The Ichthyogram

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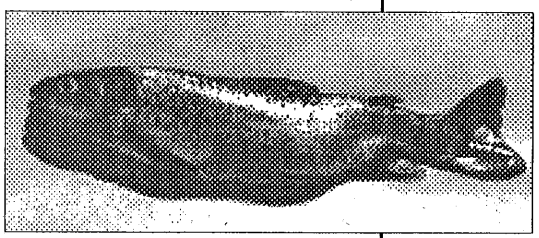
◆ **Fish Health in Utah**

Whirling Disease Discovered at New Sites in Utah!

A recent examination of rainbow trout from a commercial aquaculture facility in Wayne County led to the discovery of a new occurrence of whirling disease in Utah. The fish were purchased in December, 1992 from Trout of Paradise in Cache County in northern Utah. The whirling disease parasite was discovered in January 1993. Since it takes three to four months for detectable spores of the parasite to develop, it was concluded that the fish were infected before shipment to Wayne County. Whirling disease was later confirmed in the operation near Paradise on the Little Bear River and a satellite operation near Amalga, Utah on the Bear River. Trout of Paradise had been inspected and found to be free of all prohibited pathogens for several years (as recently as October 1992) through the combined efforts of the Utah Division of Wildlife Resources (DWR) and the U. S. Fish and Wildlife Service. They had made substantial efforts to maintain a disease-free status.



Deformed brown trout with whirling disease from Fremont River in southern Utah. Similar lesions were seen in 8% of brown trout from that area.

The hatchery at Paradise, Utah uses water from the Little Bear River and returns water back into the river. UDWR biologists from the Fisheries Experiment Station and the Northern Region decided that substantial sampling was needed in the Little Bear River drainage. Work in the Fremont River drainage in southern Utah has shown the presence of deformities and spores in various species and year classes of trout. It was hoped sampling might permit some assessment of when and where the parasite first appeared. In the Fremont drainage it was found that whenever the parasite was found in waters with naturally reproducing trout, deformed fish were present. Deformity ranged from 8 to 22% of the trout, depending upon the species and water. Where there was no natural reproduction and only stocked fish were present, there were no deformities though the parasite was found in many of the fish.

In Cache Valley, it was also decided to determine the general health and condition of the sampled fish. This was done to establish base line data needed to determine impacts of the parasite on wild populations. This involves use of a system developed in Utah for assessment of the health/condition profile (HCP) of populations of fish.

Sampling began between Hyrum Reservoir and Trout of Paradise effluent and proceeded upstream and downstream through various sites.

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Inside This Issue

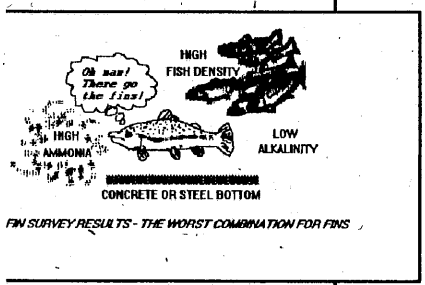
◆ RESEARCH

Is Fin Erosion in Rainbow Trout Influenced by Water Quality and Hatchery Rearing Variables?

by Tom Bosakowski

Fin condition was worse in unnatural concrete/steel systems . . .

During last spring's survey of all 10 Utah State Fish Hatcheries, a total of 24 groups of rainbow trout (20/group) were examined for signs of fin erosion. Fins were scored using Ron Goede and Bruce Barton's HCP fin index with the exception of two modifications: 1) fins were still considered eroded even if signs of active erosion-hemorrhage were not present, 2) the fin index was used on all eight fins from each trout from 20-fish samples to produce a "fin index sum" ranging from 0 to 320 for each group. Water quality and hatchery rearing variables were also measured from corresponding raceways or ponds. These included DO, hardness, alkalinity, pH, CO2, ammonia, total gas saturation, temperature, substrate type, fish density, density index, flow, flow index, and pond volume.



FIN SURVEY RESULTS - THE WORST COMBINATION FOR FINS

Stepwise multiple linear regression (NCSS software) was used to interpret the relationship between fin index sums and the hatchery variables. These fish groups averaged between 92 and 243 mm in total length and no significant correlation was observed between length and the fin index sum (r=0.045). The best-fit regression model (adjusted R^2=0.689) suggested that fin erosion was correlated with lower alkalinities, unnatural bottom substrates (concrete or steel), higher un-ionized ammonia levels, and higher fish densities. The regression model also determined the importance of these variables in the order shown above. Before attempting to interpret these results, remember that regression does not guarantee a cause and effect relationship. Some variables may act in a co-dependent manner while still others may correlate with variables not measured in the study.

