STATE OF NEVADA
DEPARTMENT OF FISH AND GAME
1100 Valley Road, Reno, Nevada • Telephone 784-6214
MAIL: P.O. BOX 10678, RENO, NEVADA 89510

PAUL LAXALT
Governor

FRANK W. GROVES
Director

IN REPLY REFER TO:

May 5, 1971

Dr. Robert Behnke
Colorado Cooperative Fishery Unit
Colorado State University
Fort Collins, Colorado 80521

Dear Dr. Behnke:

In this package are cutthroat trout specimens I collected on April 12, 1971 from Johnson Creek located on the Goshute Indian Reservation near Ibapah, Utah. This stream is the headwaters of Deep Creek but the streams do not join except during periods of highwater in the spring and early summer months. At the time these fish were collected there was a stretch of dry stream bed about 5 3/4 miles long separating the two streams.

I also collected trout from Deep Creek, Fifteen-Mile Creek, Spring Creek, and one other creek about 1.5 miles north of Fiftenn-Mile Creek. All of these streams contained rainbow trout or possibly rainbow-cutthroat hybrids. Their appearance showed little, if any, sign of cutthroat however.

Since there is a high water connection between Johnson Creek and Deep Creek there is a strong possibility that the cutthroat in Johnson Creek are no longer pure. The appearance of the Johnson Creek specimens suggest that this has already happened. The spots and spotting pattern indicate that hybridization has occurred. I hope that your examination of these trout finds that this isn't true. Please let me know at your earliest convenience.

Sincerely,

Frank E Dodge Jr

Frank H. Dodge, Jr.
Fish and Game Agent II
Nevada Dept. of Fish and Game
P.O. Box 1109
Ely, Nevada 89301

FHD:gp

Deep Crk, Utah

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ______________ LOCALITY Asay crk.

COLLECTED BY ______________ DATE ______________

Cat. # ______________ Measurements by ______________ DATE ______________

Specimen # 048

	001	002	003	004	005	006	007	008
Total L.								
Standard L.								
Body D								
Head L	249	271	282	294	277	279	267	270
Oroit L								
Upper Jaw L	116	129	147	149	148	147	139	138
Dors. Orig. to Snt. tip	491	506	537	537	523	490	506	477
Dorsal fin basal L								
Dorsal fin depressed L	225	235	198	224	225	240	238	236
Adip. fin depressed L	092	100	123	114	103	093	087	103
Caudal peduncle D	116	124	119	114	109	113	122	126
Caudal peduncle L	168	147	169	169	155	132	145	155
Vertebrae								
1st Arch gillrakers (up)	007	008	008	007	007	008	007	007
(lower)	011	011	010	011	012	011	011	011
(total)	018	019	018	018	019	019	018	018
Branchiostegal rays right	011	010	010	010	011	011	009	010
(left)	011	011	010	010	011	010	010	011
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	041	040	039	041	042	039	041	039
Scales 2 rows above lat.	170	167	162	164	165	157	161	149
Pelvic fin rays								
Pyloric caeca	039	037	035	035	034	034	038	040
Dentition	009	005	007	002	000	009	008	003

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ____________________ LOCALITY Assy Creek → Sevier river UTAH

COLLECTED BY ____________________ DATE __________

Cat. # __________ Measurements by ____________________ DATE __________

Specimen #

	1	2	3	4	5	6	7	8
Total L.								
Standard L.	173	170	177	201	155	204	172	174
Body D								
Head L	43	46	50	59	43	57	46	47
Oroit L								
Upper Jaw L	20	22	26	30	23	30	24	24
Dors. Orig. to Snt. tip	85	86	95	108	81	100	87	83
Dorsal fin basal L								
Dorsal fin depressed L	39	40	35	45	35	49	41	47
Adip. fin depressed L	16	17	20	23	16	19	15	18
Caudal peduncle D	20	21	21	23	17	23	21	22
Caudal peduncle L	29	25	30	34	24	27	25	27
Vertebrae								

Vert n=8

61	62	63	64
1	4	3	1

$\bar{x} = 62.38$

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ______________ LOCALITY Asay Crk

COLLECTED BY ______________ DATE ______________

Cat. # __________ Measurements by ______________ DATE ______________

Specimen #

048

Specimen #	009	010	011	012	013	014	015	016	x̄
Total L.									
Standard L.									
Body D									
Head L	282	260	295	293	259	288	273	279	276
Oroit L									
Upper Jaw L	155	138	147	178	133	149	150	143	144
Dors. Orig. to Snt. tip	506	515	526	513	512	527	513	515	512
Dorsal fin basal L									
Dorsal fin depressed L	166	204	244	236	241	224	214	229	224
Adip. fin depressed L	098	107	109	126	120	109	096	075	103
Caudal peduncle D	115	117	115	126	120	119	123	124	119
Caudal peduncle L	155	153	166	146	175	159	166	143	156
Vertebrae / Caudal peduncle L	~~27~~	~~30~~	~~25~~	~~28~~	~~29~~	~~32~~	~~31~~	~~23~~	
Vertebrae									
1st Arch gillrakers (up)	007	007	007	007	007	007	007	006	
(lower)	011	010	009	010	010	010	012	012	
(total)	018	017	016	017	017	017	019	018	
Branchiostegal rays right	010	009	010	009	011	011	011	011	
(left)	011	010	011	010	011	010	011	011	
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line	041	041	039	042	039	038	041	039	
Scales 2 rows above lat.	159	171	167	163	149	166	164	157	
Pelvic fin rays									
Pyloric caeca	032	034	040	038	037	044	043	033	
Dentition	000	005	000	012	000	005	002	010	

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ______________ LOCALITY Asay creek

COLLECTED BY ______________ DATE ______________

Cat. # ______________ Measurements by ______________ DATE ______________

Specimen #

	9	10	11	12	13	14	15	16
Total L.								
Standard L.	174	196	156	191	166	201	187	161
Body D								
Head L	49	51	46	56	43	58	51	45
Oroit L								
Upper Jaw L	27	27	23	34	22	30	28	23
Dors. Orig. to Snt. tip	88	101	82	98	85	106	96	83
Dorsal fin basal L								
Dorsal fin depressed L	29	40	38	45	40	45	40	37
Adip. fin depressed L	17	21	17	24	20	22	18	12
Caudal peduncle D	20	23	18	24	20	24	23	20
Caudal peduncle L								

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ______________________ LOCALITY One mile Creek → Raft River UTAH

COLLECTED BY ______________________ DATE ____________

Cat. # __________ Measurements by ______________ DATE ____________

Specimen # 008

	009	010	011					
Total L.								
Standard L.								
Body D								
Head L	271	266	278					
Oroit L								
Upper Jaw L	123	133	126					
Dors. Orig. to Snt. tip	432	451	417					
Dorsal fin basal L								
Dorsal fin depressed L	271	274	278					
Adip. fin depressed L	086	096	088					
Caudal peduncle D	098	103	101					
Caudal peduncle L	160	155	151					
Vertebrae								
1st Arch gillrakers (up)	7	7	7					
(lower)	011	011	011					
(total)	018	018	018					
Branchiostegal rays right	010	011	011					
(left)	010	012	011					
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	040	040	041					
Scales 2 rows above lat.	149	139	143					
Pelvic fin rays								
Pyloric caeca	038	040	041					
Dentition	002	010	008					

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Upper Snake R. cutthroat (large spotted) LOCALITY One Mile Crk. / Box Elder Co / Utah Raft R. drainage / below Idaho line at boundary of Sawtooth N.F.

COLLECTED BY Behnke DATE 30 July 1972

Cat. # 33 Measurements by Murphy & Trail DATE 1973

Specimen # 8

	9	10	11	x̄ Convers:	↓			
Total L.	97	160	91					
Standard L.	81	135	79					
Body D								
Head L	22	36	22		268			
Oroit L								
Upper Jaw L	10	18	10		133			
Dors. Orig. to Snt. tip	35	61	33		423			
Dorsal fin basal L								
Dorsal fin depressed L	22	37	22		289			
Adip. fin depressed L	7	13	7		096			
Caudal peduncle D	8	14	8		105			
Caudal peduncle L	13	21	12		152			

Vertebrae

	n	Range	$\bar{x}$
Gill rakers	11	16: 1, 17: –, 18: 6, 19: 1, 20: –, 21: 3	18.72
Branchiostegal rays R	11	9: 1, 10: 4, 11: 3, 12: 3	10.72
L	11	10: 2, 11: 4, 12: 5	11.27
Scales above LL	11		39.36
Scales, lat. series	11		145.63
Pyloric caeca	11		42.45
Dentition	11		6.09

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES ______________ LOCALITY One mile Creek → Raft River UTAH

COLLECTED BY ______________ DATE ______________

Cat. # ______ Measurements by ______________ DATE ______________

Specimen # 008

	001	002	003	004	005	006	007	008
Total L.								
Standard L.								
Body D								
Head L	264	267	273	256	273	257	284	267
Oroit L								
Upper Jaw L	132	133	146	128	132	132	136	143
Dors. Orig. to Snt. tip	380	440	426	425	405	404	431	450
Dorsal fin basal L								
Dorsal fin depressed L	330	307	299	270	301	294	284	281
Adip. fin depressed L	090	094	082	121	103	088	105	111
Caudal peduncle D	107	118	101	101	103	110	115	104
Caudal peduncle L	165	149	152	148	150	147	157	143
Vertebrae								
1st Arch gillrakers (up)	7	8	7	7	6	7	8	8
(lower)	011	013	012	011	010	011	013	013
(total)	018	021	019	018	016	018	021	021
Branchiostegal rays right	011	012	009	010	010	010	012	012
(left)	012	012	011	011	010	011	012	012
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	040	037	039	036	038	039	040	043
Scales 2 rows above lat.	152	138	163	142	140	144	144	148
Pelvic fin rays								
Pyloric caeca	051	046	040	040	036	038	053	044
Dentition	002	011	012	001	000	006	012	003

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Upper Snake R. Cutthroat (Large spotted) LOCALITY one mile crk / Box Elder Co / Utah Raft R. drainage / below Idaho line at boundary of Sawtooth N.F.

