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ARMADILLO FOUND IN RHEA COUNTY, TENNESSEE

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ABSTRACT

A nine-banded armadillo was found in Rhea County, Tennessee, about three and one-half miles west of Dayton on February 3, 1980. Whether it had migrated or been transported to this location is unclear.

INTRODUCTION

A nine-banded armadillo was found in Rhea County, Tennessee about three and one-half miles west of Dayton on February 3, 1980. It apparently had been run over by an automobile as one side of its shell was badly broken. Someone tossed it off of the main road into an old driveway, which prevented further damage. It was found by a local man and reported to Willard L. Henning, Curator of the Bryan College Museum.

DESCRIPTION AND DISCUSSION

The armadillo was a full grown specimen but not a large one. It weighed 8 pounds and 2 ounces, the head and body length was 15 inches, and the tail length was 13 inches. It was a female having three embryos about two and one-half inches in length. Presumably there was a fourth embryo which probably was mashed by the impact of the car injury. The specimen is being prepared for mounting for the Bryan College Museum collection.

Armadillo populations are reported from Texas to southern Kansas, and in Florida. A recent report indicates that they may occur in southern Georgia as far north as Columbia, Macon and Augusta. It is believed that this specimen was brought up from Florida and turned loose locally. Its activity during the middle of winter can be understood from reports that they do not hibernate, and the weeks prior to finding this specimen were weeks of mild weather of light freezes, generally. This specimen could have scratched for its food in the wooded area.

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CHARACTERISTICS AND DETERMINANTS OF THE FISHERIES RESOURCES OF THREE COLD TAILWATERS IN TENNESSEE

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ABSTRACT

Comparison of biological, water quality, and physical characteristics of Apalachia, Norris, and Chilhowee tailwaters indicates that the differences between these regulated streams and comparable but unregulated streams are due to a host of interrelated factors. Aquatic insect diversity is most strongly influenced by seasonal oxygen deficits. Fish species composition has been changed by altered temperature regimes and seasonal oxygen deficits. Standing crops of fish and aquatic insects are directly related to water mineral quality, substrate composition, and minimum instantaneous flows. Relatively infertile streams with adequate minimum flows can be as productive as more fertile streams with inadequate minimum flows.

INTRODUCTION

In the Tennessee Valley, there are 33 storage impoundments with hypolimnal discharges and sufficient storage volume to cause the stream below the dam (reservoir tailwater) to differ significantly from both preimpoundment conditions in the same area and from

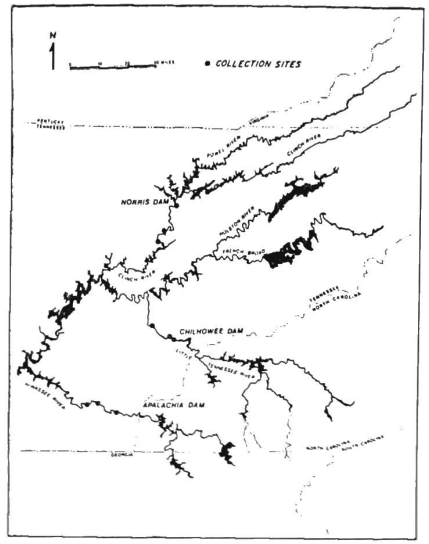

FIG. 1: *Map Showing the Collection Sites on Norris, Chilhowee, and Apalachia Tailwaters*

comparable reaches above the reservoir. Defined as that portion of a stream extending from the dam of its origin to the headwaters of a downstream reservoir or to its junction with a larger stream, these regulated and consequently unique Tennessee Valley streams have a total length of more than 300 miles and constitute an important component of the "Valley" fisheries resource.