It is not clear why higher alkalinities may be beneficial to fin health. Better buffering capacity of the water and greater water hardness are usually associated. Higher water hardness reduces the osmotic regulatory workload as well as providing an abundance of calcium and other cations. Fin condition was worse in unnatural concrete/steel systems suggesting that abrasion may initiate or promote fin erosion. High ammonia levels are toxic to trout and reduce oxygen transport in blood, however, a direct effect in causing fin erosion has not been previously described. And finally, high fish densities can be associated with behavioral changes such as fin nipping (territoriality) and a general decline in water quality. General, because no other water quality variables were selected as important other than ammonia, but their combined effects are still not fully understood.

From these overall results, a generalized management strategy to produce trout with better fin quality would include: keeping lower fish densities, using gravel or dirt bottom ponds if available, maintaining lower ammonia levels by reducing fish density or increasing water flow, and utilizing water sources with higher alkalinities (or liming ponds with low flow). Higher ration levels to reduce fin-nipping and experimentation with the nutritional value of other feeds may also be helpful. There has been some evidence at FES and Mantua hatchery this year that demand feeders may be effective in reducing fin erosion. This spring we are planning a controlled study with demand feeders on cutthroat trout and we'll keep you posted.

◆ RESEARCH

Performance and Behavior of Rainbow Trout in Covered Raceways

by Eric Wagner

Salmonids in nature are known to prefer cover (concealment), depending to some degree upon the species and temperature, size of the cover, the light intensity, and the age of the fish. This preference is rarely considered in intensive fish culture, although hatchery manuals do advise against exposure of eggs and alevins to direct sunlight.

In this study, the performance, health, and condition of fish were compared between fish reared in covered or uncovered raceways. Possible behavioral differences in cover selection between the two treatments were also determined.

Rainbow trout (*Oncorhynchus mykiss*) were reared in outdoor concrete raceways either with plywood covers or without. Growth, feed conversion, and mortality were not significantly different between the two groups after 215 days. Autopsy-based health and condition parameters were not significantly different between the two groups. Fin length measurements were also not significantly different, indicating no reduction in fin erosion due to rearing in covered raceways. Fin erosion was worst at the end of the study (mean fin index of 1.45 to 1.60), but signs of fin erosion also occurred in the first autopsy sample when the fish were about 10 g each.

When observed for 5 min in an outdoor observation tank, the preference for cover by a single fish from covered or uncovered raceways was significant ($P < 0.001$). However, there was no difference in preference between fish from covered and uncovered raceways. Observations were also made for 4-fish groups, over a 45 min period, either in the presence of a stuffed eagle or without it. During the first 15 min, fish from covered raceways stayed under cover more frequently than uncovered fish in the presence of the eagle, but not in the control groups (Table 1, page 6). No significant differences in cover preference between treatments (cover/uncovered) were noted during the second and third 15-min periods or when all periods were pooled. There was a tendency for all groups to seek cover less frequently in each successive time period.

". . covered raceway culture did not improve growth or general health."

In this study, it was hoped that feeding to satiation would alleviate the fin erosion problem as suggested by Wolf (1938) and Larmoyeux and Piper (1971). Although no controls were used to test the effect of demand feeders per se, the use of demand feeders did not eliminate fin erosion. However, fin erosion was mild until the end of the study when the fish loading was greatest and oxygen concentrations were low.

It was evident in both the single fish and 4-fish studies, that fish still sought cover. That innate survival behavior was present in these fish despite several generations of domestication and regardless of rearing method.

In conclusion, covered raceway culture did not improve growth or general health, and was only negligible in producing behavioral differences that would aid survival in the wild. This method is not recommended as a practical rearing method for domesticated rainbow trout. Further experiments with cutthroat trout are planned to see if a less domesticated species responds to the covers differently.

◆ **Information Services**

FES Library: For Your Information

by Eric Wagner

The FES library is open! The FES library has been evolving over the last few years, moving from one site to another at the station. The books in the library have been reorganized to catalogue the books of similar topics together, using the Library of Congress classification. A title list and author list are available for trying to find books if you have this information. The majority of books cover fish diseases, fisheries management, and aquaculture, but other books are available. The fish disease collection is more comprehensive than that at Utah State and other universities. Many of the Bonneville Power Administration publications are also in the library, although the coverage is primarily from 1985 to present.