COLLECTED BY Behnke DATE 30 July 72

Cat. # 33 Measurements by Murphy & Trail DATE 1973

Specimen # 8

11 Total

	1	2	3	4	5	6	7	8
Total L.	145	153	189	172	127	157	111	180
Standard L.	121	127	157	148	106	136	95	153
Body D								
Head L	32	34	43	38	29	35	27	41
Oroit L								
Upper Jaw L	16	17	23	19	14	18	13	22
Dors. Orig. to Snt. tip	46	56	67	63	43	55	41	69
Dorsal fin basal L								
Dorsal fin depressed L	40	39	47	40	32	40	27	43
Adip. fin depressed L	11	12	13	18	11	12	10	17
Caudal peduncle D	13	15	16	15	11	15	11	16
Caudal peduncle L	20	19	24	22	16	20	15	22
Ventral								

VERTEBRAE

N = 7

$\bar{x} = 61.5$

61	62
3	4

State of Utah

GOVERNOR
CALVIN L. RAMPTON

DIRECTOR
JOHN E. PHELPS

DEPT. OF NATURAL RESOURCES
DIVISION OF FISH & GAME

1596 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH 84116

Northeastern Regional Office - 64 East Main - Vernal, Utah 84078

June 18, 1971

Dr. Robert Behnke
Colorado Cooperative Fishery Unit
Colorado State University
Fort Collins, Colorado 80521

Dear Dr. Behnke:

Thank you for your letter of June 14 acknowledging the shipment of trout.

The first stock of cutthroat trout in Sheep Creek Lake was made July 22, 1959. These fish were 2100 per pound, and were stocked by airplane. The stock was from eggs received from Lahontan brood stock in Heenan Lake near the California-Nevada border. Reportedly this stock did not survive, and the lake was again stocked in 1961 with 80,000 cutthroat fry. These fish came from brood stock at Strawberry Reservoir in the spring of that year. The first spawn at Sheep Creek Lake was taken in 1964 from the fry plant made in 1961. Cutthroat fry from Sheep Creek Lake brood stock have been re-stocked to the lake every year since 1964.

Very truly yours,

John E. Phelps, Director

Larry J. Wilson,
Regional Fisheries Manager

Sheep Crk. L. Utah

Locality	Vertebrae 60	61	62	63	64	65	66	Gill rakers 15	16	17	18	19	20	21	22	23	24
STRAWBERRY RES. UTAH BROOD STOCK fm. Lake 59	1	1	3	2						1	2	4	2	1			
	N=7 $\bar{X}$=61.9							N= 10 $\bar{X}$= 19.0									
SHEEP CRK. L! introduced from Strawberry Res. stock	2	2	2						1		1	2	3	1	2		
	N=7 $\bar{X}$= 60.7							N=10 $\bar{X}$= 19.7									

Locality	Pyloric caeca N	range	$\bar{X}$	Scales, lat. ser. and above lat. line N	range	$\bar{X}$	Branchiostegal rays N	range	$\bar{X}$	Pelvic fin rays N	range	$\bar{X}$	Basibranch teeth N	range	$\bar{X}$
STRAWBERRY RES. UTAH	10	37-51	43.2	5	38-43 138-185	39.4 168.9	10 10	9-11 10-12	10.3 11.3	10	9-10	9.5	—	0-19	7.5
SHEEP CRK. L!	10	31-63	40.2	10 10	39-44 158-189	41.3 172.1	10 10	10-11 10-12	10.3 10.4	10	9-10	9.1	10	0-31+	13.3

conversions of lengths + sample means 1/

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY Yellowstone area collections (1972)

COLLECTED BY ______ DATE ______

Cat. # ______ ~~Measurements~~ CONVERSIONS by ______ DATE ______

Specimen #	1	2	3	4	5	6	7	8
Total L.								
Standard L.								
Body D								
Head L	230.52	254.34	254.20		257.25	251.62	245.60	259.91
Oroit L								
Upper Jaw L	116.32	128.23	126.52		124	126.5	125.87	136.68
Dors. Orig. to Snt. tip	441.13	462.58	443.60		452.25	460	454.37	453.38
Dorsal fin basal L								
Dorsal fin depressed L	219.93	252.07	263.61		269	264.75	241.65	241.04
Adip. fin depressed L	88.36	99.33	103.09		101.75	90	84.80	93.25
Caudal peduncle D	106.91	107.72	106.16		120.25	117.12	99.39	99.02
Caudal peduncle L	171.30	156.15	157.68		161.75	161.75	170.73	153.87
Vertebrae	63.5	61.8	61.7		62.0	62.0	61.8 ?	62.67
1st Arch gillrakers (up)								
(lower)								
(total)	19	19.65	19.63		20.25	20.37	20.0	20.66
Branchiostegal rays right	10	10.71	10.83		11.0	11.12	10.83	11
(left)	11	11.35	11.41		11.25	10.87	11.16	11.11
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	47	43.35	42.75		36.75	44.62	44.16	40.77
Scales 2 rows above lat.	171.5	167.41	161.08		143.25	163.87	173.50	178.22
Pelvic fin rays								
Pyloric caeca	33.5	42.64	42.25		39.50	46.62	48.0	58.44
Dentition	18	12.00	11.81		5.00	19.42	16.83	14.77
Sample size	2	17	12		4	8	6	9
	Hechtman Lake	Steer Creek	Stewart Creek		Elk Creek	Yellowstone River	Upper Snake River	Sedge Creek
	13	21	22				17	18

CONVERSIONS OF LENGTHS + SAMPLE MEANS

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES *Salmo clarki* LOCALITY *Yellowstone area collections* (1972)

COLLECTED BY ______ DATE ______

Cat. # ______ ~~Measurements~~ CONVERSIONS by ______ DATE ______

Specimen #

	9	10	11	12	13	14	15 (incorrect lengths)	16
Total L.								
Standard L.								
Body D								
Head L	256.46	251.22	268.11	259.94		249.34	264.11	264.80
Oroit L								
Upper Jaw L	130.55	133.84	141.92	134.13		125.29	131.49	144.04
Dors. Orig. to Snt. tip	470.76	479.48	493.75	483.94		469.88	423.83	478.50
Dorsal fin basal L								
Dorsal fin depressed L	240.39	235.28	240.56	234.55		236.89	298.02	249.78
Adip. fin depressed L	102.33	105.26	103.16	102.21		105.48	89.94	110.13
Caudal peduncle D	107.91	109.98	109.74	107.31		109.72	109.87	109.55
Caudal peduncle L	162.88	164.53	163.72	162.23		171.59	154.15	155.25
Vertebrae	62.09	61.31	61.56	61.64			61.75	62.23
1st Arch gillrakers (up)								
(lower)								
(total)	20.24	20.38	19.81	19.63		19.11	19.87	19.76
Branchiostegal rays right	9.39	10.38	10.93	10.81		10.77	11.00	10.61
(left)	10.06	11.06	11.18	11.09		10.96	11.37	11.23
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	43.24	46.06	45.56	42.45		43.85	47.62	43.30
Scales 2 rows above lat.	174.12	172.13	172.62	165.63		164.96	162.62	171.46
Pelvic fin rays								
Pyloric caeca	45.88	39.81	41.56	43.36		41.51	37.12	35.69
Dentition	12.33	11.13	13.68	12.36		6.03	15.62	21.84
Sample size	33	16	16	11		27	8	13
	/	/	/	/		/	/	/
	Bear Creek	Rock Creek	Shields River	N. Horsefly Creek		S. Paintrock Creek	Cottonwood Creek	Sohare Creek
				12			9	F9

CONVERSIONS OF LENGTHS + SAMPLE MEANS 3/

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Salmo clarki LOCALITY Yellowstone area collections (1972)

COLLECTED BY DATE

Cat. # ~~Measurements~~ CONVERSIONS by DATE

Specimen #	17	18	19	20	21		38	39
Total L.								
Standard L.								
Body D								
Head L	250.36	253.38	244.06	266.64	258.42		247.04	254.19
Oroit L								
Upper Jaw L	133.17	130.35	133.04	147.96	130.68		137.37	122.00
Dors. Orig. to Snt. tip	468.56	467.03	468.46	474.89	480.55		473.01	490.10
Dorsal fin basal L								
Dorsal fin depressed L	219.58	233.68	224.65	253.80	220.99		223.43	220.28
Adip. fin depressed L	97.00	103.44	99.80	113.21	93.51		102.55	92.27
Caudal peduncle D	103.95	105.92	106.83	108.61	109.72		102.07	112.83
Caudal peduncle L	161.59	166.30	157.68	155.27	160.29		159.32	162.37
Vertebrae	62.71	61.94	62.43	62.71	62.40		62.75	62.70
1st Arch gillrakers (up)								
(lower)								
(total)	19.14	19.76	19.86	19.57	20.00		20.25	20.10
Branchiostegal rays right	10.35	10.88	10.71	10.71	10.70		11.00	11.00
(left)	10.71	11.00	11.14	10.64	10.60		11.50	11.10
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	41.71	45.17	41.86	41.93	40.60		45.00	45.70
Scales 2 rows above lat.	171.64	171.94	175.93	165.57	172.90		174.00	165.80
Pelvic fin rays								
Pyloric caeca	38.00	38.05	36.92	37.71	38.10		46.00	40.50
Dentition	16.50	18.47	18.86	16.14	8.70		18.00	16.00
Sample size	14	17	14	14	10		4	10
	/	/	/	/	10		/	/
	Fish Creek	Spread Creek	Strawberry Creek	Pink Creek	Raspberry Creek		Salt River	Horse Creek
	10	20	23	14	15		16	11

