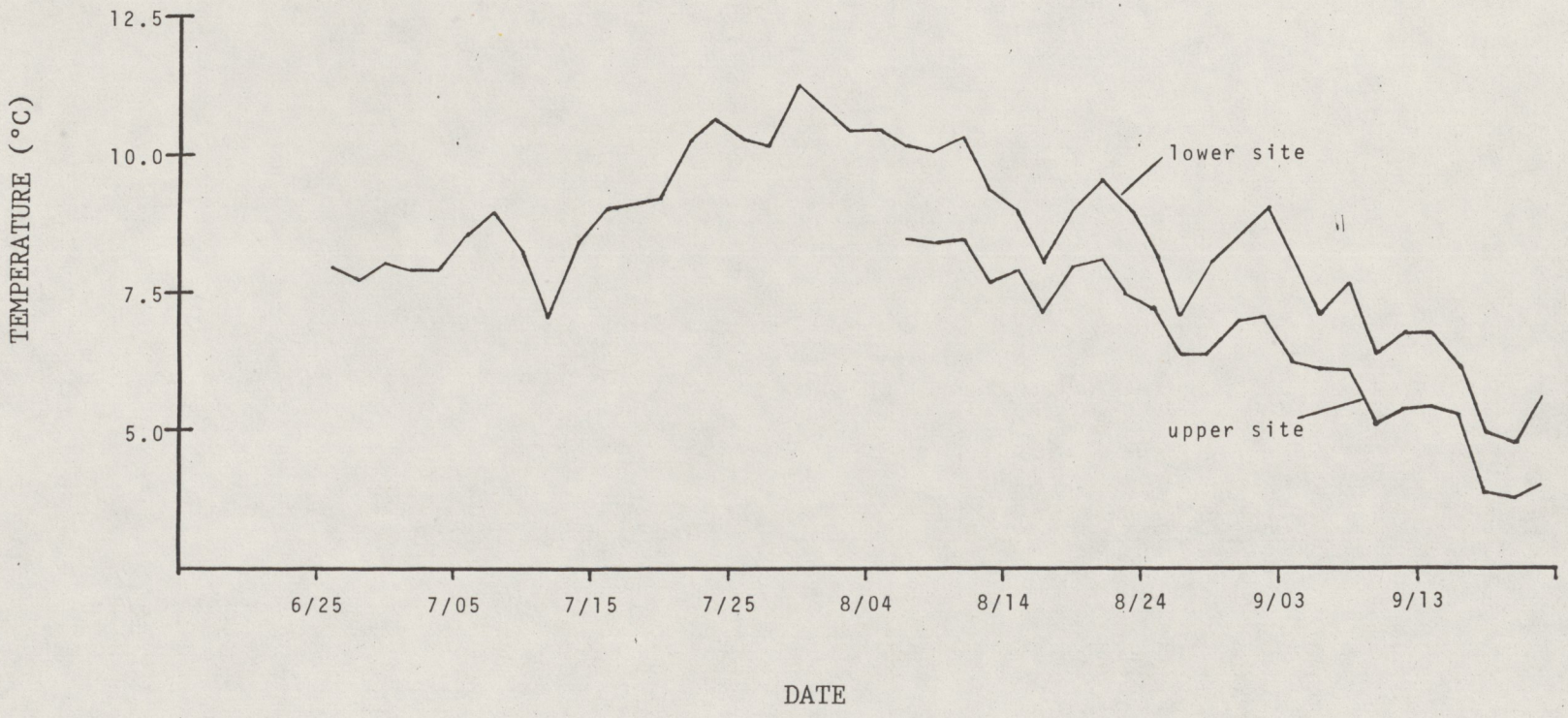

Table 3. Habitat Quality Index (HQI) predictions of standing crop (kg/ha), HQI attributes for Greenback Cutthroat populations from 1984 and 1987.

STREAMS/YEAR OF SURVEY	PERIOD FLOW (CPF)	ANNUAL STRM. FLOW VARIATION (ASFV)	MAXIMUM SUMMER TEMPERATURE	NITRATE NITROGEN	LOVER	ERODING BANK	STREAM WIDTH	WATER VELOCITY	SUBSTRATE	DEDICATED STANDING CROP kg/ha
Black Hollow Lower 1987	3	2	4	2	1	4	2	2	1	58.12
Black Hollow Upper 1987	3	2	4	2	0	4	2	2	2	38.96
Black Hollow 1984	4	2	3	3	0	4	2	2	1	46.7
Cornelius 1987	2	2	4	2	0	2	1	1	1	25.96
Cornelius 1984	3	2	4	4	2	4	2	1	1	81.0
George 1977	3	3	4	2	0	1	1	1	2	62.9
George 1984	4	2	4	4	2	4	1	1	1	82.2
Little So. Fk. Poudre 1987	4	3	2	3	0	4	3	4	0	5.59
May 1987	3	3	1	2	0	4	1	2	2	8.27
May 1984	4	2	2	3	0	4	2	2	1	24.8
Pennock 1987	4	3	2	2	0	4	3	2	1	14.5,100.5 '84
Sheep East Fork 1987	2	2	3	2	0	3	3	2	1	23.7
Sheep East Fork 1984	4	2	3	3	2	4	3	2	1	84.4
Sheep West Fork 1987	2	2	3	2	0	2	3	2	1	23.7
Sheep West Fork 1984	4	2	3	2	2	3	3	1	1	42.4
Williams Gulch Lower 1984	3	3	3	2	0	3	2	0	1	7.99
Williams Gulch Mid 1987	3	3	3	2	0	2	1	0	0	7.99
Williams Gulch Upper 1987	4	3	3	2	1	1	1	0	0	9.74
Williams Gulch 1984	4	2	4	2	3	4	1	0	2	14.5

