Loeb, H. A. 1957. Night collection of fish with electricity. New York Fish and Game Journal, 4(1):109-118.
Ming, Arvil 1964. Boom-type electro-fishing device for sampling fish populations in Oklahoma's waters. Oklahoma Fishery Reserach Laboratory, Semi-annual Report, 1964:27-33.
Jenkins, R. M. 1958. A brief appraisal of data analysis methods employed in determing standing crops of fish. Proc. of the Eleventh Annual Conf., S. E. Assoc. of Game and Fish Comm., 1957.
Ricker, W. E. Maximum sustained yields from fluctuating environments and mixed stocks. Journal of Fish Res. Bd. of Canada, 15(5):991-1006.
Seigel, Sidney, 1956. Non parametric statistics for the behavioral sciences. McGraw-Hill Book Company, Inc., New York, 312 p.
Wilcoxin, Frank and Roberta Wilcox 1964. Some rapid approximate statistical procedures. Lederle Laboratories, American Cyanimid Co., Pearl Rivere, New York, 59 p.
Witt, A., Jr. and R. S. Campbell 1959. Refinements of equipment and procedures in electro-fishing. Trans. Amer. Fish. Soc., 88:33-35.

COMPARISON OF VARIOUS DESIGNS OF WISCONSIN-TYPE TRAP NETS IN TVA RESERVOIRS[1]

By Bobby G. Grinstead *Tennessee Valley Authority*
Muscle Shoals, Alabama

ABSTRACT

Wisconsin-type trap nets were investigated to determine methods necessary to adapt this gear to TVA reservoirs, to establish the best operational procedure, and to determine the potential of this gear in an expanded commercial fishery. The study was conducted primarily in Wheeler Reservoir, Alabama. Three trap nets, modified in amount of flooring, mesh size, and floatation, were fished in combination with three lengths of lead. The lead of intermediate length was constructed of a smaller mesh size (4- instead of 5-inch) than the shorter and longer leads.

Modifications which resulted in larger commercial catches were a floor constructed in both cribs and the heart, a smaller mesh size in the heart (4- instead of 5-inch), and a 400-foot lead of 4-inch mesh. The smaller mesh in the heart resulted in a larger catch of industrial size freshwater drum, while the smaller mesh in the lead resulted in a larger catch of gizzard and threadfin shad.

The most abundant species in the catch were freshwater drum, smallmouth buffalo, and shad. Commercial fish made up 79 percent of the catch. White crappie was both the most common and abundant game fish, occurring in 79 percent of the lifts and accounting for approximately 95 percent of the game fish harvested.

INTRODUCTION

The Tennessee Valley Authority is currently investigating the commercial fisheries potential of TVA reservoirs. The objective is to determine the means by which the total fishery can be expanded to realize the greatest benefits for both sport and commercial fisheries. Investigations of the commercial fishery of the Tennessee River system have been conducted periodically since 1941 (Bryan and Tarzwell, 1941; Tarzwell, 1944; Bryan and White, 1958; Carroll, Hall, and Bishop, 1963). Current investigations include (1) evaluation of commercial fishing gear used successfully in other regions of the county, (2) development of ways to concentrate desired species for more effective harvest, (3) quarterly surveys of commercial fishermen to determine the annual harvest of commercial fish, and (4) life history studies of the more important commercial fish.

[1]Published by permission of the Tennessee Valley Authority

Specifically, this particular investigation was designed to determine what modifications are necessary to adapt the Wisconsin-type trap nets to TVA reservoirs, to establish the best operational procedure, and to determine if this gear has a potential in an expanded commercial fisheries in the Tennessee Valley. For the most part the investigation was conducted near the mouth of Elk River in Wheeler Reservoir, Alabama, but trap nets were also fished in Kentucky, Pickwick, Wilson, Guntersville, and Watts Bar reservoirs in Kentucky, Tennessee, and Alabama. The 691 net-days of fishing produced 34,678 pounds of fish. The average catch for 175 lifts was 198 pounds, of which 79.0 percent (by weight) were non-game fish. The study period extended from September 1965 until June 1967.