CHARACTER ANALYSIS SHEET

Page ____ of ____ pages

Species Salmo clarki + clarki x gairdneri

Locality Reservoir Canyon, Pine Valley Mtns., Lower section

Field No. GBS-2B Coll. by Gard, Behnke, Seegrist

Date of Coll. 9-12-58 Measurements by ________ Date ________

Jar No. ____ No. of Jars ____ No. of Spec. ____ Specimen No. ________

	N	Range	Mean	$S.D.^2$	S.D.	C.D.	SEM
Standard L	39	109-248	154.8				
Body D	39	232-285	253.6				
Head L	39	250-298	273.6				
Head D	39	171-202	185.9				
Head W	39	126-157	141.8				
Least interorbital bony W	39	59-85	68.1				
Occiput to snout tip	39	172-212	191.1				
Snout L	39	53-81	64.0				
Orbit L	39	65-92	73.4				
Upper Jaw L	39	134-193	157.3	147.3	12.1		1.94
Dorsal origin to snout tip	39	472-534	506.9				
Depressed dorsal to insertion of adipose	39	103-176	140.6				
Dorsal origin to anal o	39	324-367	346.2				
Dorsal fin basal L	39	126-172	149.0				
Dorsal fin depressed L ✓	39	200-257	229.0	241.947	15.554		2.491
Adipose fin depressed L	39	82-106	92.5				
Caudal peduncle D	39	98-128	115.3	31.1	5.58		.893
Caudal peduncle L	39	134-174	158.5	75.1 ✓	8.67 ✓		1.38
Vertebrae	39	59-65	62.5	1.36 ✓	1.17 ✓		.187 ✓
First arch gill rakers (upper)	39	6-8	7.1				
(lower)	39	11-14	12.0				
(total)	39	17-22	19.1	1.41 ✓	1.19 ✓		.190 ✓
Basibranchial teeth	*13	1-11	5.3				
Branchiostegal rays (right)	39	9-13	11.3	.734	.857		.137
(left)	39	10-13	11.4	.827	.909		.145
Pectoral fin rays	39	13-16	14.4				
Pelvic fin rays	39	9-10	9.4				
Scales in lateral line	38	116-126	121.1	4.47	2.11		.343
Scales above lateral line	34	29-48	38.5	26.0	5.10		.875
2 rows above	15	126-163	146.4				

*26 specimens w/o teeth not included

CHARACTER ANALYSIS SHEET

Page ___ of ___ pages.

Species *Salmo clarki (pleuriticus?)*

Locality *Reservoir Canyon, near Pine Valley, Utah*

Field No. *GBS-2A* Coll. by *Gard, Behnke, Seegrist*

Date of Coll. *9-58* Measurements by ______ Date ______

Jar No. ______ No. of Jars ______ No. of Spec. ______ Specimen No. ______

	N	Range	mean	S.D.²	S.D.	C.D.	SEM
Standard L	13	120-225	173.5				
Body D	13	222-273	245.9				
Head L	13	258-290	272.0				
Head D	13	164-192	179.4				
Head W	13	126-152	136.7				
Least interorbital bony W	13	63-73	67.0				
Occiput to snout tip	13	166-194	183.0				
Snout L	13	56-76	65.5				
Orbit L	13	59-76	66.5				
Upper Jaw L	13	146-176	160.2	94.7	9.73		2.70
Dorsal origin to snout tip	13	483-540	501.6				
Depressed dorsal to insertion of adipose	13	114-164	144.5				
Dorsal origin to anal o	13	324-352	338.9				
Dorsal fin basal L	13	124-155	141.0				
Dorsal fin depressed L	13	201-239	217.6	93.9	9.69		2.68
Adipose fin depressed L	13	86-102	94.2				
Caudal peduncle D	13	111-127	117.6	22.9	4.79		1.33
Caudal peduncle L	13	144-183	162.2	136.5 ✓	11.7 ✓		3.24
Vertebrae	13	61-64	62.0	.833	.911		.252 ✓
First arch gill rakers (upper)	13	6-8	7.5				
(lower)	13	11-13	12.2				
(total)	13	19-21	19.7	.564 ✓	.751 ✓		.208 ✓
Basibranchial teeth	*12	1-7	2.5				
Branchiostegal rays (right)	13	10-12	10.8	.427	.653		.181
(left)	13	10-12	11.0	.333	.577		.160
Pectoral fin rays	13	14-15	14.1				
Pelvic fin rays	13	9	9.0				
Scales in lateral line	13	118-127	121.8	7.86	2.80		.776
Scales above lateral line	10	38-46	42.1	6.54	2.56		.810
2 rows	12	145-182	159.2				

* one with (0) teeth not included
2 others included in count have root marks of more teeth, see original data sheet.

CHARACTER ANALYSIS SHEET

Page ____ of ____ pages

Species *Salmo clarki (pleuriticus?)* [Utah]

Locality *Reservoir Canyon, near Pine Valley Utah (headwaters)*

Field No. GBS-3 Coll. by *Gard, Behnke, Siegrist*

Date of Coll. 9-13-58 Measurements by ____________ Date ________

Jar No. ____ No. of Jars ____ No. of Spec. ____ Specimen No. ____________

	N	Range	Mean	$S.D.^2$	S.D.	C.D.	SEM
Standard L	18	109-181	148.6				
Body D	18	236-271	250.3				
Head L	18	254-298	279.9				
Head D	18	165-195	182.0				
Head W	18	134-155	146.8				
Least interorbital bony W	18	63-76	69.1				
Occiput to snout tip	18	172-202	187.8				
Snout L	18	56-75	65.2				
Orbit L	18	64-85	72.2				
Upper Jaw L	18	146-182	167.8	109.7	10.5		2.48
Dorsal origin to snout tip	18	488-534	512.3				
Depressed dorsal to insertion of adipose	18	99-146	124.8				
Dorsal origin to anal o	18	338-364	348.7				
Dorsal fin basal L	18	132-161	148.8				
Dorsal fin depressed L	18	221-263	244.1	95.5	9.77		2.30
Adipose fin depressed L	18	92-118	104.9				
Caudal peduncle D	18	114-130	120.8	18.0	4.24		1.00
Caudal peduncle L	18	155-170	161.6	21.3	4.62		1.09
Vertebrae	18	61-64	62.2	.736 ✓	.858 ✓		.202 ✓
First arch gill rakers (upper)	18	6-8	6.9				
(lower)	18	11-13	12.4				
(total)	18	17-21	19.3	1.04 ✓	1.02 ✓		.241 ✓
Basibranchial teeth	*16	1-9	4.9				
Branchiostegal rays (right)	18	10-11	10.7	.213	.462		.109
(left)	18	11-12	11.3	.236	.486		.115
Pectoral fin rays	18	14-15	14.2				
Pelvic fin rays	18	8-10	~~8.6~~ 9.1				
Scales in lateral line	18	118-124	121.3	3.62	1.90		.448
Scales above lateral line	15	39-44	41.5	2.27	1.51		.390
2 rows above	18	139-161	157.3 (157.6 above)				

* 2 not counted with (0) teeth.

C = Predominantly cutthroat in spotting
R = " rainbow " "
H = hybrid

CHARACTER ANALYSIS SHEET

Species Salmo clarki + clarki × gairdneri

Locality Reservoir Canyon, Pine Valley Mtns, Lower section

Field No. GBS-2B Coll. by Gard, Behnke, Seegrist

Date of Coll. 9-12-58 Measurements by Behnke Date 10-1-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen No.~~

	1 (C)	2 (C)	3 (H)	4 (H)	5 (C)	6 (H)	7 (C)
Standard L	157	170	175	148	157	248	136
Body D	39	46	45	38	39	60	34
Head L	43	47	51	41	43	74	34
Head D	29	32	34	28	28	45	24
Head W	22	25	26	21	22	39	18
Least interorbital bony W	10	12	13	11	10	21	8
Occiput to snout tip	28	34	35	28	30	49	24
Snout L	10	12	12	10	10	20	8
Orbit L	11	12	13	11	12	18	9
Upper Jaw L	26	29	29	23	26	48	19
Dorsal origin to snout tip	81	88	93	76	81	131	65
Depressed dorsal to insertion of adipose	24	30	24	18	25	34	22
Dorsal origin to anal o	54	58	59	51	51	81	46
Dorsal fin basal L	23	25	26	21	23	33	20
Dorsal fin depressed L	36	34	39	35	33	50	30
Adipose fin depressed L	14	18	17	13	15	22	13
Caudal peduncle D	19	20	20	19	18	29	16
Caudal peduncle L	25	27	26	25	24	35	23
Vertebrae	62	62	61	64	62	63	62
First arch gill rakers (upper)	7	8	7	7	7	7	6
(lower)	12	12	11	12	12	12	12
(total)	19	20	18	19	19	19	18
Basibranchial teeth	3	6	1	0	1	0	0
Branchiostegal rays (right)	11	11	11	11	11	12	11
(left)	11	12	11	12	11	12	11
Pectoral fin rays	14	13	14	15	14	14	14
Pelvic fin rays	9	9	10	10	9	10	9
Scales in lateral line	122	122	122	125	122	122	121
Scales above lateral line	47	42	38	43	44	—	38
		163	151			149	

CHARACTER ANALYSIS SHEET

Species *Salmo clarki + clarki x gairdneri*

Locality *Reservoir Canyon, Pine Valley Mtns. Lower section*

Field No. *GBS-2B* Coll. by *Gard, Behnke, Seegrist*

Date of Coll. *9-12-58* ~~Measurements~~ *conversions* by *Middleton* Date *2-20-59*

Jar No. *1* No. of Jars *1* No. of Spec. *39* Specimen No. ______

Measurements in thousandths of standard length

	1 (C)	2 (C)	3 (H)	4 (H)	5 (C)	6 (H)	7 (C)
Standard L	157	170	175	148	157	248	136
Body D	248	270	257	257	248	242	250
Head L	273	276	291	277	273	298	250
Head D	184	188	194	189	178	181	176
Head W	140	147	148	142	140	157	132
Least interorbital bony W	64	71	74	74	64	85	59
Occiput to snout tip	178	200	200	189	191	197	176
Snout L	64	71	69	68	64	81	59
Orbit L	70	71	74	74	76	73	66
Upper Jaw L	165	171	166	155	165	193	140
Dorsal origin to snout tip	515	517	531	513	515	528	478
Depressed dorsal to insertion of adipose	152	176	137	122	159	137	162
Dorsal origin to anal o	343	341	337	344	324	326	338
Dorsal fin basal L	146	147	148	142	146	133	147
Dorsal fin depressed L	229	200	223	236	210	202	221
Adipose fin depressed L	89	106	97	88	95	89	96
Caudal peduncle D	121	118	114	128	114	117	118
Caudal peduncle L	159	159	148	169	153	141	169

CHARACTER ANALYSIS SHEET

Species S. clarki + clarki x gairdneri

Locality Reservoir Canyon, Utah - lower section

Field No. GBS-2B Coll. by Gard et al

Date of Coll. 9-12-58 Measurements by Behnke Date 10-2-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen~~ No.

