UNIVERSITY OF COLORADO
INSTITUTE OF ARCTIC AND ALPINE RESEARCH

BOULDER,
COLORADO

FIELD HEADQUARTERS:
SCIENCE LODGE

7 November, 1957

Dr. Oliver B. Cope, Chief
Rocky Mountain Sport
Fisheries Investigations
United States Department of Interior
Fish and Wildlife Service
Thatcher Building
41 South Main Street
Logan, Utah

Dear Dr. Cope:

Thank you very much for the interesting report on the Green-back trout.

If, and when, you get verification that the Green-back trout actually exists and is a good subspecies, I would appreciate a list of the diagnostic characteristics. It is quite possible that Institute personnel could aid in locating the trout in other nearby waters.

I was very interested in your plans for next year; particularly your number one recommendation of the biological and life history study in the Greenbacks natural habitat. Although the upper part of the Big Thompson River is undoubtedly quite good, I was wondering if it would be easily accessible in the early spring. If you should find it desirable to gather very early season data on trout activity, food, etc. I believe it would be possible to work out arrangements to use the Institute's summer field site at Science Lodge. We make weekly trips to areas near Albion Creek throughout the year. Also, we have a good sheltered van with cooking and sleeping quarters within 3/4 of a mile of Albion Creek.

If you do not have a man that you could send down, it is a possiblility that one of Dr. Pennak's aquatic biology graduate students would be interested in assisting.

I believe that Pike Shanahan, City Watershed caretaker, collected some cutthroat trout out of the Silver Lake drainage. If they are Green-backs, perhaps this would be a desireable study area. It is rather accessible above the damsites and therefore practically free from unnatural disturbances.

The only criticism that I have on the report is that William Rickard, former Institute staff member, now Dr. William Rickard of New Mexico Highlands University should be credited with the first collections to be sent to Dr. Tanner at Fort Collins. Bill sent them to Dr. Tanner because he suspected that they might be Greenbacks, or at least he couldn't key them to anything else. He used Gordon and Everman, Biological Survey records, and a sportsmen's key printed

in about 1923 at Fort Collins.

It looks as if you are making good progress on the Green-back project. I hope that all goes well with the project as it should create a lot of interest on the part of sportsmen and conservation groups.

Sincerely,

W. S. Osburn

W.S. Osburn
Administrative and Research Assistant

Greenback trout file

Greenback

July 14, 1960

Dr. Paul R. Needham
Department of Zoology
University of California
Berkeley 4, California

Dear Paul:

While I realize that you are probably in Europe I write now as it is the first real opportunity I have had to review the ideas which you have been exchanging with me and with Howard Tanner regarding the systematics of the cutthroat trout. I am sure you realize that my long silence on this matter has not been the result of a lack of interest.

Enclosed with this letter is a copy of one I wrote to Oliver B. Cope on March 26, 1958, in which I attempted to summarize and bring up to date my feelings about the greenback cutthroat, Salmo clarki stomias. I think you will admit that we are moving (perhaps "groping" is more fitting) in a field where a great deal more objective data is critically needed if we are to reach firm conclusions.

Frankly I cannot accept your statement (in your letter to Dr. Tanner dated February 19, 1960; see also your letter to him of January 26, 1960) that the Albion Creek cutthroat represents "typical S. c. stomias". In the first place this sample is far removed from the stated type locality and, secondly, it represents a very fine-scaled form—whereas what we know of the types of stomias indicates that they represent a rather coarse-scaled population. Note Cope's recording of 42 scales above the lateral line and contrast this with Behnke's counts of 44-51 (ave. 47.2) in 9 specimens of the Albion Creek form. When I examined Cope's types (Dec., 1951) I could count only an estimated 150 and 152 scales (2 scale rows above the lateral line); even if this count were low by 25 scales, this would put the count at about 175, whereas I recorded 186 to 205 and Behnke got 178-205 scales in the Albion Creek sample. Even though the types are in very bad condition I think it would be a serious mistake for Behnke not to examine them. (Of great interest to me, incidentally, is the extraordinarily close agreement between the scale counts Bob and I got on the Albion Creek sample; his 178 versus my 190 was the only real discrepancy, and I think we could both reach a closer figure on that specimen.)

In my letter to Dr. Cope (enclosed) I was pessimistic regarding the question, "Whence came the types of S. stomias?". I reasoned that the stated type locality was no doubt erroneous, perhaps in part on the strength of Jordan's statement. One should, however, not always accept the prevailing authority—at least attempt to learn whether an alternative viewpoint may not be as reasonable or more so. Recently I completed a rather thorough study of the changing fish fauna of the American Southwest and, realizing what profound changes rivers and aquatic populations have undergone in the past century,

it made the idea of cutthroat trout near Fort Riley, Kansas, much less incredulous. Fortunately, James E. Cole, biologist at Rocky Mountain National Park, became interested in the early historical records of trout in the central Rockies and on the Great Plains, and he assembled this information for the Superintendent of Rocky Mountain National Park. These references were compiled during a decade of reading historical literature. In short, the report suggests that the Republican River, as far down as Fort Riley, should not be unequivocally ruled out as a possible trout habitat as late as the 1870's. This lead should be seriously considered and it is my understanding that Mr. Cole is looking further into the subject. In any event, one thing seems to be unquestioned: the types of Salmo stomias did not come from Albion Creek!

Bob Behnke had a query regarding the cutthroat sample from Roaring Fork River; in particular he wondered whether there might not have been some stocking of exotic species. As shown by the enclosed copy of Dr. Greenbank's notes, this seems highly unlikely. What I think this sample shows is merely that Salmo clarki (and trout in general) are extraordinarily variable creatures. Moreover, in my opinion, the Roaring Fork sample appears to be more "typical" of stomias than does the Albion Creek form.

We are not, I believe, going to be able to solve the classification of cutthroat (or other) trout without using the experimental approach. Dr. Cope embarked on such a program in 1958 but I have not heard how he is progressing.

Sincerely,

Robert R. Miller
Curator of Fishes

RRM:mw
Enc. 2

cc: Robert Behnke
James E. Cole
Oliver B. Cope
Howard A. Tanner

Forestry Building
41 South Main Street
Logan, Utah

November 15, 1957

Dr. W. S. Osburn
Administrative and Research
Assistant
University of Colorado
Boulder, Colorado

Dear Dr. Osburn:

I appreciated receiving your letter of November 7 with its comments on our report on the green-back trout. I was also glad to learn that Dr. William Rickard is the one who should receive credit for the first collections that were sent to Dr. Tanner. We shall certainly remedy this in any future reports we may prepare.

We are grateful for your suggestion that it may be possible that arrangements can be worked out for one or more of our people to use the Institutes' facilities at Science Lodge. We feel that this type of study is essential, and we would like to work in a place which would be convenient and comfortable for whomever is assigned this work. The work would consist of daily measurements and observations, and the personnel doing the work should live as close as possible to the dam site. It may will be that your situation would be a better one than in the Big Thompson drainage. We shall give this matter more thought and will advise you as to whether we shall want to make application for space with the Institute.

We have not yet heard from Dr. Miller about the items of the latest collections, but we shall certainly keep you advised of anything we may learn from him.

Yours sincerely,

Oliver B. Cope, Chief
Rocky Mountain Sport Fishery
Investigations

OBC:cg

UNIVERSITY OF MICHIGAN
Ann Arbor, Michigan, U. S. A.

Museum of Zoology

January 5, 1956

Dr. Howard A. Tanner
Colorado Cooperative Fishery Research Unit
243 Forestry Building
Colorado A & M College
Fort Collins, Colorado

Dear Dr. Tanner:

The beautifully-preserved cutthroat trout (but no whitefish) arrived on December 6, and I have just finished a preliminary study of them. Whoever preserved these fish is to be complimented; I couldn't have done a better job, and it is a real pleasure and satisfaction we work with such fine material.

The greenback cutthroat, Salmo clarki stomias Cope, was reported to have been taken at Fort Riley on the Kansas River in eastern Kansas. Obviously, the specimens did not come from this place or not likely even from the Kansas River basin. Locality data for many of the animals described on the early surveys have been found to be grossly in error. It was the custom for early collectors, such as surgeon Hammond, to work out from a base but to label material with the base-camp name. It's generally conceded that the types of stomias were actually taken in the South Platte drainage and that the greenback trout also occurs in the headwaters of the Arkansas River. These are still suppositions, however, although they may have to remain as our best guess.

I have examined the types of Cope's species at the Philadelphia Academy. They are in very poor condition (December, 1951) and I did not have good optical equipment for making scale counts. The label with the two specimens reads: "Fort Riley, Kansas, Dr. W. A. Hammond." I could not get a lateral scale count greater than 152 (made 2 rows above the lateral line), which is awfully low for a cutthroat of this type and does not agree with my own counts on cutthroats from the South Platte Basin. An error of 20 to 30 scales could easily be made under such conditions. Therefore, I do not place much emphasis on the seemingly coarse scales of the types (Cope, unfortunately, did not give a lateral scale count in his description).

The 9 specimens you sent from Albion Creek, tributary to Boulder Creek, represent a pure cutthroat stock, I feel sure. Their scale counts vary from 186 to 205 and the basibranchial teeth from 1 to more than 12, except for the smallest which apparently has none. The fine scales number the same as in Salmo clarki pleuriticus across the divide in the upper Colorado River basin, but your specimens do show some differences (albeit slight) from the Colorado subspecies. Do you know if trout have moved across the divide through Moffat Tunnel into South Boulder Creek? If so, is it possible that these fish reached Albion Creek? Your specimens also agree with the collections from Red Canyon, branch of Roaring Fork River, Sec. 4, T8N, R78W, Jackson County, Colorado, a tributary to the North Platte River. S. c. stomias is stated to differ from S. c. pleuriticus chiefly in having very large spots largely confined to the posterior one-third of the body and in the life colors (deep green back, etc.). They are obviously very closely related. I agree with you that your specimens are very different in body form and coloration from S. c. lewisi. There

is a good figure of S. c. stomias (at least so identified) on Plate I, figure 2 of the Bulletin of the U. S. Fish Commission, Vol. IX for 1889, published 1891; the specimen depicted came from Twin Lakes, Colorado (see p. 3249 of the 4th part of Jordan and Evermann's "Fishes of North and Middle America").

I wish I could state definitely that your material represents S. c. stomias, but I would only be kidding myself if I did. I believe it is a pure cutthroat stock and that it may represent the greenback cutthroat, but much more study is required to learn if S. c. stomias and S. c. pleuriticus are really different. A tentative identification as greenbacks is certainly in order and, on this basis, it is surely worth making every effort (as required by Colorado law) to preserve this stock.

Two copies of this letter are enclosed should you care to send one to the University of Colorado Museum and one, perhaps, to the Director of the Colorado Game and Fish Department.

Sincerely,

(signed)

Robert R. Miller
Associate Curator of Fishes

RRM/b

COPY

May 14, 1956

Dr. Robert R. Miller
Associate Curator of Fishes
University of Michigan
Museum of Zoology
Ann Arbor, Michigan

Dear Dr. Miller:

I very much appreciate your letter of May 9. It is true that I had about given up hope. I can't at this time say exactly how extensive our work on the native cutthroat trout will be, but the Wyoming Game & Fish Department is very much concerned with the problem and the Colorado Game & Fish Department has shown some interest. We certainly will want to take advantage of your generous offer for identification of these difficult groups, but I can't at this time tell you how extensive our requests to you will be.

In your last paragraph you requested certain information concerning the trout from Albion Creek. The trout that were sent you were caught on October 16, 1955 from Boulder County, one-half mile below Lake Albion, and were collected by a crew that included Tanner, Hayes, Bassett and Powell. Twelve additional trout from this group were retained by the Colorado Cooperative Fishery Research Unit. These fish have been examined for number of mytomes and for vertebral measurements. For this reason many are in poor condition. However, they have all been retained and are available in the fisheries collection, Forestry Building, Colorado A & M College.

If we do have occasion to send cutthroat to you for further identification, you can depend upon a good job of preservation. May I direct your attention to page 22 in the last Colorado Cooperative Fishery Research Unit Quarterly where Unit Fellow, Louis C. Rockett reports on his study of several collections of cutthroat. He mentions that the fish he examined from Albion Creek were all males and immature specimens.

Sincerely yours,

Howard A. Tanner, Unit Leader

HAT:ds

UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN, U. S. A.

MUSEUM OF ZOOLOGY

May 9, 1956

Dr. Howard A. Tanner
Colorado Cooperative Fishery Research Unit
243 Forestry Building
Colorado A & M College
Fort Collins, Colorado

Dear Dr. Tanner:

You probably have given up hope of hearing from me regarding the first paragraph of page 2 of your letter of January 13th.

While I have no real business taking on additional tasks when I already have entirely too many irons in the fire, I nevertheless feel that probably the only way you can get your native cutthroat trout checked with reasonable care and accuracy is by sending them here. I will, therefore, do the best I can in finding time to give you my opinion of the material you may send on. I trust that your specimens will be in such excellent preservation as the first lot, since this is a great help in the difficult job of identification that is involved.

By the way, would you kindly send me soon the complete data for the 9 cutthroat trout from Albion Creek so that we may catalogue them. I need: date of collection, exact locality on the creek, county, name of collector, etc. Also, I would like to know how many trout from this same collection were retained and where they are deposited.

Sincerely yours,

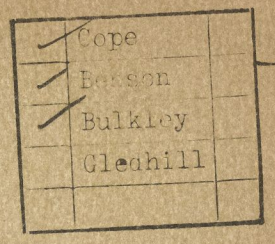
Bob Miller

Robert R. Miller
Associate Curator of Fishes

RRM:ph

UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN, U. S. A.

MUSEUM OF ZOOLOGY



March 26, 1958

Dr. Oliver B. Cope
U.S. Fish and Wildlife Service
Utah State Agricultural College
Logan, Utah

Dear Dr. Cope:

I have studied the several lots of cutthroat trout that were sent last October with a view to trying to determine whether any of the populations might represent the greenback cutthroat, Salmo clarki stomias Cope.

In attempting to decide this difficult problem the taxonomist is confronted with some pretty tough questions as follows:

(1) whence came the types of S. stomias?

(2) what do the type specimens reveal?

(3) what are the phenotypic characters by which the greenback cutthroat is supposed to be distinguished from other cutthroats?

(4) if such distinguishing characters exist, is their basis solely a response to the environment or individual variation or do the characteristics have a genetic basis?

Question number 1 is unanswered and no doubt will remain so. Originally stated to have come from near Fort Riley, which is on the Kansas River in eastern Kansas, we know from the nature of the environment there that no populations of S. clarki could possibly survive — not likely so anywhere in that drainage, which rises on the plains of eastern Colorado. Jordan (1891, Bull. U.S. Fish Comm., Vol. 9 (1889): 12–13) stated that "... there are probably no waters in which trout can live within 500 miles of Fort Riley" and he considered it probable that the types "came from some point on the South Platte, and on this supposition I have adopted the name stomias for the trout of the Platte."

Question number 2 also has a disappointing answer. I examined the two type specimens of S. stomias in 1951; they were in such poor condition that all one could conclude is that they are Salmo clarki. I could count only about 150 lateral scales (along side two rows above lateral line), which is very low for a cutthroat trout — for example, no specimens of S. clarki from the Rocky Mountain region that I have examined have had fewer than 160 scales and most have more than 170. However, considering the condition of the types and the poor microscopic equipment that was available to me, an error of as

much as 20 scales is possible. What I was able to make out of the spotting (specimens badly faded) fits the figure in Jordan (op. cit., Pl. 1, fig. 2) quite well. Also, Cope's original description of the spotting agrees with that portrayed in Jordan's figure, which was based on a specimen from Twin Lakes, Colorado (Arkansas River basin). Cope made no mention of the "green back" when he described the species, since he had not seen live or freshly-preserved specimens.

Question number 3 is certainly not resolved by reading Cope's original description. He used a few body proportions to distinguish stomias from S. c. lewisi and S. c. pleuriticus (his only reference to scales was "Forty-two longitudinal scales above the lateral line"); he also spoke of a difference (of one) in number of branchrostegal rays. Jordan (op. cit.) is evidently the one who gave stomias its present characterization: a green back, and with large black spots confined chiefly to the posterior third of the body. It seems evident from the trout you have sent that spotting is not consistent enough to be used as a distinguishing feature; whether the green back coloration is remains to be determined. I have not, however, had reports of such a color in Yellowstone, Rio Grande or Colorado River cutthroats so there just may be something to it.

Question number 4 is one, it seems to me, where you are in a position to really contribute significantly towards an answer. You are already rearing the Albion Creek cutthroat, a stock that seems to me to represent a rather uniform type, and it would be most interesting to see if the characteristics of this stock persist under different environmental conditions. One interesting meristic feature is a relatively low vertebral number, as follows: 59 (3), 60 (11), 61 (6), in the 20 specimens representing your collection and that made in 1955 by Tanner and others. The Colorado River cutthroat (several localities), in contrast, has shown the following counts: 60 (1), 61 (5), 62 (10), 63 (3), the modal number being 2 greater than that of the Albion Creek cutthroat. If vertebral number is strongly influenced by water temperature during the critical stages of development (as shown by Taning and others), then Albion and Colorado River cutthroat reared side by side under the same temperatures might be expected to yield offspring with the same average number of vertebrae; if they don't, a genetic control would be indicated.

Here are a few comments about the condition of the shipment. I will have to admit that I was disappointed (after receiving the excellently preserved specimens sent by Dr. Tanner) in the preservation of the material. Most of it evidently had been allowed to die prior to preservation; an exception was the Albion Creek lot and also some of those from Big Thompson River. I am sure you appreciate the difficulty in identifying cutthroat trout; when preservation is mediocre it makes the job virtually impossible. In general, the labels were poor — i.e., written on paper that disintegrated in transit (I enclose the worst example). Some specimens were cut along the midside (to allow entry of preservative), thus making a lateral-scale count impossible; better to make the incision on the right, lower side of the fish. No mention was made of the nature of the cutthroat mark, although I assume it was uniformly well developed. The shipment was sent collect, and this surprised me considering that I have

been identifying trout for the Fish and Wildlife Service on my own time during the past six years more or less as a friendly gesture. As a matter of fact, the demand for identification service of this sort has reached such proportions that I doubt whether I will be able to continue doing this unless I am assigned collaborator status, with compensation, on a part-time basis. Are you in a position to request such authorization? I sincerely hope so.

As of this writing there is insufficient information to state with finality whether any of the samples that have been submitted to me represent Salmo clarki stomias or, indeed, whether the greenback cutthroat trout is a valid subspecies. Not only are more (and well preserved) series of native trout needed from the east slope of the Rockies, but a careful study also should be made of the older collections in museums (such as at USNM, MCZ, and Stanford) that represent the native fauna prior to mixing of stocks by man. All possible information on planting records (official or otherwise) should be secured. One very interesting reference I recently noted (Jordan, 1920, COPEIA, No. 81: 27) stated that in 1887 there were no trout in the North Platte drainage (Big and Little Laramie rivers, Wyoming, etc.) although some had been planted a few years earlier in some of the headwaters and, in 1888, trout were stocked in Little Laramie River at the foot of Sheep Mountain. In 1899, both rivers were thoroughly stocked, as was also the North Platte from Fort Steele westward. Brook trout and Shasta rainbow trout were among the species in these early stockings; evidently Yellowstone cutthroat have been planted since 1900. References like these are probably scattered through a vast literature.

Irrespective of what kind of cutthroat trout inhabit the east slope of the Rockies now, some probably represent original strains and these should be preserved. For this reason, if for no other, I think your project is a very worthwhile one.

I am sorry I was unable to meet the deadline I set in my previous short letter to you. That week end, which I had reserved for concentration on this project, I came down with a severe intestinal upset and hence had to postpone the job until last week end. I am writing to James Cole, returning the kodaslide enlargement he sent me of the cutthroat trout taken in Big Thompson River. I do hope such colored photos will be available from any future work your group does.

Sincerely,

Robert R. Miller

Robert R. Miller,
Curator of Fishes

RRM:cm
Attachment

Received Loanback
9/13/63
BS FW

UNIVERSITY OF COLORADO MUSEUM
BOULDER, COLORADO

Sept. 12, 1963

Dr. Robert Vincent
Colorado Cooperative Fishery Research Unit
Colorado State University
Fort Collins, Colorado

Dear Dr. Vincent;

In response to your question about greenbacked trout I have searched through the somewhat disorganized parts of our fish collection which have been added in recent years. We do have some specimens of Salmo stomias; two adult specimens which are undoubtedly stomias bear the data Albion Creek, 10,000 feet, Boulder County, Colorado, 29 May 1953, William Rickard Jr. Two additional specimens from Coyote Creek, 8 miles south of Walden, Jackson County, appear to be Salmo clarkii of some sort, although not exactly like the Boulder county stomias.

I have talked with Dr. Marr, and he tells me that there are no specimens of Salmo stomias preserved at Science Lodge, but that he caught a trout which he took to be this species near Wild Basin this last summer. The individual was released.

Your plans to begin systematic collection and preservation of Colorado fishes are very commendable. Our native fish fauna is very interesting, and may not be long available for scientific documentation. If you find yourself in Boulder I would appreciate the opportunity to show you the fish collections in this museum.

yours sincerely,
Clarence J. McCoy, Jr.

UNIVERSITY OF CALIFORNIA

DEPARTMENT OF ZOÖLOGY
BERKELEY 4, CALIFORNIA

January 17, 1964

Dr. Robert E. Vincent
U.S. Fish and Wildlife Service
Cooperative Fishery Unit
Colorado State University
Fort Collins, Colorado

Dear Dr. Vincent:

I am most enthused over the idea of joining you and your group on a collecting trip this summer. If it can be arranged, I will certainly try to get out there.

I am including some original rough draft material on Salmo clarkii stomias. This essentially sums up our total knowledge on the greenback trout. If you have anything to add, I would appreciate your comments.

I have found the cutthroat trout a most interesting subject. The disappearance of the native trout throughout most of the West can be attributed to a number of factors. Previously, I had believed the native cutthroat could not successfully compete with introduced eastern brook and brown trout and that hybridization was certain if rainbows were introduced. I have found a number of localities in Nevada, however, where the native cutthroat dominates the headwater areas despite repeated introductions. To delineate the subtle ecological factors which favor the native trout in certain areas would be a fruitful field of study. For example, the eastern brook trout is generally considered as the species best adapted for the habitat of small headwater streams. The headwaters of the North Fork of the Humboldt River is stocked with 700 pounds of catchable-size, brook trout each year. Yet, when we sampled this stream in July, the native cutthroat outnumbered the brook trout by about five to one and there was no evidence of brook trout reproduction.

I should point out that although S. C. stomias can be distinguished from the Yellowstone cutthroat by having about 20 more scales in the lateral series (counted two rows above the lateral line) and about five more above the lateral line, all counts for comparative purposes should be made by the same person. The lateral series scale count is difficult and somewhat subjective. No two workers will get identical values and, generally, no two counts by the same person will be duplicated. The lateral series count is made from the scale in contact with the pectoral girdle to the end of the vertebral column, found by flexing the tail and observing the crease. The count above the lateral line begins with the first scale immediately anterior to the dorsal fin and follows a diagonal row down and posteriorly to the lateral line (the lateral line scale is not counted). I use a low power binocular microscope and sometimes paint the scales with malachite green after scraping off the mucous and drying with a jet of air. Scale counts are modified by environmental conditions but I have found no evidence that the magnitude of the differences obtained from laboratory experiments are ever duplicated in nature. I have examined many California golden trout introduced into waters with altitudinal differences of thousands of feet. The scale counts are fairly stable and the vertebral number is amazingly

constant. Pyloric caeca and gillraker number may be considered essentially genetically determined and are hardly influenced by environmental differences.

I hope this material may be of some use to you and your students.

Sincerely,

Robert J. Behnke

Robert J. Behnke
Zoology-Fisheries

RJB:pj
Encls.

Var. **stomias** (Cope) J. & G.

Body short and stout. Head large and wide, above broad and flat, without keel, with wide mandible and mouth, the end of the maxillary extending half the diameter of the eye beyond the orbit. Eye $4\frac{1}{3}$ in head. Maxillary bone of nearly uniform width. Caudal fin truncate. General coloration of *S. spilurus*, the black spots most numerous posteriorly. Head $4\frac{1}{4}$; depth $4\frac{1}{4}$. D. 12; A. 10; scales 42 above lateral line, which probably contains about 200 scales. L. 24 inches. Kansas River to Upper Missouri. (*Cope.*) Like *S. spilurus* in its large mouth and very small scales, but differing in the presence of hyoid teeth and in the broad, flat head. We have seen only the head of an old male of this form, but think it will prove to be a variety of *S. purpuratus*.

(*Salmo stomias* Cope, Hayden's Geol. Surv. Wyom. 1870, 433, 1872: *Salmo stomias* Jordan, Hayden's Geol. Surv. Terr. 1878, 795.)

Var. **henshawi** Gill & Jordan.—*Lake Tahoe Trout; Silver Trout; Black Trout.*

Body elongate, not greatly compressed. Head comparatively slender and long-acuminate, its upper surface very slightly carinated; muzzle somewhat pointed, but bluntish at the tip; head not convex above; maxillary rather short, about as in *purpuratus*, not reaching much beyond the eye. Vomerine teeth as usual; a small, rather narrow, but usually distinct patch on the hyoid bone. Dorsal fin small; caudal fin short, rather strongly forked. Scales medium. Coloration dark, the sides silvery; back about equally spotted before and behind; sides with rather distant spots; belly generally spotted; head spotted even to the snout; dorsal and caudal also spotted. Head $3\frac{3}{4}$; depth 4. D. 11; A. 12; scales 27–160–27 to 37–184–37; cœca 50–60. L. 18 inches or more, usually weighing 5 or 6 pounds, but occasionally 25–30. Lake Tahoe, Pyramid Lake, and streams of the Sierra Nevada. Evidently a variety of *Salmo purpuratus*, but with a longer and more conical head. A fine trout, now common in the San Francisco markets.

(*Salmo henshawi* Gill & Jordan, Man. Vert. ed. 2, 358: *Salmo henshawi* and *Salmo tsuppitch* Jordan & Henshaw, Rept. Chief Eng., 1878, App. NN, 196, 197, plate: *Salmo henshawi* Jordan, Proc. U. Nat. Mus. i, 75, 1878.)

151.—SALVELINUS Richardson.

Charrs.

(*Baione* DeKay; *Umbla* Rapp.)

(Nilsson; Richardson, Fauna Bor.-Amer. iii, 170, 1833: type *Salmo salvelinus* L.)

Body moderately elongate. Mouth large or small. Teeth of jaws, palatines, and tongue essentially as in *Salmo*, the hyoid patch present

or not. Vomer boat-s
raised crest, with teet
Scales very small, in
in the young, truncat
ties not strongly ma
and a fleshy projectio
with round crimson c
marginal bands of bl
clear streams and lak
times descending to t
become nearly plain
general the smallest
name of the charr; al

• Vomer with a raised cres
with teeth; hyoid
Jordan).

309. S. namaycush
(*Vermont*); *Togue*

Body elongate, cov
opment of fatty tissu
Mouth very large, the
head and jaws prop
strong. Caudal fin v
tion dark gray, some
with rounded paler sp
vermiculate above;
arge, $4\frac{1}{2}$ in head.
interorbital space ne
11; Lat. l. 185–205.
Northern New York
northward; very abu
form and color in the

(*Salmo namaycush* Walb
of authors generally: *Sal*
410: *Salmo confinis* DeKa
Salmo toma Hamlin: *Cri*
siscowet Günther vi, 123.)

•Jordan, Man. Vert. ed.
vomer, vomer.)

TAKEN FROM:

Jordan, David S., and Charles H. Gilbert. 1882
Synopsis of the fishes of No. America. U.S. Dept
of Interior; U.S. Nat. Museum 16; 316.

STATE OF COLORADO
Richard D. Lamm, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
Jack R. Grieb, Director
6060 Broadway
Denver, Colorado 80216 (825-1192)

January 7, 1983

Fred L. Bolwahnn
Field Supervisor
U.S. Fish and Wildlife Service
Endangered Species Office
1406 Federal Building
125 So. State Street
Salt Lake City, UT 84138-1197

Dear Fred:

The following is a synopsis of the greenback cutthroat trout Recovery Team meeting held in Denver, January 5th. In attendence were: Bruce Rosenlund (FWS), Dave Stevens (NPS), Bob Stuber (FS), Jim Bennett (CDOW)--Recovery Team members, and Marc Bosch (FS), Brenda Melton (FS), W. Pat Dwyer (FWS-FCDC), Dr. Kurt Fausch (Colo. St. Univ.), Ted Washington (CDOW) and Chuck Loeffler (CDOW).