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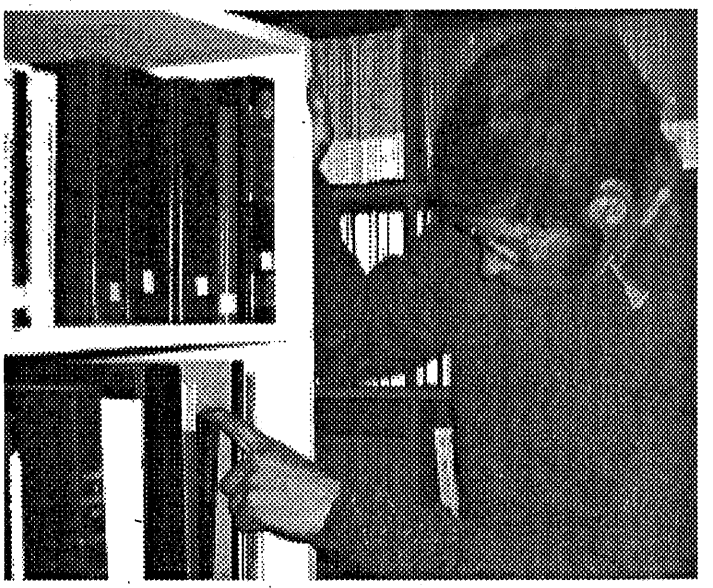
There are also a number of different journals, many of which are not available at USU. Examples include *Reviews of Fish Biology, Journal of the World Aquaculture Society, Diseases of Aquatic Organisms, Aquaculture and Fisheries Management,* and *Fish Pathology*. The collection also includes the *Canadian Journal of Fisheries and Aquatic Science, Journal of Fish Biology*, and all the American Fisheries Society journals. There are some missing years, but the latter journals are nearly complete for at least the last 20 yrs. If you have any journals you would like to donate to the library, please contact us.



For literature searching, there are Sport Fisheries Abstracts and Current References in Fish Research. The library is available for use by DWR personnel and it is hoped that these resources prove useful. Books may be signed out only by FES personnel, but a table in the library is available for your use or photocopies of key pages is permissible.

There is also a collection of DWR publications and other 'gray' literature including the Department of Health's limnological survey of Utah lakes and reservoirs. There are Federal Aid reports for many waters including Flaming Gorge, Lake Powell, Fish Lake, Bear Lake, and others. We also have DWR biennial reports for as far back as 1922 and some old issues of the old Utah Fish and Game Magazine before it was scuttled.

If you come up to Logan for a trip to the USU library, don't forget to stop in and check out our resources and perhaps stay at our newly refurbished bunkhouse.

Whirling Disease - *continued*

These included the Little Bear River, East Fork and South Fork of the Little Bear, an irrigation canal carrying water from the South Fork to the East Fork, Porcupine Reservoir, Hyrum Reservoir, Blacksmith Fork River, Logan River, Spring Creek and Summit Creek. Aquawest Inc., another commercial aquaculture facility in Cache Valley, was tested. Sampling was difficult because of snow and ice.

Infected fish were found upstream in the Little Bear River drainage. About 75% of the sampled fish were brown trout. All of them were free of the parasite. Only a few cutthroat trout were found infected. Most of the contaminated fish were rainbow trout. No infected fish were found in the South Fork of the Little Bear. Most were found below the confluence of the East and South Forks of the Little Bear. No deformed fish were found anywhere in these streams. The largest group of infected fish were found immediately above Trout of Paradise. Porcupine Reservoir upstream and Hyrum Reservoir below the contaminated facility were found free of the parasite. Biologists were surprised all fish immediately below Trout of Paradise were free of the parasite, except one small rainbow trout. Considering the life cycle of the parasite, this area should have shown the highest rate of infection. Fish in the Logan River, Summit Creek and Spring Creek were free of the parasite. Fish at Aquawest Inc. and at one site of the Blacksmith Fork have tested positiver. The pattern of infection and the lack of deformity would suggest that the parasite has not been in the river very long.

