



VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DIVISION OF FORESTRY AND WILDLIFE RESOURCES (703) 951-5481

Jan. 2, 1975

Dr. Robert S. Behrns,

Dear Bob,

Welcome home! I hope that Eastern collecting trip worked-out well for you.

I'm in the process of getting my desk cleaned and ran across a couple of items I've been saving for you. The paper by Nersall contains a section on coregonids that might be of interest. Enclosed also is a paper I reviewed for the Transactions. You probably are already aware of it; I'm sending it along just in case.

I guess that you have heard that we will be moving to Oregon where I will be the Assistant Unit Leader. I'm anxious to get my hands on some salmonids again. Looks like we will be moving in about a month. I will keep you posted.

The Peters said that you will stop in Hamburg for a visit. How was the Beer? Lüperbahn? Seegrast spent the night with us a couple of months ago - nothing new

With best wishes for the New Year,

Carl

Jim - Ted

- Keep this info: - important data
on characters of hybrids.

Ivankov, V. N. 1973. Hybrids between
the Autumn chum salmon (*Oncorhynchus*
keta) and the Coho salmon (*O. kisutch*)
Journ. Ichthyol. (Voprosy Ikhtologii), 13(1):
175-176.

	Chum salmon	Coho salmon	Hybrid
gillrakers	22.4	19-22 (19-25 [21-23])	27-29 (27.6)
caeca ¹⁵⁰⁻²⁰⁰	173.1	43-75	162-194 (179.4)

- Hybrid values exceed parental type - not
intermediate as typically expected.

~~Jim Roscoe~~
Ted Murphy

Notes on stocking trout in Snake R. - fm.
log book found in Bur. Sport Fish & Wildlife
Ser. Hatchery at Lake on Yellowstone L.

Eggs of Yellowstone Lk. collected on annual
basis ca. 1900 - 1954. Many propagated
for stocking in Park waters.

1934 38,194,000 eggs taken
22,415,000 shipped out
15,779,000 stocked in Park.

1954 - 1,000,000 taken all for Park.

74 miles of Snake River and 33 mi. Beckler R.
(trib. Snake) stocked w/ Yellowstone cutts.

Heart L., Lewis L., Shoshone L., natural
reproduction - nearly all other waters in Park
stocked. - rainbow trout & grayling also stocked

Electrophoretic distinction of rainbow trout (Salmo gairdneri), west-slope cutthroat trout (Salmo clarki), and their hybrids. Gary L. Reinitz

USFWS Genet. Lab Buelah Wyo. 82712

submitted to JFRBC - recd. In rev. I: 12:77

Species identification ^(by standard methods) unsatisfactory when 2 morphol. sim. sp. hybrids - Rainbow trout and west-slope cutthroat. Two morphologically similar sp. (Schreck and Behrke ?) (p. 3 Introd.)
- S. & B. did not mention west-slope ^(~~cut~~ west slope same as upper half) cutthroat trout

p. 4 - Rainbow trout characterized from 2000 fish of several strains from tissue culture at Fish. Gen. Lab (how many strain? wild, hatchery? geographic var.?)

6 pop. West slope cut - used - 1 Jackson R. stock. other 5?

- BuT → hybrids (F₁) made from 15 rainbow trout ♂ & 33 cut ♀ - what origin of the 15 rainbow? - are gen. identical w/ Buelah tissue samples?

14 proteins examined AAT, NADP-MDH, XDH all as single, non variant bands in all samples.

NAD-MDH, Tfn, MP, LDA, PGM, TO polymorphic in both sp. - but all variant forms found in both sp. but w/ sig. dif. in freq.

Esterase fixed for allele in 5 of 6 west slope sample. not found in rainbow.

PGI Phosphoglucose isomerase PGI fixed in west slope cut. for 6 banded pattern. distinct from any pattern

of rainbow trout - all hybrids have 5 bands
- p. 8 - Ideally, variant protein fixed in one sp.
& totally absent from 2nd sp. = sp. specific marker
Only PGI of 14 proteins examined met "criteria"

- Needs rewriting - omitting all implications to practical
fish mgt. ~~at~~ which are misleading and for practical purposes
absurd. - point out potential is there also more info for more loci
in future. - Problem - westslope cutthroat trout - what is its
native range, taxonomy, etc - Roscoe's thesis - Keim's was copy.