After introduction of new guests was made, participating agencies reviewed their 1982 accomplishments and 1983 goals:

Pat Dwyer - gave us the background on the FWS-FCDC program in Bozeman. In 1978, 66 greenbacks from Como Creek heritage were brought to the Bozeman facility and held as brood stock. Milt from 15 wild males was used to fertilize eggs from hatchery-reared females again in 1982, resulting in an 80% success to the "eye-up stage". Some mortality was later noticed, and eliminated by enhancing the vitamin E and selenium content of fish food. To compensate for (enteritis and fungal-related) mortalities among brood males, 850 fry from 1982 stock were retained in the hatchery. Over 26,000 greenback fry were transported to Colorado in 1982, and reintroduced into suitable east slope habitats, including Rocky Mountain National Park. Future production was estimated: 1983 - 20,000 to 23,000 fry; 1984 - 50,000 fry; and in 1985 - 100,000 fry.

Bob Stuber - presented slides illustrating Forest Service efforts in 1982. Five - 100m sections of Como Creek were block-netted and electrofished leading to the capture of 179 greenbacks (28% were 6" or over T.L.), and standing crop estimates ranging from slightly over 1 lb/acre to 40 lb/acre of fish over 6" T.L. Thirty percent of the sampled sections were pool, 70% riffles (the greater majority of fish were captured from pools). Bob illustrated the habitat improvement structures he proposes for use in Como Creek and othe sites - plunge pools below logs, gabbions, large rocks, etc. Efforts are in the works to help protect the Como Creek habitat by denying motor access to the area. Leavenworth Creek water quality, benthos was sampled on two occasions in 1982. Data indicated that low water temperatures, seepage from nearby mines and sparse benthos could pose substantial problems, and stocking the Creek was not recommended. Bard Creek passed its physico-chemical tests with better grades, and was subsequently stocked with 6900 (October 5) and 1100 (November 16) fry from Bozeman. The environmental assessments for Pennock Creek (and other sites in the Red Feather Lakes district) is on-going.

Ted Washington - thanked Bob Stuber for addressing many of the projects he was involved with. Ted also discussed his labor, money and manpower needs related to rehabilitate Pennock and West creeks. His field crew also located several potentially good greenback habitats, including Scott Gomer Creek and Bruno Gulch near Guanella Pass. Considerable coordination and cooperation would be required to rehabilitate these areas.

Chuck Loeffler - Cascade Creek looked "healthy" again in 1982, and likely could continue to serve as a donor source of (Arkansas River drainage) greenbacks. Virtually all of the 22-24 adult greenbacks in McAlpine's Lake were captured this spring, and some 3,000 eggs were taken, fertilized and hatched out in Vibert boxes placed in Sheep Creek (the lake's inlet). The "B" population in South Apache Creek has received substantial environmental and angling pressure and now appears fairly viable. If this population was decimated, it would be a good candidate for re-introduction with "A" stock. The brood pond (Lytle Pond) on Ft. Carson showed good growth, and was the site of some apparent

illegal fishing a few weeks ago (Rosenlund will explain). Cottonwood Creek under went some habitat enhancement in 1982, and will be stocked in 1983; Upper Greenhorn Creek was flood-scoured in 1982 and will "rest" until benthos rebounds prior to stocking. Other potential sites were identified: Timberline and Virginia lakes, and Lake Fork Creek.

Dave Stevens - talked about the "B" populations in Fay Lake and Forest Creek (?), and the experimental angling program in Hidden Valley Creek beaver ponds; Ouzel Lake and West Creek will also be fishable once they have developed.

Bruce Rosenlund - gave us a rundown on the 1982 catch-and-release angling for greenbacks in Hidden Valley Creek (RMNP). In eight days, 730 anglers-hours creeled over 600 greenbacks and 300-odd brook trout...greenbacks proved very susceptible to angling. The re-introduced population above the falls in West Creek will be surveyed in 1983. Very optimistic results have come from stocking Bear Lake - greenbacks planted at 6" T.L. grew to 8"-10" by fall, and there is perhaps some evidence of reproduction (in the inlet area) prior to 1982. The fish are easily observed by tourists. Monitoring of Ouzel Lake and Creek (stocked in 1981 and 1982) indicated that introduced fry showed moderate growth, and were <u>very</u> habitat faithful. Fry showed some upstream movement but none downstream. Because we had a surplus of Bozeman fry in 1982, Fern Lake was stocked, several months after it was rehabilitated. Lakes seem to bounce back from derris projects faster than streams, so we are all anxious to see what happens in Fern Lake. Two men were caught fishing in Lytle Pond (Ft. Carson), and as result two, and perhaps three (of the four on the stringer) greenback brood stock were killed. The state has levied its fine (a paltry $45!), and FWS/Army is proceeding with criminal charges. The case was apparently weakened by a lack of signs, posting the area; this deficiency is being corrected. The results of the Lawn Lake flood were illustrated; rehabilitation and restocking with greenbacks is probably a couple of years off. And the Upper South Fork Cache La Poudre River was assessed as a potential restoration site.

Both Marc Bosch and Brenda Melton expressed optimism and enthusiasm in dealing with FS-recovery efforts within National Forests. Closer coordination is anticipated.

Kurt Fausch - discussed the proposal he submitted to the Colorado Commission on Higher Education to study the interactions between various ages/sizes of greenbacks and brook trout, as compared to greenbacks in sympatry. These interactions must be understood before we can properly isolate greenbacks in the wild. CDOW and NPS funds and support will be solicited to help with this research.

We then launched into a status review of the Greenback Cutthroat Trout Recovery Plan. As a team, we concurred on recommendations and comments, until the section concerning "stable or self-sustaining" came up. It was agreed that Bruce Rosenlund and I would synthesize the comments regarding this concept and confer with consultants and team members to reach a concensus. Basically, we will draft a section indicating that a stable or self-sustaining population is one so designated by the majority of the Recovery Team based upon consideration of site-specific data on habitat quality and quantity, genetic population purity and taxonomic integrity, spawning recruitment/age structure, etc. We also felt that fishing, special regulations and future management should at least be mentioned (although the Team does not perceive its goals as management-oriented).

Formal federal aid reports from FWS-FCDC (Dwyer), CDOW (Loeffler; Washington), FWS (Rosenlund), et al. are now or soon will be available for distribution. The Recovery Plan will again reach the final draft stage, once Table II (Status) is updated and all other pertinent concerns are accommodated. Please let me know how to charge-off expenses related to publishing, reproducing, distributing the Plan; and what review routes you expect to be followed once the Plan is finished.

We all appreciate your interest in the recovery of the greenback cutthroat, and hope that you will agree that the revised Recovery Plan can

serve as a viable guide toward that recovery goal.

Sincerely,

Jim Bennett

James R. Bennett, Leader
Greenback Recovery Team

JRB/jg

xc: Recovery Team (4)
T. Washington (CDOW)
C. Loeffler (CDOW)
K. Fausch (CSU)
M. Bosch (FS)
B. Melton (FS)
W. P. Dwyer (FWS)
T. Hickman (FWS)
J. Roybal (FWS)
R. Behnke (CSU)
J. Torres (CDOW)
J. Grieb (CDOW)

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Greenback Team
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Bob Behnke
Department of Fishery & Wildlife
Colorado State University
Fort Collins, CO 80523

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Recovery Plan

borrowed
Oct. 31

Brett Hodgson

for Simpson's class

UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN, U. S. A.

MUSEUM OF ZOOLOGY

April 15, 1958

Dr. Oliver B. Cope
Thatcher Building
41 South Main Street
Logan, Utah

Dear Dr. Cope:

Your considerate letter of March 31st arrived just before my trip (April 4—12) to Washington, D.C., and hence I was unable to reply earlier.

I am particularly pleased to learn that you plan to carry out the rearing of the west slope and east slope cutthroat trouts under identical conditions; such experimental work is basic to our understanding of phenotypic variation in salmonids. The parents used in taking spawn should be carefully preserved along with a series from nature of each stock. I presume that the east slope stock will be from Albion Creek; if so, we now have a good sample of this strain.

I can appreciate the difficulty of proper preservation of fishes that come from remote streams available only by packhorse. This problem is one that has faced me on occasion in field trips, particularly to foreign countries. I hope, however, that containers and formalin can be packed to these streams so as to ensure good material for analysis. If this is done, I would like to offer a word of caution from my own experience. When fishes are carried on mule or horseback and preserved in liquid, the containers should be completely filled so that the specimens do not slosh about and break off fins and erode their scales. Perhaps even more satisfactory would be preservation at streamside until rigor mortis sets in and then wrapping each fish separately in formalin—soaked cloth sealed in plastic bags. This would reduce weight too. If you would like to have some of the formalin—alcohol resistant labels we use in the field, let me know and I will send on a supply.

It would be ideal if each fish could be tagged, the number recorded, and a note made at the time of preservation as to the extent, color, and intensity of the cutthroat mark. I fully realize, however, that this may not be practical under some field conditions.

If I can be employed by the Service on a part—time basis as a collaborator, I would suggest the following plan regarding examination of museum specimens. It would be far better initially for me to make one or more trips to museums to survey and evaluate the existing material with a view to borrowing critical material for further study. I would appreciate

your seeking the information on planting records and sending this to me for examination. I have already heard from the Acting Superintendent of Rocky Mountain National Park about old references to fish in the early Great Plains literature.

Incidentally I have had two very fine letters from the National Park Service expressing appreciation of my efforts thus far. I do hope that it will be possible for me to continue to cooperate on this project. Have you had any word from your Branch Chief?

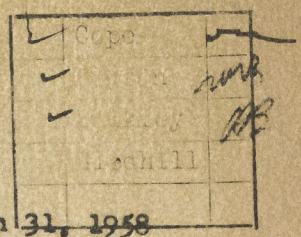
I owe you an apology regarding the payment of the shipment last October. When the specimens arrived, the container was marked "Express Collect", so I naturally assumed we paid the express charges. After receiving the copy of the Bill of Lading that you attached to your letter, showing that the collection charges were billed to the U.S. Department of the Interior, I checked with our accounting officer and found no record of the shipment having been paid at this end. I hope that this misunderstanding on my part and failure to follow up the presumed charges did not cause too much of an upset to you or your staff.

Sincerely yours,

Bob Miller

Robert R. Miller,
Curator of Fishes

RRM:cm



Director

March 31, 1958

Chief, Rocky Mountain Sport Fishery
Investigations

Green-back Trout

We have had a reply from Dr. Miller regarding the identity of the fish which we have been calling the green-back trout. Dr. Miller says, "As of this writing there is insufficient information to state with finality whether any of the samples that have been submitted to me represent Salmo clarki stomias or, indeed, whether the greenback cutthroat trout is a valid subspecies." "Irrespective of what kind of cutthroat trout inhabit the east slope of the Rockies now, some probably represent original strains and these should be preserved. For this reason, if for no other, I think your project is a very worthwhile one." Dr. Miller suggests that a careful study be made of older collections of museums that represent the native fauna prior to mixing of stocks by man and that all possible planting records should be secured.

Dr. Miller also states "I have been identifying trout for the Fish and Wildlife Service on my own time during the past six years more or less as a friendly gesture. As a matter of fact, the demand for identification service of this sort has reached such proportions that I doubt whether I will be able to continue doing this unless I am assigned collaborator status, with compensation, on a part-time basis. Are you in a position to request such authorization? I sincerely hope so."

Apparently a decision must be reached as to a course to follow with this fish in Rocky Mountain National Park. I believe that the Park Service would like us to go ahead with the restoration of this fish whether or not it is the green-back trout. By so doing it would be complying with the National Park Service policy of having their streams stocked with native fish. I propose, therefore, that we continue with this work as planned and that we follow Dr. Miller's suggestion regarding more work on the identification of this fish. I have written him to ask how he would propose to handle the work, that is, which of the tasks he would undertake and which ones he would like us to handle. With regard to collaborator status for Dr. Miller, we would appreciate having your opinion. Since we are only one of several Fish and Wildlife Service offices that have asked him to identify fish (this is the first time we have asked him), it might seem that the Branch Headquarters would be the one to organize or initiate arrangements of this sort, if it seems appropriate to name Dr. Miller as a collaborator. If some arrangement could be worked out for each Project to pay for its part of the services or for the Central Office to pay Dr. Miller from other funds, it might work out.

Oliver B. Cope

OBC:cg

Regional Director

March 31, 1958

Chief, Rocky Mountain Sport Fishery
Investigations

Green-back Trout Identity

We sent specimens of cutthroat trout from Rocky Mountain National Park to Dr. Robert R. Miller of the University of Michigan in order to learn if these fish were actually the green-back trout. Dr. Miller is still not able to say definitely that this fish is or is not Salmo clarki stomias or even whether the green-back cutthroat trout is a valid subspecies. He feels that the trout on the east slopes of the Rockies now probably represent original strains. He is interested in seeing older collections from museums and in securing old planting records. He is also interested in comparing the Colorado River cutthroat with the fish which we think might be the green-back trout when they are reared side by side under the same temperature. He states that the vertebral numbers from our collections differ from those in collections he has from the Colorado River cutthroat. He is wondering whether vertebral numbers are being strongly influenced by water temperatures during critical stages of development or whether these differences are actually genetic ones.

It occurs to me that it might be possible to rear fish as Dr. Miller suggests at the Leadville Station. Mr. French has specimens of cutthroat trout from Rocky Mountain National Park, and they might be in a condition to produce spawn this year. If he has the space, would it not be possible to secure Colorado River cutthroat spawn and rear them side by side to adulthood with spawn of the green-back trout and let Dr. Miller make comparisons of vertebral counts.

We would appreciate your comments on this proposal.

Oliver B. Cope

OBC:cg

cc: Mr. Paul Thompson
Mr. French

Green-back file

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Thatcher Building
41 South Main Street
Logan, Utah

February 18, 1958

Dr. Howard A. Tanner
Unit Leader
Colorado Cooperative Fishery
Research Unit
243 Forestry Building
Colorado State University
Fort Collins, Colorado

Dear Howard:

Many thanks for your letter of February 13 regarding your possible participation in a study of the green-back trout. We are very pleased to learn that you are interested in going ahead with studies on this subspecies.

We do not know at the moment whether we shall be studying the green-back trout in Rocky Mountain Park this summer. We have recommended to our Central Office that we continue according to the general plan included in the report which we prepared last October. Since that time there has been a little discussion on the matter of the importance of this project compared with others in this region, and on which branch should undertake the work. We have not yet been able to secure a decision which will tell us whether to plan on the work.

With regard to the exact identity of the fish, I can only say that we sent additional specimens to Dr. Miller at Ann Arbor some months ago. He has promised to give an opinion about them, but we have not heard from him. I hesitate to pester him too much about a name for this fish, although it certainly would be highly desirable to have an immediate identification in order to plan for any program that might be undertaken.

I would think that there would be plenty of room for your project and ours. We had intended to include a life history study in our work, although even in that area there would probably be enough problems to accommodate all interested parties. I would suggest that you proceed to set up a problem for your man.

Whether or not we go into the study, I think we can probably make plans to have the two groups help each other, rather than compete with each other.

Let us know what you and Dr. Olive decide, so that we can be informed when we receive a decision from on high.

Sincerely yours,

Ollie

Oliver B. Cope, Chief
Rocky Mountain Sport Fishery
Investigations

OBC:cg

From: Millett, M.T. Glaciation in the headwaters of Middle Boulder Creek Colorado.
M.S. Thesis · Univ. Colorado 1956

Middle Boulder Creek	Michigan River Basin, North Park	Frying Pan River Drainage	Snake River, Summit County	Rocky Mountain National Park	Southern Rocky Mountains	Monarch Valley	San Juan Mountains	East Side of Front Range	Arapahoe and Albion Valleys
	Eschman	Melson	Smith	Jones and Quam	Ray	Ives	Atwood and Mather	Thornbury	Morey
	1955	1954	1948	1944	1940	1936	1932	1928	1927
Protalus Ramparts	Cirque Moraines Protalus Ramparts Rock Streams	Chapman Gulch			Sprague Wisconsin V (Protalus Ramparts)				
		Hell Gate			Wisconsin IV (Long Draw)				
Park Hill Recessional Moraine	American Lakes	Ivanhoe		Upper Valley	Wisconsin III (Corral Creek)	Monarch			
Park Hill Substage	Silver Creek	Biglow	Late Stage	Park Border	Wisconsin II (Home)	Arapahoe and River	Wisconsin	Second Stage	New Moraine
Nederland Substage	Gould	Thomasville	Early Stage	Old Moraine Remnants	Wisconsin I (Twin Lakes)	Stillwater	Durango	First Stage	Old Moraine
Tungsten Mountain Substage	Owl Mountain	Lime Creek			Prairie Divide Stage		Cerro		

CORRELATION OF GLACIAL STUDIES IN THE COLORADO ROCKIES

Figure 7

Greenback
- Jailines

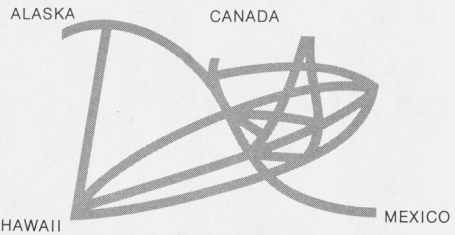
- Florence Crk.
- Black Hollow
- Fawn L. - Riddle Valley
  → Caddis L.
- Douglass
- N. Fk Big Thompson.
- if eyed eggs - acclimated fry

- S. Purdy - large fish.
  better than stunted brook trout

-

Island L. 8-10 yr.
- 10-12

Western Airlines



TA-37 12/70

Common name: Greenback cutthroat trout Scientific name: *Salmo clarki stomias* Cope

Order: Salmoniformes Family: Salmonidae

Distinguishing characteristics:

Spots large, confined mainly to posterior region; vertebrae typically 59-61; scales 180-215 in lateral series, 40-50 above lateral line; pyloric caeca typically 30-40.

Present distribution:

Unknown. Virtually all of the cutthroat trout populations now inhabiting the South Platte and Arkansas river drainages in Colorado are hybrids between two or more subspecies of *S. clarki* and perhaps rainbow trout, *S. gairdneri*. Only the population in Albion Creek, Boulder Co., Colo., was judged to represent the original genotype. Albion Creek has a dense eastern brook trout (*Salvelinus fontinalis*) population. Only 10 cutthroat specimens were found in September, 1968, by electro-fishing. These trout were removed to a barren section of Black Hollow Creek, west of Fort Collins.

Former distribution:

All suitable habitat in the South Platte and Arkansas river basins, Colorado.

Status: Endangered

Estimated numbers: Only 10 pure specimens known, September, 1968.

Breeding rate in wild/Fecundity: Unknown

Reasons for decline:

Hybridization with rainbow trout and other subspecies of cutthroat trout; competition with eastern brook trout; alteration of habitat.

Protective measures taken:

Taxonomic studies to determine purity of present east slope cutthroat populations. Removal of all eastern brook trout from upper section of a small stream (Black Hollow), construction of a barrier to upstream migration and the introduction of remaining Albion Creek cutthroat into this sanctuary.

Measures proposed:

Continued sampling and study in attempt to find uncontaminated populations; surveillance of Black Hollow Creek.

Number in captivity: None. Albion Creek specimens were formerly kept at the Leadville National Fish Hatchery, but all perished.

Breeding potential in captivity: Unknown

Remarks:

The cutthroat populations in the very headwaters of the Big Thompson River in Forest Canyon of Rocky Mountain National Park and in Goose and Island lakes of the Boulder City watershed closely resemble pure *stomias* and have been only slightly influenced by hybridization.

References:

Dieffenbach, W.H. 1966. Taxonomy of the cutthroat trout (*Salmo clarkii* Richardson) of the South Platte Drainage, Colorado. Copeia (3):414-424.

Status category:

Name: Greenback cutthroat trout
Salmo clarki stomias

Date Prepared: February, 1973

Order: Salmoniformes

Family: Salmonidae

STATUS: ENDANGERED (OUTLOOK HOPEFUL)

I. Taxonomy

A. Distinguishing characters. There are no published descriptions that are adequate to diagnose *Salmo clarki stomias* and distinguish it from other subspecies of cutthroat trout. Examination of old museum specmens and recent collections revealed that although no single character can positively identify the greenback cutthroat trout, the following characters are useful for evaluating relative purity of a population. Spots on body large, round or oblong; largest, most prominent spots in area posterior to line drawn from origin of dorsal fin to origin of anal fin. Spots on *S. c. stomias*, typically larger than in other subspecies. Spots generally absent from head; occasionally on anal fin. Coloration may be brilliant, almost gaudy, particularly on males during the breeding period. Colors on sides of body vary from dull brass to bright golden yellow with pink or red hues extending around lateral line, but not in an distinct band as in rainbow trout. Ventral region cream to orange or red. Orange or red often suffusing lower fins. Cutthroat mark usually crimson, sometimes orange. Most diagnostic meristic characters are numbers of scales, vertebrae and pyloric caeca. Typically the scale counts of *S. c. stomias* made a series counted two rows above the lateral line (lateral line series) and above the lateral line (origin of dorsal fin to lateral line) more numerous than in other subspecies of *S. clarki*.

Mean values for the lateral series count range from 185 to 215 and 44-55 above the lateral line. The numbers of vertebrae typically are 59-62 and pyloric caeca, 25-40; both counts slightly lower than in most other subspecies of S. clarki. Basibranchial teeth present, typically 3-15. Posterior gillrakers on first arch better developed than in most other subspecies.

B. Acceptance by taxonomists (validity of subspecies and taxonomic problems). The name stomias is based on two specimens collected by a Dr. Hammond on a U. S. Army expedition from Fort Riley, Kansas, to Fort Bridger, Wyoming, and return in 1856. The specimens were labeled only "Fort Riley Kansas," the shipping point. E. D. Cope described a new species Salmo stomias, on these specimens in 1872. D. S. Jordan (1891) recognized that the type specimens of stomias did not come from Fort Riley, Kansas and Jordan used the name stomias for the cutthroat trout indigenous to the headwaters of the South Platte and Arkansas river basins of Colorado and Jordan's procedure has been followed to the present. Although the name stomias could have been based on trout from the Green River, Wyoming (Fort Bridger) it is unlikely the exact source will ever by known and the name stomias will continue in its present useage.

With the advent of more modern systematic concepts, all of the varieties of cutthroat trouts have been considered as a single species, Salmo clarki, with many of the formerly recognized species, such as stomias considered as a subspecies.

Although critical, in-depth taxonomic comparisons have never been published to verify or cast doubt on the validity of the subspecies, the data accumulated by the Colorado Cooperative Fishery Unit, confirms that the cutthroat trout native to the South Platte and Arkansas river

basins is a relatively well differentiated form (see diagnosis in above section) and deserves subspecific recognition. Its closest affinities are with the Colorado River cutthroat trout, S. c. pleuriticus, from which it was evidently derived.

C. Current Activities: A problem in better defining the characteristics of S. c. stomias results from the paucity of old museum specimens and the extreme rareness of pure populations. Thus, we can only roughly estimate the natural range of variability of the diagnostic characters. There is no authoratative method to determine if a population with slightly abberant characters is within the natural range of variability or due to slight hybridization with introduced rainbow trout or other subspecies of cutthroat trout. Continued search for pure populations is the best hope for better defining the taxonomic attributes of S. c. stomias. A graduate student thesis by Colorado Cooperative Fishery Unit student, Gary Wernsman, will include all of the data available as of February, 1973 on the greenback cutthroat trout.

II. Range and Distribution

A. Historical: In headwaters of South Platte and Arkansas river basins. Permanent populations were restricted to the mountains and foothills area. The warm, turbid conditons in the South Platte and Arkansas rivers in the plains was not salmonid habitat. Trout were not native to the North Platte River drainage of Colorado and Wyoming.

B. Present: The extirpation of the greenback cutthroat trout proceeded so rapidly after the coming of the white man to Colorado, that this subspecies was commonly assumed to be extinct in its pure form by the 1930's. In 1969 the only population ideally conforming to the diagnostic characters of S. c. stomias (established from ancient museum specimens), was found in a tiny stream, locally called Como Creek, tributary to North Boulder Creek in Roosevelt National Forest, Boulder County,

Colorado. Other populations that appear to be virtually pure S. c. stomias, but probably with a slight influence of Yellowstone cutthroat trout (and possibly rainbow trout) occur in the very headwaters of the Big Thompson River in Forest Canyon of Rocky Mountain National Park and in Island Lake, a reservoir in the City of Boulder's watershed in the headwaters of North Boulder Creek. In the Arkansas River drainage the only population found closely approximating the characteristics of S. c. stomias occurs in the very headwaters of South Huerfano Creek, Huerfano County, Colorado. A small population of trout very typical of S. c. stomias in their spotting pattern, coloration and scale counts, but with slightly higher than expected vertebrae number. is found in a short section of the very headwaters of the Little South Poudre River above a barrier in Larimer County, Colorado.

A pure population persisted in Albion Creek in the City of Boulder's watershed until 1969 when the last 10 specimens were removed and transplanted into Black Hollow Creek a tributary of the Poudre River, Larimer County, Colorado. A barrier was erected on Black Hollow Creek and all of the fish eradicated in 1967. Additional transplants of S. c. stomias from Como Creek into Black Hollow Creek in 1970 has established a self-reproducing population. Another transplant from Como Creek was carried out in 1970 into a barren, isolated tributary of the Big Thompson River in Rocky Mountain National Park. The success of this transplant is not known.

A successful transplant was made outside the native range in 1967 with trout from Forest Canyon (Big Thompson River) to Florence Creek, on the Uinta Indian Reservation, Utah (Green River basin). A

transplant from Forest Canyon into Fay Lake in Rocky Mountain Park in 1959 failed to establish a population in Fay Lake, but a population has been established in Caddis Lake, below Fay Lake from fish migrating downstream.

C. Ownership: The habitats containing pure S. c. stomias in Como Creek and Black Hollow Creek are on Roosevelt National Forest lands with the exception of a few hundred yards of the head of Como Creek which is on the grounds of the Arctic and Alpine Research Institute of the University of Colorado. The habitat in Como Creek covers less than one mile of stream before a precipitous drop to North Boulder Creek. Black Hollow Creek, above the barrier contains about two miles of potential trout habitat.

The virtually pure but more dubious populations of S. c. stomias are on lands of the following agencies: Forest Canyon and Caddis Lake, Rocky Mountain National Park; Island Lake, City of Boulder, Colorado; head of Little South Poudre River, Roosevelt National Forest to Rocky Mountain National Park boundary; South Huerfano Creek, private ranch surrounded by San Isabela National Forest lands.

D. Competition for other uses (threatening factors). Fortunately, all of the habitats of the present populations with the possible exception of South Huerfano Creek appear to be relatively safe from competing uses. The public agencies give special recognition to the habitats. A threat would occur from introduction of other trouts which is a possibility from a well meaning fisherman. This possibility is considered remote in view of the size and location of these habitats. The greatest potential danger would be the destruction of the barrier dam on Black Hollow Creek. An abundant rainbow trout population occurs

below tha dam and hybridization would certainly follow any impairment of the barrier.

III. Life History and Ecology

A. Relative abundance. The pure population in Como Creek probably consists of approximately 100 adult fish. When the introduced population expands to its maximum limits in Black Hollow Creek, about 200-300 adult fish may be expected. Of the other populations, the most abundant one is in Island Lake, (40 surface acres) where approximately 5000-7000 adult trout (8-12 inches) are present (Nelson, MS. 1972).

B. Habitat description: There is nothing unique about greenback trout habitat except that the optimum conditions of oxygen, temperature, water purity etc. appear to be more extreme than with other trouts such as brown trout or rainbow trout. That is, the greenback cutthroat trout is less tolerant of adverse conditions.

The most significant factor limiting the distribution of the greenback cutthroat is introduced non-native trouts. Hybridization occurs with other subspecies of cutthroat trout and with rainbow trout. The eastern brook trout has had a particularly devastating effect by replacing the greenback trout in virtually all of the small tributary streams. For future re-introductions, only waters completely barren of other fishes will have any chance of successfully establishing the greenback cutthroat trout.

C. Food and Feeding: There is no detailed data available on the feeding habits of greenback trout, but from the bits of information available (Bulkley, MS. 1959; Jordan, 1891; Juday, 1907; Nelson MS.1972) and personal observations it appears that the greenback cutthroat trout

is eclectic and opportunistic in its feeding utilizing a variety of invertebrate foods depending on their availability. Jordan (1891) wrote that the greenback trout was not as predaceous as other cutthroat trout. This was based on his observations at Twin Lakes and at a private trout hatchery were greenbacks were maintained. There may be some truth to this observation because the greenback was never noted for its large size. Specimens of more than a pound evidently were rare.