	8 (H)	9 (H)	10 (C)	11 (H)-R	12 H-R	13 (C)	14 H-C
Standard L	151	118	131	169	134	151	191
Body D	38	30	34	42	33	37	46
Head L	42	33	34	43	36	39	51
Head D	29	23	25	29	24	28	33
Head W	22	17	18	24	18	19	27
Least interorbital bony W	10	8	8	13	9	9	13
Occiput to snout tip	30	23	24	30	24	26	35
Snout L	9	8	8	10	8	8	12
Orbit L	12	9	10	11	10	10	13
Upper Jaw L	23	18	19	23	18	23	30
Dorsal origin to snout tip	78	61	65	82	67	74	97
Depressed dorsal to insertion of adipose	23	13	19	26	19	17	28
Dorsal origin to anal o	52	41	45	59	48	52	64
Dorsal fin basal L	22	18	18	26	23	21	24
Dorsal fin depressed L	33	29	28	38	33	35	39
Adipose fin depressed L	13	11	12	14	12	14	18
Caudal peduncle D	17	13	15	20	15	18	22
Caudal peduncle L	23	20	22	28	22	24	31
Vertebrae	62	63	62	62	62	62	63
First arch gill rakers (upper)	6	7	8	7	7	6	6
(lower)	12	12	12	12	12	12	11
(total)	18	19	20	19	19	18	17
Basibranchial teeth	0	0	11	0	0	4	1
Branchiostegal rays (right)	11	12	11	11	13	11	10
(left)	11	12	11	11	13	11	10
Pectoral fin rays	15	14	14	15	15	14	14
Pelvic fin rays	9	10	9	10	10	9	9
Scales in lateral line	121	121	120	118	122	119	123
Scales above lateral line	36	38	43	32	29	40	42
	137				142		143

CHARACTER ANALYSIS SHEET

Species Salmo clarki + clarki x gairdneri

Locality Reservoir Canyon, Utah - lower section

Field No. GBS-2B Coll. by Gard, et al.

Date of Coll. 9-12-58 ~~Measurements~~ conversions by Middleton Date 2-21-59

Jar No. 1 No. of Jars 1 No. of Spec. 39 Specimen No. ______

Measurements in thousandths of standard length

	8 (H)	9 (H)	10 (C)	11 (H)	12 H-R	13 (C)	14 H-C
Standard L	151	118	131	169	134	151	191
Body D	252	254	259	248	246	245	241
Head L	278	280	259	254	269	258	267
Head D	192	195	191	171	179	185	173
Head W	146	144	137	142	134	126	141
Least interorbital bony W	66	68	61	77	67	60	68
Occiput to snout tip	199	195	183	177	179	172	183
Snout L	60	68	61	59	60	53	63
Orbit L	79	76	76	65	75	66	68
Upper Jaw L	152	152	145	136	134	152	157
Dorsal origin to snout tip	516	517	496	485	500	490	507
Depressed dorsal to insertion of adipose	152	110	145	154	142	113	146
Dorsal origin to anal o	344	347	343	349	358	344	335
Dorsal fin basal L	146	152	137	154	172	139	126
Dorsal fin depressed L	218	246	214	225	246	232	204
Adipose fin depressed L	86	93	92	83	90	93	94
Caudal peduncle D	113	110	114	118	112	119	115
Caudal peduncle L	152	169	168	165	164	159	162

CHARACTER ANALYSIS SHEET

Species S. clarki + clarki x gairdneri

Locality Utah

Field No. GBS-2B Coll. by Gard et al

Date of Coll. 9-12-58 Measurements by Behnke Date 10-3-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen No.~~

	15(H)	16(R)	17(C)	18(H)	19 H-R	20(C)	21(H)
Standard L	144	232	122	169	139	176	143
Body D	35	55	38	42	37	46	38
Head L	40	61	32	45	37	50	38
Head D	27	41	23	30	25	33	26
Head W	21	31	16	24	21	24	22
Least interorbital bony W	9	17	8	12	9	12	10
Occiput to snout tip	29	41	23	31	26	34	26
Snout L	10	16	8	11	8	12	9
Orbit L	11	15	9	12	9	12	10
Upper Jaw L	24	36	19	27	20	32	21
Dorsal origin to snout tip	76	112	61	88	70	93	72
Depressed dorsal to insertion of adipose	23	27	20	20	18	28	21
Dorsal origin to anal o	50	83	42	60	51	60	52
Dorsal fin basal L	21	35	17	24	22	25	24
Dorsal fin depressed L	30	55	26	39	33	42	36
Adipose fin depressed L	13	21	11	16	13	18	13
Caudal peduncle D	18	27	14	20	16	20	14
Caudal peduncle L	23	36	20	27	23	26	23
Vertebrae	63	64	62	64	61	63	65
First arch gill rakers (upper)	7	7	7	7	8	7	7
(lower)	12	11	12	12	11	11	12
(total)	19	18	19	19	19	18	19
Basibranchial teeth	8	0	11	0	0	0	0
Branchiostegal rays (right)	11	12	11	12	12	11	11
(left)	11	12	11	12	13	11	11
Pectoral fin rays	14	16	14	15	15	14	14
Pelvic fin rays	9	10	9	10	9	9	9
Scales in lateral line	121	121	123	126	118	121	122
Scales above lateral line	43	40	47	40	—	—	33
	137			145			133

CHARACTER ANALYSIS SHEET

Species *Salmo clarki + clarki x gairdneri*

Locality Utah

Field No. GBS-2B Coll. by Gard, et. al.

Date of Coll. 9-12-58 ~~Measurements~~ conversions by Middleton Date 2-21-59

Jar No. 1 No. of Jars 1 No. of Spec. 39 Specimen No.

Measurements in thousandths of standard length

	15 (H)	16 (R)	17 (C)	18 (H)	19 (H-R)	20 (C)	21 (H)
Standard L	144	232	122	169	139	176	143
Body D	243	237	262	248	266	261	266
Head L	278	263	262	266	266	284	266
Head D	187	177	188	177	180	187	182
Head W	146	134	131	142	151	136	154
Least interorbital bony W	62	73	66	71	65	68	70
Occiput to snout tip	201	177	188	183	187	193	182
Snout L	69	69	66	65	58	68	63
Orbit L	76	65	74	71	65	68	70
Upper Jaw L	167	155	156	160	144	182	147
Dorsal origin to snout tip	527	483	500	520	503	528	503
Depressed dorsal to insertion of adipose	160	116	164	118	129	159	147
Dorsal origin to anal o	347	358	344	355	367	341	363
Dorsal fin basal L	146	151	139	142	158	142	168
Dorsal fin depressed L	208	237	213	230	237	239	252
Adipose fin depressed L	90	91	90	95	93	102	91
Caudal peduncle D	125	116	115	118	115	114	98
Caudal peduncle L	160	155	164	160	165	148	161

CHARACTER ANALYSIS SHEET

Species S. clarki + clarki x gairdneri

Locality Utah

Field No. GBS-2B Coll. by Gard et al

Date of Coll. 9-12-58 Measurements by Behnke Date 10-6-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen No.~~

	22 (C)-H	23 H-R	24 (C)	25 R-H	26 (H)	27 R-H	28 (C)-H
Standard L	189	136	165	151	232	134	153
Body D	46	36	42	43	56	33	40
Head L	51	40	44	42	63	36	41
Head D	35	27	31	29	43	25	29
Head W	26	20	23	22	34	19	22
Least interorbital bony W	13	11	11	11	18	9	11
Occiput to snout tip	36	28	31	30	43	26	29
Snout L	12	9	11	10	16	8	10
Orbit L	13	11	11	12	15	10	11
Upper Jaw L	29	22	27	24	38	20	25
Dorsal origin to snout tip	96	71	88	79	118	67	78
Depressed dorsal to insertion of adipose	27	14	27	17	39	21	25
Dorsal origin to anal o	66	46	55	52	81	48	55
Dorsal fin basal L	30	22	23	25	35	19	24
Dorsal fin depressed L	43	33	35	38	51	30	36
Adipose fin depressed L	20	12	14	13	21	11	14
Caudal peduncle D	22	16	20	19	26	14	18
Caudal peduncle L	28	21	25	24	31	22	23
Vertebrae	61	63	63	63	64	64	62
First arch gill rakers (upper)	7	8	8	8	7	7	6
(lower)	13	12	12	13	12	11	12
(total)	20	20	20	21	19	18	18
Basibranchial teeth	0	0	1	0	0	0	0
Branchiostegal rays (right)	10	12	10	12	12	11	11
(left)	10	12	10	13	12	11	11
Pectoral fin rays	14	14	14	16	15	16	14
Pelvic fin rays	9	10	9	10	10	10	9
Scales in lateral line	119	119	120	124	124	122	119
Scales above lateral line	36	30	47	34	39	34	40
	144		157		161		146

CHARACTER ANALYSIS SHEET

Page ____ of ____ pages

Species S. clarki + clarki x gairdneri

Locality Utah

Field No. GBS-2B Coll. by Gard et al

Date of Coll. 9-12-58 ~~Measurements~~ conversions by Middleton Date 2-21-59

Jar No. 1 No. of Jars 1 No. of Spec. 39 Specimen No. ____

Measurements in thousands of standard length

	22 Ⓒ H	23 H-R	24 Ⓒ	25 R-H	26 Ⓗ	27 R-H	28 Ⓒ-H
Standard L	189	136	165	151	232	134	153
Body D	243	265	255	285	241	246	261
Head L	270	294	267	278	272	269	268
Head D	185	198	188	192	185	187	189
Head W	138	147	139	146	147	142	144
Least interorbital bony W	69	81	67	73	78	67	72
Occiput to snout tip	190	206	188	199	185	194	189
Snout L	63	66	67	66	69	60	65
Orbit L	69	81	67	79	65	75	72
Upper Jaw L	153	162	164	159	164	149	163
Dorsal origin to snout tip	508	522	533	523	509	500	509
Depressed dorsal to insertion of adipose	143	103	164	119	168	157	163
Dorsal origin to anal o	349	338	333	344	349	358	359
Dorsal fin basal L	159	162	139	166	151	142	157
Dorsal fin depressed L	227	243	212	252	220	224	235
Adipose fin depressed L	106	88	85	86	91	82	91
Caudal peduncle D	116	118	121	126	112	104	118
Caudal peduncle L	148	154	152	159	134	164	150

39
26
13

CHARACTER ANALYSIS SHEET

Species S. clarki + clarki x gairdneri

Locality Utah

Field No. GBS-213 Coll. by Gard et al

Date of Coll. 9-12-58 Measurements by Behnke Date 10-6-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen~~ No.

