NEWBERRY!

Girard, C. 1858. Ichthyology Notices – Proc. Acad. Nat. Sci. Phila. 10: 223-25.

P. 224

– Since my report upon the fishe of the U.S. P.R.R. Explor. & Surv, has passed thru the press, new facts relating to the history of the salmons of the Columbia R. have come to our knowledge, calling for various P. 225 rectifications of synonymy. The species which is figured and described under the name Salmo gairdnerii is not the Salmo gairdnerii of Sir John Richardson, Nor does it appear to be any of the other species recorded in the "Fauna Boreali Americana". To distinguish it henceforwards from its congeners we will call it Salmo newberrii; or else Salmo newberryii, just as it may suit systematic writers. It is sufficient, for the present to refer to the description alluded to above.

QH
1
A32

Cope, E. D. 1884. On the fishes of recent and Pleocene lakes of the western part of the Great Basin and of the Idaho Pliocene lake. Proc. Phila. Acad. Natural. (1883) 35: 134–168.

p. 141

Salmo purpuratus – Pyramid L., Silver Ck. (trib. Silver L.)
Klamath L. & Williamson's R.
sometime reaching 10 lbs. in Klamath L. –

* S. malma – 7 mi. Ck. – N.W. Trib. of Klamath L.

Albert's L. – S. purpuratus

Rhabdofario – Proc. Am. Philos. Soc. Nov. 1870. Idaho L. –
rod-like maxs. –

QH
1
A5 - (1882)

Cope 1889 Am. Nat. 23: 970-82

QH 1
A32Q - 1884 - Proc. Phila. Acad. Nat. Sci. (1883) 35: 134-166

1879 : 784- Am. Nat. ?
The fishes of Klamath Lake, Oregon.
Am. Nat. 13(12): 784-785.

Salmo iridea found abundant in lake as well as streams trib. to it - S. spectabilis not as abundant as iridea only collected in 7 mi. Ck.

1881. The Silver Lake of Oregon and its region. Am. Nat. 23 No. 275 : 970-982.
- Soldiers bought in S. purpuratus at Ft. Klamath up to 12 lbs. - - S. purpuratus in creeks.

Gilbert, C. H. and B. W. Evermann, 1895

A report upon investigations in the Columbia River basin with descriptions of four new species of fishes. (1894) Bull. U. S. Fish. Comm., 14 : 169-207 25 pl.

Salmo gairdnerii - steelhead abundant in larger streams of Col. basin, especially about Spokane and mouth of the Pend d'Oreille.

Salmo mykiss - Examined from Snake R. at Idaho Falls; Ross Fk. & Mink Crk. (Pocatello); - Little Spokane R. at Dart's mill; - L. Pend O'reille

- Quote - p. 200 - (also repeated in J. & E.)

- From upper Snake = typical mykiss 176-180 transverse rows - deep red slash spots posteriorly - in larger river channels - lighter colored, finer spots - fainter red mark. - Collection from * Newaukum R. at Chehalis Wash., = 120-130 scales no red streak (why cutts?) The sea-run individuals are believed to be steelhead and between it and mykiss we can't find any sharp line. - Wood R. - 150-163 scales usually no red dash - *Umatilla R. (Pendleton) *Natches R. (N. Yakima) & Patahe R. (Starbuck) 142-163 scales $\bar{x}$ 148

no red under lower jaw.

Coeur d'Alene region specimens usually distinct red mark vary in scale no. 130-166 in Lake C. d. A. (average about 145) - Little Spokane R. at Dartz Mill - conspicuous red dash - scales average 125 - Green R. at Hot Springs Wash., and for. Newaukum R. at Chehalis 123-130 scales. - We think it is not unlikely that the coastwise form should be recognized as Salmo mykiss gairdneri, though the question is sadly in need of systematic and thorough investigation.

- S. malma: not yet found in Snake R. - doubtful if it occurs above Falls. -

Jordan D.S. and Evermann D.W. 1903 American Food and Game Fishes. Doubleday, Page & Co. N.Y. 572 pp.

p. 179. Silver Trout, Salmo gibbsii Suckley - considered w/ cutthroat series.

In trib. of Col. between Shoshone Falls & the Cascades in lakes & large streams. - common in Des Chutes R. - Payette L. has Idaho small, ½ circle spots mostly above l. l. - rosy wash on side - scarcely any red on throat - scales about 140-145

- p. 160 - non migratory species and genus (Trutta).

p. 175 - Along the western slope of the Sierra Nevada there are also forms of trout with general appearance of steelheads, but with scales intermediate in number (in McCloud River), or with scales as small as in the typical cutthroat (Kern River). In these small-scaled forms more or less red appears below the lower jaw, and they are doubtless what they appear to be, really intermediate between clarkii and gairdneri. A similar series of forms occurs in the Columbia basin, the upper Snake being inhabited by clarkii, and the lower Snake by clarkii and gairdneri, together with a medley of intermediate forms.

Copeia (1213): 85

Jordan (1923) - steelhead 58 vert.

Kendall (1934) " 60 vert.

Smyth (1940) - Klamath R. count.

Stokell - N. Z. - 60-61

- J. & E. (1896: 498) - S. gairdneri

from Astoria - 137-177

newberrii - 36-146 - J. & E.

Gilbert (1898) - unable to distinguish
134, 135, 136, 143, 146

very abundant in upper Klamath L. & Rivers

no hyoid teeth.

Evermann & Meek - 1898 -

clarkii - abundant in upper Klamath L.

† rout very common in upper Klamath L. — 10-12 lbs.
not rare

only 2 gairdneri obtained in upper Klamath

- Gilbert & Evermann (1895) - confusion - cutthroat
bow -

Gilbert, C. H. 1898. The fishes of the Klamath basin. Bull. U.S. Fish Comm. (1897) 17: 1-13.

- How distinct Klamath fauna from Columbia & Sacramento. - relationships w/ Bonneville & Lahontan. (Chasmistes)

- Rutilus lacolor (Girard) - Klamath Lake. similar to obesus of Truckee R. - differing only in larger scales and extra ray in dorsal fin. - scales w/ strong concentric lines and radiating ridges. 47-52 pores in lat. line (N=15) 10-11 above dorsal rays 8-10 (8.9)

*- Siphatales in Sacramento - from Ore. -

*- Salmo gairdneri - Very abundant in Upper Klamath Lake & River - unable to distinguish from typical gairdneri no hyoid teeth or cutt mark. scale counts 134, 135, 136, 143, 146 - one or more species may have been planted here.

- S. malma - Cope reported it from Williamson R. - not seen by us.

Dymond 1947 - Roy. Ont. Mus. Zool., Misc. Publ. No. 1. - Contr. - No. 25 - 1944 -

- Nat. Hist. Soc. Brit. Col. 1(1):7-19 - prop. & comm. 1891

- Bull. Fish. Res. Bd. - 1952. No. 94 - 28 pp.

- Trans. Roy. Soc. Can. sect. 5, 37: 79-91 - Neave 1943.

- Vernon, E. H. and R. G. McMynn. 1957. Scale characteristics of yearling coastal cutthroat and steelhead trout - J. F. R. B. C. 14(2): 203-212.

- Counted 4 rows above - to tip of caudal peduncle. * - perhaps 4 or 5 too high.

88 cutthroat & 96 steelhead from Cultus L. hatchery - cutts belong & hatchery brook stock. - steelhead eggs from So. Tacoma hatchery, Wash. - eggs from Chambers Ck. run.

steelhead 127-147 $\bar{x}$ 136

cutts 146-173 $\bar{x}$ 158

- Neave 1943 - cutts - Cowichan 146-177 $\bar{x}$ 160.4

* " Vesuvius 122-154 $\bar{x}$ 137.4

steelhead - Cowichan Hatch. R. 131.5 123-143

R. 132.2 123-141

steelhead - more widely spaced circuli

cutt - slightly narrower scale

focus of cutt scale more centrally located

steelhead - displaced slightly anteriorly

∴ cutt scales smaller than steelhead at same size.

- young cutts - have less overlap in scales than steelhead

- Heave - 44 - · Cowichan

	wild -		hatchery	
	bows -	steelies	bows -	steelies
"1/3 up dorsum"				
N=61	115-130	123-159	118-133	120-137
	122.3	132.23	125.48	130.4
		N=52	N=25	N=22

- bows - resident - genotypes dif. 5 scales - 10 in wild fish - reversed - Col. R. & Sacra. + Fraser -

Jordan and Everman (1896:488) recognized three distinct species groups of western N. A. Salmo; the cutthroat series, Salmo mykiss, the steelhead series, Salmo gairdneri and the rainbow series, Salmo irideus. It was claimed that irideus had large scales (in the lat. ser.) while gairdneri had 150-180. ~~Samples from anadromous populations~~ of androm. gairdneri ~~have been examined~~ representing populations distributed from Calif. to Alaska, have been examined and the typical lateral series scale counts ~~approaching~~ range from 120 to 140 no specimens were seen which approach such high counts as given by Jordan and Everman. (All other published work - Vernon and McMynn (1957) counted ~~None~~ 96 steelhead from B.C. and ~~found~~ a range of 127-146 with a mean of 136 - for 96 steelhead examined from B.C. - Neave (1944) found 52 steelhead from the Cowichan R. B.C. to have a mean of 132 scales

Schultz - 1933 - Species of Salmon & Trout -

- 12 in. Silver salmon spawning in trib. of Idaho - not verified
Washington - scales show landlocked.

Trutta vertebrate - 58-59

- Cutthroat - 59 - 62 generally 60-61

Rainbow-steelhead (63-65) -(63-64) - see Mex. paper

believed 2 forms exhibit. Puget Sound drainage one
26-29 scales above l. l. ~~-27-28-bc~~ 120-135 in l. l.
other 29-34 140 -180

both same no. vertebrae

- gairdneri beardslei & clarki crescentis in Crescent Lake
don't vary as much as many other ca-run samples.

Origins of cutthroat & rainbow trout

- Jordan
- Kendall
-

- Bering

- chromosomes - salar

trutta

- vert.
- scalation
- spotting
- caeca

- formosanus -

- bird papers -

- Jordan
- Kendall

basibranchial teeth.

- Regan
- Mottley -

4 major groups to discuss origin etc
1 coastal rainbow
2 coastal cutthroat
3 interior cutthroat
4 "golden-Gila trout complex"

- The cutthroat series
- S. c. c. -

Characteristics
- low vert
- coarse scales

- Division of original species into 2 groups - 1 =

- Neave.

- Schultz (1936): 136 - In the Puget Sound drainage 2 types of cutthroat have been observed. They are distinguishable as follows: Scales 120-140 (usually 125-130) instead of 143 to 180. 25-29 instead of 30-36 above lat. line. Recent evidence indicates that this great variation may be caused by the different temps. during early development.

Richardson's cattle description

- "thyroid feeds — sound
out
66 cat. -

- Original account - mixed &
decomposed specimen -

- Richardson's description -
- basibranchial teeth
- 66 vert. -

Robt. C. Meigs chief of the Fish and
Game Management Division of Wash. Game Dept.

8

62 65

64

62	63	64	65
1	2	4	2
	1	3	2 2
	1	4	2

1 2 3 1

Lake Crescent & Lake Sutherland

Letter from Robert C. Mergo - Chief Fish. Mgt. Div. Wash. Game Dept. - Mar. 12, 1952

Lake Sutherland - 700 acres -

Tributary of Elwah R.
- cutthroats native
- planted - brooks, silvers, rainbows, Montana cutthroats
- Cutthroats and silvers do best.
- Still produces some large cutts - from 2-4 lbs. and sometimes larger - but main production comes from silver trout or kokanee and planted rainbow.
- heavily fished - many resorts - on highway

or card

in letter

300,000 rainbow fry planted 1955

- Lake Crescent in boundary of Olympic Nat. Park. Not stocked by Dept. since 1941 - hatchery up to 1941 ~~for~~ principally for fry for Lake Crescent & Sutherland, and other waters in area. - reports indicate fishing for beardslei was better than for several years - resemble spring steelhead.

* - both rainbows & cutts from silvers Crescent hatchery - dumped in both.

- Crescent Lake - 12 mi. long very deep.
- planted trout - Montana cutthroat, silvers, brookies, rainbows, - heavily fished.

Both Cres. & Suth. — stocking records go back to 1933 —

besides native fons — rey. cutts & bows & steelhead stocked. —

Jordan, Evermann and Clark 1930

Rainbow

sub genus Salmo

regalis Smyder

gibbsii Suckley

~~kenshi~~

beardslei Jordan & Seale

amargdus Snyder

aquilarum Snyder

irideus Gibbons

gairdneri Richardson

stonei Jordan

* newberrii Girard

- gilberti Jordan
- rosei Jordan
- aguabonita Jordan
- roosevelti E.
- whitei E.

nelsoni E.

15

Cutthroat

~~sub ges~~

sub genus (Salmo)

clarkii Richardson

lewisi (Girard)

~~bouvieri~~ (Bendire)

utah Suckley

henshawi Gill & Jordan

tahoensis Jordan and Evermann

jordani Meek

declivifrons Meek

virginalis (Girard)

pleuriticus Cope

stomias Cope

macdonaldi Jordan & Evermann

crescentis Jordan and Beardslee

~~Bean~~

bathoecetus Meek

eremogenes Evermann & Nichols

16 evermanni J. & G.

kamloops Jordan

iris kiteleyensis Dymond

mordax argentatus Bajkov.

4 gilae Miller

selenirus Snyder

alpestris Dymond

2

Evermann, B.W. and S.E. Meek 1898.
A report upon salmon investigations in the Columbia River basin and elsewhere on the Pacific Coast in 1896. Bull. U.S. Fish Comm., 17: 15-84 (1897)

- Upper Klamath Lake, Ore.
- 5 or 6 species of suckers in lake

Trout are very common and reach a very large size, 10-12 lbs. not rare - some to 14,
- don't state species

- Salmo mykiss clarkii
- Numerous specimens obtained. abundant in N. Washington, Siuslaw R., Wallowa & Altamas L. - Upper Klamath Lake & Des Chutes R. - Comparison of specimens indicates it will be necessary to recognize more species or varieties of Salmo in the northwestern portion of the U.S. than have hitherto been admitted:

- Salmo gairdneri - seen in large numbers at Astoria and The Dalles. Only 2 specimens obtained in upper Klamath L.?

Neave, F. 1943. Scale pattern and scale counting methods in relation to certain trout and other salmonids. Trans. Roy. Soc. Can., 3rd ser., 37, sect. 5: 79-91.

- 7 mid scale papillae under lat. line organ.
- generally 2 papilla / metamere - except. gorbuscha (175 in lat. line) * average no. vert. 66.

scales above & below lat. line independent of metamerism.

- Methods of counting scales - levels & stopping pts. vary.

Scales in lat. line

		range	$\bar{x}$	σ
clarkii				
Cowichan Lake hatchery		116-133	122.8	50
Veitch Ck, hatchery Vancouver Is.		116-126	119.5	30
gairdneri				
Cowichan hatchery steelhead		119-131	125.2	70
sea-run steelhead - Cowichan R.		119-129	123.3	52
non-anad. rainbow - Cowichan R.		114-124	119.7	61
Kamloops - cowichan hatchery		121-130	125.7	25
trutta - Cowichan R.		105-116	112.0	25

To estimate degree of branching by oblique rows - - count no. of oblique rows corresponding to given no. lat. line scales.

Obliquee rows above lat. line.

same as table		17Z	$\bar{X}$	+ nulla . 116-137 - 125.3
clarkii	①	146 - ~~158~~	160.4	
clarkii	②	122 - 154	137.4	
gairdneri	①	123 - 143	131.5	- Cowichan Lat. steel.
	②	123 - 141 +159	132.23	- " Rio. "
	③	115 - 130	122.3	- non acad. Rio. Comid.
	④	130 - 155	142.6	- Cariboo & Nat.

. 60 scales in lat. line - . corresponding oblique rows.
- go 1/4 - 1/3 up body count back to head -
results somewhat comparable to lat. series -
correlated -
but + nulla has more anterior branching.

	①	②	gairdneri
clarkii -	89.0	76.1	67.4 ; 68.3, 63.4, 75.2

+ nulla
73.5

THE ORIGIN OF HATCHERY RAINBOW TROUT, by P. R. Needham and Robert J. Behnke.

Rainbow trout, Salmo gairdnerii, have been propagated for almost 83 years in hatcheries in the United States. The original hatchery rainbow taken from the McCloud River, California, has since been crossed with many other strains and selectively bred for hatchery conditions until, no present-day hatchery rainbow truly represents the original McCloud River type. Probably every western State that propagated both rainbow and cutthroat trout experimented with hybrids. The cutthroat influence, such as a faint cutthroat mark and occasionally basibranchial teeth, may still be observed today (Hot Creek, California, strain) in some hatchery stocks. All hatchery rainbows that we know of, however, are coarse scaled, typically 120 - 145 scales in the lateral series.

In this paper evidence is presented that the original "Shasta" rainbow used for hatchery propagation was actually the result of mixing two types of rainbows; a resident fine scaled form and the anadromous steelhead.

When Livingstone Stone undertook the artificial propagation of king salmon, Oncorhynchus tshawytscha, on the McCloud River in the early 1870's, he noted the availability of rainbow trout and the possibilities for including them in his fish cultural activities. In 1879, the taking of rainbow eggs began at the U.S. Fish Commission station at Baird on the McCloud.

Stone's reports, found in the early volumes of the U.S. Fish Commission Bulletin, make lively reading. Troublesome incidents with Indians, poachers, thieves, mountain lions, and floods are recounted in a matter-of-fact manner. Not the least of the problems which perplexed him was the possibility that he was dealing with more than one form of rainbow trout. Stone (1883) wrote: "The question has been raised. 'Is there more than one variety of black spotted trout in the McCloud River, California?' It is settled beyond doubt that the McCloud contains Salmo iridea, the coarse scaled trout of the McCloud River proper that grows to a weight of eight or ten pounds. Is there another kind in the McCloud River, finer scaled and different shaped?" Stone examined the trout held in his trout ponds and believed that he was dealing with but a single form, but if there were two forms: they shade into each other by imperceptible degrees. Stone goes on to make a significant remark which has important implications concerning the original genotype of hatchery rainbows: "One thing is certain, which is, that if there are two or more species of trout in the ponds, the eggs distributed from these ponds are the fruit of an intermixture of both or all varieties, for all the males and females in the ponds are used indiscriminantly in the egg taking season and all seems to be equally efficient in producing fertilized ova." Stone (1884) said: "The only distinction which the writer could discover between the so-called

fine scaled and the coarse scaled varieties was simply this, viz: that the large fish in the river were coarse scaled and the smaller fish in the brooks which flow into the rivers were fine scaled." Wales (1939) pointed out that the McCloud was known to have a steelhead run. Trout for breeding purposes were taken from both the tributaries and the main stream. The eight to ten pound coarse scaled trout of the McCloud probably represented the steelhead and the fine scaled trout in the tributaries were most likely resident fish. From the circumstantial evidence, it seems highly probable that the original "Shasta rainbow" of fish culture fame had a large measure of steelhead influence in its heredity and did not represent a strictly resident trout as has been commonly believed, but was actually an amalgamation of the resident trout from the tributaries and the anadromous steelhead of the main stream.

Concerning the reality of the occurrence of both a fine scaled resident rainbow and a coarse scaled steelhead in the McCloud we must rely on analysis of the literature and examination of museum specimens in an attempt to reconstruct the actual facts, because the type locality is beneath 300 feet of water at the bottom of Shasta Lake, and hatchery introductions have altered the genotype of the trout in the upper McCloud.

Jordan and Henshaw (1878) described a trout specimen from the McCloud as identical to the cutthroat trout from Lake Tahoe. Later, Jordan (1883) believed there was but one species of trout in the McCloud and the upper Sacramento River system

and it was Salmo irideus. He claimed the fine scaled trout of the tributaries were probably the result of environmental influences. Jordan (1894) reversed himself and described the no-shee trout, Salmo irideus stonei, and the Shasta trout, Salmo gairdnerii shasta, from the McCloud. In reality, these descriptions give little evidence that two species were actually involved.

Examination of the type material of shasta and stonei at Stanford University indicates that they represented specimens taken from a single population. The types of stonei and shasta represent the fine scaled resident form. Observations on the scales support this hypothesis. There is no indication of ocean growth in the scales of three specimens examined. They revealed that they were in their fourth or fifth year while only 316 to 323 millimeters in standard length, which indicates typical slow growth in cold mountain streams. Scale counts made in the lateral series on the types of shasta or stonei and from other collections from the McCloud and Pit Rivers and their tributaries typically range from 140 - 170. In more than 100 specimens of steelhead collected from various areas from California to Alaska, the typical scale counts range from 120 - 145. Rutter (1908) presented a number of scale counts made on rainbows from the upper Sacramento system and his figures definitely show that the fine scaled rainbow was widely distributed. Some specimens from the Pit River and its tributaries have definite indications

of cutthroat influence. Besides the fine scalation, the spotting and morphology is suggestive of a cutthroat or a cutthroat-rainbow hybrid and often a cutthroat mark is present. It was probably on such specimens that Snyder (1908) based his records of cutthroat from the Pit River and Burney Creek, a tributary of the Pit.

The argument may be made that the finer scalation found in the resident trout of the upper Sacramento River area was due to a direct action of the environment. But when a number of samples from a number of localities in the upper Sacramento show from 10 to 30 more scales than a large series of steelhead collected from widely scattered areas over their entire range, we believe that this indicates a genetic basis for the finer scalation. The most plausible explanation of the fine scaled rainbow of the upper Sacramento River system is that they resulted from an infusion of interior cutthroats moving down from the Goose Lake drainage during an early connection with the Pit River. There may also have been natural headwater transfers of cutthroats from the Lahontan basin into the upper Sacramento. The subsequent introgression of cutthroat genes through the native rainbow population gave rise to a distinctive form which in the McCloud River caused much confusion both to the fish culturist and the taxonomist.

The activities of man has drastically changed the original distribution of the native trout in the upper Sacramento

system and we do not know to what extent the fine scaled form intergraded with the coarse scaled type. If the fine scaled form did make up a discrete geographical unit with some constant characters, they should be recognized as a subspecie in the rainbow series. The name stonei has priority over shasta. But because our knowledge of the situation is incomplete, we have not reached a decision concerning the scientific name of the fine scaled trout of the upper Sacramento.

We sincerely appreciate the cooperation of J. H. Wales, Oregon State University, for the loan of specimens and color notes, and of Dr. G. S. Myers of Stanford University for the loan of specimens.

Summary

The rainbow trout originally used for the establishment of hatchery rainbows was from the McCloud River, California. The McCloud and other waters of the upper Sacramento River system had a fine scaled resident trout and also runs of anadromous steelhead. Evidence is presented to show that both of these types of trout were used to establish the original hatchery rainbow; thus, the "Shasta" rainbow of fish culture fame was actually a mixture of these two forms.

Jordan, D. S.
1883. McCloud River trout. Forest and Stream. 20: 72.

1894. Descriptions of new varieties of trout. Thirteenth Bien. Rept. St. Bd. Fish Commissioners St. Calif. (1893-94): 142-143.

Jordan, D. S., and H. W. Henshaw.
1878. Report upon the fishes collected during the years 1875, 1876, and 1877, in California and Nevada. Ann. Rept. U.S. Geog. Surv. W. 100th Meridian (Wheeler Surv.). (Appendix NN of Ann. Rept. Chief of Engineers for 1878): 187-200.

Snyder, J. O.
1908. Relationships of the fish fauna of the lakes of southeastern Oregon. Bull. U.S. Bur. Fish., 27: 69-102.

Stone, L.
1883. McCloud River trout. Forest and Stream. 20: 12.

1884. Report of the operations at the trout breeding station of the United States Fish Commission on the McCloud River, California, during the year 1882. Rept. U.S. Fish Comm. 1882: 851-854.

Rutter, C.
1908. The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. Bull. U.S. Bur. Fish., 27: 105-152.

Wales, J. H.
1939. General report of investigations of the McCloud River drainage in 1938. Calif. Fish and Game. 25 (4): 272-309.

~~Snyder~~ 1.

Rutter; Cloudsley 1908. The fishes of the Sacramento-San Joaquin Basin, with a study of their distribution and variation. Bull. U.S. Bur. Fish. vol. 27: 105-152
- collected 1898-99.

p. 141 - Salmo iridea

- McCloud R - lower fins yellowish; typs of dorsal, ventrals, anal, ~~often~~ white. Scales 146-165

So. Fk. Battle Ck. above falls closely resemble the typpe McCloud fish. - Scales 151-176. above lat. line 28-32.

- Goose Lake trout - body entirely silvery w/ very small spots - widely scattered - ~~not reaching~~ all above lateral line. - long maxillary - probably cutts -

Specimens from upper Sacramento & Pit R. regions varying branches of Feather River. average 143. So. Fk. 147 scales Battle Ck. 163.

- Miller & Morton (Salvelinus malmaycush)

Rush Ck. - x 154

Wales, J. H. 1939. General Rept. of Investigations on the McCloud R. Drainage in 1938. C.F. & G. 25(4): 272-309.

-282- I have examined the original specimen of stonei and believe that if it is not a variant of the river population it is a steelhead.

- Worthington 1941
  Sal. & Trt, May No. 101: 62-99
  - Rainbows in England

- Mottley - S.&T. 30 & 3: 150
  Prg. Fish. Cult. 1935 Dec. 7-10.

- Morton - Copeia chan-chan

Title

McCloud Rev. Trout. D. S. Jordan - Trout & Stream Feb. 22, 1883
vol. 20 p. 72. SKIFG - Indiana Univ. - Feb. 13, 1883

- Answer to L. Stone - "There is but one species of bla
"So far as the collections sent to the Nat.
Museum permit us to form an opinion, there is, in the Upper Sacramento,
but one species of black-spotted trout and this species is Salmo irideus.
There is also a red-spotted trout or Char, the Dolly Varden - .
The small or "fine-scale" trout of the mountain brooks is, we think,
the same species as the river trout . - - - - says environment the factor
in the apparant differences.

- The salmo purpuratus or "Clarke's trout" of interior - -
altogether a superior animal and better worthy of the
fish cultivists attention of the
↑ The famous trout of L. Tahoe is a variety of
this species and. A few specimens have been taken in the Lower
Sacramento, but the species has not been traced up to
the McCloud.

Rainbow Trout and Steelhead - D. S. Jordan. 1884 -
Forest & Stream, June 12 1884, vol. 22 p. 386

Believes Steelhead and rainbow forms of same species.
S. g. g. & S. g. i. - Steelhead mouth larger and
tail more Truncate rather than Lunate. - This deffirence
seen between largest rainbow (McCloud R.) & average
steelhead.

Mc Cloud River Trout. - Livingston Stone - Forest & Stream. Feb. 1, 1883 vol. 20 p. 12.

The question has been raised, "Is there more than one variety of black spotted trout in the Mc Cloud River, Calif.?" It is settled beyond question that the Mc Cloud contains Salmo iridea, the coarse scaled trout of the Mc Cloud R. proper. that grows to a wt. of 8 & 10 lbs. - Is there another kind in Mc Cloud R. - finer scaled & different shaped? - Spent day examing trout from pond - these trout taken from river & tributaries nearly all over 2 yrs. old. - Opinion that only one ~~specie~~ variety of trout in U.S. trout ponds - or if 2 or more varieties they shade into each other by imperceptable degrees. - Opinion of Loren Green & Myron Green who had more experience than any other white man with these trout that - only one specie: "One thing is certain, which is, that if there are two or more species of trout in the ponds, the eggs distributed from these ponds are the fruit of an intermixture of both or all the varieties, for all the males and females in the ponds are used indiscriminately in the egg taking season and all seems to be equally efficient in producing fertilized ova."

Garman. S. 1884 - May 8 p. 290 - Forest & Stream. vol. 22

New England Salmon & Trout -

S. oquassa - 210-235 scales - 64-76 across flank

naymacush 195-215 - 56-62 - " "

- fontinalis - 195-210 - Monadnock trout - 215-240 - see Table - same - identical to fontinalis

Great Lakes brook trout - same as Monadnock -

Stone, L. 1883 - Rept. Comm. for
1880 - p. 620 -

Rainbows on set lines - salmon eggs
- fish fm., mid May - end Nov. - best in
June, July. Trapped from Trib. Creeks also
- but ready to abandon that. -

÷ McCloud rainbow fishery - first in July 1879

- Stone. 1884 - Rept. of Comm. 1881 : 1079-1083
Report of operations at the U.S. Trout Ponds,
McCloud River, California, for the season of 1881.
p. 1079
- No exertion spared in collecting breeding fish -
300 trout in breeding ponds none less than 1 lb. half
weighed over 5 and a few upwards of 8. Average
wt. of the whole number not less than 3 lb.

- Egg taking 1882 - 5th Jan. 5th May.
- 1884 : 851-855
Rept. of Operations at the Trout-breeding station of
the United St. fish comm. on the McC.R. Calif., during
the yr. 1882 - - winter cold - (coldest since whitemen came)
last year - rained more than anytime since whiteman came -
- As has been noticed heretofore, the smaller
& earlier spawn first, the larger, and older ones later - brighter,
plumper & gave smallest eggs - thin, less large eggs, largest.

Some spawners black and dirty, some bright, some strong red band others w/o.

p. 853

- Now in ponds - 2000 trout - smallest 1½-2 lb. and largest not far from 10 lb. - average 3-

- wild cats, lynxes, coons, otter, mink, numerous.

panthers - recently got very bold & numerous.

one grabbed Myron Stears dog from behind him, - never killed any fish. - check - "the question has been raised"

-". It is settled definitely that the McCloud R. contains Salmo irideus, the coarse scaled trout of the McCloud R. proper, which grows to a wt. of 8 or 10 lbs, has an obtuse nose and large eyes, bright red gill cover, broad red band.

- The question remains, is there another kind of black spotted trout in the ponds or in the McCloud, finer scaled and differently shaped?

- Examined the trout in the ponds, all caught in Lake & its Tributaries

" 854. After a thorough examination of the fish both alive and dead, I am compelled to give it as my opinion, which I admit is not based on a scientific study of them, that there is only one variety of black spotted trout in the United States ponds on the McCloud River, or that if there are two or more varieties, they shade into each other by imperceptible degrees"

Jordan, D. S. 1894. Description of new varieties of trout. Thirteenth Biennial Rept. of the State Board of Fish Commissioners of the St. of Calif. for the years 1893-94: 142-143.

The No-shee Trout

Salmo iridens stonei

Scales about 155 longitudinal series. 7—> about 25 above dat. line.

Spots few— confined chiefly to posterior part

red lateral band; cheeks & opercle red, no red between branches of lower jaw.

Specimen 14 in. . coll. by L. Stone in Mc Cloud R. at Baird, Calif. - Well known to Indians and fishermen of upper Sacramento where it is known as the No-shee. The name Nissuel said to be used by Indians for this fish in Siskiyou Co.- said abundant in Mc Cloud about 8 mi. above Baird. One Taken - 12 lb. - 2nd specimen - scales 143.

- Mc Cloud River Trout; Shasta Trout.

(Salmo gairdneri shasta - Rainbow trout of the Fish culturists).

Scales usual number about 145- Profusely but irregularly spotted - usually a trace at least of orange dashes between branches of lower jaw.

— S. g. gilberti

— scales 165—

Stone 1864 -
p. 857 - cont

"One thing is certain, which is that if there are two or more species of trout in the ponds, the eggs distributed from these ponds are the fruit of an intermixture of both or all varieties for the males & the females are used indiscriminately in the spawning season and all seem to be equally efficient in producing fertilized ova."

"The only distinction which the writer could discover between the so-called fine scaled and the coarse scaled varieties was simply this, viz: that the larger fish in the river were coarse-scaled and the smaller fish in the brooks which flow into the river were fine scaled.

- trout taken from all brooks and trib. & main river - mixed together.

- observe river or species - varieties etc. environment etc.

Stone 1885

Rept. of Operations at the U.S. Fish. Breed. Sta. on the McC. R., Calif., during the year 1883

U.S. Comm. Fish.

- Rept. 1882: 1001-1006.

- Began spawning Jan. 3. - Apr. 5. no bimodal distrib.

- Cold winter 82-83 - San Francisco snow - 1½ since Calif. settled.

1885 - Dec. 27 - Apr. 29 - spawning -

Rept. 1879 XXXI 1884 - Dec. 28 - May 28

- Introduced into Japan in 1877 from Mc Cloud

Dec. 26 1885 - May 10 1886

Rept. 1886 - (1889) - Rept. of operat. at U.S. Fish. & Fish. sta. on Mi. C. R. for the year 1885 - 87 - 737-746

Sept. 7 - small trout

14

15 - 2 very large + small

"

"

Oct. - tapers off

more large than small

↓

Nov. - ~~rain~~

- large trout

rain

- Traps blocked

Dec. - flooding

Jan. no mention of size

Table VI p. 475

Sept. 11 - 4 small trout large trout very scarce

Sept. - small trout

15 - large trout

Oct. - more large than small

Wales, J. H. 1939. General report of investigations on the McCloud River drainage in 1938. Calif. Fish & G. 25(4): 272-309.

*- p. 279 - 33,000 to E. Chazari Mexico Fish Comm. 1888

STone recognized great variation in color & shape of brood fish - dark-dirty + bright w/ red band. - thought difference between stream & river fish environmentally induced.

✓ Indians recognized - No-shee trout - Jordan named it Salmo irideus stonei also S. g. shasta.

(Jordan didn't realize steelhead went to McC Creek)
- check size of brood fish

- No-shee reported to attain a large size, as great as 12 lbs. -

p. 282 - Steelhead run in McCloud not ordinarily recognized but Joseph Campbell assures me that he formerly trapped them along w/ non migratory rainbows.

- Wales' 2 lb. rainbow unusual - 5 lb. caught in 1917.

many 8-10 in. dolly vardens caught.

heavy mud flows began about 1922.

DOLLY VARDEN

- Mrs. Masson - who actually gave name Dolly Varden (according to her) - says Dollies occurred in upper Sacramento in vicinity of Dunsmuir. - One fisherman claimed caught dollies in ~~mouth~~ pit R. mouth of Squaw Ck. - most 8-10 in. But reported to 16 lbs

Wheeler

* headwaters of Tate Ck. has population of golden trout -

Opposite Tate Ck. - short spring run from Black Fox Mtn. another pop. of golden trout. - resemble S. roosevelti.

* later changed mind -

?? (where are these specimens)

- Claiborne Ck - p. 302 - ideal conditions for producing non migratory strain rainbow, 15 ft. shear drop - Believed native.

- fine scaled - coarse scaled
Kendall, W. C. 1921. - shasta - gilberti - vert. counts.
What are rainbow trout and steelhead trout? Trans. Am. Fish. Soc. (1920) 50 :187-195.

- Salmonidae represent zone system of distribution

- It does not seem possible that large scaled fish entering the Colo. could ever become the small scaled species of the Kern, or a small scaled form from any source could ever directly change into a large scaled fish of another locality. - - - - Durango trout not derived from Missouri or Snake R. -

- p. 192 - " Now the fact appears to be that the form bearing the name Salmo iridens is an anadromous form. But the form from the Mc Cloud River which has been propagated artificially under the name "rainbow trout" (Salmo iridens)" is a distinct species which Jordan has named Salmo shasta. - small scales indicates originated in more northern section of our zone system. - than did the coast-wise rainbow or steelhead. - Kern R. trout similar to Mc Cloud - gilberti & shasta same type of fish.

- Steelhead must continue to bear name S. gairdneri -

- rainbow has 63 vert, steelhead 60. (counting all segments. invariably in the specimens which I have so far examined.

SOURCES OF NON MI[GRATORY] ROM NATURAL POPULATIONS

P. R. Needha[m] J. Behnke

Previous articles have appeared in this journal dealing with the attempt to develop a hatchery strain of ~~rainbow trout~~ non - migratory rainbow trout (Ratledge and Cornell 1953; Carbine 1953). ~~Although~~ the advantages of a non-migratory rainbow trout are, assumably, many, would it not be more feasible, both economically and biologically, to locate and utilize a natural population of non-migratory rainbow trout ~~that has evolved the non-migratory habit through natural selection~~?

In our studies on the genus Salmo in western North America, we have collected and examined specimens of rainbow trout from diverse environments over its entire range from Mexico to Alaska. Many of the populations investigated were of the non-migratory type, often tagged with the specific or sub specific name irideus. There are no morphological characters which will separate all non-migratory trout from all migratory trout. However, a population of rainbow trout isolated above a barrier falls in Claireborne Creek , a tributary of the McCloud River in California, not only has developed a non-migratory habit, but also a distinctive morphological character which makes it readily recognized from other rainbow trout - even those examined from below the falls.

The important character is the low number of branchiostegal rays. All 23 specimens examined from Claireborne Creek above the falls had 9 branchiostegal rays on the right side; 17 specimens had 9 rays on the left side and 6 had 10 rays on the left. (Counts were made in accordance with Hubbs and Lagler, 1949). No overlap was found this character when compared with 483 specimens of rainbow trout collected in various parts of their range from California to Alaska, ~~no overlap is found~~. These 483 trout represent samples from ~~26 populations including two hatchery strains~~ Mexican forms; the low branchiostegal ray count is distinct from the

nelsoni type of Baja California, but certain populations on the mainland have extremely reduced meristic counts, (Needham and Gard 1959) in press including the branchiostegal ray counts.

It is significant that every one of the Claireborne Creek trout could be separated from all of the other rainbow samples from Baja California to Alaska on the basis of 9 branchiostegal rays on the right side. When the total branchiostegal ray count is considered, i. e. the sum of the left and the right sides, 17 specimens have a total of 18 rays (9on the right and 9 on the left) and 6 specimens have a total of 19. (9on the right and 10 on the left) Of the above mentioned trout, a single example has a total count of 19 rays. This fish was from Riske Creek, B.C. and had the unusual count of 10 rays on the right and 9 on the left. Generally,if there is a higher number of branchiostegal rays on one side, it tends to be on the left side.