D. Reproduction: Although no detailed data is available on reproduction there is no reason to suspect that S. c. stomias has any basically different spawning requirements than other subspecies of S. clarki. Spawning occurs in flowing water in late spring or early summer, depending on water temperature. Nelson (MS. 1972) reported the spawning run from Island Lake peaked during the first two weeks of July, 1971 (elevation 10,500 feet). The fecundity of 7 females from Island Lake, averaging 273 mm and 185 g. averaged 299 eggs.

E. Interdependence and competition with other animal species. Historically the greenback trout coexisted, at least at lower elevations with a variety of fish species indigenous to the South Platte and Arkansas river systems such as longnose sucker Catostomus catostomus, white sucker, C. commersoni, longnose dace, Rhinichthyes cataractae and creek chub, Semotilus atromaculatus. Sculpins of the genus Cottus, mountain sucker subgenus Pantosteus and Rocky Mountain whitefish, Prosopium williamsoni, typically associated with other subspecies of cutthroat trout were absent from the native range of S. c. stomias. The drastic decline and virtual disappearance of the greenback trout was due to introductions of non-native trouts and subsequent hybridization and displacement. The presence of introduced

trouts are the most significant limiting factor to expanding the present distribution of greenback trout.

IV. Research Needs (management recommendations). Two major objectives are: (1) to increase the abundance of greenback trout by introductions into new waters that are presently barren of fish or where all fishes are eliminated and (2): To find additional sources of pure greenback trout. The first objective is enthusiastically endorsed by Roosevelt National Forest and Rocky Mountain National Park biologists. Potential transplant sites are currently being considered. The second objective is doubtful. The east slope streams of the Arkansas and South Platte drainages have been relatively well covered. The area is large however, and there is always the possibility that another site similar to the Como Creek situation will be found.

It is not recommended that a brood stock be developed in a hatchery. Adults from Albion Creek and from Forest Canyon were formerly held at the Leadville National Fish Hatchery with this goal in mind. These trout were extremely difficult to maintain. The Albion Creek trout all perished and the males and females from Forest Canyon did not ripen at the same time. If a brood stock could be developed under hatchery conditions, artificial selection for domestication would be unavoidable.

V. Authorities: Robert Behnke, Colorado Cooperative Fishery Unit, Colorado State University, Fort Collins, Colorado 80521. Taxonomy, distribution.

James Mullen, U.S. Bureau of Sport Fisheries and Wildlife, Vernal, Utah. Mr. Mullen handles fisheries investigations for Rocky Mountain National Park and would be involved with plans for greenback restoration.

Wesley Nelson, Colorado Division of Wildlife, Research Laboratory, Fort

Collins, Colorado 80521. Biology, reproduction and artificial propagation of Island Lake population.

VI. Annotated Bibliography

Anon. 1878. Trout in the Rocky Mountains, Forest and Stream, 9(25):468-469. Tells of abundance of trout (greenback cutthroat in Poudre River). Also relates crowded conditions and over-fishing in Denver area.

Behnke, R. J. 1969. Rare and endangered species report: the greenback trout. Colo. Coop. Fish. Unit, C.S.U., Fort Collins, Colo. 80521:5p. (Mimeo). Discusses discovery of pure population of greenback trout in Como Creek and presents taxonomic characters.

Bulkley, R. V. 1959. Report on 1958 fishing studies by the Bureau of Sport Fisheries and Wildlife on Rocky Mountain National Park. Rocky Mountain Sport Fisheries Investigations, Administrative report: 38p. Data on the greenback trout in upper Big Thompson R., Forest Canyon, Rocky Mountain National Park, includes food habits, age, growth, reproduction, sex ratios and migration.

Cope, E. E. 1872. Report on the reptiles and fishes obtained by the naturalists of the expedition. U.S. Geol. Surv. Wyoming (Hayden's Survey): 432-442. Original description of "Salmo stomias."

Cope, O. B. 1964. Revised Bibliography on the cutthroat trout. Bur. Spt. Fish. Wildlf. Res. Rept. 65:43p. A compilation of 221 abstracts of publications on Salmo clarki.

Cross, F. B. and L. J. Olund. 1961. Geographic variations in the cyprinid fish Hybopsis gracilis. Univ. Kans. Pub. Mus. Nat. Hist., 13(7): 323-348. Details the confusion in the type localities of several species of fishes described from collections made by the 1856 expedition from Fort Riley, Kansas to Fort Bridger, Wyo., including "Salmo stomias."

Dieffenbach, W. H. 1964. Taxomony and selected life history of the cutthroat trout (Salmo clarki Richardson) of the South Platte drainage. Colorado. M.S. theses, Colo. St. Univ: 49p. Taxonomic data, age and growth of 4 populations of suspected greenback trout. Actually, Albion Creek represented the only pure greenback population considered by the author. The population selected by the author as the best representative of S. c. stomias (Black Hollow Creek) is slightly hybridized with rainbow trout.

Dieffenbach, W. H. 1966. Taxonomy of the cutthroat trout (Salmo clarkii Richardson) of the South Platte drainage, Colorado. Copeia (3):414-424. A brief version of M.S. thesis prepared for publication.

Greene, W. S. 1937. Colorado trout. Colo. Mus. Nat. Hist, Popular Ser., No. 2:48p. Statement that greenback trout was probably extinct.

Jordan, D. S. 1891. Report of explorations in Colorado and Utah during the summer of 1889 with an account of the fishes found in each of the river basins examined. Bull. U.S. Fish. Comm., 9:1-40. First use of the name stomias for the cutthroat trout native to the South Platte and Arkansas river systems. Data on distribution, taxonomy and some natural history.

Jordan, D. S. 1920. Planted trout in the Platte drainage. Copeia, no. 85:72-73. Confirms that North Platte basin had no native trout.

Juday, C. 1907. A study of Twin Lakes, Colorado, with especial consideration of the food habits of the trouts. Bull. U. S. Bur. Fish., 26:147-178. Data on food habits of greenback trout in Twin Lakes.

Land, S. E. 1913. The black-spotted mountain trout. Trans. Amer. Fish. Soc., 42:183-189. Comments on greenback trout and mention of stocking trout in North Platte River basin in 1891 which was formerly barren of trout.

Nelson, W. C. 1972. An unexploited population of greenback trout. Paper presented at 1972 annual meeting of Colo. - Wyo. A.F.S. chapter. Mimeographed: 13p. (Available from author: Colo. Div. Wildlife, Prospect St., Fort Collins, Colo. 80521). Population estimates, food habits, spawning, age and growth of a virtually pure greenback population in Island Lake (City of Boulder watershed).

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

N2217

TO : Superintendent

DATE: August 13, 1975

FROM : Research Biologist

SUBJECT: Proposed Greenback Trout Restoration

As proposed in the Resources Management Plan for Rocky Mountain National Park (approved by Regional Director June 12, 1975), several more streams and/or lakes need to be restored to the greenback cutthroat trout (Salmo clarki stomias) for research and management purposes. The objectives of these projects are: (1) to document feasibility of restoration of water presently occupied by brook trout, (2) to progress toward the goal of restoration of native species where possible, (3) to remove the greenback trout from endangered status.

It is proposed to restore Bear Lake to greenback trout in October 1975. This project is in direct cooperation with the Secretary of Interior's Recovery Team for the greenback trout. The objective of the recovery is to reclassify the greenback as "Threatened", thus allowing more liberal management by State and Federal agencies.

Description of proposed action--The restoration of Bear Lake would require the treatment of 11.2 surface acres with a fish toxicant, to remove the brook trout (Salvelinus fontinalis). Experience has shown that the native greenback cannot compete successfully with this exotic fish. Application of a 10% solution of antimycin (diluting a 20% emulsifiable concentrate) would be made by the venturi boat method. Application rate will be .5 parts per billion, applied by experienced Fish & Wildlife Service biologist assisted by the Park research biologist. In concentrations planned, the toxicant will not affect other aquatic organisms, waterfowl or mammals. Detoxification will be made below the outlet by the addition of potassium permanganate and closely monitored downstream.

It is proposed that Bear Lake be opened to public fishing on or about September 2 to allow for the beneficial use of some of the brook trout prior to treatment. The lake will be closely monitored, obtaining sizes, weights and other statistics of all fish removed by the fishermen. All fish killed in the subsequent treatment will be recovered and similar data obtained for research purposes.

The success of the treatment will be checked by gill netting. If all goes as planned, the transplanting of greenback trout will be conducted later in October. The source of the stock will be Como Creek, with the approval of the U.S. Forest Service and the State Division of Wildlife. This is the only pure population of greenback which is accessible.

Description of the Environment--Bear Lake is 11.2 surface acres, with a maximum depth of 33 feet and an average depth of 12 feet. It lies in the subalpine forest zone at an elevation of 9,475 feet above sea level. The shoreline on the south is forested with Engelmann spruce and subalpine fir. The north shore is boulder strewn, with quaking aspen common. A beaver colony is presently using the lake.

Visitation is very high and an asphalt-paved self-guided nature trail follows the shoreline. It is accessible by road, with a large parking area located about 100 yards east of the shore. The area is also the trailhead for many popular park trails.

Bear Lake was previously poisoned with rotenone on October 23, 1946, primarily to kill a large sucker population. Subsequently it was restocked with rainbow trout in 1947 and 1950. Eastern brook trout were introduced in 1955 and have since dominated the fish populations, although rainbow had also been stocked up until 1959. Fishing was closed entirely from 1962 until 1973.

Impact of Proposal--The proposed action will result in no environmental impact not discussed in the Resources Management Plan. Bear Lake is presently closed to public fishing from April 1 through October 31. The winter fishing which would have to be relinquished is insignificant. Since the greenback trout is on the endangered species list, no fishing or other harassment could be allowed until declassification. This action should improve the chances for survival of the species and help justify removal from endangered status.

Since Bear Lake is so heavily visited, it makes an ideal site for interpretation of the greenback trout and the recovery efforts. The accessibility of the site also will make it available as a source of stock to use elsewhere in the future.

The toxicant is an antibiotic produced by streptomyces. It has been shown to be specific to fish, and especially trout, causing death in concentrations that are harmless to other aquatic life, waterfowl and mammals. It enters fish via the gills and irreverisbly blocks cellular respiration at the cytochrome level in the oxidative phosphorylation pathway. It is colorless and odorless in water and does not repel fish from treated areas. Antimycin degrades rapidly in water within a few days or less, depending on temperature and ph. Detoxification can be accomplished by the addition of potassium permanganate. The brook trout is particularly vulnerable to the toxicant in cold, soft water at very low concentration (100% kill at 0.2 ppb). Exposure time needed is especially short.

Coordination--This project is being coordinated through the Greenback Trout Recovery Team whose membership includes the U.S. Forest Service, Colorado Division of Wildlife and the U.S. Fish & Wildlife Service.

Coordination will also be made with the Estes Park Water Department, since they take water out of Glacier Creek for human consumption.

Since this study is discussed in the Resources Management Plan, no formal environmental assessment is being prepared.

Approval is requested for this project.

David R. Stevens
Research Biologist

Approved:

Superintendent

7/30/75

In Reply Refer To:
FWS/TA

JUL 28 1975

Memorandum

To: Regional Director, FWS, Denver, Colorado

From: Associate Director - Federal Assistance

Subject: Pesticide Proposals R6-PA-1 and 8

The subject proposals were reviewed by the Program Review Panel of the Federal Working Group on Pest Management, July 23. The Panel had no comment.

You are authorized to proceed with these projects as submitted, using Antimycin to control fish populations in the upper South Platte River drainage, Colorado and Red Butte Creek drainage, Utah.

Keith M. Schreiner

Attachments

CC:
James W. Mullan

FEDERAL WORKING GROUP ON PEST MANAGEMENT
PEST CONTROL PROGRAM REPORT

DEPARTMENT/AGENCY: U.S. Fish & Wildl. Ser. & U.S. National Park Ser.
DIVISION: USFW, Planning & Assistance, Vernal, Utah
DATE SUBMITTED: 11/19/74
PERSON TO CONTACT/TELEPHONE NO.: James W. Mullan

Refer to attached instructions before completing form. Be sure that entries are correctly aligned horizontally.

OBJECTIVE	PESTICIDE	APPLICATION					SENSITIVE AREAS[1]	REMARKS
a) PROJECT NO. b) SPECIFIC TARGET PEST (*Include life stage or stage of growth*) c) PURPOSE (*If crop protection, what crop?*)	a) COMMON NAME b) FORMULATION c) % AI, AE, OR LB/GAL d) REGISTRATION NO. (*required*)	a) FORM APPLIED (*Dust, granule, emulsion, bait, solution, gas, etc.*) b) USE STRENGTH(%) OR DILUTION RATE c) DILUENT	LBS AI PER ACRE OR OTHER RATE	a) METHOD (*Aerial, ground, aerosol, ULV, LV, Other*) b) EQUIPMENT (*type*)	a) ACRES OR OTHER UNIT TO BE TREATED b) NUMBER OF APPLICATIONS c) NUMBER OF SITES d) SPECIFIC DESCRIPTION OF SITES	a) MONTH(S) OF YEAR b) STATE(S)	a) AREAS TO BE AVOIDED b) AREAS TO BE TREATED WITH CAUTION *Specify (a)or(b)* [1]Croplands, lakes streams, food, human exposure, endangered species, other.	a) PRECAUTIONS TO BE TAKEN b) USE OF TRAINED/CERTIFIED PERSONNEL c) STATE AND LOCAL COORDINATION d) OTHER PESTICIDES BEING APPLIED TO SAME SITE e) MONITORING f) OTHER
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
a. R-2-75 b. Brook trout c. Restoration of green-back cutthroat trout	a. Antimycin b. emulsifiable concentrate. 240 cc. (solution 20%) and 240 cc. Diluent. d. 8991-7	a. solution	0.5 ppb	Venturi boat method	a. 11.2 surface acres (pd) b. one c. one d. 11.2 SA natural pond Rocky Mt.Nat. Park, Colo. (Bear Lake)	or Sept.Oct ax Colo	a. /none b. Ordinary precautions that pertain to National Park Areas.	a. Treat at fall low water levels b. Under supervision of Nat. Park and Fish and Wildl. Serbiologists c. Not needed but Colo. Div. Wildl. Res. will be notified. d. None e. Monitor to know when detoxified so as to proceed with restocking. f. None

FWGPM Form #2

1. (a) AGENCY - U.S. Fish & Wildlife & Nat. Park Ser. (b) Project No R-2-75 (c) Target Pest - Brook trout

2. Restoration of rare-and-endangered greenback cutthroat trout (Salmo clarki stomias) to a typical lake (Bear Lake) of Rocky Mountain National Park, Colo. A prototype project relating to an eventual overall recovery plan for the species within the park. Besides providing knowledge on lake existance and augmenting precarious present distribution and abundance of the greenback cutthroat, this renovated greenback cutthroat population could serve as a source of eggs in meeting the demands of a large drainage restoration project for the species in 5-10 years.

3. AREA TO BE TREATED Bear Lake (12.2 surface acres), a typical cirque lake of Rocky Mountain National Park with summer-fall water temperatures in the range of 40-65° F., p.H. 7.0 - 7.3, and total hardness of 30-40 ppm.

4. METHOD Application of toxicant using Venturi boat method. Detoxification of small outflow stream with potassium permanganate if flowing.

5. SPECIAL PRECAUTIONS Not needed.

6. ALTERNATIVE MATERIALS OR METHODS - Not needed.

7. COOPERATORS - Joint project between National Park Service and U.S. Fish & Wildlife Service.

8. MONITORING - Not needed.

SPECIAL MANAGEMENT PROGRAMS

FOR

RARE AND ENDANGERED SPECIES

GREENBACK CUTTHROAT TROUT

SALMO CLARKI STOMIAS

Prepared by Dale L Wills Date 3-11-74
DALE WILLS, Wildlife Biologist

Approved by L A Amicarella Date 3/15/74
L. A. AMICARELLA, Forest Supervisor

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Jim Rawsell
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SPECIAL MANAGEMENT PROGRAM

FOR THE

GREENBACK CUTTHROAT TROUT

History

The Greenback trout was determined by the Secretary of the Interior to be an endangered species in 1964. Its original distribution was limited to the Arkansas and South Platte Rivers drainages in Colorado. The population declined from deterioration of habitat, by hybridization, and competition with introduced Brook and Rainbow trout. The Yellowstone Cutthroat is the most common cutthroat trout now found in South Platte and Arkansas drainage due to stocking programs as a large number of eggs are readily available from the U.S. Bureau of Sport Fisheries and Wildlife fish hatchery located at Yellowstone Lake in Wyoming.

Distribution

In 1964 a student from the Cooperative Fisheries Unit at CSU located a small population of Greenback Cutthroat trout in Black Hollow Creek on the Poudre District. Brook trout were found in the headwaters of Black Hollow Creek in 1966 and it became necessary to take action to maintain the Greenback population. The Cooperative Fisheries Unit electrofished the stream, obtaining 55 fish which were transplanted to Hourglass Creek on the Poudre District. Hourglass Creek was barren of fish and was considered to be suitable habitat. Reproduction from the transplant to Hourglass Creek was observed in 1972.

In 1967, through a cooperative program between the Cooperative Fisheries Unit, Colorado Game, Fish and Parks Department and the Roosevelt National Forest a barrier was constructed near the mouth of Black Hollow Creek. The stream was renovated to establish a barren section for restocking with Greenback trout. In August of 1968, ten Greenback trout were obtained from Albion Creek in the Boulder watershed and were transplated to Black Hollow Creek. Albion Creek contained a few remnants of a Greenback population among a prolific Brook trout population.

During September, 1969, in a small stream known as Como Creek, a tributary to North Boulder Creek, another population of Greenback trout were located. Fifty-two specimens were collected and held at the CSU Cooperative Fisheries Unit and were later transplanted to Black Hollow Creek in July of 1970. Black Hollow now has a self-reproducing population. Another transplant from Como Creek was made to an isolated tributary of the Big Thompson River in Rocky Mountain Park during 1970.

Within Rocky Mountain National Park a population of Greenback trout which show a slight influence of Yellowstone Cutthroat was found in 1959 and some were transplanted to Fay Lake within the Park. The transplant failed in Fay Lake, but became established in Caddis Lake by downstream migration. Another successful transplant of this strain was made outside the native range, in 1967, to Florence Creek in the Uinta Indian Reservation in Utah.

Island Lake located within the City of Boulder's watershed on the Boulder Ranger District, contains a population of Greenback trout that shows a slight influence of hybridization with the Yellowstone Cutthroat. The Colorado Division of Wildlife has been taking eggs from these and using the fry to stock Greenback trout in Rawah Lakes No. 3 and 4, Snow Lake and Brent Lake on the Roosevelt National Forest.

A population of cutthroat trout found in the Roaring Fork Creek on the Redfeather Ranger District are fairly good representatives of the Greenback trout; Behnke (1973a) states that they are not "pure" and that trout other than Greenback were probably introduced into these waters.

Habitat Requirements

Greenback trout requirements for oxygen, temperature, and water quality are higher than for other trout. These conditions are not so extreme that they cannot be met, but do require consideration in establishment of additional population. Stream temperature should not exceed 65° F during the summer and fall or exceed 55° F during the spawning and egg development period. Dissolved oxygen should be near 7 ppm during the spawning period and rarely less than 6 ppm during the remainder of the year. Ph should be within a range of 6.5 to 8.5. Turbidity should not exceed 10 Jackson turbidity units (JTU).

The findings of Bulkley (1959) Nelson (1972) and Behnke (1973), indicate that the Greenback trout appears to be an opportunist in its feeding. It utilizes a wide variety of invertebrate foods both aquatic and terrestrial depending upon availablity.

The Greenback trout spawns in flowing water in late spring or early summer, depending on water temperature, similar to other cutthroats. Nelson (1972) found that spawning reached its peak at Island Lake during the first two weeks of July. Bulkely (1959) reported spawning was observed on July 1 and completed by July 15 in Forest Canyon in Rocky Mountain National Park.

Greenback Characteristics

The distinguishing taxonomic characteristics of the Greenback trout are described in Behnke (1973b). In general, the spots on the body are large round or oblong and typically larger than other subspecies of cutthroat trout. The spots are generally absent on the head. Coloration

during breeding periods vary from dull brass to bright golden yellow with pink or red hues extending along the lateral line but not in a distinct band as in rainbow trout. Ventral region is cream to orange or red. The lower fins are often suffuse with orange or red. The cutthroat mark is usually crimson but sometimes is orange. To determine purity it is necessary to count scale, vertebrea and pyloric caeca as described by Behnke (1973b).

The Greenback trout readily hybridizes with other subspecies of Cutthroat trout and the Rainbow trout. It is not capable of competing with Brook trout.

The Greenback trout is susceptible to fishing pressure and the population can easily be over fished. (Behnke 1973a).

Present Management

1. Maintain barrier constructed in 1967 in Black Hollow Creek to prevent upstream migration of other trout.

2. Existing population are checked periodically to determine their status.

3. Areas are not closed to fishing.

4. Colorado Division of Wildlife are taking spawn from the Greenback trout in the Boulder watershed and are used for stocking in Rawah Lakes No. 3 and No. 4, and Brent and Snow Lakes.

Management Direction to Maintain Habitat and Populations

1. Develop coordinated management objectives and procedures with Rocky Mountain National Park, Bureau of Sport Fisheries, Colorado Division of Wildlife, and U.S. Forest Service.

2. Maintain surveillance of present Greenback trout populations and habitat.

3. Fully protect Greenback trout habitat when planning other resource uses or activities.

4. Discourage human activity in areas where Greenback trout are found thereby limiting the amount of fishing pressure exerted on the population.

5. Search for additional suitable waters which can be stocked with and can maintain populations of the Greenback trout as well as other possible sites where they may still be present.

6. Collect stream data information on existing fisheries.

7. Discourage introduction of trout other than Greenback in the Roaring Fork Creek drainage on the Redfeather District.

Action Plan

1. Maintain surveillance of populations checking for invasion of other trout species in Greenback trout habitat.

2. Determine need for closing area by Como Creek to camping and vehicular use to protect the Greenback trout.

3. Request fisheries biologist assistance to conduct biological and physical inventory of Black Hollow, Como, and Hourglass Creeks, and other appropriate creeks.

4. Initiate action to irradicate other species of trout in Greenback water as necessary.

5. Establish Greenback trout in additional water as found and agreed upon with the Colorado Division of Wildlife and other cooperating agencies using the present populations as sources for transplanting stock.

6. Distribute new releases concerning transplants of Greenback trout from National Forest streams when they occur.

A second, and no doubt last chance, to preserve

our unique native cutthroat forms?

James W. Mullan
Fishery Management Biologist
5/28/75

Park Service policy emphasizes restoration of native fauna, including the greenback cutthroat.

(2) The U. S. Forest Service controls most of the remaining high country land in the headwaters of the Arkansas and South Platte drainages and this agency's interest in the greenback cutthroat is consistent with various legislation mandating activities.

(3) The Colorado Division of Wildlife has a clear and sovereign trust to manage such resident fish species.

Basically, all three agencies have prepared functional recovery plans for their areas of interest and responsibility. These plans or reports are:

Mullan, James W. 1973. Consideration in perpetuation of greenback cutthroat trout (Salmo clarki stomias). Special Report, Fishery Management Program, Rocky Mountain National Park, USFWS, 26 p.

Wills, Dale L. 1974. Special management programs for rare and endangered species, greenback cutthroat trout, Salmo clarki stomias. U.S.F.S., 7 p.

Jones, R. A. 1974. Colorado research and management plan for the recovery of the greenback cutthroat trout, Salmo clarki stomias. Colo. Div. of Wildlife. p 38-49.

These reports, embodying serious prototype restoration efforts underway, could be melded into a single recovery plan to comply with "Guidelines for recovery plans and teams" as issued by the Office of Endangered Species September 25, 1974.

This would be an expeditious and perfunctionary course of action relative to the greenback. It would not constitute a single, effective,

efficient concentrated effort for all the cutthroat species, however, whose ultimate identification (due to comparative analysis), quantification as sport fish, and restoration are mutually related.

GOALS

Without clear goals, management action cannot be properly judged as to adequacy of performance. Although the Endangered Species Act of 1973 appears too broadly stated, it does develop a fairly clear mandate in respect to: "...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, ..." I can only interpret this to mean wild communities in natural habitat, with a synonymy existing between habitat and species; not a situation where the population is perpetuated indefinitely by artificial means, although it may be initially so established. Possible ambiquities in the act relate to the point or definition when a species and/or habitat is appropriately changed in classification from endangered to threatened or eliminated from either classification.

Specifically,.the purpose of the recovery plan and team is to prevent species extinction, and, if possible, to establish flourishing populations in wild habitat. The greatest incentive to this end rests ultimately in identifying the utilitarian value of such subspecies of trout in fisheries management, much as has been done with certain strains of brook trout in the East (Flack and Webster, 1974), and as recommended by Mullan (1973, 1974).

PROBLEMS

A problem as defined here is anything that prevents, reduces or threatens the realization of a recovery plan.

The great taxonomic variability existing in the subspecies of cutthroat trout, currently precluding absolute authoritative opinion on taxonomic diagnosis of some subspecies has been described by Behnke (1970 and 1972). Fortunately, due to the past efforts of Behnke (1973) in identifying and restoring remnant populations of pure greenback cutthroat trout, this recovery team can proceed with that subspecies. Unfortunately, if we are to take a broader, and in the end a more renumerative and logical course of action involving all the cutthroat subspecies, then it is essential to recognize that the unique expertiseness of Dr. Behnke in identification problems constitutes the first prerequisite of such an endeavor. Currently, we lack this needed comprehensive taxonomic capability.

As already implied, problems limiting the restoration of the greenback cutthroat have been mostly identified and acknowledged in the three recovery plans, which is generally not the case with the other cutthroat subspecies. How identification, quantification as sport fish, and restoration of all subspecies of cutthroat trout are mutually related is perhaps best illustrated by the current state of knowledge concerning the greenback.

STATE OF KNOWLEDGE (greenback)

I. Identity (covered by papers by Behnke and M. S. Thesis of Wernsman).

A. Taxonomy

(1) Definition - adequate

(2) Description - adequate

B. Nomenclature

(1) Valid scientific names - adequate

(2) Synonyms - adequate

(3) Standard common names, vernacular names - adequate

C. General variability

(1) Fragmentation (races, varieties, hybrids) - vague, but some knowledge, i.e., Pikes Peak hybrids.

(2) Genetic data (chromosome number, protein specificity) - some work in progress Ut. St. Univ.

II. Distribution

A. Delineation of the total area of distribution and ecological characterization of this area - fair knowledge of original range, high mountain areas of Arkansas and South Platte Rivers. Current distribution within that range: Forest Canyon of Big Thompson River, Caddis Lake, Hidden Valley Creek (these are all R.M.N. Park), various streams and lakes of Boulder City water supply, Black Hollow Creek, and Hourlass Creek. These are all relatively pure populations. Hybrid populations are known for city of Colorado Springs' water supply lakes on Pikes Peak (Arkansas River drainage) and Roaring Fork Creek. Forest Canyon greenback were successfully introduced into Florence Creek, Utah, in 1967, and this is only known introduction outside native range.

B. Distribution outside native range. Foregoing Utah introduction only one known. Adaptability of greenback for specific environmental conditions outside its native range, not known. Like many game fish species outside its natural range, the greenback cutthroat could have management advantages in certain of these waters if potential were identified and quantified.

C. Behavioristic and ecological determinants of the general limits of distribution and of the variations of these limits and of differential distribution. Hard data is lacking. Jones (1974)

and Wills (1974) both state that greenback cutthroat trout requirements for oxygen, temperature, and water quality are higher than for other trout, i.e., p.H. 6.5-8.5, maximum 10 JTV, etc. However, no reference(s) is provided to support such contention. Headwater areas, especially in Rocky Mountain Nat. Park, are characteristically soft with p.H. near neutral. The Utah introduction that led to establishment of a viable self-sustaining population in Florence Creek represents quite different water quality. P.H. (8.0-8.2), oxygen and water temperature are similar to that quoted, but conductivity (800-1,000 micromhos) is much higher as is turbidity. However, there can be little question that greenback are basically fish of oligotrophic waters and that shifts away from this standard have been associated with declines in population abundance, i.e., alteration and degradation of habitat.

Mullan (1973), based on inconclusive observations, speculates that greenback trout may have a greater cold tolerance and may spawn slightly earlier than other trout species. If so, this could represent a significant management advantage in high altitude lakes and streams.