	29 H-C	30 H-C	31 (H)	32 (H)	33 R-H	34 (H)	C 35 (H)
Standard L	188	148	148	134	133	138	129
Body D	49	39	41	34	32	32	32
Head L	55	41	42	36	37	40	35
Head D	35	28	29	26	25	25	26
Head W	28	21	22	18	18	19	19
Least interorbital bony W	13	10	10	10	8	9	8
Occiput to snout tip	38	30	30	26	27	27	25
Snout L	74	10	10	8	8	9	7
Orbit L	13	12	11	10	11	11	10
Upper Jaw L	33	24	25	20	20	22	18
Dorsal origin to snout tip	98	74	76	65	65	69	64
Depressed dorsal to insertion of adipose	25	19	23	19	19	17	17
Dorsal origin to anal o	66	54	50	47	46	48	46
Dorsal fin basal L	28	25	21	22	20	20	21
Dorsal fin depressed L	45	38	33	34	32	34	31
Adipose fin depressed L	18	17	11	13	13	13	11
Caudal peduncle D	21	17	17	15	14	16	15
Caudal peduncle L	28	22	24	22	21	22	22
Vertebrae	62	61	64	63	59	63	61
First arch gill rakers (upper)	8	6	7	8	6	7	8
(lower)	14	11	11	13	12	13	13
(total)	22	17	18	21	18	20	21
Basibranchial teeth	0	0	0	0	0	9	0
Branchiostegal rays (right)	11	10	11	13	10	11	11
(left)	12	10	12	13	10	11	12
Pectoral fin rays	15	14	15	14	13	14	16
Pelvic fin rays	10	9	10	10	9	9	10
Scales in lateral line	122	122	124	119	l.l/spc incompl	119	116
Scales above lateral line	—	40	34	34	33	40	31
	162				126		

CHARACTER ANALYSIS SHEET

Species S. clarki + clarki x gairdneri

Locality Utah

Field No. GBS-213 Coll. by Gard, et al.

Date of Coll. 9-12-58 ~~Measurements~~ conversions by Middleton Date 2-24-59

Jar No. 1 No. of Jars 1 No. of Spec. 39 Specimen No.

Measurements in thousandths of standard length

	29 H-C	30 H-C	31 (H)	32 (H)	33 R-H	34 H-C	35 (H)
Standard L	188	148	148	134	133	138	129
Body D	260	263	277	254	240	232	248
Head L	292	277	284	269	278	290	271
Head D	186	189	196	194	188	181	202
Head W	149	142	149	134	135	138	147
Least interorbital bony W	69	68	68	75	60	65	62
Occiput to snout tip	202	203	203	194	203	195	194
Snout L	74	68	68	60	60	65	54
Orbit L	69	81	74	75	83	80	78
Upper Jaw L	175	162	169	150	150	159	140
Dorsal origin to snout tip	520	500	513	485	488	500	496
Depressed dorsal to insertion of adipose	133	128	155	142	143	123	132
Dorsal origin to anal o	350	365	338	351	345	348	357
Dorsal fin basal L	149	169	142	164	150	145	163
Dorsal fin depressed L	239	257	223	254	240	246	240
Adipose fin depressed L	96	115	74	97	98	94	85
Caudal peduncle D	112	115	115	112	105	116	116
Caudal peduncle L	149	149	162	164	158	159	171

CHARACTER ANALYSIS SHEET

Species S. clarki × gairdneri

Locality Utah

Field No. GB5-2B Coll. by Gard et. al.

Date of Coll. 9-12-58 Measurements by Behnke Date 10-7-58

Jar No. 1 No. of Jars 1 No. of Spec. 39 ~~Specimen No.~~

	36 (C)	37 (H)-C	38 (H)	39 C-H			
Standard L	144	109	126	118			
Body D	37	29	30	30			
Head L	40	30	33	34			
Head D	27	20	23	22			
Head W	20	16	17	17			
Least interorbital bony W	9	7	8	8			
Occiput to snout tip	26	22	23	25			
Snout L	9	6	7	7			
Orbit L	10	10	9	10			
Upper Jaw L	23	17	18	19			
Dorsal origin to snout tip	68	54	62	63			
Depressed dorsal to insertion of adipose	16	14	16	17			
Dorsal origin to anal o	49	39	43	39			
Dorsal fin basal L	19	15	19	18			
Dorsal fin depressed L	29	25	29	28			
Adipose fin depressed L	15	10	11	11			
Caudal peduncle D	17	13	14	13			
Caudal peduncle L	25	18	21	18			
Vertebrae	62	62	64	62			
First arch gill rakers (upper)	8	6	7	8			
(lower)	13	12	12	13			
(total)	21	18	19	21			
Basibranchial teeth	6	7	0	0			
Branchiostegal rays (right)	10	12	12	9			
(left)	11	13	12	10			
Pectoral fin rays	14	14	14	15			
Pelvic fin rays	9	9	9	9			
Scales in lateral line	122	118	120	121			
Scales above lateral line	48	39	36	/			

CHARACTER ANALYSIS SHEET

Species S. clarki x gairdneri

Locality Utah

Field No. GBS-2B Coll. by Gard, et al

Date of Coll. 9-12-58 ~~Measurements~~ conversions by Middleton Date 2-24-59

Jar No. 1 No. of Jars 1 No. of Spec. 39 Specimen No.

Measurements in thousandths of standard length

	36 (C)	37 (H)-C	38 (H)	39 C-H		
Standard L	144	109	126	118		
Body D	257	266	238	254		
Head L	278	275	262	288		
Head D	187	183	182	186		
Head W	139	147	135	144		
Least interorbital bony W	62	64	63	68		
Occiput to snout tip	180	202	182	212		
Snout L	62	55	56	59		
Orbit L	69	92	71	85		
Upper Jaw L	160	156	143	161		
Dorsal origin to snout tip	472	495	492	534		
Depressed dorsal to insertion of adipose	111	128	127	144		
Dorsal origin to anal o	340	358	341	330		
Dorsal fin basal L	132	138	151	152		
Dorsal fin depressed L	201	229	230	237		
Adipose fin depressed L	104	92	87	93		
Caudal peduncle D	118	119	111	110		
Caudal peduncle L	174	165	167	152		

~~LIBRARY~~
PINE Valley, UTAH

8

S.C. pleuriticus & hybrids

1. Resevoir canyon coll. 1958
G~~...~~BS2A and G~~...~~BS 3 are pure cutts
GB~~Y~~S 2 B are hybrids

2 Water canyon Coll Sept 1973

CURRENT STATUS OF CUTTHROAT SUBSPECIES IN THE WESTERN BONNEVILLE BASIN

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and
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Fisheries Biologist
Utah State Office

Presented to the Desert Fishes Council
Annual Meeting, November 17-18, 1977
Death Valley, California

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Abstract. Recent discoveries of native cutthroat trout populations in desert mountain ranges on the western fringe of the Bonneville Basin have prompted intensified management efforts by state and federal agencies. Analysis of Snake Valley cutthroat specimens in Trout Creek, Deep Creek Mountain range, Utah indicate this is a pure strain of the trout which once inhabited Pleistocene Lake Bonneville and which was though to be extinct in Utah. The Snake Valley cutthroat is similar to *Salmo clarki utah* of the eastern Bonneville Basin, however electrophoretic and morphomeristic analysis show unique genetic differences brought about by long-term isolation (8,000 years) from the rest of the Bonneville Basin cutthroat. This cutthroat is a common ancestor to several other limited cutthroat populations within the Basin in Nevada. In May 1977 the BLM withdrew from mineral entry about 27,000 acres within the Deep Creek Mountains for protection of this cutthroat and other unique resources on the range. Results of 1977 stream surveys on the Pilot Peak Mountain Range Utah indicate the presence of the threatened Lahontan cutthroat, *Salmo clarki henshawi*, in one isolated stream.

INTRODUCTION

Historically, the ancient Pleistocene Lake Bonneville in the Great Basin once supported a cutthroat trout, native to the Snake Valley area of Utah-Nevada. This trout once abounded in the area's several streams upon the Lake's decline (Hickman, 1977). The cutthroat population rapidly declined because of deteriorating habitat in the Twentieth Century to a point where it was believed to be extinct within its native range (Behnke 1976a) (Refer Figure 1).