- Hybridization not only rainbow trout (which can be readily detected by
traditional means) but other subsp. cutt. & var. hatchery stock &
cutt. golden. - Now from paper we note that
one protein, PGI, can differentiate 6 samples of west
cutt. from 15 rainbow trout - ^{is sp. specific? also in} Question: cutt. is it
all rainbow trout - ^{upper at least all forms within in Montana.} samples from wide range geographic
of S. G. and all cutt. subsp. (only west slope?)

but only 71 which a novice could learn to
distinguish in few minutes by noting ^{clear-cut diff. between all rainbow & west slope in spots, etc}
^{scales, vert, color}
^{breeding}

why bother? - But then prob. high 50-75 yrs or so
rainbow genes at low levels - ex. 10% - 50% chance of
detection in sample of 10 sp. - But ^{no in rainbow by} no way
not major prob. - obvious - subtle mixing of cutt. subsp. - no
hint that of use here

- Have Allen look over PGI.

- Present full standard pan. of ^{Group} ~~Group~~ ^{Standard} ~~Standard~~ ^{cler}

vert,

Esterase fixed in 5 + 6 westslope samples at allele not found in rainbow trout. hybrids showed pattern of either parent or summation of both.

SDH (sorbitol dehydrogenase) a 5 banded pattern different in 5 + 6 westslope samples from all rainbow

Proteins analyzed

LDH, Sorbitol dehydrogenase, Xanthine dehyd., Tetrazolium dehyd., Esterase, Isocitrate dehyd., MBH, NADP-dependent, NAD-dependent, Phosphoglucose isomerase, α Glycerophosphate dehyd., Phosphoglucosmutase, Aspartate aminotransferase, muscle protein, Transferrin (serum) others fm. muscle or liver.

Ref.

Schmidtke, J., G. Dunkhorst & W. Engel. 1975 Genetic variation of phosphoglucose isomerase isoenzymes in fish *Ostareophysis* & *Isospondyli*. *Comp. Biochem. Physiol.* 50B: 395-98.

Utter; Hodgins & Allendorf .74. Biochem. genet. studies of fishes: potentials, limitations: 213-238 In, *Biochem. & Biophysical Perspectives in Marine Biol.* vol. 1, Acad. Press
- C. L. Markert 1975 - Isozymes IV. *Genetics & Evol.* Acad. Press
(Allendorf, Utter & Hilde: 415-32)

- Avise, Kitto 73 - Phosphoglucose isomerase gene duplication in bony fish - evol. history. *Biochem. Genet.* 8: 113-132.

Op't. Hof, J., Wolf, Krone. 69 sorbitol dehydrogenase in vert. - *Humangenetik* 8: 175-82.

Reinitiz' thesis

- Comparison of similarities of protein patterns representing allelic frequencies at several gene loci.
- " Several samples from same populations included in this study.

samples include

- Yellowstone h. cutthroat
 - Hatchery stock rainbow trout
 - 1 upper Missouri (Odell Cr. trail - - -)
 - Arlee hatchery stock westslope cutt.
 - 21 populations from Clark Fork drainage
- Results: westslope cutts consistently different Yellowstone h. cutts and rainbow (not much evidence to conclusion that rainbow-yellowstone "biochemically" ^{more} "closer related" than yellowstone-westslope) - due to inadequate samples of S. gardneri and Yellowstone - Snake River, etc.

Walden Fish Sch.