III. Bionomics and Life History

A. Reproduction

(1) Maturity (age and size). Bulkley (1959) and Nelson 1972 have reported on one stream and one lake-stream ecosystem, respectively.

(2) Fecundity. Nelson's (op. cit.) and Bulkley's (op. cit.) data indicate that it is low.

(3) Spawning. Same as (1). Whether greenback will spawn in landlocked lakes with upwelling, etc., as brook trout do, needs to be determined.

(4) Egg. Nelson (op. cit.) gives egg size.

B. Larval history. Bulkley made observations of fry in streams. Nelson and Bulkley both suggest that scales may not be formed during the first year of life due to hatching in the late summer, so that scales lack first growth check.

C. Adult history

(1) Longevity. Average three to four years (five growing seasons) (Bulkley and Nelson, op. cit.). Limited specimens studied suggest maximum could be higher. Both populations examined essentially unexploited.

(2) Hardiness. Inference of available data suggest a very hardy species, however, whether this is more so than other salmonids remains to be demonstrated.

(3) Competitors. Apparently most other fish species, but particular brook trout. Brook trout were subsequently introduced into Florence Creek, Utah, following the successful establishment of greenback cutthroat. This mixed population is being followed to see how long it will take the brook trout to completely displace the greenback. Biological principle (Cole, 1954; Griffith, 1971) indicates the key mechanisms involved in this displacement are; earlier age of brook trout at first reproduction and earlier emergence from spawning gravel, assuring a size advantage.

(4) Predators. Apparently normal predators of all salmonids.

(5) Parasites and diseases. Not known.

(6) Greatest size - although known as a small fish less than 12 inches on average, so is the brook trout, which in given environments reaches a maximum of up to 14 pounds. Thus the greatest size attainable by the greenback is unknown.

D. Nutrition and growth

(1) Feeding (time, place, manner, season). Not much is documented, but it logically can be assumed that feeding is similar to other salmonids.

(2) Food. Evidently, and not surprisingly, an opportunistic feeder (Bulkley, 1959; Nelson, 1972).

(3) Relative and absolute growth patterns and rates. Bulkley (op. cit.) and Nelson (op. cit) provide limited data.

(4) Relation of growth to feeding, to other activities, and to environmental factors. Unknown.

E. Behavior

(1) Migration and local movements. Bulkley (op. cit.) suggests that greenback spawn within their home range in the headwaters of Forest Canyon where spawning gravel is abundant. However, there well could be downstream movement in fall to escape harsh winter conditions, with return in the spring, as demonstrated for other cutthroat subspecies. If so, this could explain the failure of the greenback introduction to the headwater of the North Fork of the Big Thompson River (Mullan, 1969 and 1970). While the cascade below the stream-lake complex stocked did not constitute a barrier to downstream movement, it was a barrier to upstream movement.

(2) Other behavior. Behavioral differences for greenback compared to other trout are virtually unknown. It is these differences, if any, which might fit into a management scheme in maximizing angling opportunity in a given situation, i.e., Rocky Mt. National Park.

IV. Population (stock)

A. Structure

(1) Sex ratio. Nelson (1972) provides only known data.

(2) Age Composition. Limited to Bulkley (1959) and Nelson (1972).

(3) Size composition. As in (2).

B. Size and Density

(1) Average size. Lake population 9.8-10.2", average 10", Nelson (1972); stream population, 9.0 inch average, Bulkley (1959); however, suspected hybrid greenback from lakes in Rocky Mt. National Park of much larger size have been reported by Mullan (1973).

(2) Changes in size. Aside from foregoing, there is little other information.

(3) Average density. Nelson reported between 5,000 (144.5 lbs/SA) and 10,000 (289.0 lbs/SA) spawning greenback from Island Lake (34.6 SA). This is a remarkably high standing crop considering the oligotrophic nature of the lake.

(4) Changes in density. Unknown.

C. Natality and recruitment

(1) Natality. Unknown. Suspected of being low, hence a desired characteristic in attaining lower population densities and larger individual fish in streams now occupied by heavy densities of brook trout of small size.

(2) Natality rates. Unknown.

D. Mortality, morbidity

(1) Rates of mortality. Unknown.

(2) Factors or conditions affecting mortality. Unknown.

(3) Factors or conditions affecting morbidity. Unknown.

(4) Relation of morbidity to mortality rates. Unknown.

E. Dynamics of population. Unknown.

F. Relation of population to community and ecosystem, biological production, etc. Unknown.

V. Exploitation

A. Fishing seasons, regulations, and results

(1) Effort and intensity. Unknown.

(2) Selectivity. Unknown.

(3) Catches. Unknown.

It has been theorized, based on other cutthroat subspecies, that greenback trout are susceptable to fishing pressure and a population can be easily overfished, and that special regulation, i.e., catch and release, will be required in management.

B. Management

(1) Propagation. Attempts at propagation (1960's) at the Leadville N. F. Hatchery failed due to unequal maturation between the sexes. The Colorado Division of Wildlife took about 30,000 eggs in the summer of 1974 from Island Lake and the young are being reared for establishment of additional populations (Jones, 1974). Similar propagation efforts with the Pikes Peak hybrid cutthroats by the state are routine.

(2) Restoration of habitat. This has been largely restricted to eliminating competitor fish species, especially the brook trout, using fish toxicants. The remote Fay Lake drainage (R.M.N. Park, a chain of three small lakes and 2.2 miles of stream, was treated with rotenone downstream to a 60-foot cascade in 1958 (Bulkley, 1959) to eliminate introduced Yellowstone cutthroat. Greenback cutthroat were successfully re-established in Caddis Lake, the lowermost lake in this chain of high elevation lakes. Black Hollow Creek, a small tributary to the Poudre River, was rehabilitated with rotenone for greenback in 1967. Hidden Valley Creek (4.7 miles, plus an extensive beaver pond complex), a tributary to the Fall River in R.M.N. Park, was treated with antimycin to eliminate brook trout. Preliminary monitoring in 1974 indicated elimination of brook trout and spawning of the introduced greenback.

CONCLUSION AND SUMMARY

Fairly obviously our knowledge concerning greenback cutthroat evolved sufficiently to permit rational recovery of the species. (1) Adequate remnant pure populations of seed stock have been identified for transplant programs, virtually eliminating the need for a propagation effort within the context of the Endangered Species Act of 1973, but not necessarily within the context of how the ecological and bahavioral differences of this subspecies of cutthroat fit into a management scheme to maximize angling opportunity. (2) Habitat on the East Slope of Rocky Mt. Nat. Park is virtually pristine for the species except as it has been usurped by the exotic brook trout. Under National Park policy this habitat is neither endangered or threatened. The major unresolved problem weighing on eventual restoration of the greenback in this habit is whether brook trout can be completely eliminated from selected and substantial drainage areas that will provide more than threshold wild population densities of the species.

Certainly, the greenback cutthroat is not an endangered species at this juncture in the sense that we are dealing with a few basket cases. Exactly what would be the minimum requirement beyond threshold abundance so as to delete it from the threatened category may be a matter of some differences of opinion. Certainly, restoration to the Fall River drainge, which makes up 11% of the land mass within the Park and consists of 43.8 miles of stream and 14 lakes (130.3 surface acres), involving upward of 100,000 individual wild fish, represents a possible such goal at this time. Such a restoration is tentatively planned pending the success of the various prototype restorations.

Ultimate restoration rests with identifying and quantifying possible values of the greenback, i.e., greater cold tolerance, lower reproductive potential compared to brook trout, ability to grow to relatively large size in extremely limited stream habitat, etc., and being able to completely eliminate competing salmonid species, especially brook trout. Fortunately, the fish toxicant antimycin, due to extreme toxicity to salmonids in soft, low p.H. waters, offers the promise of a highly effective tool in accomplishing this goal. However, these possiblities and promises can only be reconciled with pragmatic technology through on-going prototype doing and monitoring.

And, the same is true relative to all the other cutthroat subspecies that are endangered and trheatened, i.e., the Colorado River cutthroat for the West Slope of Rocky Mountain National Park. However, the taxonomic status of these other subspecies of cutthroat have, in most cases, not been

sufficiently resolved to allow for a valid action program at this time. And, this group does not have the capability to do the job without Dr. Behnke.

Thus it is recommended that this recovery team give consideration as to how we might retain the services of Dr. Behnke and implement a single, effective concentrated effort for all the cutthroat subspecies that are endangered or threatened. Due to fortuitous circumstances, we are having a second chance relative to the unique native cutthroat forms, many of which were believed extinct up until recently. The past is admittedly only prologue to the future, but it shouldn't be overlooked that we wouldn't be sitting here today considering a recovery plan for the greenback cutthroat unless Dr. Behnke had not given consideration to the cutthroat trout as a group in the past.

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Nelson, W.C. - 1972 - An unexploited population of Greenback trout, Paper presented at 1972 annual meeting Colorado-Wyoming A.F.S. Chapter. Mimographed 13 page.

Stonica

- ~~Sept~~, Aug 27-31 - Mullen helicoptered into isolated barren stream stocked w/ Como Ck. fish in 1970(?) - no sign of any fish.

- Hidden Valley to be treated w/ antimycin wk. of Sept. 10. Como Ck. greenbacks planned introd. - Oct. 15 -

1982 Greenback Cutthroat Trout Recovery Program - Arapaho and Roosevelt National Forests, Colorado

Robert J. Stuber, USDA Forest Service,
Arapaho and Roosevelt National Forests,
Fort Collins, Colorado
(Colorado-Wyoming Chapter)

ABSTRACT

Approximately 20 percent of the historic range of the threatened greenback cutthroat trout (Salmo clarki stomias) lies within Arapaho and Roosevelt National Forests. 1982 recovery efforts included monitoring one of the few remaining naturally occurring populations and its habitat, preparing stream habitat for reintroductions, and actual reintroductions into streams on the Forests.

The greenback cutthroat trout population in the 3.0 miles of occupied habitat at Como Creek appears to be stable. Measures have been proposed to protect and enhance this habitat. Non-native trout were removed from 12.0 miles of George and Cornelius Creeks, and a barrier to repopulation by non-native species was installed. Greenback fry will be reintroduced in 1983. Approximately 20,000 greenback fry were reintroduced into 20 miles of stream habitat (five streams) on the Forests during 1982.

INTRODUCTION

Historically, the greenback cutthroat trout was the only trout native to the South Platte and Arkansas River drainages, with the exception of the now extinct yellowfin cutthroat trout in Twin Lakes, Colorado. It's biology and ecology have been described by Behnke and Zarn (1976) and Behnke (1979). This endemic trout was classified as endangered in 1973 with the passage of the Endangered Species Act. Major reasons for its decline were over-exploitation, and competition and/or hybridization with introduced non-native trout. Recovery progress made during the 1970's led to a downlisting to a threatened status in 1978 (Greenback Cutthroat Trout Recovery Team 1982).

Approximately 20 percent of the historic range of the greenback cutthroat trout lies within Arapaho and Roosevelt National Forests (Figure 1). These Forests are only in the South Platte River portion of the historic range. The following information is a summary of the 1982 recovery efforts on these Forests. All the recovery activities have been a cooperative effort by the U. S. Fish and Wildlife Service, National Park Service, Colorado Division of Wildlife, and Forest Service.

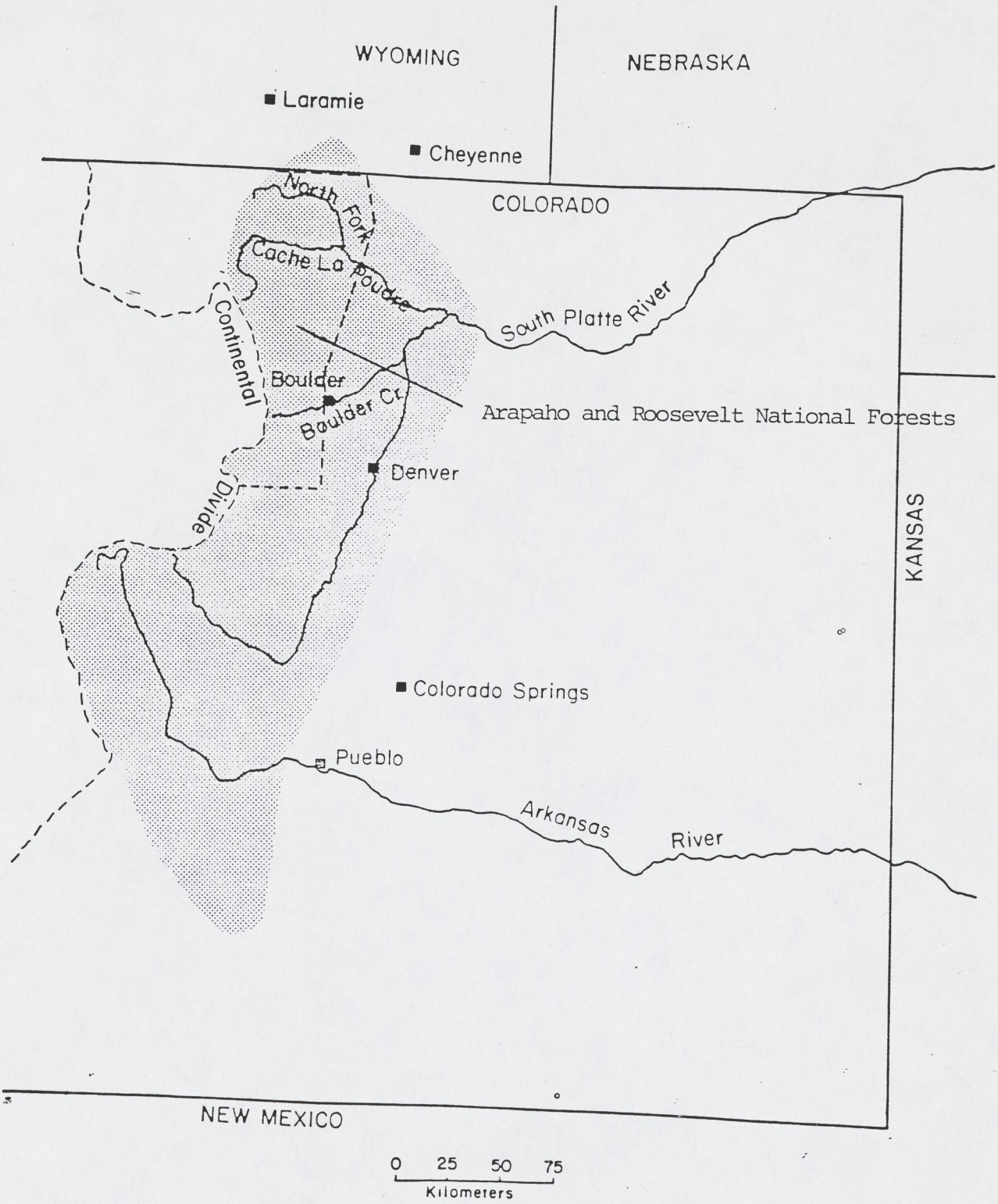

Figure 1. Historic distribution of the greenback cutthroat trout, Salmo clarki stomias (adapted from Behnke and Zarn 1976).

MONITORING EXISTING POPULATIONS

One of the tasks of the Greenback Cutthroat Trout Recovery Plan is to monitor known populations and their habitat (Greenback Cutthroat Recovery Team 1977; 1982). In 1969, one of the few remaining populations was discovered in Como Creek, a tributary to North Boulder Creek. It is a small stream with an average width of approximately 6 feet (2 m), and an average low flow of 2-3 cfs. Approximately 3.0 miles (4.8 km) of stream are inhabited by greenback cutthroat trout. A series of downstream waterfalls acts as a barrier to the upstream movement of non-native trout to that stream section occupied by greenbacks. It is felt that early settlers transplanted the greenback cutthroat trout above the barrier (R. J. Behnke, personal communication). The Colorado Division of Wildlife has established a fishing closure to protect this population. A population and habitat survey was conducted on September 7-9, 1982.

Methods. Five 100-m sections were sampled. Fish were captured with a backpack eletrofishing unit. Habitat preferences (pool versus riffle/run areas) were determined by placing a block net at both ends of each habitat type. Actual habitat characteristics (percent pools, instream cover, etc.) were measured on a transect basis.

Results. A total of 178 greenback cutthroat trout were captured (Table 1). Standing crop was estimated to be 36.8 lb./acre (41.2 kg/ha). The number present in the entire 3.0 miles of habitable stream was estimated to be 1,800. In addition, numerous young-of-the-year (YOY) were captured, which was an indication that reproduction had occurred in 1982.

Pools comprised approximately 40 percent of the stream area, whereas riffle/run areas comprised 60 percent. Greenback cutthroat trout displayed a preference for pool areas, as over twice as many (122 versus 56) were captured in this habitat type (Table 2). This habitat preference was further substantiated by testing the hypothesis that fish were randomly distributed (i.e., 40 percent should be expected in the pool areas, 60 percent in the riffle/run areas). It was demonstrated from a chi-square test that the observed distribution was significantly different than the expected distribution ($X^2 = 28.83$, $P<0.001$). Also, fish captured in pool areas were larger than those from riffle/run areas, as there was a significant difference between the respective mean lengths and weights (1.0 percent level of significance, $P=0.001$).

Recommendations. Two recommendations have been proposed based on the results of the 1982 survey. First, install approximately 8-10 log check dams (overpours) in one of the sampling stations where quality pool areas are lacking. The purpose would be to increase the amount and quality of pools. If the population exhibits a positive response (i.e., increased biomass, larger fish, etc.), more structures would be placed in other stream sections where there is a lack of quality pools. Second, the area would be managed to ensure the long-term protection of the habitat. Unimproved access roads into the Como Creek area would be closed to general vehicular traffic, as there are presently a number of stream crossings where habitat degradation has occurred. Also, a withdrawal from any future mineral entry in the Como Creek watershed would be requested.

Table 1. Numbers, size, and standing crop estimates of greenback cutthroat trout captured at Como Creek, September 7-9, 1982.

Station	Number Captured		Average length (mm) [a]	Average weight (g) [a]	Standing crop (kg/ha)	
	Total No.	No.>150mm			All Trout	Trout>150mm
One	40	12	117 (38-236)	41 (9-141)	40.3	32.9
Two	38	8	117 (71-193)	32 (18-86)	24.9	21.5
Three	42	15	126 (69-241)	36 (5-163)	60.6	49.9
Four	57	15	127 (64-211)	27 (9-109)	65.9	38.0
Five	1	0	147	27	1.5	0
Combined Data	178	50	126 (38-241)	36 (5-163)	41.2	28.3

[a] figure in parenthesis is range

Table 2. Number and size of greenback cutthroat trout captured in each habitat type at Como Creek, September 7-9, 1982.

Sta.	Pool Areas				Riffle/Run Areas			
	Amount of Area (%)	No. fish	Avg. length (mm)	Avg. weight (g)	Amt. of area(%)	No. fish	Avg. length (mm)	Avg. weight (g)
One	40	24	130	45	60	16	96	32
Two	46	22	119	41	54	16	109	23
Three	31	24	145	50	69	18	109	18
Four	47	51	127	32	53	6	119	18
Five	50	1	147	32	50	0	-	-
Combined Data	42	122	130	32	58	56	107	23

ESTABLISHING NEW POPULATIONS

Preparing Habitat For Reintroductions. Another task of the Recovery Plan is to reintroduce greenback cutthroat trout into suitable habitats throughout the historic range. The first step in this process is to identify and survey potential habitat. Once a candidate water has been selected, the habitat must be prepared for the actual reintroduction. Often the candidate water has an existing population of non-native trout. Two problems must then be overcome: (1) removal of the non-native trout population; and (2) prevention of repopulation by the non-native trout. This sequence is reversed in the actual habitat preparation. First, a barrier to reinvasion must be created. One common technique is to install a structure which forms an impassable waterfall. Another innovative method described by Rinne and Stefferud (1982) for the reintroduction of the endangered Gila trout (Salmo gilae) is to blast a vertical notch in the bedrock of a steep section of stream to create the impassable waterfall. This technique may be especially appropriate for reintroductions into streams within Wilderness Areas where the use of mechanized equipment is strongly discouraged. The second step of the sequence is to remove the non-native trout, usually by chemical treatment (i.e., rotenone, antimycin).

George and Cornelius Creeks, two small streams in the North Fork of the Cache la Poudre River drainage were selected as reintroduction sites in 1981. Cornelius Creek is a tributary to George Creek. Brook trout were present in both streams. Approximately 12 miles of stream were deemed to be suitable habitat for greenback cutthroat trout.

A rock-filled gabion barrier was constructed in July of 1981. Native rock was used to fill the gabion wire baskets. It is located in a narrow canyon section of George Creek, below the confluence with Cornelius Creek. It creates a 4-5 foot waterfall. The barrier has withstood spring runoff conditions during 1982 and 1983. The only required maintenance has been occasional debris removal.

Brook trout were removed by treating the 12.0 miles of stream above the barrier with rotenone in July of 1982 (low flow period). The applied dosage was 3.0 ppm. Rotenone was dispensed using six drip stations. In addition, shallow weedy areas and beaver ponds were treated using a backpack spray unit to ensure a complete removal. Caged live brook trout were placed immediately above each drip station to monitor the effectiveness of the next upstream drip station. The effects of the rotenone were limited to the area designated for treatment by introducing potassium permanganate ($KMnO^4$) immediately below the gabion barrier, which effectively neutralized the rotenone. The treatment was judged to be successful in terms of eliminating all of the brook trout above the barrier. Approximately 10,000 greenback cutthroat trout fry will be reintroduced in 1983.

Actual Reintroductions. Five streams on the Arapaho and Roosevelt National Forests were stocked with greenback cutthroat trout fry in 1982. A total of 19,600 fry were introduced into approximately 19.0 miles (30.4 km) of stream. Fry came from the U. S. Fish and Wildlife Service Fish Cultural Development

Center in Bozeman, Montana. Broodstock for this hatchery source were originally obtained from Como Creek in 1977. Also milt taken from wild males in Hidden Valley Creek, a greenback stream in Rocky Mountain National Park, has been used in recent years to maintain the "wildness" of this hatchery source.

Stocking was conducted in September. The weight of fry at stocking was 500 per pound (230 per kg.). Average length was approximately 1.5 in. (40 mm).

All five streams have natural gradient barriers. Some of the streams had non-native trout populations which had been introduced at some time in the past above the barriers. The fish were removed prior to the stocking of greenback cutthroat trout. A summary of streams stocked is listed in Table 3, along with drainage, historic fish population data, number of fry stocked, and miles stocked, respectively.

Table 3. Summary of greenback cutthroat trout stocking in streams in Arapaho and Roosevelt National Forests during 1982.

Stream	Drainage	Prior Fish Population	Number Stocked	Miles of Habitable Stream
Bard Creek	Clear Creek	Barren	6,900	6.5
Hourglass Creek	South Fork Cache la Poudre River	Barren	1,500	1.5
May Creek	Cache la Poudre River	Brook trout removed in 1981	2,000	2.0
Sheep Creek	Cache la Poudre River	Rainbow trout removed in 1981	7,200	7.0
Williams Gulch	Cache la Poudre River	Barren	2,000	2.0

All introduced populations will be monitored and protected. Fry will be stocked in subsequent years, whenever possible, to establish multiple age class populations. Fishing may be allowed on a limited basis (i.e., catch and release) once the Greenback Cutthroat Trout Recovery Team deems that a viable population has been established.

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

IN REPLY REFER TO:

January 16, 1981

Greenback Cutthroat Trout
Recovery Team Members and Cooperators

Subject: Status and Future Plans for the Greenback Cutthroat Trout Broodstock. Part B. Job 9, Greenback Cutthroat Trout Recovery Plan

Dear Team Members and Cooperators:

In 1977, a need was recognized for the establishment of a hatchery broodstock of greenback cutthroat trout based upon the pure population found in Como Creek. The goal of the broodstock program was to determine if pure greenbacks could be reared in a hatchery, and to hopefully provide large numbers of fry for some renovation projects in the early 1980's. Historically, all greenback renovation projects had been restocked with 40-80 greenbacks from Como Creek. Although the stocking of small numbers of greenbacks is successful in establishing new populations (North Fork Big Thompson and Hidden Valley Creek), the almost 10 years required to allow the population to establish itself to where they can be fished as a wild trout fisheries was found to be a major problem when attempting to acquire good fisheries habitat for future renovation projects. The ability to restock waters with greenback fry for 1 to 3 years following renovation was seen as a way of establishing wild trout fisheries within 4 to 5 years.

The long term goal of the broodstock program was not to develop a hatchery adapted strain of pure greenbacks. However, it was recognized that if a disease free, hatchery adapted source of pure greenbacks was developed that they could possibly be used instead of non-native cutthroats for routine fisheries management within the South Platte drainage. It was anticipated that a wild lake/stream run of pure greenbacks would be developed for the long term need for greenback eggs. Unfortunately, the founding of an easily accessible lake/stream run of greenbacks presently appears no closer to reality than four years ago.

On the positive side, the establishment of a hatchery broodstock now appears to be a success. Approximately 900 pure greenbacks, now 3 inches in length, are being held at the USFWS Fish Cultural Development Center (FCDC) in Bozeman, Montana for stocking into renovated waters in 1981. In addition, 260 pure greenbacks from the egg take in 1979, are now 8 to 9 inches in length and are being held as the source of a large number of eggs starting in 1982.

At this time I would like to discuss the following 3 topics concerning the greenback broodstock program and call for your input as to the proposed actions and the future of the program:

1. Present Status of the Como Creek Greenback Broodstock at the Fish Cultural Development Center.

2. Establishment of a greenback broodstock at the Saratoga National Fish Hatchery.

3. Stocking of the greenbacks now held at the FCDC in 1981 and future years.

Status of the Greenback Broodstock

In review, 66 greenbacks were transferred from Como Creek to the FCDC at Bozeman, Montana on October 26, 1977. The first spawn in 1978 was not very successful due to asnychrony of the males and females. Twelve greenbacks from the 1978 spawn have survived to January 1981. These 12 greenbacks still remain at the FCDC, and are anticipated to be ready to spawn in the spring of 1981.

In 1979, both sexes ripened in a similar time period, allowing for a more successful spawn than the previous year. Presently, 260 greenbacks 8 to 9 inches in length remain at the FCDC from the 1979 spawn. These 260 fish are being held as an anticipated source of approximately 10,000 eggs in 1982, and approximately 35,000 eggs in 1983.

1980 was a good year, with the original Como Creek fish producing the best spawn to date. Presently, 900 greenbacks, 3 inches in length, are being held at the FCDC for stocking as 4 to 5 inch fish into Sheep Creek and Bear Lake during June, 1981.

In 1981, there will only be about 20 fish available for spawning - 8 of the original Como Creek greenbacks and 12 greenbacks from the 1978 spawn. The first priority for eggs obtained in 1981 will be fry for Ouzel Lake. However, depending upon the amount of eggs actually taken, some eyed eggs may also be shipped to Bear Lake and the Saratoga NFH.

From 1982 to 1985, 10,000 to 35,000 eggs should be available. Some tentative stocking plans for this time period have already been made. However, input is requested from program managers who may have future programs requiring greenback eggs or fry. Future maintenance of a hatchery broodstock will be based upon needs by management.

Establishment of a Greenback Broodstock at the Saratoga National Fish Hatchery, Saratoga, Wyoming

The NFH at Saratoga, Wyoming, has served as a trout broodstock hatchery for the many years. Due to a disease outbreak (enteric redmouth) in 1980, the

broodstock was removed and the hatchery was disinfected. Since the hatchery has a closed water supply, the chances for eliminating the disease and for the hatchery to remain disease-free are good.

The future mission of the Saratoga NFH is primarily to be a source of eggs from unique trout species. Included in this group of unique species would be the greenback cutthroat, with eggs to start the Saratoga program coming from the FCDC. Although advantages could be realized from this move, disease problems for the Fish and Wildlife Service could arise.

Advantages of moving the programs to Saratoga would be:

1. A closer short term source of greenbacks for establishing wild populations beginning in 1984 or 1985.

2. A closer long term source of pure greenbacks for management work in the South Platte drainage.

3. Free space and time at the FCDC for other development work.

Problems:

1. Kidney Disease. In 1979, kidney disease was found in one of the experimental groups of trout at the FCDC. Greenbacks have always been held seperately from other experimental trout at the FCDC, with all greenback mortality examined for obligate salmonid diseases. To date, no obligate salmonid diseases have been isolated from any greenbacks at the FCDC.