The two large trap nets most commonly used in commercial fisheries are the Lake Erie and Wisconsin types. The Winconsin-type was selected for this study because its design could be used in a wider range of habitats. Use of the Lake Erie-type trap net in TVA reservoirs has been described by Hargis (1967). Descriptions and handling procedures for these kinds of nets have been published by Langlois (1954) and the Bureau of Commercial Fisheries (1964).

METHODS AND MATERIALS

The configuration of the three trap nets used in this study resembles figure 1. Nets had 2 1/4 inch (mesh sizes given in stretch measure) number 15 knotted nylon webbing in the dipping crib, 3 1/2 inch number 12 nylon in the first crib, and either 4- or 5-inch number 12 nylon in the lead, heart, hood, winkers, and wings. Webbing for all nets was hung 18 inches to the foot on 3/8 inch polyethelene line. Horizontal spreaders across the back of the dipping crib consisted of a 3 by 3 inch wooden member along the top and a 2 inch steel pipe along the bottom. After the net was set, a 2 by 2 inch wooden vertical spreader was tied to the centers of the horizontal spreaders to help hold the net open.

Construction of the three trap nets, identified as A, B, and C, varied as follows:

Net A had floors in both cribs; 4 inch webbing in the wings, heart, winkers, and hood; and 2 1/2 x 9 inch plastic floats and 1 1/4 pound cast iron weights spaced nine feet apart.

Net B had a floor in only the dipping crib; 5 inch webbing in the wings heart, winkers, and hood; 3 by 10 inch steel floats on 14 foot centers; and 1 1/4 pound cast iron weights on 7 foot centers.

Net C had flooring in both cribs and the heart. Floatation and mesh sizes were the same as in Net B.

Leads of three lengths were used interchangeably with the three nets. The 300 and 500 foot leads were constructed of 5 inch number 12 nylon and had 3 by 10 inch steel floats on 14 foot centers and 1 1/4 pound cast iron weights on 7 foot centers. The 400 foot lead was constructed of 4 inch mesh number 12 nylon and had 2 1/2 by 9 inch plastic floats and 1 1/4 pound cast iron weights on 9 foot centers.

The nets were set with six anchors. These were made of 1 1/2 inch iron rod with 4 by 6 inch mud plates welded to each leg. Each weighed about 35 pounds. Anchor lines were 3/8 inch polyethelene with lengths of 400 feet for the tail anchor, 300 for the wing and side anchors, and 50 for the lead anchor. Lifting lines, with buoys, were attached to the back of the dipping crib and at the junction of the two cribs.

The DAKWA, a 35-foot steel hulled reserach vessel, was used to lift the gear. The vessel was powered by a 160-hp diesel engine. Its work deck was fitted with two gin poles located on opposite gunnels near the stern, a mast and boom, and a double spool winch with a single gypsy head.

The trap net was raised on the windward side of the vessel by pulling the forward lifting line over the gunnel with the gypsy head. When the top of the net reached the surface, the boom was positioned over the net and the hook placed in loops tied in the lifting line near the top of the sides of the net. The net was then lifted with the boom and gypsy head until the floor at the junction of the two cribs cleared the water by approximately three feet. The back of the net was lifted with the appropriate gin pole until the net was suspended alongside the vessel with the catch pocketed in the back of the dipping crib. An inverted V-shaped slot was unlaced in

