

EXPERIMENTAL USE OF THE HAUL SEINE FOR ROUGH FISH REMOVAL IN FOUR TENNESSEE IMPOUNDMENTS

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ABSTRACT

Four Tennessee impoundments, namely; Melton Hill Reservoir on the Clinch River, Watts Bar and Chickamauga reservoirs on the Tennessee River, and Douglas Lake on the French Broad River, were experimentally fished with an 1,800 yard haul seine from September 17 through December 11, 1963.

Objectives of the experiment are as follows: To determine the effect of the haul seine in taking valuable market fish and other non-game fish; to determine its effect on game fish as to mortality and catchability, and to explore its possibilities as a sampling method for reservoir fish populations.

A crew of seven men operated the gear and a fisheries biologist was present during the operation.

The haul seine yielded 154,226 pounds of rough fish and 9,991 game fish by number, during the three months of the operation, which consisted of 54 days of actual fishing and 53 separate hauls. Four hundred and thirty-one (431) hours of operation or 3,017 man-hours were employed in this winter phase of the experiment. The original investment was valued at \$14,960. Returns netted approximately \$1,868 per month¹ at an operational cost of about \$4,160 per month, leaving a monthly deficit of \$2,292.

The average catch per 1,000 yards of seine netted approximately 1,617 pounds of rough fish and 105 game fish by number. The average

¹ Based on wholesale prices per pound of fish.

haul yielded 2,909 pounds of rough fish and 188 game fish by number. Harvest was greatest when the reservoir was stable or rising, and decreased when the reservoir was dropping.

Stomach analysis revealed that catfish, large drum, and redear sunfish were utilizing the Asiatic clam, *Corbicula fluminea*, a recent arrival in Tennessee waters.

Results of the haul seine experiment demonstrated that this gear could be used accurately to sample shoreline fish populations and to locate winter concentrations of certain game fish as well as rough fish. One 400-yard haul on Douglas Reservoir yielded 382 game fish weighing approximately 423 pounds and 100 pounds of rough fish.

Finding concentrations of marketable rough fish in locations suitable for seining and a market for gizzard shad and other potential commercial fish such as small drum, are the main factors affecting the commercial success of the haul seine.

INTRODUCTION

In an effort to better control the rough fish populations in Tennessee reservoirs, the Tennessee Game and Fish Commission initiated the use of the haul seine in four reservoirs of East Tennessee. This experimental project was accomplished through a bid-type contract with a local fish market operator.

Commercial value of the haul seine harvest did not defray the initial expense or meet current expenses, but other findings justify the continued use of the haul seine as a means of rough fish removal and reservoir sampling device.

Objectives of the haul seine project are as follows: (1) To determine the effects of the haul seine in taking valuable commercial fish and potential market fish such as gizzard shad, small drum, and gar; (2) to determine its effect on rough fish populations over a period of years; (3) to determine its effectiveness in taking game fish and the resulting degree of mortality; (4) to compare the overall results with other methods of rough fish removal, and (5) to explore the possibilities of its potential as a method of sampling reservoir shoreline fish populations.

Reservoirs fished in this study include Melton Hill on the Clinch River, Douglas on the French Broad River, and Watts Bar and Chickamauga on the Tennessee River. The first phase of the haul seine project was conducted from September 17 through December 11, 1963.

PERSONNEL AND EQUIPMENT

Personnel operating the haul seine included the crew chief and six other commercial fishermen. A fisheries biologist was present during most of the operation and at the time of the harvest. Other Game and Fish Commission personnel were invited to attend the operation, and objectives and techniques of the operations were explained to all visitors. List 1. Includes an annotated list of equipment and a minimum initial cost.

FISHING METHODS

Actual fishing of the gear included anchoring one end of the haul seine near the bank and striking out with the seine barge perpendicular to the bank and gradually stretching the seine in a semi-circle or rough rectangle back toward the same shoreline. The actual plan depended on the depth, slope, and type of bottom of the area to be covered. In very shallow areas, much of the seining was done by hand or a combination of outboard motor, winch, and pulling by hand. Toggle lines were spaced 100 feet apart on the seine proper and the seine was re-

Table 1. Reservoir Statistics on Four Reservoirs Chosen for the Haul Seine Experiment.