If the Claireborne Creek trout were to be introduced into other waters, the branchiostegal ray count would serve many of the functions of a tag. An advantage over a tag would be, that while a tagged trout will not pass the tag on to their offspring, it may be assumed that the low branchiostegal ray count will be inherited. Of course this hypothesis must be tested under diverse environmental conditions and experiments will be neccessary to establish the limits of variation that the environment can induce in this character. Wilder (1952) raised 50 eastern brook trout, Salvelinus fontinalis, at 5.5°C. which yielded a range in branchiostegal rays of from 9 to 12 with a mean of 10.76. He also raised 46 specimens of the same parentage at 0.9°C. these also produced a range of 9 to 12 but the mean was reduced to 10. 26. - check significance

It should be assumed that the Claireborne Creek trout will freely interbreed with other rainbow trout if given the opportunity, but due to rigorous selection for resident life in a small stream it is possible that a degree of reproductive isolation might originate from habitat preference.

Wales, (1939) mentioned the Claireborne Creek trout and also discussed the possibilities of propagating it as a non-migratory strain. For small mountain streams where previous introductions of rainbow trout have been unsuccessful, such a trout as the Claireborne Creek rainbow, may prove a useful tool in fish culture.

Many of the specimens surveyed were kindly loaned by Stanford University, the California Academy of Sciences, and the University of British Columbia, for which we gratefully aknowledge their cooperation.

Literature Cited

Carbine, W. F.
1953. Further data on the development of a non migratory strain of rainbow trout. Prog. Fish Cult. 15 (2): 83-84.

Hubbs, C.L. and K. F. Lagler
1949. Fishes of the Great Lakes Region. Bull. 26, Cranbrook Inst. of Sci. 186 pp.

Needham, P. R. and R. Gard
1959. The rainbow trout in Mexico and California with notes on the cutthroat series.

Ratledge, H. M. and J. H. Cornell
1953. Migratory tendencies of the Manchester (Iowa) rainbow trout. Prog. Fish Cult. 15 (2): 57-62.

Wales, J. H.
1939. General report of investigations on the McCloud River drainage in 1938. Calif. Fish and Game. 25 (4): 272-309.

Quotations From Some Currently Influential Books On Scientific Reasoning

For personal use only

On Certainty - Wittgenstein (1969)

"We use judgements as principals of judgement." (An infinite regress - Wm. J. McConnell)

"We do not learn the practice of making empirical judgements by learning rules. We are taught judgements and their connection with other judgements. A [web] of judgements is made plausible to us." (We develop a mindset from our Tribe - Wm. J. McConnell)

"Not only rules but also examples are needed for establishing a practice. Our rules leave loop-holes open and the practice (craft, science) has to [demonstrate] itself."

"When we first begin to believe (learn) anything, what we believe is not a single proposition, it is a whole system of propositions. Light dawns gradually over the whole."

"In order to make a mistake, a man must already judge in conformity with mankind."

"Doesn't testing (doubting) come to an end?"

"The difficulty [with science] is to realize the groundlessness of our believing." (Groundless means without ultimate proof here - Wm. J. McConnell)

"At some point one has to pass from explanation to mere description."

"Knowledge is in the end based on acknowledgement." (On authority - Wm. J. McConnell)

On Certainty (Continued)

"If someone doubted whether the earth has existed a hundred years ago, I should not understand, for this reason: I would not know what such a person would still allow to be counted as evidence and what not." (What authority does he accept? - Wm. J. McConnell)

"So rational suspicion must have grounds. We might also say: the reasonable man believes this. Thus we should not call anybody reasonable who believed something in despite of scientific evidence. But who says what is reasonable to believe in this situation?"

"That is to say, it belongs to the logic of our scientific investigations (physics) that certain things are in deed not doubted." (We agree not to doubt some things - Wm. J. McConnell)

"My life consists in my being content to accept many things." (On authority - Wm. J. McConnell)

"..... it is difficult to begin at the beginning and not try to go further back."

(it then follows that:)

I must recognize certain authorities in order to make judgements at all. (Authorities are agreed upon beginnings - Wm. J. McConnell)

Conjectures and Refutations - Popper (1965)

"All terms (measurements) are theoretical.....though some are more theoretical than others." (Numbers on a dial or stick; color of a liquid in a tube; counts of similar things in a visual field, only mean what we agree they mean. - Wm. J. McConnell)

"[We can only make scientific predictions about] systems which can be described as well isolated, stationary and recurrent. These systems are very rare in nature..... The life cycles of organisms are part of a semi-stationary or very slowly changing biological chain of events." (Also recurrent and well isolated from catastrophies because once the creature is dead it no longer is expected to act like a member of its species - Wm. J. McConnell)

"But inductive logic is impossible [because it] must involve either an infinite regress or [is based on authority]." (The evidence for induction is an induction depending on an induction, etc.; or else some wise man said induction was valid and we acknowledged his authority because he seemed wise - Wm. J. McConnell)

[All theories are metaphysics (myths).]

"[All theories] are conjecture as opposed to indubitable knowledge."

"No logically possible future observation can ever contradict the class of past observations." (Quoted from Hume by Popper) (A scientific experiment doesn't consist in checking on the accuracy of past observations. It is possible that the past does not agree with the future relative to it. - Wm. J. McConnell)

Philosophy of Biological Science - Hull (1974)

"In short, is there a single philosophy of science that is equally applicable to all areas of natural science or are there several, each appropriate in its own domain?"

"From its inception, philosophers and scientists have not been satisfied with evolutionary theory as a scientific theory."
"It is unfalsifiable" [it is tautological, it can't predict, it can only explain].

"That is, no property which can be used to distinguish the species under investigation from all other species is universally distributed among the members of the species and vice versa."

"The currently accepted paradigm of a scientific law is a process law...."
"Process laws are possible only for systems like the solar system that are effectively closed - with respect to the relevant variables."
("The solar system is closed only on a human time scale" - Wm. J. McConnell)

[then perhaps:]

"There are no biological theories" (or is it all a matter of judgement about time scales and aggregates vs individuals - Wm. J. McConnell)

"If the basic laws of quantum physics are necessarily statistical, then perhaps the prevalence of statistical laws in biology is not all that bad."
(Maybe the only science is that based on quantum theory which is the statistics of huge numbers. But biological statistics are seldom about huge numbers. - Wm. J. McConnell)

Philosophical Remarks - Wittgenstein (1964, 1975)

"And when, as in set theory [mathematics], tries to [prove reality], we ought to cut it down to size."

"Causality rests on an observed uniformity. Now that doesn't mean that a uniformity we have observed until now will go on forever [but it must have] been uniform until now."

"The complexity of philosophy is not in its matter, but in our tangled understanding. Philosophy unties the knots in our thinking, [to do so] it must make movements as complicated as [those that tied the knots]."

"To explain is more than to describe; but every explanation contains a description."

Zettel - Wittgenstein (1967)

"To understand sums in the elementary school the children would have to be important philosophers, failing that they need practice." (A dig at modern math - Wm. J. McConnell)

"The classifications of philosophers and psychologists: they classify clouds by their [changing] shapes." (And maybe ecologists to? - Wm. J. McConnell)

"Sufficient evidence passes over into insufficient without a definite borderline."

"Any explanation has its foundation in training. Educators ought to remember this." (We must be trained to "believe a problem" before a theory can be offered as an explanation - Wm. J. McConnell)

"Concepts with fixed limit would demand a uniformity of behavior. But where I am certain, someone else is uncertain. And that is a fact of nature."

Against Method - Feyerabend (1978)

"Scientific education as we know it today has precisely this aim [:brain washing]. It simplifies science by simplifying its participants...."

"Now science is never a completed process, therefore it is always "before" the event. Simplicity, elegance or consistency are never necessary conditions of scientific practice."

(Quote from Niels Bohr by Feyerabend)

"..... hypotheses inconsistent with observations, facts and experimental results need no special defense for there is not a single interesting theory that agrees with all the known facts in its domain."

"As a result, a theory may clash with evidence not because it is not correct, but because the evidence is contaminated."

"We need a dream world in order to discover the features of the real world we think we inhabit (and which may actually be just another dream world)."

"Hypotheses contradicting well confirmed theories give us evidence that cannot be obtained in any other way. Proliferation of theories is beneficial for science, while uniformity impairs its critical power."

"..... that this appearance of success [consistency, predictions] cannot in the least be regarded as a sign of the truth and correspondence with nature."

"There is no idea, however ancient and absurd, that is not capable of improving our knowledge."

Against Method (Continued)

"..... the only principal which does not inhibit progress is anything goes."

The Methodology of Scientific Research Programs -

Lakatos (1978)

"Scientific theories are not only equally unprovable and equally improbable but they are also equally undisprovable."

"As science grows; the power of [new] empirical evidence diminishes."

"A given fact is explained scientifically only if a new fact is also explained with it."

"..... refutation without an alternative shows nothing but the poverty of our imagination in providing a rescue hypothesis."

"There is no falsification before the emergence of a better theory."

".....: the probability of a theory given evidence can depend only on the theory and the evidence and not upon whether the evidence was produced before or after the theory."

"It is a succession of theories and not one given theory which is appraised as scientific or psuedo-scientific."

(Paraphrased to shorten and make clearer.)

"In writing the history of science one compares the neat rational story with the original unedited untidy notes to find out how false the first is and how irrational the second is."

"Some of the most important research programmes in the history of science were grafted on to older programmes with which they were blatantly inconsistent."

The Methodology of Scientific Research Programs (Continued)

"The history of science has been and should be a history of competing research programmes but it has not been and must not become a succession of periods of [non-competitive science]: the sooner [disagreement] starts, the better for progress."

"All this suggests that we must not discard a budding research programme simply because it has so far failed to overtake a powerful rival [it should be sheltered for awhile]".

"Our considerations explain why crucial experiments are seen to be crucial only decades later."

(As in textbooks - Wm. J. McConnell)

"Our scientific folklore, however, is impregnated with theories of instant rationality."

"There are no such things as crucial experiments."

"..... each test is a challenge to the whole of our knowledge." (Not just the fragment being tested - Wm. J. McConnell)

"Neither the logicians proof of inconsistency nor the experimental scientists verdict of anomaly can defeat a research programme in one blow."

Mr. Ron Jones

- Mammoth Su
- Fish to freezer
- Lo High Re

Mathur et al 1985

'a transformation of univariate preference factors into simple probabilities is erroneous.' - Subjective rating of 1.0 (maximum WUA) - is not equivalent to probability of 1.0. - i.e. not 100% chance of finding a given species in "cell" of Transect rated '1.0'. - Only means that most individuals of species were captured or observed at that depth & velocity at time of observation & collection.

narrow vs. broad niche

- WUA - simply based on ratio's - - 100 fish sampled 20 occured at 3 ft. depth, 10 each at various other dist - 3 ft. = 1.0 - but vs. 100 sampled - every one at particular depth - (dominant sp. substrate riffles < 1 ft.):
- Thus, low correlations between pref. & standing crop.

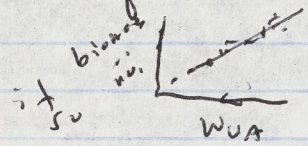
+1 IFIMS - restriction to use - first --- canned programs, then (Bovee 1982) - preference curves should be taken from unexploited pop. at carrying capacity." - a virtually impossible for gamefish - and cannot know "carrying capacity"

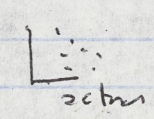
"spike dace exploited by s.m. bass" -

"WUA independence of variables depth & velocity not independence of flow"

"carrying capacity - see Hall & Knight. -

comes down to - "Is WUA positively related to fish biomass in a predictable manner?"





was documentation of such relationship in primary literature

← 100 units WUA one section = 100 WUA units depth-velocity but - trout - MICROHABITAT ca. 5% of channel actually used 95% of time - more at low feeding - but this section of more microhab - 10x more trout -

* Bourgeois Parsons - Bourgeois (1984) - microhabitat - low velocity cover amidst high $\bar{x}$ velocity (cell w/ to 6) maximize net energy gain feeding (invert. drift). Obviously such behavior greatly increases complexity of model + depth, velocity, substrate assume to be independent - NOT SO - - Assumption total WUA - large amts poor habit = small amt optimal

Denver So. Platte

- Only can work when pop. at carrying capacity & the strictly habitat limited (not food or some other - peak flow ← Nehring - (year - class strength).

complexities
quantifiable objects
but less effective for predictive

INTROD

— Dewitson flow... — flow — habitat — target fish — assumptions — models & IFIM
— Why predictions not zero → Hall Kwak
— niche — interships.

interpret in nature
regulatory
Nat. Variat
undetermined
non-recurrent
Illustrative techniques

— warning — caution! —

excessive costs, delays, lack results
— ask right questions —

need
— Probs — WUA — habitat quality = 1
steel values for quant. mitigation trade-off
carrying capacity
carrying capacity?

- WUA increase / 50% → bio spawning → 50% more / fewer years under?

adult habitat ... ...

what do test WUA with?

— Minimal times. — Sp.

— table —
Factors Affecting Num by
Physic - cs
Biol.

WUA not transferable
Denver R. Pk
1.0 rome more sig. + fr other

Quantifiable - reproducible vs. subjective — cover
- intersection
- current vel. min
- potential for improv
but never with be precise.

Historical Rev. —

- C.F.G. 60 - PGE (water rel) → IFIM =
only Binns - by HQI to river biomass
connect program - quick - easy - 'repeatable'
to IFIM. — now — each site do own curve

Limitations for Accuracy of Predictions

How much WUA 1.0 needed to sustain capacity? 10-15% stm microbes
to utilize food produced.

narrow niche sp.
vs,
broad niche

— WUA 1.0 - how sensitive - sample depth or velocity where most
occurred at time sampling but daytime — season —
w/ other species.

- biol. limit. override depth, velocity, sub, cover → spillcrest, brooks, withdrawal,

— Empirical — spring streams — Regulated — Salmon, Chinook, mixture w/ Cutthroat, Rainbow, Brown trout, Brook Trout — peaked ever — temp.

habitat improvement
overstock

age, size
diff. fry juveniles adults

Food limit. w/ Hab limit.
- Ar Sable, Berry Creek - Ore. clear cuts → Eastern U.S. (Loam)
— Mason food cake —

Velocity — not 'preferred' only tolerated.

Mr. Pat Dwyer
U.S. Fish and Wildlife Service
Fish Technology Center
4050 Bridger Canyon Road
Bozeman, MT 59715

- greenbooks:
2-4

Dear Pat:

- Measurable & unmeasurable responses
What does it predict? - should be something that can be measured on standing crop of fish - (only Binns). - or does it only produce an numerical index which can not be measured, tested or verified? WUA

mixture of empirical & conceptual aspects

- Some can be measured & tested - ex. cross-sectn wetted perimeter
70% area x 6 in. depth across a riffle - & 100 cfs. -
- ~~but if~~ check see if indeed 100 cfs produces result of 70% of channel wetted and 6 in depth - & ~~but know~~ what impact on target fish species - if only 50 & 30% less does pop. suffer? - How much.
WUA - % optimum habitat - but what is optimum - max - no. eggs spawning - no max juveniles - adult - overwintering - no. with -

- Attempts to test IFIM HEP:
carrying capacity - -

Velocity - tolerate - do not prefer - select only in sense to optimize feeding

- IFG - variables that change w/ discharge
1. velocity 2. depth - substrate ?? cover (undercut banks turbulence)
readily measured & modeled for simulation

why need interpretation

- * Preference few large trout occupying first class habitats (most preferred - deep hole under bank or log) - ~~most~~ 2 adult, 6-10 occupy 2nd-3rd class secondary - but by numerical abundance the depth, velocities etc - would rank highest.

trophy habitat - can predict w/ survival-growth w/ good??

* Velocity pref. - also changes when taken -
low flow - 5 cfs 50 5 (50) cfs.
- depth pref. also

Dr. Leo Marnell

Jack. - Saddler
- Kalispell MT 59
- Creston Hatch.
- Iowa Fish.

- with only a predominant brown

Some find corr. w/ brown that but not other spp
- Steelhead, Cutthroat, Rainbow, ~~Brook~~ Brown
Atlantic Salmon no relationship

Loar (ed. 88) - South. Appalachian brown - RB
each sp. S.C. for each age group to WUA
% useable area for each stage of life
when brown & RB sympatric - no comp

- Habitat Variables for S.I. curves for model must be precisely measured (repeatable) - such measures as stream width, depth w/ standard instrument etc
precision of variables
- Cover - % boulder - pool quality - bank stability - subjective - varies w/ individual - introduce error of unknown magnitude

→ N. Am 1984 Table 3 biomass
ft² WUA at 100 ft - Gunnison - 77,400 - 300 kg/100 m
but correlation So. Platte - 41,300 313 2x WUA
Poudre - 18,400 - 40 - 8x.
S. Fk. Rio Grande S. 5200 - 34
Mid Fk. So Platte 5400 - 16
- suckers -

Carrying Capacity 8.6 g/ft² x WUA adult
- Max. WUA used. (flow that gives max. value)
So. Platte Chessman Corp. at Carrying Capacity)
- Suggest need winter flow WUA.

Brown Trout - PHABSIM -
- SI curves vel., depth, substrate, cover, temp
SI curves - category I - prof. judgement, lit. review
utilization curves - II: based on field data
analysis - freq. histograms
not appropriate (velocities)
- freq. - U - but may be what available (suckers accommodations)
should be transformable
category III curves - utilization curves - corrected for environmental bias - Therefore represent preference of sp.
very few exist
(corrected for utilization vs availability).

Category IV curves (conditional preference curves) describe habitat requirements as a function of interaction among variables - ex. depth utilization depending on cover, velocity, time of day a year.
- just beginning to be developed.
- Category I curves generally utilized
Nose velocity vs. $\bar{x}$ column velocity -
other useful, practical additions - velocity - time of hatch, & incub. (effective spawning and winter habitat. nursery - 2 wks.

brown trout after spawning
- min. depth - or ice depth
- scour velocity.

appear - Constant update modifications of S I curves.

variables different of invest. for Type II curves

fry ↕ w. Y.-O.Y. of size ? - To dit streams
juvenile, I yearlings, I +
adult II + 5-6 in - 15-16 in.

- also % substrate
- detritus (organic debris) substrate might be little use to fish but - bridge production enormous input into food supply.
- shallow, broken, gravel bar

- Sp. interSp. dif. Sp. interaction R.B. - Cutts ? B.C. Idaho cutts always most in or crescentus, Or. - or Kootenays

Overriding Exclusion factors
Empirical or zero multiplicative factor - Ex spike dace, longnose minnow, or Gila chub most not scour obs. S.M. bass adt 6 in + in exceeds 10/2 sm
- Cutthroat, rainbow trout - 100 ft. stream if brown/RB occurs.
(Category IV(?) - cutts in Yellowstone R.

Eagle →

Lotic (84) - U.S. Dept. Energy - effort to provide guidance to hydropower developers & regulators - to evaluate validity of physical habitat indices (WUA), in predicting response of trout pop. to change in flow.
Trout Symposium, So. Appalachian streams - east. Tenn. - west. N.C.
R.B. & Brown - pop. est. + Habitat (WUA measured - each site.
Some correl. brown trout & habitat
little none w/ rainbows

no correlation
(as w/ Nehalem - brook, RB, coho) - Thus recommend sp. interactions be considered.

① streamflow change → habitat ② change → ③ fish pop. change
↓ quantity WUA ④ → ⑤ ??

not considered in IFIM - physical response — biological response
nutrient invert. — food limited vs. habitat limited
clear-cut - primary prod. only works w/ habitat limited pop
One — Murphy et al '83 / Hopkins '83 - Au Sable - Bow R.
- Berry Crk.
Quant. Values - in 2 large ballpark but not by section row or seat. vs. livestock - Lawrence Crk
two species
but w/ no or neg. correlation - not in the ballpark.
- Hoppr - measured depth, velocity, substrate, cover
- Au Sable - growth dif but not pop #'s
major shortcoming * - fry, juvenile, adults - unchanged - but biomass -

Question validity of 'preference' for velocity tolerate not prefer
only brings food
substrate = as food production
- overwinter - cover
- moderate velocity.

- Fig 4.2.2.1 - dif. curves IFIM curves vs. dependent on site
* Brown + RB sympatric not additive - partially additive - niche facts
not — but 2 WUA not correct - see Nehalem -
÷ some significant positive correlation (age 0 = incubation habitat)
but none of relationships explain more than 75% of brown trout abundance or biomass.
* copies: - p 206 - fig. 4.5-1. + 208 - RB (neg.)
no statistical signif.

% usable area
WUA = PUA - By performing WUA each month of year (based on USGS flow records) - to detect minimum habitat value during annual cycle and for each life stage, = habitat expressed as % usable habitat is more frequently related to abundance/biomass than instantaneous WUA = better more explanation of differences
for brown trout
- but no manipulations did much for rainbow trout abundance/biomass or habitat factor, little - no correlation
- Probably due to interaction w/ brown trout

annual WUA min
- high flow
- lo flow
- least values
incubation

Cover neg. correlation !! - something wrong w/ 'cover' in terms of definition of cover not same between man + fish.

"instream cover adequate -- therefore food limited --

— Basic rationale IF — change in flow - change in habitat - change fish

Thus - go habitat - direct - fish (food, disease, ⇒ competition

fish pop. expands limit habitat (carrying capacity

or food supply..." — Then not so accurate

expert finger random not costs for advice

Assume direct relationship between habitat & fish in

accuracy of predict it their habitat can quantified - quantity change in

1. habitat correlated & accurate are

1. - Habitat limits

Findings

IFG4 hydraulic simulation. model not reliable

for high gradient streams w/ mobile bed material

- should not be required. for flow assessments.

"Identification of sensitive life stages, based

et Nehring Anderson on either long term empirical studies or on

inferences from sci. lit. for similar rivers, should

be a part of IF assessment."

WATERS (76)

- field measurements - data ⇒ computer

models - relationships between flow - food producing areas,

spawning areas, resting microhabitat, & cover areas

weighting factors can vary (curves) to adapt to different species

IPG developed methodology for Calif. trout streams below

dams. — in turn based on 1960 Calif. F&G. method

to determine flow requirements of trout based on assumption that basic requirements include food,

spawning & shelter (cover) - measured as:

depth, velocity, & substrate criteria - so that

changes could be noted w/ flow changes

1960 C.F.G had training session Taylor Calc.

— 1960's - little standardization of methods of various

methodologies for recommending streamflows.

— ~~that~~ Select 'key' areas of stream - make Transect

'representative' reaches

- Dam releases diff. predetermined flows

refined * Computer program - "suitability curves" = weighting factors

Cover rating = subjective 0 - 1.0

depth recorded .2 ft. fm. bottom
- output as relative units (WUA) plotted against flow

Hooper 1973 PGE rept. - Flow on Trout -
↑ Caution - Plotted results (relative units)
should not in themselves be construed as making flow recommendations - rather they make represent relationships determined in most quantitative & least subjective manner possible - Depict relationships that all parties can agree on and allow for professional judgement.

PGE - "first" generic -
- Dif. IFG - sp. specific
- Resting - food producing
- fry, juveniles.
couple hydraulic model IFG4 ~ WSP.

Bur Rec Water Surface Profile
computer model predicts change depth velocity or flows
- but can be large dif. between actual & predicted velocity
due to substrate, roughness, turbulent fm
re "Manning's" roughness coefficient value or "n" value
usually not precise -
* bottom configuration changes at dif flow."

Barry (79) - biggest dif. - Montana method (30% of ADF)
vs. cross sect. & IFG4 - when max flow 100% x min. flo
(A2) - then 30% too high." -
WUA - e.g. brown trout - no relationship to RB, BK, CUTT
p. 29 Table 12 errors for predicting velocities
± IFG underest vels

+ - Stability of flows - remove peaks -
headwater streams w/ diversions - (p. 40-41) no. & biomass
2-10 x higher below diversions than above
- Velocity factor IFG3 habitat program - & WUA high flows
If WUA above ≥ below - most years same
improvement 6-8 1.-2 months May - July pond too high - ?
- boulders - create pockets zero vels - improvements not detected
unless precise microhabitat - "hose" velocity detected -

FWS Rebuttal

"Useable living space controls fish density in streams."
"concept of limiting habitat episodes should be focus of validation studies".

assumption inherent w IFIM: "biomass of sp. in absence of fishing mortality or stocking can be positively correlated to the limiting habitat events for one or more life stages" - physical habitat - not so - Sphaerium, bony minnow - S.M. bass - brook trout: brown, r.b. -

- independence of variables - depth/velocity -

dismiss "evidence fairly conclusive that physical interaction of depth and velocity are meaningless to fish" - Not so! - turbulence as cover - could be taken in to account in multivariate suitability function.

- but subjective

"It is interesting to note that it is fairly common to obtain better correlation WUA & biomass than WUA - numbers".
← better habitat - not only more fish but grow better".

"IT is true that biomass predictions cannot be made with IFIM in its current configuration"
— ~~Need~~ Emphasize need for comprehensive planning process before IFIM - better to study temp. food supply, water qual. before implementation

Trout yield "habitat limiting"?!

Rio Grande sucker
Colo. R. trout
biol. interactions

Burning Gorge
temp change

Mullan

Statistics: Type I error - mistakenly rejecting hypothesis when true
2 " accepting hypoth as true when its false.
- Not predict S.C. or biomass but carrying capacity (may need why not at carrying capacity)

FWS (Trail et al. - Obtain HSI criteria for 4 sp.
(presence or absence (if HSI value .4 or more - then predict spike dace present) - 4 sp. tested 2 presence right predicted - 2 not wrong predicted
present absent? 50/50 (= guess)

carrying capacity - s.c. 10% of acre has 1.0 vel in WUA - 90% has .01.
Denver Wirry Bk vs. .5 fps - biomass?,? - riffles - food drift to provide feeding areas! - can stock lb./acre type habitat

- Li / Schreck, & Rodnick -
Coho, steelhead, cutthroat sympat. allopat various combinations - in different drainages.
S.I. only applicable to site where made - apply to another stream - lacks correlation
+ rainbow trout in 3 streams

Buckley et al - test cutthroat model - many streams - compare individual variable - i.e. biomass (carrying cap) directly related to HSI score - - - no correlation
- Since no direct linear relationship between SI and biomass of individual component - aggregation technique (aggregation of errors) not valid -
HSI scores not accurately predict biomass of cutt. + rainbow

Kaeyher-Mayham - - 'standardization' = major argument for HEP-HSI.
to predict impact - but lose credibility when invalid.
"building reliable models may be a possibility only over small, relatively homogeneous geographical areas".

- If can't predict S.C. (linear rel. both SI and biomass) then can't expect predict consequences of changing environment.
- Thus, whole goal to accurately predict change in quantified or refuted — if can't take model for one river & apply to other! similar to before — changed after

EPRI critique - a symposium

critiques statistical bases for models - many constraints violated for statistical validity - how curves formed - etc

- basic assumptions - how data collected, analyzed - does it have biological significance meaning (= cause - effect relationship to fish)

- critical riffle - 70% of depth + pass from 4 in. 2 in

- Wetted perimeter method - : no inherent basis for selecting a point on a wetted perimeter vs. discharge curve as an appropriate streamflow Statistics chosen have no inherent biological meaning - what is appropriate starting point * problem - streams not homogeneous

Empirical

Binns & Eisermann - ① late summer stream flow (55% of ADF) ② Annual flow variation $\frac{max}{min}$ — spring creeks below dams

* HQE = Biomass

- max. summer temp., nitrate, % cover, stability of streambanks, emt. submerged vegetation (spring creeks), velocity, width.

- Livestock exclosures - why several fold ↑ of trout? - depth, velocity

- Lawrence Crk. Wisc. - -

of no flow change

i.e. planning level only - no decision making

HEP / HSI model curves - useful in sense it focuses attention on variables which may be important - as how to scale, transform aggregate & interact - but shitty justification for any other purpose

No (Complete lack of) evidence that HSI - is indicative of true habitat suitability ~ carrying capacity or standing crop, - or anything else besides meaningless metric number

IFG4 - hydraulic model - predicts changes depth, velocity as changes fs

habitat index metric

WUA - changes depth, velocity & SI conv to sp. (substrate cover)

- assumptions changes in depth, velocity, cover - adequate to describe effects of flow on fish habitat. - based on observation of species degree aggregate (use, preference) for specific velocities, depth, substrate, cover. at diff. stages of life history

- Also assumes WUA - as mitigation trade off that 100 WUA - WUA opt 1.0

- 2x sub optimum (.5). is or good?: ~ plots WUA against discharge - but better to use empirical curve -

Q plotting year-class w/ discharge (Nehring) -

- IFG HABTAT - IFIM based on Waters 1976 -
(IF symp.) - velocity, depth, substrate, cover ... for resting, spawning, food production, - changes w/ flow - HABSAT - IFIM - connects w hydraulic model - expresses = WUA -

* Au Sable WUA not changed - bio assn

Berry Crk - ① ↓ 150 - 100 16/ sec - why - nutrients - not part of HSI -

mitigation w/ flow - ② Lawrence Crk + Livestock - habitat change w flow changes -

good
fair poor - excellent
habitat
g, - River Regulation & changing flow regs
Problem - Historical Rev. -- Tennant method - cross section. basalon 200--
--- Quantifiable - Trade-offs - IFIM - WUA .... post. gain - loss - bet - —
conflicts - conflict resolution -

- Need for direct observation on fishes -- subject matter -- to offset ignored w/ mechanics of model building & operation — realize true complexities not omitted from simplistic assumption of model input

E. S. Tech. Bull. 1986 X1(4): - Desert pupfish, final listing as Cyprinodon macularius
end: 7 Mar. 86 - Crit. Hab. - Quitobaquito Springs, Pima Co. - AZ (only AZ loc.)
Sept. 18, 85 other AZ proposed - Little Colo spine dace - Leptodeira mollispinis
- Gila robusta grahami - Gila nadiril club
Gila intermedia -
considered * for possible addition
Contact w/ Meffe - Trusch - MJ not available

Denver water Bd. - So. Platte 500-700 lb./acre wild trout
- trade WUA's = amt. -
Problem — cannot get lb=lb. WUA=WUA.
* Typical "unexplored" situation - what WUA for eagles?!
AZ = spine dace loach minnow? in Verde? - - —

② Trusch & Parsons (85)
① Water Resources Bull. 1983 19(3): 499-500.
- History --- need predict what happens when — — —
Problems of prediction.
Re flow to habitat. - - velocity, depth, substrate, cover, (temp)
life history stages - spawning (most narrow) - rearing - adult. Conservation.
channel morphology & flow vs depth. - living space (habitat) in channel.
* Prob. IFIM can deterministic - but fish vary in preference, resting, feeding, day, night, season, other up. - — no model accounts for -
- May be great change in modified flow - ex increase (Central Az not) or decrease which changes channel morphology & sediment transport & thus dramatic change habitat.

③ Environmental Impact Assessment Review 1981, 2(3): 265-78
"Great amt. time, $ spent on baseline studies - but rarely are useful for predicting consequences of ecosystem perturbations —
* Empirical - best track on zoo-con-zoo ill. b/c rapid growth below ∆ where Λ = — - why? - —
* Anderson & Nehring 85 - 59 - Hydro power symp.

(2)

- to make work - needs no exceptions. rich experience & sound judgement

*- One key factor! - spring flows (at hatching) - need 0 velocity

And. & Vehring (cont.) -

— Colo. - high > normal = pro weak year class
lower ≤ normal = strong year class

* Canyons habitat. flood plain

So. Platte - Cheesman - flows - 10 yr. - x̄ 162 cfs - 15 cfs - 1829 cfs >100x - but canyon habitat - very low flows (winter) - low as 5 cfs - ≠ greatest yr. class

vs.

(Canyon area - temp. water - redds - in channel or wetted - percolat.. fry habitat best for 15-300 cfs.

- if low flow - 0 eggs to dewater during spawning - then incubation O.K.
- after ca. 8 wks. - y.o.y. handle velocity - O.K.

* personal experience expertise to interpret most important!

interpretive assessment vs. mindless methodology needed

* overflow channel - Muraic-Trahey.

(p. 72)

- Shirvell & Morantz 1983 - = WUA and Atl. salmon juveniles weak or even negative correlation.

- Methods - 2 basic types (1) standard values (typically min flow)
(2) incremental - quantifies trade-offs -
more sophisticated & quantifiable objectives | but WUA ↑ ↓ - - - like button

p. 177 - definition method - methodology

Q curves - low flow - during 10 yr. per. lowest flow for 7 consecutive days

p. 178 - Allred (1976): " If instream flow interests expect to compete with other uses for limited water supplies, they must be able to demonstrate with the same types of analyses and approach as other uses the need for instream flows and the effect of not obtaining those flows".
(Instream flow needs) -
(1) Protect existing resource conditions
(2) Quantify trade-offs - by describing response of fish habitat to changing flows.

* - See p. 180 - Is there need for complex, expensive Incremental Analysis - vs. Standard setting - Existing Resource: Each Threat - Location data not known by IFG -

Standard setting

p. 180

* - Important to avoid pitfall of implementing complex expensive field study (IFIM) - w/o first making feasibility analyses -

Reconnaissance Feasibility - I ID fish sp., recreational intent, (eagles) that may be affected -

- II stream segments of planning concern

III Agency policies (E&A) - goals to meet

IV - Quantify historical regime

range - ∴ - ann. hydrographs, duration ann - change

V - what known about past, present sp. - response to historical change

VI Forecast future flow regime -

change in -

- ~~ocean~~ impact on hydrology

- room for modification

slow
how change temp, sediment, channel morphol. (ex spawning year -

VI Multi-jurisdictional opportunities to maximize benefits

- Unresolved - Then IFIM -

IFIM - only step - not whole process! not end in itself

Kondolf & Sale p. 184 - long term Stability of river channels & IFG.

"dynamic equilibrium" (cite RLM study -) - fluvial geomorphology

downcutting - | with present prevailing flow regime & sediment transp

change equilibrium | (FWS - predictive - No way to know!).

Schumm (77) very expensive but still

- Increase flows (CAP water) = increase sediment transport capacity (w/o new input) = degradation, bank erosion as transport capacity exceeded, channel widening & deepening. & particularly, unstable flood plain rivers

- Cross sections (WWA) - change yr-to-yr -

✓ IBI - Lynn Schrader - modifications for Colo. front range streams

* user, IFIM

Spike dace Medium fatgide

crit. Hab. Prop
Sycamore Crk. lower mile
* Continuously, Verde R. upstream to Sullivan L.

Problems - I Philosophical - Logical
II Biological
III Statistical

— Annear & Condor 1984 - test relative bias predictive flow-fish - IFIM - many more

— Changes in habitat use
- day - night - Larimore - Garrels (51)
sympatric - allopatric - Li & Schreck (54)
Lotz et al. 84
seasonally - Sheppard & Johnson (85)
combination - Moyle & Baltz (85)

How HSI curves determine need flexibility

Problems sampling techniques - Rinne (85)

- Layher & Maughan (85) HSI models suitable only for planning level, should not be used for decision making.
- Broad niche sp. vs, narrow niche -

Arrogance of Ignorance - Mayer 84

Glova, G. J. 1986. Interaction for food and space between experimental populations of juvenile coho salmon (O. k.) and coastal cutthroat trout (S. c.) in a laboratory stream. Hydrobiologia 132: 155-168.
- allopatry same habitat preference pools vs. riffles - at dif. temp. - when sympatric - segregated - at 5°C less segregation sp. — "interactive" segregation
ex. selective vs.

adaptability (broad niche) interactive

vs. instream selective factors

- Ark. in events by species

Biol Rep. 85(6).

Holling, C. S. (ed.) 1978. Adaptive environmental assessment and management. John Wiley, N.Y.: 377.
- One first to widely promote use of computer simulation model for environmental assessment - stressed need highly abstract view of nature, may be for the reality - only years of monitoring for - bit information is used.

- Letter Simon → Wilmot (Aug. 7, 67)

- typical marker chromosome.
  constriction on short arm → cutthroat (yellowstone + Coastal)

- rainbow ← constriction on long arm.

- Kobayashi 63 - Nakete - gorbuscha

BASIC

QL1
C65

~~1920 (85):72~~

~~1926 (155):141~~ S. trutta valid name (prior 1758 - Widegren - Hubbs Told Jordan

~~1929 (173):88~~

~~1948 (3):183~~ 174- Miller, Col. R. - Nev. -

1954 (2):124

~~1954 (2):120~~

~~1949 (2):111~~

~~1916 (29):28~~ Opinion Int. Zool. Com opinion 60 Opinion 41 S. prior name for W. Europe
S. irideus resurrected / x irideus

~~1929 (173):86~~

~~1923 (121):85~~ - S. gairdneri = O. nerka no salmo >60 vert. steelhead has 58

~~1937 (3):138~~

~~1931 (2):33~~ - salmo ostr. reg. freshwaters

~~1924 (136):50~~

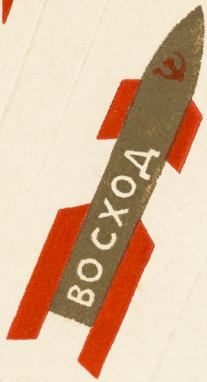
~~1946 (1):25~~

~~1919 (44):79~~

~~1960 (3):249~~ Northcote (recol x)

Jordan 1920 Cop. 85: 72-73 Trout of Rio Grand.
- all sp. (x.pt. lewisi same as clarki.)

Miller Miller 1948 (3) 174-187 Salmon, Brannan, Owyhee R.
(Snake drainage Nev).
p. 185 - Either S. gairdneri or S. clarki or both prob.
once native but subpure pop. prob. gone.



С новым годом!

Dec. 27

Dear Polly, Doug, Bob (John has separate card):

Greetings for the new year. The Russians celebrate on Jan. 1st but just like our Christmas without any mention of religion. They may have goose stuffed with cabbage as the main course. We're going to try to bake a chicken. The meat is generally tough, so I'll also feature caviar and champagne, just in case. At the near-by hotel I can purchase such luxury items at reduced prices with American traveler checks. - I was warned about sending manuscripts through the mail - so I wont send the trout manuscript back to Berkeley until I go to Germany, perhaps in the spring. - Go ahead and send my thesis section though, because there are many copies of that.

Leningrad is all decorated up for the holiday - big Christmas trees and Santa Clauses. I read in the Daily Worker about the revolution at the Univ. It must have been exciting. What did the Zoology Dept. do? Was John over there leading a contingent for freedom?

I also heard on the radio about great floods in northern Calif. - What's going on over here. All we hear is that everything is fine and getting better. I notice cartoons depicting the latest machinations of the

imperialists. We can buy the N.Y. Daily Worker and the San Francisco People's World at the University kiosk, just down the street. They seem to be somewhat left-wing. I'm going to ask them if they will carry the Oakland Tribune. The students need something to stir them up - I pass by the "Sathy Gate" of the Univ. every day and not once have I seen anyone passing out literature, giving a speech or picketing. Yet the papers are all praising this sort of behavior at Cal. - I'm going to carry a sign down there today: "Fire the Board of Regents."