In 1953 Ted Frantz, Nevada Fish and Game Department, discovered a cutthroat trout population in Pine Creek on Mt. Wheeler, Nevada (Frantz and King 1958). Samples were sent to Dr. Robert Miller who indicated

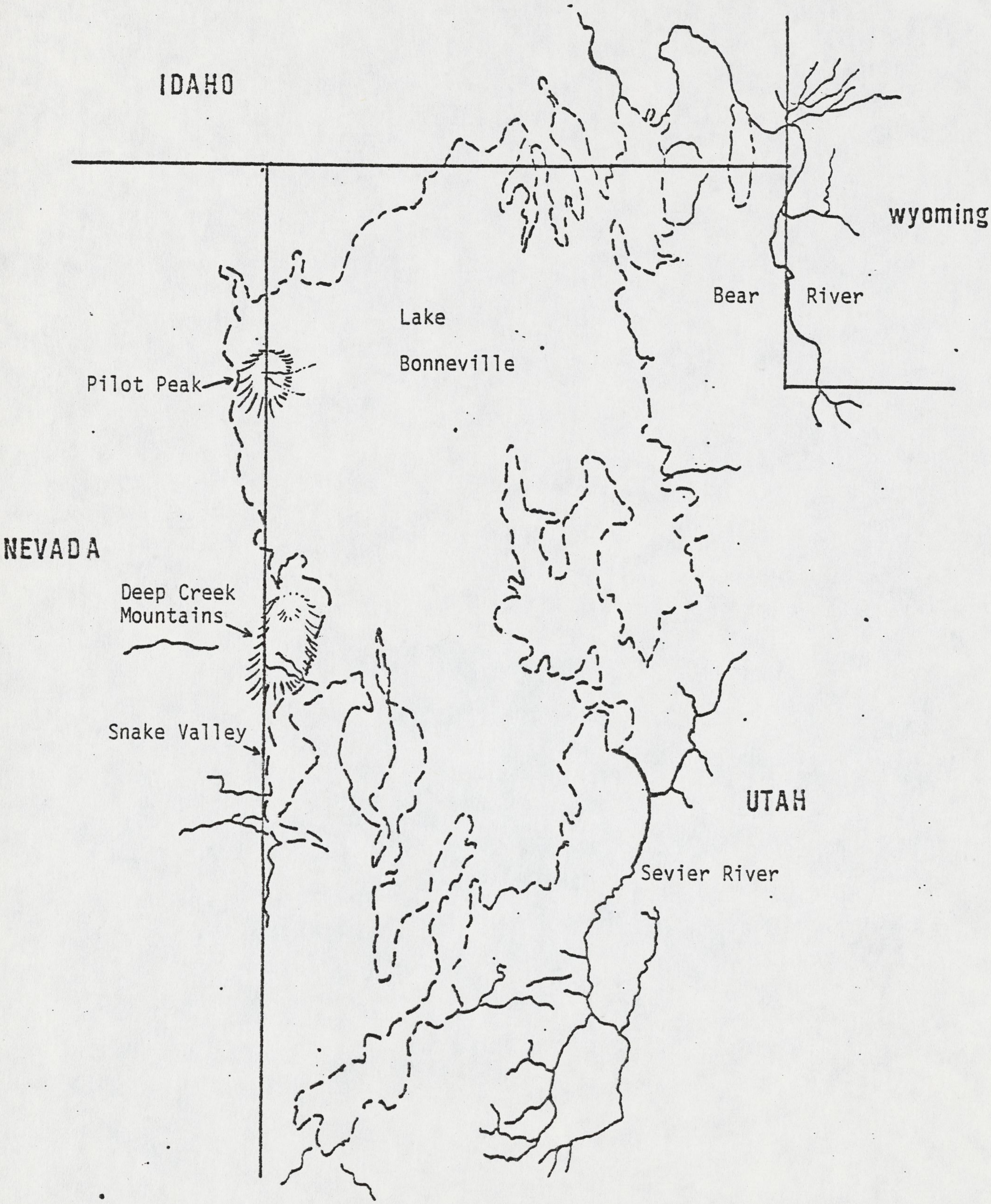

Figure 1. Area Map Location Showing The Western Bonneville Basin Area.

that they represented pure cutthroat trout. But Dr. Miller was unable to assign them to any described subspecies (letter from Dr. Miller to F. Dodge, May 26, 1971). It was assumed that this cutthroat was introduced from Trout Creek drainage of the Snake Valley area(Miller and Alcorn, 1946). This seemed unlikely when one considers that there were streams closer to Pine Creek which probably contained cutthroat trout (Lehman, Baker, Snake and Hendrys Creeks). Behnke (1976a) indicates the most logical origin of the Pine Creek cutthroat was from Lehman Creek (Mt. Wheeler tributary of the Snake Valley region) via the Osceola Ditch, constructed as a pioneer waterway.

During 1953 the Nevada Fish and Game Department introduced 44 fish from Pine Creek into Hampton Creek, Nevada. A second transplant of 54 cutthroat from Pine Creek was made into Goshute Creek, Nevada, in 1960. The Nevada Fish and Game Department, assuming these were Utah cutthroat, Salmo clarki utah, closed these streams to fishing and listed S.c. utah as an endangered species in Nevada. Mr. Frank Dodge, Nevada Fish and Game Department, in 1972, found a population of cutthroat trout in the headwaters of Hendrys Creek (Mt. Moriah tributary of the Snake Valley region) which resembled those found in Pine Creek. Following this, several unsuccessful attempts were made by the Nevada Fish and Game Department to locate additional pure populations of cutthroat trout in the Snake Valley area of Utah and Nevada.

In 1973 the BLM (Utah) began stream habitat surveys in the Deep Creek Mountain Range in an attempt to define critical habitats and possible remnant populations of the cutthroat. In the spring of 1974, BLM biologists Don Duff and Josh Warburton discovered cutthroat in the extreme headwaters of Trout Creek, Utah, above a natural barrier falls. Subsequent sampling and analysis by the BLM, Utah Division of Wildlife Resourses and Colorado State University (under contract funded by BLM) determined that Trout Creek specimens were pure strain fish of the Bonneville Basin. Inventories have continued to date and the only stream found to contain a pure population was Trout Creek. Hybridized populations (with rainbow trout) were found in Birch Creek and Johnson Creek (Hickman, 1977) (Refer to Figure 2).

REASONS FOR DECLINE

When the Snake Valley arm of Lake Bonneville dried up there were reletively few perennial streams in the area. In addition to this, since the mid 1800's, introductions of non-native trouts, climatic conditions, irrigation practices and habitat loss and degradation have been influential in reducing the number of cutthroat populations in the Snake Valley area. Replacement and hybridization from introductions of exotic rainbow trout (Salmo gairdneri) has posed the most

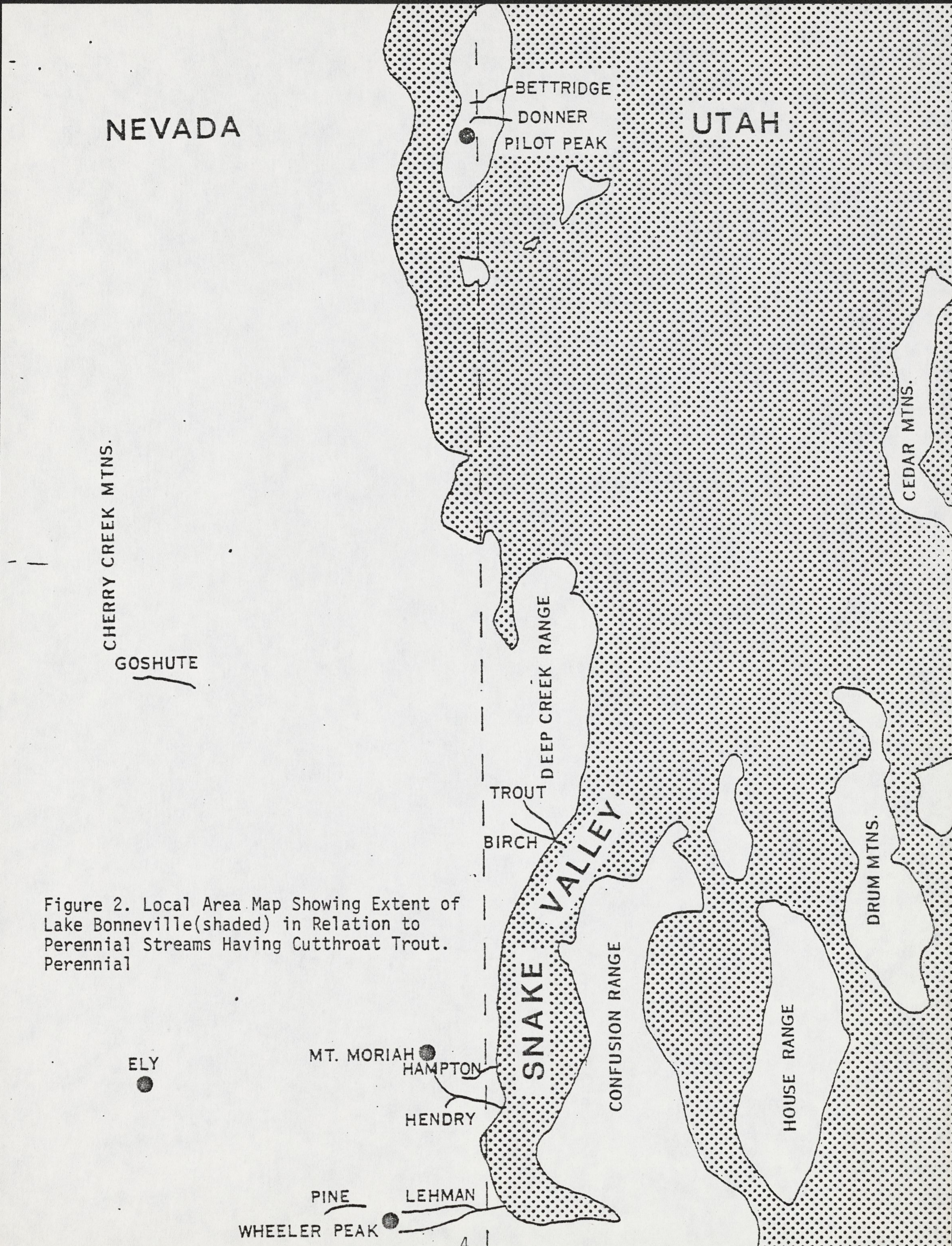

Figure 2. Local Area Map Showing Extent of Lake Bonneville(shaded) in Relation to Perennial Streams Having Cutthroat Trout. Perennial

significant impact to the survival of the Snake Valley cutthroat. Virtually every stream in the Snake Valley region, capable of supporting trout, has been stocked with rainbows. Brook trout are also capable of replacing the cutthroat through competition because of earlier spawning periods and it's ability to become better adapted to life in small spring-fed headwater streams.