Effects of reservoirs on downstream characteristics have been discussed by Armitage (1977), Brown et al. (1967), Churchill (1958), Crisp et al. (1973), Lehmkuhl (1972), Little (1970), Neel (1963), Pfitzer (1954), Spence and Hynes (1971), Tarzwell (1938), and others. Typical responses of streams to the storage and regulated discharge of water which largely governs their flow include altered temperature regimes, extreme flow fluctuations, reduced turbidity, a general dampening of chemical fluctuations (e.g., alkalinity, pH, and nutrient concentrations), and in some cases seasonal dissolved oxygen deficits and/or high concentrations of certain heavy metals. Biological responses attributable to these environmental changes typically include changes in the structure of fish and benthic macroinvertebrate communities and increased growth of benthic algae. The degree of difference between these tailwater communities and those found in unregulated streams is directly determined by the abiotic changes listed above and is greatest in the cold tailwaters. Although these altered streams often present unique fish management opportunities (e.g., large-river trout fisheries in the Southeast), one or more of the associated factors which create an opportunity may also be the principal limiting factor for the same tailwater fishery. For example, a high ratio of reservoir storage volume to discharge volume will result in cold downstream temperatures suitable for trout management, but may also cause a serious oxygen depletion problem.

TVA initiated a series of tailwater investigations in 1972 with the objective of characterizing major reservoir tailwaters with respect to important ecosystem components. Once characterized, recommendations for the management and improvement of tailwater fisheries could be made. This report is the first in a series of tailwater evaluations and presents the results of surveys in Norris, Chilhowee, and Apalachia tailwaters. Information in this and subsequent reports should be helpful to fishery managers and others interested in improving this valuable and largely underutilized resource.

MATERIALS AND METHODS

Description of the Areas

The locations of Norris, Chilhowee, and Apalachia tailwaters are shown in Figure 1. This report deals only with the upper 10-15 miles or "trout managed" sections of the tailwaters. Although all three are cold tailwaters, their characteristics and the operation of the reservoirs from which they originate differ considerably.

Norris is a 13,759.6 hectare meter (34,200-acre) reservoir with a full pool volume of 318,308 hectare meters (2,567,000-acre feet) whereas Apalachia and Chilhowee reservoirs have surface acreages of 262.2 hectares (648) and 707 hectares (1,747) and full pool volumes of 7,250.9 hectare meters (58,700-acre feet) and 843.8 hectare, meters (6,805-acre feet), respectively. While discharges from Norris and Chilhowee dams create cold water reaches immediately below the dams, water from Apalachia Reservoir is bypassed around the original river channel downstream for approximately 7 miles, where it passes through the Apalachia powerhouse and is discharged to the original channel. This, in effect, results in a warm water tributary created by inflows from streams between the dam and powerhouse, finally merging with cold water immediately below the powerhouse.

Although all three tailwaters are subject to radical changes

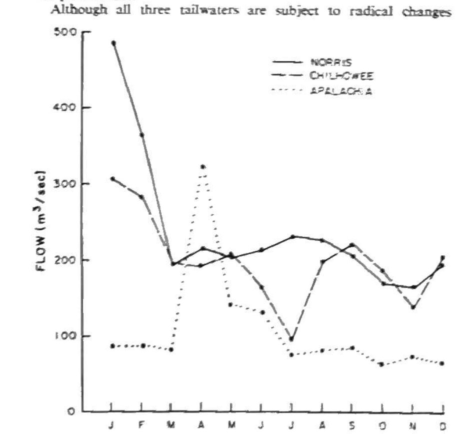

FIG. 2: *Mean Monthly Flows; Norris, Chilhowee, and Apalachia Tailwaters, 1974*

inflow over very short periods of time, the degree of fluctuation is dampened in Chilhowee tailwater because of a continuous minimum flow of at least 39.2 m^3/s (1,400 cfs). Minimum flows in Norris and Apalachia tailwaters depend upon dam leakage and tributary inflow and are often less than 1.68 m^3/s (60 cfs). All three tailwaters have extended high and low flow periods (Figure 2), the periodicity of which is determined primarily by hydroelectric and flood control needs. The only flows scheduled specifically for fisheries or recreational purposes are on Norris tailwater, where flows are reduced at least two hours daily during late summer and fall when dissolved oxygen concentrations below the dam are less than 4 ppm, and on Apalachia where in summer both low and high flows are regularly scheduled for fishing and canoeing.