— Regards Bob Behnke

McFadden, J.T. & E.L. Cooper 1962. An ecological comparison of six populations of brown trout (Salmo trutta). T.A.F.S. 91(1):53-62

Streams	Conduct.	by/acre trout	all fish/ac	Age groups II	III	IV	V	
Cedar Run	412	68	68	25	14	3	0	
Spring	331	58	354	12	3	1	6	
Spruce	281	137	212	105	29	7	1	(1 = VII)
Young Woman's	43	98	134	48	39	2	0	
Kettle	41	64	228	50	12	3	0	
Shaver	36	13	46	16	5	2	0	
4 mile run				12	6	2	1	VI 1
6 " "				56	15	6	5	1

* Young Woman's Crk. (C&R - illegal to keep trout) has highest III - IV mortality - .549/year = .049 (95% mortality) - high survival I-II (65%) II-III - 82%

Ibid:60 - Mueller & Coolett L. De Smet 11% return

Nov. 1956 STI Bull. - 3 yrs ago Conn. reorganized - May 1954. long range program published - to equitably expand as necessary to set limit on hatch. trout prod - limit set at 100,000 lbs/annualy (catchables) - without this limits as well cancer, the trout hatchery crops would continue to eat away the vitals of the fishery program - Conn. anglers owe debt gratitude to Conn. Bd. Fish. & Game for wisdom and intestinal fortitude.

Ibid - Virginia coast - 70/catchable trout creeled.-

Gard, R. and D.W. Seegrist. 1972. Abundance and harvest of trout in Sagehen Creek, California. T.A.F.S. 101(3):463-

10 yr. x̄ standing crop 37 lb/acre. anglers annually remove 23-47% (x̄ 33%) all trout > 99 mm. - recommend spec. regs to recycle -

- brook: I 119 mm, II 166, III 206, IV 236

over 10 yrs - great annual fluctuations ~ 300-900 trout/acre - x̄ 478 / acre

Fishing pressure 150-224 hr./acre (1.27) x̄ size brook 142-154 mm. (I-II.) 160

CPH 1,108-1,178 CP/acre 169-302 (224) ~ 20-25 lb/acre 165-194 - 88 49

anglers/hrs. - 2381 1805 1692 } 10 yr. x̄ 1779 192-236 brn 15

anglers 970 780 603 } 732

hr/day 2.43 hrs/acre. x̄ angler day yield - 15-25 (x̄ 22) lb./acre

2.43
732 | 1779
1464
3159
2220

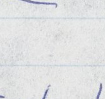
Szyhen (cont.) $\bar{x}$ 7 1% brookies 7 15 mm caught annually
34% RB, 47% browns.
27-68% of biomass annually caught of all trout 100 mm & larger
-quote McFadden 1969 98(1) (p. 43) - Not until management viewed as a generator of new trend rather than answer to old trend - will it be possible to carry out effective long-range planning
Section VI closed to angling after 1955 - $\bar{x}$ no. & $\bar{x}$ wt of all trout nearly doubled & trout 8 in. & larger increased 14x

Shetter, D.S. and G.R. Alexander 1962. Effects of flies-only restriction on angling and fall trout populations in Hunt Club, Montmorency County, Michigan. T.A.F.S. 91(3): 295-302

	Stocked and wild / flies only	42-54	55-59	
trips		259 - 195	223 - 313	
hrs.		748 396	461 596	
	3 (2.1 / 7.5 / 6 / 15)	2.5/hr. day	2 hr. / day	2.1 / hr. day 1.9 hr. / day 1.9, 2.10, 2.1, 2.5 hr./day

Stevens, J.B. 1966. Angler success as a quality determinant of sport fishery recreational values. T.A.F.S. 95(4): 357-362
angler success as per unit/effort (hrs/day) - Yaquina Bay, Ore. salmon fishing - 10% increase in salmon catch - increase effort by 10% - i.e. CPH some - increase hrs/day. - study to determine economic loss from pollution decreasing success - days. hrs/day - better fishing - more days, more hrs/day -

San Juan Shuffle * Hiderbrand, S.G. 1971. The effect of coho spawning on the benthic invertebrates of the Platte R., Benzie Co., Mich. T.A.F.S. 100(1): 61-68 - signif. decrease no./wt./diversity in spawning areas (compare w/ control) - wts. 1-2 gm/ft.2 or. .5 g/ft.2
no. 100 - 400 vs. 100



- McFadden et al. 1964 - Mich. opinion survey
stocking improves fishing to important degree 73% trout 33% warmwater
- new emphasis choice mgt. options - lakes mean improvement. #1 - stocking 49% trout fish. 17% non-trout

Randle, A.C. and F.C. Cramer, 1941. The Squaw Creek Test Stream. Calif. F. & G. 27(3): 172-184.

Comparable to Sagehen fishery - trout almost all small
80% catch 4-8 in

rainbows ~~trout~~ 2500 - 5000 / yr. CPH 1.4-2.4 --

* ~~hrs~~/angler day. 1937-1940 - 7.3, 6.3, 5.4, 4.1
CPH 2.4 1.4 1.6 1.6

1940 - hrs. fished: near road —— 3.8
remote areas —— 5.1

Wales, J.H. 1947. Castle Lake trout investigations 1946 catch, and chemical removal of all fish. C.F.G. 33(2): 267-286

% anglers catching 50% 1943-46 15 of ~~237~~, 10 of ~~120~~, 13 of 140, 20 of 407

	1941	42	43	44	45	46	
$\bar{x}$ hrs/day	3.5	5.3	4.0	3.1	3.4	4.0	(~~per~~ year)

(by month) for 1946

May - 3.3, June, 4.2, July 4.5, Aug. 4.2, Sept. 2.5, Oct. 2.2 $\bar{x}$ = 4.0.

— FW501

— — ~~Add~~ — 2 roles - terminology - bkgr. assumed -

— theme - deduction - paradigms - what most common denominator

= Evolution — role current events (info content- used informally explained insight)

- How think - is improved

— ~~Role~~ Fish. Mgt. - Wat. Res. in ground needs study progr

- Ex. Role establish fact.

- Fisheries - — — Colo. $20 - Lund Kokan

did more thinking - -

How make, present case. (in court) hold up

— — - Colo. establish -

students have functional basis -- memorize, assimilate - interpret synthesize

- vs. roles - goals vs. goal.

Electroph. henshawi - bouvieri - Landlocks - Coll -

Behnke & Zorn 1976, Soltz & Naiman 1981, Mong. 79-81

- coll - Hubbs 34 - U. Ore. - 72 - Perry 83-84

		meristics	scales	caeca	Br.	
Humboldt subsp.	henshawi	23-25	160-170	50-65	9-11	2N = 64
	willa-whitehorse	21	145-150 ~~135~~ 135	45-48	"	
	Alvordensis	23-24	~~145-150~~	42	7-8 *	error should be pelvic rays
	bouvieri	18-20	165-150	35-42	"	F-9 8.6
	humboldt	21	135-145	50-60	"	

Univ. Mich. MZ

130493 - Ore., Harney Co., C.L. Hubbs + family July 26, 1934 N=5

130532 Nev., Humboldt Co., " Virgin Crk. - Aug. 2, 34. N=41 (spec. *14 as Typ.)

130492 - Trout Crk. - July 26, 34 - S. gairdneri N=27

130491 - " hybrid N=1

130494 " + N=50(-)

1972 - sampled very headwaters E. Fk. Trout Crk. + Cottonwood Crk

Trib. Pueblo Slough

* Bond, Ore. Agr. Exp. Sta. Bull 58 = willow-whitehorse or henshawi

+ williams + Bond (~~83~~) - ~~S.W. Nat.~~ Grt. Basin Nat. 43: 409-420 (Alvord form)

+ boraxobius

— Couch: - Antelope Crk - Cottonwood - ?? -

improvements - grazing (present -

- Armantrout & Crouse, Whitehorse cutthroat trout

Proc. Desert Fishes Council, 1980

- willow, (Antelope)? whitehorse w/ Trib., Little Whitehorse

Fifteenmile, Cottonwood, & Doolittle (which native

which introduced - NE- originate drain - north slope - Trout Crk.

Mtns - N.W. - & Alvord & S - Lahontan

2700 m. top. Trout Crk. Mtns

1250m. Valley floor — stream to Valley Flr

Jot - irrigation diversions at edge of Valley flr

Reservation

2 mi. whitehorse

for 4 mi. willow

c. 90% Willow-Whitehorse drain

BLM Issued -

36 + 40 stream miles habitable by trout will be BLM if trade

Smith:

Pat Trotter: Whitehorse Crk. - pool w/ cotts 85°F. ?

ACEC - Whitehorse basin

proposed - - butter strip ?

6 3/4 mi. Antelope Crk., 5 mi., 15 mi. Crk., 4 mi.

Doolittle, 3 mi. Cottonwood, 8 mi. Little Whitehorse

6.5 mi. Willow, 8.5 mi. - whitehorse -

Antelope - Doolittle stacked?

- 15 mi.

Smith - 2 - Alvord overflowed in 2 places

? - Mathews - or Owyhee - or Whitehorse ??

Descent Alvord's whitehorse bar

- irrigate Whitehorse Ranch

trout in canyons and headwater

- poor habitat. long history overgrazing
- sediment, lack riparian veg.

* South East ~~East — One Lower~~

Quinn R. Lahontan, ~~Humboldt~~

"remarkable resistance to poor habitat"

(as Humboldt, Box R.) -

Owyhee - Malheur. Both - very. not.

based on present topography

- lowest divide between Antelope Crk - Ore. Cowyee Co (Lahontan) -

- * but - Coyote L., floor of whitehorse Basin - only 20-30 m. below crest to east to connect Crooked Crk. drainage (Owyhee) (Snake R.

1971 BLM w/ Ore. D. F. & W. & Whitehorse Ranch. initiated HMP. Habitat improvements - small trough-each dams & pens

Beavers - ponds silted - limited by ice shelf - beaver abandon

willow plantings - line stock exclosure areas.

Trout in Antelope Crk. (1971 ?!) - other stream sections & tributaries above natural barriers - (which ?, ?)

Recently (?, when) - stocked into Van Horn & Marquito Crks. (Alvord)

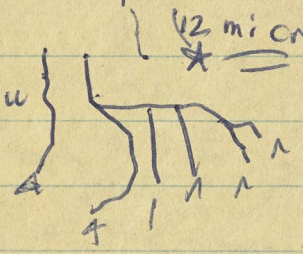
1980 - Revised HMP - more fencing, habitat improvements

Cottonwood ?

Preferred Land Use Alternative

Wilderness Study Area - Willow Crk. 15 mi. Crks + 184,190 acres - recommend.

Riparian Mgt. Areas - Willow



Loudenslager, E. J. and G. A. E. Gall. 1980. Geogr. patterns of protein variation and subspeciation in cutthroat Trout, S. c. Syst. Zool. 29(1): 27-42

Isocitrate dehydrogenase (liver tissue) IDH-3

henshawi.

15 samples (N:) ~~140~~ allele 140 fixed or predominant (w/ allele 170

7 samples (4 yellowstone (bouveri), 2 s.c. utah, 1 pleuriticus) all fixed for allele 100

2 samples lewisi (one Missoula, one Columbia) fixed for " 115

Malic enzyme ME (agrees w/ bouveri (+PHI-3) allele 125 vs. lewisi (" 100)

Malate dehydrog. MDH-2 - fixed or predom. (one except.) for allele 130 vs. fixed 100 for yellow bouveri + lewisi

Locus

SDH-1 Sorbitol dehydrogenase

henshawi. allele 250 fixed or predom. (alternate allele 40)

Alleles 40/100 probably lewisi-introduced

- Yellowstone + lewisi fixed for 40

pleuriticus fixed for 100

utah (Pine Crk. - Corbute (Sam) ca 50/50 alleles 250 - 100

SDH-2 - utah + pleuriticus fixed for 0 allele

others - 100 predom. - lewisi 40

↳ Shasta Crk. Neu. - add ball - SDH-2, esterases, MDH-2

appeals
including
turn to
circulation

South, to the Okhotsk Sea slope district
spine mountain ridge also was only region mountain-valleys frozen (glacial ice)
Therefore on all extent of coast of Pacific Ocean, from Alaska to
Sakhalin, not was possible considerably break significant rupture area malma. However in
between among different mountain-valley ice isolated and created
secondary lakes further endemic species and forms. These
endemics include longhead charr of L. Kronotskoye
and the endemic charr of L. Dalnee, reproductively isolated
from malma (Omelchenko 1974). The nose charr represent an
endemic subspecies. G. Glubokovsky (1976), comparative osteology
of skull of L. Nachikinsko charr, not known with his characteristics osteological
diff. fm. S. neiva and Yessei skoi charr S. taimatschelgi. He also
however noted, that the charr of L. Nachinkinsko has
fewer gill rakers. In our specimens fm. 21-24 rakers.
This form likewise item, as the endemic charr of L. Dalnee, not
possible related belongs to Pacific Ocean group of species. Of
the original distinctive native of Nachinskoe charr has explanation cause origin in ancient times
in L. Nachinskoe depression (Braitseva et al. 1968), to
endemism of Dalnee charr difficult now explanation cause origin.

M. K. Glubokovsky (1976;77) did not confirm
earlier previous opinion. K. A. Savvaitova (1973) about the
changeability of charr in Kamchatka R. basin. This study
concluded that in Kamchatka R basin 2 species forms of charrs
malma and albus. Malma is represented by lake-river
benthophage and anadromous, lake predator and
stone charr, described by A. Ya. Taranetz as
S. malma ssp. kusnezovi (sic). With this species it is closest
related to white charr of L. Kronotskoye. Yet however, that
according to series of characters, G. Glubokovsky assumed
for distinction of this sp. and malma, the white charr
more close to malma, additional than typical albus, accepts
Distribution of albus not studied known. in other rivers basin
of Far East. it not

Allendorf, F. W. and S. K. Phelps. 1980. Loss of genetic variation in a hatchery stock of cutthroat trout. Trans. A.F.S. 109(5): 537-543.

~~Robertson~~ Robinson, F. W. and J. C. Tash. 1979. Feeding by Arizona trout (Salmo apache) and brown trout (Salmo trutta) at different light intensities. Env. Biol. Fish. 4(4): 363-368.

eye

why browns more difficult to catch.

light intensity - 9.5×10^{1} foot lamberts

9.5×10^{-5} -

Apache fed on brine shrimp slightly more than browns at 9.5×10^{1}, 9.5×10^{-1}, about same at 9.5×10^{-3}, but brown trout fed at 9.5×10^{-1} and Apache did not. - browns stayed near bottom, sought cover in bright light - apaches didn't

browns in containers 88% time Apache only 6%

- 2 streams - brown outnumber Apache 20:1 = 4:1 but daytime 1 fly fishing (22 hrs.) caught 55 Apache 4 brown.

- if say browns 10× more abundant but Apache 10× more common 100:1 vulnerability.

Big Bonito Crk - brown feed less actively during day, Apache in shallow riffles browns seldom seen - .

Dangers of sophistication - conflict common sense

enzyme 1.5 or 1.8% depleted net-spawning effectiveness by 90%
AGP: alpha glycerophosphate dehydrogenase

Crawford, B.A. 1977. A study of the contribution of hatchery-reared summer steelhead to wild steelhead recruitment through the use of genetic markers. p. 16-19 in. -- Genet-Implic. Steelh. Mgt. Col. Coop

- Recent years steelhead harvest decreased below 1953 levels (before massive smolt releases) - despite increased contribution to catch of hatchery fish - wild stocks dramatic decline.
- Long term study Kalama since 1974
- Kalama received plants hatchery summer-run since 1951. - Source since 1957 from Skamania Hatchery origin fm. crosses between Washougal R. & Klickitat R. steelhead between 1951 and 1957 * - "Has Therefore for apx. 20 years the Kalama R. has received hatchery fish that were probably genetically different than the native Kalama R. summer steelhead that undoubtedly had many centuries to develop through natural selection into a discrete group of fish." - "The introduced fish have, however, augmented the native stocks to produce one of the top ten summer steelhead sport fishing streams in WA."
- "In addition Kalama R. receives a substantial winter-run plant from Beaver Crk. Hatchery origin from Elochoman and Cowlitz rivers steelhead.
- Possible harmful impacts = 1. poor survival, inferior genetic combinations of hatchery x native. 2. competition of young. 3. Hybridization between native summer run and early maturing winter-run hatchery fish.

*(1980) paper - 107 spawning pairs observed in Gobar Crk. - twice

73-74 year class observed 77-78

color coded summer x winter fish observed spawning together (hybridizing) <2%! - This could easily be in 2% error in correct identif. of winter & summer run - or confusion between w/ wild

then - " Observed mixed spawning on several occasions = strong evidence that genetic exchange occurs - electrophoretic analysis doesn't contradict this. ... " It appears that summer & winter runs not presently reproductively isolated.

Genetic marking - Skamania Hatchery steelhead 18% have AGP allele variant - wild steelhead of Kalama have 1.5% -

- A selective breeding scheme produced 100% occurrence of AGP variant - first stocked 1976, subsequent to be released 77-79.

- 9 miles upstream from mouth on Kalama R. a 12 ft. high falls is barrier to upstream migration - fishway constructed virtually all spawning above the falls.

* Presently summer steelhead escapement in Kalama is 65.5% hatchery origin and 31.5% wild origin. which means that changes spawning H x H = 47%, H x W = 43% W x W = 10% since natural selection - differential mortality favor native race?? -

Chilcote, M.W., B.A. Crawford, and S.A. Leider. 1980. A genetic comparison of sympatric populations of summer and winter steelheads, Trans. Am. Fish. Soc. 109 (2): 203-206.

1973 & 74 year-classes of adult, wild, summer & winter runs in Kalama. Overall genetic differences observed = no greater between summer & winter runs than between year-classes of same run. - Suggests that summer & winter run not reproductively isolated

long term study NMFS & WA. Dept. Game began 1975

It would seem that the successful management of summer and winter steelheads depends on knowing how distinctive the two races really are, especially when they occur sympatrically.

Hatchery, wild separated by scales 2 yrs. FW = wild 1 yr. hatch. - color coded 2 yrs on summer & winter fish. Dec.-Apr. Chrib. Gobar Creek observed spawning steelhead.

sign. lack of evolution & sig. neg. selection for myt. - neg.

* 1. What is survival to return spawning "hybrids"?

2. Why summer run AGP ratio? - when only 10% - good mating

* - Conclude that separate stock for S. & W. runs needs re-evaluation - what to do? is hatchery prog. that destroys native runs

- How explain genetic of run! - primitive - like mit. dif. No logical environmental infl.

Harshbarger, T. J. and P. E. Porter 1979. Survival of brown trout eggs: two planting techniques compared. Prog. Fish Cult. 41(4): 206-209,

1 mil. eggs in 9.5 km. Silo Mills R. N. Carolina. 4th order stream

7 sites planted both w/ direct in gravel + Vibert boxes. (both Vibert + Vib. - Whitlock types).

59%/wk. mortality for all methods for 4 wks - then much higher mortality in boxes than gravel -

just before hatching cold spell, anchor ice, caused high mortalities - to hatching - 0% in Vibert 15% U. W. 20% gravel.

- Swim-up - 0 - 4% - 10%

sediment - fungus in boxes.

Klamath

Grt. Basin trout paper - John Wiley

* Jap. Jour. - L. Biwa - river, lake forms mosa -

Saile - EB msp - Salv. MS.
Rust 6587
- Nov. 20 - warm water
Nov 27 - cold water

Mac Crimmon, H.R. and B.L. Gots 1979, World distribution of Atlantic salmon, Salmo salar. JFRBC 36(4): 422-457.

see Critique - Evol. 33(3):1001

Johnson, M.S. & M.F. Mickevich. 1977. Variability and evolutionary rates of characters. Evolution 31(3): 642-648.

Compare morphol. characters w/ enzyme data for Menidia. - Allelic freq. for 24 loci in 22 populations. + $\bar{X}$'s, S.D. of 22 morphol. characters in 22 pops - Strong association of variability - evol. rates between morphol. & gene loci data.

Evol. 33(3): Thomomys bottae subsp. gen. sim. 78.-S.

G. Smith character displacement Catostomus

T.A.F.S. 108(3): 271-276 redshiner flourish in intermittent, harsh environments. - may reproduce intermittently - characteristic prairie stream.

C.R. Feldmeth,
- Hirshfield, M.F. and D.L. Soltz. 1980. C
Genetic differences in physiological tolerances of Amargosa pupfish (Cyprinodon nevadensis) populations. Science, 207: 999-1001. - 2 subsp. - spring vs Amargosa R. stable vs. fluctuating environ. - 400-500 yrs. isolation - dif. O_2, temp. lethal limit.

Matthews and Hill '79 - redshiners - niche, juveniles, adults -
Am. Mid. Nat. 101.(2): 366-72

T-shirt Baldes

~~Fowler + Steinitz 56 - G. arabica Bull Res. Council Israel~~

Goren. 1974. Freshwater fishes of Israel.
[Israel J. Zool. 23: 67-118 QL1 I81 Mirogrex

[Zoologica Scripta 2 Zoli QL1 S5Z 4: 5-20

Goren, Fishelson, Trewavas. 73. -[Bull. Br. Mus. Nat. Hist. (Zool.) 27(6): 293 QL1 B75
Luciobrama - 34(1): 1-69
boraline fish.

crayfish ↑ 22%
—— J. Wildl. Mgt. 1960 - 44(4): 871-880
—— Norwegian Fish. Mar. Serv. Res. Dev.
QH 83 F47 Tech. Rep. 567: 20p.
(1) —— Ferguson, Andrew 1980. Biochem. Syst. Evol, Chapt. 9

J. F. R B. C. 1970 27: 643 QH1 C143
TAFS 71 100(2): 382
~~Grt. Basin N.T. Mem. - 79~~ Snd. Sp. Symp.
- Aquaculture 1979. 17: 267-278 sterile coho.
(2) - Schumm. S. - fluvial Geomorph. GB 561. S35
(3) I49 USGS - Yampa flow July-Aug 80 - -
- Wyo. G. & T. monogr. ser.

(Cont.) - Use brown trout Au Sable R.

Compter Model to estimate magnitude of possible genetic effects fm. fishing regulations. -

No data presented on trends in size - if growth reduced or fewer older fish.

Recent years dramatic decline in % of larger fish in catch & shocking samples.

- * But all hypothetical data - growth rate curves, etc.

Kincaid showed hatch. selectin fast growers x fast growers = fast, ~~but~~ reduced spread in growth rate - indicates very few genes perhaps only 1 or 2 involved.

*(- Prob. only reflect selectin to ~~accept~~ utilize of diet) -

* Model assigns growth rate to 2 unlinked loci each w/ 2 alleles. a_1, a_2, b_1, b_2

all fish mature at 2+ (3rd yr.) - random mating. fecundity proportional to wt. of ♀

- Despite excellent work of Alexander (77) - data on sources of mortality of trout in Au Sable system still sketchy -- a large fraction, even major fraction in some cases due to unknown causes. - Thus additional mortality (compensatory ?) due to fishing when fish exceed min. size set at 10%, 20%, 30%, 40%.

* No compensatory survivorship has been added for those fish not caught - despite some evidence that it occurs - fig. 8 - predicted fm model at 40% increased 10% for angling - and 28 yr 1959-1977 ↑ size proportion of brown trout in "We Wo Sum" section of Au Sable R. - major increase small < 6 in (now 6 in) 6-7.4 - decrease longer - 8-16 in fish 25-75% fewer - w/ 10 in. min size - then 12 in. min (1973) - flies only 7x more young of year - some no. yearlings - may be artifact sampling

fm, 1959-1977 brown trout increased from ~700 to ~800 in this stretch while biomass decreased by 36% - brook trout in this stretch decrease ~630 to ~500 w/ 65% decline biomass - overall 40% decline trout biomass.

40% could be normal fluctuation

* - if genetic change - no external forces = no change biomass - may be -

- What seems certain is growth rate less now! - No! - no ageing done could be fewer older fish - higher mort.

Favro, L.D., P.K. Kuo, and J.F. McDonald, 1980. Effects of unconventional size limits on the growth rate of trout. Can. J. Fish. Aquat. Sci. 37(5): 873-876. - fishing mortality set at 40% few genes for growth. Computer model 20 years -- hardly any dif. between regulations, min, max, slot, in end result for maintaining more, longer trout in pop. -: fig. 3 if growth rate strictly nonheritable -- -- -- model show that any slot limits, - same depression in the no. of larger fish as that produced by conventional limits. - Unconventional size limits will produce changes in details of pop. structure however, it is not expected that these experimental limits by themselves can reverse the genetic changes which may have taken place in pop. as result of previous selective fishing.

1980 Mich. instituted slot 8-12 in. size limit on stretch of AuSable

Ibid. 1979. 36(1): 552-561.

- "In view of the time and expense involved in assessing the impact of unconventional size limits by field testing, it would seem prudent to use a similar model to attempt to foresee the effects of these limits. ("previous paper showed changes in size distribution of a wild trout population under conventional regulations are consistant with the predictions of a computer model which attributes these changes to genetic effects." - Tempus

1979. Population-genetic study of the effects of selective fishing on the growth rate of trout. -- 36(5): 552-561.

Can decline in no. larger fish be due to changes in gene pool caused by selective fishing? - Min. size limit or max limit selects for fastest growing individuals. - Many citations (U. Wash., Fish Gen. Lab.) - * but always when stocked in wild grow slower than less "growth selected" --

Demonstrate that growth rate is strongly heritable

% mortality size-compensatory? spawning? selection? ↙

Brocows rainbows So. Platte

Brook 3000#/20-

T. A. F. S. Butler - Hawthorne. 68. 97: 37-41

Jenkins - Kwain 69. - An. Beh. Monog. 2: 57-123

McPhail, J. D. 1967. Distribution of freshwater fishes in western Washington. N.W. Sci. 41(1): 1-11.

- Pant. platyrynchus in Willamette - Prosopium willamsoni

S. confluentis

breaks later east-west WA fish distrib. ← Cascades →

only Columbia R.

Rhinichthys cataractae, Richardsonius balteatus Catostomus columbianus

= last glaciation of Puget Sound advanced 15,000 BP

Chehalis not glaciated

Allendorf, F. W., D. M. Esperland, and D. T. Scow. 1980. Coexistence of native and introduced rainbow trout in the Kootenai River drainage. Proc. Mont. Acad. Sci. 39: 25-36.

Johnson, J. H. and N. H. Ringler. 1980. Diets of juvenile coho salmon (Oncorhynchus kisutch) and steelhead trout (Salmo gairdneri) relative to prey availability. Canad. J. Zool. 58 (4): 553-558

June-Sept. - Coho most heavily on terrestrial invertebrates

Trib. L. Ontario steelhead on benthic invert. - not significant overlap.

coho prefer pools, steelhead riffles.

+ - diel fluctuation in invert. (aquatic) drift (dawn - dusk - after) but more or less constant drift (night) from terrestrial invert.

Canad. J. Fish. Aquat. Sci.

$56.40 Supply & Services Canada
Hull, Quebec Can. K1A 0S9
pay to Receiver Gen. Canada

Arnold Doe. Gazetteer Arsh. names (← I 49)

- Jordan D. S. 1895. Bull. U.S. Fish. Comm. 14 (for 1894)

San Luis Obispo Co. fishes * S. mykiss gairdneri, S. m. irideus.

C-6 - Repts - Glacier Stocks

Amax ; E. A. R,

- Corps Eng. - flows, flooding - wetland veg. - 3 sys
- Dept. Health - water qual.

- Exec. Summary : Proposed action ... bury Ark. R. culvert
- designed of capacity to handle 1/100 yr. peak runoff flood . Short term impact . slight increase ex we in sediment during construct. for short distance downstream . long term , increase (1 acre) 1 ft depth = 23 ft width
- loss of 1800 ft. stream w/ riparian vegetation , to be mitigated by creation of new ponded areas to create ≥ 1 (1.5-2.) acre, aquatic and riparian wetland habitat. ok
- greenback rest. - broadstrk (cont pop. in Ark) - fed. sl. fish - No long term chgs in flows, water quality .

Fed. Agency would want Ex R or write EIS - so

- Air Quality

- Description of Project (or Proposed Action, etc)

Description. Present Environment of Site.

- Envi. Impacts
- Mitigation - enhancement
- Alternatives to Project. ... No Action ... what would happen to Climax Mine operation - output, no. jobs affected, monetary losses - if proposed action not carried out.

Alternate sites ... reasons why no other site is feasible

- Cite regs - brochure - other - ve - environ. assessment Climax area - appr - even
- how many acres - filled - - Rights, ownership of land
- End. threat sp. -

On site - off site impacts

- Dif. govt. agencies ... dif formats but - all - NEPA
- Productivity human environ. Qual. life - short term, long term, irreversible & ir... commitments of

Zuckerman call Ralph Alig Ext. 489

1 Recreation

2 Scenic, cultural (more visible, social sig.) - nat. resources * Swanson Anthropol. survey.

Geol. - soils, minerals : (Paleontology - studies) reveal earthquake dangers, mineral lost

Agr. lands.

Fish, wildlife, veg., end. sp., recreation, [Landuse, transportation employment - chgs

D.M. Rosenberg V, 17, Rosh, et al — 1981. Recent trends in environmental impact assessment. Can. J. Fish. Aquat. Sci. 38(5): 591-624.

Narver D.W. 1975. Notes on the ecology of cutthroat trout (Salmo clarki) in Great Central Lake Vancouver Island British Columbia. Environment Canada, Fish., Mar. Serv. Tech. Rep. 567: 20p. — anglers catch sampled 69, 70

324 cutts, 23 rainbow, 2 Dolly Varden

cutts to VII To 598 mm $\bar{x}$ 366 mm

diet fish. (sockeye, stickleback) ants, cicada

- Gold's pop.

Hirshfield, M.F., & C.R. Feldmeth, & D.L. Soltz. 1980. Genetic differences in physiological tolerances of Amargosa pupfish (Cyprinodon nevadensis) populations. Feb. 29 Science, 207( ): 999-1000. 2 subsp. evol. sep. 400-5000 yrs. - in dif. environ. - dif. select. pressures stable temp w. fluctuating - no detectable genetic dif gene loci but morphol. & ecol. - dif. in lethal temp. & oxygen level. as w/ LDH - pressure - Adversity selected = stability select'n - see Goodman-Whitaker Am. Sci

C. n. amargosae - Amargosa R.

C. n. milonectes - Big Spring.

- C.&R. Symp. 77 Humboldt
- Wildtrout Symp - yellowstone.
- Trans Am - Rime - Gila trout = psuedo? -
- Mysis - JFRBC - Morgan. et. al. 78 35: 1572-1579. Nov. 78 issue - w/to. wildlife - fish Habitat.
- Kokanee - Bowin & Klein
- Loodenslager, Kitchin 79 Copeia (4): 673 - S.R., Yellowstone similarities -
- H. Thorgaard - chromosomes lewisi bowiei J. FRBC 78
- McGlade 79 Coned. brook trout - Can. J. Zool. 57(10): 1998-2002
- JFRBC 37(2) - Exploitation stimulates recruit./production
- Fish, Envir. Can. Tech. Rep 740 lake fertiliz.
- Stalnaker - Clar? - Snake Valley cutt - Comp. Biochem, Physiol B 64(4): 391 -
- May et. al 78 - S.C.; Utah
- K. A. Dahlberg. 1979. Beyond the green revolution. Princeton: 256p.
- modern "improved" strains domestic crops disaster in ~~not~~ areas w/o fertiliz., herbicides, irrigation, pesticides - Nat. Select. & genotypes us man
- Winter, G. W., C. B. Schreck, and J. D. McIntyre, 1980. Meristic comparison of four stocks of steelhead trout (Salmo gairdneri). Copeia (1): 160-162.

- Irv Kornfield - Sunapee ms.

- Chilcote, M.W., B.A. Crawford, and S. A. Leider. 1980 A genetic comparison of sympatric populations of summer and winter steelheads. T.A.F.S. 109(2): 203-206
Kalama R - no gene dif.

see Hershfield above!

- Schreck 80 - Copeia - steelhead meristics - environ. influ. -

- Rosenlund 330 So. Garrison, Lakewood CO 80226
Ypsilon L. results - early stocking. - Donner Crk. (temp. 34° Aom)
MIS - plevriticus ; Icke pond Ft. Carson for Cascade Crk.

Swanson 79 - antibiosis genetics, early feeding specid, sympatry, ecology char/whitefish

* Jergeson, Kimberly, Swanson 78 - pollen paper

- detectable electrophoretic change / loci 10^7 yrs. - 1/2 chance 50/50 10 loci - 1 mil. yrs. divergence
+ x + - hybrids - trotta x salar fontinalis x namaycush
F2 - FN one sp. gene represses on - electroph. comes out as opponent - not hybrid.

* T.A.F.S. - stupid summer/winter Kalama R. steelhead rev. 109(2): Chilcote, et. al.: 203-206

- Coffin, P. 1975. "Saving the red-banded trout. New. Outdoors & Wildlf. Rev. 9(1): 15-16. 83° - Chino Crk. - "may have eventual fisheries mgt. implications when fisheries mgt. becomes sophisticated enough to appreciate this unique trout."

Loudenslager & Gall 1980 - Syst. Zool. -

Reimers 79 - 24 yr. old brook trout. Col. J. of G. 65(4): 196-215

Vigg and Koch. 80 T. A.F.S. henshawi - 23° - 3: 336-39

Cutthroat Eg.

INSTRUCTIONS FOR INCUBATION AND PRESERVATION

OF FERTILIZED EGGS

Samples of fertilized eggs for chromosome studies should be taken, using the following procedure:

1. Fertilize a sub-sample of approximately 2 oz. of eggs from each of five females, keeping the eggs from each fish separate (1 oz. adequate if supply limited).
2. Incubate separately in cheesecloth bags and after 32 temperature ~~hours~~ units have been accumulated, place the eggs in a fixative (Fixative: 1 part glacial acetic acid, 3 parts 95% alcohol).
3. The developed eggs from each female should be preserved separately in individual 4 oz. bottles to which the fixative is added to cover the eggs after placing the living eggs in the bottle.
4. If possible, different males should be used for each female; if not possible, please indicate on which eggs different males were used.
5. Store in refrigerator above freezing until shipped or studied.

— Hope you can get NPS interested in restoration of native Snake Valley cutthroat - I suspect Birch Crk and Hendrys Crk. pop. are now gone and Trout Crk. may persist above a new barrier in 1-2 mi. Tiny habitat w 100-200 fish — It you can come up with a 1991 update on current status, let me know.

A summary of information on a unique form of cutthroat trout native to the Snake Valley section of the Bonneville Basin, Utah and Nevada

Comment to Univ. Nev. L.V. student doing survey for Gnt. Basin N.P.

Prepared for BLM
Salt Lake City, Utah
by
Robert J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
March, 1976

Introduction

A cutthroat trout population discovered in 1953 in Pine Creek on the eastern slopes of Mt. Wheeler, Nevada, has been a most enigmatic fish. There is no doubt that the Pine Creek cutthroat is a pure population, uncontaminated by hybridization and undoubtedly it is not native to Pine Creek which drains into a desiccating basin originally devoid of fish. It has been assumed that the original range of the Pine Creek trout is Snake Valley, Utah, part of the Bonneville basin. The question, which until now, has not been satisfactorily answered is: Are the distinctive characters differentiating the cutthroat trout in Pine Creek from other Bonneville basin cutthroats (Salmo clarki utah), the result of local speciation in a single parental stock, or does it represent a more widespread divergence characterizing all of the native cutthroat trout of Snake Valley?

Recent collections allow for a more confident answer to this question and fully support the contention that the cutthroat trout native to Snake Valley is distinct from S. c. utah. Analysis of the data from several samples provides a basis to differentiate the Snake Valley cutthroat trout from S. c. utah and other subspecies of Salmo clarki and indicates the expected

Previously, the only specimens I have examined from tributaries of Savery Creek were from the headwaters of Big Sandstone Creek and from tributaries to Big Sandstone Creek. I assume that pure populations from other tributaries of Savery Creek should be virtually identical to the pure populations in the Big Sandstone drainage.

Unfortunately, the distinctive spotting pattern, diagnostic of Little Snake drainage native trout, could not be fairly evaluated because of the badly faded condition of the specimens. I did not observe any indication of an obvious influence of rainbow trout in the spotting pattern, however. Table 1 compares the meristic data of the present specimens with a general composite of values derived from 25 specimens from 6 streams of the Big Sandstone drainage.

Table 1. Comparison of specimens from Dirtyman Creek and Hell Canyon Creek with specimens of S. c. pleuriticus from the Big Sandstone drainage.

Locality	Gillrakers	Pyloric caeca	Scales above l.l. and in lat. ser.	Basibranchial teeth
Big Sandstone Crk. and Tributaries N=25	(1) 18-21 (19-20)	(1) 30-40 (35)	(1) 42-50 (46-47) 175-205 (185-190)	(1) 3-15 (8-10)
Dirtyman Crk. N=10	17-21 (19.3)	31-38 (35)	41-50 (44.8) 166-192 (182.1)	2 no teeth 8 w/1-5(3.0)
Hell Canyon Crk. N=2	19,20	36,36	41,46 174 (2)	teeth absent in both specimens

(1) typical ranges and (mean) values of 6 samples.

(2) body decomposed in one specimen and lateral series scale counts not possible.

Two of 10 specimens lack basibranchial teeth in the sample from Dirtyman Creek and the number of teeth is reduced in comparison with Big Sandstone specimens. Except for slightly lower scale counts, there is no other indication of a rainbow trout hybrid influence. Such a population would rank as a "B" grade (probably "B+") in the system of Binns (1977). The two specimens from Hell Canyon Creek both lack basibranchial teeth. The scale counts are lower than expected for pure pleuriticus, but the caecal counts are typical. Rainbow trout typically have 25 to 30 scales above the lateral line and 120 to 140 scales in the lateral series and 50 to 60 pyloric caeca. A very slight influence from rainbow trout can greatly suppress basibranchial teeth. Larger samples would be necessary for a more authoritative opinion, but the Hell Canyon population would probably merit a "C" grade S. c. pleuriticus (about 75% or more native).