2. Disease Classifications. Mr. Paul Janeke of the Fish Disease Control Center feels that under present USFWS fish disease classification, movement of eggs from the FCDC to the Saratoga NFH would require Washington office approval and a parenthetical kidney disease classification for Saratoga.

Assuming that a parenthetical kidney disease classification is acceptable at Saratoga, Mr. Janeke suggested the following procedure to prepare for a transfer from the FCDC to Saratoga.

1. Continue monitoring of FCDC greenback mortality,

2. Examine all FCDC greenback broodstock by fecal sampling method in 1981.

3. All eggs - only eggs will be considered for transfer - will be water hardened in Erythromycin.

4. If tests are negative, some eggs could be considered for shipment in 1981. However, the bulk of eggs would probably come in 1982.

A Section 7 will have to be prepared by the U. S. Fish and Wildlife Service for this move.

As for the future of the broodstock program at the FCDC, it should not be disposed of until it is proven that fertilized eggs can be obtained from Saratoga. Failures of a greenback program at the Leadville NFH in the 1800's and 1950's seems to indicate that all hatchery environments are not conducive to greenback spawning success.

Stocking Plan, 1981

Bear Lake and Sheep Creek, June 1981.

1. Stocking rate. Approximately 450 to Sheep Creek and 450 to Bear Lake. Greenbacks will be 4 to 5 inches in length.

2. Procedure. In mid-June, greenbacks will be transported by the FCDC to Estes Park. DOW could pick up greenbacks for Sheep Creek at Estes Park. Expenses for the tranportation by the FCDC ($600) will be paid for by Colorado Fisheries Assistance.

3. Permits. Section 7 will be needed for both Bear Lake and Sheep Creek. NSP and DOW should make requests to Area Manager, USFWS, Salt Lake City, Utah.

Ouzel Lake and Creek, September, 1981

1. Stocking rate. Approximately 1,000 fry.

2. Procedure. Ship fry via air freight, Bozeman to Denver.

3. Permits. Section 7 to be requested by NPS.

If the 1981 greenback egg production is in excess of the 1981 Ouzel Lake needs, the following two projects should also be considered in 1981. If eggs are not available in 1981, projects to be completed in 1982.

Bear Lake, July 1981

1. Stocking rate. 300 eyed eggs in outlet stream.

2. Procedure. When eyed eggs are available, incubate and hatch eggs in outlet stream in an attempt to bio-engineer a lake outlet spawning greenback population.

3. Permits. Section 7 request by NPS should leave date open for 1981 and 1982.

Saratoga NFH, July 1981

If the disease classification is resolved, 500 eyed eggs could be shipped in 1981. Majority of eggs would come in 1982.

Tentative stocking for 1982 to 1984 is shown on the enclosed schedule. Particularly for 1983 and beyond, input is needed from Team Members, Agencies, and Fisheries Managers if they foresee a need for greenbacks in their management plans for the future. Possibly, future discussion of the broodstock program should be held at the next team meeting.

Tentative stocking schedule based upon projects completed by Rocky Mountain National Park and requests from Ted Washington, DOW.

Bruce D. Rosenlund
U. S. Fish and Wildlife Service
Colorado Fisheries Assistance

Enclosure

cc: Area Manager, SLC
FCDC
FDCC
Robin Knox
Dave Langlois
Dave Stevens
Richard Moore
Jack Larmoyeux
Eddie Kochman
Ted Washington
Dr. Behnke
R. O. HFR
R. O., End Sp.
Saratoga NFH
Vi Solt

BDR:CFO:fw

Tentative Greenback Stocking Schedule

Area	1981	1982	1983	1984	1985
Bear Lake	450 @ 5"				
Sheep Creek*	450 @ 5"				
Bear Lake Outlet	300 eyed eggs	500 eyed eggs			
Ouzel Lake & Creek	1000 fry	3000 fry	5000 fry		
Saratoga NFH	500 eyed eggs	2500 eyed eggs			
West Creek, below falls		1000 fry	2500 fry	2500 fry	
George Creek*	)				
Cornelius Creek*	)	1500?	2500 fry?	??	
Little Beaver Creek*	)				
Williams Gulch*			Stock if available		
East Fork*			Stock if available		
May Creek*	??				
Fern Lake			5000?	5000?	
* = DOW projects					

Actual numbers stocked subject to change, depending upon program needs and fish available.

PROPOSAL TO
SPORT FISHERY RESEARCH FOUNDATION

A SPORT FISH FOR HIGH-ALTITUDE COLD WATERS:

THE ECOLOGY AND TAXONOMY OF THE GREENBACK CUTTHROAT TROUT

Submitted by
Colorado Cooperative Fishery Unit

August, 1963

TITLE

A Sport Fish For High-Altitude Cold Waters: The Ecology and Taxonomy of the Greenback Cutthroat Trout

ABSTRACT

This project proposes to explore the existence of a more desirable sport fish that will thrive, yet not stunt, in high-altitude cold waters. The native greenback cutthroat trout of the upper Arkansas and Platte River drainages was chosen as the most likely fish. The environmental requirements, taxonomic relationships, zoogeographic position, and preliminary life-history data are to be analyzed.

BACKGROUND INFORMATION

A population can become only as large as available food or other limiting factors will maintain. The measuring criteria in a fish population is total pounds, not size of the individual. Therefore, many populations of fishes tend to stunt, that is, to be composed of a large number of small, mature individuals. Throughout the Rocky Mountain states, stunting is a major fishery management problem. These states contain thousands of miles of streams located at an elevation of 6,000 to 12,000 feet: streams that are typically small, have cool water temperatures, and short growing seasons.

During the early part of the century, nearly all the more accessible streams were stocked with brook trout; later cutthroat trout have been used to a lesser extent. Both fishes have shown strong tendencies toward stunting. Thus, a large potential fishery is remaining under-utilized because many fishermen do not appreciate catching 6 to 8 inch, undernourished fishes.

The inability of hatchery cutthroat trout to perform suitably in these streams may arise from a misadapted genetic stock. Almost all hatchery strains of cutthroat trout originated from lake-dwelling populations. The potamodromous behavior and physiological adaptation of cutthroat trout in Yellowstone Lake are vastly different from the behavior and adaptation required for optimum survival in a small mountain stream.

THE PROPOSED STUDY

The greenback cutthroat trout is the native trout of the upper Arkansas and Platte Rivers. As the native species in these high-altitude headwater streams, it was adapted to the small-stream, coldwater habitat. It is questionable whether the greenback cutthroat trout is still extant. Man-caused habitat change, hybridization with introduced strains of cutthroat trout, competition with exotic brook and brown trouts, and long-term climatic change have influenced the decline. However, it is likely that somewhere within its original range, relict populations exist. If a relict population can be found, it may be possible to propagate a strain that would be more desirable for use in waters now occupied by stunted brook trout.

After reviewing previous studies, searching stocking records, and interviewing early settlers, isolated populations of cutthroat trout in three major drainages -- the Arkansas, the South Platte, and the Cache la Poudre -- have been chosen for further investigation. Five populations of cutthroat trout that preliminary studies indicate are most likely to be greenback cutthroat trout have been selected.

THEORETICAL BASIS OF THE PROPOSED STUDY

Through natural selection each population has evolved to fit a particular natural environment. Plastic species with a wide phenotypic range, as the Salmonidae, afford a large, varied gene pool from which highly adapted species can evolve. Within the broad gene pool of the species complex of cutthroat trout, it seems plausible that those fishes occupying the upper Arkansas and Platte Rivers (a region of almost no natural lakes) may have been selectively adapted for an environment of small, cold streams.

It is common for small, disjunct populations to linger within the once wide range of a species. Headwaters above barriers, tributaries that are dry in the lower reaches, and isolated streams or spring areas of optimum habitat frequently provide refuge.

APPROACHES TO THE PROPOSED STUDY

1. Obtain an accurate description of what has been named and described as the greenback cutthroat trout.

2. Collect approximately 50 fish from each population for taxonomic and life-history data.

3. Compile preliminary life-history data as age, growth rate, age of maturity, fecundity, etc.

4. Study and measure unique environmental conditions of the five populations.

5. Study species composition and community relationships of the greenback cutthroat trout community.

6. Analyze past distribution and zoogeographic position.

7. Make morphometric counts and measurements to determine taxonomic relationships with previous descriptions and to determine if identifying characteristic are apparent.

The foregoing will provide a body of base knowledge about the five selected populations that can be compared to existing information on cutthroat trout. A conclusion can then be reached whether any of the study populations are greenback cutthroat trout; or if not, it can be concluded that this strain of cutthroat trout is probably no longer extant.

RESOURCES REQUIRED

Time: August 1, 1963, to December 31, 1964. The graduate assistant will work almost full time on this project. He has completed 30 hours of university course work towards a degree.

Manpower: Supervision -- Robert E. Vincent, Unit Leader, Major Professor
Howard A. Tanner, Colorado Game, Fish and Parks
Graduate Assistant -- William H. Dieffenbach, M.S. degree student.

Equipment: The necessary vehicles, collecting equipment, and laboratory equipment will be furnished by the Colorado Cooperative Fishery Unit.

BIOGRAPHICAL DATA OF WILLIAM H. DIEFFENBACH

Personal: Born - July 16, 1936. Jersey City, New Jersey.
Married - one child.
Has lived in Colorado since 1956.
Present address - 500 E. Magnolia, Fort Collins, Colorado.

Education: Secondary, W. L. Dickinson High School, Jersey City, New Jersey. 1955.
Bachelor of Science of Fishery Science, Colorado State University, 1961.

Education: (continued)

Enrolled September 1962, as a Master of Science student. Grades (A equals 4) accumulative average, undergraduate, 2.7, 30 hours of graduate work, 3.4.

Employment: Summers of 1960 and 1961 - Field assistant, Colorado Game, Fish and Parks Department. Assisted graduate students on the following projects: Verticle Distribution of Fishes in a Fluctuating Reservoir, Age, Growth, and Reproduction of the Splake Trout, and Reproduction of Cutthroat Trout of Trappers Lake, Colorado.

Fall and Winter of 1960 and 1961, part-time, care and repair of Unit equipment.

Hobbies: Fishing, bird hunting, rearing tropical fishes.

Honors and Societies: American Fisheries Society

Xi Sigma Pi (Forestry Honorary)

Supplement

A Sport Fish for High-Altitude Cold Waters:
The Ecology and Taxonomy of the Greenback Cutthroat Trout.

Estimated Project Costs

First Year

Fellowship: Annual Stipend		$ 2800.00	
Equipment:			
Jars and preservative	120.00		
Electrofishing gear			
Back-pack portable shocker	350.00		
Stereozoom microscope & illuminator	500.00		
Disecting kit, calibers, etc.	15.00		
Scales	5.00		
Camp gear: tent, tarp, stove			
cook kit, etc.	100.00		
Waders: 1 pair	20.00	1110.00	
Labor:			
Undergraduate student to assist mounting and preparing scales 100 hours @ $1.25		125.00	
Mileage: 5000 miles @.07		350.00	
Photocopying:			
Rare documents and papers		100.00	
Miscellaneous supplies:			
Maps, plastic sacks, thermometers, scale envelopes, etc.		100.00	$4585.00
Contingency: Ten Percent		458.00	
		TOTAL	$5043.00

Second Year

Fellowship:		
Five months @ $234.00	$1170.00	
Labor:		
Undergraduate student to assist in mounting and preparing scales 100 hours @ $1.25	125.00	
Mileage:		
5000 miles @.07	350.00	
Miscellaneous supplies:	100.00	$1745.00
Contingency: Ten Percent	174.00	
	TOTAL	$1919.00
	PROJECT TOTAL	$6962.00

Bill Dieffenbach

Title: Ecology and Zoogeography of the Greenback Cutthroat Trout.

Problem: The greenback cutthroat trout (Salmo clarki stomias) Cope, 1870, is believed to be the native trout of the Upper Platte and Arkansas River drainages. As the native species of the high altitude streams, the greenback must be well adapted to the cold water stream habitat. Introduction of brook trout (Salvelinus fontinalis) and the addition of other cutthroat trout species to the habitat of the greenback has reduced the greenback's distribution. The brook trout and the lake dwelling cutthroat group are not well adapted to the cold water streams in which the greenback subspecies has developed. The addition of these unfit species ø has resulted in many stunted brook and cutthroat populations in our streams.

Studies of varying intensity and duration have attempted to find a pure strain of greenback trout. Conclusions to date are that if a greenback trout does exist as a subspecies

it must be in the high tributary streams where it is protected from hybridization and the inroads of civilization. This study will use data from past studies, stocking records, collection reports, and personal viewpoints of earlier writers to select a few headwater streams for field study. In the selected areas cutthroat trout will be studied to determine if there is a strain of cutthroat trout which has the characteristics of the greenback as described by Cope 1870, and differing significantly from the other subspecies of cutthroat (Salmo clarki) to warrant identification as greenback cutthroat trout (Salmo clarki stomias).

If the greenback can be verified as a distinct subspecies it will be adventgeous to renovate stunted brook and cutthroat populations and re-establish the native greenback in the cold water high altitude streams.

Objectives:

1. To obtain an accurate description of what has been named the greenback cutthroat trout.

2. To select areas of study that are likely to contain pure greenback cutthroat trout.

3. Study life history, environment and distribution of the greenback trout.

4. Study species composition and general condition of populations as a indication of species interaction.

5. Analysis of past distribution and taxonomic position of the greenback and hypothisize present condition in relation to the past.

6. Draw conclusions from the search of the literature and field study wheather the greenback can be found in pure strain.

7. Determine if the greenback is the fish adapted, through its ecologic history, for high altitude cold water streams.

Problem analysis:

A. To be answered

1. Original and subsequent description of the greenback.

2. Life history of the greenback.

3. Morphometry of the greenback.

4.

5.

B. Not to be answered.

1. Areas of present distribution.

2. Food habits

3. Intraspecies relationships in the cutthroat species (Salmo clarki).

4. Effects of exploitation on mixed populations, ie. cutthroat-brook.

5. Environmental selection, stream or lake.

6.
7.

Delimitations:

1. The study will be limited to the field seasons of 1963 and 1964.

2. The study will be limited to selected areas in which trout populations are believed to be pure strain greenback cutthroat trout.

3. Collection of study specimens will be made in stream

and beaver pond habitat.

4.

5.

Outline:

A. History

1. Past and present distribution

2. Stocking records of study areas

B. Characteristics

1. Historic

C. Anatomical measurements

D. Habitat classification

1. Geologic

2. Man caused

a. Enviornmental changes

b. Biological change

E. Ecology

1. Life history

Resources Required:

A. Time and timetable

Fieldwork - 1963 3 months @ 30 days/month

1964 4 " " " "

210 days field work

Anatomical measurements and other data will be obtained during the fall and winter of 1963 and 1964.

B. Manpower

Graduate Assistant - 18 months

C. Equipment

House trailer	10% per year	1963	$400.00
		1964	360.00
Vehicle @	$0.07 per mile	(10,000 miles)	700.00
Field equipment			1200.00
Laboratory equipment			250.00
Salary (18 months)			4090.00
Total			$ 7000.00

Table . -- Salmo clarkii stomias

Sample and Date of Collection	Gillrakers			Vertebrae			Basibranchial Teeth			Scales Lateral Series			Scales Above Lateral Line		
	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean
SOUTH PLATTE SYSTEM															
Moraine Park Colorado - 1889	1	19		1	59		1	~~absent~~ 0		1	195		1	44	
Bear Creek, Morrison, Colorado - 1889	4	16-20	18.3	4	62-63	62.5	1 3	~~1~~ 1 tooth ~~3~~ 0 teeth					4	41-44	42.7
Pingaree Park Colorado - 1932	2	18-20					2	1-6		2	196-213		2	47-48	
Albion Creek, Boulder Co. Colorado - 1955	9	18-22	19.4	9	59-61	60.1	7	1-23	6.9	9	178-205	191.2	9	44-51	47.2
Big Thompson River, Rocky Mtn Nat. Park Colorado - 1959	20	18-21	19.1	20	59-62	60.8	19 1	1-10 (1) - 0 teeth	7.1	19	177-215	199.8	11	43-51	47.5
NORTH PLATTE															
Red Canyon, Jackson Co., Colorado - 1950	20	18-22	19.6	20	59-61	59.9	~~20~~ 15 5	1-13 (5) - 0 teeth	4.2	20	172-194	184.5	20	40-49	44.0
ARKANSAS SYSTEM															
Arkansas R., Leadville Colorado - 1889	2	21-22		4	60-62	61.0	2	2-12		2	198-213		2	46-49	
Twin Lakes, Leadville Colorado - 1889	8	18-20	19.5	7	61-62	61.7	8	6-14	10.6	7	170-202	186.9	7	46-53	49.0

Univ. Kansas Publ. Mus. Nat. Hist.
vol. 17(3):23-189. Artie L. Metcalf. 1966.

Univ. Kansas
Lawrence

Fishes of the Kansas River System in relation to Zoogeography of the Great Plains.

- Species probably not occurring in the Kansas R. basin.

- Several doubtful records by Cope ('64, '65, '71) based on coll. of Dr. W. A. Hammond a surgeon to expedition under command of Lt. F. T. Bryan.

Itinerary of expedition summarized by O. Lund and Cross (1961, Univ. Kans. Publ. Nat. Hist. 13(7):323-41)

- Traversed - Kansas, Platte, & Green (Wyo.) from Ft. Riley to Bridgers Pass, Wyo & back. - Fishes listed by Cope as from Platte R. near Ft. Riley - seem not to come from any single locality or even single stream system

- Trutta lewisi Cope 1865: 85 • Proc. Acad. Nat. Sci. Phil. 78-6.

S. stomias Cope 1871 Geol. Surv. Wyo.

- Agrees w/ Evermann & Cox - prob. came from headwater Platte.

- Evermann & Cox 1896 - Rept. Miss. R. fishes - Rept. Comm. Fish. 20:325-429.

2 pap for Colo. Fish or Trappers L.

Behnke

1972 Island L. data

COLORADO TROUT LAKE STUDIES, 1972

Wesley C. Nelson
Wildlife Research Leader

May 31, 1973

Division of Wildlife
Colorado Department of Natural Resources
Fort Collins, Colorado 80521

INTRODUCTION

Colorado contains more than 2,000 natural lakes, many of which support trout populations. Essentially all of these lakes are located in the mountains at elevations between 2,440 and 4,080 meters and most are small (90% <8 ha) and not very deep (<15 m) (Nelson 1970a). Consequently, the overall resource comprises only about 6,500 surface hectares and has a limited potential for fish production. Nevertheless, these lakes are a valuable recreational resource because of their location and scenic qualities. Furthermore, use of the resource is increasing at least as rapidly as the population and may soon result in its degradation. If this resource is to be preserved or enhanced, more knowledge concerning its present and potential status and use is essential.

Previous studies of high altitude lakes in Colorado have been concerned primarily with evaluation of stocking and other management practices and have been confined to relatively few lakes (Weberg 1954 Barrows 1956 and 1962, and Nelson 1964). This study was initiated in 1967 with the objective of characterizing the kinds of lake environments found in Colorado and relating these to use patterns, fish populations and management practices. Initial phases have been devoted to survey of a few lakes in each of the major mountain ranges of the State as well as to continuing studies of some of these (Nelson 1968, 1970b, and 1972). The project also includes a study of concentrations of fallout radionuclides in fish from these lakes in cooperation with Dr. F. W. Whicker of the Department of Radiology and Radiation Biology at Colorado State University (USAEC Contract No. AT11-1-1156).

METHODS

Lakes surveyed for the first time were sounded with a hand line or a depthmeter at intervals along two or more transects. Water temperatures were measured at one meter intervals from surface to bottom with a thermistor type thermometer. Depth of visibility was determined with a 10 cm diameter secchi disk. Water samples were taken at surface, mid-depth (in some lakes) and near bottom with a plastic sampler. Oxygen content of these was determined in the field by means of the Alsterberg modification of the Winkler method. Water samples were saved for later determination of pH, alkalinity, specific conductance, total solids and concentrations of certain ions in the laboratory. Qualitative plankton samples were taken by vertical hauls of #10 mesh and 28 micron mesh nets. Ca, K and Fe in water samples were measured by atomic absorption methods.

In most cases fish were sampled by means of overnight sets of graduated mesh (7.5-55 mm) gill nets. In a few cases fish were caught by rod. Species and sex of fish caught were determined and each was measured and weighed. Scale and otolith as well as stomach samples were taken from some fish. Samples of larger fish from some lakes were saved for later measurement of ^{137}Cs and ^{90}Sr concentrations.

At Island Lake a weir and trap were placed in the main (south) branch of the inlet stream on June 13. A weir was also placed in the other (north) branch on June 14. Following this, the stream above both weirs was sampled with an electroshocker. All fish caught were measured, weighed, marked and then released. On June 15 both branches were shocked again in order to get a sample for estimate of the fish population above the weirs. All these fish were treated as above. At

intervals of from one to four days, fish accumulated in the main branch trap were removed, measured, weighed, marked and released upstream. A few of these were killed for ovary samples. A narrow gap was made in the minor branch weir so that fish could pass through it. These were not counted. From July 12-14 both branches were again shocked to obtain samples for population estimates. Also during this period spawn was taken from a number of fish. The weirs were removed on July 20. Stream flow was measured with a current meter at weekly intervals during this period. Stream temperature was recorded continuously with a thermograph.

Limnological measurements and samples as well as fish samples (by gill net) were taken in Island Lake at approximately monthly intervals from June 6 to September 22. Marked fish recaptured in August and September samples were used for population estimates. These were made by the mark and recapture method using Chapman's (1951) formula. Confidence limits were derived according to Chapman's (1948) criteria and using the binomial graphs given by Adams (1951).

A plant of 1,260 creel size rainbow trout was made in East Twin Lake on June 30. A batch of fingerling rainbow trout was marked with finclips on July 5 and planted by airplane on July 10 as designated in Table 1. A sample of 148 of these marked fish had a mean length of 72 mm and a mean weight of 3.4 g.

Table 1. Fingerling rainbow trout stocking schedule in 1972.

Region Lake	Elevation m	Area ha	Number per ha	Number total	Finclip
NE					
L. Agnes	3,250	8.1	116	940	Dorsal
U. Snow	3,510	6.9	72	500	Adipose
Abyss	3,856	5.7	53	300	Adipose
Summit	3,911	13	62	800	Adipose
NW					
Pacific	4,084	4.0	50	200	Adipose
SW					
Big Highland Mary	3,685	18	67	1,200	Adipose
Little Highland Mary	3,688	4.9	61	300	Adipose

RESULTS AND DISCUSSION

Island Lake

This lake in the Front Range (Fig. 1) is within the City of Boulder watershed which is closed to public use. It is at an elevation of 3,140 m and has a surface area of 14 ha and a maximum depth of 5 m. Physical and chemical conditions (Table 2) were similar to those in previous years. Thermal and chemical stratification was slight and depth of secchi disk visibility varied little (3.0-3.5 m). In the inlet stream temperature increased but oxygen concentration and specific conductance decreased (Table 2). Flow rate decreased from a maximum of 0.44 m^3/sec on June 19 to 0.23 m^3/sec on July 10.

Table 2. Physical and chemical conditions in Island Lake in 1972.

Date	Temperature °C			Oxygen Conc. mg/l		
	0 m	5 m	Inlet	0 m	5 m	Inlet
June 6	6.6	5.1	3.5	9.3	9.4	9.6
July 10	12.2	11.2	10.6	8.4	8.2	8.2
Aug. 17	13.7	13.1	12.2	8.0	8.0	7.8
Sept. 21	8.3	7.3	9.0	8.3	--	8.4

Date	Tot. Alk. mg/l		Sp. Cond. µmhos/cm		K Conc. mg/l	Ca Conc. mg/l
	0 m	Inlet	0 m	Inlet	0 m	0 m
June 6	8	5	12	23	0.4	2.6
July 10	7	6	10	19	0.3	1.9
Aug. 17	7	5	9	8	0.2	1.7
Sept. 21	6	6	10	10	0.4	2.0

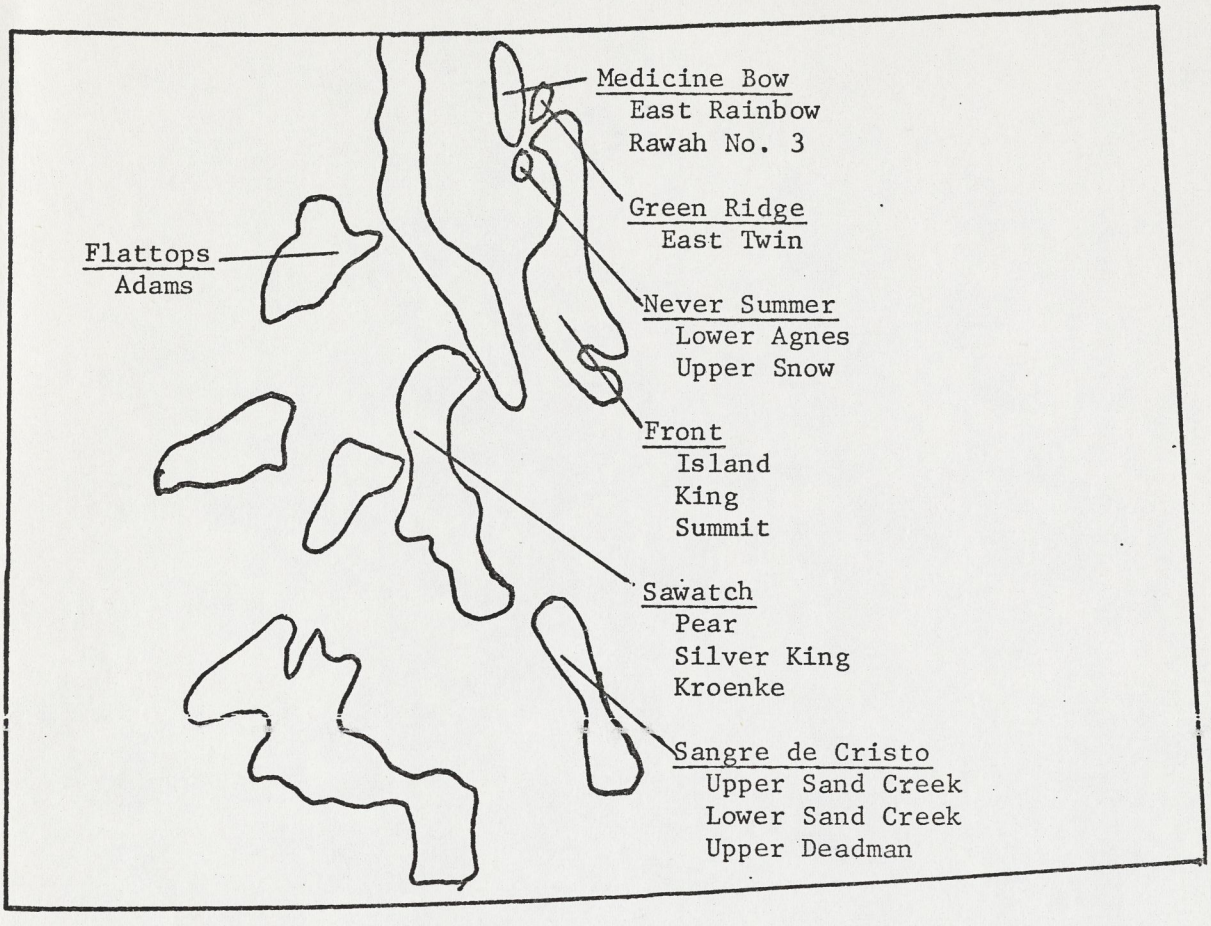

Figure 1. Location of lakes sampled in 1972.

According to Behnke (1969) this lake contains an "essentially pure" population of greenback, cutthroat trout (Salmo clarki stomias Cope). Cutthroat trout statistics differed little as between the four gillnet sample dates (Table 3) or as between lake and stream samples (Fig. 2). Mean lengths (256-258 mm) and weights (156-165 g) of fish sampled from the lake in 1970 and 1971 (Nelson 1972) were slightly less than in 1972. Otolith and stomach samples taken in 1972 have not been analyzed yet.

Table 3. Sample statistics for cutthroat trout caught from Island Lake in 1972.

Date	No. Fish	Prop. Females	Length-mm		Weight-g	
			mean	range	mean	range
June 8	31	0.45	259	162-316	163	40-283
July 11	59	0.47	254	146-315	173	30-316
Aug. 18	28	0.62	250	134-319	157	23-271
Sept. 22	84	0.63	261	137-315	170	22-284

A total of 1,165 fish were logged through the upstream trap on the main (south) branch of the inlet stream between June 15 and July 20, 1972. Of these, 20 subsequently died or were killed for samples and 11 were recaptured, previously marked fish. Overall 33% of the fish had been marked in 1970, 6% in 1971 and 1% in both years. The timing and pattern of upstream migration (Fig. 3) were similar to those in 1970 (ibid). That is, migration began in late June, coincident with decreasing stream flow and increasing stream temperature, and continued up until mid-July.