Reservoir	Stream Impounded	Year of Impoundment	Normal Pool Elevation	Normal Acreage	Period of Haul Seine Experimental Use
Melton Hill	Clinch River	1963	795	5,720	Sept. 15 & 16, 1963
Douglas	French Broad River	1943	1,000	30,600	Dec. 11, 1963
Watts Bar	Tennessee River	1942	745	38,600	Sept. 19 to Oct. 30, 1963
Chickamauga	Tennessee River	1940	685	34,500	Nov. 2 to Dec. 6, 1963

tried by attaching the winch rope to a toggle line as retraction demanded. The haul seine was first used in Melton Hill to evaluate the rough fish population in this young reservoir, but the low market value of these small fish, and the presence of trash made it necessary to transfer the operation to Watts Bar Reservoir. In Chickamauga Reservoir, where extremely large areas were available, an "end haul" method was used. A 400-yard section of the seine was stretched and set and the remaining 1,400 yards of the seine were pulled from the opposite end of the area. The bag, section of the seine was retrieved by means of a gasoline-powered winch attached to a flat-bottom boat moored to the bank. This end haul permitted larger areas to be covered, easier handling of the seine, and prevented fish from escaping. In Douglas Lake, only the 400-yard section was used. Areas seined ranged from approximately 10 surface acres to 130 surface acres. Game fish were returned to the water as quickly as they appeared in the seine and were the first to be removed from the pen at the end of the haul. The fish were penned up at the end of the haul by bringing the bag (See List 1) against a wire fence backstop to prevent shallow water turbulence and muddying while the fish were separated and loaded into boats along side.



John Conder, Supervisor of Commercial Fisheries and Minnows for the Tennessee Game and Fish Commission (left), and Loudon County Game and Fish Officer Kenneth Wilson, are pictured in the foreground above as commercial fishermen pull in some 1,500 yards of haul seine used during a recent test of heavy commercial fishing gear at Watts Bar. (Photo by Tennessee Game and Fish Commission.)

List 1. Haul Seine Equipment and Approximate Cost of Investment (Minimum Requirements).

Nomenclature	Number	Unit	Cost	Amount
Haul Seine 1800 yards Nylon 2½" mesh, 16 ft. deep, bag section 1½" mesh, 16 ft. deep, 35 ft. long.	1	each	\$4,300.00	\$4,300.00
Vehicle	2	each	2,500.00	5,000.00
Boat, 14 to 16 foot Flat Bottom	4	each	400.00	1,600.00
Outboard Motor 18 and 28 horse power	4	each	350.00	1,400.00
Barge—10' x 20'	1	each	1,500.00	1,500.00
Winch with 9 horse power gasoline engine	1	each	400.00	400.00
Boat Trailer	1	each	200.00	200.00
Rope and Twine				200.00
Miscellaneous Con- struction Costs				200.00
Nylon Rope ½" x 100 yards	1	100 yds.	60.00	60.00
Gill Net 1½" x 100 yards	1	each	60.00	60.00
Wire Fence 1" x 2" x 4' x 100'	1	each	20.00	20.00
Steel Stakes	10	each	1.00	10.00
Dip Nets	5	each	2.00	10.00
TOTAL				\$14,960.00

Table 2. Rough Fish Poundage from Haul Seine Operation in Four Tennessee Reservoirs.

RESERVOIR	NUMBER OF HAULS	SPECIES						TOTALS
		Carp	Buffalo	Carp- sucker	Catfish	Paddle- fish	Drum	
Melton Hill	2	5	500	(50) ¹	8	—	25	(500) ² 538
Douglas	3	463	1265	—	7	—	3	2 1740
Watts Bar	26	4841	20392	1322	1121	11	2414	31475 61576
Chickamauga	22	18472	21466	4782	3135	—	2913	39604 ³ 90372
TOTALS	53	23781	43623	6104	4271	11	5355	71081 154226

¹ Approximately 50 pounds of carp sucker weighed in with buffalo.