Ten Am

Cook St. No. 77843

STATE OF MONTANA



DEPARTMENT OF

FISH AND GAME

1420 East 6th Avenue
Helena, Montana 59620
October 2, 1981

Dr. Robert Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523

Dear Bob:

We are starting to use specific fish strains and the first results are promising. The waters Fred Eiserman referred to are our best examples. Here are the details:

Middle Creek Reservoir (also called Hyalite Reservoir; T04S, R06E, S15, in Gallatin River drainage, near Bozeman) has a long history of planting with hatchery cutthroat trout going back to 1953. Fish from our Yellowstone Lake stock were planted starting in 1967 and 10,000 4- to 5-inchers were planted in 1970, 1971, and 1972. In 1973 catchables were tried with 5,000 approximately 9-inchers being planted. In spite of this effort, in 1974 and 1975 Jerry Wells (who was doing his masters thesis work) found a good grayling run but essentially no spawning cutthroat in the West Fork of Hyalite Creek, the principle spawning tributary to the reservoir. A decision was made to try our McBride strain of cutthroat trout, which was brought into the hatchery system in 1969 (you may recall our correspondence), and 20,000 2- to 3-inchers were planted each year from 1976 through 1978. This past spring an estimated 400 cutthroat trout were found on a spawning run in the West Fork. They averaged 2 pounds and some were as large as 4½ pounds.

Fred probably didn't mention it, but Pat Marcuson, who has personally surveyed 1,000 mountain lakes in south central Montana, has found the McBride strain grows better and has a much greater potential for reproducing than did our Yellowstone Lake strain (we haven't had Yellowstone Lake cutthroat in our hatchery system since 1976). For example, Jasper Lake, a 55-acre lake at 10,000 feet elevation in south central Montana (T09S, R17E, S23, near Red Lodge), was planted in 1968 with 7,040 3-inch Yellowstone Lake cutthroat. Pat checked the lake a total of four times over the years but found no reproduction and the largest fish were 18-inches with weights of 1-1/4 to 1-3/4 pounds. The lake was planted next in 1974; this time with 7,200 2-inch McBride strain cutthroat. It was again checked four times and now the fish were reproducing and reached a maximum of 22 inches and 3-3/4 pounds. Pat mentioned that the McBride strain has been able to spawn even in marginal situations, for example in unconsolidated snow-melt streams just a few feet (up to 20) from a lake. As for our Yellowstone Lake strain, he could only think of two

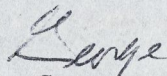
Dr. Robert Behnke
October 2, 1981
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mountain lakes, Leo (T09S, R16E, S6, 8½ acres, at 9,300 feet elevation) where spawning resulted in a very low density population and Jordan Lake (T07S, R13E, S11, 12.7 acres at 8,790 feet elevation), where they spawned in the outlet and rather than moving back upstream into the lake, moved downstream where they became established.

Willow Creek Reservoir (also called Harrison Reservoir, T01S, R01W, S27 in Jefferson River drainage near town of Harrison) was the other reservoir Fred mentioned. The excellent rainbow spawning run into Willow Creek was used as a hatchery egg source from 1942 through the late 1950's - all eggs available were taken. The run collapsed and periodic monitoring of the stream through 1976 indicated insignificant numbers of spawning rainbow. Apparently the failure of the run to rebuild was due to (1) the inability of the fall spawning rainbow regularly planted in the reservoir to reproduce and (2) low stream flows in dry years resulting from irrigation withdrawals. In 1977, 1978, and 1980 we were able to procure Lake DeSmet rainbow eggs (100,000 each year) from Wyoming. These were reared to fingerling size (1 to 3 inches), part were planted in the reservoir and the balance in Willow Creek. This year there was a phenomenal run which Emmett Colley, our hatchery bureau chief, estimated to consist of about 1,000 fish averaging 3 pounds each.

Bob, your monograph has filled a definite need and has been well received. I would not have guessed there was a need for a revision without your saying so. The only problem we have had is in procuring sufficient copies for our field people. We hope it will be more readily available this time. Incidentally, the two reports you requested are enclosed.

Kindest regards,



George D. Holton
Assistant Administrator
Fisheries Division

GDH/bjm
Encl.