Hybrid gradients may occur in some streams, as discussed in my last Wyoming report on Little Snake drainage cutthroat trout. Obvious hybrid specimens may occur in a downstream area and apparently pure specimens are found a few miles upstream in the headwaters of some streams. Precisely how purity can be maintained in such situations without some physical barrier isolating and protecting the pure populations is not known, but it can be assumed that where a pure population is not physically isolated from hybridization and no evidence of a hybrid influence (or very slight influence) can be detected, the environment must greatly favor the maintenance of the native genotype and strongly select again non-native genes in the population. In such situations, any change in the environment may favor the hybrid genes and the hybrid influence would be stimulated.

LITERATURE CITED

Binns, No. a. 1977. Present status of indigenous populations of cutthroat trout, Salmo clarki, in southwest Wyoming. Wyo. Game and Fish Dept. Fish. Tech. Bull. 2:58p.

U.S. GOVERNMENT PRINTING OFFICE 870-427

Catalog No.	Accession No.	Original No.	Name	Locality		When Collected	R
3776			Salmo clarki pleuriticus	WY, Carbon Co., North Fork of Little Snake River, T13N, R85W, Sec. 27 Snake River Dr.	6	18 Sept 1972	R Co
7			Salmo clarki pleuriticus	WY, Uinta Co., Horse Creek, trib. to Black Forks near Robertson Green River Dr.	7	1975	
8			Salmo clarki stomias	CO, South Hartford Creek - above confluence with Outlet Creek Arkansas River Dr.	8	4 Sept. 1963	
9			Salmo clarki stomias	CO, Boulder Co., Island Lake - headwaters of Big Thompson River Missouri River Dr.	9	3 July 1963	
3780			Salmo clarki stomias	CO, Boulder Co., North Boulder Creek btwn Green Lake and Island Lake Missouri River Dr.	0	10 July 1964	
1			Salmo clarki stomias	CO, Larimer Co., Little South Poudre River above Starkeys Pond - Rocky Mtn. Nat'l Park South Platte Dr.	1	11 August 1965	
2			Salmo clarki stomias	CO, Larimer Co., Big Thompson River above Pool and below Tombstone Bridge - Rocky Mtn. Nat'l Park South Platte Dr.	2	26 August 1966	
3			Salmo clarki stomias	CO, Larimer Co., Big Thompson River in Forest Canon Rocky Mtn. Nat'l Park South Platte Dr.	3	July 1966	
4			Salmo clarki stomias	CO, Larimer Co., Forest Canyon - in a tributary to Big Thompson River (very headwaters) Rocky Mtn Nat'l Park South Platte Dr.	4	29 August 1967	
5			Salmo clarki stomias	CO, Larimer Co., Caddis Lake (Fry Lake System) Rocky Mtn. Nat'l Park South Platte Dr.	5	19 July 1972	
6			Salmo clarki stomias	CO, Larimer Co., Caddis Lake Rocky Mtn. Nat'l Park South Platte Dr.	6	10 July 1979	
7			Salmo clarki pleuriticus	CO, Larimer Co., Nicota Creek; headwaters of Cache la Poudre River above Long Draw Missouri River Dr.	7	11 Sept 1966	
8			Salmo clarki pleuriticus	CO, Eagle Co., Harvey Lake, tributary to Cross Cr. Eagle River Dr.	8	4-8 August 1969	
9			Salmo clarki pleuriticus	CO, Grand Co., Below Long Draw Ditch Colorado R. Dr.	9	12 August 1970	
3790			Salmo clarki pleuriticus	CO, Pitkin Co., Nickelson Creek, tributary to Capitol Creek Colorado R. Dr.	0	21 August 1972	
1			Salmo clarki pleuriticus	CO, Eagle Co., West Cross Creek Colorado R. Dr.	1	25 October 1972	
2			Salmo clarki pleuriticus	CO, Cunningham Creek - tributary to Frying Pan River Colorado R. Dr.	2	19 July 1973	
3			Salmo clarki pleuriticus	CO, Pitkin Co., North Thompson (Frying Pan - Roaring Fork) Colorado R. Dr.	3	16 August 1973	
4			Salmo clarki pleuriticus	CO, Pitkin Co., Middle Thompson Creek Colorado R. Dr.	4	16 August 1973	
5			Salmo clarki pleuriticus	CO, Pitkin Co., Capitol Creek - trib to Roaring Fork River Colorado R. Dr.	5	21 August 1973	
6			Salmo clarki pleuriticus	CO, Larimer Co., Ypsilon Lake - Rocky Mtn Nat'l Park Colorado R. Dr.	6	1981	
7			Salmo clarki pleuriticus	CO, Garfield Co., Battlement Creek Colorado R. Dr.	7	—	
8			Salmo clarki lewisi	MT, Flathead Co., Middle Quartz Lake Glacier Nat'l Park Flathead / Columbia R. Dr.	8	1979	
9			Salmo clarki lewisi	MT, Flathead Co., Grace Lake Glacier Nat'l Park Flathead / Columbia R. Dr.	9	1979	
3800			Salmo clarki lewisi	MT, Flathead Co. Kintla Lake Glacier Nat'l Park Flathead / Columbia R. Dr.	0	1980	

JULE-AFTEN-1930

Dear Schmitz family,

How are things with you? We are all fine. But we haven't seen you for too many years. In October 1972 we went down the coast line of the States of Washington, Oregon, and California for collecting tumour bearing flatfish specimens. On our way we met Carl Schreck and his family in Corvallis and the Sedon family in Berkeley. Probably next September we will go over to Japan for some weeks for further studies on flatfish skin tumours. This time Fort Collins will be on the schedule for a stop over.

Best wishes for a merry Christmas and a happy New Year

Liolaus and Gabriele

P.S. Bob, thanks for your critical comments on Mr. Vossughi's thesis. I would like once to discuss this decline of scientific standards in our faculty staff on the basis of your letter. Villwock, who "directed" Mr. Vossughi's "research", of course knew about your studies on Iranian fishes - at least I told him about it. Why they did not contact you or Mr. Saadati I don't know. Prof. Kossow even refused to examine Mr. Vossughi because of his ignorance. In spite of this the faculty accepted his "thesis".

Sorry

Liolaus

MIT LUFTPOST
PAR AVION
BY AIR MAIL
DEUTSCHE BUNDESPOST
50
SCHLOSS NEUSCHWANSTEIN
DEUTSCHE BUNDESPOST
10
SCHLOSS GLÜCKSBURG
DEUTSCHE BUNDESPOST
50
RICHTFUNKSTELLE
DEUTSCHE BUNDESPOST
HAMBURG
Dr. R. D. Behnke
COLORADO STATE UNIVERSITY
FORT COLLINS, COLORADO
80523
U.S.A.
K. PETERS
GERNOTSTR. 10
HAMBURG 50 / W. GERM.

Peters — Salvelinus ms. — profundus — Brenner — ?

Arabian — Aphanius dis.

4 cypr.

no Tigres — Eu fam.

Gholamhossein Wossughi Hamburg 1978

undergrad.

— Ph.D. ? Export? — an term paper.

— Ladiges, Numann, Banarescu — omitted Berg 1901

— follow — Heckel (1846) — Berg (49)

Annandale (Hora 1920), L. Studied specimens, Hamburg, Bavarian St. mus. Munich, Frankfurt mus. — also his brother sent spec. in 1977. — Why not Vienna — Heckel ? ? spec.

— Acknowledg thanks Villwock — advice & Kossorig

Numanns specimens 64-68 — used by Karaman (68, 71)

— Map drainage basins wrong (Shiraz Kor. R. basin not Persian Gulf drainage) — Region of inland basin — all lumped into one ?

IUCN

Schizocypris — Khorassan, Gorgan.

1971-1975 — Dozent in Biology i Sporthochschule in Tehran, completed thesis — Dec. 77.

— citation Berinkey 1956. the taxonomical examination of the otoliths of Hungary.

— first spi

Alburnus orontis — Caspian, Kazim choi specimens

Sardab — Rezaiyeh prob. A. atropatenae

Kazim

type locality Orontes R., Lebanon. — we find Capito — Tigres, mesolepis Zeyan atropatenae

— one sp. Alburnus in Iran — 2 sp. Caspian

undescrib. Rez. -

(2) " = Namek (Qom R. - new tehn.)

(never read cites Keyserling (1861) A. mesolepis Esfahan (internal basin)

We note Sm. lit. = Berg - 2 Caspian
1 Zayenderud - 4
1 Rezaiyeh

— we found new one Rezaiyeh. 4 = 8 sp.

2 new sp. Qom
1 Tigres. 1 Reza

Alburnoides bipunctatus eichwaldi 1 sp Alburnoides Iran
- Tehran

2 new sp. in Hamburg coll. (Turkey, Iraq)

1 - new sp. Rezaiyeh -

3 sp. Tigris Iran

Kessler irrational exl extremes splitting at generic level spl lumping at sp. level

Schizothorax pelzami - Hanum 1977 -

Schizothorax sinuatus Heckel 1843 - Central Hindu Kush, Afghanistan
Banarescu & Nalbant (75) - not in lit. cit.
Peters?

Description new subsp. -
Capoeta capoeta arrenquice - near Arak.

8 D.
39-40 l.l., 6 anal rays

— our new Arak Var has - 50-60 l.l.

★ Porcelain Plate. Courtesy of Bing and Grøndahl Museum, Copenhagen (Denmark), to benefit the United Nations Children's Fund (UNICEF). ★ Assiette de porcelaine décorée. Reproduction autorisée par le Musée Bing et Grøndahl, Copenhague (Danemark), au profit du Fonds des Nations Unies pour l'enfance (UNICEF). ★ Plato de porcelana ; cortesía del Museo Bing y Grøndahl, Copenhague (Dinamarca). Contribución al Fondo de las Naciones Unidas para la Infancia (UNICEF). ★ Фарфоровое блюдо. Работа любезно предоставлена Музеем Бинг и Грендаль, Копенгаген (Дания), Детскому фонду Организации Объединенных Наций (ЮНИСЕФ) в благотворительных целях. ★ 瓷盘。 丹麦哥本哈根，宾／格朗达尔博物馆特许联合国儿童基金会采用。★ Dänische Weihnachtsteller • mit freundlicher Genehmigung des Bing und Grøndahl Museums, Kopenhagen (Dänemark), zugunsten von UNICEF, Kinderhilfswerk der Vereinten Nationen.

PRINTED IN SWITZERLAND

Meylan, A. 1964. Le polymorphisme chromosomique de Sorex araneus L. Rev. Suisse Zool. 71(4): 903-983

Robertsonian polymorphism : 2 distinct types -
(A) - monomorphic ; 23 chromosomes + fundamental autosome no. (N.F.) of 38
(B) - NF. of 36 and chromosome polymorphism - & 2N = 21 to 31.
- altho morphologically similar must be treated as 2 species. - demonstrating independence of chromosomes & organic evolution.

VI
857

Scheffelt E. : Schweizer
1926 - Fische : Fischerei
im Bodensee. 172 pp.
- Stuttgart. 1926

NOTICE TO AUTHORS

PLEASE READ THIS NOTICE CAREFULLY BEFORE PREPARING MANUSCRIPTS

All manuscripts must be typewritten on good bond paper. Manuscripts on erasable bond or mimeograph bond will not be accepted.

All material in the manuscript, including text, literature cited, tables and table headings, figure legends, and footnotes, must be typewritten, double-spaced.

Nothing in the manuscript should be underlined except Latin names of genera and species.

Titles of manuscripts should be brief, but should indicate clearly the field of study and the group of animals being reported on.

Each table should be on a separate sheet, numbered with an Arabic numeral, and should have a short but amply descriptive heading. Footnotes to tables are to be avoided if possible, but when necessary, should be concise and clearly indicated. Material in the text should not duplicate that in the tables.

Each figure should be on a separate sheet numbered with an Arabic numeral. All maps, graphs, charts, drawings, and photographs should be numbered as figures. Illustrations larger than 8½ × 11 inches are unnecessary, and cause added mailing expense to the author and the Society. Glossy prints of oversized illustrations are reproduced easily, and there is less likelihood of their being damaged in handling. When several charts or photographs are grouped as one figure, they must be trimmed and spaced as intended for final reproduction. Each part of such a group figure should be lettered with a block letter in the lower left corner. Typewritten lettering on figures is not acceptable. Legends for figures should be typewritten on a separate sheet.

Styles for citing literature in major papers and notes are those in the most recent issue of COPEIA. Names of journals should be abbreviated according to the *World List of Scientific Periodicals.*

Major papers are those longer than six pages of double-spaced (elite type) manuscript. Title and author(s) should be centered at the top of the first page. A major paper must include an abstract, on a separate page, that recapitulates the findings in the paper. It should not be a description of the work done. The address(es) of the author(s) should be placed at the end of the literature cited.

Ichthyological and herpetological notes are those papers with fewer than six pages of double-spaced (elite type) manuscript. The title is run into the first paragraph, and the author(s) name and address(es) are placed at the end of the manuscript. Literature cited is included in the body of the manuscript, with titles of papers omitted.

All manuscripts, preferably in duplicate, should be sent by first class mail to the appropriate divisional editor, who will acknowledge receipt. First page proofs will be furnished each author, and they must be returned promptly to the Managing Editor. It is expected that each author will have retained a copy of the manuscript for checking the proofs.

Orders for reprints must be submitted directly to Allen Press, Lawrence, Kansas, when the proofs are returned to the Managing Editor. Forms for such orders will be supplied with the proofs.

The editors recommend the following guides for assistance in preparing manuscripts:

Style Manual for Biological Journals (1964, American Institute of Biological Sciences, 2000 P Street, NW, Washington, D. C. 20036). $3.00

A Handbook for Biological Illustration by F. W. Zweifel (1961, University of Chicago Press, Chicago 37, Illinois). $1.95

Webster's Third New International Dictionary (1963, G. & C. Merriam Company, Springfield, Massachusetts).

The editors are:

Herpetological Editor: GEORGE B. RABB, Chicago Zoological Park, Brookfield, Illinois.

Ichthyological Editor: BRUCE B. COLLETTE, Ichthyological Laboratory, U. S. National Museum, Washington, D. C. 20560.

Managing Editor: LOUIS A. KRUMHOLZ, Department of Biology, University of Louisville, Louisville, Kentucky 40208.

— Chromosomes — (Electrophoresis - serology)
(White's book) — ??

Post, A. 1965. Vergleichende Untersuchungen der Chromosomenzahlen bei Süsswasser-Teleosteern. Zeit. für Zool. Syst. u. Evol., Bd. 3: 47-93.

106 sp. 19 fam. examined -
79 have N=24 - (only salmonids higher)
N=24 of ancestral impt.
(Student project) — lit. survey - new techniques local fishes - gill arch ?? - Russian work - (Dorofeeva) - Svardson - Swain - M'Phail -

Kobayasi, H. 1963. Some cytological observations on fertilization in the cross between the dog salmon and the pink salmon. Cytologia 28(4): 365-75. (S.F.A.* 5482)

Ohno, S. et al. 1965. Post zygotic rearrangements in in rainbow trout (S. irideus G.) Cytogenetics, 4(2): 117-129.
S.F.A. * 8499 2n = 58-65 (in same individual?)

Nayyar, P.P. 1966. Karyotype studies in 13 sp. of fishes. Genetica, 37(1): 78-92 (India)
Spermatogonial & 2ndary spermatocytes used - 9 families of fishes

Khaterin, D.K. 1965. Znachenie nekotorykh taksonomicheskikh kriteriev lososei. Dokl. Akad. Nauk. 165(3):711-13. otoliths of S. salar, Trutta, lacustris.

Lieder, U. 1956 Chromosomenstudien an Knochenfischen.
IV. Die Chromosomenverhältnisse bei der Regenbogen
und Bachforelle und ihren Bastarden. Zeitschrift
für Fischerei und deren Hilfswissenschaften. Band
4 N.F. Heft 7/8: 589-594.

- Salmo iridens Gibbons (- note: During this work - the work
of J.E. Wright, 1955 - Prog. Fish. Cult. 17(4) appeared. - Wright also
found rainbow 2N=60.
opx 10 prs. rod shaped (opx 100 arms.)
appx 3-5 prs. J shaped

- hybrids Trutta × (iridens / gairdneri) = 2N = 70

"Discussion" with a no. of 2N=60 S. iridens. very good opx
Svärdson; belief that basic salmonid haploid no. 10, - Furthermore
strengthening Svärdson: belief that salmonids are old polyploids -

---

- Coregonus - Ambühl

- Dargetzi

100 f.;-
SZ.

24

4

145.
46 23.5% ÷ 200

10,000
8000
2000
2,000

16. 2600

2 280
2.5 Tsz.

$1.25 pr 42c
46 1.50

Ford C.E. and J. L. Hamerton. 1959.

A system of chromosomal polymorphism in the common shrew (Sorex araneus L.). Proc. Int. Cong. Zool. (1958): 177-179.

English shrew
42 trapped. - individuals constant no.
but ♂; vary from 22 to 27
♀; 22-25.

shrews multiple sex chromosome system in ♂;
XY$_1$Y$_2$ ♂ XX ♀

(12) 6 pr. metacentric always present
3 pr. appears as metacentric or 2 acrocentric
- confused by trivalent assoc. in spermatocytes

5 types chromosomal polymorphism known to occur in natural pop. - ① translocation heterozygosity ② inversion heterozygosity ③ supernumerary inert chromosomes ④ unequal bivalents ⑤ fragmentation - fusion changes. Only last known in mammals.

1964. Fixation and fat extraction before staining and squashing for chromosomes of fish embryos. Stain. Technology. 39: 45-47.

Simons, R. C.

1964. Cytogenetics, relationships and evolution in Salmonidae. Ph.D. thesis Univ. Wash.

- hypothesis + salmonids similar in total chromosome material - despite disparity of no.

S. salar - ex. of pericentric inversions and whole arm reciprocal translocations.

relate centric fusion - hybridization + environmental condition as factors in evolution of salmonid species.

Doesn't believe Salmo + Onc. 2 genera.

kelta + gorbuscha further apart than commonly believed

- Generally decrease in chromosome no. w/ increase specialization

Wright (55) - thought S. trutta + Salvelinus closer than S. t. to S. g.

Allen (55) - says no - S. t. chromosomes more homologous w/ S. salar.

- Questionable tool - success of hybridization

- Salmo marmoratus x S. t. and Gadus macrocephalus w/ O. kelta (Terao, 35:

most salmonids have appx 100 arms.

diff. in no. explained by relation of meta - & acrocentrics

O. kelta + O. gorbuscha - 150,000 fry released 1962

over 4% returned to hatchery (Hoodsport Salmon Hatchery, Mason Co., Wash.) - in 1963. - 1 725 produced -

O. mason : 63-70 - but 104 arms confident count (Ca)
acrocentrics of mason have short 2nd arms - comparable
to S. c. clarkii - not known among other Salmo
or Oncorhynchus nor Salvelinus.

- Chromosome number not invariable! -
S. c. clarkii Washougal R. - Wash. 2 samples 1 had count of
68 or 69 - other have 70. (same locality)
- Minter Crk. - one has 70 - other (N=10) sample, embryos of
62, 63, 63, 63, 64, 65, 65, 66, 66, 67 (2N)
Also S. g. gairdneri Minter Crk. - of 20 counts only
one has 60 - others 61-66 - Soos Crk. - all 60

S. c. lewisi. Lauri L. Montana - 1=66 1=65 or 66
3=64

Counts not considered results of poor technique or errors
Departures of one or two counts in 25 is usual. May be result
of counting error.

- S. gairdneri 2N=58 · 106 arm smallest no. - arm =
clarki

table 4 IIa

	2N	acro	meta	arms	total counts
O. masou Hokkaido	63-70	?	?	ca. 104	10
S. c. clarki * Wash. Washougal R., Clark Co. Minter Crk., Pierce Co.	70	34	36	106	60
S. c. lewisi * Mont. Lawri L., Flathead Co.	64	22	42	106	25
" Wash. L. Leavenworth Nat. Fish Hatchery	64	22	42	106	~~50~~
" Wyo. Jackson Nat. Fish Hatch.	64	22	42	106	25
S. c. henshawi Nev. - Summit L.	64	22	42	106	25
S. g. gairdneri * Wash.	60	16	44	104	45
S. aguabonita Nev.	58	10	48	106	25

* = micositaat counts.

- heteromorphic acrocentric chromosome. - variably present or absent in some species - observed in aguabonita, gairdneri & S. c. lewisi.

- longest acrocentric in rainbow x cutthroat - seems to be one of heteromorphic pair - which appears in alternate condition w/ equal frequency. - aguabonita - smallest acrocentric seems to be variably w/ or w/o a mate.

Svardson - reported small acrocentric pigment in Coregonus laveratus -

- Got counts from corneal cells - agree w/ blastula

Hoodsport Salmon Hatchery Mason Co. (II 6)

? 6% return of F_1 released

F_2 *keta* × *gorbuscha*

1961 – Wash. St. Dept. Fish. 150,000 F_1 ♂ *O. k.* × ♀ *O. g.* – released as yolk sacs absorbed early 1962 – more than 4% returned to hatchery as mature adults fall 1963 F_2's

Initial viability of *O. g.* ♀ × *O. k.* ♂ mean 95% – subsequent survival to fry stage – 42.7% (to active feeding)

abnormalities noted – in eye diameter, as ~~spinal cob~~ vertebral column

some eyes almost absent w/o melanin

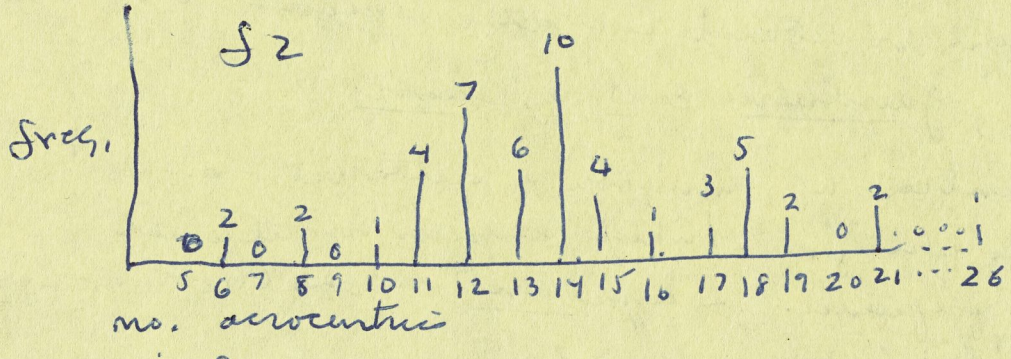
about 70% (of 42%) appear normal superficially

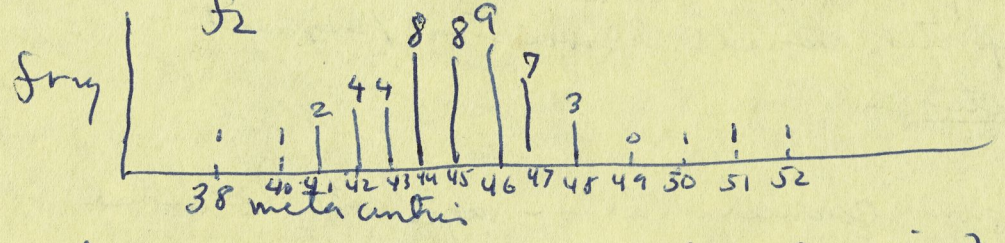
In general cleavages appear normal – Atypical no. (106–124) mostly were near-tetraploid – 18 of 300 3 haploids found (28–32) – 2 were neither haploid nor tetraploid (45 and 75)

Typical counts 56–69 in sample of 50.

	2N	meta	acro	arm
O. k.	74	28	46	102
O. g.	52	52	0	104
F_1	63	40	23	103
F_2	59×	45×	14×	104+

× = mean no.





Greater than expected no. of meta centrics in F_2 – all but 2 more than F_1 – less acrocentrics – all except 1 less than 23 of F_1

Pairing of absence of pairing in meiotic chromosomes is the only info enabling decisions on degree of species relatedness. — 'Some observations (techniques prevent complete analyses) - indicates pairing very nearly complete. - parent species not diverged enough to obscure chromosome homology.

- Speciation & Change in Chromosome No.

Evolutionary direction - reduction in no. by fusion. higher no. closer to primitive condition - Specialization typified by reduction. - linkage of 2 acro → ∧ = non random segregation - typified by rigid cgs. life cycle of O. g. (all metacentrics).

O. most specialized

O. & Salmo less primitive than Salvelinus

pericentric inversion /\2/ meta becomes acro

explains salar

brunta & 112 arms 6 are borderline metacentrics (1 micron) if (Simon 63) called one or 2 cleavages. may have reported 104 arms. because length diminishes (like - subtelocentrics on S. c. clarkii).

"The several species studied to date are remarkably similar with respect to total hereditary material. Species divergence has apparently progressed by a major process of shuffling the linkage relationships of the ancestral complement.

potential for variability by gross changes in chromosome morphology is great in Salmonines

Other groups of closely related animals have divergent chromosomes (White 45 - insect) - (Matthey Reptiles) Les Chromosome des Vertebres (Chu & Giles 57 - primates

Am. Nat. XCI (8601 273-82)

= Many niches - ~~variable~~ = specialize ~~much recombinator~~

- marginal - harsh environment can't afford, to recombine specialize

("Lucretius")

anadromous vs freshwater
constant fluctuating.

Potential importance and consequences of Hybridization

Hoar (58 - evolution of migratory behavior Oncorh) - J.F.R.B.C. 15(3):371-

considered O. g. split from O. k. in 4B a first step of O. evolution - if so - then all metacentrics of O. k. would be homologues to metacentrics of pinks - & ~~gorbuscha~~ metacentric = 2 beta acrocentrics. - doesn't seem to be case -.

- pink not from beta per se - but diverged at some remote time from ancestor which karyotype differs from both present species.

- Puzzle why 72 have less chromosomes than 71 only 3 (63, 64 & 69) of 50 comparable to 63 of 71 47 less - May be due to preferential viability of metacentrics and/or centric fusion in 71 gametes.

"In theory - hybridization could account for many of the chromosomal alterations which appear as basis of speciation in salmonid fishes" -

Hybridization

G.L. review of Mayr — book

Stebbins. 63-(Am. Sp. & Evol. - Perspectives in Am. Scientist 51(3): 362-370

minor role in stable environment - in new unstable environment - can have profound effects on major evolutionary trends - .

- Future studies of chromosome segregation to F_2 hybrids would appear to offer a potential hope for resolving the question (importance of hybridization in speciation).

- Until further studies are made, there appears no justification for combining Salmo & Salvelinus

- No constant characters separate Salmo from Oncorhynchus -

- Salvelinus suggested more primitive than Salmo & On. on basis of 80-84 chromosomes

Teras 1935 — Gadus + Oncorhynchus

J. Jap. Genetics 9(3):183

also Hubbs (55) — + White (45)

hybridization of Fish Sp. in nature

– Erroneous conclusions based on hybridization

	2N			
S. c. clarkii	70	34	36	106
lewisi (3)	64	22	42	106
henshawi	64	22	42	106
gairdneri	60	16	44	104
Eyrostomiles	58	10	48	106

Salmonid species — Salmonidae (Thymallus) 102 — Pleuroglossus ? – Osmerid –

52 – 84

1923

Kyle, H. M. The classification and phylogeny of the Teleostei Anteriores. Wissenschaftliche Meeresuntersuchungen (herausgegeben von der Kommission zur wissenschaftlichen Untersuchung der Deutschen Meere in Kiel und der Biologischen Anstalt auf Helgoland.)
Neue Folge. Vierzehnter Band. (vol. 14)
Heft. 2 : 197 - 240.

— Primitive post. pelvics - long enenclosed abdominal cavity
— Advanced - pelvic bones reaches cleithrum - encases cavity

- Bases classification on attachment of pelvic girdle

- ~~Abdom~~. Post.
- Irregulares
- Anteriores - evolved from Post. due to disappearance of open air bladder.

Tel. Anteriores arranged into 5 major groups or orders based on balancing conditions of the abdominal region.

— Sub Class Teleostomi, Phylum Tel. Anteriores 5 orders

order 1. Irregulares.
- Sub orders
- Division - Synognathiformes, Pleclognathi, Ammodytiformes, Anacanthini, Mugiliformes, Gasterosteiformes, Anabantiformes, Atherniiformes, Scombresociformes

Order II Trachinoidea
Gobies - Pediculati - Symbranchii - Blennies - etc.
Batrachiformes

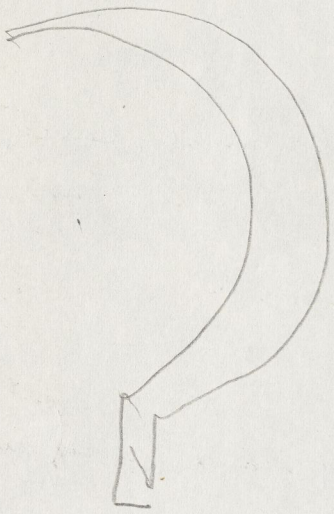
Order III Carangioidea
- Labrids, Pomacentrids, Chichlids, Pleuronectiformes

Order IV Percoidea

Order V Scomberoidea

— Ammodytes most primitive ("Personnel") - Ant. Teleost.

"Ammodytes is a variant of the Herring" p. 235.



3 ft. 3 in - 1m

200 cm = 6 ft. 6 in.

~~1180~~ cm. = 6 : 2

=

90 k.

198 m.

99 - 218

СЕРП УХОВ

Serb

~~200~~

167

(67) 10%

61

10к. = ГРИВЕННИК 165

20к = ДВУГРИВЕННИК 71-72

~~ЧЕТЫРЕ~~ = 3 КОП

15 КОП - ПЯТИАЛТЫННЫЙ ~~71~~ - 65

6 - 10%

25к = ЧЕ

50 - ПОЛТИННИК

Kissner - On brains of fishes

Clupeiformes:

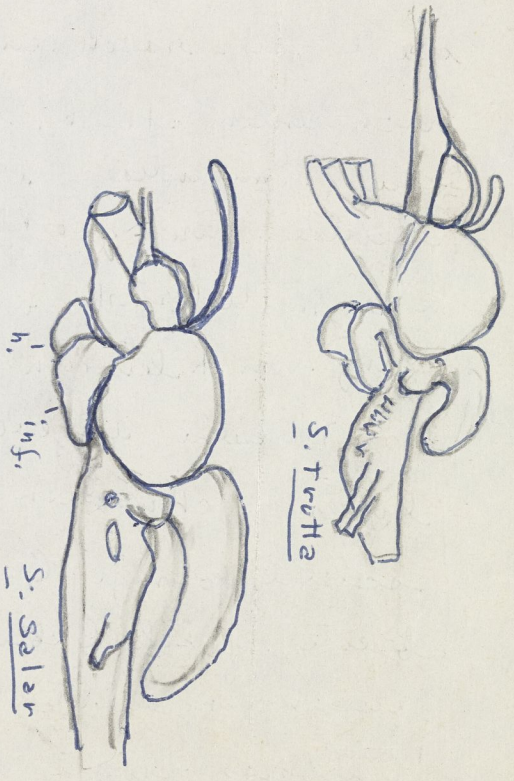
Salmo trutta Table 4 fig. 4-6 (7) = S. alp.

Lives in the sea where it feeds on fishe and crustaceans. Like the salmon it comes into rivers. A strong olfactory nerve ends in a thick, long Bulbi olfactorii, which immediately goes into the basal part of the Corpora striata, in there a roundish-arch dorsal part - like a cap - fits over the basal (abschnitten) - a short epiphyse - D - The large, roundish-oval optic lobes are - vorn niedrig und steigen nach hinten zu beträchtlicher Höhe an, then quickly again falls away. Hinten weichen sie in der Medianen ganz wenig auseinander. Das lange Corpus cerebelli steigt sehr rasch ein Stück in die Höhe, biegt dann caudal nach unten herab, sodass es weit nach hinten überhängt. Seine Eminentiae granulares sind kräftige, nierenförmige Gebilde, deren konkave Fläche parallel den Lobi optici läuft. Die mittelstarke Valvula ist eine Valvula quadrigemina, fast ganz vom Kleinhirn bedeckt werden die kaum als Verdickung der Medulla angedeuteten Lobi vagales, die nach hinten in langen, schwachen Leisten auslaufen, wie auch die schmale, schlitzförmige Oeffnung der Rautengrube. Die N. optici sind breite, flache Gebilde, deren jeder aus einem sehr breiten, zusammengefalteten Bande besteht. Als Ausdruck dieses Aufbaues findet man an ihrer Aussenfläche Längsstreifen. Das infundibulum wird völlig von einer breiten, dachförmigen Hypophyse überlagert. Die kleinen Lobi inferiores, die hinten ein wenig breiter sind als vorn, sind sehr einfach gestaltet; nur lateral wird ein schwacher Wulst durch die seichte Oculomotoriusfurche abdifferenziert. Der Saccus vasculosus, der bis zum Hinterrande der Lobi inferiores reicht, ist gross, wie ein breiter Schlauch geformt.

Salmo salar - ist Räuber und unternimmt zur Laichzeit noch ausgedehntere Wanderungen als Salmo trutta.

Sein Gehirn gleicht dem vorigen prinzipiell, nur scheinen die Corpora striata fast würfelig, besser gefurcht. Die Epiphyse ist sehr lang, distal kolbig verdickt. Das Tectum opticum ist gegenüber dem von trutta breiter und kürzer, ist ihm an Masse aber durchaus gleich. Noch viel stärker aber ist hier das sehr weit nach hinten überhangende Corpus cerebelli, dessen Valvula mittelgross und dessen Eminentiae granulares zwar gut abgesetzt, doch recht klein sind. Die Lobi vagales, vom Kleinhirn bedeckt, sind etwas besser ausgeprägt; sehr dick und rund sind die N. optici. Die grosse Hypophyse gleicht der von trutta. Dagegen sind die Lobi inferiores breiter und mächtiger, der Saccus vasculosus wieder kürzer.

- greatest dif.
epiphysis
cerebellum
optic lectum broader, shorter in salar.
hypophysis larger in salar



Исаакиевский
собор.

Library Ⓐ (paper) – Moseman's paper
Ⓑ Oyler's ward c.z.s.
* 97387

-write Czech.

- Seminar ———
announcements:
Grt. Lakes – should be 2 sem. –
· but: most prob. dramatic successes in fish mgt. in history
faced w/ Mich-lake full of alewives – total fishing – >100
comm – fishermen – sub standard living – crash program
– no pilot studies – no research – need action – make
decision – what would you have done? – Smith es
Middleton tells us the rational for course of action
– successful beyond their wildest hopes – * * into stat.

- Hiram Li – 20th
– Dec. 4 – discussion or rep. – assign 5-10 min to each –

Pat Devies
Richard Duchrow – handouts by 20th – rough draft
Bob Lackey
Bruce May

Fish Seminar

- Everhart: list of registered students.
  - Square L., Aroostook Co., Snowshoe tract

- 23 Hagan 30 Computer - units Bldg.? - demonstration walton ex.
  7 Peters 14 Middleton 21 Li
  Dec. 4 week Dec 4 symposium. - pick panel.

- library request? -

- weeds - fish.
  - mammals
  - fish
  - crayfish
  obvious effects - . control: chem., mech., biol.
  - role in ecosystem

Students volunteers.

- Charley Gould 206 Braden 3650
- Dave Jefferson 303 Braden 3154

C F S
SH11
C3
vol.25 1939

- T.U. - Hatchery Trout: wild -
- Tanner - who coho wed F.G. sem.
- Peters - Rdc Bld. - 2 wks. - 837 / 12. Fry

- Fill out sched. - who fr. credit
  - Carpenter - miner. ?
  - blackboard - ?
  - projector ?

⇒ Reimers ?
mon. 7th ?
-

TROUT UNLIMITED

CUTTHROAT CHAPTER

September 19, 1968

TO: Colorado Trout Unlimited Members

FROM: Van

SUBJECT: What's Going On

It's been a busy year to date with much accomplished and much, much more to be done. Membership is up and new Chapter formation is on schedule with a total of 6 assured by the end of the year, up from the 3 we had. Our goal is 1,500 members and 15 chapters in Colorado by the end of calendar year 1970.

The Cutthroat Chapter banquet in May was a great success and did much to establish Colorado in the forefront of National Trout Unlimited activity. This is to become an annual affair of one of the Chapters each year.

The Western Regional Trout Unlimited meeting will be hosted by Colorado on September 27th and 28th of this year. There will be excellent speakers and seminars and all of you should plan to attend. Mark the dinner on Friday night at the Old Navarre in Denver on your list. Joseph G. Moore, the Commissioner of the Federal Water Pollution Control Administration, will be the major speaker. Mr. Moore will explain the benefits that can be derived here in Colorado from the new water quality control laws. Let's take advantage of the opportunity to learn what can be done. Various seminars and workshops will be held Saturday morning.

Projects in the works include a stream protection law similar to Montana, the opening of Cheesman Reservoir to the public, partial salvation of the North Fork of the South Platte from the ravages of the Denver Water Board, pollution abatement on the South Platte in Denver, establishment of additional quality waters including the lower Frying Pan and - membership, membership, membership.

See you at the Western Regional.

Van

R. P. Van Gytenbeek
Chairman
Colorado Council of Trout Unlimited

OFFICE MEMO

TO:

Date

FROM: Brynildson, O.M. and C.L. Brynildson. 1954.

SUBJECT: Impacts of a floodwater-retarding structure on yearclass strength and production by wild brown trout in a Wisconsin Coulee stream. Wis. Dept. Nat. Res. Tech. Bull. no. 146:

-re. ice, temp., survival -- Combs & Burrows. 1957. (B.I.D. R.E.) Threshold temp. for normal develop. of Chinook salmon eggs. P.J.C. 28(1):3-6

Pac. salmon egg incubation -- constant temp. 40°F or below - high mortality - virtually complete at 35° - But if initial incubation temp. >42°F for month - Tolerate long periods of 33°F.