Exploitation, though not likely a limiting factor by itself, can reduce the number of catchables and may act to favor other exotics such as the brooks, browns, and hybirds. It has been documented that cutthroat trout are highly vulnerable to angling mortality (Behnke and Zarn 1976.)

Livestock grazing imposes a serious and subtle threat to the survival of the cutthroat trout, in the arid Snake Valley region. Grazing becomes significant when discussing sites for reintroductions, since much of the prime grasslands exist in headwater meadow areas. Livestock interests in the Bonneville Basin have been unconcerned about stream protection of rare trout populations. These problems have made the BLM very cautious in planning for additional habitat sites for future reintroductions of the Snake Valley cutthroat. Many studies have shown that livestock grazing destroys and degrades riparian vegetation, and streambanks soil stability resulting in alterations of channel morphology, loss of cover, and a reduction in numbers and biomass of fish particularly older and larger trout (Behnke 1977). Studies and management of livestock impacted areas should be made in order to rehabilitate the grazed areas either through improvement of the existing grazing system, or livestock exclusion (Platts 1977). The BLM in Utah and Nevada has been involved in stream side fencing programs to protect the riparian habitat of streams containing sensitive, or rare trout populations from continued livestock damage (Goshute Creek, Nevada, and Birch Creek, near Beaver, Utah).

Droughts and violent thunder storms may have historically eliminated cutthroat populations from some high gradient streams, since natural recolonization could not be effective after desiccation of the pluvial lake in Snake Valley. This may account for the high number of barren streams found in the Snake Vally region prior to rainbow trout introductions.

Past surface disturbance impacts from mining have been slight and of short duration, the main damage resulting from equipment movement and road construction to and from the mine site. There exists little room for trails or roads in some of the narrow canyons, therefore, the streambed may be utilized for such purposes, in some areas. Recent uranium mining activities in Utah's Deep Creek Mountains have caused concern over the future impacts of mining to the resources of this fragile desert island ecosystem environment.

The effects of all these environmental impacts on the cutthroat trout populations are greatly magnified when considered collectively. Many of the streams in the Snake Valley region have been affected by all of these major impacts at some point in time during the recent past history of the area.

UNIQUENESS OF SNAKE VALLEY CUTTHROAT TROUT

Ancient Lake Bonneville went through several periods of fluctuations in which water levels which were closely associated with climatic conditions (Gilbert 1879). According to Broecker and Kaufman (1965), four low levels occurred between 8,000 and 22,000 years ago, including one period of complete desiccation followed by refilling that took place about 11,000 years ago. The final desiccation occurred approximately 8,000 years. This final desiccation of Lake Bonneville resulted in ten or twelve independent basins being formed, one of which was the Snake Valley basin (Gilbert 1890). The northern portions of Snake Valley shows a lake level elevation of about 5,100 feet. This would have prevented water from flowing out of Snake Valley and into the Great Salt Lake Basin. In addition to such physical isolation, the cutthroat were forced to seek refuge in the streams to overcome the increased saline conditions brought on by the desiccation (Hunt et al 1953). Thus, many populations of cutthroat in the Bonneville Basin have been isolated from contact with each for about 8,000 years.

Wydoski et al (1976) conducted a study of the electrophoretic patterns of proteins in cutthroat located in the Bonneville Basin, as well as with several other groups of cutthroat, and rainbow trout. No protein was unique or distinctive for S. c. utah specimens, but an unusual variation for muscle lactate dehydrogenase (LDH) was found in cutthroat from Trout and Goshute Creeks, indicating a common ancestor. This unusually complex variation seems to indicate the presence of a variant allele. A unique evolutionary event, or series of events, occurred in the Snake Valley cutthroat trout LDH, which would indicate long-term isolation from the rest of the Bonneville Basin cutthroat trout.

Comparison of samples of the least chub, Iotichthys phlegethontis in the western Bonneville Basin add credence to the assumption of incipient speciation in fishes isolated in Snake Valley. Samples from Donner Springs (Pilot Peak Area) have the typical fin ray counts given by Sigler and Miller (1963). These found in Snake Valley have one less ray in the dorsal (7), anal (6) and pelvic (7) fins.

Smith (1966) stated that the mountain suckers, (Pantosteus platyrhynchus) of Deep Creek, in the Deep Creek Mountain area, is differentiated from the typical Northern Bonneville form.

The Snake Valley cutthroat trout differs from other cutthroat trout of the Bonneville Basin by having more basibranchial teeth and gillrakers, and fewer scales in the lateral line series. The spotting pattern is more uniformly distributed over the body, and not so concentrated posteriorly as in other Bonneville Basin cutthroat. The head appears longer and deeper with the body being more compressed and caudal peduncle deeper, all of which gives it a more chunky body appearance (Behnke 1976 a, b).

STATUS OF THE SNAKE VALLEY CUTTHROAT TROUT

Pure populations are found in Pine, Goshute, Hampton, and Hendrys Creeks of Nevada and in Trout Creek, in Utah (refer to Figure 2). Hybridized populations are found in Muncy and Mill Creeks, Nevada, and Birch and Johnson Creeks, in Utah (Behnke 1976a, Hickman 1977).

Goshute Creek probably has the highest number of Snake Valley cutthroat, having about 1,500 in 4 miles of stream (McLelland 1975). The Nevada BLM, and Nevada Fish and Game Department (NFG), have been instrumental in protecting and enhancing the habitat in Goshute Creek. During the 1977 drought Goshute Creek lost about 38% of the cutthroat population per mile. Because of these conditions a concerned NFG took 71 cutthroat from Goshute Creek and transplanted them proportionately into Water Canyon Creek (four stream miles habitat) and Clear Creek (one stream mile habitat).

Pine Creek, a very small stream with little habitat, has about 100 cutthroats (excluding fry), as does Hampton Creek, which is also a small stream (McLelland 1975). Pine Creek suffered some mortality as a result of the 1977 drought. Mile Creek, another creek with transplanted cutthroat, lost its entire population as the creek dried up from the drought.

Hendrys Creek had about 200 cutthroat in the headwater area in 1973. In 1974 eradication of rainbow trout below the barrier was conducted on Hendry's Creek to aid the fish's survival. Hendrys, Goshute, and Pine Creeks have now closed to angling use. Goshute and Hampton Creeks have past histories of losing all of their fish from flash floods, and this is the reason they were barren in 1953 and 1960. Because of its small size Pine Creek is also vulnerable to flash flooding. Therefore, the potential exists that the cutthroat populations in these streams could be lost in the future. During the 1977 drought NFG estimates that 50% of the cutthroat populations in Hendry's and Hampton Creeks were lost because of dry stream sections. In the interest of managing these unique fish, NFG has identified about 25 streams suitable for reintroductions. They plan to rehabilitate about two to four streams per year in this effort.

During 1977, one of the most significant items to take place in the basin for the protection of desert fishes, and the environment occurred in the Deep Creek Mountains when the BLM filed for an emergency withdrawal of a 27,000 acre area of critical environmental concern within the mountain range because of increased uranium mining activity, which threatened to destroy many of the unique resources of the mountain area. A significant item in justifying this action was the presence of the rare Snake Valley cutthroat in only about 1¼ miles of critical habitat on Trout Creek as well as the presence of the rare giant stonefly (Pteronarcys princeps). The area was withdrawn from mineral entry on May 3, 1977 by the Secretary of the Interior under section 204(e) of the Federal Land Policy and Management Act of 1976 (PL 94-579). This withdrawal stays in effect for a 3-year period, and allows time for study of all resources to ascertain their values.

In September, 1977, the BLM (Utah) funded a contract to the Utah Division of Wildlife Resources to provide for an inventory of all fish and wildlife resources on the mountain range. The contract will last until April, 1979, and will provide BLM with inventory data necessary to evaluate the future withdrawal status. Hopefully, the contract will define possible other streams inhabited by the cutthroat on the mountain.

In late October, 1977, the Utah Division of Wildlife Resources(DWR), eradicated the rainbow trout below the natural falls barrier on Trout Creek as a start to implement management plans designed to expand the cutthroat population. Future plans call for the transportation cutthroat from Trout Creek into the headwaters of Red Cedar Creek a remote stream on the mountain, which was given first priority for transplant efforts. The DWR plans to rehabilitate about seven additional east slope streams to enhance cutthroat survival back into their historic range. A habitat management plan (HMP) is being developed for the entire mountain ecosystem by the BLM, in cooperation with the Utah Division of Wildlife Resources, will specify management of all east slope streams for the cutthroat. The complete HMP is scheduled for completion in 1978-79 for all of the mountain resources, of which the cutthroat is an integral part of the fauna. At present the BLM has developed a HMP for Trout Creek and began implementation of this plan in 1977 using Sikes Act (P.L. 93-452) authorities. Using Youth Conservation Corps (YCC) workers, some 75 long-type stream improvement structures were constructed in July in Trout Creek to aid the bank stabilization and pool quality enhancement for the cutthroat. Stream improvement work is scheduled again in 1978 by BLM using the YCC.

Although there are differences in the taxonomic characters between _S. c. utah_ and the cutthroat found in Snake Valley, there also exists much overlap. Basibranchial teeth counts, which seem to be a distinctive characteristic separating the two forms, were found to be similar in number in one _S. c. utah_ sample from Willow Creek, Jordan River drainage, Utah (Hickman 1977). With the analysis of more samples from the Bonneville Basin the degree of overlap between these cutthroat becomes more obvious. This overlap is further substantiated through the use of a computer-aided discriminant function analysis, which evaluates the similarities and differences between samples (Hickman 1977). Sixteen(16) morphomeristic character measurements (refer to Table 1) from samples of various described and undescribed subspecies of cutthroat trout, and one sample of rainbow trout, were compared (refer to Figure 2). The closer the group centroid (represented by dot in Fig. 3) the more similar the samples. The cutthroat trout in Snake Valley and _S. c. utah_ are closely situated, indicating a high degree of similarity. Of interest is the similarity depicted in the discriminate function plot between _S. c. pleuriticus_ (Colorado River Cutthroat) and S. _c. stomias_ (Greenback cutthroat). This supports the taxonomic evaluations of Behnke and Zarn (1976) that _S. c. pleuriticus_ gave rise to _S. c. stomias_ via an ancient headwater transfer, and that there exists little taxonomic difference between the two subspecies.

