❖ The Ichthyogram ❖

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◆ **Fish Culture Research**

"BRAKE TROUT" PROJECT BEGINS AT FES

Researchers and pathologists at the Fisheries Experiment Station (FES) have initiated work on a project to produce a new fish that may provide both good fishing and disease resistance. In October, researcher Eric Wagner traveled to Fish Lake in southern Utah, the site of an annual collection of lake trout eggs for production of splake (lake trout ♀ and brook trout ♂). For this project, however, brown trout males from the J. Perry Egan hatchery were used to fertilize the lake trout eggs. The 54,000 eggs were then subjected to a warm water "shock" (28° C for 10 minutes) to induce triploidy. Researchers have shown that triploid hybrids often survive and perform better than their diploid counterparts.

The fish eggs have just been moved from the isolation hatchery at Fish Lake to the FES for hatching and rearing. Approximately 40% of the eggs have reached the "eye-up" stage. Barring unforeseen setbacks, sufficient numbers of fish should be available for use later in 1994.

The diet preferences and other biologic characteristics of brake trout will need to be evaluated to learn where the hybrid may best be applied. Fisheries biologists hope that this fish will take after its piscivorous parents and be a useful tool in the management of overabundant forage fish. It is also hoped that the fish will be adaptable to a stream environment. This fish is sterile, so there is no danger of it breeding with other trout species. Pathologists hope to produce a fish that will possess the reported resistance of both parent strains to *Myxobolus cerebralis*, the parasite causing whirling disease.

Current plans are to include these fish as part of the sentinel fish evaluation of streams in the Fremont River drainage (previously rotenoned to eradicate *M. cerebralis)* in 1994. Brake trout will be compared in their susceptibility to whirling disease with the highly susceptible rainbow trout. Possible sites for fishery evaluation in lakes and streams in the southern region of Utah are also being considered.

Chris Wilson

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Literature Cited

[1]Behnke, R. 1979. Monograph of the native trouts of the genus *Salmo* of western North America.

[2]Trotter, P.C. 1987. Cutthroat: native trout of the West. Colorado Associated University Press, Boulder.

[3]Range based on 10 fish samples from each of two pure populations in Colorado (Wagner 1980, Colorado River cutthroat trout collection 1980: character analysis summary. Report to the Colorado Division of Wildlife).

Eric Wagner

A Pathologist's Merry Christmas

While caring for sick fish one night
even though 'twas Christmas eve
I heard a noise out in the yard
as I was about to leave.

I then decided to investigate
the noise though I heard no more
So I silently crept through the dark
till I stood before the door.

As I listened so intently
to the noise beyond the portal
I figured what I heard was surely
bound to be a mortal.

I seemed to hear the clear sharp tinkle
of tiny silver bells
As it wended through the night's chill air
and o'er the spimd of the wells.

Wondering and quiet
I stood several moments or so
Until unless mistaken
I heard a "HO HO HO!"

At this I quickly grabbed my gun
and then threw wide the door
And there before me was revealed a sight
that smacked of Christmas Lore.

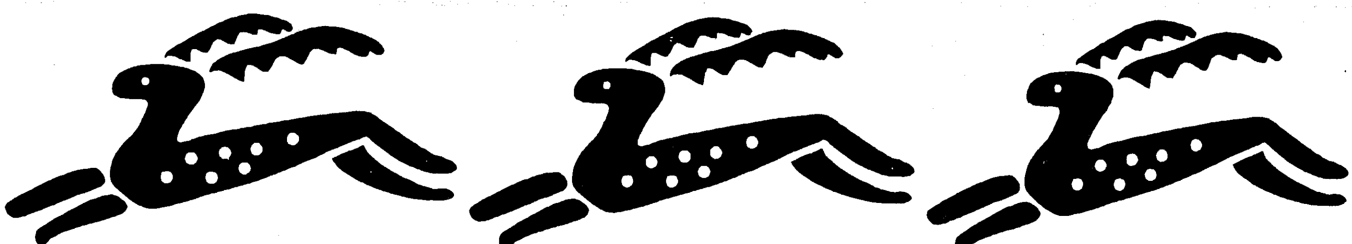
"HO HO HO" he said,
a merry old man with a chin of floss
All dressed in red with a tassled cap
I knew it was Santa Claus

He said "I've traveled far this night,
many fish hatcheries I have seen
to deliver presents to hatchery men
who I've heard have not been mean."