Geo. Holton
use wild strains
L. Koozevusa



STATE OF MONTANA
Department of Fish, Wildlife and Parks
1420 East Sixth Avenue
Helena, Montana 59601

To: Bob Behnke
Department of Fishery and Wildlife Biology
Biology
Colorado State University
Fort Collins, Colorado 80523

FIRST CLASS MAIL

letter Oct 2, 81

- starting to use specific wild stock
- results are promising
- cuts - Hyalite Res. near Boyers
- years of cut stock & domesticated yellowbills
- MCB and L. stock 20,000 frozen 1978-80
- 1981 - spaw 400 2-yr 1b. phase
- in spawning run up full
- able to successfully reproduce when worse before
- Willow Ark Res
- Regularly stocked domesticated R.B.
- no evidence spawning
- L. Piedmont wild R.B.
- 1977-80 - 1981,
- about 1000 spaw \bar{x} 3 lb
- spawning
- cut costs
- make better fish.

TENSION
ENVELOPES

CLASP No. 90
9 X 12

Hunter, G.A., E. M. Donaldson, F.W. Goetz, and P.R. Edgell.
(submitted to TAFS ^{revised} July 81). Production of all female
and sterile groups of coho salmon (*Oncorhynchus*
kisutch) and experimental evidence for male
heterogamety.

Estradiol = all ♀

methyltestosterone = all sterile (94%)

administer

May 77 Two, 2 hr. immersion of eggs (310°C + 380°C days)
+ Two 2 hr. immersion of alevins (500°C + 570°C days)
+ feeding for 90 days (650° - 1550°C days) in feed.

Dec. 79 43.1 cm (400 µg/L.) - 48.5 cm
Nov. 80

42.4 cm. (100 µg/L.) - 47.3 cm.

40.7 cm. control _____

* Goetz, F.W., E. M. Donaldson, G.A. Hunter, and H. M. Dye. 1979.
Effects of estradiol-17 β and 17 α -methyltestosterone
on gonadal differentiation in the coho salmon,
Oncorhynchus kisutch. *Aquaculture* 17: 267-278.

\$3.50 Müller, J.W. and L. C. Rockett. 1980, Lake De Smet,
history and management. Wyo. Game Dept. Monogr. no. 3. 82p.
Cheyenne, WY 82002

see SFA

➤ Ryman & Stahl 1980 *Can. J.* 37(1) -
genetic change from small sample of wild fish
used to establish hatch. (Donner Crk.)

➤ Busack, C. A. and G. A. E. Goll. 1980.
Ancestry of artificially propagated California rainbow
trout strains. *C. F. S.* 66(1):17-24.

*
+ ore-WA
rept.
on
origin
hatch.
stocks

- Coleman 49 - originally at Coleman M.H. - Kamloops
Pennask L. B.C. - but mixed w/ steelhead & resident
rainbows from Battle Crk. - Now at CFS Hot Crk. - not considered
as Kamloops

- PIT R. strain - 68-70 native trout running up
Sachs Springs Crk. to Crystal 2, hatchery.

- Junction Kamloops - 64 Junction L. stocked
w/ Diamond L. OR. trout - Diamond L. stocked w/
Pennask L. trout in 1955.

➤ McCrimmon, H.R. 1972. World distrib. of rainbow trout (*S. g.*).
Further consideration *J. F. R. B. C.* 29:1788-1791.

➤ McCraig, R.S. 1960 Effect of sea-run alleles
on rainbow trout and brown trout in reclaimed ponds.
I (small) slower growth - II + - faster - overall
reduction survival, biomass w/ alleles.

➤ Wyo. Wildlife Folio
S15351

fed. species response to overgraz. -
- jugular vein cut - hind side capillaries

Benson, C. V. 1978. Fluctuations in the level of yellow lake Lahontan during the last 40,000 years. Quaternary Research, 9(3): 300-318. 7000-5000 BP extreme low - hot dry - Walker L. dune (Eagle L.)

Busack, C. A. and G. A. E. Gall. 19~~79~~⁸⁰. Ancestry of artificially propagated California rainbow trout strains. C. F. C. 66(1): 17-24.