-Neitzel, D.A. and C.D. Becker. 1985. Tolerance of eggs, embryos, and alevins of Chinook salmon to temp. change and reduced humidity in dewatered redds. T.A.F.S. 114(2): 267-273

90% humidity lethal

FORTY-YEAR STATUS REVIEW

When I began my study of western trout in 1957, the cutthroat trout was generally considered as more of a rare curiosity than an important species of fisheries management. According to the concept of utilitarian values of nature of good, bad, and indifferent species, in relation to their direct human benefits, the cutthroat trout was not ranked high. Federal and state fisheries programs ranged from benign neglect to outright extermination in relation to cutthroat trout. Their replacement by rainbow, brown, and brook trout was perceived by many to be a good thing. Three subspecies (henshawi, stomias, and utah) were believed to be extinct in 1957 and have since been "resuscitated." Another, unrecognized subspecies (Alvord cutthroat) has become extinct (while awaiting "genetic characterization"). The coastal cutthroat has considerably declined over the past 40 years because of their dependence on the smallest first and second order streams and impact on such steams by logging. Yellowstone Lake has long been known as the stronghold of inland cutthroat. Formerly, Yellowstone was managed for maximum sustained yield under the utilitarian view of natural resource exploitation. Protection of various subspecies of western trout under the Endangered Species Act has had mixed results. Undoubtedly, the greenback cutthroat (stomias) has greatly benefitted, but for most others, legal action has been necessary to enforce provisions of the ESA. Particularly in respect to livestock impacts, the problem is similar to fighting many brush fires. Hopefully, more rapid progress for protection and enhancement can be made with conservation agreements, as is currently done in Utah, rather than ESA listing.

utilitarian - intrinsic symbiotic greenback - CO pat. beetle - some sp. and equal than other

Robert J. Behnke
Professor of Fishery Biology
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523-1474

— C. B. II(1):1 - private lands
habitat conserv. planning — 1982 ESA amend. - allowed lawful activity, if submit. fund & conserv. plan to mitigate

C B 555

see: C.B. 11(1):6

- think globally act locally

Ask: ? Trail system Ft. Collins. - sales tax

- How many people were living on earth ? ±10%

5.6-5.7 billion

-5.8

Cdi Senator: Wayne Allard Ben Campbell Schaffer

- How long double ? > WWII pop cycle 11.2 carbons our forefathers placed 2 bil.

- triple

- 95. - 2675 mil.

- 1995 - 130 x 2 bill

2x 3x -

- Energy use/capita developed, underdeveloped

U.S. — Africa, Asia

China - 1.2 bil - all drive cars - elec. - life style

- would you give up life style as American - hunter-gatherer ?

- Cynicism ? - Mega problem — basis of C.B. crisis

Gist of course - -- Majors - Coll. N.R. - holistic - econ. perspect.

- biology - sci. ? - politics, law - Congress. St. legislation

- End Sp. Act. - State Game - captive breeding (salmon in hatcheries)

- Forest products Industry

vote ! - 15-25 - 20% - Wayne Allard

>60 ~ 80% N.B.S. - volunteers

talking —

chicken little cry wolf

1994 - Nat. Report - C.B. - How get message ?

Why do we want to save bio. diversity

- Fair - just ? - Any public system better ?

- political constraints -

- Sem. Conserv. Genetics - st. dev. - but negative — realistic - polymorphs.

% resources - primary production ⇒ human

1st ANNUAL MEETING OF THE COLO-WYO. CHAPTER OF THE
AMERICAN FISHERIES SOCIETY

APRIL 1, 1966

Room 208 Student Center, Colorado State University, Fort Collins, Colorado

---

MEETING THEME: The Cutthroat Trout in Colorado and Wyoming.

8:30 - 9:00 AM Discussion of Purposes of the Colo-Wyo Chapter - Harold Hagen

9:00 - 10:10 AM Business Meeting

10:10 - 10:30 AM Coffee Break

10:30 - 11:00 AM Taxonomy of the Colorado Greenback and the Gila trouts - Bob Vincent

11:00 - 11:30 AM Taxonomy of the Colorado River Cutthroat Trout and its relation to the Snake River and Yellowstone Cutthroat trouts - George Baxter

11:30 - 1:00 PM LUNCH. The Chapter is invited to join the Society of the Sigma Xi Friday luncheon. Luncheon speaker: Harold Hagen,
Title: Zoogeography and evolutionary adaptation of various races of cutthroat trout in Colorado and Wyoming.

1:00 - 1:30 PM Cutthroat Trout Culture, procedures used for brood stock, spawning, hatching and swimming up fry - Earl Wilde — 3 generations spawning moved from March → Dec. — distributed in other waters.

1:30 - 2:00 PM Cutthroat Trout Culture, procedures used in fingerling and catchable trout rearing - Tom French

2:00 - 2:30 PM Cutthroat Trout Management in Yellowstone Park - Phil Sharpe

2:30 - 3:00 PM A preliminary report on the biology of the cutthroat trout in the Snake River, Wyoming - Pete Hayden — Trib. — rainbow spawning (a few hybrids found) one mo. before cutt (Apr - m. - May)

3:00 - 3:20 PM Coffee Break

3:20 - 3:50 PM A comparative study of the cutthroat and brook trout fisheries in beaver ponds of Wyoming - Dick Lakey

3:50 - 4:40 PM Cutthroat Trout Management in Wyoming.
Discussion Moderator - Fred Eiserman
remnant rainbow pop. in Star Valley — brown pop. some area but soon dominated by cutthroat
The Salt and Snake Rivers - Max Rollefson
The Green River - Bob Jackson
The Wind River - Chuck Vicx
The Shoshone and Clark's Fork Rivers - Lou Pachacek
Lahonton cutthroat trout in Wyoming - Jack Kanaly

4:40 - 5:10 PM Cutthroat Trout Management and research in Colorado - Wes Nelson

5:10 - 5:40 PM Re-stocking cutthroat trout following brook trout removal - Dick Klein

5:40 - 6:00 PM Adjourn

— where coexist - factors involved
— hybridization / ecological dif.
separation → spawning

Norrell A. Tompson
Calo St Forks Dept
317 Prospect
Box 567 Fort Collins

Regional Headquarters
Monterey, Calo.

working in San Juan
drainage

For:

Dr. Robert Behnke

- Burkhardt's BLM Rep ?
  - Douglas Crk ?
- Idaho Rip. Veg. Analysis
- Womack, R. 1975. M.S. Thesis Douglas Crk.
  1882 - 1961 - present 10 m. incisement fm. erosion
- Schuman 1975 - Episodic erosion = modification geomorphic cycle
- BLM soil rep.

- Schuman, Swanson - Livestock
  - CUSC

TU, Audubon, Nat-Wildlf, Wilderness, Sc., Izaak Walton League

laboratory techniques involved in slime
on slime molds.

mine the presence of Salmonella in water
quired isolation and identification of
waste products from an industrial waste.

ent of Bacteriology, 1970-1972

of fish for determination of their micro-
ciate the flora with the fish's resident
d testing coho salmon for their microbial

n County Campus, 1966-1969

General laboratory procedures including
with testing agricultural well water for
n and nitrogen compounds and testing
off.

Hanzel, D. A. - cutts in Montana

Proc. Mont. Ac. S. 19:32-71.

S. clarkii

S. salvelinus West - malma

Columbia

East → Missouri - S. clarkii

Thymallus arcticus

Prosopium williamsoni

Prosopium williamsoni

☆ No Thymallus

- desc. clarkii dist.

w/ T. arcticus - (more northerly - not west - Michigan

x Prosp. will. - .

- malma (salvelinus)

- not prim. relict dist.

- no really distinct from

(Lahontan must unique

but not s. of Lahontan

w/ other species (Siphateles & Gila chilo)

- Emphasize upper Snake.

Lots lots

OUTLINE FOR THE CLASSIFICATION OF WESTERN TROUTS

Robert J. Behnke

University of California, Berkeley

More than 35 specific or subspecific names have been applied to the native trouts of the genus Salmo of western North America. I recognize two major evolutionary divergences; the cutthroat series and the rainbow series. The golden trout complex is a third evolutionary line that suggests its origin from a primitive cutthroat-rainbow intermediate form or from early cutthroat-rainbow hybridization in the lower Colorado River area. The limits of species and subspecies are difficult to assess because reproductive isolation between the evolutionary lines is slight. No single definition of a species or subspecies is adequate to handle the classification of our western trouts. For the interior cutthroat trout, I recognize subspecies if all of the native populations within a drainage basin, or a geographical area, share a complex of characters which differentiate these populations from other cutthroat populations outside the basin. If the variability is as great among populations within a basin as it is between inter-basin populations, then all such inter-basin populations are considered as the same subspecies.

On this basis, I consider the Yellowstone, the Colorado River, the Rio Grande, and the Bonneville basin cutthroat trout all

as the subspecies, Salmo clarkii lewisi. The native cutthroat of the Arkansas and Platte drainages may be recognized as the subspecies S. c. stomias.

TAXONOMY AND SELECTED LIFE HISTORY OF THE CUTTHROAT TROUT (*Salmo clarki* Richardson) OF THE SOUTH PLATTE DRAINAGE, COLORADO

Taxonomy and selected life history of fifty cutthroat trout (*Salmo clarki* Richardson) from four high-altitude tributary streams of the South Platte drainage, Colorado were studied. Study areas were selected to determine the existence of fish that represent the native greenback cutthroat trout (*S. c. stomias* Cope).

The life history study indicated that the cutthroat trout in the South Platte drainage are either isolated from other trout or in association with brook trout (*Salvelinus fontinalis* Mitchill). Age groups represented were from years I through V.

Morphological measurements were of little value in separating cutthroat trout into subspecies. Counts of scales above lateral line, scales in lateral line, scales two rows above lateral line, hyoid teeth, and spotting distribution provided the best information. On the basis of anatomical counts, cutthroat trout from Blackhollow Creek, Larimer County, Colorado seem to represent the greenback cutthroat trout. Scale counts of 42 above the lateral line, 138 in the lateral line, 194 two rows above the lateral line, and a hyoid teeth count of 7 characterized this population.

William H. Dieffenbach

S. c. stomias

S. c. virginalis

S. apache

– My views –
– Several years collecting examining old museum specimens
– what characters imptt. – what indicates divergence –
what easily changed or modified –
– Two main closely related series – w/ intermediate group
– cutthroat – rainbow – goldens (transitional result of hybridiz)
altho 2 sp. Calif. – Alaska

– What is species – subsp.?!
– Degree of dif??
– Live together w/o hybridizing in nature –
exceptions – golden –

– Briefly – my classification
rainbows – coastal waters – Kamchatka – one sp. & subsp.
Mexico – Alaska
– interior waters – Eagle L. – Athabasca R.
– One. desiccation basins intermediate hybrids

cutts – N. Cal – S. Alaska – coastal – 1 subsp. S. c. c.
interior – S. c. l. – large spotted – small spotted

– Kalontan
S. c. henshawi
new subsp. Humboldtensis
– Yellowstone
– upper Snake.
– Bonneville
– Colorado
– Rio Grande
– gill rakers 18-21 –
– scales 150-~~190~~
– vert. 60-63

stomias

Arkansas – Platte –
distinct subsp. – fine, sucker, few vert.
few pyloric caeca – large spot –
may be distinct enough ecology – to
coexist w/ other cutts – Twin Lakes

– History – Kansas R. – Canadian R. Type specimen

3rd groups - goldens

1 - Gila

2 - Mexican

3 - Calif. - asc. w/ lower Colo

4 - Cepache - Geographical - Faunal History

- all distinct w/ coloration - low vert. - low calca

- splitting - meristic character. = 4 subsp.

- How to approach - ∴ chromosomes - (clarki 69-70, golden 58, rainbow 60)

refined serology - electrophoresis

muscle protein

antigen - antibody reaction

- What needed is comparative test handle large samples clearly indicate. ∴ compare a stable trait governed by many genes - scores

(blood groups)

Dieffenbach, W. H. 1964. Taxonomy and selected life history of the cutthroat trout (*Salmo clarki* Richardson) of the South Platte Drainage, Colorado. M.S. Thesis Colo. St Univ. 49 pp.

* see Jordan, D.S. 1878. Bull. U.S. Geol. & Geog. Surv. of the Territories 4: 407-442
1878. ibid 4: 777-830
. said Kansas R. specimens not of *pleuriticus*

* Check Cope's data - where else specimens coll. -
(Rio Grande ?)

- Branchiostegals 10-11

		C2	calcs	C2
- basibranchial teeth -	Albion Creek	5-12	(8.5)	27-34 (31) 30.7
	Blackhollow	4-10	(7)	34-41 (37)
	No. Boulder	5-11	(8)	33-40 (37) 36-6
	Roaring Creek	7-14	(11)	28-34 (31) 34.2

approx. from graphs

	Calcs scales l.l.	above	2 rows above
Albion	121-130 (127)	39-42 (41)	180-183 (182)
Blackhollow	136-144 (139)	41-44 (42.5)	190-193 (192)
No. Boulder	127-134 (129)	37-41 (39)	178-181 (179)
Roaring Creek	125-133 (128)	38-41 (39)	179-181 (180)

Regan, D. M. 1964. Ecology of the Gila trout
M.S. thesis. Colo St. Univ. 57 pp.

Table 8 - meristic characters

	Miller (50)	N	Needham & Gard (59)	N	present study	N
Scales 2 rows above l.l.	137-151 (141.2)	25	136-153 (146.0)	17	130-154 (143)	25
above l.l.	24-29	16	28-35 (31.8)	17	25-33 (29)	25
branchiostegals	9-11 (10.2)	25	10-11 (10.6)	25	10-11 (10.6)	25
pelvic	9-10 (9.6)	34	9-10 (9.8)	20	9-10 (9.8)	25
pyloric caeca	31-42	20	———		28-38 (32)	25
Siz.	72-126 mm (104)		70-127 mm (92)		98-157 (110)	
head l.	296-320 (306)	N 6	291-315 (302)	N 17	273-319 (294)	25
jaw	162-175 (169)	6	148-172 (161)	"	144-184 (157)	25
Dorsal origin Snt. tip	523-542 (534)	"	507-537 (522)	"	505-547 (530)	
Dorsal fin basal	138-148 (142)		135-153 (143)		137-165 (148)	
Dorsal fin depressed	237-253 (243)		233-256 (246)		227-262 (241)	
adipose	118-125 (122)		98-117 (108)		104-129 (114)	

Diamond Creek.

Borisov, P. G. 1928. Dog salmon and navaga from the Lena basin. Materialy Komissii po Izucheniya Yakutskoi Avtonomnoi Sovetskoi Sotsialisticheskoi respubliki. Vypusk 27. 1-15.

— O. keta D. 4,10 A. 3,14 P. I 15. V. 10 ll. 141
rakers 21 branch. 12/13 caeca 231.
Amer. (Berg) D. 3-4, 9-11 ; A. 3, 13-5 P. I 12-14
V. I, 8-11 ll. 125-150 rakers 20-25 branch. 11-14 caeca 135-185
Berg - on one specimen keta from Lena - 105 caeca.

Snyder, J. O. 1931. Salmon of the Klamath River California. Fish Div. Fish and Game of Calif. Fish Bull. 34. 130pp.

Sac. R. salmon larger (what about steelhead?)
& have fewer rakers & caeca -
(McGregor C. J. O. 9 (4): 134-150 (1923) -

	Klamath	N	Sacramento
caeca	93-193 (132.2)	?	134-214 (176.4)
rakers	24-30 (24.7)	?	21-35 (23.5)
vert.	66-68 (67.0)		62-65 (63.8) ← see Seymour

Klamath
— lat. ser. 130-148 (C2 139) above l. l. 25-32 (C2. 29)

rakers	23	24	25	26	27	28	29	N	(Snyder's figures)
	1	2	15	43	33	17	9	~~120~~ 110	26.3
	3	4	15 4 3 24	0	33	34 33 27 94	27	120) 70.0 66	6

D. 10-13 (C2. 11.3)
A. 13-16 (14.5)
Branch. 13-18 (C2. 15.7)

* - Klamath L. basin now closed to migration by Copco Dam. - not known if salmon runs ever in Williamson R. but once salmon passed beyond where Copco Dam now located.

Many reciprocal transplants - Sacramento ↔ Klamath -

- rainbows - Klamath - Sac.
newberryi - stonei steelhead x resident
both areas - 2 distinct forms as in Sacramento - Pit ;
older name - perhaps steelhead ! - stonei - all
intermediate forms ??

- "Fishes Gulf Maine" p. 120 : 0 specimen of one of whitefishes (probably C. quadrilateralis) -) mouth Sissiboo R. St. Marys Bay, Nova Scotia ; Sept. 1919. (Huntsman. Contr. Canad. Biol. (1921) 1922 : 59) - probably stray from freshwater.

Промысловые рыбы СССР

- C. albula - 2 basic types
① common syapuskka - 10-20 (23) cm. - rakers to 52

② sigus ; 20-40 (43) cm. rakers to 55-56.
Finland Gulf - runs up Neva. - concentrated around Baltic.

C. sardinella - pyloric caeca - Ob 53-74

- C. lucens. Vert. Lena - 52-53 caudal 27.6 - 24.8
- closest to C. autumnalis and C. peled.

C. peled - 56-68 rakers. (Kara 46-58 (53)) Pyasina 41-47
caeca 65-135 Vert. Irtysh 60-64, L. Endyr (Irtysh basin)
56-61 - Lena w/ urostyle 58-62 (32+31)

- masses of. caudal vert. 37.1 - 26.6

lavaretus - In Neva ① low rakered C. l. lavaretus 21-33 (25-29) anadromous
② medium C. l. infra-medrospinatus 27-40 (35)
③ high C. l. infrasp pallasi 39-48 (42-44)

Withler, F. C. 1966. Variability in life history characteristics of steelhead trout (Salmo gairdneri) along the Pacific coast of North America. Jour. Fish. Res. Bd. Can. 23(3): 365-393.

- 2 groups recognized. ocean stream Nov 1 - Apr. 30 = winter.
  " May 1 - Sept. 30 = summer
  8 streams studied 3 of 8 have summer runs.
  (Capilano - Seymour - Coquitlam).
- * - Believed unique habit altho mention of spring & fall runs of Rt. salmon in East Canada & 3 runs chinooks in Columbia R.

* captured by angling - ♀ 56.5 - 76.1% of winter catch > summer
  but Trapping studies on other streams show equal ratio

618 winter run fish 54 (8.7%) 2nd spawning 11 (1.8%) - 3rd
3rd spawners observed from 4 streams.
Cheakamus R. 31.3% of run are repeat spawners.
(of repeat spawners ♀ = 81.5%. ♂ = 18.5%).

302 summer spawners 15 (5.0%) 2nd spawner 1 (.3%) 3rd -
again most repeat spawners are ♀.

winter runs $\bar{x}$ l. 28.4 in. ♂
28.2 in. ♀
winter runs a fraction larger - 28.4 vs. 28.2 ♂
28.2 vs. 26.7 ♀
surprising in that summer run come up 5-8 mo. sooner.
than normal 1-4 yrs. ocean life of winter.
stomach samples largely empty.

* - But in some river system - (Capilano & Seymour - summer run ♂ averages 1 in. larger than ♀ - see table IV.

14 different life history categories (combinations of freshwater - marine life) years in freshwater / years in ocean: 2/2 2/3 3/2 3/3 made up 92 %

yearling smolts 1/0 - only in one river (8.4%) of sample -

- Comparison of data of Waddell Ck. - Oregon & Wash rivers - suggest - in central & south. parts of range - winter runs first enter streams Oct. 15 - Nov. 15 - - both - Dec. Jan. - most in Feb. - then decrease - 2 peaks in Waddell Ck. due to age class dif. (not demonstrated in other streams).

- more ♀ survive spawning than ♂, in all stream studied.

- gairdnerii - irideus

Q11
M56

S. namaycush huronicus -

Hubbs, C. L. 1930. Further additions and corrections to the list of the fishes of the Great Lakes and tributary waters. Pap. Mich. Acad. Sci. Art. Lett., 11: 425-436

p. 426. "It seems clear, despite the contrary interpretation of Jordan (1923), that Salmo gairdnerii Rich. was based on the large, rather fine-scaled steelhead which runs up the Columbia River from the ocean." -- Copeia 121:55 Name of steelhead

"The typical subspecies gairdnerii, as it has several times been observed, differs appreciably from the common coarse-scaled type of the small coastal streams of the Pacific Coast, S. g. irideus. The two forms, however, cannot be regarded as specifically distinct, on the species criterion of virtually complete differentiation (which I accept). The whole group of races comprising the rainbow or steelhead series, with the probable exception of the golden trout, are too alike and too overlapping in their characters to admit the view that any one is completely differentiated from the other."

p. 426 Cristivomer namaycush huronicus Hubbs - Brief characterization given by Hubbs 1929, 155 in Book of Huron Mountain. It will be discussed

in article in Ecology. The former account of the subsp. will have to be regarded as the type diagnosis. - and here quoted: 427. -

"Of exceptional interest is the occurrence in Rush Lake of two kinds of lake trout. The ordinary type occurs in moderate depths in the summer, while the Rush L. trout (C. n. hoyi) occupies the deep trough, which though little more than ¼ mi. wide, descends to a depth of 270 ft. This deepwater trout reaches a wt. of about 2 lb. only, and matures when considerably smaller, at a size when the shallow water type is always immature. It also spawns earlier, in late summer rather than in the fall. So far as known, this interesting little trout occurs nowhere else." -

The most noteworthy physical characteristics of the new form are the broadly U-shaped snout, as seen from above, the small mouth, and the lack of sexual dimorphism.

Idaho F. & G. Dept. 1962.

Studies of two races of cutthroat trout in northern Idaho by Robert C. Averett. - Fed. Aid to fish restoration completion project F-47-R-1

N=145 - Scales 1 row above lat. line:

$\bar{X}$'s - 148.9, 160.9, 161.7, 162.1, 173.0, 174.8

Pyloric caeca - $\bar{X}$'s - 32.0, 32.7, 33.3, 35.7, 36.1, 34.1

Rakers - 18.1 - 18.8

57 pp.

U.S. Dept. Int. 11 pp.
Fish & Wildl. Ser.

Bulkley, R.V. 1963. Natural variation in spotting, hyoid teeth counts, and coloration of Yellowstone cutthroat trout, Salmo clarki lewisi Girard. - Spec. Sci. Rept. no. 460

Yellowstone Lake - 1960 - spawning runs at mouth of Arnica, Pelican, Grouse and Chipmunk Creeks.

Turbid Lake - 1960 - Bear & Sedge creeks - long isolated from Yellowstone - Stocked in 1939-40 w/ 50,000 Yellowstone + no known stocking + natives there originally

Creston Hatchery - Kalispell Mont. 1961
- Taken from Yellowstone L. in 1948.

age group III represent 4th generation - fastest growing fish selected as brood stock - no other selection or mixing w/ other cutthroats.

- floor mouth removed & dried -

			$\bar{X}$
color patterns			
range in spots	Yellowstone L.	15-149	
	Sedge Cr.	9-36	22.4
	Creston		96.9
Teeth -	Creston	18-68	39.8
	Sedge	2-12	5.3
	Yellowstone	0-37	13.5

ours N = 29, 1-27, 13.7

4 Trout no teeth
1 14.8 in. Arnica Crk.
3 3.1-3.2 in. Sedge Crk.

Spots & teeth increased w/ age in Sedge Crk. & Creston hatchery age grp. III $\bar{X}$ = 42.0
I $\bar{X}$ = 14.2

— Yellowstone L. stock mixed by hatchery operations —.

Dif. in color a/ age & sex. +-S-+

"Use of color as a major factor for separating cutthroat subspecies needs reevaluation"

"These comparisons indicate that the Yellowstone cutthroat trout is a very plastic subspecies so far as spotting, hyoid teeth, and body coloration are concerned and that wide natural variations in these characters can be expected"

5 Copies

Report on a trip to ~~the~~ Roxy Ann Lake and Red Canyon, Routt National Forest, Jackson County, Colorado; August 12-15, 1966.

Robert E. Vincent and Robert J. Behnke
Colorado Cooperative Fishery Unit
Fort Collins, Colorado.

According to historical records, the North Platte River basin originally was devoid of trout. In 1950, 20 specimens of an unusual trout were taken from Red Canyon, below Roxy Ann Lake, a headwater tributary of the North Platte. These ~~head~~ specimens, preserved in the collections of the University of Michigan, possess several peculiar ~~characters~~ characters, not readily explained by introductions of any known form of trout.

The stream through Red Canyon originates from Roxy Ann Lake at an elevation of 10,200 ft. in the Mt. Zirkel Primitive Area of Routt National Forest. Roxy Ann Lake is 10 miles by trail from the nearest ~~ac~~ road and we gratefully appreciate the cooperation of Mr. Richard Takes of the Colorado Game

Fish and Parks Department who arranged a helicopter flight to the ~~edge~~ boundary of the Primitive Area, about one mile from Roxy Ann Lake.

In Roxy Ann Lake we caught and observed only Yellowstone cutthroat trout (6-9 in.), ~~stocked as fingerlings last year~~. A small lake at an elevation of approximately 250 ft. above Roxy Ann also contained similar cutthroat trout and some rainbows. Five rainbows, in excellent condition, from 6 to 14 inches were caught. Judging from the success and growth of the introduced cutthroat, it appears that almost no natural reproduction occurs in the two lakes.

In the stream below ~~the~~ Roxy Ann Lake, a series of a most unique trout ~~were~~ was obtained. These trout exhibited a wide range of variation in color, spotting and ~~gen~~ morphology. Several were quadily splashed with gold and crimson with well marked borders on the dorsal, pelvic, and anal fins; typical of California golden trout, Salmo aguabonita. Others appeared to be Yellowstone cutthroats, ~~and~~ Salmo clarkii lewisi; ~~other~~ some,

had the general appearance of rainbow trout, Salmo gairdneri; ~~most specimens~~ but all degrees of intermediacy were present.

~~Preliminary observations~~

A sample of these trout ~~were~~ was preserved and carried out for study. Preliminary observations on the coloration, spotting, and fin markings suggests the present population of trout in Red Canyon ~~are~~ is the result of hybridization between the California golden trout, the Yellowstone cutthroat trout, and the rainbow trout - it is almost certain that they are not an indigenous North Platte trout. An analysis of characters such as number of scales, vertebrae, pyloric caeca, basibranchial teeth, and fin rays should indicate the relative contribution of the parental species to this highly heterozygous gene pool.

The stream through Red Canyon is good trout habitat. The trout are abundant, easy to catch, but not large; averaging 6 to 10 inches. About every one half mile there are waterfalls

or cascades forming barriers to upstream migration. There is an indistinct trail through the canyon, but from all signs, it has extremely limited human use.

The tributary streams of Roxy Ann Lake and the small lake above were observed ~~with a view to~~ to estimate their ~~value~~ spawning potential with a view as to their possibilities as ~~the establishing~~ sanctuary areas for self-sustaining populations for rare and endangered subspecies of cutthroat trout. Natural reproduction in these lakes is severely limited, or perhaps nil, due to fine sand and gravel washed in during snow run-off. Virtually no suitable sized gravel to insure adequate aeration of the developing eggs is available in the inlet streams.

Good gravel is found along the shore lines and ~~there~~ with modification of the inlet streams to direct a scouring current through ~~the~~ some introduced gravel, such high mountain lakes may be made to function as sanctuaries for rare trout or perhaps

grayling.

On the return trail, we observed a population of large, fat, cutthroat trout in Nelson Creek, between Slide Lakes and Rainbow Lakes.

~~Locked gates prevented our access to the lower Red Canyon area where it joins Roaring Fork, which we planned to approach from below.~~

We planned to examine the lower Red Canyon where it joins Roaring Fork, but locked gates prevented our access. The fauna of the headwaters of Roaring Fork near the Continental Divide Trail should be investigated and its waters evaluated as a sanctuary.

Cutthroat trout were collected from Corral Creek, a small tributary in the upper Poudre River drainage, during our return to Fort Collins. These specimens will be used in a comparative study of cutthroat trout populations presently found in the South Platte basin to determine the status

of the endemic east slope cutthroat, *Salmo clarkii stomias*.

Insert under Methods

Orthodox taxonomic methods are used in this paper in preference to numerical taxonomy since many of the forms discussed here are, even now, poorly known and their characters have been studied but little. For this reason, we believe with Michener (1963, p.159) that orthodox taxonomy should precede numerical taxonomy, "until most of the species involved....are recognized". Lack of time in which to apply numerical methods was a further factor involved but ultimately, of course, the phenetic affinities of the species discussed should be studied by machine analysis.

Wyoming Dept. Fish + Game
Progress Rept.,
serology 7 Salmo

Darryll Bingham : "Serological
Variance in Wyoming Cutthroat Trout"
Western Sec. St. Game + Fish Comm.
Tucson Ariz.
June 6

9. Oncorhynchus kamloops Jordan, Forest and Stream, 34 (19), 1892: 405. Kamloops L., B.C.

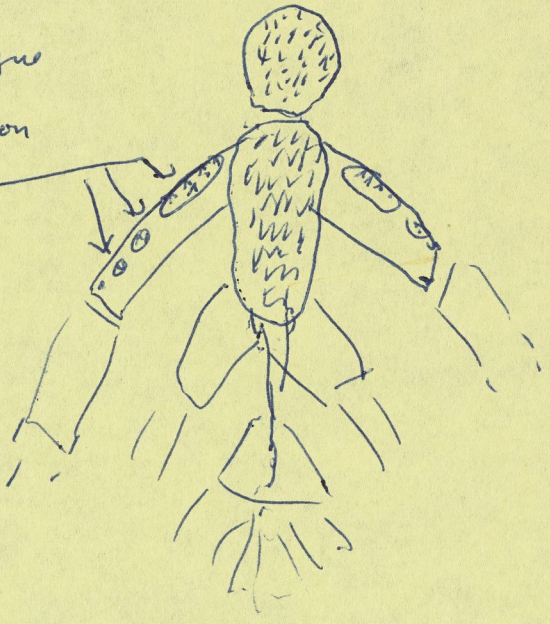
10. Salmo irideus stonei Jordan, Thirteenth Bien. Rept. Calif. Fish Comm., 1894: 142. McCloud R., Calif.

11. Salmo gairdnerii shasta Jordan, Thirteenth Bien. Rept. Calif. Fish Comm., 1894: 142. McCloud R., Calif.

Chapman, W. M. 1948.

The osteology and relationships of the round herring Etrumeus microdon Temminck and Schlegel. Proc. Calif. Acad. Sci. 26 no. (2): 25-41.

Fig. 10 - - teeth covering tongue basibranchial & on hypobranchials



suprabasal bone poorly developed and edentulous in Clupeidae covers 1st 2 basibranchials & completely covered w/ teeth
"There are small patches of teeth or separable bony plates on the hypobranchials of 1st gill arch

---

. . . . The osteology and relationships of the Microstomidae, a family of Oceanic fishes, ibid: 26 no.1 : 1-22

- Günther (1866) - put all fam. w/ Salmonidae -

pyloric caeca present
- No especially close relationships w/ salmonoid fish
Nansenia agrees w/ Opisthoproctoid fishes by lacking dentition on premax & max - palatines & pterygoid vomers - considered in suborder Opisthoproctoidei - Diverge from Argentinids such as tongue dentition, loss of mesocoracoid - reduced vert. & branchiostegal rays but nearest known relative is Argentinidae

Bathylagidae - more extreme than Microstomidae - lose tongue teeth - 1st basibranchial plate - lose pharyngeal teeth - lose air bladder - - Macropinnidae & Opisthoproctidae more ~~bizarre~~ bizarre

Stokell & Stokell

1937 – Lake Taupo 61.1 vert.

(Russian R. origin – southerly S. of
w/ lower no. –) – Snyder – Klamath.

R.R. Miller found a single bicuspid tooth in one spec. (120mm ♂)

Simons - Letter IV: 9:64 - Calif. golden trout 2n = 58

Nikolsky (1963) - predatory species more pyloric caeca - neg. cor. between gillrakers and caeca. -

Fossils - Uyeno - Lawis

Northcote (1960)

Calca no.

definitive - no.

Burnstock 57

Quart. Jour. Micros. Sci., 100 (2) (no. 56, 183-98)

Vladykov, (54) - environmental influence.

Vernon (1957)

— clarke — see

ke Tullett

62-65 (63.9). In 1932 with warmer water, the vertebrae number increased to 63-67 (64.5). This is the highest mean value yet reported in the literature for any Salmo. Mottley (op.cit.) listed a count of 63-66 (64.4) for 25 Kamloops from Cottonwood Lake. This is the identical range and mean reported by Needham and Gard (1959) for rainbows from the Rio Tabacatiado in Mexico and the highest reported for any Salmo from a natural environment.

Canadian Rainbows -- Origin and Distribution: Rainbows are the dominant trout of the Fraser River system. The coastal cutthroat occurs only sporadically in the tributaries of the lower Fraser (Dymond, 1932). The cutthroat described by Dymond (1931) as Salmo clarkii alpestris from tributaries of the Fraser and upper Columbia is of the interior lewisi type. The distribution of this cutthroat in the Fraser tributaries is most plausibly explained by headwater stream transfers from the upper Columbia tributaries. Mottley (1934a) and Lindsey (1956) pointed out that large areas of the Kamloops trout range were inundated by large bodies of water during the Pleistocene. Both the rainbow and cutthroat probably were present at that time. The disappearance of cutthroats from the upper Fraser may be explained by a gradual hybridization and assimilation into a rainbow population which was better adapted to the changing conditions. Perhaps the higher scale counts and the tendency toward 9 pelvic rays may be attributed to such early introgression of cutthroats into the rainbow gene pool.

Mackenzie River System: Rainbows were known to be native to the Athabasca River system of the Mackenzie drainage in Alberta. The only taxonomic work to appear on these trout to date seems to be misleading. Rajkov (1927) reported two types of rainbows from the Athabasca system in Jasper National

- Sobal & Sneath

Salmo gairdneri

- synonymy - correct -

- Fossil evidence - Miller - Leith -
  - La Rivers

- Discussion - gillrakers (Reshetnikov - Svvatkin - Mc increase in 3 yr)
  - caeca - Nikolsky -

- Stomias - Fowler (1912) - Canadian R. -

- Independence L. - Chapman - see also Gorline -
  - new illustration

- Golden trout - Salmo aguabonita Cutthroat

- Southerly - S. gairdneri - lower vert. - Snyder Klamath -
  Stokell - Stokell - (1937) R. Taupo 61.1 vert. (prob. 1 too low) - Russian R.
  origin - see Trout of Taupo - Heintz -

- clarkii : Katspoodl R. = N. Fork Lewis R. - Washington

- regalis : - Gradient (2 pl) - 3 series
  - D.E.C. - sub genus
  - sub sp. rainbow -
  - Cordone -

- apache - basibranchial teeth -

- Chromosomes - Simon. - cutts - golden trout

- Vladykov -

ЗАМ. Кому — смерть мужьям

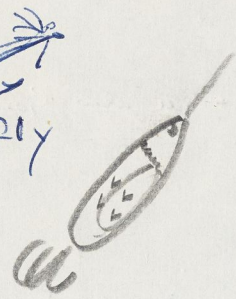
НОВОГО муж

of the

Ничего

Death of the husband.

смерть кому мужьям



fly

смерть мужа

кто

дать мужу.

I whom. me my.

the her.

they them

have [hɔ:v]

to. translate

patient

предприятие.

-11 C° 32 20 22. 10 20 22

12° +10° F.

-8° 16 14 17-18° F

ОВАТЬ - to feel

Я ЧУВСТВУЮ

Ну-с.

San Francisco - 60° F. - 70° C

+15-16 °C · 20-22°C

Los Angeles - 80°

+25°C

70 10

-40°C

n e

Nikolsky (1963) stated belief that predatory species have more pyloric caeca and presented evidence that in species of the Caspian shad (Caspialosa) there is a negative correlation between numbers of gillrakers and pyloric caeca.

tried by t - not such good correlation among salmonid fish for us.

Coregonus - Salmo - O. -

Rainbows — 541 | 42

mykiss — 8 | 3

24

32 573

32

541

549 | 45

goldens. 137 | 7

686 | 52

686
549
137

1192 | 133

cutts 1878 | 185

185
52
133

185
52
3

	N. specimens	N. samples
Rainbows (mykiss)	541 8	42 3
goldens (Calif. + Arizona (20))	137	7
Cutthroat (+ hybrids)	1192	133
Totals	1878	185

CA J 1956

S. Tk. Kern 16

Timoshina, L. A. 1972. Embryonic development of the rainbow trout (*Salmo gairdneri irideus*) at different temperatures. Journal of Ichthyology 12: 425-432.

Edminster, F. C.

The Effect of Reforestation on Game. 21st Amer. Game Conf. 1935 : 313-318

Hartman, G. F. and C. A. Gill 1968.
Distribution of juvenile steelhead and cutthroat trout (*Salmo gairdneri* and *S. clarki clarki*) within streams in southwestern British Columbia. J. Fish. Res. Bd. Canada, 25(1): 33-48.

1964 - Кунджа - Salvelinus

leucomaenis (Pallas) ● Озер южного сах. ● :164-167

In: Озера Юж. сах. и их ихтиофф. Изд. Моск. ун.

Savvaitova, 1961- Zool Zhur. 40(11): 1696-

l. l. 123-134 (127.2) 120-128

Meristic characters of S. leucomaenis

Kamchatka N N Sakhalin

branchiostegals N
R. 11-13 (12.3 13
L. 9-12 (10.7)
1 3 4

Stocks 120-125 127.2

gill rakers	15-20	18.46	13	42	12-20	17.20
vert.	62-64	62.62	13			
caeca	16-23	20.00	11	36	11-23	16.34
D.	10-12 (10.6) branched				9-11	(10.5)
A.	8-9 (8.8)				7-9	(8.2)
P.	12-14 (12.9) ↙ pect.				11-14	
					17-20	12-15 (12.8) (13.8)

McPhail - Dry Ck. (Yukon) rakers (18). Caeca 13-18 ((16)

vert. 62-64 (63)

- Northern malma - 18-24 $\bar{x}$s 21-22 vert. 65-71 $\bar{x}$s 67-68

caeca - 21-36 (26-28)

Southern - rakers 14-20 (15-19) vert. ($\bar{x}$s 63-65)

caeca - ($\bar{x}$s 20-35)

alpinus - ① East arctic

$\bar{x}$s (25-29) (66-68) caeca (36-46)

why not malma ??? - ② west. - Bering (22-24) (66-68) very few [3] (23-35) ←

③ Bristol Bay & Gulf -

(23-25) (67-68) (43-53)

Table I

Group	No. of specimens	Standard length (x̄)	Museum number	Locality	Date of collection

Mighell, J.L. and J.R. Dangel. 1975. Hatching survival of hybrids of Oncorhynchus masou with Salmo gairdneri and with North American species of Oncorhynchus. NOAA Fish. Bull, 73(2): 447-449.