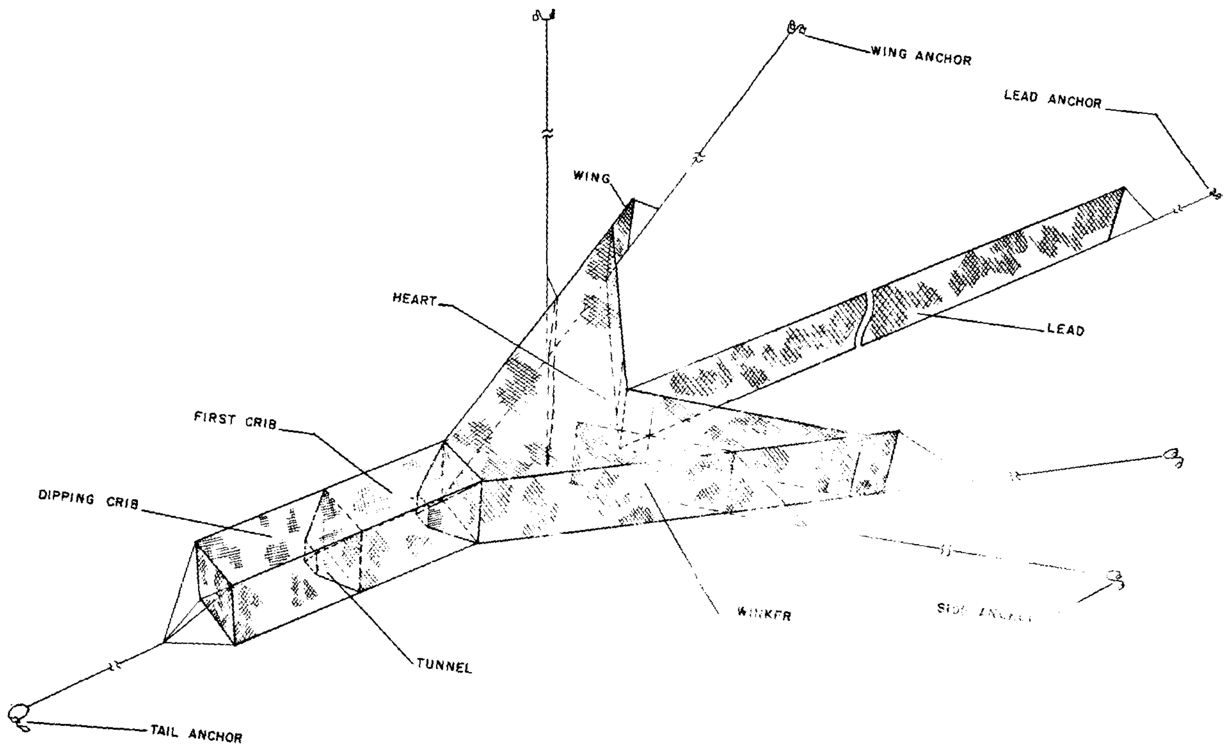

Figure 1. Ten-foot Wisconsin-type trap net.

the side of the crib and the catch was removed with dip nets. The lifting procedure took approximately 30 minutes regardless of size of catch – a 600 pound catch could be removed in about the same time as a 100 pound catch.

The catch was sorted into game and commercial fish. Species of game fish were noted and total weights recorded. During the early phase of the investigation (September 1965 through June 1966) commercial fish data included combined weight, number of fish, and minimum and maximum total lengths for each species. Later (July 1966 through June 1967), commercial fish were sorted by species and then classed either industrial or marketable.

Marketable fish were those commonly sold in local fish markets for human consumption. This group included catfish of all sizes, and buffalo, carp, carpsucker, freshwater drum, and paddlefish over 11 inches in total length. Fish of these species less than 11 inches long and all other commercial species regardless of size were recorded as industrial fish. Measurements taken during this period included the combined weight and number of each species in each category and the total length of the smallest and largest fish of each species in each category.

Weights are used as the measurement of the total catch and in calculations of species compositions. Common names of fishes are those recommended by the *American Fisheries Society, Special Publication No. 2* (Bailey et al., 1960).

Data from this investigation are not an accurate estimate of the potential trap net catch since they were collected under experimental conditions involving changes in design of the gear and operational procedures. The mean catch might be expected to be considerably higher if only the most efficient procedure and gear were used. Since data on the distributional patterns of commercial fish are not available for TVA reservoirs, the sampling procedure was to select various types of habitat and select the gear for each set at random. According to Lambou (1961), sets made in this manner are also not conducive to high mean catch. When more information on distribution is available, an experienced commercial fishermen can choose those sets that will yield the desired fish at a higher rate. Therefore, his average catch should be considerably higher than indicated by this study.