Table 1. Morphomeristic Characters Used in the Discriminant Function Analysis, 1977.

Head Length	Gillrakers total
Upper Jaw Length	Branchiostegal rays right
Snout tip to dorsal fin origin	Branchiostegal rays left
Dorsal fin length	Scales above latera line
Caudal peduncle depth	Pelvic fin rays
Caudal peduncle length	Pyloric caeca
Gillrakers upper	Basibranchial teeth
Gillrakers lower	

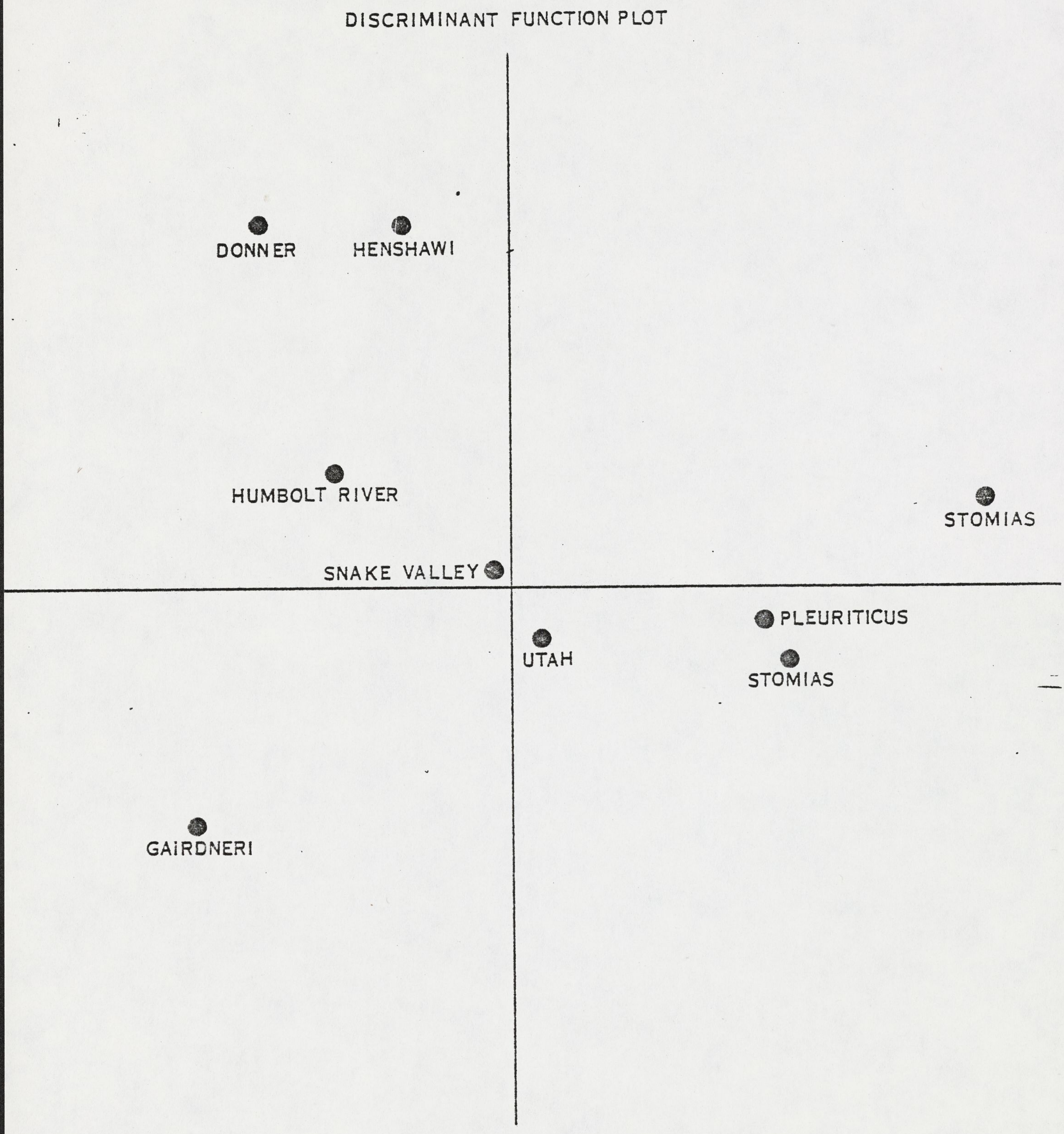

Figure 3. Discriminant Function Plot Analysis Chart Showing Relationship of Cutthroat Subspecies Based on Morphomeristic Characters.

To avoid taxonomic confusion, which has led to subspecies classification delays, the cutthroat trout in Snake Valley should be considered a unique form of S. c. utah. S. c. utah is not abundant in any portion of its native range, and at one point was thought to be extinct as a pure form (Miller 1950, Cope 1955, Platts 1957, and Sigler and Miller 1963). The 1973 version of the U.S. Department of Interior's "Red Book" of endangered and threatened species listed S. c. utah as "status undetermined;" the International Union for the Conservation of Nature (1969) listed it as rare; Holden et al (1974) considered it endangered; the Wyoming Game and Fish Department lists it as rare, the Nevada Fish and Game Department considers it endangered, and Behnke (1973, 1976b) considers it to be rare with a highly restricted distribution.

CUTTHROAT DISCOVERY IN THE PILOT PEAK RANGE

In an effort to locate additional populations of Bonneville Basin cutthroat trout, a survey of the Pilot Peak Range (North of Wendover on the Utah-Nevada border) was conducted in 1977 by the BLM and Colorado State University (under a contract funded by BLM).

As a result of these surveys only two streams were found containing sufficient annual flows to support trout populations. One stream, to the north of Pilot Peak, Bettridge Creek has an abundant population of rainbow trout which were first stocked by the Utah Division of Wildlife Resources in the 1940's, or early 1950's. The other stream, located in the adjacent canyon to the south of Bettridge Creek, is unnamed (for the present we have called it Donner Creek since it historically drained into Donner Springs). The city of Wendover, Utah obtains a portion of its water supply from this creek.

Mr. Kent Sumners, Utah Division of Wildlife Resources, discovered the presence of the cutthroat in Donner Creek in April, 1977 while sampling the stream at the request of the BLM. Subsequent collection of specimens by the authors and their later analysis at Colorado State University confirmed this classification. Taxonomic analysis of the 17 trout sampled from Donner Creek proved most interesting. They are pure strain cutthroat trout (no sign of hybridization) and have a higher gillraker count than any other cutthroat population (24-29, avg. 26.1).

The origin of this cutthroat is uncertain, however Mr. Howard Gibson, retired water master for the city of Wendover, indicated that the cutthroat were in Donner Creek when he commenced work on the stream in 1952 (personal comm. with H. Gibson, Wendover Utah). None of the other local residents contacted could provide any information pertaining to the cutthroat, and most were unaware of its existence in Donner Creek. The Nevada Fish and Game Department has no record of cutthroat stockings in the Pilot Peak Range (letter to Don Duff, BLM, SLC from Pat Coffin, Nevada Fish & Game Dept., Elko, October 1977). The only cutthroat exhibiting such high gillraker numbers is the Lahontan cutthroat trout (S.c. henshawi)

(Behnke and Zarn, 1976). The most probable origin of the Donner Creek cutthroat is Pyramid Lake, since from the late 1890's to 1930 cutthroat trout from Pyramid Lake were stocked extensively in Nevada. In 1910 Elko County received a large shipment of eggs but no records exist on where these fish were stocked. Little stocking of Lahontan cutthroat occurred from 1931-1942, but in 1950 Lahontan trout from Summit Lake, Nevada were used for stocking. After 1930 S. c. henshawi was considered rare and it seems unlikely that a creek in the Pilot Range would be stocked with this cutthroat subspecies.

The discriminant function analysis Table 1 and Figure 3) indicates that the cutthroat from Donner Creek are the most similar to S. c. henshawi.

SUMMARY

The Snake Valley cutthroat, a form of S. c. utah, is a unique desert fish resource located in the western Bonneville Basin which is worthy of protection and management for the scientific community as well as the American public. S. c. utah has promising possibilities for enhancing the basin's states fisheries programs for wild trout management. The 1975 listing of endangered and threatened fishes of the western U.S. by the Desert Fishes Council did not consider this subspecies. We feel adequate habitat and species data now exists on which to base subspecies naming and status recommendations for this cutthroat. It is our recommendation to the Council that this subspecies be listed on the Council's list as threatened throughout its range in Utah, Nevada, and Wyoming. This classification should serve as an aid to organizations and agencies responsible for management of habitat and species in the future. The ultimate management design for this subspecies, and all others so classified is to provide management to a degree whereby survival and protectionof the species and its habitat is assured, so critical status classification can be removed. However, should environmental conditions continue to deteriorate and this subspecies eventually be listed by the U.S. Fish and Wildlife Service as threatened, then this classification would provide the necessary protective status while still allowing for recovery programs to function.

The interest in desert fishes management has intensified by agencies and the scientific community by the discovery in 1977 of S. c. henshawi in Donner Creek of the Pilot Peak Mountain Range. The major significance of this find of S. c. henshawi is that it very likely represents the original Pyramid Lake genotype - the largest trout native to western North America and long believed to be extinct (Trojnar and Behnke, 1975, Behnke and Zarn, 1976). This find is worthy of intense management effort by the Utah Division of Wildlife Resources (DWR) and the BLM, since the existance of this pure strain fish is extremely limited as indicated by its official threatened status by the U.S. Fish & Wildlife Service. Colorado State University is continuing contract studies on this mountain range for the BLM. The BLM plans to implement the Pilot Peak Mountains HMP in 1978 under Sikes Act authorities in cooperation with the DWR. Stream habitat improvements are being planned for Bettridge Creek which at present has a natural reproducing population of rainbow trout. This creek could serve in the future as a possible transplant site for the Lahontan cutthroat in Donner Creek. Both creeks have good stream habitat being in a relatively undisturbed state from man and livestock activities and located in a remote area adjacent to the arid wastes of the Great Salt Lake desert salt flats.

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