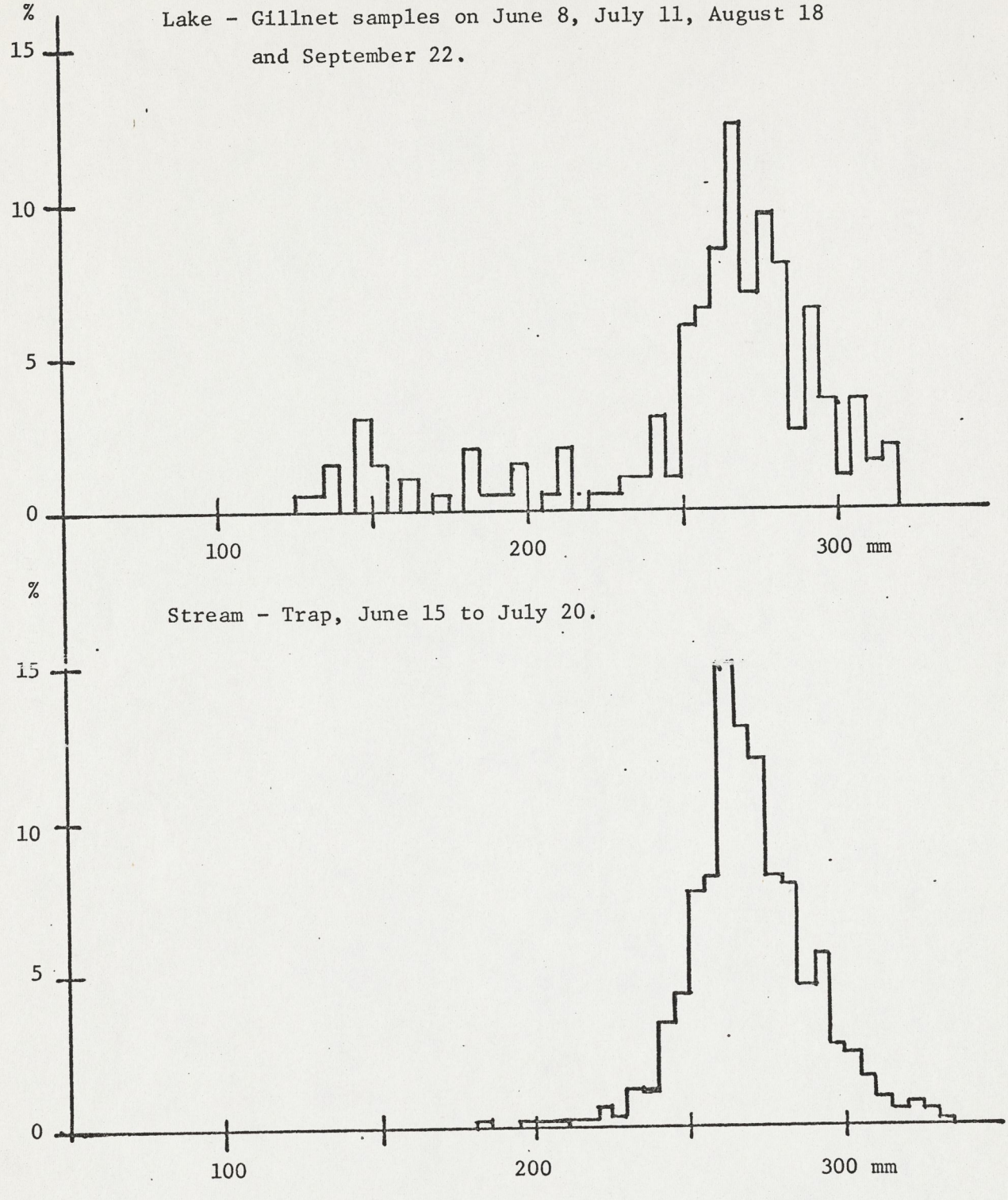

Figure 2. Length-frequency distributions of cutthroat trout from Island Lake in 1972.

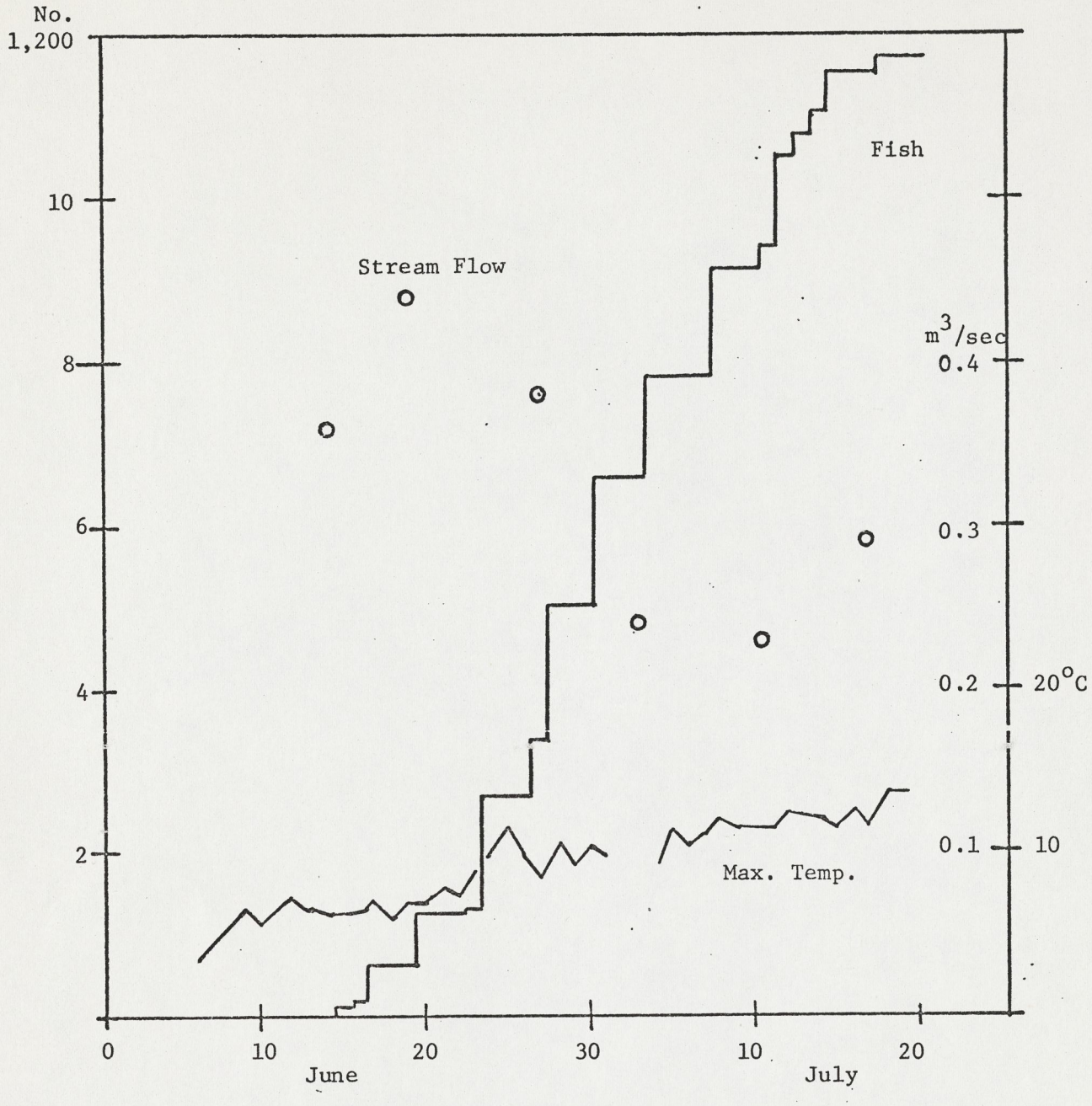

Figure 3. Cumulative number of cutthroat trout logged through upstream trap on the main branch of the Island Lake inlet in 1972.

The length-frequency distribution of upstream migrants in 1972 (Fig. 2) was similar to those for migrants in 1970 and 1971 but shows that the fish were generally larger in 1972. This is due mainly to the fact that unmarked fish were larger (mean length 272 mm) than those that had been marked in 1970 (265 mm) or in 1971 (266 mm).

Four fish were sampled from the lake and twenty from the stream between June 15 and July 10 for egg samples. Their mean length was 274 mm (range, 232-311) and the mean number of eggs was 413 (216-675). Mean egg number was 315 in 1970 but mean length was less (259 mm, ibid.). A total of 86 females spawned between July 13 and 17, 1972 produced 24,600 eggs or 286/female. The mean take from 257 fish spawned between July 1 and 7, 1970 was 218/female (ibid.).

Estimates of fish populations in both branches of the inlet stream above the weirs on June 15 (Table 4) support the visual observation that few fish were present then. The estimate for the main (south) branch on July 13 is close to the number logged upstream plus the number estimated to be present on June 15 (1,203 fish). The fact that a few fish were logged upstream twice shows that some fish were able to bypass the trap. The total estimated population of 1,610 on July 13-14 is similar to that (1,700) for July 13-15, 1970 (ibid.).

Estimates of the population of spawner-size fish in the lake in 1972 made from gillnet samples in August and September have wide confidence limits since few marked fish were recaptured (Table 4). Furthermore, they depend on the assumption that all marked fish had returned to the lake by then. On September 20, at least, no fish were observed in the stream. Numbers of marked and unmarked fish in pairs (large and small mesh) of nets set at different places in the lake on September 21 were not significantly different from those expected on

the basis of overall proportions of each (X^2 = 2.71, 5 df, P = 0.74). This indicates that marked fish were randomly distributed about the lake. Comparable estimates of the 1970 population varied from 5,000 to 11,000 fish, depending on the particular group of marked fish used, and that for the 1971 population was 13,000 fish (ibid.). Re-estimates of the 1970 population made from the September 22, 1972 sample varied from 6,000 to 9,000 and that for the 1971 population was 14,000.

Table 4. Fish population estimates for Island Lake in 1972.

Location	Date	Sample size	Marked fish
Stream[a]			
S. Branch	June 15	13	10
N. Branch	June 15	17	21
S. Branch	July 13	299	1,074
N. Branch	July 14	120	218
Lake[b]	Aug. 18	21	1,453
	Sept. 22	75	1,453

Location	Recaptures	Population	95% Conf. limits
Stream			
as	3	38	19-140
above	12	29	24-47
	252	1,270	1,200-1,400
	77	340	300-390
Lake			
as	3	8,000	3,500-29,000
above	11	9,200	5,300-18,000

[a] Minimum size 200 mm

[b] Minimum size 220 mm

East Twin Lake

This montane lake (Fig. 1) is at an elevation of 2,882 m and has a surface area of 8.2 ha and a depth of 7 m. Sampling effort this year was concentrated in the period before and after ice breakup. Conditions on April 20 and May 9 (Table 5) were typical of those found in late spring under ice cover in this lake in previous years. On May 23 there was open water around the edge of the lake in some places and the remaining ice cover was quite rotten. Increases in temperature and oxygen concentration and decreases in other chemical factors in the upper three meters on this date show the effects of inflow. Conditions in bottom waters were still little changed. On May 31, soon after complete ice breakup, thermal stratification was already well developed in the upper three meters. Oxygen concentration was greater at three meters than on May 23, but that at the bottom was only slightly increased. However, concentrations of most chemical factors in bottom waters decreased considerably.

Although sampling was less frequent, similar conditions were observed before and after ice breakup in 1967-1970. It was suggested that either spring circulation was incomplete or that deoxygenation following circulation was very rapid (Nelson 1968, 1970b and 1972). Data given by Hakonson (1972) shows that on June 4, 1971, soon after ice breakup, lake waters were reoxygenated to the bottom (5.2 mg/1) and oxygen did not become low at the bottom (0.5 mg/1) until June 24. Therefore, it seems that deoxygenation could not be as rapid as is implied by the 1967-1970 and 1972 results. Hakonson (1972) used a Hydrolab II B with oxygen probe, which was calibrated against samples using the same Alsterberg modification of the Winkler method

that I used. Possibly this last method was inappropriate due to the presence of interfering substances. Iron--probably ferrous--was present in greater quantities in bottom water samples prior to ice breakup than afterwards, but in any case total iron was less than one mg/l (Table 5).

Table 5. Physical and chemical conditions in East Twin Lake in 1972.

Date	Ice or Secchi Depth m	Temperature °C			Oxygen Conc. mg/l			Tot. Alk. mg/l	
		0-1m	3m	6-7m	0-1m	3m	6-7m	0-1m	6-7m
April 20	0.6 I	0.3	2.6	4.0	2.6	1.6	0.0	21	30
May 9	0.6 I	0.9	3.1	4.2	2.7	1.6	0.0	20	34
May 23	0.3 I	3.6	4.6	4.5	5.1	2.0	0.0	17	38
May 31	1.2 S	12.0	6.6	4.9	6.2	3.0	0.4	18	21
Oct. 19	1.5 S	7.0	6.5	6.3	7.8	7.6	7.6	19	18

Date	Sp. Cond. µmhos/cm		K Conc. mg/l		Ca Conc. mg/l		Fe Conc. mg/l	
	0-1m	6-7m	0-1m	6-7m	0-1m	6-7m	0-1m	6-7m
April 20	60	78	1.8	1.8	7.8	11.2	<0.1	0.3
May 9	58	81	1.8	1.8	7.2	10.6	<0.1	0.3
May 23	44	72	1.5	1.8	5.4	10.6	<0.1	0.3
May 31	44	55	1.6	1.6	5.6	7.7	<0.1	0.1
Oct. 19	51	46	1.5	1.5	6.4	6.4	<0.1	<0.1

No special study was made of the fish population in East Twin Lake this year. A gillnet sample was taken on October 19. Two larger fish caught (mean total length, 442 mm) were survivors from the previous year. Growth of fish from this year's plant (90 fish, means 343 mm and 494 g) was comparable to that in previous years.

Other Lakes

General locations of other lakes sampled this year are shown on Fig. 1 and their physical characteristics are given in Table 6. Adams Lake in the NW region and all the lakes in the NE region except Summit but none of the lakes in the SE and SW regions have been sampled in previous years. Thermal stratification was well developed at 5-10 m depth in King, Rawah No. 3, Agnes and Snow lakes. Some stratification below 10 m was still present in Upper Sand Creek Lake. Oxygen concentrations in bottom waters were low in King, Rawah No. 3 and the Sand Creek lakes (Table 7). Other chemical conditions in lakes previously sampled were quite similar to those found in previous years. Concentrations of the various chemical factors in lakes in the southern part of the Sangre de Cristo Range sampled in 1972 were much less than those of two lakes sampled in 1967 in the northern part of the range. Conditions in lakes in the Sawatch Range were similar to those of other lakes in this range sampled in previous years. Conditions in Summit Lake were similar to those found at a comparable time in 1950 (Pennak 1955).

The five largest rainbow trout caught from three of the lakes in 1972 (Table 8) were similar in size and probably originated from plants made in 1969 since scale analyses indicated they were age III.

In most cases fish listed as being from the 1970 plant (Table 8) could be clearly identified as age II from scale analyses. Furthermore, no rainbow plants were made before or after 1970 in Upper Snow, the Sand Creek, Kroenke, Pear and Silver King lakes. All but one age II fish from Lower Agnes Lake and four of those from Upper Snow Lake had both ventral fins removed. Originally all these finclipped fish were scheduled for Lower Agnes Lake and unmarked fish for Upper Snow Lake. None of the

Table 6. Physical characteristics of other lakes sampled in 1972.

Region Lake	Date	Elev. m	Area ha	Max. Depth m	Secchi Depth m	Temperature °C surf.	Temperature °C bottom
NE							
Lower Agnes	8-23	3,250	8.1	17	7.4	10.8	6.2
East Rainbow	8-1	3,268	2.4	4	4	16.0	13.8
Rawah No. 3	8-2	3,314	10	37	4.2	10.9	3.9
King	7-27	3,484	3.7	20	2.0	12.1	4.2
Upper Snow	8-22	3,510	7.1	18	3.7	9.9	5.5
Summit	9-5	3,911	13	15	5.0	7.0	6.7
NW							
Adams	8-29	3,293	14	10	4.9	13.4	13.0
SE							
L. Sand Creek	9-14	3,496	8.4	11	5.7	8.4	7.0
Kroenke	9-13	3,523	4.5	4	4	8.5	7.9
U. Sand Creek	9-13	3,580	11	13	3.5	9.9	6.1
Pear	9-12	3,688	3.3	8	2.2	7.1	6.9
Silver King	9-12	3,840	3.5	4	4	4.0	3.9
SW							
Upper Deadman	9-14	3,567	5.4	8	2.2	8.9	8.2

rainbow trout caught from Lower Agnes Lake in 1970 had this mark but 14 out of 16 age I fish caught in 1971 did. All of the rainbow trout caught from Upper Snow Lake in 1970 and 15 out of 19 caught in 1971 had this mark. Apparently there was some mixup in loading the fish into the nine compartments of the planting tank with the result that both lakes received marked and unmarked fish in 1970.

Table 7. Chemical conditions in other lakes sampled in 1972.

Lake	Oxygen Conc. mg/l surf.	Oxygen Conc. mg/l bott.	Tot. Alk. mg/l surf.	Sp. Cond. µmhos/cm surf.	K. Conc. mg/l surf.	Ca Conc. mg/l surf.
L. Agnes	7.8	7.0	12	25	0.2	4.7
E. Rainbow	7.2	7.8	8	12	0.3	2.0
Rawah #3	9.0	5.4	6	7	0.2	1.3
King	7.4	3.4	7	10	0.5	1.2
U. Snow	8.0	8.4	4	6	0.1	1.7
Summit	7.6	7.0	6	11	0.4	2.2
Adams	8.0	8.0	47	100	0.2	12.0
L. Sand Cr.	7.0	5.4	12	30	0.6	5.2
Kroenke	8.4	--	16	32	0.2	3.2
U. Sand Cr.	7.4	5.4	12	27	0.4	5.4
Pear	8.4	8.4	18	32	0.4	6.6
Silver King	7.6	--	13	25	0.3	5.4
U. Deadman	8.4	--	15	40	0.3	5.5

Considering the small sample sizes and differences in sample dates it is likely that mean sizes of fish from the 1970 plant do not differ significantly between lakes with the possible exception of Rawah No. 3 and Upper Snow lakes (Table 8). In this last lake mean length in 1972 was about the same as that in 1970 (145 mm) but less than that in 1971 (168 mm, Nelson 1972). Overall means (excluding Snow Lake) for the 55 fish from the 1970 plant caught in 1972 were 236 mm and 156 g as compared to means of 190 mm and 88 g for the 73 fish from this plant caught from 7 lakes in 1971. These may be compared to mean body lengths at ages I and II as calculated from scale measurements and body-scale

Table 8. Summary of statistics for rainbow trout caught in 1972.

Lake	Date	Year Planted[a]	No. Fish	Length-mm mean	Length-mm range	Weight-g mean	Weight-g range
Lower Agnes	8-24	1969	2	335	309-361	442	340-543
Adams	8-30	1969	1	356	--	408	--
Rawah No. 3	8-3	1969	2	328	320-336	358	289-426
Lower Agnes	8-24	1970	14	232	174-296	163	62-322
East Rainbow	8-2	1970	3	286	276-293	233	213-253
Adams	8-30	1970	5	274	257-309	206	178-256
Rawah No. 3	8-3	1970	13	193	154-269	81	33-179
King	7-28	1970	0	--	--	--	--
Lower Sand Creek	9-14	1970	1	295	--	252	--
Upper Snow	8-23	1970	8	147	131-168	31	24-43
Kroenke	9-13	1970	3	263	220-302	196	108-270
Upper Sand Creek	9-14	1970	4	250	177-295	180	65-259
Pear	9-13	1970	4	228	221-236	135	120-152
Silver King	9-14	1970	7	247	214-290	159	102-236
Summit	9-5	1970	1	297	--	291	--
Lower Agnes	8-24	1971	13	158	129-180	43	24-61
East Rainbow	8-2	1971	5	187	174-196	68	48-96
Adams	8-30	1971	2	170	154-185	58	42-73
Rawah No. 3	8-3	1971	8	129	121-140	23	18-30
Summit	9-5	1971	5	178	144-209	67	28-109
Lower Agnes	8-24	1972	1	129	--	24	--

[a] As determined from age by scale analyses, from finclip and/or from stocking record (see text).

regressions (Table 9). Examination of five fish (35-59 mm long) from a sample of those planted in 1970 showed that scale length varied from 0-24 mm (80X mag.). Use of this data in the calculated regressions would increase the slope and would not necessarily give a better estimate of

the size at scale formation as the intercept. From examination of data plots it is inferred that a sigmoid curve might be more appropriate.

Table 9. Mean body-scale relationships for 1970 plant rainbow trout.[a]

Year	Age	No. Fish	Regression Y =	r	Scale Length X-mm[b]	Body Length Y-mm
1971	I	73	47 + 1.89X	0.88	49	140
1972	I	55	86 + 1.58X	0.72	38	146
1971-72	I	128	53 + 1.87X	0.84	44	135
1972	II	55	86 + 1.58X	0.72	73	201

[a] Snow Lake excluded

[b] At 80X magnification

Rainbow trout planted in Lower Agnes Lake in 1971 were marked with a both ventral finclip since it was thought at the time that all of those with this mark in 1970 had been planted in Upper Snow Lake. However, as noted above marked fish from the 1970 plant did turn up in Lower Agnes Lake in 1971. Consequently, fish from both plants were recovered in 1972 and had to be distinguished by scale analyses. Fish planted in other lakes in 1971 were unmarked so had to be distinguished by the same means. In most cases, this was not a problem since scale length at presumed annulus I for fish caught in 1972 was clearly greater than scale length for a sample of four fish from those planted in 1971. As was the case for fish planted in 1970, mean lengths and weights of fish planted in 1971 are probably not significantly different between lakes with the possible exception of those from Rawah No. 3 Lake (Table 8). Overall means for all 33 fish are 155 mm and 45 g.

The one fish recovered from the 1972 plant in Lower Agnes Lake in 1972 (Table 8) was marked with a dorsal finclip.

It has been found to be very difficult, if not impossible, to recognize annuli on scales of larger cutthroat trout. Consequently, otoliths were taken from many of those caught in 1972. Examination of some of these shows that rings, possibly annuli, can be recognized on some but not others. Successful use of this method will probably depend on proper treatment of the otolith as well as having a rather extensive collection covering fish of all sizes and a series of successive dates from a given lake. However, this method may be of aid in identifying fish from known plants in the lakes sampled.

Cutthroat trout (two-inch, adipose finclipped) were last planted in Lower Agnes Lake in 1967. Since none of those caught in 1972 (Table 10) were marked, they probably originated from plants of fry in 1966 or earlier. Otoliths of these fish had from four to six rings. None of the adipose finclipped cutthroat trout (two-inch) planted in Upper Snow Lake in 1968 were recovered in 1972. Consequently, those caught this year (Table 10) had to come from plants of fry made in 1970-71 and in 1967 or earlier. Otoliths of fish from 225-336 mm long had from three to five rings. According to stocking records, King Lake received plants of cutthroat trout fry in 1964 and 1966-68 but rainbow in 1970. No rainbow trout were caught in 1972 but a number of cutthroat trout were (Table 10). Ten of the fish were less than 200 mm long but otoliths from six of these had from one to four rings. Otoliths of the two larger fish had four or five rings. Otoliths from fish planted in 1968 should have four annuli.

Table 10. Summary of statistics for cutthroat trout caught in 1972.

Lake	Date	No. Fish	Length-mm		Weight-g	
			mean	range	mean	range
Lower Agnes	8-24	3	300	292-306	289	259-321
King	7-28	12	159	129-230	42	20-100
Lower Sand Creek	9-14	10	256	150-392	206	37-589
Upper Snow	8-23	9	211	94-336	126	6-370
Kroenke	9-13	10	196	94-305	90	7-259
Upper Deadman	9-15	14	270	135-410	277	24-717
Upper Sand Creek	9-14	2	358	336-379	449	326-572
Pear	9-13	9	257	175-358	201	46-484
Silver King	9-13	3	161	101-270	65	7-177

With the exception of 1970 when plants of rainbow trout were made for this study, plants of cutthroat trout fry were made in the Sand Creek lakes in alternate years since 1962. Only two larger cutthroat trout were caught from the Upper Lake but a variety of sizes were caught from the Lower Lake (Table 10). Otoliths of fish longer than 250 mm had from two to six rings.

Kroenke and Silver King lakes received plants of cutthroat trout fry in alternate years since 1963. Fish of all sizes were caught from them in 1972 (Table 10) but otoliths haven't been examined.

Pear Lake was planted with cutthroat trout fry in 1966 and 1969. Fish of all sizes were caught in 1972 (Table 10) but their otoliths haven't been examined. Upper Deadman Lake was planted with cutthroat trout fry in 1963, 1968 and 1970. Fish of all sizes were caught in 1972 (Table 10). Otoliths from then had from one to three rings.

Twenty-one brook trout (122-302 mm and 20-237 g) were caught from Rawah No. 3 Lake in 1972. These originate from natural spawn.

The one brown trout (341 mm, 478 g) caught from Lower Agnes Lake in 1972 had an adipose flinclip so originated from a plant of two-inch fish in 1967. Four annuli could be recognized on scales from this fish but only three rings on otoliths. Either should have five.

Thirty-three longnose suckers (139-310 mm, 26-311 g) were caught from Lower Agnes Lake in 1972. Similar catches have been made in previous years. The population is self-reproducing.

CONCLUSIONS AND RECOMMENDATIONS

Island Lake

Results for this year generally verified the conclusion made previously (Nelson 1972) that the greenback cutthroat trout population in this lake has potential as a source of spawn. Estimates of actual (1,600 fish) as well as potential (9,200 fish) spawner populations were similar to those for 1970 and 1971. On the average, fish were slightly larger in 1972 than previously and contained more eggs. However, females ripened at various times during the migration so that it was not possible to obtain very many eggs at any given time. For this reason it is recommended that the study be continued one more year to see if this pattern is repeated and to try holding some females until they do become ripe.

East Twin Lake

Results of samples taken from this lake soon before and after ice breakup did not unequivocally demonstrate the occurrence or lack of spring circulation as was hoped. That is, oxygen concentration in bottom waters remained at or near zero throughout but concentrations of other chemical ions decreased following ice breakup. It is believed that the oxygen demand of lake waters is insufficient to reduce bottom water concentration to near zero in a period of a few days. It is recommended that a similar sampling program be done in 1973. Some fish survived over the winter this year. Growth of fish planted this year was good and comparable to previous years. It is recommended that previous stocking rates continue.

Other Lakes

The thirteen other lakes sampled this year ranged in elevation from 3,250 to 3,911 m, in area from 3-14 ha and in depth from 4 to 37 m. Limnological conditions in the six lakes sampled in previous years were similar this year. Conditions in the seven lakes first sampled this year fell within the range of all lakes previously sampled. Thermal stratification and some depletion of oxygen in bottom waters was found in some of the lakes.

All but one of the lakes sampled this year had been planted with two-inch rainbow trout in July, 1970. Sixty-three fish (0-14 per lake) from this plant were recovered in 1972. Mean sizes of these fish varied between lakes (147-297 mm and 31-291 g) but were probably not significantly different with the exception of those for Rawah No. 3 and Upper Snow lakes. Based on overall means (excluding Snow Lake) growth of fish from this plant was 46 mm and 68 g from 1971 to 1972. From scale sample analyses overall mean body length at age I was calculated to be from 135 to 146 mm and that at age II to be from 190 to 201 mm.

Cutthroat trout of all sizes were recovered from most of the lakes in which they had been stocked in recent years. Preliminary examination of otoliths taken from some of these fish showed that they were not of much use for aging purposes.

Since there are still 16 lakes that were planted with rainbow trout fingerlings in 1970 to be sampled, no recommendations concerning stocking rates and frequencies will be made here. Results for most of the lakes routinely planted with cutthroat trout fry indicate that this practice is successful and should continue.

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A Spawning Population Study Of The Greenback Cutthroat Trout Of Island Lake

Ned Horner
FW-300
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Abstract

The greenback cutthroat trout, (Salmo clarki stomias), is a rare and endangered species and at one time was thought to be extinct. This report discusses the description and history of the greenback and presents data collected on the spawning population of at least 5,000 fish of Island Lake in the Boulder Watershed with consideration given to its management possibilities.