DISCUSSION

A latin square sampling system was used to test the influences of net design and lengths of the lead on total catch. This system enabled the three trap nets and three leads to be fished in all possible combinations during three cruises. The combinations of nets and leads were as follows, with the net designated by letter and the length of lead in feet given in parenthesis:

Cruise I	August	1966	A (400)	B (500)	C (300)
Cruise II	Dec-Jan	1967	A (300)	B (400)	C (500)
Cruise III	Mar-Apr	1967	A (500)	B (300)	C (400)

Influence of Net Design

Total Catch

During the period August 1966 to April 1967, the nets harvested 19,975 pounds of fish in 92 lifts, for an average catch per lift of 217 pounds. Total catch, catch per lift, and number of lifts for each combination of net and lead are given in table 1.

Total catch is directly proportional to the amount of flooring in the trap net. Net B, which had flooring in the dipping crib only, had the smallest catch per lift (121.0 pounds) while Net C, which had flooring in both cribs and the heart, had the largest catch (285.8 pounds). Except for these differences in flooring, the two nets were identical. Net A, which had flooring in both cribs but not in the heart, had different floatation and a smaller sized mesh in the heart. It had an average catch per lift of 241.5 pounds. The mean catch of Net B was significantly less than either Net A ($t = 3.35$, 59 d.f., $p < .005$) or Net C ($t = 4.14$, 59 d.f., $p < .005$), but there was no significant difference in the mean catches of Nets A and C ($t = .90$, 60 d.f., $.40 > p > .30$).

TABLE 1.
The total catch of various trap nets and lead combinations.

Lead		*Net A*	*Net B*	*Net C*	*Total*
300	Total pounds	3074.6	1893.3	1883.9	6851.8
	Lifts	11	10	10	31
	Pounds per lift	279.5	189.3	188.4	221.0
400	Total pounds	1940.6	614.3	3143.7	5698.6
	Lifts	11	9	10	30
	Pounds per lift	176.4	68.3	314.4	190.0
500	Total pounds	2470.1	1123.2	3830.9	7424.2
	Lifts	9	11	11	31
	Pounds per lift	274.5	102.1	348.2	239.5
Combined Leads	Total pounds	7485.3	3630.8	8858.5	19,974.6
	Lifts	31	30	31	92
	Pounds per lift	241.5	121.0	285.8	217.1

Different lead lengths produced minimal differences in total catch. Means ranged from 190.0 to 239.5 pounds per lift, with the smaller catch being taken with the 400-foot lead and the larger catch with the 500-foot lead. These means did not differ significantly ($t = 1.06$, 59 d.f., $.30 > p > .20$). A two-way model one analysis of variance test indicates total catch is not significantly influenced by either the various leads or the interaction of lead and net but does differ significantly with the various nets (table 2).

TABLE 2.
The significance of differences in total catch of various trap net and lead combinations.

Two Way, Model One, Analysis of Variance

Source	*Sum of Squares*	*Degrees of Freedom*	*Mean Squares*	*F*	*Probability*
Between leads	38,127.12	2	19,063.56	.74	$.50 > p > .25$
Between trap nets	441,432.01	2	220,716.01	8.52	$.001 > p > .0005$
Interaction	255,752.56	4	63,938.14	2.47	$.10 > p > .05$
Within cells	2,149,519.12	83	25,897.82		
Total	2,884,830.81	91			

Species Composition

Freshwater drum was the dominant (33.6 percent) commercial fish harvested (table 3). Following in decreasing order were smallmouth buffalo (28.5 percent) and gizzard and threadfin shad combined (19.6 percent). No attempt was made to separate the threadfin shad from the predominant gizzard shad.