Depth of water level fluctuation in the three tailwaters is a function of stream width, gradient, and average maximum turbine discharge at the dam. For example, Norris Dam has an average maximum turbine discharge of 8,000 cfs as compared to 11,000 cfs for Chilhowee, yet Norris tailwater has a range of water level fluctuation similar to that of Chilhowee because of a more narrow channel.

Stream substrates are quite different in each of the three tailwaters. Chilhowee's substrate is dominated by large boulders in pool areas, and boulders, rubble, and gravel, respectively, in shoal areas; Apalachia has extensive rubble and gravel shoals 6 to 12 miles below the powerhouse, but bedrock predominates in the upper section; with the exception of pockets of gravel and rubble and a few sand, gravel, and rubble shoals. Bedrock is the predominant substrate in Norris tailwater.

Because of extensive algal growths (primarily *Cladophora* sp.) covering much of the stream bottom, Norris tailwater has more aquatic vegetation than either Chilhowee or Apalachia, Chilhowee has extensive localized beds of *Ulothrix rivularis* with random scatterings of algae such as *Tuomega* sp.; the most common aquatic plant in Apalachia tailwater is *Ulothrix* sp. (Pfitzer 1960).

All three tailwaters are subject to intermittently high turbidities during low-flow periods whenever tributary streams are high and turbid.

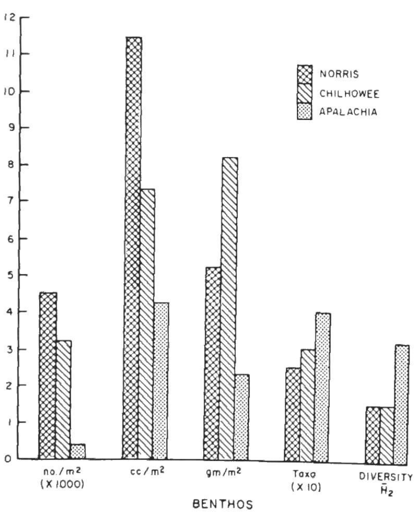

FIG. 3: *A Comparison of Selected Characteristics of Benthic Fauna Communities in Norris, Chilhowee, and Apalachia Tailwaters, Nov, 1971 through Oct, 1972*

Water Quality Measurements

TVA's Water Quality and Ecology Branch routinely monitors a number of water quality parameters in the discharges from the powerhouses. Water quality data in this report are based on that monitoring and additional limnological measurements taken concurrently with biological samples.

Benthic Fauna

Samples were taken quarterly during low-flow periods with an unmodified Surber square-foot sampler from November 1971 through October 1972. All samples were preserved in the field in 10 percent Formalin, and after sorting in the laboratory were transferred to vials containing 70 percent alcohol. Organisms were identified to genus with the exception of chironomids and annelids, which were identified to family and class, respectively.

Fish

All fish samples were collected through the cooperative efforts of TVA and Tennessee Wildlife Resources Agency (TWRA) biologists using block nets to isolate sample areas and fish toxicants to immobilize the fish. Game fish and the more common rough fish were weighed, measured, and identified in the field; others were preserved in 10 percent Formalin for laboratory identification.

RESULTS

Benthos

The three tailwaters showed distinct differences in diversities, dominant organisms, and standing crops of benthic macroinvertebrates. With just 25 and 30 taxa respectively, benthic faunal diversity was low in Norris and Chilhowee tailwaters; this is further demonstrated by their identical mean annual diversity index (H_2) of 1.4 (Figure 3). Appalachia supported a much more diverse fauna (41 taxa; H_2 = 3.2).

TABLE. 1. *Seasonal comparison of mean number of taxa, numbers, weight, volume, and diversity.*

		# Taxa	#'s/m²	Wt.	Vol.	H
Norris	Fall	12	2,670.5	3.985	7.9	1.6
	Winter	13	2,394.3	2.102	2.6	2.1
	Spring	10	11,199.4	13.439	30.6	0.8
	Summer	9	1,805.0	2.854	3.0	1.2
Chilhowee	Fall	12	2,314.8	3.287	3.6	1.5
	Winter	20	6,954.6	15.444	10.3	1.9
	Spring	—	—	—	—	—
	Summer	15	2,432.7	8.597	9.7	1.8
Apalachia	Fall	15	241.9	2.574	3.9	3.2
	Winter	24	1,017.9	3.600	4.0	3.2
	Spring	—	—	—	—	—
	Summer	14	194.4	3.496	4.7	3.3