² An estimated 500 pounds of shad were taken in Melton Hill.

³ Includes approximately 1,000 pounds of longnose and shortnose gar taken in the Hiwassee River section of Chickawauga Reservoir.

Table 3. Combined Monthly Rough Fish Poundage from Haul Seine Operation in Four Tennessee Reservoirs.

MONTH	NUMBER OF HAULS	SPECIES							TOTALS
		Carp	Buffalo	Carp- sucker	Catfish	Paddle- fish	Drum	Shad	
September	12	1127	9135	603	406	—	508	12778	24557
October	16	2914	11257	719	723	11	1931	18747	36302
November	19	16986	20509	4586	3003	—	2577	38604	86265
December*	6	2754	2722	196	139	—	339	952	7102
TOTALS	53	43623	43623	6104	4271	11	5355	71081	154226

* Includes three short (400 yard) hauls in Douglas Reservoir.

List 2. Weekly Itemized Cost of Haul Seine Operation.

Wages—six men	\$600.00
Vehicles (3) gasoline and maintenance	300.00
Miscellaneous maintenance	100.00
Outboard motor gasoline and oil	40.00
TOTAL	\$1,040.00

DATA COLLECTED

Data were recorded on a Daily Harvest Report based on commercial categories and values, and listing physical conditions of the weather, water, and area seined. Rough fish were weighed according to species and size groups when they reached the market. A daily record was kept of the poundage and disposition of the fish. Except for shad, most fish were disposed of by direct sale. Shad and other unmarketable fish were transported to disposal units since no profitable market could be obtained.

Game fish were recorded by species, number, and sample weights as they were removed from the seine or pen. In addition to other data on the form, miscellaneous information was recorded: Scale samples and stomach contents were taken at random. Unusual circumstances or situations were noted, such as changes in lake elevation, weather, and the occurrence of turtles and other aquatic forms in or near the area. Names of persons contacted at or near the site of the haul seine operation were recorded.

HARVEST COMPOSITION

During the three months of the study which consisted of 54 days of actual fishing and 53 separate hauls, 154,226 pounds of rough fish were harvested and 9,991 game fish by number were captured and released from the haul seine. This gives an average of nearly 3,000 pounds of rough fish per haul. Species poundage by reservoir is given in Table 2. Shad comprised 40 per cent of the total weight of rough fish and was the most plentiful followed by buffalo 28 per cent, carp 15 per cent, carpsucker 4 per cent, drum 4 per cent, catfish 3 per cent, and paddlefish trace per cent.

Approximately 1,000 pounds of gar were taken in the Hiwassee River sector of Chickamauga Reservoir, but these fish were of insignificant commercial or technical value, so are not listed separately in Table 2. The best haul was made on the Hiwassee River on November 15th, yielding 17,925 pounds of rough fish and 924 game fish which weighed approximately 300 pounds, giving a total weight of 18,225 pounds for the approximate 130 surface acres covered or 140 pounds per acre. Rough fish poundage by months is given in Table 3. November was the most productive month. This is partly attributed to the better seining areas in Chickamauga Reservoir and also the larger percentage of carp apparently available.

Crappie comprised 55 per cent of the game fish catch followed by sunfish (reदार and bluegill) 31 per cent, white bass 8 per cent, largemouth bass 4 per cent, sauger 2 per cent, and smallmouth bass (from Watts Bar only) trace per cent. Game fish numbers and weights by reservoirs are shown in Tables 4 and 5. Douglas Reservoir game fish will not compare accurately with other reservoirs since they were captured in a two and one-half inch bag mesh in contrast to the one and one-half inch mesh used elsewhere. Shad were practically eliminated and game fish numbers reduced when the mesh size of the bag was increased to by-pass the unmarketable shad. Game fish average weights were nearly doubled with this increase in mesh size from one and one-half inches to two and one-half inches, while numbers dropped to

Table 4. Number and Total Weight¹ of Game Fish Caught in Haul Seine by Reservoir.