- Mt. Whitney - great mixture - rainbow, steelhead, Kamloops, lab. cult.
- Virginia (Wyethville) - mixture - mainly McCleod K.
- Hotchk - Springville Utah x Whitney
- Davis - Hotchk x Virg.
- MT Shasta - fm. private source Idaho
- Coleman (kept at Hotchk) - origin 1949 - Kamloop from Pennask L. B.C. - to Coleman Nat. Hotel - mixed w/ steelhead & rainbow
- Pt. R. - 1968-70 - run of wild trout in Sucke Springs Ark. (trid. pct.) - resistant to *Cratemyxa*
- Junction Kamloops - fm. ¹⁹⁶⁴ Junction Res., Mono. Co. - fm. Diamond L., Ore. - fm. Pennask L. B.C. (1955) - * But 500,000 hatch. rainbow planted in Diamond L. 1962 maintained in Junction Res. - not domesticated brood stock
- Eagle L. - 1959 - low of 16 spawners for Eagle L. - both domesticated and wild stocks used. raised in hatch. to maturity but domestic brood stock not maintained.

Boddy, B. A. 1979. Morphological and ecological divergence within the lake whitefish (*C. c.*) species complex in Yukon Territory. J. F. R. B. C. 36(10): 1214-1222.

5 lakes low / hi raker - low rakers benthic feeders asc. w/ bottom hi rakers, plankton feeders - thruout lake, - hi rakers earlier maturity shorter life. - These lakes lack ciscoes - low raker seem typical of Yukon *C. c.* - hi raker unusual.

Dezadeesh L. (Alsek)

Hansen

Squanga, Little Teslin, Teenzh (clustered, head Yukon)

Des. rakes 20-26(23) + 30-36(33)

one 25-25 + 30-31 x pt Squanga 25-28

Hansen L. poisoned - only known B.C. symp. pair Dragon 2. - also eradicated (trout stocks) - dwarf Squanga form probably gone from cisco introduction - main lakes - no cisco;

Healy, M. C. 1980. Growth and recruitment in experimentally exploited lake whitefish pop. (*C. c.*) populations. ibid 37(2): 255-267
* Growth, recruitment, production stimulated by exploitation.

Jukes, T. H. 1980. Silent nucleotide substitutions and the molecular evolutionary clock. *Sci.* 210 (Nov. 28): 973-978

"silent" substitutions DNA codon changes that do not change amino acid sequence -

Histone which has only 3% ^{amino acid seq.} dif. between peas and cows shows 33% silent substitution between 2 sp. sea urchin.

Trp A genes bacteria - 25% silent subst. vs. 15% dif amino sequence - - Thus most codon changes selectively neutral. - neutral, near neutral nucleotide substitutions of DNA result of genetic drift

Lewin, W. 1980. Evolutionary Theory under fire. *Science* 210 (Nov. 21): 883-87

Chicago Conf. on macroevolution

5-10 mil. ^{ca. 50,000 yrs.}
- species stable long time then "abruptly" give rise to new sp. rather than slow, gradual accumulation many small dif.

generalist vs specialist sp.

slow ^{wide sp.} to speciate narrow mt - easily extirp'd - rapid speciation - many sp.

Salmo salvelinus Coregonus - Af. lakes

Braman, J. C., C. B. Stahlacker, G. T. Klar, and T. M. Farley. 1980.

Hemoglobin polymorphism in adult cutthroat trout, Salmo clarkii.

Jour. Exp. Zool. 211: 411-413. 80 + 93 Yellowstone L. cut

have hemoglobin similar to ^{that} found in rainbows.

- Rourke, A. W. and R. L. Wallace. 1978. A morphological and electrophoretic comparison of Henry's Lake Salmo clarkii and Salmo gairdneri hybrids. *Comp. Biochem. Physiol.*, 60B: 447-451. - Despite forced hybridization, natural reproduction strongly favors native genotype.

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Polyploidy: biological relevance. Plenum Pub. Corp.