Dominant organisms (Figure 4), differed considerably among the three tailwaters. Norris was dominated by chironomids and isopods during the fall and winter with chironomids increasing to approximately 90 percent during the spring and summer. Simuliids were predominant in the Chilhowee samples at all seasons with their numbers highest during the summer. Because of extended high flows, no spring samples were taken on Chilhowee or Apalachia. Trichopterans were next in abundance, and chironomids and ephemeropterans were present in small numbers. Benthic organisms in Apalachia tailwater were more evenly distributed during all seasons sampled (in terms of percentage composition) than in Norris or Chilhowee. Trichopterans comprised 27 to 42 percent of the samples, and ephemeropterans, gastropods, chironomids, simuliids, and others were well represented.

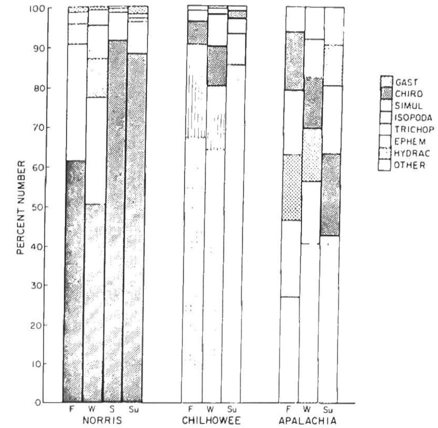

FIG. 4: *Seasonal Percentage Composition of Macrobenthos by Numbers (November, 1971-October, 1972)*

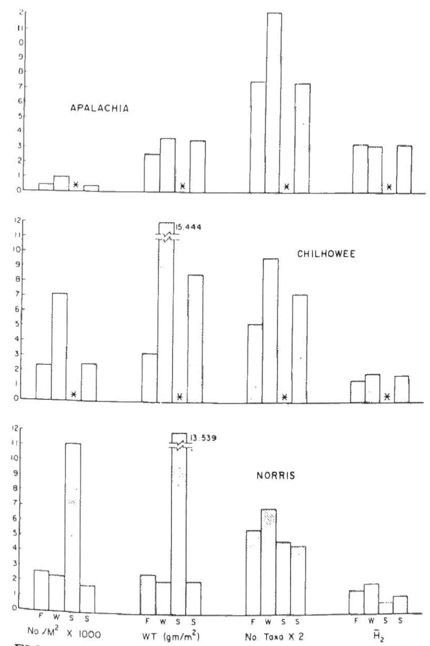

FIG. 5: *Seasonal Comparative Characteristics of Macrobenthos Collected from Norris, Chilhowee, and Apalachia Tailwaters, November 1971-October, 1972*

*No Sample Taken

Standing crop estimates (Figure 3 and Table 1) were consistently lower in Apalachia than in Norris or Chilhowee tailwaters. Norris had the highest mean annual standing crop as measured by numbers and volume, but was lower than Chilhowee by weight, possibly owing to a measurement or procedural error in the weight determinations. The absence of high seasonal peaks productivity such as generally occur during the winter in Chilhowee and during the spring in Norris make Apalachia appear less productive in macrobenthic biomass than it actually is (Figure 5).

Fish

Examination of all recent data (Boles 1969 and unpublished data of TVA and TWRA) shows Chilhowee tailwater yielded 75 species, Apalachia yielded 66 species, and Norris tailwater (41 species) had the least complex piscine community (Table 2). Thirty-one species were common to the three tailwaters. Based on collections in 1974 alone, Apalachia has a more diverse fish assemblage than either Norris or Chilhowee (Figure 6).