RESERVOIR	NUMBER OF HAULS	Largemouth Bass	Smallmouth Bass	Crappie ²	White Bass	Sauger	Sunfish ³	Total Number	Total Weight
Melton	2	4	—	2	2	—	—	8	? ⁴
Watts Bar	26	121	30	1748	603	128	711	3341	?
Chickawauga	22	231	—	3405	216	46	2331	6229	2768
Douglas ⁵	3	38	—	340	35	1	—	413	600
TOTALS	53	394	30	5495	855	175	3042	9991	?

¹ Total weights determined by random samples.

² Primarily white Crappie.

³ Bluegill and redear sunfish.

⁴ Weights were not recorded in Melton Hill or Watts Bar Reservoirs.

⁵ In Douglas Reservoir, the 2½" mesh bag section replaced the 1½" mesh.

Table 5. Poundage and Percentage of Rough Fish and Game Fish in Chickawauga and Douglas Reservoirs.

RESERVOIR	NUMBER HAULS	Total Weight	Percentage Weight	Total Weight	Percentage Weight	Total Weight
Chickawauga 1½" mesh	19	87679	96.9	2734	3.1	90413
Chickawauga 2½" mesh	3	2693	98.7	34	1.3	2727
Douglas 2½" mesh	3	1740	96.6	600	34.0	2340
TOTALS	25	92112	95.3	3368	3.6	95480

Table 6. Size Range and Average Length (inches) of Game Fish Taken in Haul Seine.

RESERVOIR	Largemouth Bass		Smallmouth Bass		Crappie		White Bass		Sauger		Sunfish	
	Range	Av. L.	Range	Av. L.	Range	Av. L.	Range	Av. L.	Range	Av. L.	Range	Av. L.
Watts Bar	9-19	15	10-25	15.0	8-16	10	10	10.0				
Melton Hil	10	10			10	10.8	9-15	12.0	13-18	15.5	5-8	6.8
Chickamauga	10-21	14			6-15	10.0	9-13	11.0	10-17	13.0	5-9	6.9*
Douglas† Combined Range	17-26	20			11-16	13.5	12-16	14.0	18	18.0		
& Average Length	9-26	14.7	10-25	15.0	8-16	11.0	9-16	11.8	10-18	15.5	5-9	6.85

* Average length for redear sunfish was approximately seven inches. Average length for bluegill was six inches.
 † Size range for Douglas is larger because of larger mesh size. See text.

less than half the projected catch for at least the sunfish and crappie.

Total weights of game fish were calculated from random samples starting with the Chickamauga operations in November since a more accurate comparison of rough fish to game fish was desired. This comparison for Chickawauga and Douglas reservoirs is shown in Table 5. Game fish comprised 3.6 per cent of the catch by weight for these two reservoirs combined, i.e., for each 3.5 pounds of game fish caught, 96.5 pounds of rough fish were removed from these reservoirs.

Average lengths are a rough approximation since only a small percentage of the fish were actually measured. However, this rough data satisfies the objectives of this project. Tables 5 and 6 further reveal the potential of the haul seine as a sampling device for reservoirs.

LABOR, OPERATION HOURS, AND FISHING SUCCESS

To evaluate the economics of the haul seine operation, time of operation was recorded and tabulated giving the results in Table 7. When the average monthly income of \$1,868 is compared with average monthly expenses (List 2) of \$4,160, it is readily seen that the haul seine operation was a losing proposition financially. These figures leave a rough monthly deficit of \$2,292 and the contractor must be complimented on his perseverance in staying with the operation for experimental reasons. A market for shad at 2c per pound would have added \$473.87 to the monthly income and this potential should be considered. Monetary values of the commercial harvest by reservoirs are given in Table 8. Considering time and labor and the commercial value of rough fish, fishing success was best in Chickawauga, followed successively by Watts Bar, Douglas, and Melton Hill. The 53 hauls entailed 431 hours of seine operation and gave an average of 356.5 pounds of rough fish per operation hour and 51.7 pounds per man hour.