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Excellent list
 received
 last week
 from
 [unclear]
 [unclear]
 [unclear]

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*check by 1967
Barnes 1970
Steelhead*

*Burns. 1970
Spawning bed sedimentation*

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Dodge & Mac
1971
→

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Migrate - 1974
of migration

Neave 1972

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- attenuated, well developed vakers
- rounded parr marks

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Rainbow B.C. LOCALITY Lower Nehalem R

COLLECTED BY Pollard DATE 1979

Cat. # _____ Measurements by EW DATE 12/6/79

Specimen # _____

	<u>cyst at insertion</u>	<u>3</u>	<u>11</u>	<u>7</u>	<u>1</u>				
Total L.	<u>pelvic</u>	<u>121</u>	<u>145</u>	<u>126</u>	<u>135</u>				
Standard L.	<u>ray</u>	<u>99</u>	<u>120</u>	<u>104</u>	<u>113</u>				
Body D									
Head L									
Orbit L									
Upper Jaw L									
Dors. Orig. to Snt. tip									
Dorsal fin basal L									
Dorsal fin depressed L									
Adip. fin depressed L									
Caudal peduncle D									
Caudal peduncle L									
Vertebrae									
1st Arch gillrakers (up)		<u>8/0</u>	<u>8/0</u>	<u>7/0</u>	<u>8/0</u>				
(lower)		<u>11/0</u>	<u>12/0</u>	<u>12/0</u>	<u>12/0</u>				
(total)		<u>19</u>	<u>20</u>	<u>19</u>	<u>20</u>				
Branchiostegal rays right									
(left)									
Dorsal rays									
Anal rays									
Pectoral fin rays									
Scales in lateral line									
Scales above lateral line		<u>27</u>	<u>26</u>	<u>26</u>	<u>28</u>				
Scales 2 rows above lat.		<u>128</u>	<u>127</u>	<u>123</u>	<u>141</u>				
Pelvic fin rays		<u>10</u>	<u>9</u>	<u>10</u>	<u>10</u>				
Pyloric caeca		<u>-</u>	<u>40</u>	<u>40</u>	<u>30</u>				
Dentition		<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>				
			<u>↑</u>						
			<u>intestinal</u>	<u>parasites</u>					

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

B.C.

SPECIES Rainbow LOCALITY Lower Heber R.

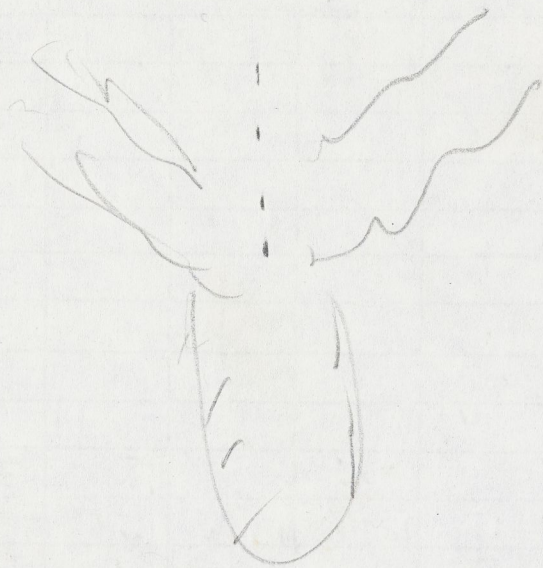
COLLECTED BY Pollard DATE 1979

Cat. # _____ Measurements by EW DATE 12/5/79

Specimen #

	10	4	6	12	13	5	8	9
Total L.	133	122	162	153	142	140	134	145
Standard L.	111	102	135	126	120	115	109	120
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	8/0	7/0	8/0	8/0	7/0	7/0	8/0	7/0
(lower)	12/0	12/0	12/0	12/0	12/0	12/0	11/0	12/0
(total)	20	19	20	20	19	19	19	
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	27	27	30	29	25	27	27	27
Scales 2 rows above lat.	137	134	129	128	138	135	132	136
Pelvic fin rays	10	10	10	10	10	10	10	10
Pyloric caeca	25	33	41	46	32	31	44	42
Dentition	0	1	0	0	0	0	0	0

↑ ↑ intestinal parasites



CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Rainbow LOCALITY Walbran main stem U/S abstr.