TABLE. 2. *The relative abundance of fish in Norris, Chilhowee, and Apalachia tailwaters. A = abundant, C = common, O = occasional, R = rare.*

Common Name	Scientific Name	Norris	Chilhowee	Apalachia
Ohio lamprey	*Ichthyomyzon bdellium*	—	O	R
Chesnut lamprey	*I. castaneus*	—	O	R
American brook lamprey	*Lampetra lamottei*	—	O	R
Spotted gar	*Lepisosteus oculatus*	—	R	—
Longnose gar	*L. osseus*	R	A	R
Skipjack herring	*Alosa chrysochloris*	R	C	R
Gizzard shad	*Dorosoma cepedianum*	C	C	R
Threadfin shad	*D. petenense*	O	R	—
Mooneye	*Hiodon tergisus*	—	C	R
Rainbow trout	*Salmo gairdneri*	A	A	A
Brown trout	*S. trutta*	—	A	A
Brook trout	*Salvelinus fontinalis*	—	R	—
Muskellunge	*Esox masquinongy*	R	—	—
Stoneroller	*Campostoma anomalum*	R	O	A
Carp	*Cyprinus carpio*	A	A	—
Speckled chub	*Hybopsis aestivalis*	—	O	—
Bigeye chub	*H. amblops*	—	R	R
Silver chub	*H. storeriana*	—	O	—
River chub	*Nocomis micropogon*	—	A	A
Emerald shiner	*Notropis atherinoides*	R	O	—
Warpaint shiner	*N. coccogenis*	—	O	C
Common shiner	*N. cornutus*	R	O	C
Whitetail shiner	*N. galacturus*	R	O	C
Tennessee shiner	*N. leuciodus*	—	O	C
Silver shiner	*N. photogenis*	—	O	—
Mirror shiner	*N. spectrunculus*	—	—	C
Spotfin shiner	*N. spilopterus*	—	O	C
Telescope shiner	*N. telescopus*	—	—	R
Steelcolor shiner	*N. whipplei*	—	—	O
Stargazing minnow	*Phenacobius uranops*	—	O	—
Bluntnose minnow	*Pimephales notatus*	R	—	—
Blacknose dace	*Rhinichthys atratulus*	R	O	R
Creek chub	*Semotilus atromaculatus*	—	O	R
River carpsucker	*Carpiodes carpio*	R	R	O
Quillback	*C. cyprinus*	A	R	R
White sucker	*Catostomus commersoni*	R	O	—
Blue sucker	*Cycleptus elongatus*	—	R	—
Northern hog sucker	*Hypentelium nigricans*	A	A	A

(continued next page)

Common Name	Scientific Name	Norris	Chilhowee	Apalachia
Smallmouth buffalo	*Ictiobus bubalus*	C	O	R
Bigmouth buffalo	*I. cyprinellus*	—	—	R
Black buffalo	*I. niger*	—	R	R
Spotted sucker	*Minytrema melanops*	—	—	O
Silver redhorse	*Moxostoma anisurum*	R	O	—
River redhorse	*M. carinatum*	R	O	R
Black redhorse	*M. duquesnei*	O	O	C
Golden redhorse	*M. erythrurum*	O	O	C
Shorthead redhorse	*M. macrolepidotum*	R	O	—
Black bullhead	*Ictalurus melas*	—	O	R
Yellow bullhead	*I. natalis*	—	—	R
Channel catfish	*I. punctatus*	C	O	O
Mountain madtom	*Noturus eleutherus*	—	R	—
Flathead catfish	*Pylodictis olivaris*	—	O	O
Northern studfish	*Fundulus catenatus*	—	O	—
Blackspotted topminnow	*F. olivaceus*	—	—	O
White bass	*Morone chrysops*	O	R	R
Striped bass	*M. saxatilis*	O	R	—
Rock bass	*Ambloplites rupestris*	R	C	C
Redbreast sunfish	*Lepomis auritus*	O	O	C
Warmouth	*L. gulosus*	—	R	R
Green sunfish	*L. cyanellus*	R	O	C
Bluegill	*L. macrochirus*	O	C	C
Longear sunfish	*L. megalotis*	—	R	R
Redear sunfish	*L. microlophus*	—	—	O
Smallmouth bass	*Micropterus dolomieui*	R	O	R
Spotted bass	*M. punctulatus*	R	O	R
Largemouth bass	*M. salmoides*	R	R	R
White crappie	*Pomoxis annularis*	R	R	R
Black crappie	*P. nigromaculatus*	—	R	—
Greenside darter	*Etheostoma blenniodes*	—	R	—
Bluebreast darter	*E. camurum*	—	—	O
Greenfin darter	*E. chlorobranchium*	—	R	—
Redline darter	*E. rufilineatum*	—	C	O
Tn. snubnose darter	*E. simoterum*	—	C	O
Speckled darter	*E. stigmaeum*	—	—	R
Banded darter	*Etheostoma zonale*	R	C	O
Yellow perch	*Perca flavescens*	—	R	R
Tangerine darter	*Percina aurantiaca*	—	—	C
Blotch-side logperch	*Percina burtoni*	—	—	R
Logperch	*P. caprodes*	A	A	C
Gilt darter	*P. evides*	—	A	C
Dusky darter	*P. sciera*	—	C	—
River darter	*P. shumardi*	—	O	—
Olive darter	*P. squamata*	—	—	O
Snail darter	*P. tanasi*	—	C	R
Sauger	*Stizostedion canadense*	R	O	C
Walleye	*S. vitreum vitreum*	O	R	—
Freshwater drum	*Aplodinotus grunniens*	C	C	R
Mottled sculpin	*Cottus bairdi*	—	A	A
Banded sculpin	*C. carolinae*	A	A	A
Brook silverside	*Labidesthes sicculus*	R	C	R
	NUMBER OF SPECIES	41	75	66