Commercial species composition was tested for homogeneity by contingency tables to determine if trap net design or length of lead had any influence on the catch rate of any species (tables 4 and 6). The method used for pooling species for chi-square calculations, in which the expected frequency for a species was less than 3.5, was to combine the three species of catfish into one category and the remaining low frequency species into a second category. An elaboration on this manner of pooling is given by Houser and Ghent (1964).

Significant differences were observed when comparing species composition with the various nets (table 4) and lead lengths (table 6). A significant difference indicates

TABLE 3.
Species composition by weight of fish taken in trap nets during fiscal years 1966 and 1967.

Species	*1966* *lbs.*	*%*	*1967* *lbs.*	*%*	*Total* *lbs.*	*%*
Carp	81.4	0.9	191.7	1.0	273.1	1.0
Smallmouth buffalo	1719.6	19.8	6103.2	32.6	7822.8	28.5
Bigmouth buffalo	340.4	3.9	341.8	1.8	682.2	2.5
Freshwater drum	2665.2	30.7	6551.7	35.0	9216.9	33.6
Shad[1]	2545.6	29.3	2830.1	15.1	5375.7	19.6
Channel catfish	473.4	5.4	391.0	2.1	864.4	3.2
Blue catfish	132.9	1.5	144.8	0.8	277.7	1.0
Flathead catfish	117.3	1.3	1156.0	6.2	1273.3	4.6
Redhorse[2]	8.5	0.1	28.8	0.2	37.3	0.1
Spotted sucker	4.2	t	21.6	0.1	25.8	0.1
River carpsucker	53.7	0.6	285.4	1.5	339.1	1.2
Mooneye	3.1	t	118.8	0.6	121.9	0.4
Skipjack herring	185.2	2.1	282.7	1.5	467.9	1.7
Paddlefish	356.4	4.1	250.5	1.3	606.9	2.2
Gar[3]	6.2	0.1	5.6	t	11.8	t
Blue sucker	—	—	6.8	t	6.8	t
		99.8		99.8		99.8
Commercial fish	8693.1	75.4	18,710.5	80.8	27,403.6	79.0
Game fish	2838.3	24.6	4434.2	19.2	7272.5	21.0
Total	11,531.4	100.0	23,144.7	100.0	34,676.1	100.0

1. Gizzard and threadfin shad.
2. Golden, black, shorthead, silver, and northern redhorse.
3. Shortnose and spotted gar.
t = less than .05.

that the gear was either selective for a particular species or that the samples represented different populations. If the gear was selective for a particular species, or group of species, a pattern of deviations from the expected should be evident, and by arranging data in tables these relationships could be observed.

Table 4 indicates that the catch of freshwater drum deviated from the expected by the largest extent, contributing 22.9 (49.2 percent) of the total chi-square. Excluding the drum reduces the total chi-square to 15.2 with 6 degrees of freedom ($.025 > p > .01$).

These data suggest that Net A most efficiently harvested freshwater drum. Since this is an important commercial fish, the factor responsible for the increased effectiveness should be incorporated in the design of a trap net for TVA reservoirs.

Size of Fish

The catch of industrial and marketable fish for each trap net is presented in table 5. Comparison of these data shows a significant difference between observed and expected catches of the two groups, with the greatest difference resulting from a larger than expected catch of industrial fish in Net A. This net harvested 2,571.8 pounds of industrial and 817.3 pounds of marketable freshwater drum, whereas, Net B harvested 34.7 and 413.5 pounds, and Net C harvested 650.6 and 1,448.6 pounds respectively. The ratios of industrial and marketable fish harvested with nets B and C were not significantly different. Because Net A was known to have harvested a large percentage of industrial freshwater drum, a similar test was conducted excluding this species. The difference in these catches was also non-significant. Thus, except for freshwater drum, the ratios of industrial and marketable fish were similar in all three nets.

TABLE 4.

Species of commercial fish harvested with different trap nets, September 1966 to May 1967.