I. Purpose:

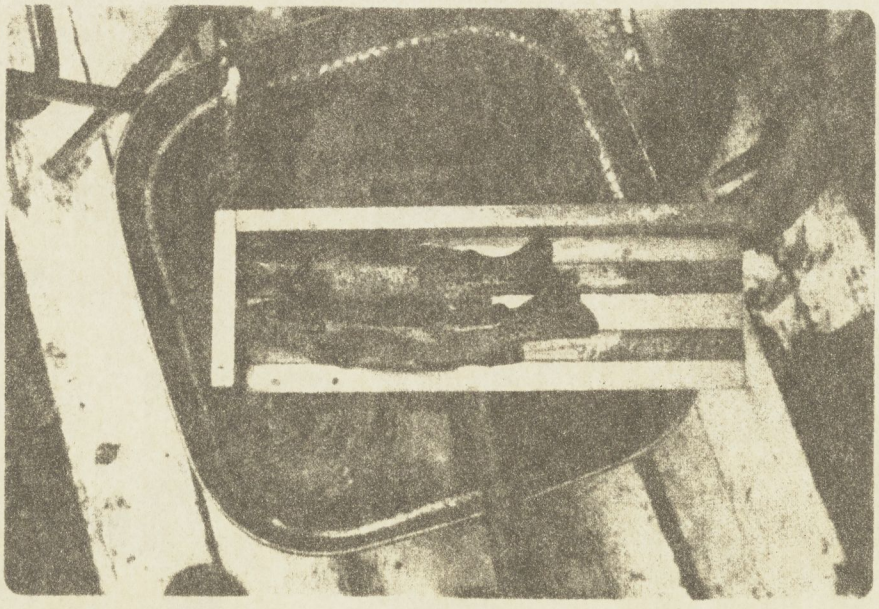
The purpose of this report is to review the description and history of the greenback cutthroat trout, (Salmo clarki stomias), to make available data collected on the greenback of Island Lake and to suggest some management possibilities the data presents. The greenback cutthroat is the original trout of Colorado but due to the introduction of non-native trout species, is now a rare and endangered species. Pure populations are extremely rare and Island Lake in the Boulder Watershed contains the largest known population of relatively pure greenback cutthroat, (Nelson, 1972). It is important to preserve the greenbacks habitat and re-establish its numbers because this fish is an integral part of our wilderness ecosystem and the greenbacks unique behavioral and ecological differences could provide quality fishing in the future.

II. Fish Description:

There are no published descriptions of Salmo clarki stomias that can distinguish it from other species of cutthroats but certain features are helpful in identifying pure strains. The greenback is a relatively small fish seldom exceeding 12 inches and 1 pound. It has large black spots concentrated on the posterior half of the body which are generally lacking from the head and occasionally the anal fin. The back has a green-brassy appearance and the sides vary from a dull brass to a bright golden yellow. There is generally a pink or red color around the lateral line but it is not concentrated in a distinct

band as in rainbow trout. The ventral region varies from cream to orange or red and in males during the breeding season may be a bright crimson. Lower fins are generally tinted orange or red and the cutthroat mark is usually crimson or orange, (picture 1). Other features such as counts of scales, (lateral line series and from the dorsal fin to the lateral line), vertebra and pyloric caeca are helpful in identifying S. c. stomias. Scale counts are generally higher than in other cutthroat trout, ranging from 185-215 for the lateral line series and 44-55 above the lateral line. Vertebrae counts are typically 59-62 and pyloric caeca are 25-49, which are both slightly lower than other subspecies of cutthroat. The posterior gill rakers are generally better developed than in most other subspecies and basibranchial teeth counts are generally 3-15. (Behnke, unpub. paper, 1973).

Picture 1:



Greenbacks generally have a low tolerance to adverse conditions and require optimum conditions of oxygen, temperature and water purity to survive. Because of this, they are not successful in competing with non-native trout such as rainbows, brookies and other cutthroats, (Behnke, unpub. paper, 1973).

III. History:

Not much is known about S. c. stomias due to the extreme rarity of pure populations. After much confusion in earlier years, D. S. Jordan, (1891), described the greenback as indigenous to the headwaters of the South Platte and Arkansas river basins of Colorado. The white man's mining and irrigating operations, over-exploitation and introduction of non-native trout species soon eliminated this unique fish from its former range and by the 1930's, the greenback was thought to be extinct in its pure form, (Green, W. S., 1937).

In 1955 however, an unusual cutthroat was discovered in Albion Creek, a small stream between Albion and Silver lakes in the Boulder Watershed. Dr. R. R. Miller, Curator of Fishes, University of Michigan, examined the fish and concluded the specimens may or may not be the endemic greenback cutthroat, (Cope, 1959). Another population of unusual cutthroat was discovered in Como Creek, a small tributary to North Boulder Creek in the Roosevelt National Forest and was identified as a pure greenback cutthroat strain by Dr. Robert J. Behnke, an authority on Salmo clarki species. Other populations of

virtually pure greenbacks with some Yellowstone cutthroat and rainbow trout influence were known to exist in the headwaters of the Big Thompson River, (Forest Canyon, Rocky Mountain National Park), South Huerfano Creek, (Huerfano County, Colorado), and in Island Lake, (Boulder Watershed), (Behnke, unpub. paper, 1973).

The last 10 existing greenbacks from Albion Creek and others from Como Creek were transplanted to a barren stretch of Black Hollow Creek, (tributary of the Poudre River, Larimer County, Colorado), in 1970 and have formed a self-sustaining population above a man-made barrier. Other successful transplants have been made to Florence Creek on the Uinta Indian Reservation, Utah and in Caddis Lake, Rocky Mountain National Park, (Behnke, unpub. paper, 1973).

Attempts were made to keep a brood stock at the Leadville Fish Hatchery in 1965 but this proved futile. The fish either died or ripened at different times making it impossible to take spawn.

Fortunately, existing populations of greenbacks are fairly well protected from man's destruction by the inaccessibility of their present habitats and the special recognition given to them by public agencies. If it were not for these isolated habitats, pure greenback populations would have been extinct long ago.

Picture 1:

Island Lake (center)

IV. Study Area:

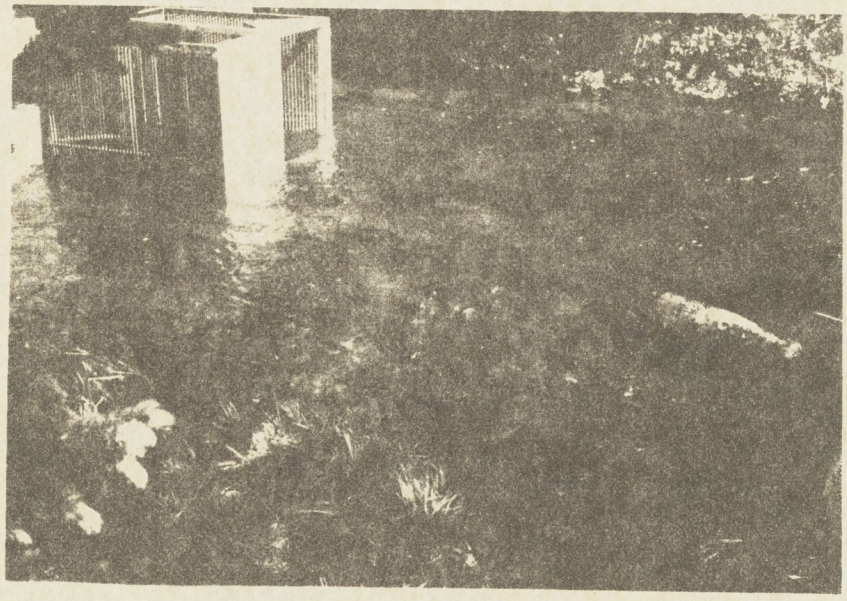
Island Lake, (picture 1), is one of several lakes in the Boulder Watershed that contains fish populations. It is fed by Arapaho Glacier, Colorado's largest, and is located at an elevation of 3,140 m. It has an area of 14 ha and a maximum depth of 6m, (Nelson, 1972). Two main feeder streams are present, one of which is suitable for spawning.

The watershed has been closed to public use for many years so its fish populations are essentially wild and unexploited. Island Lake has been studied since 1970 by Dr. Wes Nelson, Colorado Division of Wildlife, and a population of essentially pure greenbacks, (Behnke, 1969), of at least 5,000 to as many as 14,000 fish is known to exist there,

(Nelson, 1972). I worked for Dr. Nelson in 1973 and will report on some of the data collected.

In earlier years it was noted that a sizeable spawning run existed that might be used for propogation purposes and an intensive study was begun on the lake and major inlet stream in 1970. The major (south) branch and minor (north) branch of North Boulder Creek are suitable for spawning for approximatly 2/10 of a mile upstream. Attempts were made in 1970, 1972 and 1973 to trap and take spawn from some of these fish.

Picture 3:



Trap and fish in major branch

V. Methods:

A trap was placed in the main branch, (picture 3), and a

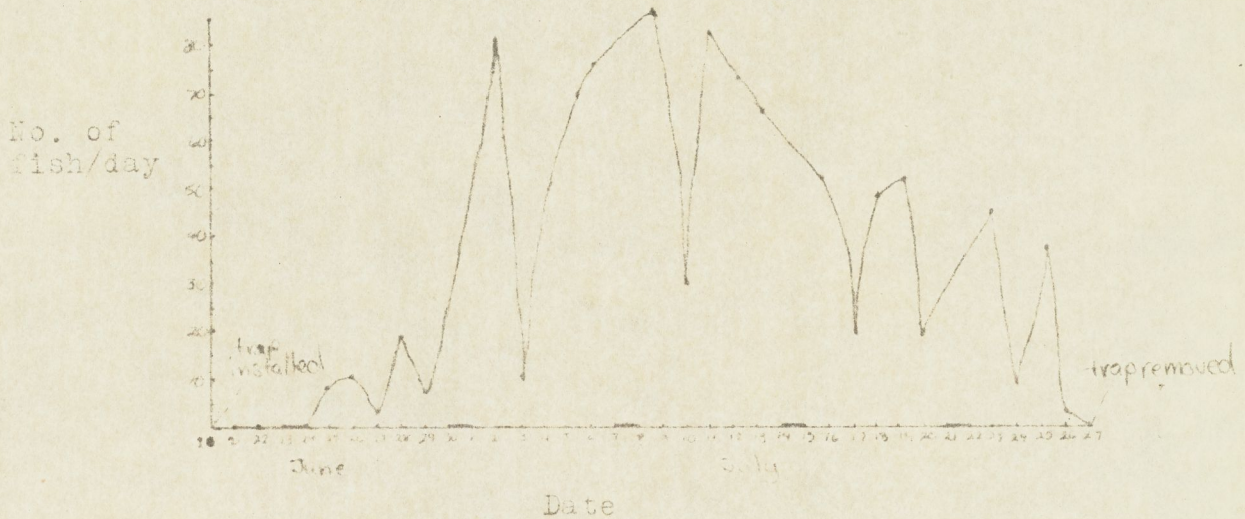
weir in the minor branch. The weir allowed fish to pass freely into the minor branch, but could be closed off during population studies. Fish were logged up, weighed, measured, marked with a numbered spagetti tag and held in live boxes til ripe. Some females were sacrificed for egg counts. Stream flow was taken once a week with a current meter and stream temperature was recorded continuously with a thermograph. Population estimates were made before, during and after the spawning run and all eggs spawned were taken to the Bellvue Fish Hatchery, Bellvue Colorado.

VI. Results:

Population estimates were made by the single-sample, mark and recapture method (Peterson) using Chapman's (1951) formula $\left(\hat{N} = \frac{(m+1)(C+1)}{(r+1)} - 1\right)$. The first estimate was made June 21 and 22 just after the trap and weir were installed, to see how many fish were in the stream before the spawning run. The population in the major branch was estimated at 17 fish and only 1 fish and 3 fingerlings could be found in the minor branch after three shockings. Our second estimate was made July 26 and 27 after the majority of fish had gone through the trap. The population in the major branch was estimated at 1,190 and the minor branch at 325. An error resulted in 64 fish found above the trap, so the 1,190 estimate is slightly inaccurate. Our last estimate was made August 13 by fly rod sampling and visual sightings. A total of 39 fish were accounted for in the major branch, (12 caught, 26 seen) and 13

in the minor branch, (6 caught, 7 seen). Population estimates for the major branch during the height of the spawning run was 1,610 in 1970 and 1,700 in 1971.

Graph 1: Trap Catch Record for Major Branch - 1973



From this data and data from previous years, it is shown that upstream migration is concentrated in the first two weeks of July and occurs during a period of decreasing stream flow and increasing water temperature, (graph 1). The run reaches its peak in mid-July and downstream migration takes place in late July and early to mid-August, (Nelson, 1972).

Spawn was taken at two separate times during July when sufficient numbers of ripe fish had accumulated in the live boxes. On July 13, 87 females were spawned yielding a total of 25,648 eggs, (hatchery estimate was 21,960), or 294 eggs/fish. On July 20, 193 females were spawned yielding a total of 43,256 eggs, (hatchery estimate was 52,096), or 224 eggs/ fish.

Results of spawn taken and average fecundity for this and previous years is shown in tables 1 and 2.

Table 1: Spawn Taken

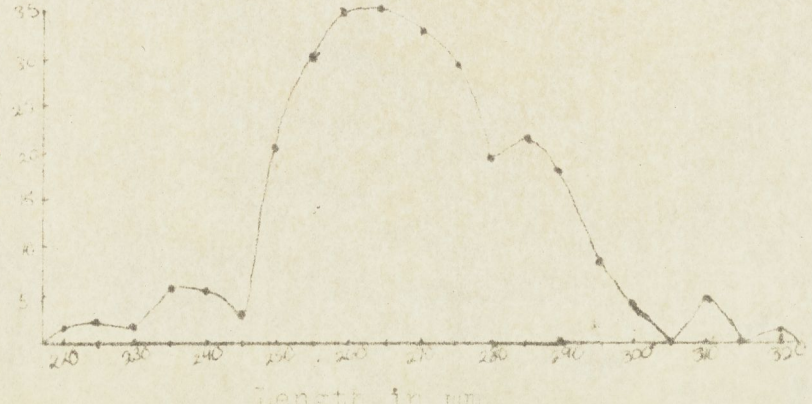
Year	No. of Fish	Eggs/Fish	Total No. Eggs
1970	257	218	56,000
1971	64	72	4,600
1972	86	286	24,600
1973	280	246	68,900

Table 2: Average Fecundity

Year	Mean No. Eggs/Fish
1970	315
1972	413
1973	418

Length frequency for spawned females in 1973 is shown in Graph 2. This corresponds favorably with the findings of other years that 95% of the spawning population falls between 200-300 mm, (Nelson, 1972).

Graph 2: Length Frequency of Spawned Females - 1973



Mortality of the eggs was very high resulting in a pick off of 71%. Only 21,750 fry hatched from the original 74,856 eggs, (hatchery estimate). This higher than usual mortality could be the result of the greenbacks low tolerance to adverse conditions, immature spawn taking proceedures or many immature eggs being included in the total number. The fry were planted in September of 1973 and the locations are noted in table 3.

Table 3: Planting Record

Year	No. of Fry	Location
1970	1,400	Iceberg
"	1,200	Rawah No. 4
1972	4,800	North Michigan
1973	9,500	Chambers Lake
"	4,800	Barnes Meadow
"	2,850	Rolfes No. 2
"	4,250	Rolfes No. 3
"	1,750	East Rainbow
"	750	Lower Carry
"	750	Rock Hole

VII. Conclusions:

It appears that the greenback cutthroat trout population of Island Lake can be used as a source of spawn providing permission is granted by the City of Boulder. The lake contains a spawning population of at least 5,000 and probably more than 10,000 fish of which 2,000 to 3,000 may try to spawn in a

given year. These fish are relatively small, 200-300 mm, and the number of eggs/fish is low, 200-300. The potential annual spawn would vary from about 200,000 to 500,000 but actual spawn taken would probably be much less, (Nelson, 1972).

VIII. Recommendations:

It would seem possible for an experienced spawn taking crew to go in during the spawning peak in mid-July and take a fair number of eggs, (50,000), out of the major branch. The minor branch should be left alone to allow for some natural recruitment to the lake. Areas to be planted should be made available before spawn is taken so the fry are not needlessly wasted. I think that most of our spawn taking efforts in the past have been wasted because the fry probably had little chance of surviving in the lakes in which they were planted.

IX. Discussion:

The greenback cutthroat trout could offer fishermen a quality fishing experience seldom found today. For many years, emphasis has been placed on raising mass numbers of catchable size trout and hoping they will not get caught out soon after they are stocked. This provides quantity fishing but minimal quality. The factors that make these fish grow fast and easy to raise, substantially reduce their chances of surviving in the wild environment.

Dr. Behnke has suggested that genetic diversity of wild trout be preserved and used in wild trout fisheries management.

The unique behavioral and ecological differences wild trout have could be used to maximize angling opportunity. A large macro-niche could be divided up and utilized by many unique species or subspecies, resulting in greater numbers of fish and a larger biomass.

The greenback is unique in that it is especially well adapted to cold, clear, high mountain lakes and streams. It isn't a large or spectacular fish, but is extremely beautiful and as wild as the wilderness it inhabits. This unique cutthroat could provide a quality fishing experience for those fishermen who are looking for something extra.

Blue Island Lake spawning population has the potential of bringing the greenback cutthroat trout out of the dark shadow of extinction. If the correct measures are taken, many high mount in lakes and streams now shunted with brook trout populations or barren of fish could be alive with the original trout of Colorado.

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Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216

February 1, 1984

Mr. Fred Bolwahnn
Section 7, Team Leader
U.S. Fish and Wildlife Service
Federal Building, Room 1311
125 South State Street
Salt Lake City, UT 84138

Dear Fred:

The Greenback Cutthroat Trout Recovery Team meeting of January 11, 1984 was very successful. Let me give you an outline of what we covered, which reflects the scope of our 1983 inter-agency recovery/management efforts.

The meeting convened at 9:30 at the CDOW in Denver, and was attended by: Ted Washington (CDOW), Jane Roybal (USFWS), Dave Flemming (USFWS), Brenda Melton (USFS), John Hale (USFWS), Steve Yamashita (CDOW), Chuck Loeffler (CDOW), Pat Dwyer (USFWS), Larry Visscher (USFWS), Don Prichard (BLM), Marc Bosch (USFS); and Recovery Team members Bob Stuber (USFS), Dave Stevens (NPS), Bruce Rosenlund (USFWS) and Jim Bennett (CDOW).

As there was no old business, the meeting then proceeded with agenda items. Reports were heard from cooperating agencies on their 1983 progress and 1984 plans:

a. Washington (CDOW) - detailed his efforts to secure some quality habitats as reintroduction sites: Scott Gomer Creek, Bruno Gulch, Frozen and Abyss lakes. Unfortunately, water quality problems, and the cumbersome nature of designating part of this system as an "experimental population" has complicated our recovery objectives somewhat. Plans for 1984 include Craig Creek and Jackson ponds.

b. Loeffler (CDOW) - reported on his monitoring of greenbacks in Cascade, Cottonwood and Greenhorn creeks, and plans a difficult rehabilitation project on the Lake Fork drainage into Tourquoise Lake. The results of egg-taking from McAlpine's Lake were disappointing.

c. Rosenlund (FWS/NPS program) - addressed the Lawn Lake renovation, Ouzel Lake, the new "world record" greenback (4.4 pound male) from Fort Carson's Lytle Spring Pond; he described the interagency milt-taking operation, from wild male greenbacks in Como and Hidden Valley creeks, to introduce wild genes into the Bozeman hatchery stock. We now have some good comparative data from the limited catch-and-release fishing for greenbacks in Hidden Valley beaver ponds (RMNP). Egg-taking from Lytle Springs Pond also proved un-successful.

d. Stuber (USFS) - touted the installation of 10 log structures into Como Creek to improve the marginal habitats there. Through controlled comparison of standing biomass of trout, we will be able to evaluate the USFS' techniques by 1985. Plans were made to install a fish barrier on West Creek, and Pennock Creek will be worked on in 1984.

e. Dwyer (USFWS/FTC) - outlined the inception, progress and goals for the current greenback cutthroat hatchery program in Bozeman, Montana. Dwyer projects as many as 75,000 greenback fry annually will be available for Colorado use in the near future. Some trout were held back in 1983, so that they could be stocked-out in spring of 1984 at a larger size. A comparison of these strategies will be made by cooperating agencies.

f. Miscellaneous - ten greenbacks from the South Fork Cache la Poudre population were sacrificed for use in an electrophoretic/taxonomic evaluation of Rocky Mountain Region cutthroat trout. The results may affect our recovery philosophies, and are expected in February.

Jane Roybal gave the group a status report on the Recovery Plan. It was agreed that some of its contents should be up-dated; Rosenlund volunteered, and all substantial changes have been made. The Plan is now at the printers office, and should be available by late February. A quick poll of participants showed that over 100 copies are already spoken-for; 150 copies will be printed.

Dave Flemming gave us an interpretation of how the new "experimental population" status under the E.S.A. should work. It was agreed that this rather formal process could not help solve our immediate management problems (Bruno Gulch, etc.). USFWS will keep us posted on relevant developments.

A memorandum of agreement (MOA) between CDOW-USFWS was drafted for review by appropriate state and federal personnel. It would allow the transfer of funds from state budgets to FWS to help defray expenses associated with rearing and transporting greenback fry to/from the Bozeman (or other) hatchery.

The Team also drafted a letter expressing concern over anticipated problems including our limited recovery successes in the Arkansas drainage. Proposed solutions included the establishment and production of a brood operation at Saratoga, Wyoming, where separate holding and production facilities for Arkansas and South Platte drainage fish can be maintained.

A review of our 1983 stocking program was made. In September, some 26,000 greenback fry from Bozeman, arrived in Colorado. USFWS, NPS, USFS and CDOW personnel coordinated their efforts to stock these fry into existing and rehabilitated sites over a three-day period. Plans for 1984 include the stocking of up to 2,000 larger (5-6") fingerlings into difficult areas, where survival will be assessed against the planting of smaller-sized fish. September 11th has been tentatively selected as the arrival date for our 1984 Bozeman-reared fry.

The Team will respond to a Federal Register request for data, information and input into the status review of the threatened greenback cutthroat trout. Comments are due by April 6, 1984.

The Team budget for 1983-84 was estimated by Jane Roybal to be $2,000, and will include Recovery Plan-related expenses. Some discussion was prompted by the news that CDOW's Section 6 (of ESA) funds for 1984-85 greenback work were cut by 100 percent. As the Colorado portion of this recovery effort is very reliant upon federal assistance, we urge the FWS to re-think its decision to cut 1984-85 funds, and to give serious consideration to enhancing next fiscal year's budget to maintain our recovery momentum.

The meeting concluded, after a round-table discussion of progress, plans and philosophies, at 12:45.

If you have any questions or comments about the Team's progress or plans, please call me in Denver.

Sincerely,

Jim Bennett

James R. Bennett, Leader
Greenback Recovery Team

JRB/jg

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

10/27/69

Dear Bob:

The enclosed info listed (therefore confidential) from the files of P.W.N.P. may be of interest to you. It was to me, inasmuch as it disclosed the outcome of the attempt to propagate greenbacks at the Ludville N.F.H. Bob Azevedo was not aware of the mix-up. Therefore, p. 2, para 1, of your memo paper of Oct 1969 perhaps needs to be revised.

We spent a week in Sept at PWNP and it appears that the headwater area of the North Fork of the Big Thompson River in and just below Lake Louise is known. This area appears to represent an ideal area for introducing greenbacks in 1970. Both stream and lake conditions are represented. I will incorporate the full details

of such a venture and any suggestions of yours in a report to the park this winter.

We are scheduled to check on the Greenbrook introduction to Florence Creek next week. This early winter in the high country may upset plans. Nevertheless, I will keep in touch.

Joni

MAY 24 1967

N1423-ORM

Memorandum

To: Assistant Director, Operations
Through: Chief, Division of Resources Management and Visitor Protection

From: Aquatic Resources Biologist, WASO

Subject: Rocky Mountain Greenback Trout

Chief Ranger Jim Randall and Park Biologist Ted Bucknell, Rocky Mountain National Park, called me on May 16 to discuss Mr. Arnberger's memorandum of May 8 that dealt with the availability of greenback trout fingerlings at the Leadville Federal Fish Hatchery in relation to the approved stocking program in the park for 1967.

Fishery Services Biologist Peterson, Bureau of Sport Fisheries and Wildlife, called several weeks ago and informed park personnel that 45,000 fingerling greenback trout, spawned at the Leadville Hatchery from stock secured in Forest Canyon in 1965, would be available for stocking in Rocky Mountain National Park. He wanted to know where they could be planted in park waters.

Present park personnel did not know under what conditions and for what purposes the trout had been collected in Forest Canyon. They assumed that some committment had been made to the Bureau to plant the offspring in Rocky Mountain National Park waters and that they were obligated, therefore, to do so. The approved stocking schedule in the approved Long-Range Fishery Management for the park, however, provides for the stocking of 14,500 cutthroat trout fingerlings in park waters in 1967.

Possible uses of the available supply of greenback trout fingerlings were discussed. Park personnel are concerned that these fish should be used where they could produce the most benefit. They felt that to use them to supply the stocking requirements in park lakes for 1967 would neither be desirable nor beneficial use of these fish. These lakes have little or no natural reproduction; consequently, trout populations are maintained essentially by periodic stocking and the chances of the greenback trout becoming establish would be unlikely.

I discouraged the suggestion that the fingerlings be planted in the waters of Forest Canyon because of the potential danger that fish from the hatchery might introduce diseases or other factors into waters that contain wild trout populations that are probably being supported already at a maximum level.

Another suggestion was that the trout might be stocked into "barren waters" such as Arrowhead Lake to determine if they could survive in such situations. Such stocking, however, is contrary to the Long-Range Plan that establishes the principle that barren park waters shall not be stocked. Furthermore, the introduction of a "stream" trout into a lake environment could be expected to be of doubtful value and in Arrowhead Lake or other "barren" lakes such introductions would be temporary in nature because areas for natural spawning are lacking.

It was not considered advisable to stock the fingerlings in park streams as they are already "loaded" with wild trout.

It was suggested that perhaps the State of Colorado could use the greenback trout for stocking in other waters of the State.

Park personnel mentioned that Bureau Biologists Robert Azevedo and Jack Hemphill and former Park Biologist Neil Guse were familiar with conditions under which the greenback trout stock was taken. I suggested that I discuss the matter with them and then make a return call to Rocky Mountain.

Neil Guse, now stationed in Yosemite, stated that 92 greenback trout were secured from Forest Canyon in 1965 upon the request of Dr. Robert Vincent and George Post, Bureau of Sport Fisheries and Wildlife, Colorado Fishery Research Unit, Colorado State University. They wanted specimens for seriological work directed toward redefining the taxonomic status of the subspecies. They proposed that the trout would be reared through three generations at the Leadville Hatchery to determine if they would maintain their characteristics and breed "true." Then the stock would be transferred to the Saratoga Hatchery in Wyoming where the Bureau maintains its research stocks of trout.

Mr. Guse reports that the greenback trout were not transferred from Forest Canyon to the Leadville Hatchery for the purpose of establishing a brood stock for this subspecies for stocking in park waters.

Finally, on Friday, May 19, I made connection with Jack Hemphill, Regional Supervisor, Fishery Services, in the Bureau's Regional Office in Albuquerque. He expressed surprise that the hatchery personnel had not contacted the Regional Office regarding the distribution of the greenback trout fingerlings. He agreed that the stock should be planted only in waters in which the introduction could be expected to provide lasting benefit. He stated that he could use the stock of greenback trout fingerlings in the Bureau's endangered species program. He was certain that the State of Colorado has several waters suitable for the introduction of greenback trout and that State personnel would be interested in entering into a cooperative venture.

I passed this information on to Jim Randall on Friday. I suggested that in light of our conversation that the Superintendent would be expected to prepare no more than an acknowledgement of Mr. Arnberger's memorandum to complete the files on this matter.

In summary, it is evident that the greenback trout fingerlings were not intended for use in the Rocky Mountain trout stocking program and that the Bureau will use the fish in the endangered species program elsewhere in Colorado.

Signed

O. L. Wallis

NL423-ORN

MAY 25 1967

Memorandum

To: Regional Director, Midwest Region

From: Assistant Director, Operations

Subject: Proposed Trout Stocking in Rocky Mountain National Park, Follow-up on Memorandum of May 8.