Rainbow trout, northern hog suckers, and sculpins (banded and/or mottled) are abundant in all three tailwaters. Other dominant assemblages are carp, quillbacks, and logperch (Norris); brown trout, stonerollers, and river chubs (Apalachia); and brown trout, longnose gar, carp, river chubs, logperch, gilt darters, and banded darters in Chilhowee tailwater.

Results of quantitative fish sampling in the fall of 1974 (Table 3, Figure 6) show Norris tailwater to have the highest standing crop (439 fish and 51 kg per hectare) and Apalachia the lowest (169 fish and 15 kg per hectare). Standing crop for Chilhowee is estimated at 289 fish and 16 kg per hectare.

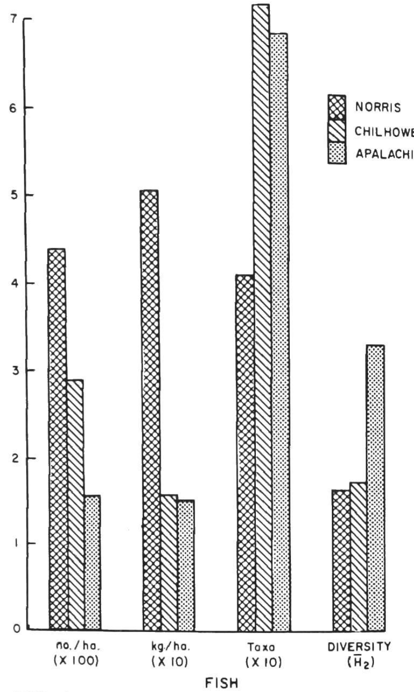

FIG. 6: *A Comparison of Selected Characteristics of Fish Populations in Norris, Chilhowee and Apalachia Tailwaters, Fall, 1974*

Water Quality

With the exception of pronounced annual late summer and fall oxygen deficits in Norris, all three tailwaters have excellent water quality (Figure 7) which is minimally influenced by municipal and industrial discharges in both upstream areas and in the tailwaters proper. Concentrations of minerals, and therefore basic productivity and buffering capacity, are higher in Norris than in Chilhowee and Apalachia, both of which have very soft water.

Discussion

Although all three tailwaters exhibit impoundment effects, the manifestation and severity of these effects vary considerably. Compared with upstream areas (Crossman et al., 1973, TVA 1970), it is evident that physical, chemical, and biological characteristics of the Clinch River (Norris tailwater) are most changed, and those of the Hiwassee River (Apalachia tailwater) are least affected. These changes can be related directly to upstream water quality and limnological and operational characteristics of the reservoir. Specific casual relationships for biological characteristics of these unique aquatic systems are more difficult to establish.