I said "If to other fish hatcheries you've been
even though you're good and so merry
There are a few things first to tend to
so we can be sanitary.

Jolly old Saint Nicholas
though good ones only you choose
You'll not get inside this hatchery door
'til you disinfect your shoes!"

Ron Goede (1964)



◆ Fish Culture Research

SURVIVAL OF RAINBOW TROUT IN NEW CONCRETE

Raceways for the culture of fish are commonly made of concrete. Concrete is composed of cement, water, sand and stones. General purpose Portland cement is principally composed of calcium oxide (lime, 64.7%), silica oxides (21.8%), aluminum oxide (4.9%), and iron oxide (2.4%). Minor amounts of Na2O, K2O, MgO, and SO3 are also present. Concern about the possible toxicity of new concrete to cultured fish prompted a toxicity study.

A series of 13 concrete raceways (1.13 m wide x 0.61 deep x 5.49 m long) were reconstructed in the spring of 1993 at the Fisheries Experiment Station. Only the head wall remained from the old raceways. The raceways had 3 to 4 months to cure before they were filled for the experiment which began on 29 August 1993. No water was added to raceways prior to the experiment.

"..results indicate that cured concrete does not present any short-term health risks to juvenile trout."

While the raceways were being filled, 30 juvenile rainbow trout (Sand Creek strain, mean weight 32 g) were stocked into each of two new raceways and two control raceways. On each of the following four days, an additional two new raceways were stocked. Flows were maintained at 39 L/min in each raceway for the duration of the experiment. All raceways began receiving water at the start of the experiment. Water quality tests were conducted according to standard methods on the first day, day 10, and day 23 when the experiment was terminated. Parameters measured included pH, temperature, dissolved oxygen, hardness and alkalinity. The latter two parameters were titrated with an accuracy of ±17 mg/L using a commercial test kit. Mortality was evaluated after 96 h and at day 23 when the experiment was terminated.

After 96 h or after 23 days, there were no mortalities in any of the raceways. Water quality results indicated that there were neglible differences in water quality between control and newly constructed raceways, at least among the parameters measured. It is unlikely that aluminum would be a factor since the solubility of aluminum oxide is extremely low, especially at a basic pH.

The results indicate that cured concrete does not present any short-term health risks to juvenile trout, even when stocked in the very first water in a new raceway. There are currently cutthroat trout in the raceways and they are healthy. It appears that no waiting or flushing period is required before stocking fish.
Eric Wagner

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1. Bosakowski, T. and E.J. Wagner. 1994. A survey of trout fin erosion, water quality, and rearing conditions at state fish hatcheries in Utah. J. World Aquacult. Soc., in press.
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-Thomas Bosakowski

◆ Fish Culture Research

COBBLE-BOTTOM RACEWAYS IMPROVE FIN CONDITION OF RAINBOW TROUT

In last year's survey of fin erosion at Utah state fish hatcheries, Bosakowski and Wagner (*J. World Aquacult. Soc.*, in press) found that natural bottom substrates (gravel/dirt ponds) correlated with better fin condition. In a first follow-up study (*Ichthyogram* Vol. 4, No. 2), cobble substrates did show a slight but statistically significant effect on reducing fin erosion for cutthroat trout (*Onchorynchus clarki*, Bear Lake Bonneville strain). This article reports on a second follow-up experiment which was conducted with rainbow trout (*O. mykiss*, Ten Sleep strain).

. . .the improvements in fin condition only amount to about a 5-10% reduction in fin erosion.