Craig, P.C. and V.A. Poulin. 1975. Movements and growth of Arctic grayling (T. a.) and juvenile Arctic char (S. a.) in a small arctic stream, Alaska. J.F.R.B.C, 32(5): 689-697.

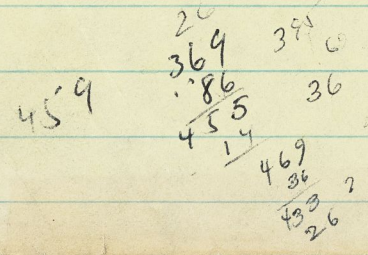
Bustard, D.R. and D.W. Narver. 1975. Preferences of juvenile coho salmon (O. k.) and cutthroat trout (S. c.) relative to simulated alteration of winter habitat. JFRBC 32(5): 681-687.

Flick, W.A. and D.A. Webster 1975. Movement, growth and survival in a stream population of wild brook trout (S. f.) during a period of removal of non-trout species. JFRBC 32(8): 1359-1367.

Regier 76 - JFRBC 33(5): 1213-1232

Hoar, 1976 - " " " : 1234-52 smolt evol.

Tessop 76 " " 33(4,1): 529-33 native-non native salm return



Botorf

Iron papers folio Q1 S35

Q11 U7 Science 188 : 107-116

Utah Acad. Sci Arts Lett 51 pt 1 : 66

65 42 (II) 280-83

73 50 pt 1 Holden STR Nucleus

A Amer. Mid. Nat. 1957 QH1 A35 58 : 232-56

63 70 : 257-90

109 : 83-92 QH1 A5

QL 614 I24 - Ichthyologia Beograd 1975 5(1)

Rev. Roumanie Biol. Ser. Zool. 17(5) 1972

(1) Folio GB651 basement Snr cost

Int. Assn. Hydrobiol. I 58 : Publ. 96

[Minn. Volunteer

[River Ecology ed. B. A. Whitton

Proc. Japan Acad. 50 : 507-11

J. Range Mgt.

J. Soil & Water Cons

Alwyne Wheeler >5 Fishes of world

Rangeman's Journ. 3(2) -

(B) origin genus - English 1968 - Proc. Amer. Philosph. Soc. 112 : 170.

folio TA1 C452 - Civil Engineering 3(2) : 6 3rd fl.

- Arnoldia 1974 6(25) Tilapia Jubb

QK 479 A7 Outdoor Life June 1903 : 397-400 Trouting on the Laramie -

(C) folio SK1 C8 - Powder - 85% natives - caught 38 native trout in Laramie 60% rainbow 40% brook

(2) Idaho Wildlf. Rev. 1970 Mar/Apr. - Gebhards, Vanishing Stream

Hydrobiological Journal 1971, 72 73(6) Folio SK387 A33

Hydrobiological Annals (Annales d'Hydrobiologie) 1975 6(2) : 145-156 - carca.

touch up, add references (select which ones) - grazing touch up - modified, reasons why dropt. (RM Sta. Res. ? - Gila Trout Recovery Plan)
- lack of native trout mentioned in EIS USFS Colo -
Allendorf's pop. - MDH Apache trout -

Gila trout recovery team: Gila Trout Recovery Plan Outline Jan 19, 1976.

Dr. James Johnson - Colo-Wyo Chapt. ACS March 76 -
A proposed change in livestock grazing on National Resource Lands and its effects on aquatic and riparian communities. - - disproportionate impact utilization in riparian vs. upland range. " stream sacrifice area - raised question on effects of rest rotation for woody riparian veg.

Grove, A. (ed) 1976. Stream management of salmonids. Supplement to Trout magazine, 17(1): 31p.
- livestock - cut bank - gully problem - solution? treatment?
- mitigation pond - 20 ft. 5000 1000 ≈ 2.5 acres 2 mi. stream = 5 acres
500 lb/acre.

Ostariophysi - Gonorhynchiformes - Rosen & Greenwood 1970 Amer. Mus. Novit. 2428.
Greenwood - Egypt fossils - J. Zool. London 1972 168: 503-19.
Nei Genetic distance 1972 Amer. Nat. 106: 283-392 + 1973 J. Mol. Evol. 2: 323-28.
Greenwood 74 evol. sp. flock Bull. Brit. Mus (Nat. Hist.) Zool. Spec. 6,
Univ. Fla. Dept. Environ. Eng. Sci. Rep. ENV 07-75-1 Biol Control crayfish
Turner 74 pupfish Evol. 28: 281-94.

P.H. Greenwood 75 A History of Fishes 3rd ed.
See Rosen's review of Briggs 75 Quart. Rev. Biol. 50: 69-70.

Practical knowledge — max. size
- age at maturity - fecundity

Evol. - Adaptive -

CJFAS (12) - stickleback - adaptive morphological: feeding type (pelagic: benthic)

Proc. Knowledge - Coho. - Nickelson et al.: 2443-49 -
- stocking hatchery presmolts increases no. juvenile
- no change in returning adults - Lut. * unstocked streams
(- some no. adults (all wild vs. hatchery + wild)) -- produce more young

Simons McDaniel Hasbrouck

- Cunjak & Power: 43 (10): 1970-81 - winter habitat brook trout
- slower water - more cover - less aggression - 'packing' - groundwater
- 1988 - Hearn & Kynard salar x gairdneri O, I interactive

- Gore, J. A. (ed.) 1985. The restoration of rivers and streams: theories and experience. ~~Butterworth Publ.~~ Ann Arbor Science book: 280 p.
- chapter by Henderson and Ohmart re riparian area in Grand Canyon & restoration of area

Kevin * · Zooplankton sp. - lakes (endemic) w/ & a/o Mysis CJFAS. 43(2): 420-
- 43(4) - smelt predation on whitefishes 43(5) - bird review

S. alpinus Greenland - 3 groups - incipient sympatric speciation
- Riget - Nygaard, Christensen 86 - 43(4): 985-92.

SRL
1 - Orth, D. J. and O. E. Maughan. 1986. In defense of the instream flow incremental methodology. CJFAS 43(5): 1092-93
2 - Mathur, D.; W. H. Bason; C. A. Silver 86 -
Reply to "In defense of..." ibid 1093-94.

AK
- Murphy et al 43(6) - clearcut - buffered - old forest stream
- sunlight + debris (cover): best

- Rivanna R.

- Front R. chan (N).

- brook trout one of most widely studied spp. but ~~life history~~ ecology, physiology, but accurate classific. of local trout and relations yet to be accomp. - In ex. the two distinct subsp. involved? Have should Aurora trout of Silver Trout & Woodward?

- Distrib.

- unusual - Mich. - grayling
Ohio - Garlick.

- Finish w/ on your read.

- sea trout - Cape Cod - sea winter after spawning

- *unusual - spring run → sea north - sea - summer - return with or fall → sea - in-out - same river.

* S. & E - said repeated many times Alabama - only NE Georgia - NW S. Car. -
Iowa - Ohio - Mich.

- sea trout - brook trout 2 sp.

Devil & Daniel Webster brook trout > Daniel Webster
- Mitchill 1815 - 100 < 1 lb. largest 4½ lb

- Stenekin Penn. St. et al 1981
8 samples Penn (3) N.Y. (2), Tenn. (2), Grt. Smoky Mtn. N.C. N.P. (1)
- subsp. ? - Va. w. Va.

-suggest Roanoke - Potomac

Dr. Bethke:

After your technical review, we shall go over these ~~manu~~ articles in the fashion shown by this example

Jester X

Jester, Douglas B. 1973. Life history, ecology, and management of the smallmouth buffalo, Ictiobus bubalus (Rafinesque), with reference to Elephant Butte Lake. New Mexico Agricultural Experiment Station Research Report 261:111p.

Mirza, M. & A. Rashid Al. Wan. 1978 (recd 1980). Schizothorax skarduensis, new species (Pisces, Cyprinidae) a new fish from Pakistan. Biologia (Lahore) 24(2): 199-204.

Bio. Abst.

Samples from each lot of eggs should be taken for chromosome studies, using the following procedure:

1. Fertilize a sub-sample of approximately 2 oz. of eggs from each female, keeping the eggs from each fish separate.
2. Incubate separately in cheesecloth bags and after 32 temperature units have been accumulated, place the eggs in a fixative (fixative: 1 part glacial acetic acid, 3 parts 95% alcohol).
3. The developed eggs from each female should be preserved in a 4 oz. bottle to which the fixative is added to cover the eggs after placing the living eggs in the bottle.

About 5 females from each species should provide some sort of minimal sample. RS.

Salvethymus svetovidovi gen. et sp. nova – новая эндемичная рыба из подсемейства лососевых (Salmoninae) из оз. Эльгыгытгын (Центральная Чукотка)

Chereshnev & Skopets, 1990. Вопр. ихтиол. V. I. 30(2): 201-213

L. Elgygytgyn – formed in meteroite crater 3.5 mil BP
once higher level → K-lyma (now to Anadyr) ca. 500 m elevation
$\bar{x}$ depth ca. 100 m, max d. 179 m, area 113 km²
2 m ice cover – only 2-3 months ice free, some years ice not completely gone
max surface temp. 6-7°C – at 50 m 2-3°C
transparency 40 m.
other fishes. S. boganidae, S. elgyticus Thymallus arcticus mertensi
Cottus cognatus

(57.8) (54.1)
50-70 specs, 44-63 taken 105-119 d.l.
D III 7-9/8, A III 7-9/8, P I,12-14/Σ, V II,7-9/8.
Bran. – 8-11 (9.4) R 9-12 (10.2) L
vert 55-59 (56.3)

- lit. - white
  - slides
- Little lit. on problem fishes
  - muckon soils, waters - - - none specif. in lit
  - U.S. - 150 yrs greater than Mediterranean 6,000-7,000 yrs.
    Dust bowl, open range-
    - S.C.S. - channelization, pinpoint phyte control
      - cut rip. / rip/rap
      - war - armies - after ever - - -
    - Bureau Crew, Dur Rec, S.C.S., TVA.

2. 2 spec - end. sp. - game fish

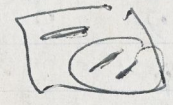
Colo. R. - -

Col. Crk.

Fall ♀ - spots belly

Poudre Pass 1 adult 7 x 01 8/26/—

Ovando - 2 larger downlers (Poudre)



La Poudre Pass Crk - below bridge at La Poudre Pass Ranger Sta.

8/26/88 coll. Fischer (1. 223mm S.L. 261mm T.L.

typical cutt - spots (smaller than eye pupil) - above - below lat. line over body - but rel. sparse - few large spots on caudal peduncle no spots abdomen or on top head.

falls? bonner specimens (2-6): 47mm, 53mm, 44, 48, 46, 47 T.L.) 44, 47, 47, 48, 48, 53 (48.)

willow crik. rel. large Y.O.Y. ca. 47 2 mos. since emergence 2 mos. crik. bridge

P 9; 8/13 (5/9) 21 14 parr marks = cutthroat bands 16 — 000,1,1,1 - spots not yet formed.

more pleuritics than stamens but few large spots - scales, rakers (gill), teeth - ?

S. a. l. l. 49/50 Lat. Rec. 206

caeca 36 - much fat

stomach gorged w/ food - guts, grasshoppers

Ovando Crk. c 1/4 mi. below Sulzer L. Colo. R.

8/9/88 - Fischer w/ fly rod.

238, 273mm TL.

largest specimen greenback-like spotting - but more numerous close-set than typical - rel. med. large over sides body - orange-red hue ventral - other specimen more hybrid spotting - heavily spotted on body - mod-small all over body & on top of head - largest on peduncle - over-whel. cutthroat. but definitely not pure. x influ. - Hatch. - Dream L. ?

		teeth	P	46	caeca
238mm →	8/13 (5/6) 21 11	4	9	184	34
273 →	7/11 (4/5) 18	6	9	196	39

Fall R. above Cascade Falls, off Fall R. Rd.

N=2 254, 248 mm T.L.

one med-small spots all over body, other - rel. large spots all over body on ventral region - no spots on head.

8/12/20 (2/0) P/9 trem/9 48/179 40 - seems 2 ~~or more~~ dif cutts ancestors

8/13/21 (1/0) P/9 2 48/182 34

The Loch 1987 coll. - Fischer

TL - 246, 223, 235, 317 mm

first 3 large, sparse spots - green back - like largest RB x cutt hybrid spotting

8/13/21 (5/4) P/9 trem/2 46/174 37 mayfly

8/13/21 (4/7) 9 6 43/168 39 chironomids green head like

7/14/21 (4/6) 9 4 39/165 41

hybrid spots 7/14 (4/8) 9 1 45/183 29

~~37~~

Webster, D. W. and W. A. Flick. Species management. Pages 40-47 in W. King (ed.). Wild trout management proceedings, Trout Unlimited.

Sterile fish references

Donaldson, E. M. and G. A. Hunter. 1982. Sex control of fish with particular reference to salmonids. Can. J. Fish. & Aquat. Sci. 39: 99-110.

Donaldson, E. M., G. A. Hunter, F. W. Goetz, and P. R. Edgell. 1982. Production of all female and sterile coho salmon and experimental evidence of male heterogamety. Trans. Am. Fish. Soc. 111: 367-372.

Jalabert, B., R. Ball, and B. Chevassus. 1975. Preliminary experiments on sex control in trout: production of sterile fishes and simultaneous self-fertilizing hermaphrodites. Ann. Biol. Anim. Biophys. 15(1): 19-28.

Solar, I. I., E. M. Donaldson, and G. A. Hunter. 1984. Optimization of treatment regimes for controlled sex differentiation and sterilization in wild rainbow trout (Salmo gairdneri) by oral administration of 17α methyltestosterone. Aquaculture 42: 29-139.

* Mischke, Warren. 1985. Sterilization of fish for management purposes. Proc. Colo.-Wyo. Am. Fish. Soc. (in press) - Wyoming Game & Fish Dept., Box 71, Rock River, WY 82083

Goudie, C. A. 1984. Tissue distribution and elimination of radiolabelled methyltestosterone administered in the diet to sexually undifferentiated and adult Tilapia (Oreochromis) aurea. Ph.D. thesis, Auburn Univ. (90% eliminated 24 hrs, 99% in 21 days -- re. human consumption)

↓

Can. J. Fish. Aquat. Sci. 1988 45(8): 1490-94

Parkinson — sterile kokanee ~ longer life, low survival after stocking.

OFFICE MEMO

TO:

Date

FROM:

SUBJECT: Elizabeth West
borrowed on Feb 17, 1986

REMARKS:

1 Appendix B Salmonid Habitat Criteria of Report of Engineering and biological literature pertaining to the aquatic environment CSU 1984

2 The effects of stream alterations on Salmon and trout habitats in Oregon. Oregon Dept. of Fish + Wildlife 1985

3 Habitat disturbance and recovery
California state University, 1981

Recruiting 9/19/75 Sorting operation

(These cutthroat moved to West Lake with speckle punch officiated)

Native	Smallmouth bass
9.5 - 4.1	6.3 - 4.6
11.2 - 7.4	9.9 - 5.5
12.6 - 6.2	
11.8 - 6.7	
11.4 - 5.9	
10.4 - 5.4	
9.6 - 4.6	
9.8 - 4.6	
10.2 - 4.6	
10.3 - 5.2	
11.0 - 6.9	
9.4 - 4.0	
9.7 - 4.4	
8.8 - 11.8	
~~[illegible]~~	
10.3 - 5.2	
9.2 - 4.4	
9.6 - 7.1	
10.5 - 5.8	
7.1 - 1.9	
8.6 - 3.1	
10.3 - 5.1	
9.3 - 4.0	
10.0 - 4.5	
9.7 -	
9.6 - 4.2	
10.5 - 5.1	
10.3 - 5.2	
9.5 - 4.0	
9.5 - 4.1	

Total S.R. cutthroat moved to West Lake - 83
All speckle punched

WDR

ADDISON-WESLEY PUBLISHING COMPANY, INC., READING, MASS. A-W Datafarm® 20V

DOWDY LAKE 9-16-75 rehabilitation

Cutthroat TROUT

length(in)	weight (oz)	LENGTH	WEIGHT
9.8	4.6	10.0	4.5
9.8	4.6	10.0	4.7
10.2	5.4		
7.4	2.0	||| ||| ||| ||| cuts	
10.1	4.8	8 SM bass	
9.6	4.3	L 12.0	1 3/4 lbs LV
9.7	4.3	L 22.5	5 lbs Ad
10.1	5.0		
9.5	4.0		
10.0	4.7		
10.0	4.4		
11.8	8.8		
9.7	4.4		
9.8	4.7		
10.5	6.3		
11.7	8.7		
10.8	6.5		
9.9	4.6		
9.4	4.3		
10.1	5.4		
10.2	4.8		
10.4	5.6		
9.9	4.5		
9.4	3.9		
9.9	4.6		
9.1	3.5		
9.9	4.6		
9.8	4.5		
9.8	4.8		
10.1	5.0		
10.8	6.8		
10.2	4.9		
9.3	4.2		

Lengths of SM bass on scale sample envelopes

These fish picked up by seining crew and are in addition to those measured or noted elsewhere.

All these fish were killed by fish toxicant

WDK

Mosquito Control

U.S. Bur. Fish. ~~Fish. Comm.~~ Rept. 1922 -

Progress Biol. Inq. append. XIII : 24
"Fish as agent of mosquito control" - S.F. Hildebrand w/. U.S. Pub. Health - only Gambusia mentioned

- Moore, J.P. - Use of fishes for control of mosquitoes in northern freshwaters of the U.S. - Appendix IV 60p. (doc. 923)
- Sunfish, bluebanded, common mudminnow, killifish -

+ Hildebrand, S.F. 1918 - Fishes in relation to mosquito control - Appx. IX Rept. U.S. Comm. Fish. 1918 - 15p.

+ Seal, W.P. 1908: Fishes & mosquito problem. Sci. Am. Supplement vol. 65 # 1691 - 351-52.
1910. Fishes in relation to mosquito problem. Bull. U.S. Bur. Fish. vol. 28 pt. 2 (1908): 831-838.

- See other Bur. Repts. (Ent. + Biol. Inq.) mainly concerned w/ plants & mosquito & Gambusia

Krumholz, L.A. 1948. Reproduction in the western mosquitofish · G. a. and its use in mosquito control. Ecol. Monogr. 18 : 1-43.

Goudie. Cheryl Ann. 1984. Tissue distribution and elimination of radiolabelled methytestosterone administered in the diet to sexually ~~immature~~ undifferentiated and adult tilapia, Tilapia (Oreochromis) aurea.

Ph.D. thesis Auburn Univ.

after feeding of methyl. steroid.

body levels decreased 90% in 24 hr. and 99% after 21 days. - In adults, 90% loss in 4 days, and 99.5% decrease in 21 days.

- No health hazard - further dilution w/ growth (fr. <1 gm to 1 kg ex.).

COLLEGE OF FORESTRY & NATURAL RESOURCES
MICRO-COMPUTER LAB
NEWSLETTER
April 9, 1986

UPCOMING SEMINARS:

LOTUS II - This seminar will pick up where the last LOTUS seminar left off. Participants should have some prior experience with LOTUS including starting up and entering data. This seminar will take a hands-on approach. Topics to be covered include:

-- Basic Operations
-- Formulas & Graphics

Time: 12:00 p
Date: Wed., April 16

SOFTWARE & HARDWARE NEWS:

The lab has acquired a video projector (Electrohome) capable of projecting directly from a computer onto a large screen. This projector is available for general class use in the lab. Come on in and take a look.

AutoCAD has arrived and is now operational. This Drafting and Graphics program is available for use on the PC-8's. AutoCAD can be used for preparing graphs of any sort. Other drafting capabilities include:

-- Interior design and facility planning
-- Architectural drawings
-- Work-flow charts & organizational drawings
-- Plots & other representations of mathematic & scientific functions
-- Drawings for electronic, chemical, civil, and mechanical engineering applications.

CURRENT HOURS:

A schedule of class periods is posted on bulletin boards located outside RM 107A and in the atrium outside the lab. Below are the hours the lab is currently open for use.

--SCHEDULE--	
Monday	8:00 a - 8:00 p
Tues.	8:00 a - 8:00 p
Wed.	8:00 a - 8:00 p
Thurs.	8:00 a - 8:00 p
Fri.	8:00 a - 5:00 p
Sat.	------CLOSED-----
Sun.	4:00 p - 10:00 p

Trout Article

- At. salmon N. Engl. —

Why end. coho - steelhead when AK surplus -

- 1970s → Ocean Cndn hatchery prod, invest. ↑ juggernaut - snowball downhill, bigger, faster momentum hand to river, revenue

Nov
- fisheries

- 1970s - salmon, steelhead Col. R. & trs

- steelhead rept NMFS
- Chapman -

Kalama R.

— Osprey

Reiersdichler

— Purpose save natural diversity
range adaptiveness
replicability - hatchery overwhelm

supplementation ? to hatch. -

N. Umpqua coastal cutt

- Can't solve today problem with hatchery + Thinking that Technol. fix causes the theory evol. - Many theory evol. - minor variation

Col Trout steelhead symp.
Legislators
- legislation ban banning prop. of nonnative !

T.U. anglers wild vs. hatchery 1974 Royle Kalama R.

hatch selective
- disease
- behavior (bold, timid)
- timing, spawning, age at
- fecundity
- diet -

— impact straying - stock one strays (stocked in) home to south (wild st

- increase exploitation wild - can't separate if types

- residualizing ⟷ mix anad. - resident pop.

- disease -

Gidrobiologicheskiy Zhurnal, 1970, No. 3: 23-28

(3)

CONTENT AND DYNAMICS OF ORGANIC MATTER IN THE VORONEZH RIVER

I. M. Rozinoyer, A. P. Saprykina, S. M. Poroyskaya, and
L. I. Bakina, Voronezh Institute of Technology

Reassigned to Blanken

Abstract

1. Volatile fatty acids and reducing sugars are predominant among the organic substances investigated in the Voronezh River.

2. The following seasonal changes were established in the organic matter content of Voronezh River water: [redacted] (i) amino acids - from 9.0 to 4.16 µg/liter (maximum in the summer and fall, minimum during the flood period); volatile fatty acids - from 6.2 to 34.2 meq/liter (maximum during the summer-fall low-water period, minimum in the winter), mostly acetic acid, somewhat less butyric acid (almost no propionic acid); humic acids - from 1.9 µg C/liter (during the winter low-water period) to 51.9 µg C/liter (during the spring flood). The amount of reducing [redacted] sugars scarcely changed (a slight decrease in the winter).

3. The indices of permanganate oxidizability and organic carbon vary from marker to marker. Their concentration increases downstream owing to pollution by household and industrial effluents.

Gidrobiologicheskiy Zhurnal, 1970, No. 3: 37-43

(5)

PRIMARY PRODUCTION OF PHYTOPLANKTON AND ROLE OF BACTERIA IN THE DESTRUCTION OF ORGANIC MATTER IN LAKE VYALOZERO (KOLA PENINSULA)

V. G. Drabkova and G. I. Letanskaya, Laboratory of Lake Science, Leningrad State University

Abstract

1. The primary production of phytoplankton in the 0 to 6 cm layer of Lake Vyalozero during the period under study ranged at the different stations from 1.0 to 1.36 g O/m^2 (recalculated for the entire lake - 35 metric tons/24 hours). The daily P/B ratio was 0.3 on the average.

2. The bacterial population of the water ranged from 350,000 to 850,000 kl/ml and was distributed fairly uniformly over the expanse of the lake. The most polluted region is the Udogub cove which affects the adjacent water.

3. There is a relationship between the amount of bacterial biomass destroyed and produced. The difference represents the actual number of bacteria that take part in oxidizing the organic matter. In the southern part of the lake where the destruction is most intense, the production of the microbial biomass is greatest - about 60 mg C/m^3.

4. The amount of organic matter destroyed, as calculated from the production of the bacterial biomass, is similar to that in dark bottles (50 and 55 metric tons C/24 hours for the entire lake).

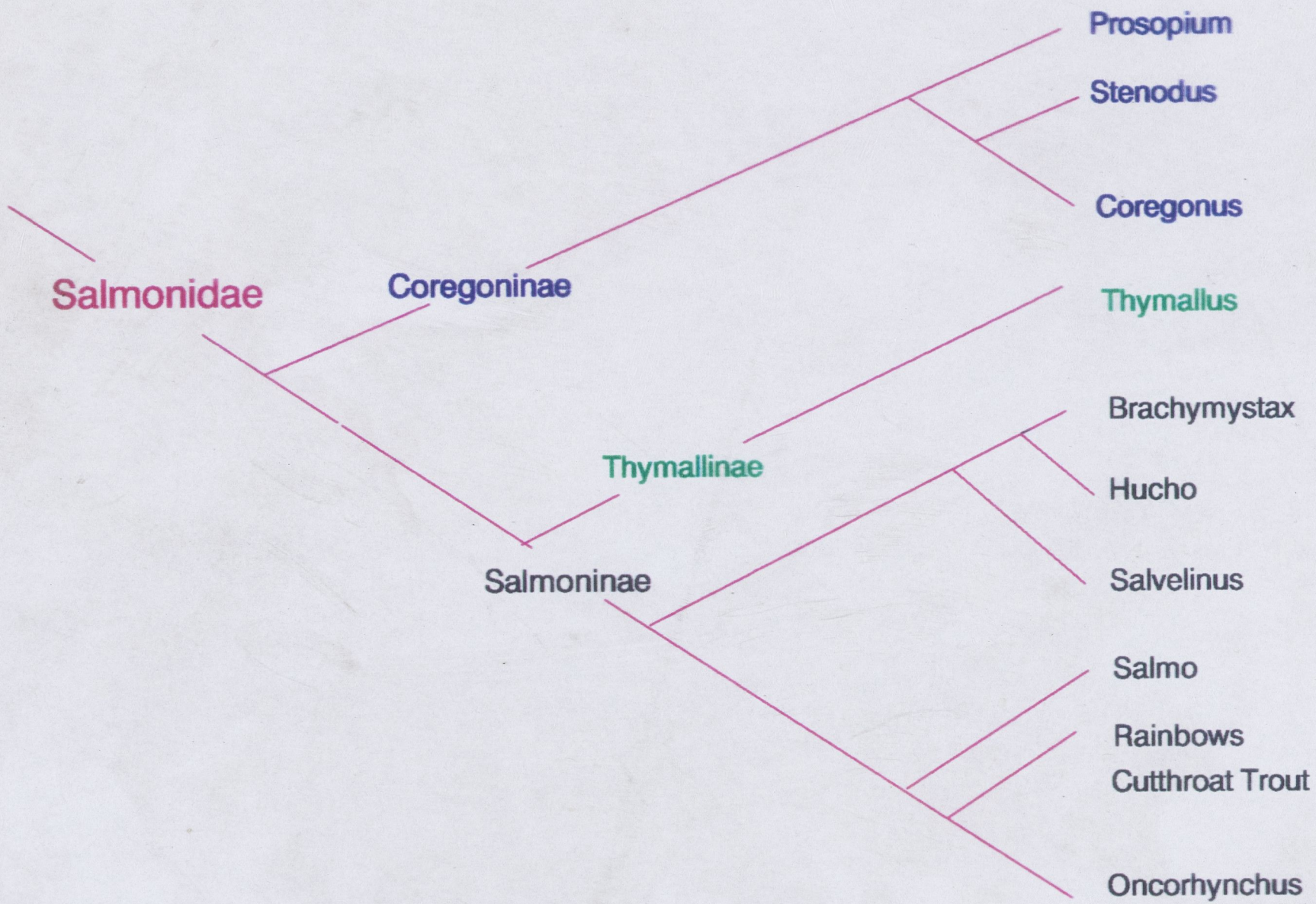
5. The benthic deposits of the lake absorb a substantial amount of oxygen (0.5 to 1.5 g O/m^2/24 hours). They oxidize approximately 35% of the total amount of organic matter oxidized in the lake.

6. About 40% of the organic matter in the lake is of autochthonous origin.

Strains, Genetics,
Tex. redband-temp
Emerald L.

reprints Air Force letters

candidate, Dick Cheney, complained about the Clinton administration's creating national monuments..."willy-nilly all over the West". This appeal to local control vs. big brotherism of the federal government is a popular political theme in the West. What is ignored in such appeals to the local anti-federalist ~~redneck element~~ sentiment is that sometimes national interest sometimes must override regional provincialism on some matters of importance to the ~~whole~~ country as a whole. In the long term, ~~having~~ having a national monument ~~forced~~ on a region proves highly beneficial.


Prosopium
Stenodus
Coregonus
Salmonidae
Coregoninae
Thymallus
Brachymystax
Thymallinae
Hucho
Salmoninae
Salvelinus
Salmo
Rainbows
Cutthroat Trout
Oncorhynchus

Letter, Apr. 25, 54, W. J. Berg & B. E. Bentley
~~Salvatierra Tabajo~~ Landa Yetsa
to Carlos Yrureta goyena.

Re. Genetic similarity of San Pablo Martir Trout

17 alleles of 38 gene loci

* Unique allele at CK-2 (never found before)

+ LDH-1 - allele, heretofore known only for Rio Mayo

Table 1: 17 polymorphic loci

	San Rafael	Baja Santo Domingo	Martir Crk	Sonora Rio Mayo	Chihuahua San Luis	Eel	Gualala	Hatcheries Shasta	Pit
CK-1	100 70								
CK-2	115	500	.154	000					
	100	500	.846	1.000					
GPD-1	140 100 80								
IDH-2									
" -3/4									
	150		.028		1.000				
LDH-1	100		.972						
MPH 3-4									
PK 1-2									

Some big dif: San Rafael - Santo Domingo
.86
.4 - .14
.6 - .56
.25 - .44
.75

Pos-2 100 85

P2-112

List of 1983 samples & populations used for comparisons (G. Gall pers. comm.)

Sacramento R. above L. Shasta

6 samples

Upper McCloud R. (8 pop.)

Nelson R. of Lower Pit (E. Fk. & Main)

Lower Pit (Potem Crk., Little Roaring Crk., Rock Crk. - 1983)

Middle & Lower Pit (Ash, Halls Canyon, Turner 83)

Goose L. - 8 pop. Goose L. + Upper Pit

— Mt. Wheeler —

Smith - Catostomid fishes

p. 65 - "

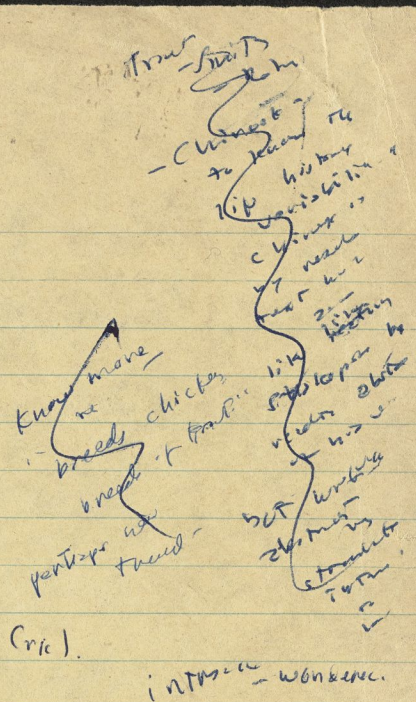
C. platyrhynchus - pops. inhabiting Deep Creek Mtns. - appear to be more similar to Sevier R. pops. than to northern Bonneville or Lahontan basins - accord. to vert. & scale #s.

— 1876 Newhall coll Calif Co
- sent Jordan - Calif 1875
- gold = S. pleuriticus

Jordan 1894 mykiss · agairdneri

Jordan & Gilbert 1896 - fm gilberti by isolation
(c.

1899 - fm. shasta R.B. - not gilbert.
1908 - fm. gilberti



- 1872-73 Stone's coll. - incl. Mcloud R Ind. L.
+ Clear L. (Iceberg Cr.)

- 1875-76-77 U.S. Fish Comm. Collects in
- around Calif. - first steam golden trout. - pleuriticus

Jordan has 1878 coll Baird "Dolly Varden"
1892 Pres. Stanford.

— Calif check list Leo Shapovalov - Alan Cordone 1940

S. a. a	S. g. g
S. a. w.	S. g. gilli
S. g. gilli	

steelhead - S. g. gairdneri = S. g. irideus
S. g. spilurus (Pit)
S. g. kamloops ——— = S. g. g
S. g. stonei

need to common sense
- bits of inserity! - Cut Meadow Creek hybrid in upper.
lower - pure Little Kern golden in middle - (Hightest Eng.
- eradicate upper & lower

-1870-

Garlick 1857 - Norris 1868 Fish Hist

Robert Roosevelt 1876 AFCult. meet. "This is national centennial (1876)'s fish culture has existed only a few years; what will be its condition at its centennial (1976)? The most enthusiastic can hardly conceive ... A new science was being born into the world ... but the clear light is visible at last ... There need be no fear for the future, and in much less than 100 years the waters of America will teem with food for the poor and hungry, which all may come & take" carp

1892 - meeting L. Stone - "Salmon deemed artificial culture good but can't guarantee survival - - proposed salmon refer (Adjt. Park & School Appropriation Act.) -

$578.80

Seth Green 1871 - 15 000 shad to Calif. - Sac R.

L. Stone 1873 - appointed on

Fish. Dept. Humboldt St.
Arcata 95521

USFS
RM Forest
For. Soil. Lab
Ariz. St. Tempe
85287

Loudenslager, E. J., S. N. Rinne, G. A. E. Gall, and R. E. Dzuid. 1986. Biochemical genetic studies of native Arizona and New Mexico trout. S.W. Nat. 31(2):221-34

36 loci - Apache, Gila, Rio Mayo trout
24 loci monomorphic

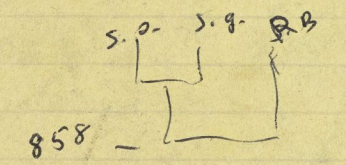
	Allele	Rio Mayo	Apache	Gila
IdDH - 2 (Iditol dehydrog.)	135	1.00		
	100	—	1.00	1.00
LDH - 1	150	1.00		
	100	—	1.00	1.00
PEP-A (peptidase)	110	—		1.00
	100	1.00	1.00	—
MDH - 3,4	100	1.00		Spruce Ck 1.00
	75		.955 - 1.00	0 - .281 - .533
PEP - B	150		.94 - 1.00	1.00
	100	1.00	.05 .06	

w/in var. - S. apache .992
S. gilae .977

average genetic identity gilae - apache = I = .931

apache - gairdneri I = .852

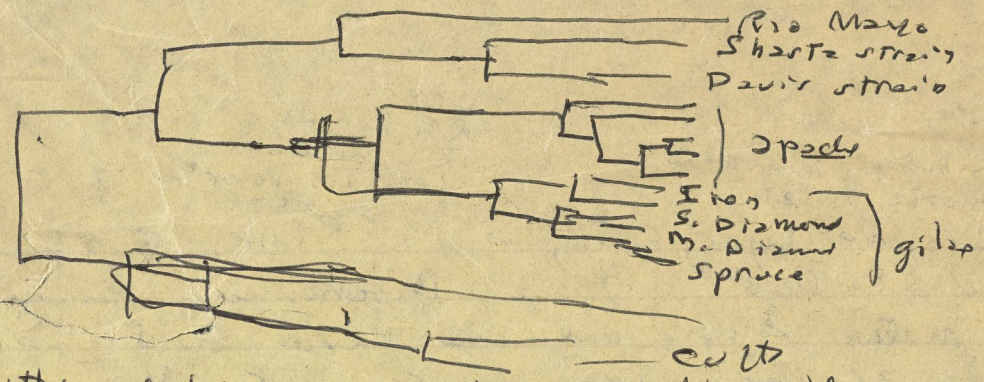
gilae - gairdneri I = .864



Gila & Apache - 3 cutt subsp. (henshawi, pleuriticus, bouvieri I = 724

Rio Mayo - S. gairdneri I = .902
" - S. gilae I = .812
" - S. apache I = .807

Loud. & Gall (80) - cutts I - bouvieri - pleurit. .937
utah - lewisi .754



Note cutts subsp. greater genetic diff. than all "RB group" — note Spruce & Main Diamond — S. Diamond & Spruce level differentiation.

— Rio Mayo

IcDH-3 ——— 170 · Rio Mayo —

(isocitrate dehydrog) 140 → 1,00 — most gila & apache >1.0 except South Diamond (.533)

RB(?) - 100 — RB ?

Aulstad, Gjedrem and Skjervold 1972. Genetic and environmental sources of variation in length and weight of rainbow trout. J. Fish. Res. Bd. Can. 29(3): 237-41

Nyman, O.L. and J.H.C. Pippy. 1972. Differences in Atlantic salmon, Salmo salar, from North America and Europe. ibid: 179-185.

"Lavarello" and "bondello"

2 Forms of Coregonus L. Maggiore, Italy -

Bio Abstract 1968, 49 (2)* 6046, 6047, 6048, 6054,

Hi → Am. Midl. Nat. 78(2):428-435, - Stream order & species diversity.

16(2):83-90 - Natural hybrids found (11.8% pop.) in Trib. L. Chuzenji

* 6061 - Kato, Teiichi 1966. Studies on the techniques of salmon and trout culturing III. Growth and survival rate of S. pluvius, S. fontinalis, & S. ♀ p. x S. f. ♂ - Freshw. Fish. Res. Lab. Bull. 16(1):59-64.

- pond culture - S. f. best growth, > S. p. > hybrids - but! - hybrids had highest survival 88%

egg & sperm of hybrids formed developing zygote ~~food~~ what then???

* 6076 Savvaitova, K.A. 1966 Salvelinus leucomaenis of some lakes on the Kunashir Is. of the Kuril Is. Vestn. Mosk. Univ. Ser. 6 Biol. Pochvoved. 21(4): 35-42.

* 6079 - J. An. Ecol. 1966 35(2):303-311 - Competetion & coexistence trutta - Sculpin - & minnow -

BASIC Corrigonus Study ~~606~~ 6046, 6047, 6648, 6054

Salvelinus - 6061, 6076

units	A	B	C	D	F	
3,3,4	26	20	41	30	22	139
3,3	~~14~~	3	2	1		
	104	60	82	30	0	

104
60
82
30
276

139 | 276

> 1.97 for all - incl. Notre Dame failures.