TABLE 3. *Numbers and weights of fish per hectare, Norris, Chilhowee, and Apalachia tailwaters; fall, 1974. Individual weights or grams per hectare, total weights are in kilograms per hectare.*

	Apalachia 9/29/74					
	Upper		Middle		Lower	
Common Name	No./ha	Gm/ha	No./ha	Wt./ha	No./ha	Wt./ha
American brook lamprey	0.53	TR	—	—	—	—
Ohio lamprey	1.82	28.68	—	—	—	—
Rainbow trout	7.37	936.68	6.90	746.21	2.7	901.89
Brown trout	0.53	62.11	—	—	—	—
Mooneye	—	—	—	—	1.35	315.94
Stoneroller	17.37	413.37	6.90	TR	2.03	61.35
River chub	26.32	986.84	54.02	1,465.29	5.41	168.72
Warpaint shiner	45.58	227	3.45	TR	5.41	33.72
Whitetail shiner	4.74	97.95	2.30	52.18	—	—
Telescope shiner	—	—	5.75	TR	—	—
Tennessee shiner	7.37	222.21	—	—	—	—
Mirror shiner	1.05	TR	3.45	TR	—	—
Common shiner	0.53	TR	—	—	—	—
Blacknose dace	—	—	1.15	TR	—	—
Largemouth buffalo	—	—	—	—	0.63	613.51
Golden redhorse	1.58	934.26	—	—	11.49	10,126.01
Northern hogsucker	11.05	2,351.26	6.90	2,572.64	20.27	7,181.15
Black bullhead	0.53	143.37	—	—	—	—
Yellow bullhead	1.05	121.84	—	—	—	—
Channel catfish	—	—	—	—	2.03	1,564.46
Rock bass	2.16	145.74	3.45	266.09	4.05	588.99
Redear sunfish	9.47	461.16	—	—	14.11	2,027.64
Redbreast sunfish	6.32	757.47	3.45	386.09	4.73	834.39
Green sunfish	2.11	47.79	1.15	52.18	—	—
Bluegill	3.16	272.42	4.60	271.26	8.11	892.64
Smallmouth bass	—	—	1.15	TR	0.68	30.68
Spotted bass	—	—	—	—	1.35	208.58
Greenside darter	1.58	23.89	1.15	TR	—	—
Redline darter	0.53	TR	—	—	—	—
Tennessee snubnose darter	—	—	1.15	TR	—	—
Yellow perch	—	—	—	—	3.38	622.70
Logperch	25.79	432.47	13.7	318.28	38.51	73.18
Gilt darter	4.74	57.32	8.04	TR	—	—
Sauger	—	—	—	—	0.68	843.58
Drum	—	—	—	—	2.03	1,840.54
Sculpin*	26.84	205.47	85.06	725.28	3.38	39.86
TOTALS (number and kilograms per hectare)	160.53	8.93	213.79	6.87	132.43	29.45
Diversity (H_2)	3.6		2.9		3.4	
NO. of taxa	25		19		20	

	Norris 10/15/74		Chilhowee 10/2/74			
	Upper		Upper		Lower	
Common Name	No./ha	Wt./ha	No./ha	Wt./ha	No./ha	Wt./ha
Chestnut lamprey	—	—	1.81	2.72	—	—
Rainbow trout	266.20	26,226.9	2.73	296.72	—	—
Brown trout	—	—	4.37	1,249.73	23.63	4,501.82
Stoneroller	8.8	157.15	—	—	0.91	1.81
Carp	3.8	4,627.3	—	—	7.27	12,727.27
River chub	—	—	1.09	1.64	3.64	234.54
Warpaint shiner	—	—	0.55	TR	—	—
Black buffalo	1.92	1,746.15	—	—	—	—
Quillback carpsucker	17.31	6,722.69	—	—	—	—
Golden redhorse	10	5,884.54	—	—	0.91	843.64
Northern hogsucker	8.85	1,763.61	10.38	1,250.82	37.27	3,501.82
Silver redhorse	—	—	—	—	0.91	1,545.45
Black redhorse	3.08	1,728.69	—	—	3.64	2,225.45
White sucker	0.38	174.61	—	—	—	—
Green sunfish	—	—	—	—	0.91	3.64
Bluegill	1.92	34.92	14.21	602.19	9	9
Smallmouth bass	—	—	0.55	1.09	—	—
Greenside darter	—	—	—	—	0.91	4.54
Logperch	0.77	17.46	—	—	11.82	172.73
Dusky darter	—	—	—	—	1.82	1.82
Sauger	0.38	69.85	—	—	—	—
Sculpin*	115.38	1,274.69	398.36	2,040.98	48.18	305.46
Brook silverside	0.38	TR	2.19	1.09	—	—
TOTALS (number and kilograms per hectare)	439.61	50.78	434.43	5.44	143.64	26.07
Diversity (H_2)	1.6		0.6		2.8	
NO. of taxa	14		10		15	