In our memorandum of May 8, the subject of the availability of greenback trout fingerlings in relation to the approved stocking schedule for Rocky Mountain National Park for 1967 was discussed. Additional information on this matter and further clarification were requested.

Subsequently, Chief Ranger James Randall and Park Biologist Ted Bucknell discussed this situation with Mr. Wallis. He, in turn, talked with the other biologists concerned about this matter. It now appears that the greenback trout fingerlings were not actually intended for use in the Rocky Mountain National Park stocking program and that the Bureau will use the available fish in the endangered species program elsewhere in Colorado.

You will be interested in the enclosed copy of Mr. Wallis' discusaion on the status of this subject.

(Sgd) Edward L. Hummel

Enclosure

CC:
Superintendent, Rocky Mountain w/c of encl.

45,000 non existant greenback fingerlings

Cutthroat trout from Pikes' Peak - lake #5, ~~#~~ Boemer or Middle Beaver Creek basin, el. 10,931 ft., Arkansas River system. Source of cutthroat eggs for ~~Reg~~ SE Region (Colorado Springs).

Originally a series of natural lakes, but raised for water supply reservoirs around turn of the century. ~~Were~~ Were trout present before stocking of lakes from Leadville Hatchery about 1909-1910 ?

These lakes have been used since about 1913 for state and federal hatcheries. However, stagecoach road and resort hotel were here before official stocking records and there is likelihood of individuals carrying trout from Beaver Creek (stomiss) to this headwater area and establishing population. From 350,000 to 1,500,000 eggs taken per year. Average about 700,000. These eggs mainly used in SE and NE regions.

Both males and females may ~~to~~ have ~~co~~ bright red colors on ventral region. Much variability in coloration and spotting. Base colors from bright yellow-brown to silvery ~~and~~ with greenish tints. Red on operele most with red tinted lower fins, some

with reddish tips to dorsal fin.
Cutthroat mark prominent - some with scarlet over whole ventral region, including head.

- U.S. Fish Comm. Rept. 1909 - cutthroat introduction into Middle Beaver Crk. - men Clyde - (may be in the 7 Lakes)

(Rockett)

Lost Lake - .2 mi. NE Chambers L. (Poudre)
Black Hollow Crk. - Poudre
Trap Crk. - Poudre
Roaring Crk. - Poudre (Isolated by falls - beaver ponds)

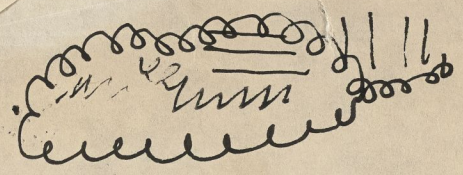
- Lost L. specimens (coll. Oct.) : small, irregularly shaped spot - opercle, pectoral fins - striking scarlet (scales 164-172) - from fry of Trappers L.

- Black Hollow: large spots (evenly distrib), liter colored (yellowish) operculum, fins orange-yellow - no pink lateral band as in Lost Lake -

- Roaring Crk: slightly smaller spots - concent. on caudal ped. & above l. l. - fins as Black Hollow - indistinct pink operculum - band.
scales 179-187) spotting seems to be stomias.

- Trap Crk. (N=4) large spots posteriorly - belly ♂ and spotted on largest. - definite pink operculum & lat. band. - scales: 144-164.

- Albion Crk. large spots, post. - anal generally spotted. blotched pink bands - belly pink but perhaps because ♂'s. - appear to be stomias



D. 10-13

D. & A. says A. 10-12 but no sig. dif.
between pop. - no dif. gill rakers,
or branchiostegals

Pyloric caeca - no dif.

- Neffenbach
- Albion Crk., Big Thompson, Hague Crk, Ypsilon Crk. (So. Platte) + Tonahutu Crk. - Colo.
* - Fairy Lakes - drainage - treated - stocked w/ Forest Canyon trout.

- * James Cole
Biblio. ref. fishes - Great Plains.

MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

BUREAU OF SPORT FISHERIES & WILDLIFE
Region 2, Albuquerque, New Mexico 87103

TO : Dr. Robert Behnke, Assistant Unit Leader
Colorado Cooperative Fishery Unit

DATE: July 31, 1972

FROM : Regional Supervisor (Endangered Species Team Leader)
Division of Fishery Services

SUBJECT: Rare and Endangered Symposium in Albuquerque

Your letter of July 6, 1972 regarding your presentation on September 22-23, at the symposium sponsored by the New Mexico Fish and Game Department, was discussed by the Regional Endangered Species Team.

It is hoped that further information as to the Bureau's Endangered Species Program, its budget and organization, will be available by September. The Team will be available for such discussions with you and Dr. Steinhoff any time during the week of September 18, 1972.

Your participation in the symposium, I'm sure, will have to be coordinated with your transfer to the Division of Fishery Research, which should be in effect by September.

Bob

Robert L. Azevedo

— memo request meetings —
dates AFS
places Albuquerque
role in meeting
→ sent to Bur Sport Fish & Wildlife Dept. Dept. Wash D.C.
— to Division Attn. Div. Fish. Res.

Wash. office 202-343-5729-
-2079-
Potts - -2639-
Div. Fish. Res.

Joe Wright Crk.

N=3

?_ N=1

below Joe Wright reservoir

private for long time

Caroline L. - Sect. 32-33 township 2S range 74 w.

11,920

all small mature ripe fish

-irrigation lakes headwaters of fall Crk.

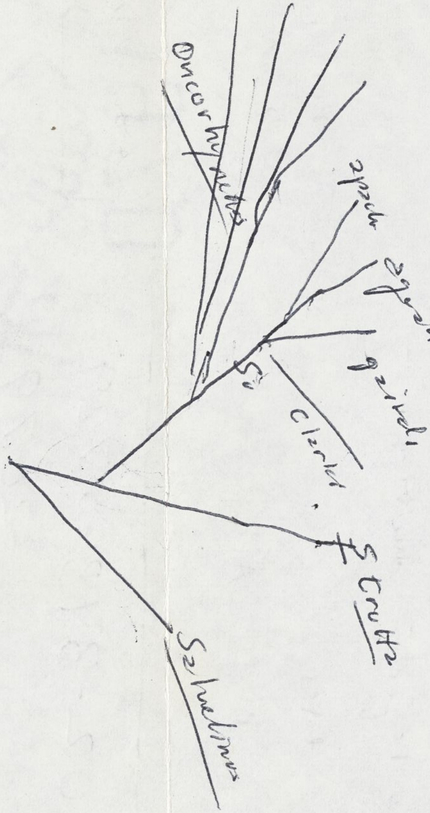
So. Platte drain

Biota and Chemistry of Piceance Crk.

1970

7.

Dreaming — trout stakes —



Divisional Correspondence Only

STATE OF COLORADO

DIVISION OF WILDLIFE

DEPARTMENT OF NATURAL RESOURCES

DATE: September 29, 1983

TO: Greenback Cutthroat Recovery Team Members

FROM: Jim Bennett

SUBJECT: Some recent, future business

Here are some bits and pieces for your consideration and comment. Some 22,500 greenback fry arrived in Fort Collins on September 26th. They were apportioned (September 26-28) as follows:

Water	Surface Acre/stream-mile	No. Stocked[a]
Bard Creek	5.0	2056
Cornelius Creek	5.0	2544
George Creek	5.0	2618
Sheep Creek	5.0	2480
May Creek	2.5	800
(Hourglass Creek)	(1.25)	(638)[b]
William's Gulch	1.9	~1000
Fern Lake (RMNP)	9.2	4699
Fern Creek (RMNP)	0.9	460
Ouzel Lake (RMNP)	6.4	3269
Ouzel Creek (RMNP)	1.9	970
	44.05	~21,500

---

[a]Stocked at rate of 510/surface-acre or stream-mile.

[b]Deleted from stocking schedule in favor of Black Hollow Creek (1,000 stocked).

(Don't check my arithmetic too carefully!)

In addition, we held back some 2,000 of the larger fry in Bozeman. These will be stocked-out at 5-7 inches in Bard, Sheep (et al.) creeks next July. CDOW will make every effort to compensate Pat Dwyer's (FCDC) expenses by providing FCDC with an equivalent amount ($) of fish food... from NE's budget.

Tentative date for Recovery Team meeting: mid-January, 1984. If you have any suggested agenda topics, please pass them on to me by mid-December. We should have the Recovery Plan ready for distribution within a month--100 copies.

JRB/jg
xc: T. Washington (NE), C. Loeffler (SE), K. Fausch (CSU), R. Behnke (CSU), J. Roybal (USFWS)

Dr. Robert J. Behnke, Asst. Leader
Colorado Cooperative Fishery Unit
Bureau of Sport Fisheries & Wildlife
Room 242 Forestry Building
Colorado State University
Fort Collins, Colorado 80521

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

N1423-N

NOV 9 1970

Memorandum

To: Director, Bureau of Sport Fisheries and Wildlife
Through: Assistant Secretary for Fish and Wildlife and Parks

From: Acting Director, National Park Service

Subject: Fishery Management Investigations, Rocky Mountain National Park and Blue Ridge Parkway

We acknowledge the receipt of the fishery management report for Rocky Mountain National Park by James W. Mullan, dated April 1, that Mr. McBroom transmitted with his memorandum of October 2 and the fishery management report for the Blue Ridge Parkway by Ronald D. Jones, dated September 10, that accompanied Mr. White's memorandum of October 22.

Each of these fine reports will prove useful to the National Park Service in the cooperative management of the fishery resources in areas we administer. We express our appreciation to your Bureau and its staff of capable fishery biologists for this assistance.

Studies conducted in waters along the Blue Ridge Parkway by Biologists Frank Richardson and Ronald Jones have been instrumental in the development and conduct of a fishery management program that is well accepted by parkway visitors and consistent with Service objectives.

Cooperative investigations in Rocky Mountain National Park in which Mr. Mullan and Dr. Robert J. Behnke of your fishery unit at Colorado State University participated provided the basis for the introduction of the greenback cutthroat trout, an endangered species, into the North Fork of the Big Thompson River, on October 19. We have just received a progress report on this project from our Research Biologist David R. Stevens and are enclosing a copy for your information.

(SGD) EDWARD A. HUMMEL

Enclosure

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
ROCKY MOUNTAIN NATIONAL PARK
AND
SHADOW MOUNTAIN NATIONAL RECREATION AREA
ESTES PARK, COLORADO 80517

file

IN REPLY REFER TO:
N1423

PROJECT REPORT

GREENBACK CUTTHROAT TROUT PROJECT

prepared by

David R. Stevens
Research Biologist, ONSS
October 1970

The greenback cutthroat trout (Salmo clarkii stomias) was the native trout in the headwaters of the South Platte River and is therefore considered the native trout east of the Continental Divide in Rocky Mountain National Park. Subsequent to the present program, the only population of greenback in the Park existed in the headwaters of the Big Thompson River in Forest Canyon. This fish, as a result of prior stocking practices, is probably not a pure strain of the original greenback trout, however, it is close enough to be considered as such for management purposes according to Dr. Robert J. Behnke of the Cooperative Fishery Unit at Colorado State University. Only two other populations, neither of which is well protected, are known to exist outside the Park. The greenback trout was listed as endangered by the Bureau of Sport Fisheries and Wildlife in the 1968 edition of the "Red Book". In order to help insure survival of the species it was decided that its range within the Park should be expanded utilizing the most pure strain of the fish available.

Approximately 50 greenback trout were transferred from a tributary of North Boulder Creek to the North Fork of the Big Thompson River drainage within the Park on October 19, 1970. This project was in cooperation with Dr. Behnke and the Cooperative Fishery Unit.

The source of the fish was a small tributary of North Boulder Creek ($NW\frac{1}{4}$, $NE\frac{1}{4}$, Sec. 26, T1N, R73W) in Boulder County. This population was discovered and determined as far as possible to be a pure genotype of the native greenback cutthroat trout by Dr. Behnke. The fish, ranging in size from one to six inches length, were removed from about a quarter-mile section of stream in about one hour by electro-shocking with backpack equipment. They were placed in a truck-mounted

fish tank which had been filled with water from the brood stream and driven to Estes Park, a distance of about 38 miles by road. At Estes Park they were transferred to plastic bags filled with 2 to 3 gallons of water and super-saturated with pure oxygen. A total of five bags were used with about 10 fish per bag. They were carried in two trips by helicopter to the release site, about 15 minutes flying time. The total elapsed time from the source to the release site was about four hours. The fish were handled as little as possible to preclude injury. No distress was noted as the fish were released.

The site of release is a tributary of the North Fork of the Big Thompson River in the northern part of Rocky Mountain National Park. It consists of Lake Louise, some small shallow ponds and about 1½ miles of sub-alpine stream down to a barrier cascade. (See map). Investigations were made in September 1969 (Mullan, 1970) and July 1970 by James W. Mullan, Bureau of Sport Fisheries and Wildlife, Vernal, Utah, assisted by David Butts, Park Resource Manager, and myself. Sampling by various techniques, fish toxicants in the stream sections and gill nets in the lakes, revealed no fish above the barrier. This complex of lakes and streams represent a variety of habitat types including deep holes, undercut banks, and gravel spawning areas with an abundance of food organisms. This drainage system would have been within the original range of the fish but was probably never occupied by the trout due to the natural barriers below.

Follow-up investigations will be conducted in the next two or three years to determine survival and reproductive success. The successful establishment of a population in this drainage would be a big step toward the ultimate perpetuation of the greenback cutthroat trout.

References:

Behnke, Robert J. 1969. Rare and endangered species: The Greenback Trout, Colorado Cooperative Fishery Unit Report. mimeo. 5 pp.

Mullan, James W. 1970. Progress report on fishery management program Rocky Mountain National Park. Bureau of Sport Fisheries and Wildlife, 9 pp.

NORTH FORK BIG THOMPSON

"Fishery Management Program"

1972

Rocky Mountain National Park

checked out by Terry

Cacek 491-5830

Salmo clarkii stomias

The endemic cutthroat trout of the upper Arkansas and Platte drainages in the Missouri River system form a distincitive group worthy of taxonomic recognition at the subspecific level. These trout are fine scaled, typically with 175-210 scales in the lateral series and 40 to 52 scales above the lateral line. They have large, roundish spots, sparsely distributed and concentrated on the caudal peduncle (fig. _).

A confusing situation exists concerning the original distribution and type locality of *S. c. stomias*. Cope (1872a) described *Salmo* (*Salar*) *stomias* based on two specimens collected by Dr. William A. Hammond, M.D. from: "The Platte River, from near Fort Riley, Kansas". Cope distinguished *stomias* by its large head and mouth and 42 scales above the lateral line. The Platte River does not flow through Kansas. Fort Riley is at the junction of the Republican and Kansas rivers. Later, Cope (1872b) stated that "Its habitat, so far as known, is the Kansas River, far to the eastward of the Rocky Mountains". He claimed that his earlier reference to the Platte River was erroneous. Cope and Yarrow (1875) maintained that the type locality of *stomias* was the Kansas River and not the Platte. Jordan (1891) said there were no trout in the Kansas River and that there was no suitable habitat for trout within 500 miles of Fort Riley. Jordan considered the type locality to be the Platte River and the name, *stomias*, was applied to the cutthroat trout of the Arkansas and Platte Rivers. Cope (1872b) considered the trout of the Platte River to be *Salmo pleuriticus*.

Dr. R. R. Miller of the University of Michigan has ~~been interested in stomias and~~ examined the type specimens of *stomias* at the National Museum. ~~The specimens~~ They are in poor condition and an accurate scale count was difficult but his counts of 150 and 152 scales in the lateral series ~~on the types,~~ are much lower than any known specimens of *stomias* from the Arkansas and Platte river systems.

Information provided to Dr. Miller by James Cole, biologist with the National Park Service, indicates that the Republican River as far south as Fort Riley, Kansas, may have provided trout habitat as recently as 1870. The topography of the area between the South Platte and the Arkansas rivers suggests the probability that trout occurred in Kansas when environmental conditions were favorable. There are, however, no authentic records of indigenous endemic trout from any rivers between the South Platte and Arkansas drainages and the origin of the type specimens of stomias remains a mystery.

Some of the locality records of the specimens of Cope and Yarrow are known to be in error. The exactness of the data of the many early western explorers who gathered the specimens was probably not of the highest order. The type specimens of stomias may actually represent Rio Grande trout.

Although a collection of stomias was made in 1950 from Red Canyon, a tributary of the North Platte River in Jackson County, Colorado, we know of no previous mention in the literature concerning native endemic trout in the North Platte drainage. Jordan (1920a) recounted the notes of Mr. Ralph Montega, who said there were no trout in the tributaries of the North Platte in 1887. Land (1913) also stated that the North Platte had no native endemic trout but "native trout" were stocked in the headwaters of the North Platte at North Park, Colorado, in 1891 and 1892, as well as the headwaters of the Big Laramie River in Laramie County, Colorado.

Museum material on stomias is not abundant. Until recently, it was feared that stomias was extinct, but in the past few years, some collections of stomias have been made in isolated tributaries of the Platte River. All the specimens of stomias examined were fine scaled and large spotted trout. Their characters show less variability between samples than the cutthroat trout of other interior drainage basins. Besides this relatively high degree of homogeneity, the fact that stomias once occurred sympatrically in Twin Lakes with a cutthroat of Colorado River origin, indicates that stomias has been

isolated more completely and for a longer duration than any other group of cutthroat trout except, perhaps, the Lahontan cutthroat, S. c. henshawi.

Meristic Characters

; Table ____ displays some of the meristic variation in our samples of stomias. In 60 specimens from 8 localities, the scale counts range from 170 to 215; more than any other group of cutthroat trout. Some populations have a low number of vertebrae. The mean value of 59.95 for the Red Canyon sample is the lowest of any cutthroat aample used in this study. Some populations have a tendency for the loss of basibranchial teeth which is a common occurrence among small isolated populations of interior cutthroat. The arrangement of the basibranchial teeth is typically in a singlw row in stomias although exceptions to this were noted , particularly in the Twin Lakes specimens,

Twenty specimens from the Big Thompson River had from 22 to 40 (31.4) pyloric caeca. This is much lower than the typical caecal counts made on other cutthroat and rainbow trout and approaches the number found in Mexican and California golden trout. A low number of pyloric caeca may prove another distinctive character differentiating stomias from other interior cutthroat trout. — Counts as low have recently been reported for lewisi from the Columbia R. drainage.

We do not know to what extent stomias will hybridize with introduced cutthroat and rainbow trout or how significant a role hybridization has played in the drastic reduction in the distribution of stomias. The area where the 1959 collection of stomias was made in the Big Thompson River was stocked with 160,000 yellowstone cutthroats in 1922 and with 130,000 in 1923. This fact was disclosed in a letter from O. L. Wallis to Dr. R. R. Miller. The effect that these introductions had on the native stomias appears to be nil. Based on spotting, scale, vertebrae and caecal counts, the 1959 collection seems to represent essentially a pure strain. Every effort should be made to certify the purity of present populations and protect them from introductions.

The sample from Red Canyon is the only known collection of trout from the North Platte drainage. These were collected by Dr. John Greenbank and his field notes indicate that the area is extremely remote and not likely to have introduced trout. The characteristics of the Red Canyon trout indicate a native strain slightly differentiated from South Platte and Arkansas River stomias. They have fewer scales and vertebrae, 12 of the 20 have 10 pelvic rays and the spots are smaller and more numerous than in the other stomias examined.

Although our material on stomias is not comprehensive, the data indicate that the endemic trout of the Arkansas and Platte drainages should be retained as a valid subspecies. Unless it can be demonstrated conclusively that the type specimens of stomias did not come from the Platte or Arkansas drainages, the name stomias should continue to be applied in its present interpretation.

The Red Canyon collection was made by Greenbank in Aug. 1950. - Red Canyon is branch of Roaring Fork R. - One mile below Roxy Ann Lake - 11,000 ft. el., near Continental Divide - Jackson Co. - These trout appear to be stomias, but their being native to this area must be considered as doubtful due to the fact that native trout were not belived to occur in the North Platte system.

Table . -- *Salmo clarkii* stomias

Sample and Date of Collection	Gillrakers			Vertebrae			Basibranchial Teeth			Scales Lateral Series			Scales Above Lateral Line		
	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean
SOUTH PLATTE SYSTEM															
Moraine Park Colorado - 1889	1	19		1	59		1	absent		1	195		1	44	
Bear Creek, Morrison, Colorado - 1889	4	16-20	18.3	4	62-63	62.5		1 - 1 tooth 3 - 0 teeth					4	41-44	42.7
Pingaree Park Colorado - 1932	2	18-20					2	1-6		2	196-213		2	47-48	
Albion Creek, Boulder Co. Colorado - 1955	9	18-22	19.4	9	59-61	60.1	7	1-23	6.9	9	178-205	191.2	9	44-51	47.2
Big Thompson River, Rocky Mtn Nat. Park Colorado - 1959	20	18-21	19.1	20	59-62	60.8	19	1-10 ← 1 - 0 teeth	7.1	19	177-215	199.8	11	43-51	47.5
NORTH PLATTE															
Red Canyon, Jackson Co., Colorado - 1950	20	18-22	19.6	20	59-61	59.9	15 20 ← 5	1-13 - 0 teeth	4.2	20	172-194	184.5	20	40-49	44.0
ARKANSAS SYSTEM															
Arkansas R., Leadville Colorado - 1889	2	21-22		4	60-62	61.0	2	2-12		2	198-213		2	46-49	
Twin Lakes, Leadville Colorado - 1889	8	18-20	19.5	7	61-62	61.7	8	6-14	10.6	7	170-202	186.9	7	46-53	49.0
S. c. lewisi Yellowstone L.	30	19-23	20.6	30	60-63	61.5	29	1-27	13.7	30	149-202	170.3	30	36-48	41.8

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

June 25, 1965

E. A. Benson
Project Power Manager
Bureau of Reclamation
Montrose, Colorado

Dear Mr. Benson:

Reference is made to a telephone conversation on June 24, 1965 with Mr. George Hensley, Acting Project Power Manager, Bureau of Reclamation. This office requested a change in the helicopter utilization dates from June 29 through July 1, 1965 to July 20 through July 22, 1965. Mr. Hensley indicated the change to be satisfactory and may very well be a better selection than the original schedule since the helicopter has been industriously engaged in flood damage surveillance. The request was initiated as a result of unfavorable ground condition reports from the Rocky Mountain National Park Service personnel, these included observations of excessive amounts of snow cover and heavy stream flows.

Keeping the reassigned schedule in mind the following itinerary should be considered current:

July 19th - Final equipment preparation by Bureau of Sport Fisheries and Wildlife personnelin Fort Collins, Colorado and continue to the Estes Park area.
July 20th - Ingress of personnel and equipment to the collection site in the Forest Canyon area. Overnight.
July 21st - Collection of fishes by electrofishing methods. Overnight.
July 22nd - Egress of personnel and equipment, transportation of collected fishes to the Leadville National Fish Hatchery Leadville, Colorado.

Consideration displayed toward the unexpected change in the helicopter utilization is greatly appreciated.

Yours truly,

Fishery Management Biologist
Bureau of Sport Fisheries & Wild.
Branch of Fishery Mgmt. Services
Springville, Utah

cc: Regional Director
Att. Jack E. Hemphill
Dr. Robert E. Vincent
Tom French
Neal Guse

Dr. Robert E. Vincent, Leader
Colorado Cooperative Fishery Unit
Bureau of Sport Fisheries & Wildlife
Room 242 Forestry Building
Colorado State University
Fort Collins, Colorado

OPTIONAL FORM NO. 10
5010-104

UNITED STATES GOVERNMENT

Memorandum

BUREAU OF SPORT FISHERIES & WILDLIFE
Region 2, Albuquerque, New Mexico

TO : Fishery Management Biologist
Springville, Utah

DATE: June 3, 1965

FROM : Assistant Regional Supervisor, Branch of Fishery Management Services, Albuquerque, New Mexico

SUBJECT: Forest Canyon Cutthroat Trout, Rocky Mountain National Park, Colorado

I spoke with Dr. Robert E. Vincent on the phone June 2, 1965, regarding the taking of adults and/or eggs of the cutthroat trout found in Forest Canyon. He and Dr. George Post will carry out genetic studies to determine if these fish are the (greenback) strain.

Dr. Vincent will make several inquiries regarding availability of helicopter service at Boulder and Denver, Colorado, and the availability of the State Game and Fish plane to transport fish to Leadville National Fish Hatchery for retention. It was felt that sometime during the last two weeks of June would be most suitable and that two days would be sufficient time to collect the hundred adult fish and/or eggs. Electrofishing will be used to make the collection and fish will be anesthetized and packed in snow or damp cloth for the trip out. The location of the fish tank or plane would be determined after Dr. Vincent's inquiries.

You should refer to a report on our anesthetization of fish for transportation from Alpine Lake found in the Wind River Indian Reservation folders.

Cost of helicopter service will be covered by the Springville Field Office. This should not exceed more than three hours flight and standby time or from $400 to $450, depending upon arrangements with local flying service. The number of persons involved in the trip can be determined by you. You may wish to have Larry Peterson accompany you on this trip along with either Dr. Post or Robert Vincent.

The Leadville distribution unit will be quite busy during this time of the season and will not be available for transporting the fish from the Rocky Mountain area to Leadville. Dr. Vincent stated that he may be able to arrange for the State plane to meet the helicopter at either Estes Park or another location for transport to Leadville Hatchery. If this cannot be arranged, two alternatives may be necessary. You may wish to arrange for the use of the Ute Tribe's small tank or the Springville Hatchery's small tank or arrange for the use of Colorado Fish and Game distribution unit. Dr. Vincent stated that he could furnish most of the equipment which would consist of a lightweight electrofishing unit and spare parts along with necessary camping gear.

You should immediately contact Dr. Vincent regarding the necessary preparations for the trip the latter part of this month.

This office would appreciate any information regarding the preparation or tentative schedule for the taking of cutthroat trout from Forest Canyon.

Robert L. Azevedo

Robert L. Azevedo

cc: Colorado Cooperative Fishery Unit

Greenback Ct. sent to Seedville

1958 — 26 from Albion Creek — Aug & Oct, 1957
50 from Forest Canyon

1959. — 89 from Forest Canyon.

In 1958 Spawning in Fort Canyon began July 1, completed by July 15.

July 5, 1963

E. Robert Turner
City Manager
Boulder, Colorado

Dear Mr. Turner:

Thank you for your letter of July 1, 1963, regarding access to the Boulder watershed area. The name of the student desiring an entrance permit is William H. Dieffenbach.

Thank you for your courtesy in providing this permit. We will make further arrangements with Mr. Platt.

Sincerely yours,

Robert E. Vincent
Unit Leader

REV/hvh

RECEIVED
BSF & W-REG. 2
JUL 2 1963
F M S
COLORADO COOP.

CITY OF BOULDER, COLORADO

July 1, 1963

Mr. Robert E. Vincent
United States Department of Interior
Colorado State University
Fort Collins, Colorado

Dear Mr. Vincent:

This will acknowledge your letter of 20 June 1963 requesting a permit for access to the Boulder watershed area.

Please send us the name of the student requiring this, and we will return a valid permit to you.

Further arrangements should be made by the student with Mr. Platt concerning access to the watershed and regulations governing visitors to this area.

Sincerely yours,

E. Robert Turner

E. Robert Turner
City Manager

by JMB.

EBT:jh

cc: Tom Platt
File

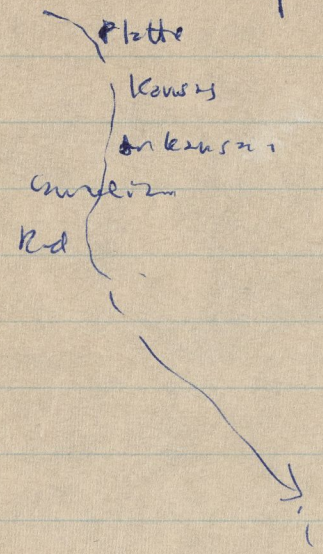
Artie Metcalf - Fishes of the Kansas R. System.

C.L. Smith: fossil fishes: Copeia 1954(4):282
58(3):176. 1962(3):505

p. 69 - Connections - Platte, Kansas, & Arkansas
preglacial connections & continuing into Pleistocene
until late Illinoian & possibly later.

- brown & rainbow trout stocked in streams &
springs of Kansas R. system - Colo. - Nebraska - Kansas
Wray, Yuma Co., Colo. - In N. Fork Republican R.
in Yuma Co., brown trout reproduce. - cool, clear water

- Pre glacial



166
25
18
209

25/100 sp.