CATCH PER UNIT OF EFFORT

Harvest per 1,000 linear yards of netting is given in Tables 9 and 10. This may be compared to trammel and gill net catch per 1,000 yards in Norris Reservoir (Carroll et al 1963) in Table 11. The haul seine was 488 per cent more effective than three to five inch nets used during the winter of 1958 at Norris Reservoir which was the first time commercial dishing was permitted in Norris.

Because Norris is a storage reservoir on the Clinch River, and Chickawauga is a mainstream reservoir on the Tennessee River, this comparison is offered only as possible evidence of the effectiveness of the haul seine and the comparison of the gear may reflect the differences in the fish populations more accurately than the difference in the effectiveness of the gear. Catch per 1,000 yards with trammel net whip sets yielded an average of 1,630 pounds of rough fish in T.V.A. lakes of Alabama (White 1959) as compared to 1,616 pounds with the haul seine in Tennessee impoundments, and 1646 pounds of fish with the haul seine in Florida (Moody 1957). Chickamauga averaged 2,281 pounds. In Watts Bar, trammel nets yielded an average of 118 pounds for the winter quarter of 1962 as compared to 1,310 pounds for the haul seine in September and October of 1963.

The average haul yielded 2,909 pounds of rough fish using 1,800 yards of running seine. The best end haul from Chickamauga yielded 16,925 pounds of rough fish and is added to Table 10 to exemplify the possibilities of the haul seine.

WATER LEVELS

It has been opined by fishermen, including the writer, that poor fishing success accompanies periods of drawdown. Results of this

Table 7. Number of Operation Hours and Men Hours per pound of Rough Fish and per Number of Game Fish Caught with the Haul Seine.

RESERVOIR	NUMBER OPERATION HOURS	NUMBER MAN HOURS	TOTAL LBS. ROUGH FISH	Total No. Game Fish	GAME FISH Number per Op/Hr.	POUNDS PER Op/Hr.	ROUGH FISH Pounds Per Man/Hour
Melton Hill	17	119	538	8	.5	31.6	4.5
Douglas	8	56	1740	413	51.5	217.5	7.3
Watts Bar	237	1659	61576	3341	14.1	259.0	37.6
Chickawauga	169	1183	90372	6229	36.2	535.1	76.5
Total or Average	431	3017	154226	9991	23.2	356.5	51.3
Best Single Haul	18	126	16925	924	56.9	940.3	134.3

Table 8. Wholesale Values¹ of Commercial Fish Taken in Haul Seine.

COMMERCIAL SPECIES	Price Range	Average Price	Watts Bar	Chickamauga	Total From All Four Reservoirs
Buffalo	\$.06-.10	\$.08	\$1631.36	\$1717.28	\$3489.84
Catfish	.20-.26	.22	246.62	689.70	939.16
Carp	.02-.05	.03	145.23	554.16	713.43
Carp sucker	.03-.05	.04	52.88	191.28	244.16
Drum	.03-.05	.04	96.56	116.52	214.20
Paddlefish	.10-.20	.20	2.20		2.20
Total or Average	\$.02-.30	\$.11	\$2174.85	\$3268.94	\$5602.99

¹ Prices paid to commercial fishermen per pound of whole fish.