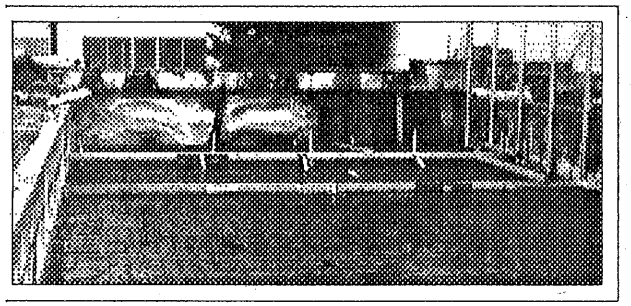
HCP profiles were determined for many of the sampled fish. The fish had little or no fat storage, but in all other aspects they appeared normal. The low fat reserves were most likely due to the winter and loss of habitat due to the drought. A big surprise was the discovery of two atypical groups of rainbow trout in the Little Bear River drainage. These two groups were more consistent with fish living in a hatchery. When captured, biologists immediately noticed that these fish were physically much more robust than the other fish they had been collecting. The fish showed a pale coloration, quite unlike wild trout. Independently in the laboratory, DWR's fish pathologists found that these fish had heavy deposits of stored fat compared to other fishes in the river. The fins showed active erosion commonly found in hatcheries, especially cement raceways. There were abnormal gills and abrasions on the noses. The profile also showed that the fish had not eaten for at least a couple of weeks. This would suggest that the fish had not learned to eat in the stream. In both cases, these fish were found only in culverts at road accesses.

It was concluded that these questionable fish had not been in the river for more than about two or three weeks. The most recent plants by the DWR were August 1992. Fish having lived in the stream that long would no longer display these characteristics. These fish were also found to be infected with whirling disease. Since it takes three to four months for detectable spores to develop, these fish were probably infected when they were planted. Since these fish were found positive, the DWR hatchery that stocked the stream was retested and found negative for the parasite. DNA testing is being planned in an effort to determine the source of the infected fish .

The source of whirling disease at Trout of Paradise and in the Little Bear River drainage remains a mystery. The finding of infected fish upstream of the hatchery implies the possibility that it may have been contaminated from the river water used in their operation. The locations and appearance of the infected fish raise the distinct possibility of deliberate eco-sabotage of the downstream facilities. In some states, "zone regulations" have been instituted to permit transfer of infected fish only to areas where whirliing disease exists. Wildlife officials in these states have expressed concerns that infected fish have been deliberately stocked by malefactors in uncontaminated areas to expand the range of permissible sales. Biologists are concerned that this scenario may have already occured in Utah. Because of this concern, several private hatcheries in Utah are being tested earlier than usual to ensure they have not been contaminated with the parasite.

Chris Wilson

FES Raceway Facelift



Land for the Logan Hatchery was purchased in 1928 and several sizes of zig-zag raceways constructed for production of fish. In 1961, additional raceways were constructed on some newly acquired land adjacent to the old ones. After 65 years, several raceway walls in the older section have fallen over and most of the system has not been used for years due to holes, leaks, and other problems. This spring, one small portion of the old hatchery will get a facelift, with the help of the Utah Division of Wildlife's Field Services branch. The project is expected to be completed by July for experiments with cutthroat trout rearing densities.

Bunkhouse Reopens at FES

After several years absence, the Fisheries Experiment Station will soon reopen limited housing facilities. A full service facility including bunk beds, kitchen, lounge and bath facilities as well as meeting rooms will be available. The facilities are located in the old "white house", located adjacent to the main station buildings.

Housing facilities were available for a number of years at the station and were used extensively. Ron Goede, director of the station, documented that the housing facilities saved the state over $30,000 in years past, based on the number of users. It is hoped the bunkhouse will be used extensively to provide areas for fisheries meetings, training sessions, library researchers and visiting guests.