Species	Net A Catch per lift		Net A Expect	Net A Chi-sq.	Net B Catch per lift		Net B Expect	Net B Chi-sq.	Net C Catch per lift		Net C Expect	Net C Chi-sq.	N
	---pounds---				---pounds---				---pounds---				---pounds---
Freshwater drum	109.3		80.6	10.2	14.9		35.3	11.8	67.7		76.1	0.9	191.9
Smallmouth buffalo	65.4		69.7	0.3	44.6		30.5	6.5	56.1		65.8	1.4	166.1
Shad[1]	15.4		27.4	5.3	17.1		12.0	2.2	32.8		25.9	1.8	65.3
Flathead catfish	7.7)				4.0)				21.8)				
Channel catfish	1.7)	10.4	19.7	4.4	2.3)	7.1	8.7	0.3	5.4)	29.4	28.6	t	46.9
Blue catfish	1.0)				0.8)				2.2)				
Bigmouth buffalo	2.1)				2.8)				3.7)				
Paddlefish	4.2)				1.6)				1.7)				
Skipjack herring	2.5)				1.8)				4.6)				
River carpsucker	2.5)	14.8	17.9	0.5	1.1)	10.6	7.9	0.9	4.2)	17.3	16.9	t	42.7
Mooneye	0.9)				2.2)				0.7)				
Carp	2.4)				0.8)				1.3)				
Redhorse[2]	0.0)				0.1)				0.6)				
Spotted sucker	0.1)				0.1)				0.5)				
Gar[3]	0.1)				0.1)				0.0)				
Total	215.3				94.3				203.3				512.9

Total chi-square, 8 d.f., = 46.5 $p < .0005$

1. Gizzard and threadfin shad.
2. Golden, black, shorthead, silver, and northern redhorse.
3. Shortnose and spotted gar.

t = less than .05.

TABLE 5.
Industrial and marketable fish harvested by different trap nets, September 1966 to May 1967.

Species	*Net A*		*Net B*		*Net C*		*Total*	
	Industrial	*Marketable*	*Industrial*	*Marketable*	*Industrial*	*Marketable*	*Industrial*	*Marketable*
	---*pounds*---		---*pounds*---		---*pounds*---		---*pounds*---	
Carp	0.0	74.5	0.0	23.7	0.0	38.9	0.0	137.1
Smallmouth buffalo	85.5	1944.6	38.3	1298.3	54.6	1684.3	178.4	4927.2
Bigmouth buffalo	0.0	66.8	0.0	85.3	1.5	111.9	1.5	264.0
Freshwater drum	2571.8	817.3	34.7	413.5	650.6	1448.6	3257.1	2679.4
Shad[1]	478.2	0.0	513.4	0.0	1018.2	0.0	2009.8	0.0
Channel catfish	0.0	52.6	0.0	69.1	0.0	168.0	0.0	289.7
Blue catfish	0.0	32.1	0.0	25.1	0.0	67.1	0.0	124.3
Flathead catfish	0.0	239.2	0.0	120.7	0.0	675.6	0.0	1035.5
Redhorse[2]	0.0	0.0	2.6	0.0	20.3	0.0	22.9	0.0
Spotted sucker	2.0	0.0	4.5	0.0	15.1	0.0	21.6	0.0
River carpsucker	5.6	71.5	3.4	29.2	7.0	124.7	16.0	225.4
Mooneye	29.0	0.0	65.6	0.0	22.4	0.0	117.0	0.0
Skipjack herring	80.4	0.0	52.5	0.0	142.6	0.0	275.5	0.0
Paddlefish	0.0	132.1	0.0	48.7	0.0	51.3	0.0	232.1
Gar[3]	2.5	0.0	3.1	0.0	0.0	0.0	5.6	0.0
Total	3255.0	3430.7	718.1	2113.6	1932.3	4370.4	5905.4	9914.7

1. Gizzard and threadfin shad.
2. Golden, black, shorthead, silver, and northern redhorse.
3. Shortnose and spotted gar.

TABLE 6.
Species of commercial fish harvested in trap nets with different lead lengths, September 1966 to May 1967.