study tend to support this hypothesis as illustrated in Figures 1 and 2. Winter drawdown was in effect with little changes in water temperature for either Watts Bar or Chickamauga reservoirs during the haul seine operation. Surface water temperature for Watts Bar during the month of October dropped from 74°F. to 65°F. and elevation from 740.5 feet to 738.2 feet. Water temperature for Chickamauga dropped from 65°F. to 49°F. and elevation from 678.3 feet to 676.2 feet. Decline in the harvest for Watts Bar Reservoir corresponded to a lowering of water levels. Stable or rising reservoir conditions produced the better catches. The greatest variation occurred in the Hiwassee section of Chickamauga Reservoir on November 15th and 16th, where the largest single harvest was taken. This was because of the large area seined, rising elevation, and a fairly clean bottom. Harvest for the two separate hauls on the 19th and 20th yielded the largest harvest for two days fishing under comparable conditions. Lesser deviations are due to snags encountered during the seining operation which resulted in tears in the netting and escape of fish. Further evaluation of water levels is recommended, but from the data at hand, the trend is clear at least in Watts Bar where seining conditions were more stable and a drop in the water level of only 2.3 feet affected fish movements and harvest. Seizable areas of high value have been charted on navigation maps, and it is expected that complimentary results will be realized during similar physical conditions of weather and water fluctuation. The effects of water fluctuations on fish movements in Reelfoot Lake support findings of this paper (Nichols, 1957).

Table 9. Rough Fish Catch per Unit of Effort With the Haul Seine.

SPECIES	TOTAL POUNDAGE HARVESTED			POUNDAGE PER 1000 YDS. OF SEINE		
	Watts Bar	Chicka- mauga	All Four Reservoirs	Watts Bar	Chicka- mauga	All Four Reservoirs
Buffalo	20392	21466	43623	433.0	542.0	457.2
Carp	4841	18472	23781	103.0	466.0	249.2
Carp sucker	1322	4782	6104	28.7	120.7	64.0
Catfish	1121	3135	4271	23.8	79.2	44.8
Drum	2414	2913	5355	51.4	73.5	56.1
Shad	31475	39604	71081	669.3	1000.0	745.0
All Rough Fish	61576	90372	154226	1310.0	2281.4	1616.3

Table 10. Game Fish Catch per Unit of Effort With the Haul Seine.

SPECIES	TOTAL NUMBER CAUGHT			NUMBER PER 1000 YDS. OF SEINE		
	Watts Bar	Chicka- mauga	All Four Reservoirs	Watts Bar	Chicka- mauga	All Four Reservoirs
Largemouth Bass	121	231	394	2.6	5.8	4.1
Smallmouth Bass*	30	—	30	0.6	—	0.6
Crappie	1748	3405	5495	37.2	85.9	57.6
White Bass	603	216	855	12.8	5.4	8.9
Sauger	128	46	175	2.6	1.2	1.8
Sunfish	711	2331	3042	15.2	58.8	31.9
All Gamefish	3341	6229	9991	71.0	157.1	104.6

* Smallmouth Bass taken only from Watts Bar Reservoir.

Table 11. Catch per Unit of Effort for All Rough Fish During Three Seasons of Commercial Fishing at Norris Reservoir in Tennessee*

SPECIES	CATCH PER 1000 YDS. OF NET BY WEIGHT		
	1958-59	1959-60	1960
Paddlefish	162.2	33.0	12.1
Flathead Catfish	79.9	28.2	23.5
Carp	55.8	30.0	18.8
Carp	24.1	8.7	8.9
Drum	3.7	1.4	1.6
Longnose gar	2.4	1.2	1.5
Channel Catfish	1.7	0.9	1.5
Redhorse	1.0	0.6	0.8
All Rough Fish	330.8	104.0	68.7

* This table gives harvest for 3" to 5" gill and trammel nets and is reprinted in part from "Three Seasons of Rough Fish Removal at Norris Reservoir, Tennessee," Billy B. Carroll et al, Transactions American Fisheries Society, Vol. 92, No. 4, October, 1963 pp. 356-364.