Approximately 1300 rainbows were stocked into each of four raceways: two with cobble bottoms and two with typical concrete bottoms (controls). Otherwise the fish were reared under normal production procedures for up to 9 months of age (180 mm). Fins were evaluated after 5, 7, and 9 months of treatment. All eight fins for each fish were scored with a scale of 0-2, such that a fish with perfect fins would have a score of 0 and a fish with severe erosion of all fins would have a score of 16. Results showed a significant reduction of erosion with cobble bottoms by 9 months (Figure 1A) and regressions lines (Figure 1B) indicated a widening of this gap with time. At the end of the study (9 mos), maximum fin lengths were also measured to further quantify the extent of fin erosion. Comparing these lengths to total body length gives a "relative fin length" which permits comparison regardless of body size. These results also indicated that cobble bottoms produced fish with significantly longer fins (Figure 2).

There are certainly other problems involved in fin erosion. For example, the dorsal fins were almost all gone by the time the fish were about 65 mm in length. This is due to a behavior called "fin nipping", but was not a problem with cutthroat trout. Other factors such as density and feeding method/schedule have been shown to effect nipping/erosion. Additionally, water quality and nutrition are also factors which have been implicated in fin erosion.

Although the results of the rainbow study were statistically significant, the improvements in fin condition only amount to about a 5-10% reduction in fin erosion. While this degree of improvement may seem small or insignificant, remember that a 1% improvement in survival can result in 100,000 more fish in Utah waters! Also note that the walls of all the raceways in these experiments were concrete, thus additional improvements in fin condition can be expected if fish are raised in more natural gravel or earthen systems.

-Thomas Bosakowski

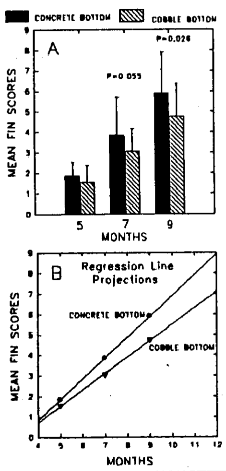

Figure 1. Mean fin scores for rainbow trout raised in raceways with concrete or cobble bottoms (A). Regression of fin scores over time (B).

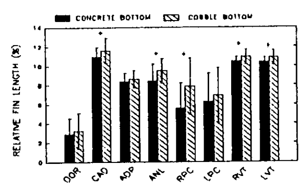

Figure 2. Relative fin lengths (fin length/total length * 100) for rainbow trout (* indicates $p < 0.05$).

◆ Fish Genetics

Meristics and Inbreeding of Logan River Cutthroat Trout

Cutthroat trout samples were taken by electrofishing on September 15-16, 1993 from sections near Logan Cave and the Dugway. Inbreeding was assessed by comparing counts of meristic characters such as fin rays, gill rakers, and mandibular pores. The mean of the differences between the left and right side is known as "fluctuating asymmetry". The asymmetry results from gene homozygosity which negatively affects the normal growth and development of fish, resulting in different counts between the left and right side. In more severe cases, the fish are crippled due to problems with normal development. Inbreeding has been demonstrated to increase the crippling rate, reduce egg eyeup, reduce hatching success, and negatively impact growth of fry (Kincaid 1983, Aquaculture 33:215).

In addition to the characters used to evaluate inbreeding, other characters such as the pyloric ceca and basibranchial teeth counts were examined to identify to which cutthroat trout subspecies the Logan River stock belongs. Scale counts were made 2 rows above the lateral line. The meristic characters are summarized in table 1.

Does the slot limit encourage fish to reproduce with siblings . . .?

Results indicated that the Bonneville subspecie (*O. clarki* utah) characters are still well represented. The pyloric ceca counts are below those reported for the Yellowstone cutthroat and the scale counts are below those for Colorado River cutthroat trout. One fish sampled was clearly a rainbow-cutthroat trout hybrid based upon the spotting pattern and low scale count (126). The ceca counts were difficult given the condition of the fish after being in the refridgerator overnight, so there may be a margin of error (± 4) to consider with those values. A sample size of 20 was used for evaluation of basibranchial teeth, scales, and ceca. For the gill rakers, a sample size of 40 was used since these values were used in the inbreeding evaluation.