> Undergraduate only w/ those acceptable Transfer credits from Notre Dame — 2.59

A	B	C	D	F
~~18~~	6,9,6,3	17,9,3	7	8
26	6,8	6	1	0
4	38	35	—	
	3	2		
104	114	70	7	0

104
114
70
7
295

26
38
35
7
8
114

2.59
114 | 295
228
670
570
100

Bell 76 Syst. Zool. 25(3) - genetic identity scores may be independent of adaptive morphological evolution - protein evol. may not be closely connected to organismic evol. - as is evol. of regulatory genes (control expression of gene coding for polypeptide).

- Genetic identity & tax. distance may be in agreement if divergence dependent on Time.

- Threats, Mgt. etc - Schumm 69 TASAE - Most severe erosion in arid, semi arid (15-20 in/yr. precip.) - Vegetative cover most vulnerable - less dem. fragile - longer regen. - changes hydraulic regime, immediate response in channel system - greater veg - peak flows ramify - sig. channel changes over long distances -

- Irving, Elle & Bjornn 1977 - fishes Teton R.

	Teton Valley 74	75	Teton Canyon 74	75	Below Teton Dam 74	75	of fish. coll.
cutt.	6% - 9%		27% -		33% - 37%		
brk.	27% - 30%		2% -		<1% - <1%		
rnbw.	6 - 6		11 -		4 - 5		
whitefish	58% - 47%		59% -		53% - 41%		
suckers	3% - 8		2%		10% - 16		

3,078 cutts tagged, 284 recaptures - in Teton Valley, Teton Canyon & Bitch Cks. - sedentary; - Below Teton Dam some moved 5-20 mi. downstream to overwinter - most fish esp. above dam moved less than 1 mi.

ann. mortal. cutts below dam 74 .44 & 75 .25 — 74 .51 & 75 .54 (Canyon) .47-.50 (Valley)

angler hrs. 74 27,956 - 75 32,364, - catch 74 38,400, 75 47,100 gamefish

74	75
39% cutts	29% cutts
31% brk.	23% brk.
28% rnbw.	47% rnbw.
2% whitefish	1% whitefish

voluntary release 39% 74 - (15,000) 31% (14,600) 75

(B)

Teton R. (cont)

	'74	'75
CPMbt	1.41	1.45

x cutt caught 266mm

brk ~~rnbw~~ 228, rnbw. 256

most fished w/ bait Ann. mortal. based on angler caught length freq.

for cutts - >60% for most zones.

most anglers favored the reservoir construction

8 zones 1,2,3 (below dam), 4,5,6 (canyon), 7, 8 (Valley) 8 (Bitch Crk.)

* Water temp. below Teton Dam (prior to construction) became warmer earlier in year than upstream (Valley).

→ Ranked (71) - St. Joe cutt. angling exploitation - ann. mortality 80%.

— Ann. mortality on l/f angler fish creeled - 3 sect. .43 - .73 ('74), .62 - .69 ('75) overall - 64%

→ Section by Wallace on evaluation of cutts.

— * look at Basibranchial teeth - 30-40 !,! - Henry, C.

hybrids w rainbow & fine-spotted S.R. - but resist hybridiz. to amazing large degree - hatchery rainbows continually stocked

— * wild rainbows exist in Teton R.

→ Obvious hybrid spots w/ basibranch. teeth ! -

Test genetic affinities / relationships
: morphological
: biochem
: karyotype
hybrid. exp. - fertility -

Chevassus, B. MS. submitted to Genet. Sovr. Zool. Rev. Jan. 77 -
Hybridization in Salmonidae : Results and perspectives.

Salmo x Salvelinus — Fi but no fertility

Salmo (Brown x salmon) - Parasalmo (rainbow + cut - fertile
x not fertile
inter subgeneric

Oncorhynchus.
D.S. salmon x sea trout hybrids. Salmon Res. Trust Ireland, Ann. Rep. 1970, 15: 41-58.
but others say reduced fertility.

Piggins, 1970, obtained F2 & F3 salar x trutta hybrids
- not as clear cut

O. masou x O. rhodurus x S. trutta 50-70% survival to 18 mo.
fertility low?

Nygren et. al - 1975. Hereditas, 81: 55-62.
- Rainbow x Brown hybrids - Prog. fish Cult. ?

Avise & Gold 77 - Evolution - Chromosomal evidence speciation - -
Some phylads different rates speciation - when genetic distance between sp. is function of time & X level of genetic divergence between living sp. will be apprx. same in sp. rich & sp. poor phylads of similar age - when genetic distance is function of number of speciation event in history of phylad, living sp. of sp. rich phylads much more distinct than sp. of sp. poor phylads on the average. - Speciation events occurred much more frequently in Cyprinidae (sp. rich) than in Centrarchidae (sp. poor)
chromosomal evol. conservative
- But X level genetic differentiation in minnows - surfperches are similar

Avise et al 75 - Hesperoleucas vs. Lavinia - genetic identity .95 (at local pop. level).

incertae sedis NOAA Fish. Bull. 73(2): 447-49
1975 I49
27

(1) Bustard, D.R. and D.W. Narver 1975.
Preferences of juvenile coho salmon (O. k.) and cutthroat trout (S. c.) relative to simulation alteration of winter habitat. J. F.R.B.C, 32(5): 681-687
cutts coho
Both sp. preferred sidepools with overhanging bank cover & w/ clean rather than silted substrate.

(2) steelhead coho — + —— & ——— 1975. Aspects of winter ecology of juvenile coho salmon (O. k.) and steelhead trout (S. g.) ibid: 667-680
- cohos less ase. w/ bottom than ~~ct~~ steelhead.
Coho - w/ overhanging banks more than steelhead
steelhead more w/ rocks (10-25 cm)
about twice ≈ survival rate for coho in overwintering in beaver ponds.

(3) brooks non-game removal Flick, W.A. and D.A. Webster, 1975. Movement, growth and survival in a stream population of wild brook trout (S. f.) during a period of removal of non-trout speeis. J.F.R.B.C. 32(8): 1359-1367.
Small Adirondack stream 13 yrs. non trout: 124,000 = 2000 kg removed. 13,000 = 500 kg. trout caught.
No change growth & survival - 13.3-17.3-21.3 cm at I, II, III X̄ = 82% mortality from II-V - mainly natural. but movement essentially ceased after reduction

brook trout pop. food, veg. & hab. veg. (4) O'Connor, J.F. and G. Power. 1976. Production of brook trout (S. f.) in four streams in the Matamek watershed, Quebec. J.F.R.B.C. 33(1): 6-18.
14.5-66.4 kg./ha. production in 4 stream.
In most productive streams production controlled by food.
" least " " " " " cover.

native-non-native salmo (5) Jessop, B.M. 1976. Distribution and timing of tag recoveries from native and non native At. salmon (S. s.) released into Big Salmon R., New Brunswick Ibid. 33 (4) 829-833. Native recoveries .1-2.0% non-native .1-0.6% - See ref. Ritter, J.A. 72, 75 "Lower ocean survival rates for hatchery reared At. salmon stocks released in rivers other than native stream. Int. Comm. Exp. Sea. - . .

Reinitz (6) Reinitz G.L. 1977. Electrophoretic ~~distinction~~ distinction between rainbow trout (S. g.) & west-slope cutthroat trout (S. c.) and their hybrids JFRBC. 34(8): 1236-39.
West Slope (1) Jacko Hatch 100 (2) Alice Crk. 30 each (3) Bear Trap Crk. (4) Sauve Gulch Crk., Beaver Crk. Poor Man Crk.
3 strains rainbow 2000 fish - + 30 fm. Jacko Hatch.
Hybrid - 13 proteins ~~loci~~ examd
PGI - unique between all cutts & rainbow - hybrid recognized

small analysis (7) Copeman, D.G. 1977 Population differences in rainbow smelt, O. m.: multivariate analysis of mensural and meristic data. Ibid 34(8): 1220-29.
taken ret. to. 3 years
small. & stunted.

for Jack Dassu spec.
Arctic whitefish
- Lindsey - Peel R. distrib.

Hoar, W.S. 1976. 'Smolt transformation: evolution, behavior, and physiology, J.F.R.B.C. 33(5): 1234-1252 - Trout chan - more prim. than salmon.
Evol. freshwater

- Franzin Clayton, 1977. Biochem. genetic study zoogeog. of lake whitefish in west. can. J.F.R.B.C. 34(5): 617-25

- Drauf White sucker salsp. validity. - Bowmish Crossman 34(3): 371-5

- Reisenbichler, R.R. & J.D. McIntyre 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, S. g. 34(1): 123-28.

DNA hybrid.

Sharrett, A.J. R.C. Simon, J.D. McIntyre. 1977 Reassociation and hybridization properties of DNAs from several species of fish. Comp. Biochem. Physiol. B 56(1): 81-85

- SFA .77-00196 - J. Fish. Biol. 8(2): 119-125 (1976) 2 pop. Fundulus heteroclitus - Hudson R. - New Haven differ in 2 acrocentrics & 2 nucl. constrictions

- Avise, J.C., J.J. Smith, and F.J. Ayala. 1975. Adaptive differentiation with little genic change between two native California minnows. Evolution 29(3): 411-426.
24 loci - Hesperoleucas symmetricus - Lavinia exilicauda. conclude differ at one electrophoretically detectable codon substitution for every 20 loci - signif. adaptive differential leading to speciation has occurred w/ relatively few genic changes. From common ancestor mid or late Pleistocene

Evol. 29(3): 427-37

— Child, A.R., A.M. Barnell, & N.P. Wilkins. 1976. The existence of two races of Atlantic salmon (S. s. L.) in the British Isles. J. Fish. Biol. 8(1): 35-43. - different allelic frequ. transferrin

— S. mykiss - 15(6) 2 art.

— sticklebacks - Larson, G.L. 1976. 'Social behavior and feeding ability of two phenotypes of G. a. in relation to their spatial, trophic temporal segregation in a temperate lake. Can. J. Zool. 54(2): 107-12

EPA
23
600/3-81-021

Hall, J. D. and N. J. Knight. 1981. Natural variation in abundance of salmonid populations in streams and its implications for design of impact studies. U.S. E. P. A. 600/3-81-021: 85 p.

60g/m² 10-600kg/ha max.

Factors influencing abundance

A Physical
1. flow
2. habitat quality

B Biol.
1. food abund.
2. predation
3. movement & migration.

(what about competition? - not listed).

Streamflow - Ore - Scheechlia - Smoker -
core/of 17 mo. residency of coho - ocean catch 2yrs later
- table 2 - mostly neg. corel. : flow/coho abund. (flows too high).
Also: - neg. correl. - ± Jan. discharge & Nov. - May smolts.
- "Our conclusion is that there is no solid basis for a relationship between streamflow and abundance of coho, cutthroat trout in these streams, a surprising result in the face of so much other evidence for such a relation. - Small size of streams and low no. fish may have reduced power of analysis".
Sagehen - brown trout biomass best corr w/ Dec. flows
brooks w/ Feb. flows - RB sig. neg. cor. w/ Jan. Apr. June
brooks & RB mainly neg (non sig.) cor. - browns
mainly pos.

— Food.

+ food limiting! Mason (76) fed coho young - increased biomass 6-7x - but no sig. increase in smolts next year. - overwinter carrying capacity put limits on smolt production.
Allen (51) Horokiwi Stream - food supply regulated pop. - no ↑ growth
Mc Millan Bledsoe* Triska et. al. 1981 - coast cutthroat production 2x more in open stream
Over/closed section compared w/ forest canopy section due to primary prod. ↑.
& insect emergence? - Murphy (79 - expanded study).

Predation

Champoeg - Elson At. salmon - New Brunswick - mergansers, fishing flies
flows in study controlled - predation reduced to 10% - smolt output -
1,000-5,000 increased to 14,000-24,000 during yrs. pred. control.

EPA
23
600/3-79-059

Warren, C.E. 1979. Toward classification and rationale for watershed management and stream protection. U.S. E.P.A. 600/3-79-059: 143p.

Eberhardt, L.L. 76 Quantitative ecology and impact assessment. J. Environ. mgt. 4: 27-70

" 78. Appraising variability in pop. studies. J. wildl. Mgt. 42: 207-238.

Nickelson, T.E. 1975. Streamflow requirements of salmonids: Ore. Wildl. Comm. Ann. Prog. Rep. AFS-62-4 19p.

R.E. Hafele 78 — " " - OR Dept. F.&W. Proj. AFS-62-2 R.R. Reisenbichler. 1977. " " " " " 24p

SIGMA Xi

29 September, 1989
Friday Noon

Lory Student Center
North Ballroom

Dr. Lloyd Walker
Department of Agriculture & Chemistry Engr.
Colorado State University

"Appropriate Technology In Kenya"

Appropriate technology as defined here is what equipment methods people in Kenya use to accomplish tasks. Kenyan appropriate technology demonstrates innovative adaptations and efficient use of resources.

Dr. Paul Ayers will introduce the speaker

****

SIGMA Xi

06 October, 1989
Friday Noon

Lory Student Center
North Ballroom

Dr. Sherwood Idso
Water Conservation Laboratory
USDA Agriculture Research Center
Tempe, Arizona

"Global Warming - To Be Or Not To Be"

Chris Bauman
22 Juniper Hill Loop
Cedar Crest, N.M.
87008

- head hump - general species head guard ~~w~~ avoid to
us.
don't mean to turn avoid parasites - hatchery
Congeniality
into hostility - but real thy
require - sharpen to
to gen-in

ex. - Snake -

Rhesus

T.B. (?)-

ROBERT J. BEHNKE
DEPARTMENT OF FISHERY AND
WILDLIFE BIOLOGY

— If not no. ill only - also

— Suggested involvement better mgt.

Colo Springs T.U.

AT - salmon - Co. for better M2% smelt: water mm production - better Temp. my Rampart Res.

— 15 license 14½ catchable - Quota - how much total

Colo. fishery depends on catchable trout ?.? - Of > 11

license buyers - how catch distributed? 10-15% >50% —

raise stocking rates / Already high subsidy - why increase unbalance ?.?

Divide trout spec. regs. — Niche Packing — N. Mich. - brook brown benthic, RB - colts - pelagic

- lake trout, browns - pred. stunted brookies

- Spec. races - bandy scrubbed surface warm 83° —

- pred. - forage fish. Eagle L. RB. Eastward →

— Sterile!?

— short 2yrs - biomass vs
— wizard oil vs —

SRP — avoid knee jerk - Cottonwood Co.

Calif. — fish Chinook · steelhead · vs
do not occur

— # why work - mitigation - enhance
side channels - backwater - spawning areas

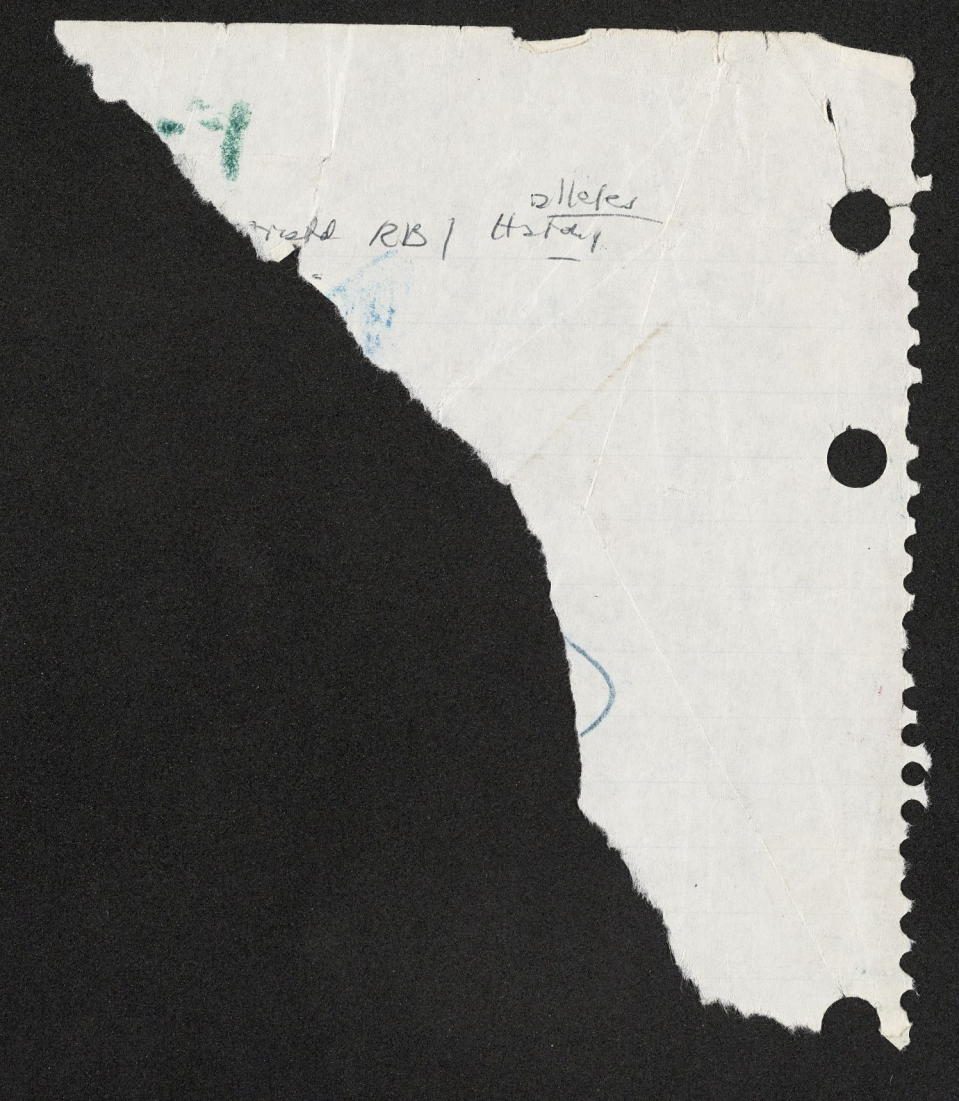
— Knowledge ~~of~~ data · — Rand-McNally Research Atlas

White Rep. — Modify Binns · cover into diffs

Types * linear (km.) rather than areal (km²) because

optimum cover w/ shoreline.

- highly
- Dizzied tow
- Need c
- for prob
cause - eff
riffle
-what
- spew
-
-
-


RB

- Systematist - Taxonomist - friendly policeman - enforcer unpop. law

Class - Mon Apr. 27 Vladykov - 1962 Copl 1872

- Rules - Parasalmo - Rhabdofario
genus - subgen

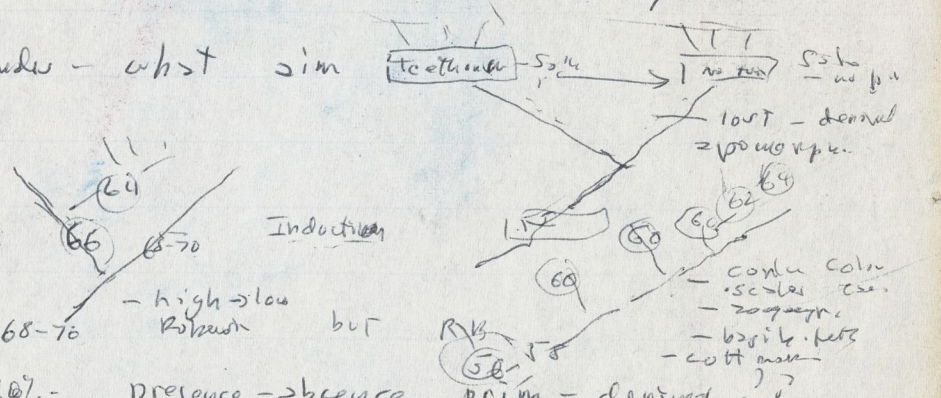
- Seminar * George Snyder Dir. NMFS Lab. -
Pres. C.S.V. student body 1958-

- Genetic Diversity - amazing complexity - Nasmo R. Icy Straw

3 races - 30 miles long - Ave R. - 400 m. - 2 races pinks
- no electroph. dif. - hybrids ?
- enzyme freqs. - no change 1 st run
- allele

1. reprod. isol. - develop. dif. spawn - esch - late
how obtain biol. selection * key to both enter sea narrow two
- resist disturbance - then colby - ...

- Classif - methods - what aim



- Chromosomes - cladistic definition sp. above sp. zygomorph. characters

- EDH - AGP - 90-100% - presence - absence - prim - derived ? ?
reversable ? ? - probably so most enzymes

- but - specific arrows

* Solar - trouts Corpion Sea. 100% - Volga 80 vs. 58 - polychotomy ?
starter 75 52 56-60

* Irish pollen --- Autumnalis - 1972 " " - but no cont 1900 - clades

* see Gould - panda -

Lit. handout

* fine-spotted S.R. coll 2N = 64 - electroph. ident. yellowstone

* Shaklee - bonefish Albula vulpes - Million years - Mole clock -

① few generations hatchery sweden - 50,000,000 -

② Bythmos Panama - several fold dif. 3 mil. yrs. 1-10

Ask question - what is assumption - allele change constant rate
two - no - but -

— no survival, no survival — lethal
— survival — adjustment — sublethal
— Tolerance — short time — less active — less growth
— some effect
— Thrive — no effect
— human — 12,000 - 20,000 ft. el.
— normal — redblood cells

— but — empirical evidence compare 1977-78 - 4
86 - 87 survival - catch - growth.
+ L. McConaughy 20°C 4 ppm w/ spawning runs

— 'Normal' functions - resting, feeding, repro.
— except for activity standard or active metabolism

Katz et al. 1959 - juvenile coho, chinook. - virtually no swimming impairment at 20° C ~ 3 ppm O_2

— Sigs - note ~~4 & 6~~ no oil!
— at 18°C - Fisher's data vs. Herman et al.

640
139 m²
5760
1920
640
88,960 acres

Harvest / Habitat

Limit your kill, Don't kill your Limit. - interpretation from generalities & specs

- A w/ Lee Wirth - Conservation to be valued to be enjoyed only once.
- Resiliency - if habitat - main emphasis - overfishing pop. rapid recovery - et. P/B guppies 1 lb. = 13 lb. dam;
- but - rapid turnover 1-2 - 9x (if all live max)
problems overharvest - Edward R. Hewitt: 1948! - Dr 1918 - realized that the growing use of the automobile, with its easy transportation, would soon spoil all public trout fishing" - Lee Wirth - seen the future -
- T.U. 1973-9-10 - which brown is overwinter mortality
- re. harvest & Slough Cut. Yellowstone
- * Yellowstone Park - pruning etc. - See Yellowstone
- "need for massive propagation - stocks" - 1923 -
Lost Yet - ? - all on wild, self-sustaining if habitat
- no grazing - [illegible] pollution & clear timber cutting, reservoirs, ? - -
- Myron Reed Rev. 1885 Lost generations fly fishing

stock fry is no good.

Yellowstone & old logging - - - - 10,000 - 8000 fry
? - 16,000 - [illegible] - 30,000 sight day

etc
but brown trout

basic premise human nature - trophy - short term self-int - grizzly
regulations effective - enforced - open fishing

Limit your kill, don't kill your limit.
Catch vs. kill

Re. harvest - commercial / sport
- fish hogs IInd overkill - self interest
Colin
- regulations - seasons, size, bag limit
- 25/day 5-10" limit - but
- late 19th hatcheries - no need for regulations so abundant

- Trout Autumn - pretty back slow
- WY - Miracle Mile - 1.2 C&R 6.4 8.7x/yr
but
- earliest T.U. 1959 "science" great mortality
60-70% comm vanish w/o title - brook tr
3 yrs. - 2-3 - nothing
- "further Res. necessary" - don't have fish - etc -
- elitist - polarized / catch&th - wild
egalitarian issue. beer & pretzels & brief chanderay
kill/rest release
Yellowstone 9.7x = value
Madison
- carry kill rest / recycle
morals, ethics
- conspiracy theory

guppies P/B=13 - no brook
Trout Ut. 59-60 - over winter mortality - brook vs. danger inducept reason
- 0-1-2-3
50-100
100-90 1 2 -
10% -

BIG THOMPSON RIVER
HISTORICAL FISH SAMPLING INFORMATION
STANDARD REGULATION LOCATIONS

CHUCK'S PLACE STATION				
YEAR	SPECIES / BIOMASS	% COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1989	RBT = 184 TOTAL LOC = 30 214	70 9	20.3 19.2	2 2
1991	RBT = 226 TOTAL LOC = 63 289	74 16	21.1 23.4	2 7
1995	RBT = 184 TOTAL LOC = 68 252	76 18	21.2 25.0	5 11
1997	RBT = 181 TOTAL LOC = 107 289	74 13	21.3 24.5	8 10
1998	RBT = 361 TOTAL LOC = 70 431	83 12	19.6 24.9	16 14
1999	RBT = 298 TOTAL LOC = 70 368	82 16	22.4 23.7	18 8

NEW HABITAT IMPROVEMENT SITE BELOW DAM				
YEAR	SPECIES / BIOMASS	% COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1993 (BEFORE PROJECT)	RBT = 65 TOTAL LOC = 31 96 HAT = 36* +36 = 132	60 18 13	17.5 17.5 26.6	4 3 4
1995 (BEFORE PROJECT)	RBT = 37 TOTAL LOC = 44 81 SRN* = 10 +10 = 91	47 17 27	18.7 17.5 26.8	4 1 0
1996 (BEFORE PROJECT)	RBT = 120 TOTAL LOC = 54 174	62 29	21.2 24.2	26 14
1998 (AFTER PROJECT)	RBT = 177 TOTAL LOC = 78 255	64 33	21.8 18.2	9 16
1999 (AFTER PROJECT)	RBT = 105 TOTAL LOC = 78 184	54 78	20.6 22.2	19 13

STANDARD REGULATION LOCATIONS

"OLD" HABITAT IMPROVEMENT SITE BELOW DAM

YEAR	SPECIES / BIOMASS	% COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1993 (BEFORE PROJECT)	RBT = 69 TOTAL LOC = 33 102 HAT = 23* + 23 = 125	64 21 9	19.1 23.4 29.0	3 1 3
1995 (AFTER PROJECT)	RBT = 96 TOTAL LOC = 145 241 SRN = 58* + 58 = 299	42 48 5	19.9 20.5 25.0	5 9
1996 (AFTER PROJECT)	RBT = 147 TOTAL LOC = 168 315	53 34	17.2 22.9	11 19
1997 (AFTER PROJECT)	RBT = 70 TOTAL LOC = 96 166	56 36	13.8 23.9	0 7
1998 (AFTER PROJECT)	RBT = 71 TOTAL LOC = 80 151	47 50	17.6 19.8	6 18

WALTONIA

YEAR	SPECIES / BIOMASS	% COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1997	RBT = 182 TOTAL LOC = 40 222	72 9	17.7 23.5	3 1
1998	RBT = 354 TOTAL LOC = 84 438	81 10	16.6 22.3	1 6
1999	RBT = 153 TOTAL LOC = 45 198	84 13	17.3 20.9	0 2

SINGLE SAMPLED STATIONS IN STANDARD REGULATION AREAS

BELOW IDLEWYLD DAM - 1992

YEAR	SPECIES/BIOMASS	%COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1992	RBT = 86 TOTAL LOC = 77 163	22 35	24.6 19.8	1 0
TURNOUT ABOVE INDIAN VILLAGE - 1992				
1992	RBT = 57 TOTAL LOC = 148 205	10 45	23.8 18.5	2 3
.25 MILE UPSTREAM FROM POWER PLANT AT CANYON MOUTH				
1992	RBT = 25 TOTAL LOC = 69 94	15 68	22.6 18.0	0 1
RIVERVIEW CAMPGROUND				
1992	RBT = 69* TOTAL LOC = 123* 192	22 38	22.4 22.7	10 11

• = INCLUDES FISH WHICH PROBABLY ESCAPED FROM THE FISH KILL ZONE A MILE UPSTREAM

BIG THOMPSON RIVER HISTORICAL SAMPLING INFORMATION
SPECIAL REGULATION LOCATIONS

YEAR	SPECIES/BIOMASS	%COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12'
HANDICAP RAMP				
1989	RBT = 90 TOTAL	36	18.9	1
	LOC = 73 163	60	21.2	5
1991	RBT = 118 TOTAL	53	21.0	1
	LOC = 77 185	41	22.0	6
1997	RBT = 123 TOTAL	54	20.6	2
	LOC = 132 255	37	24.6	7
1998	RBT = 106 TOTAL	64	18.3	2
	LOC = 75 181	31	23.1	3
1999	RBT = 89 TOTAL	57	21.3	1
	LOC = 76 165	39	24.1	8
GRANDPA'S (POOR SAMPLING EFFICIENCY)				
1989	RBT = 116 TOTAL	78	17.7	0
	LOC = 29 145	17	18.7	0
1991	RBT = 156 TOTAL	73	19.0	0
	LOC = 59 215	25	19.7	2
1993	RBT = 95 TOTAL	76	18.0	0
	LOC = 53 148	23	23.1	3
1995	RBT = 106 TOTAL	78	20.5	0
	LOC = 27 133	15	24.0	2
1997	RBT = 101 TOTAL	79	19.9	5
	LOC = 37 138	15	24.7	4
TWIN PINES				
1989	RBT = 136 TOTAL	72	19.7	2
	LOC = 54 190	25	20.6	0
1991	RBT = 140 TOTAL	61	20.9	1
	LOC = 72 212	34	20.3	1
1995	RBT = 169 TOTAL	61	22.8	2
	LOC = 100 269	37	22.5	4
1997	RBT = 115 TOTAL	66	22.4	8
	LOC = 61 176	33	24.2	1
1999	RBT = 162 TOTAL	70	21.2	15
	LOC = 128 290	28	23.5	5
SINGLE STATION SITES IN CATCH AND RELEASE SITUATIONS				
SYLVAN DALE RANCH				
YEAR	SPECIES / BIOMASS	% COMPOSITION	AVERAGE LENGTH (CM)	NUMBER OVER 12"
1997	RBT = 94 TOTAL	24	25.4	21
	LOC = 62 156	43	26.8	33
1998	RBT = 55 TOTAL	34	26.3	17
	LOC = 71 126	54	26.3	27
CROCKER RANCH				
1993	RBT = 159 TOTAL	73	22.3	24
	LOC = 40 199	14	24.0	10
PRIVATE, CATCH AND RELEASE CEDAR COVE				
1991	RBT = 115 TOTAL	59	18.8	2
	LOC = 42 157	22	19.5	3
1995	RBT = 22 TOTAL	9	30.6	7
	LOC = 67 89	50	24.5	9

OBSERVATIONS AND INTERPRETATIONS

NO CLEAR DOWNWARD TRENDS IN EITHER STANDARD OR SPECIAL REGULATION AREAS.....WE ARE ACTUALLY IN BETTER SHAPE THAN EARLY 90S

1 NO WHIRLING DISEASE EFFECTS ON A POPULATION SCALE

2 NO "CLASSIC" RESPONSE TO CATCH AND RELEASE REGULATIONS, I.E. RAINBOW NUMBERS ARE NOT DRAMATICALLY HIGHER THAN BROWN TROUT NUMBERS IN COMPARISON BETWEEN AREAS, AND BIOMASS IS NOT GREATER, IT ACTUALLY AVERAGES 20% LESS.

3 BIOMASS TRENDS: SPECIAL REG SITES SHOWED 3 UNCHANGED, 1 SIGNIFICANTLY UP, 1 MILDLY DOWN. STANDARD REG SITES SHOWED 3 UNCHANGED AND 2 SIGNIFICANTLY UP

BIG T DOESN'T GROW BIG FISH VERY OFTEN REGARDLESS OF REGULATION STRATEGY, FISH OVER 12" STD = 7.6 RBT AND 7.7 LOC PER SITE, SPECIAL REG SECTIONS = 5.4 RBT AND 6.7 LOC PER SITE

AVERAGED BIOMASS (KG/HA) SAMPLING SITES OVER THE YEARS				
YEAR	AVERAGE AT STANDARD REG SITES		AVERAGE AT SPECIAL REG SITES	
1989	214	1 SITE	166	3 SITES
1991	289	1 SITE	189	3 SITES
1992	163	4 SITES	--	--
1993	111	2 SITES	174	2 SITES
1995	214	2 SITES	133	2 SITES
1996	245	2 SITES	--	--
1997	226	2 SITES	174	5 SITES
1998	319	4 SITES	152	2 SITES
1999	250	3 SITES	228	2 SITES
TOTAL	197	21 SITES	156	19 SITES

CREEL CENSUS SHOWED CATCH RATE DROPPED FROM 1992 TO 1997, DWM CONTACTS SHOWED CATCH RATE DROPPED BY 50 % AFTER STOCKING CEASED, HAS REMAINED THE SAME SINCE

USE IN STANDARD REGULATION FORMERLY STOCKED AREA HAS DROPPED 42% USE IN SPECIAL REGULATION AREA HAS INCREASED 31%

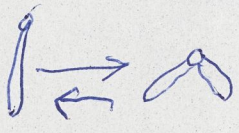
I cannot indicate at this time whether there has been a fusion or fragmentation of chromosomes in the case of these two species. It would be of value to examine the karyotypes of the four western North American species of Prosopium to determine whether the direction of these translocations involved fusion or fragmentation in the group's evolution. In general, a reduction in diploid number by fusion of acrocentrics (White, 1954) in the more recent forms would be expected.

Table 6. Diploid numbers and chromosome morphology of Great Lakes coregonines

Species	2N	Metacentric	Submeta-centric	Acrocentric	Arm no.
C. clupeaformis	80	20	8	52	108
C. artedii	80	16	10	54	106
C. reighardi	80	12	12	56	104
C. zenithicus	80	10	8	62	98
C. hoyi	80	10	8	62	98
P. coulteri	82	10	8	64	100
P. cylindraceum	78	12	10	56	100

clarki 68-70 - 106

trutta 80 - 96



Kats 74

G. Brown Goode (Dymond Calico)
1888 Am. Fishes

p. 476. In the Sacramento Valley the ridiculous and inappropriate name "Dolly Varden" is is retained.

p. 495

Talleork and other recent writers have applied a horrible name cutthroat trout, which is hoped will never be sanctioned in literature.

PHONE CALL

Date_____

M. _____

You were called at_____

By M. _____

Return the call to_____

The message was_____

_____

_____

_____

_____

Willis King – summarized SC symp.

Chr. Notes [1989]

balanced – selective

– Habitat is home plus importance

– Don't cut soil mantle water spring channel

"The status of hatchery vs. wild trout is still not fully understood and seems to depend on the region, the species, numbers, size and method of stocking. Discussion on this subject ~~topic~~ ~~heated~~ more than down and demonstrated the Hazards of generalities!

– Dysart – connecting in Reds … for USFWS to take leadership role in developing strains of fish that survive –

– Hebert "wild stock" 79.

– Starker – Multiple Use = Multiple exploitation BLM-USFS Commodity oriented livestock, timber.

Leopold – 79 – favorite theme – watershed – environmental protection – why not more research on how grazing, logging, etc. affect trout – cited me – also Behnke pointed out we are not at all about fisheries problem – we are dealing with problems of land use.

– 56 – next symp. – –

"May I urge all of you who administer fisheries programs to assign a high priority to the study of watershed relationships to trout populations. With good data we can be invincible for better conservation of those riparian strips that are so important to our interests in fishes. Let us direct our energy and resources to assembling the data to prove the point, that protection of the riparian strip is the key to trout management. – " Then when we reassemble in another 5 years and Bob Behnke asks, "What the hell good came out of Wild Trout II, we can have an answer for him!

mykiss III a,

table III ~~Morpho~~ Sunga e mykiss

	N		
l. l.	43	110 - 144	(126.2)
	41	116 - 138	(126.3)

* scales D → l. l.
21-30 (24.3)

beginning adipose → l. l.
12-20 (16.7)

	N		
Ext. cer. above	21	118 - 150	(132.1)
	21	115 - 135	(129.2)

adipose → l. l.	24	11 - 16	(13.4)
	24	11 - 15	(13.5)

sur → VI
Basibranchial teeth · ect b !

D 47/124 9 - 11 (9.9) / 9 - 10 (10.0) + II - IV

A 47/123 8 - 10 (9.4) / 8 - 10 (9.4) + II - IV

P 48/124 11 - 14 (12.6) / 11 - 14 (12.6) * branched + I

V. 33/79 8 - 9 (8.4) / 8 - 10 (9.2) * branched + I

Rakers 48/111 16 - 22 (19.1) / 16 - 22 (18.6)

Branchiostegals 47/123 R 11 - 13 (12.0) / 10 - 13 (11.8)
41/122 L 9 - 12 (10.1) / 9 - 12 (10.6)

calca 37/95 30 - 61 (44.0) / 20 - 70 (41.8)

vert. 40/90 60 - 65 (62.2) / 60 - 64 (62.5)

III b.

Mykiss moves in the rivers for spawning Sept. → Nov. – Spawning take place in April - May still under the ice. Some reproduce in Jan. – Feb. – running ♂'s noted in Jan. (по М.В. Доброванной).

– – Young go to sea. May – June – sengya. don't feed in freshwater – mykiss eats varieties foods – vert – invert – even mice.

This description of mykiss is slightly different from Behnke (61) who came to analagous conclusions of one sp. of Salmo on Kamchatka. The difference between our data and his on is on almost all of the meristic characters except gillrakers. Most dif. about range of variation. His vert. no. far less than for our mykiss. Our counts for X-rays of mykiss from collection of A.N. which Behnke studied we found 61-63 instead of 57-59.

Kamchatkan mykiss is very close to American specie of genus Salmo. – 33 sp. of Am. Salmo described. –

– In N. Am. 2 groups S. g. & S. c. Which group mykiss closest to?

history

Mykiss IV (a)

- Bost sentire p. 601:

S. g. to 112 cm. 14.5 kg. (typically 400-800 gms). diagnoses - - -

scales lat. ser. 115-180 D. 10-13

A 8-12 rakers 16-22 caeca 27-80 (91)

vert. 55-66 (62-65) - basibranchial teeth absent.

S. c. 75 cm. & 6.8 Kg. (600-800)

- - - Scales 120-180 (sometimes more)

D. 8-11 A. 8-12 rakers 14-22

caeca 27-57 vert. 59-62 (60-61)

basibranchial teeth present.

- subsp. lewisi -

- Table 5 compares S. g. S. c. & S. m.