TABLE 1. Greenback Cutthroat Trout Population Parameters, 1987.

STREAM	DATE	SITE LENGTH (m)	SITE AREA (m)	NO. CAPTURED	SITE POP. EST.	POP. DENSITY (#/ha)	AVERAGE LENGTH (mm)	LENGTH RANGE (mm)	AVERAGE WEIGHT (g)	WEIGHT RANGE (g)	STANDING CROP EST. (kg/ha)
Black Hollow Lower	7/6/87	100	312	19	20	641	164	80-219	50.6	5-105	32.4
Black Hollow Middle	7/15/87	60.6	193	11	11	569	190	150-220	74.2	28-120	42.2
Black Hollow Upper	7/7/87	100	317	18	24	757	163	109-206	44.3	14-78	33.5
Black Hollow Combined		260.6	822	48	55	669	172.3	80-220	56.4	5-120	37.7
Cornelius Greenbacks	7/30/87	100	125	11	12	960	193.9	141-230	66.4	30-105	63.7
Cornelius Brook Trout	7/30/87	100	125	8	8	640	86.3	51-142	10.6	3-30	6.8
Cornelius Species Combined	7/30/87	100	125	19	19	1520	148.6	57-230	42.9	3-105	65.2
George	7/30/87	100	193	34	34	1762	148.7	82-237	40.9	6-110	72.1
Little So. Fork Poudre	8/12/87	100	571	9	12	210	219	172-285	135.6	55-305	28.5
May Lower	8/10/87	100	253	15	17	672	157.1	83-200	44.5	5-85	29.9
May Upper	8/10/87	100	253	16	16	632	154.6	73-210	50.3	4-105	31.8
May Combined		200	506	31	33	652	155.8	73-210	47.4	4-105	30.9
Sheep E. Fork	7/14/87	90.9	341	34	36	1056	152.7	90-238	35.5	6-112	37.5
Sheep W. Fork	7/13/87	90.9	341	34	34	997	175.2	154-207	49.9	153-207	49.8
Sheep Combined		181.8	682	68	70	1026	164	90-207	42.7	6-207	43.8
Williams Gulch Lower	7/16/87	90.9	180	16	16	889	140.9	59-223	34.4	1-84	30.6
Williams Gulch Middle	7/27/87	100	177	53	54	3050	111.6	60-195	17.7	3-58	54.0
Williams Gulch Upper	7/27/87	100	149	30	31	2081	136.3	72-205	26.8	3-71	55.8
Williams Gulch Combined		290.9	506	99	101	2007	129.6	59-223	30.8	1-84	46.8

Table 2. Length Frequencies of Greenback Cutthroat Trout Collected in 1987. * Indicates fish were captured but not enumerated.

LENGTH (mm)	BLACK-HOLLOW LOWER	BLACK-HOLLOW MIDDLE	BLACK-HOLLOW UPPER	CORNELIUS	GEORGE	LITTLE SO. FRK POUDRE	MAY LOWER	MAY UPPER	SHEEP E. FORK	SHEEP W. FORK	WILLIAMS GULCH LOWER	WILLIAMS GULCH MIDDLE	WILLIAMS GULCH UPPER
20									*	*			
30	*			*	*						*	*	*
40													
50											1		
60											2		
70					7			1				28	7
80	2				8		1	1					
90									1				
100			1						1		2		1
110			2						2		2		
120	1								3				1
130	1		1				1		4		1	5	2
140	1			1			2	2	3			5	5
150	2	1	2				4	4	8	4	2	6	4
160			4	1			4	4	4	7	1	3	7
170	4		2	1	2	2	1	1	4	10		2	1
180	4	3	3		6			1	1	9	2	2	1
190	3	3		3	5	1	1	1	1	2		2	
200		3	3	2	3	1	1			2	1		1
210	1			2	1	1		1			1		
220		1				1					1		
230				1	2				1				
240						1							
250						1							
260													
270													
280						1							