The inbreeding evaluation resulted in the following fluctuating asymmetry values:

Cutthroat Trout	2.65 ± 1.61 (SD)
Brown Trout	1.70 ± 1.45

It appeared that the Logan River cutthroat trout were slightly more inbred than other populations mentioned in the literature. This was surprising, given the variety of introductions into the river over the years. Historical stocking records indicated that "natives" were stocked mainly as fry or small fingerlings, but with no indication of the fish source. Rainbow trout were stocked in the river up until 1983, but currently are only stocked in the impoundments on the lower portion of the river. There is no barrier to upstream migration, so rainbow trout have been collected from sites as far up as Temple Fork where natural reproduction has been observed.

The true causes of inbreeding in the cutthroat trout would have to be researched. Some possibilities: the inbreeding may be a result of the limited distribution of the trout in the river where the possibility of sibling matings are greater than in properly managed hatchery broodstock programs. Fishing may also have an impact on fish distribution. The Logan River ranked 4th for the most stream fishing pressure in Utah according to a recent survey. The current slot limit (2 under 12 inches and 1 over 18 inches) appears to be providing sustained fishing recreation, yet raises an intriguing question; Does the slot

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limit encourage fish to reproduce with siblings due to selective harvest of the young and old age classes?

Figure 1. Reference Asymmetry Values from other Studies

ORIGIN	STRAIN	MEAN ASYMMETRY/AUTHOR
Rainbow Trout		
hatchery	Arlee-1	1.80 (Leary et al 1984)
hatchery	Sand Creek	1.25 (Wagner 1993)
hatchery	Arlee-2	1.46 "
hatchery	Boulder	1.37 "
hatchery	Chambers Cr.	1.35 "
hatchery	Erwin	1.60 "
hatchery	Goldendale	1.60 "
hatchery	McConaughy	1.43 "
hatchery	Shasta	1.89 "
hatchery	Tasmanian	1.74 "
hatchery	Sinker Cr, ID	1.61 "
Cutthroat trout		
F_1 hatchery	Bonneville (Manning Meadow)	3.15 (Wagner 1993)
wild	Granite Cr., MT	1.86 (Leary et al. 1984
wild	O'Keefe Cr., MT	1.82 "
wild	Emery Cr., MT	1.93 (Leary et al. 1985
wild	Hungry Horse Cr., MT	1.85
Brook trout		
wild	Mud L., MT	1.43 (Leary et al. 1984)
wild	Tin Cup Cr., MT	1.59 (Leary et al. 1984)

Table 1. Summary of Logan River cutthroat trout meristic characters

Species/Strain Scientific Name	gill rakers	basi-branchial teeth	pyloric caeca	lateral scales
Yellowstone cutthroat *O. c. bouvieri*	18-23	22	52-63	165-180
Snake R. cutthroat *O. clarki*	------	4-30	32-51	136-188
Lahontan cutthroat *O. c. henshaawi*	21-28	well developed	50+	150-180
Bonneville cutthroat *O. c. utah*	16-21	5-10	25-55	140-180
Colorado R. cutthroat *O. c. pleuriticus*	17-21	4-15[3]	25-45	170-205+
Rainbow trout *O. mykiss*	-------	0	40-70	120-140
Cutthroat trout **Logan River**	**16-22** **(19.1)**	**6-12** **(7.6)**	**19-45** **(34.25)**	**129-182** **(161)**

(range, mean in parentheses) compared to ranges for other strains [1,2].

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Editor	Chris Wilson
Contributors	Tom Bosakowski
	Eric Wagner

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Send comments or change of address to:
EDITOR, The Ichthyogram, 1465 W. 200 N., Logan, UT 84321.

THE ICHTHYOGRAM
Fisheries Experiment Station
1465 W. 200 N.
Logan, UT 84321-6262