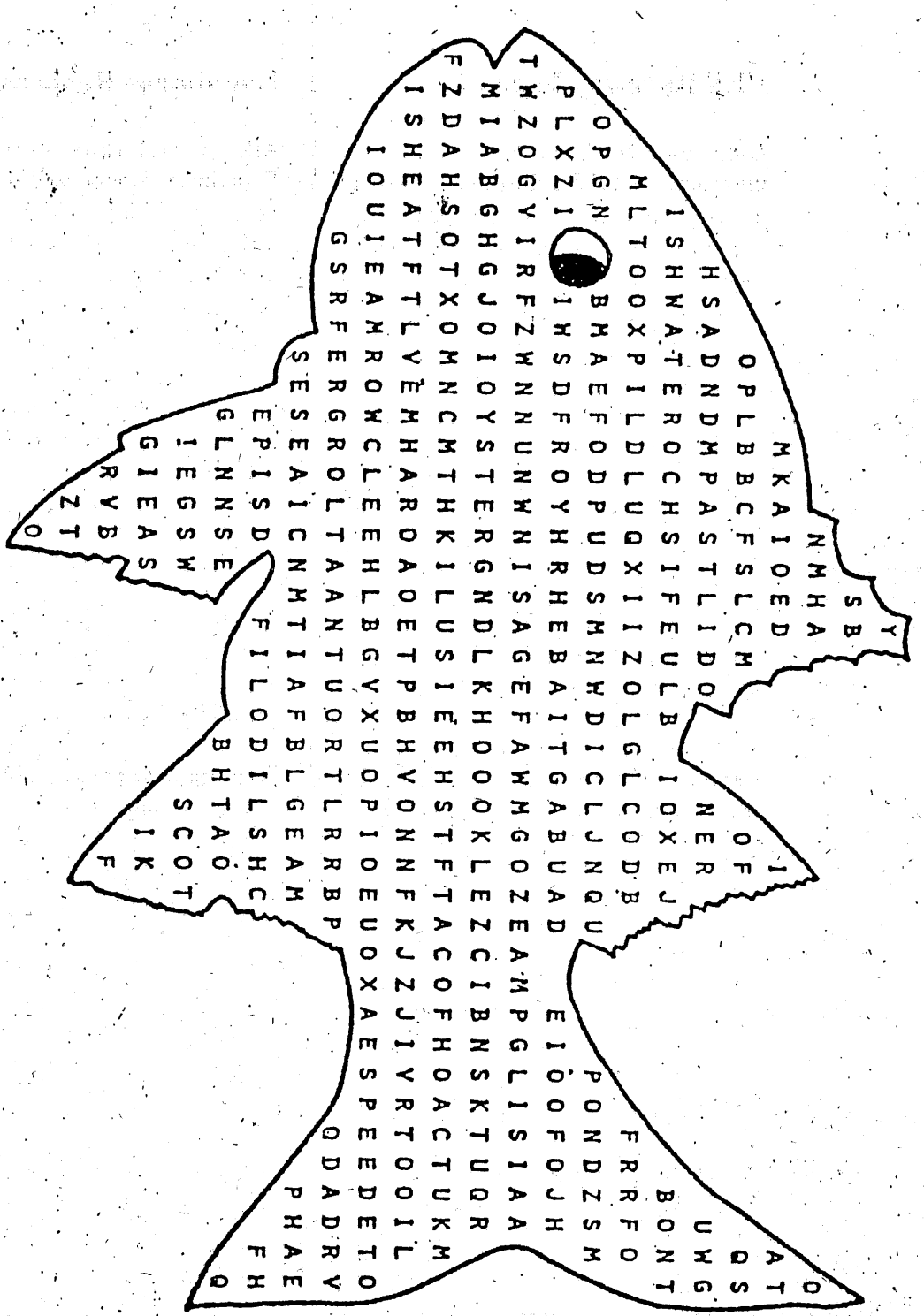
Fourteen beds are available for UDWR use. Those wishing to use the facility should contact Shirley Devenport at 752-1066 for reservations. The use of existing facilities may prove useful in light of increasing budget cuts by the Utah legislature.

Performance and Behavior of Rainbow Trout - continued

Table 1. Mean number of fish under cover (± SD) observed at 1 minute intervals for 45 minutes in the presence of a potential predator or without. The sample size (*N*) indicates the number of groups (four fish each) observed for each treatment. Mean values with a common subscript letter for each covered-uncovered pair are not significantly different ($P > 0.050$).

Minutes	Stuffed Eagle		Control	
	Covered ($N = 4$)	Uncovered ($N = 4$)	Covered ($N = 5$)	Uncovered ($N = 5$)
0-15	3.8 ± 0.11a	2.5 ± .021b	3.0 ± 1.04a	3.3 ± 0.72a
15-30	2.6 ± 1.43a	2.1 .± 0.11a	2.2 ± 1.35a	2.8 ± 0.93a
30-45	1.7 .± 1.17	1.6 ± 0.40a	2.0 ± 1.11a	2.6 ± 0.86a
Total Period				
(0-45)	2.7 ± 0.89a	2.0 ± 0.11	2.4 ± 1.05a	2.9 ± 0.77a

CATCH OF THE DAY



WORD LIST

BAIT
BASS
BLUEFISH
BOAT
BONES
CARP
CLAM
DEEPSEA
DOLPHIN
EEL
FIN
FISH
FLOUNDER
GILL
HADDOCK
HALIBUT
HOOK
LAKE
LOBSTER
OCEAN
OYSTER
PERCH
PICKEREL
PIKE
POLES
POND
ROD
SALMON
SCALES
SEA
SHAD
SHARK
SHELLFISH
SHRIMP
STREAM
SWIM
SWORDFISH
TROUT
WATER
WORM