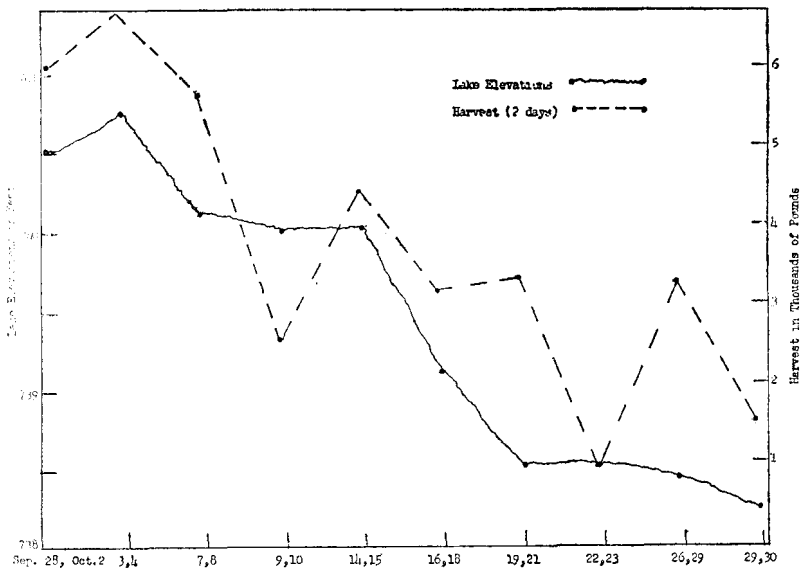


Figure 1. Rough Fish Harvest in Relation to Lake Elevations, Watts Bar, October, 1963

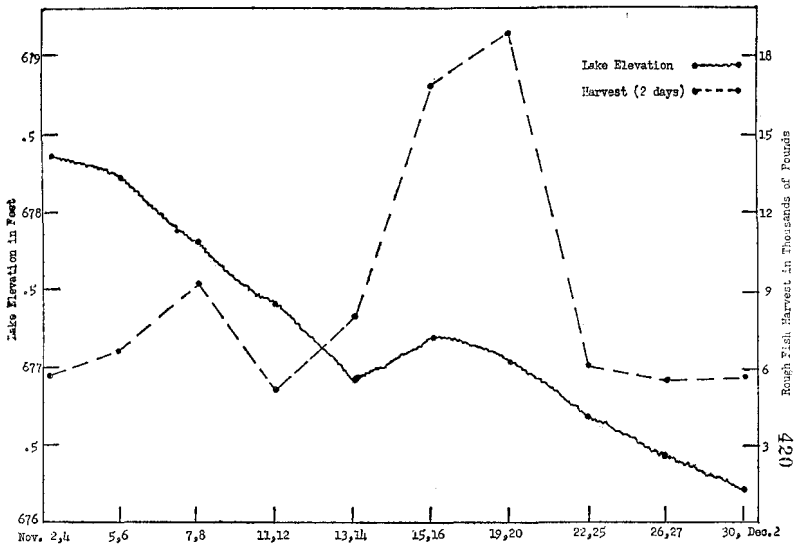


Figure 2. Rough Fish Harvest in Relation to Lake Elevation, Chickamauga, November, 1963

MISCELLANEOUS DATA DERIVED FROM THE HAUL SEINE PROJECT

Stomach analysis revealed that catfish, redear sunfish, and large drum (over one pound) were utilizing the Asiatic clam, *Corbicula fluminea*, which is now present in large numbers along the shores of the Tennessee River impoundments (Sinclair, 1961). A redear sunfish population explosion is attributed to the occurrence of the Asiatic clam which appeared in 100 per cent of the more than 100 redear sunfish examined. All game fish from Douglas Lake appeared to be in excellent condition. Crappie from Chickamauga Reservoir were in poor condition and largemouth bass and white bass were in fair condition. Game fish losses from the haul seine totaled 13 fish with crappie incurring 99 per cent of these losses. Losses occurred after a large harvest when game fish trapped in the rear of the bag succumbed to the crowded, muddy conditions.

One hundred and thirty-one (131) turtles including the common snapper, soft shell, redeared turtle, map turtle, and slider, were taken in the haul seine in Chickamauga in November. No turtles were recorded from Watts Bar in October. The last turtles were taken on November 27th. Only the common snapper and softshell were of commercial value and the few harvested were of little technical value.

DISCUSSION AND CONCLUSIONS

Results of the haul seine experiment thus far are not encouraging from an economic point of view as illustrated in Figures 1 and 2. It is hoped that in the future, higher concentrations of marketable fish can be located in areas suitable for seining operation. Much valuable time was lost in freeing the seine from obstructions and trash and then repairing the seine before operations could be resumed. Extensive examination of areas and clearing of otherwise favorable areas is necessary for the success of haul seine activities.