COLLECTED BY Pollard + Hooten DATE 1979/7

Cat. # Measurements by EW DATE 12/3/79

Specimen #

6 1 10 8 2 7 13 3

Total L.	126	110	108	131	111	147	121	107
Standard L.	102	91	90	107	91	120	99	88
Body D								
Head L								
Orbit L								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	7/0	7/0	7/0	7/0	7/0	7/1	7/0	7/6
(lower)	11/0	12/0	12/0	12/0	12/0	12/0	12/0	11/0
(total)	18	19	19	19	19	19	19	18
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	30	28	26	26	27	28	28	22
Scales 2 rows above lat.	133	132	134	134	128	134	126	132
Pelvic fin rays	10	10	10	10	10	10	10	9
Pyloric caeca	38	39	26	42	36	44	36	36
Dentition	0	1	0	0	0	0	0	0

Some intestinal parasites

		pelvic	teeth
Cezca	34	10	0
	28?	10	0

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES Rainbow LOCALITY Upper Heber R.

COLLECTED BY Pollard DATE 1979

Cat. # _____ Measurements by EW DATE 11/29/79

Specimen #	1	2	3	4	5	6	7	8
Total L.	147	139	131	130	111	115	141	133
Standard L.	122	114	109	107	92	94	116	109
Body D								
Head L.								
Orbit L.								
Upper Jaw L								
Dors. Orig. to Snt. tip								
Dorsal fin basal L								
Dorsal fin depressed L								
Adip. fin depressed L								
Caudal peduncle D								
Caudal peduncle L								
Vertebrae								
1st Arch gillrakers (up)	8/0	7/0	8/0	7/2	7/0	6/0	7/0	8/0
(lower)	10/0	11/0	13/0	10/2	13/0	11/0	11/1	13/1
(total)	18	18	21	17	20	17	18	21
Branchiostegal rays right								
(left)								
Dorsal rays								
Anal rays								
Pectoral fin rays								
Scales in lateral line								
Scales above lateral line	28	27	27	32	25	26	30	27
Scales 2 rows above lat.	141	134	130	135	118	133	141	136
Pelvic fin rays	10	10	10	10	10	10	10	10
Pyloric caeca	38	42	42	42	27	32	35	30
Dentition	0	0	0	0	0	0	0	0

↑ Intestinal Parasites

5, #4 - gillrakers somewhat stubby

CHARACTER ANALYSIS SHEET - COLORADO COOPERATIVE FISHERY UNIT

SPECIES

Rainbow

LOCALITY

Upper Heber R.

COLLECTED BY

Pollard

DATE

1979

Cat. #

Measurements by

EW

DATE

11/30/79

Specimen #

9 10 11 12 13 14 15

	9	10	11	12	13	14	15
Total L.	125	130	139	117	108	119	83
Standard L.	109	109	116	98	89	99	68
Body D							
Head L.							
Orbit L.							
Upper Jaw L.							
Dors. Orig. to Snt. tip							
Dorsal fin basal L							
Dorsal fin depressed L							
Adip. fin depressed L							
Caudal peduncle D							
Caudal peduncle L							
Vertebrae							
1st Arch gillrakers (up)	7/0	8/0	7/2	7/1	7/1	7/1	7/0
(lower)	13/0	13/0	11/6	11/2	11/0	13/2	11/0
(total)	20	21	18	18	18	20	18
Branchiostegal rays right							
(left)							
Dorsal rays							
Anal rays							
Pectoral fin rays							
Scales in lateral line							
Scales above lateral line	28	28	28	26	26	28	27
Scales 2 rows above lat.	128	134	132	123	121	128	120
Pelvic fin rays	10	10	10	10	10	10	10
Pyloric caeca	25	28	32	36	-	34	41
Dentition	0	0	0	0	10	0	0

- some lower
 gill rakers
 not dep. properly

large, 'roundish' (redband type) spots
redband parr marking

- above lat. line

parr mark all

Tokers 19, 21, 21

28, 29, 30

141, 143, 149

Louderlager

Thorpe

58 - redband

58, 60, 62, 64
coll.

but not con. w/ elects

Smith (69)

Desm K,

summer steelhead

57-21 (18.7)

127-141 (135.4)