	S. m. / S. g.	S. g.	S. c. / S. m.
size ext.			
body form			
upper jaw	not always in tad./eye	- long -	far beyond eye.
color			red or orange wash-marking on
"	- base* of first ray of P.V.A. fin white.		internal edge of each whole lower jaw - base ray of P.V.A.* seldom dif. fin color
Basibranchial Teeth	yes	yes / no	yes fem. other fins.
Caeca	20-70	27-80 (71)	27-57
Chromosomes*	?	60 16 / 44 1	64 22 / 42 1

In some characters intermediate - length & type of upper jaw. To ~~a large degree~~ spends more time in fresh water than the steelhead, and ~~to~~ lesser (extent) than cutthroat.

Some characters have taxonomic value -
Such characters as cutthroat mark and basibranchial teeth. - Cutt mark one of main characters of clarkii but very weakly developed in young and anadromous fish and may be completely lacking. - Some have rose stripe. basibranchial teeth not always present. M. & G. found 3 teeth in S. g.

- Selm. ~~C & J~~ when arctic not so cold perhaps in Miocene

In At. & Pac. - parallelism S. salar & trutta & S. g. & S. c. - Such an occurrence is observed within each species, in that number with the Kamchatka trout.

I(a)

The Systematic Position of Kamchatkan salmon - Salmo penshinensis Pallas and the Mykiss, Salmo mykiss (Walbaum). and their relationships with American representatives of the genus Salmo. - K.A. Savvaitova and V. D. Lebedev. В V. I. 6(4) (1966): 593-608.

Kamchatkan semga (S. p. P.) and mykiss (S. m. W.) belong to Pacific subgenus of Salmo - Parasalmo of Vladykov (63.). The anadromous semga inhabits the tundra rivers of western Kamchatka. It occurs in lesser no. in eastern streams to the R. Kamchatka, it is known from Okhost coast - Lonkovaya R. near Oly, and in Amur delta to south of mouth of Amur. possibly also on the Commander Is. - the second form, almost entirely a freshwater fish, rarely migratory anadromous, occurs in all rivers where anadromous form occurs and in many rivers in west & east where anadromous form does not occur.

They have wide Distrib. in Kamchatka but are not as abundant as Pac. salmon. —

— — — — —

In June - Sept. 65 gathered material

УТКа

from R. Utka and КИХЧИК in western Kamchatka (both senga + mykiss). Mainly followed Pravdin (39) in counts + measurements. 54 specimens of senga (from these 22 spec. ↑ young) (мокрый нос smolts!) and 124 specimens mykiss (from these, 104 spec. - immature young). Cebo - S. penshinensis A.H. СССР #37818 and mykiss #37817 + 23596 in all 5 specimens.

Allometric character - (Rohrs, 19) + plastic character (-65).

Kamchathan senga of R. Utka and Kikhchik characterized by following: D. III-IV, 9-11 (9.7) A III-IV, 8-10 (9.4); P. I-11-14 (12.6); V. I, 8-9 (8.9); l.l. 110-144 (126.2); 2 rows above l.l. 118-150 (132.1) and adipose → l.l. 11-16 (13.4) ? *branchiostegals R. 11-13 (12.0), L. 9-12 (10.1) rakers. 16-22 (19.1). Caeca. 30-61 (44.0) vert. 60-65 (62.2) *basibranchial teeth present.

Size to 860 mm. - (Derzhavin - to 960 mm.)

lite rose along lat. l. - not always a distinct stripe, - operculum also rose. Coloring is intensive during spawning. Some migratory specimens rose on lower jaw and (throat - ?pectoral), + ventral + anal fins

---

mykiss - VI (61)

p. 595

Tabe I - Semga - water Kamchatkan rivers

	(smolt, young) N=22	adults N=26
L. (Smith)	14-28 (18.6) cm.	56-86 (67.2) cm.
rakers	16-21 (18.6)	18-22 (19.5)
caeca	30-54 (44.3)	32-61 (44.0)

- The data agrees w/ Derzhavin (29) - however our material limited by the magnitude of characters - as well as as true the ~~width~~ broader stripe. (greater variability)

- The mykiss from the waters studied —

D III-IV, 9-10 (10) A III-IV 8-10 (9.3) P. I; 11-14 (12.6); V I, 8-10 (9.2); l.l. 116-138 (126.3) 2 rows above 115-135 (129.2) - scales end adipose t. l. l. 11-15 (13.3) *? branchiostegals R. 10-13 (11.8) L. 9-12 (10.6) - rakers 16-22 (18.6), caeca 20-70 (41.8) vert. 60-64 (62.5) - basibranchial * teeth present. mykiss usually smaller than semga - 350-450 mm. but - 650 (Berg) & even 900 mm. (~~Derzhavin~~ Pravdin 28). - On back & side to l. l, are numerous x-shaped dark spots. Below lat. line on pedencle & sometimes on forward part of body. round black spots on head. many black spots on dorsal, adipose & caudal fin. - black stripe around outer border of adipose fin.

P.V. & A. fins rose or bright red; - the outer rays - white. Along side of body on l.l. & operculum - bright red or crimson stripe, esp. in spawning. - general background color - golden-green, sometimes dark. abdomen white or grey (a little in certain areas & spots).

Sexual dimorphism not sharply noticed - but sexually ripe ♀ not caught. — — —

Our data differs some from Berg (1916, 48). He claimed 16-17 gillrakers and 14-15 scales end of adipose → l.l., - We counted 16-22 & 11-15. On the same specimens used by Berg at A.H. - we counted 17-19 rakers & 11-15 scale. - Main dif. between sengya & mykiss is in life history & coloration. Very little dif. in meristic characters. —

Table II

mykiss fm. western Kamchatka

	N=29 10-14.9 cm.		N=62 15-19.9 cm.		N=14 20-23.9 cm.		23-45 cm N=19	
rakers	16-20	18.1	17-22	18.6	16-21	19.4	18-21	18.7
caeca	20-60	40.0	20-70	43.9	34-56	46.3	41-56	48.8

Comparison of Kamchatkan sengya & mykiss leads to conclusion that on western Kamchatka their is one species of genus Salmo, which have anadromous & resident pop. and name Salmo mykiss Walbaum has priority.

What is E. M. T.?

C. B. 11(1): 41– Grumbine

Why adverse reaction
- Threat to status quo

- Change in policy
  Intensive land/Ecosystem Mgt. → maneuverage (chaining)
  Timber more intensive practices
  new forestry ?
  more weeds
  — vague-fuzzy — public lab
  ecol. integrity
  sustainable

Conservation Biology

(ISSN #0888-8892)

Blackwell Science
Commerce Place
350 Main Street
Malden, MA 02148
(617) 388-8250
Fax (617) 388-8260

PERIODICALS

MOVING?

*Please **print** your **new** address below.*

Name _____

Address _____

_____

_____

Telephone __(____)_____

Address change effective _____/_____/_____

*Please fax or mail this entire sheet (**with old mailing label**) to the fax number or address above 6 weeks prior to the effective date.*

CB 11 (1) 70721
ROBERT BEHNKE
CO STATE UNIV
FISHERY & WILDLIFE BIOL
FT COLLINS CO 80523

PRINTED WITH SOY INK

Printed on recycled paper.

Phelps, T.T. 1949. Fishing Dreams (London)

McCormick, L.J. 1937. Fishing Round the World (Scribner)

Osten, E. 1946. Tournament Fly & Bait Casting (Barnes)

Caine, L.S. 1949. North American Freshwater Sport Fish (Barnes)

Hall, C.B. (no date) Ponds and Fish Culture (Faber & Faber)

N.Y. Conserv. Dept. Biol. Surveys -- Upper Hudson (1932), Erie-Niagara (1928) Long Island (1938), Oswegatchie & Black (1931)

Herter, G.L. 1941 (3rd ed.) - Professional Fly Tying and Tackle Making - Manual and Manufacturers Guide

Koller, K. 1955. Complete Book of Fishing Tackle (paper) $.75
Heddon President - top line $.75 - Black Beauty $3.75 bamboo, $4.00 glass
Orvis deluxe $.90 'Bel' $.50 glass

Wetzel, C.M. 1945 (2nd ed.) Practical Fly Fishing

Kreider, C.M. 1951. The bamboo rod and how to build it. Macmillan. ($2.95 & $3.50)

Pickard, F.W. 1936. 16 British Trout Rivers (Putnam)
1940 Trout Fishing in New Zealand in Wartime.
Peart, L.R. 1937. Fishing in the Making (Macmillan)
recommends Trout Fisheries by J.C. Mottram.

Harbin, Col. Dave - $.40 Flying Sportsman 1952

B.B. 1946 - The Fisherman's Bedside Book. Scribner.

Fox, C.K. 1950 Advanced Baitcasting (Putnam)

Frazer, P.D. (1914 & 1942 -- Apr. 1947) Amateur Rodmaking (Macmillan)

Walden, H.T. Angler's Choice - Anthology. 1947 (Macmillan)
- Frank Forester story 16th - Long Is. - Liffe Successors & Sermons

15 miles to East - are long Is. par excellence trout fishing - sea-run fest - salt meadows.

Steel, F. R. 1947 Bait casting with a thermometer

Herter, G. L. 1949. Professional Split-Bamboo Rod Building Manual and Manufacturers Guide.

Sportsmen's Year Book 1946 - National Sportsman Inc. (Hunting & fishing mag.)

Outdoor Life Encyclopedia (1942 - 1947 6th print).
+ Wise Encyclop.

BEHNKE, R. J., Colorado State University, Fort Collins, CO 80523.
Quantitative and Qualitative Aspects of Assessing Biodiversity.

Limitations of quantitative methods of genetic analysis denoting indices of heterozyogisity, percent polymorphism, within and among variation, genetic similarity, etc. include the tiny amount of the genome sampled and the general lack of association of determined genetic parameters with adaptive life history traits such as degree of migratory behavior, predator avoidance response, feeding specializations, interspecific competitive interactions, age at sexual maturity, maximum size and life span, etc. Examples of diversity within subspecies of cutthroat trout are used to illustrate the need for both quantitative and qualitative methods for in-depth analysis of biodiversity and to demonstrate that highly significant differences in life history traits, not amenable to quantitative genetic analysis, can evolve in relatively short periods of time under strong selective pressures.

3/10/93

Bob —

at the last minute, we switched to using a local drawing of a bull trout, since that was the main purpose of the investigation.

Hopefully, BLM and other federal and state agencies will be doing a lot more for bull trout and redbands in the near future.

Allan T.

UNITED STATES
DEPARTMENT
OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

Allan E. Thomas
FISH AND WILDLIFE BIOLOGIST

IDAHO STATE OFFICE
3380 AMERICANA TERRACE
BOISE, IDAHO 83706

FTS/COM (208) 384-3066
FAX (208) 384-3290
RES (208) 376-5939

Bull Trout DX - distrib

— Coverden 79 50 Sep 89 —

RB; K.A. Pleyte, and P.E. Thiesen

Phillips. 1989 Copeia (1): 47-53
Patterns of chromosomal nucleolar organizer region (NOR) variation in fishes of the genus Salvelinus

Pleyte, K.A., S.D. Duncan, and R.B. Phillips. 1992.
Evolutionary relationships of the salmonid fish genus Salvelinus inferred from DNA sequences of the first internal transcribed spacer (ITS 1) of ribosomal DNA. Molecular Phylogenetics and Evol. 1(3): 223-230. — conf.-lewisi. font. namaycush malma alpinus

ITS1, 5.8 Phill

Crane 92 albezymei
ph. D. — confluentus w/ lewisi

Crane et al. 90 - CJFAS — mtDNA confluentus, subsp. alpinus. — w/ malma Dowdin - perm. comm

Phillips, R.B., K.A. Pleyte, and M.A. Brown. 1992.
Salmonid phylogeny inferred from ribosomal DNA restriction maps. CJFAS 49(1): 2345-53.

continues and in the next 4-5 years a reduction will occur for females, and for males age, size, and weight will be stabilized.

2. Absolute numbers of the spawning part of the beluga population has been halved.

3. The number of female beluga coming to spawn in the Volga at present is stabilized, for males a gradual increase is recorded. In the next 5-6 years there will not be a sharp increase in catches and they will not exceed 0.5-0.5 thousand tons.

LITERATURE CITED

Babushkin, N. Ya. Biology and Fishery for Caspian beluga. Tr. VNII mor. ryb. khoz-va i oceanography, *52*, No. 1, pp. 183-258, 1964.

Vlasenko, A. D., A. P. Slivka, A. S. Novikova et al., Rate of natural reproduction of sturgeon under conditions involving the complex use of water resources. Tez. nauch. dokl. Vsesoyuz. soveshch. "Sturgeon Fishery in USSR waters", Astrokhan': Volga, pp. 66-67, 1984.

Harold Duebbert 8B

Improve Ponds and Watersheds --Save Soil and Wildlife

(5)

WERNER O. NAGEL and MARION CLARK

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE

AGRICULTURAL EXTENSION SERVICE

CIRCULAR 565 Columbia, Missouri AUGUST, 1948

FOREWORD

A well managed pond offers more than recreation or direct profit. Birds, attracted by the water and vegetation, destroy many insects. Cool, clear water, piped through pond dams to tanks below, is more relished by livestock than the warm, stagnant water found in the shallows of unimproved ponds. Also, every pond built in a gully or an eroding area is an important part of the flood-control and soil-saving program of the entire state. A well built, well protected pond of good size can be made of more value than any other crop area of the same size on the same farm.

Fish, waterfowl, minnows, game birds, song birds and useful wild animals all thrive in and around a well managed pond. Some of these may be used privately or harvested and sold; or the pond may be rented to sportsmen at a reasonable price.*

Also, by affording opportunities for fishing, swimming, boating, and skating, the larger ponds and lakes are helping to solve the community recreation problem.

*Consult current wildlife regulations for information on legal methods and requirements.

Improve Ponds and Watersheds --Save Soil and Wildlife

WERNER O. NAGEL and MARION CLARK*

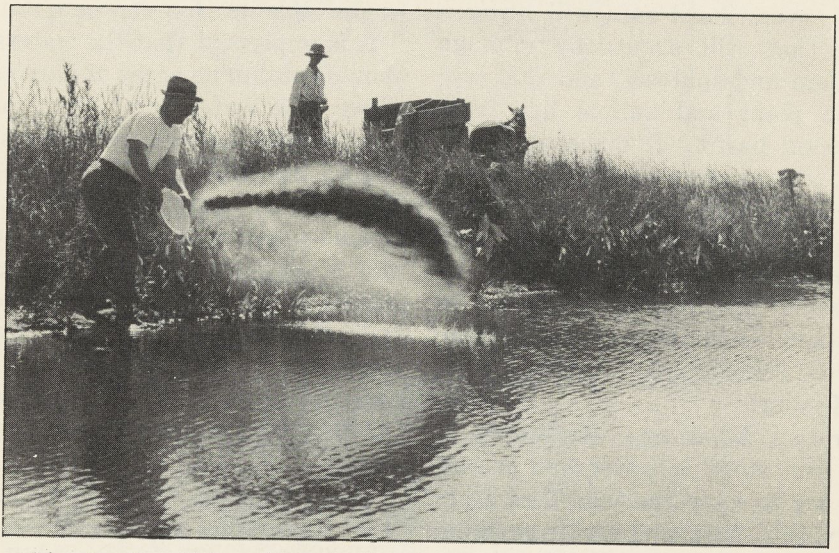


Fig. 1.—Fertilizing the pond increases fish production and helps keep down aquatic growth. Protected pond banks stop erosion and help keep the water clear.

In this circular are plans for improving the rougher areas of your farm. It can be done by the construction and protection of ponds, either alone or in connection with woodlands or permanent pasture. It will also be explained how existing ponds, now used only to water livestock, can by improvement and protection be made to produce valuable wildlife crops. Finally, the best methods of prolonging the usefulness of the pond will be discussed.

Size and Depth of Ponds.—To be most useful, a pond should be at least one-fourth of an acre in size, and it should average at least 6 feet in depth in the deepest quarter of the pond. An average depth of 6 feet over so large an area means that there will be some places much deeper than that. Larger ponds should be deeper, but should not average more than 15 feet deep in the deepest quarter unless the water supply is large enough to insure complete and

Mr. Nagel is administrative assistant in the Game Section of the Missouri State Conservation Commission. Mr. Clark is extension agricultural engineer with the University of Missouri College of Agriculture.

frequent replacement of the impounded water.

If the watershed is too small for the size of the pond, the water level will be lowered too much during dry periods. If the watershed is too large, every hard rain will bring a flood that will eventually damage the dam and spillway, and that will sweep plant and animal life from the pond basin. It is better, however, to have the watershed too large than too small, since excess water can be controlled by a well constructed dam and spillway and by diversion ditches, as explained in Missouri Agricultural Extension Service Circular 482, " Farm Ponds in Missouri."

Protect Pond and Watershed.—The first steps in watershed protection are to keep the land free from cultivation, fires, and severe grazing, as these are fundamental erosion control measures. If it is not possible to keep the entire watershed ungrazed, at least the banks, ditches, dam, spillway, and cover within 100 feet of the waterline should be kept free from stock. If the pond is large enough to provide drinking water for livestock without lowering the level too much this should be done by piping the water through the dam to a tank below. The tank should be at least 20 feet from the dam and separated from it by a fence.

Improve the Watershed.—The real values in watershed improvement are those resulting from erosion control. The use of plants that check erosion and rebuild the soil, while constituting at the same time profitable timber crops and emergency pasture, is in itself a good agricultural practice. That such plantings *also* make it possible to convert a poor pond into a good wildlife habitat simply adds to the benefits that can be obtained.

It is important that the watershed should contain no areas of bare earth above the water-line. Such areas may be planted or developed as ungrazed woodlots, or covered with a thick sod by seeding with a mixture of blue-grass, red top, orchard grass, and Korean lespedeza. The grass should be sown in fall, the lespedeza the following spring. On large watersheds it is possible to have both timber and grassland. In this case, the woodlot should occupy the upper slopes.

When covered with dense vegetation, the ground holds rain water so that it seeps *slowly* down-hill and arrives in the pond basin fairly clear. The slowing action is important, because the water comes into the pond a little at a time, the water-level remains more nearly constant and the soil is left behind. This saves much wear on the spillway, and allows the growth of fish and plants that could not otherwise survive.

Improve Pond and Banks.—The pond itself is the heart of the watershed area, when wildlife crops are considered, and it is here that many of the benefits of erosion control are most evident. In the improvement of ponds, as with watersheds, planting the right kind of vegetation for the kind of wildlife wanted is

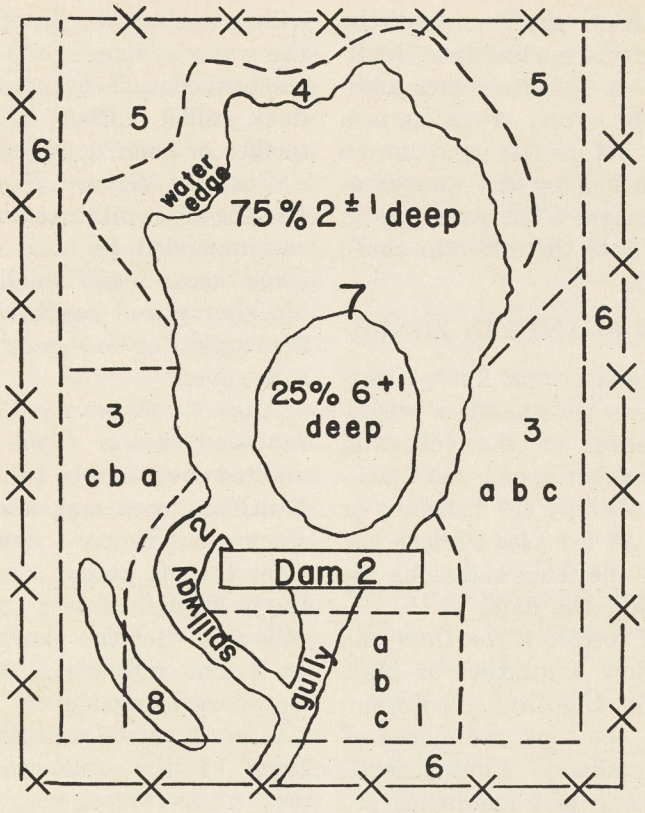


Fig. 2.—A plan for pond planting. Planting zones are: 1 Shelter and escape cover. 2 Protection for dam and spillway. 3 Concealment and food. 4 Erosion control and food. 5 Grassy nesting cover. 6 Fencerow escape, nesting and winter cover. 7 Food and shelter in the pond. 8 Windbreak.

most important. Too much vegetation growing in the water gives too much protection to small fish, and uses up fertility. Too little vegetation on the slopes and at the water's edge permits erosion and results in a muddy pond. If fish of large size are the main interest, it is best to keep plants entirely out of the water itself, to prevent overcrowding and stunting. If other wildlife, like waterfowl, frogs, and muskrats are wanted, it is desirable to plant the kind of aquatic vegetation they need for food and cover. In any case, there should always be a good growth around the banks to provide food, nesting places, and cover for the quail, songbirds, and small animals that live best near water. Shoreline plants help check erosion on the banks, and the larger ones provide shade which helps keep water temperatures down and reduces evaporation.

A plan for pond planting is shown in Figure 2. The fence is very important: it is needed to protect the

pond area from grazing, and the water itself from muddying and contamination. It also furnishes additional wildlife cover. Fencing is a requirement before the pond can be stocked with fish by the Conservation Commission. The numbers in this figure locate the different zones of planting.

ARRANGE PLANTS IN ZONES

Zone 1. Shelter and Escape Cover. Plant three wide bands of shrubbery, consisting of the following plants set two feet apart: (a) blackberry or raspberry; (b) hazelnut or wild plum. At (c) seed Sericea lespedeza, up to the fence and along the old ditch below the dam.

Zone 2. Protection for Dam and Spillway. Sow a mixture of bluegrass, red top, timothy, and Korean lespedeza on the tops and slopes of the dam and spillway. Liming, fertilizing, mulching and manuring are highly recommended.

Zone 3. Escape Cover, Concealment Cover, and Food. Seed smartweed and millet just above the waterline, carrying it back at least 8 or 10 feet. Then, in bands, plant the following: (a) Korean lespedeza; (b) hazelnut or crabapple in groups of 3 or 4 plants set four feet apart, with the groups set 12 feet apart; (c) seed Sericea lespedeza up to the fence.

One or two water-side trees, like river birch or sycamore, may be planted above the waterline, provided they are at least 100 feet from the dam.

Zone 4. Erosion Control and Food. Plant spike-rush and water willow in clumps a few feet apart at the water's edge. Back of this sow smartweed and barnyard grass or duck millet. Plant a few button bushes or osier dogwood.

Zone 5. Grassy Nesting Cover. Use the grass mixture and treatment recommended for the dam. In a large area, plant small clumps of blackberry and raspberry about 30 feet apart for food, nesting, and escape cover.

Zone 6. Fencerow Escape, Nesting, and Winter Cover. Here the planted cover can be the fence itself. Multiflora rose makes an excellent, stock-proof fence, provided instructions for soil preparation and planting as furnished with the plants are followed. Set the plants as a fence at 1-foot intervals. Sow Sericea lespedeza alongside.

Zone 7. Food and Shelter in the Pond. If the production of a good crop of good-sized bass and bluegill is the main object, do not plant anything in the water itself, except as follows: In new ponds, before filled with water, lime and fertilize the entire basin and seed to millet. A growth of millet on the pond bottom will help greatly to keep the water clear and furnish needed minerals. After the pond is full, set spike-rush, calamus and water willow at the water's edge, using water willow at the dam to stop wave erosion.

For a multiple purpose pond, add arrow-head lily in the shallow bays and plant river bullrush in the shallow water. The aquatic plants will not prevent having some fishing, often good. They are not recom-

mended, however, for the best in pond fish production.

For a pond wanted mainly to produce the best possible fishing, definite rules must be followed. These are explained in a bulletin by the Missouri Conservation Commission at Jefferson City, and farmers planning a fish pond should write for and follow these rules.

Zone 8. Windbreak. The Multiflora fence will offer enough protection on otherwise unprotected ponds, except on high, exposed prairies. Here it is wise to plant a row or two of trees on the south and west sides, except where this will bring the trees nearer the dam than the 100-foot "safe" distance. Black locust, catalpa and red cedar (where there are no apple orchards nearby) will afford this protection without competing too much with the rose fence. Evergreens make excellent windbreaks. Of these, the native (yellow) pine is recommended for southern Missouri, while jack-pine has proved good in the northern counties. All these trees may be ordered through the county extension agent.

PLANTS, FISH, FERTILIZER

Source and Cost of Materials.—Water and marsh plants can usually be secured from nearby ponds and marshes. Information on identification, planting and sources of the plants needed can be secured from the local representative of the Conservation Commission, or by writing to the central office at Jefferson City.

Fertilize New or Sterile Ponds.—The watershed, and particularly the raw areas of new ponds should be fertilized before seeding or planting, just as one would fertilize to grow a good grain crop. In addition, all raw areas should be loosened and manured. The water itself should be fertilized for good fish production. The general rule in new or sterile ponds is 100 pounds per water-acre of a good balanced commercial fertilizer, scattered in the water, until about 1000 pounds per acre per year have been added. Fertilization should begin in the spring and be repeated at about two-week intervals through the summer. Ponds vary in the amount needed. A rough test is the color of the water; this should be rather brownish, but fairly clear. When the hand can be seen with the arm immersed up to the elbow, in "tea-colored" water, fertilization is about right.

Fertilizing in this way promotes good fish growth, and also helps keep down unwanted aquatic vegetation. It does, however, decrease the desirability of ponds for stock watering. Instructions on keeping aquatic "weeds" out of ponds wanted primarily for fish production can be secured from the Conservation Commission without cost.

Suitable Kinds of Fish.—A balanced combination of bass and bluegill (bream) is the recommended planting for good farm fish ponds. This is the only stocking recommended or furnished by the Conservation Commission, and is limited to ponds meeting the Commission's specifications. To secure an initial stocking of fish, farmers should con-

tact the local Wildlife Conservation Agent, to learn if their ponds meet the requirements and to make application. Ponds may also be suitable for producing minnows for use or sale as bait. Information on making a minnow-rearing pond can be secured from the Commission.

Attention is directed especially to the black-head and bluntnosed minnows. These are excellent bait minnows, and good bait minnows are becoming scarce and costly. Often a good business can be built up by selling minnows to resorts and to bait fishermen.

PONDS ON WASTE AREAS

Many farms that have no suitable ponds have some waste lands where suitable ponds may be built. Raw gullies and eroded watersheds may be improved by erosion control measures to form good drainage areas. Although this requires some extra effort, the control of erosion on such areas is worthwhile in itself, and when it has been accomplished a good pond with all its benefits may soon follow.

Erosion Control the First Step.—On very poor or moderately gullied land it is advisable to begin erosion control on the watershed one or two seasons before the pond is started. Trees should be planted on the slopes, and temporary checks put in the gullies to catch enough silt to allow planting with black locust, cane, or Kafir corn. These temporary checks can be built most economically from wire and brush in many sections of the state. In the Ozarks region, however, loose rock dams (loose rock held in place with woven wire) will be more practical and permanent than wire and brush checks. If the gullies are planted to annual crops, a sodding crop, such as red-top, or Sericea lespedeza may later be used. Finally, when sod and trees together have checked the erosion, the pond may be built. This plan is illustrated in Figure 3.

Control by Using Terraces.—A more readily effective, more permanent and therefore more satisfactory control, by means of terraces above the pond with permanent outlets into the basin, is illustrated in Figure 4. Timber or sod cover is then developed over the terraced watershed. Terraces and terrace outlets are described in more detail in Missouri Experiment Station Bulletin 507, "Terracing for Erosion Control," and Missouri Agricultural Extension Service Circular 355, "Terrace Outlets for Missouri."

The Settling-Basin Control.—A third method is to construct above the main pond, a smaller pond to act as a silting basin. The silting basin is constructed by building a dam and dykes intercepting the water from all gullies that would drain into the pond. This allows water from the watershed to be collected in a silting basin where all of the heavier soil particles and most of the fine silt settles out before the water flows into the pond. Thus it is practically clear water that flows into the lower basin through a pipe operating on the same principle as the soil-saving

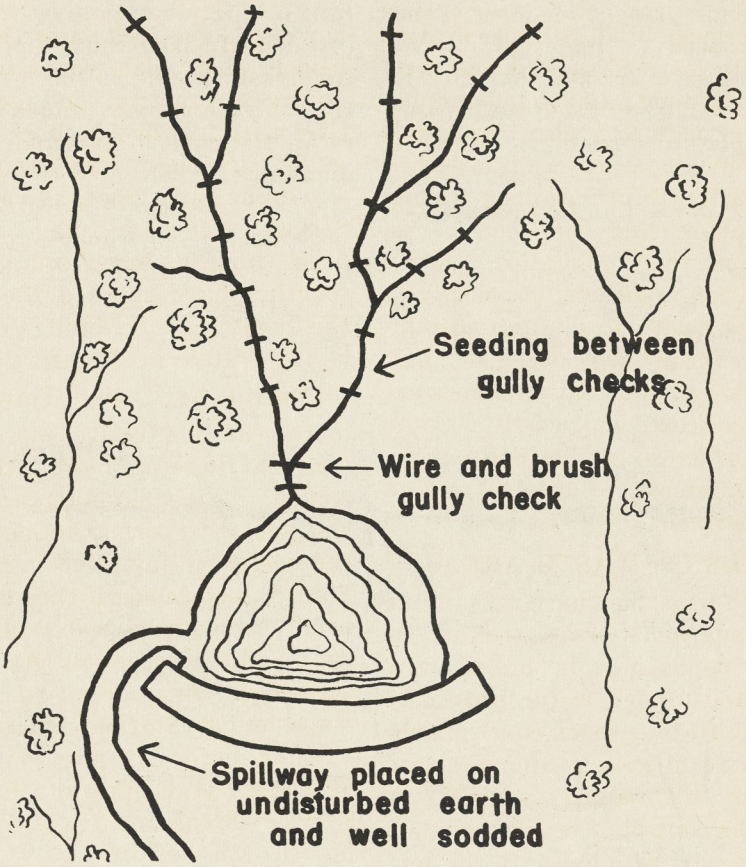


Fig. 3.—Tree planting, sodding and mechanical checks should be used to control erosion on gullied land before the pond is built.

dam discussed in Bulletin 499. A general plan is shown in Figure 5.

When the upper basin has become filled with silt, it may be planted to black locust or the swamp species mentioned above, and later sodded. Meanwhile the upper ends of the gullies have been planted and checked, and the watershed is under control.

The first of these three plans will require a longer period to become effective, although little or no cash expenditure will be necessary. The last two plans will require slightly higher cash expenditure but will be effective immediately. However, the effectiveness of these two plans will be somewhat increased as sod and tree growth become established. In any case, the pond should not be built until it is evident that erosion is being controlled.

By observing the suggestions given in this and the other circulars cited, poorly improved ponds and

waste lands present on most farms may be used to make productive wildlife areas, in addition to the benefits resulting from soil-saving and usable erosion-control crops.

Not All Ponds Can Be Improved.— Some ponds are so small, so poorly built, or so badly located that all the benefits mentioned cannot be obtained without excessive cost. For instance, if a pond must supply water for livestock, and if this use lowers the water level very much between rains, the pond is too small to be of much use to fish and other wildlife. It would be better to keep it simply as a stock pond, though to prolong its life the watershed should be protected as described in this circular.

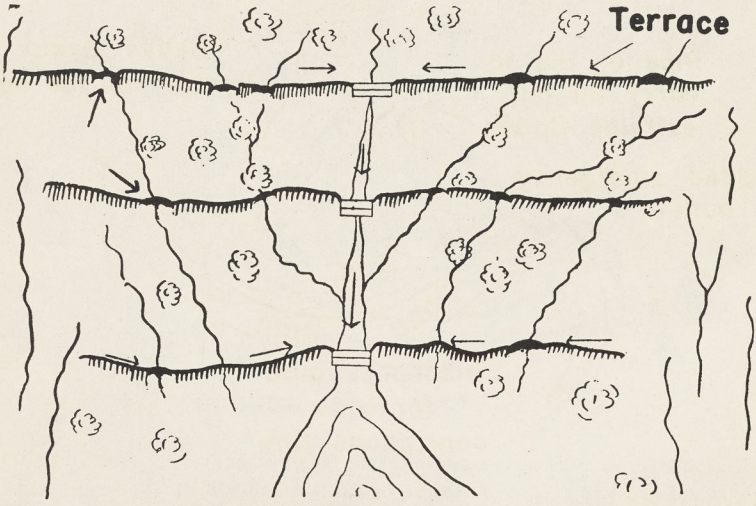


Fig. 4.—Terraces may be required on badly eroded slopes above the pond. Heavy arrows in upper left corner indicate earth fills where terrace crosses the gully. Note the outlet leading up from the pond in the center of the diagram, controlled by three permanent structures.

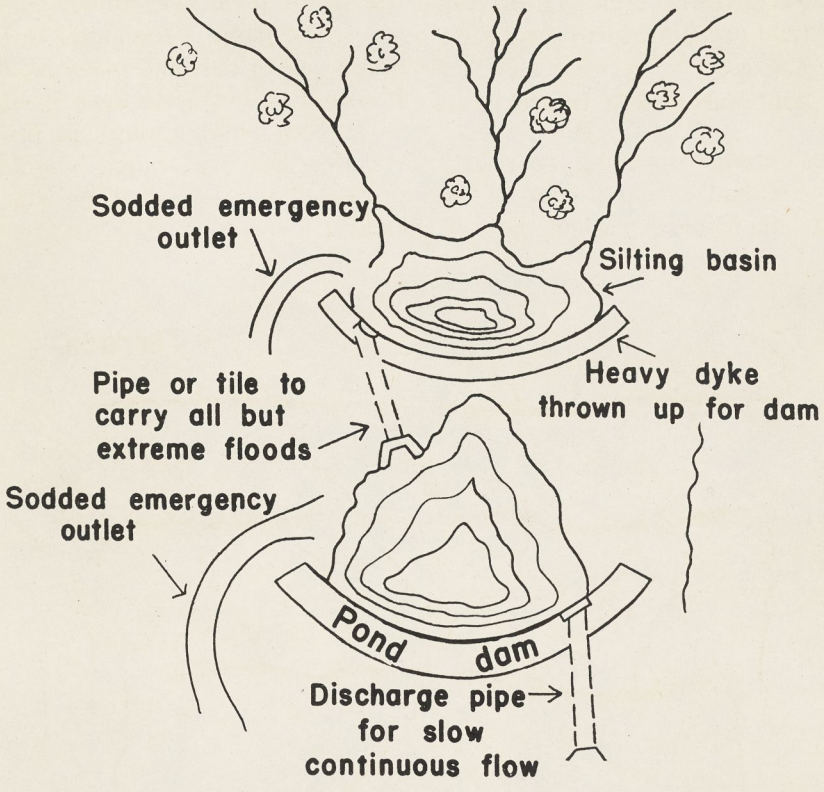
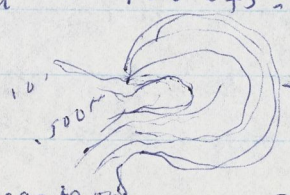


Fig. 5.—A silting basin may be built above the main pond.

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING
J. W. BURCH, Director, Agricultural Extension Service
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914

FWS research involvement -
first stimulated by outcries by cons - 1962 Chem. Co
Sec. Udall instructed Fews - study needs
assigned to Utah St - Ph.D. Tm Vanicek (67, 64-6
actually Vanicek's work one of most useful
because correlated year-class strength w/ sp

- What survey? - too big a
to follow as other - vs. short
nursery habitat. - pr
Thus - low fl - needed 200 observ's
logical, philosph-biol. argm't
- curves . not indepen
- not determinis
- not consider interaction other sp
(was below min - a.
PHABSIM applied to 6 reaches - 3 each Green & Colo.
- try to predict too much.
habitat suitability curves for sp. -
- WUA Stm(cfs)
Only Three 1981 - much more - use for all data.
- Habitat Suitability Curves -
YOY Squawfish curves all Green Colo data
- preferences; - sand - (no actually velocity),
velocity - bank 0-1-2'
- ex. 8-9 in. preferred depth - 100 cfs = 1 in. - this change 1000 cfs
p. 9 = should not be concentrated in Black Rock -
& Temp. 60-65°F - some or
- prefer 8 ft. adult humpback depth - none >40 ft.



1000 - 10,000
- need habitat this handles - such chan
1000 108 6-8 ft.
1120 - 7100 60

Kidd

Sect. 7 Consult – No Biol. Basis – because no habitat-flow data

Bur Rec – Final Repo. – Draft Conserv. Plan – Rec. Plan

Miller – (Archer) – no evidence ∃ no mention – no matter how much $ ∃ – such data will be had! –

Basic for Reason for failure

Quality investigator – Peer Review – selection committee

quality control

Res. Inst. … Harvard, Yale, – mgr Univ. – value of Miller

but – peer Rev. USFWS. Lamberton, Shields – B.S. wildlife.

Specific – IFG failed to make acceptable habitat-flow relationships – spawning – y.o.y. (Yampa – White)

Flow Methodologies – Tennant – 1 x section – IFG

philosophical logical – Problems – deterministic – independence

My papers

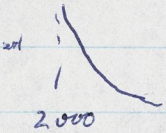
– My attempts to get needed research done – CRWCD 1978-79 meetings FWS – after my services – wanted $ ∃ –

– NCWD – Windy Gap – accountability – not done.

p. 15

cr

- serve as tools in developing flow recommend.
  not at sources of inviolable minimum flow requirmt
Black Rock - no fig 9 - YOY - ~~per~~ stable 2000 - 4000 -
dips - 6000 - rises peak 7-10 cfs - drops off (because
overbank flow - bed control - never the July-Aug water years
- Moab side - peaks at



A fig 10

would be more comp. - Lisa - Ruby Canyon
more YOY than Black Rocks - more comparable
to Moab site.

"flow changes not likely to have major effect on humpback
chub & black rats

"results may be used to formulate certain hypotheses
regarding effects of changes in discharge ... ~~They~~ should
not be construed as flow recommendations or standards
against which a project should be evaluated"

p. 33 A Flow analyses & WUA - show general positive
relationship. (Virgin flow vs. present) of depletion
on spawning fish YOY