One other most important factor in the failure of the operation economically, is the occurrence of unmarketable gizzard shad. Much

extra time and money was spent in removing shad from the seine, then transporting and disposing of them at a financial loss to the contractor. Had a market for shad been established, the haul seine would still be in full use to the advantage of the commercial fishing enterprise and fish management efforts.

The haul seine appears to be more efficient for rough fish removal than the conventional gill and trammel nets now used in Tennessee reservoirs. The writer feels that if the major difficulties of locating concentrations of marketable fish in seinable areas are overcome, and new markets found for potential commercial fish, the haul seine can easily be the most efficient piece of commercial gear presently used for controlling rough fish populations in southern reservoirs. The near 80 tons of rough fish removed during the three months of intermittent operation is an impressive figure.

During the course of the study, it was evident that the haul seine could be used for spot-checking concentrations of game fish. One haul covering approximately ten acres with 400 yards of seine yielded 382 game fish weighing approximately 423 pounds. This haul definitely intercepted a winter crappie concentration over a "clear" shallow mud slope just off the main channel of Douglas Lake during winter drawdown. Two other comparable hauls yielded a high percentage of rough fish and this was the only haul in which game fish outnumbered and/or outweighed rough fish. High crappie percentages also occurred at several locations on Chickamauga Reservoir, but weight percentages were much in favor of rough fish. Cross reference of Tables 2 through 5, plus tabulation data, reveals that game fish and rough fish were never present in any given area in near equal number or total weight. An unexpected discovery was the redear sunfish, *Lepomis microlophus* boom in Chickamauga Reservoir. Redear sunfish comprised 77 per cent of the sunfish taken in the haul seine and are replacing the former dominant bluegill as confirmed by previous population study data (Nichols, 1956, 1958).

Although 130,000 redear were stocked in the Tennessee River below the Fort Loudon dam because of the occurrence of the Asiatic clam, the vast number and age of the harvestable redear presently in Chickamauga Reservoir cannot be credited to this planting. A discussion with Billy B. Isom of the Tennessee Valley Authority revealed that a similar redear sunfish explosion followed the presence of *Corbicula* in Wheeler Reservoir in Alabama.

These facts illustrated the potential of the haul seine as a method of sampling shoreline reservoir populations. Haul seine data may give us some basic clues as to what constitutes good rough fish or game fish territory and the writer submits that wintertime use of the haul seine, coupled with summer rotanone sampling, can enable the fishery biologist to more fully understand reservoir fish populations and thus, better manage this most important fishery resource.

Considering the poundage of rough fish harvested and all the data derived from the haul seine project, it can be regarded as no less than a successful and valuable experiment. Its potential should not be disregarded in the face of minor defaults.

ACKNOWLEDGEMENTS

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THE EFFECTS OF CHANNELIZATION UPON THE FISH POPULATIONS OF LOTIC WATERS IN EASTERN NORTH CAROLINA

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ABSTRACT

This paper concerns an evaluation of the effects of habitat alteration associated with stream channelization in eastern North Carolina. The evaluation was based upon a comparison of fish populations found in 23 channeled streams, and 36 proximate natural streams within the Chowan, Neuse, Northeast Cape Fear, Pamlico, Perquimans, and Tar River Watersheds.

These comparisons indicated that reductions in the magnitude of 90 per cent occurred both in weight of game fish per acre, and in number of game fish exceeding six inches total length per acre, following channelization.

The data further revealed that no significant return towards the natural stream populations occurred within a 40-year period following channelization.

For some time, fishery workers have realized that alteration of habitat caused by a formal program of channelization of natural stream beds to obtain better drainage and to reduce flooding of surrounding croplands was detrimental to indigenous fish populations. Until now, however, the extent of damages to fishery resources have not been fully evaluated, but the increasing number of channelization projects and particularly their encroachment upon larger and better fishing streams