*Cottus bairdi and Cottus carolinae

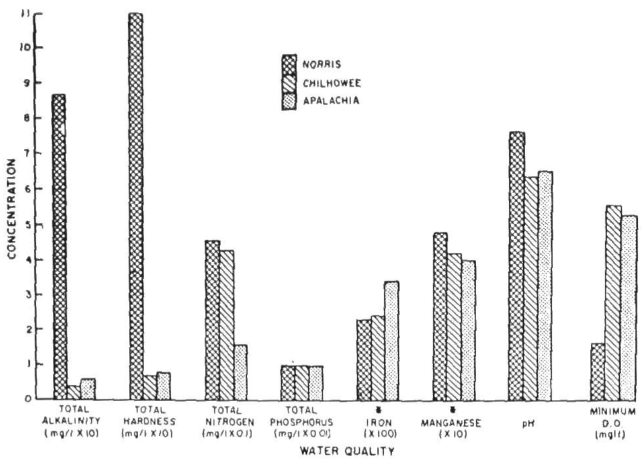

FIG. 7: *A Comparison of Selected Water Quality Pa- waters, 1974*

Lehmkuhl (1972) stressed altered temperature regimes as the principal cause of reduced benthic faunal diversity in the south Sasketchewan River below Gardiner Dam. Spence and Hynes (1971) attributed benthic faunal changes downstream of a relatively small impoundment to changes in available particulate organics and increased benthic algal growth as well as temperature. Brown, et al. (1967) in a study of three Arkansas tailwaters ascribed faunal differences to "complex ecological relationships." Differences in the nature and operation of Norris, Chilhowee, and Apalachia Reservoirs provide a good basis to hypothesize causes of faunal differences in these tailwaters.

Faunal assemblages of Apalachia tailwaters most nearly resemble communities from similar, but unregulated streams; correlations of contrasting abiotic conditions in Norris and Chilhowee with faunal differences between those tailwaters and Apalachia should serve as the basis for establishment of casual relationships. Using this rationale, one can analyze the relative importance of key determinants (assumed in this instance to be minimum flows, stream bed substrate, and seasonal dissolved oxygen levels) in causing observed effects. This approach is justified since mineral quality would have little effect on faunal community structure, and none of the tailwaters were ever shown to have high concentrations of heavy metals or other toxic substances.

Substrate composition is certainly important to both fish and benthic fauna; however, since both Norris and Apalachia have a preponderance of bedrock in their upper reaches, it must be assumed that the lower faunal diversities and numbers of taxa in Norris are not due to substrate alone. The same conclusion can be reached regarding minimum flow. Although Chilhowee tailwater has much more favorable conditions, minimum flows are almost identical in Norris (fewest taxa) and Apalachia (most taxa, highest diversity). Seasonally low dissolved oxygen concentration is the only major abiotic characteristic not shared by two or more of the tailwaters and consequently may be assumed to be largely responsible for the unique faunal community in Norris tailwater. This observation is in agreement with data reported for other tailwaters in North America.

In summary, this investigation of three cold tailwaters in Tennessee confirms the conclusions of others who recognize that tailwater biota are governed by the interaction of a number of complex ecological relationships, but further proposes that dissolved oxygen is the factor most limiting to the maintenance of diverse tailwater faunal assemblages. Other biological differences such as standing crops and seasonal abundances of fish and bottom fauna are more directly influenced by temperature, mineral quality, flow regimes, and substrate composition.

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