Species	300 Catch per lift	300	300 Expect	300 Chi-sq.	400 Catch per lift	400	400 Expect	400 Chi-sq.	500 Catch per lift	500	500 Expect	500 Chi-sq.	N
	---pounds---				---pounds---				---pounds---				---pounds---
Freshwater drum	95.3		67.4	11.5	17.2		55.3	26.2	79.6		69.4	1.5	192.1
Smallmouth buffalo	48.2		58.4	1.8	57.6		47.9	2.0	60.7		60.2	t	166.5
Shad[1]	16.2		23.1	2.1	33.8		19.0	11.5	15.9		23.8	2.6	65.9
Flathead catfish	8.4)				21.4)				4.4)				
Channel catfish	1.6)	11.4	16.7	1.7	2.9)	25.9	13.7	10.9	4.9)	10.3	17.2	2.8	47.6
Blue catfish	1.4)				1.6)				1.0)				
Bigmouth buffalo	3.0)				2.5)				3.2)				
Paddlefish	1.9)				0.9)				4.7)				
Skipjack herring	1.5)				4.2)				3.3)				
River carpsucker	1.3)	9.6	15.1	2.0	2.3)	13.8	12.4	0.2	4.2)	19.6	15.5	1.1	43.0
Mooneye	1.1)				1.2)				1.5)				
Carp	0.6)				2.1)				1.8)				
Redhorse[2]	0.1)				0.3)				0.6)				
Spotted sucker	0.1)				0.3)				0.1)				
Gar[3]	0.0)				0.0)				0.2)				
Total	180.7				148.3				186.1				515.1

Length of Lead in Feet: 300, 400, 500.

Total chi-square, 8 d.f., = 77.9 $p < .0005$

1. Gizzard and threadfin shad.
2. Golden, black, shorthead, silver, and northern redhorse.
3. Shortnose and spotted gar.

t = less than .05.

Means of the three nets, excluding industrial drum, indicate the catch of Net A more intermediate between Nets B and C than noted previously. The mean catches, excluding drum, for Nets B, A, and C were 93.2, 132.7, and 182.3 pounds, respectively. Data noted previously on the mean catches of all species were 121.0, 241.5, and 285.8 pounds, respectively. The mean commercial catch from Net C, excluding industrial drum, was significantly greater than Net B ($t = 3.09$, 59 d.f., $p < .01$), but there were no significant differences between Nets A and B ($t = 1.52$, 59 d.f., $.20 > p > .10$) or between Nets A and C ($t = 1.50$, 59 d.f., $.20 > p > .10$).

Influence of Lead Length

Species compositions of the commercial fish catch made with the various leads were found to be significantly different from the expected. The largest contribution to the total chi-square came from the 400-foot lead (table 6). The sum of the chi-squares from this column was 50.8, or 65.2 percent of the total. Differences in the species composition of the catch of the 300- and 500-foot leads were non-significant, indicating the catch with the 400-foot lead is different. The 400-foot lead produced fewer than expected freshwater drum and more than expected shad and catfish. This lead differed in length, mesh size, and floatation.

Catches with the three lead lengths are shown in table 7. The differences between industrial and marketable fish are significant. Percentages of industrial fish taken were 57.2 with the 300-foot lead, 29.6 with the 400, and 24.0 with the 500. However, the industrial catch with the 300-foot lead contained an exceptionally large percentage (78.9) of freshwater drum, a majority of which (2,512.8 pounds) were harvested on the cruise that combined Net A with the 300-foot lead. Whether the trap net design or the lead was responsible cannot be determined statistically, although it appears that the smaller mesh size in the heart of Net A, rather than the shorter lead, was responsible. This is also indicated (table 7) by a larger catch of industrial freshwater drum with the 500-foot lead than with the 400-foot lead (664.9 as compared with 61.0 pounds). The assumption that the larger catch of industrial freshwater drum was the result of the smaller mesh size in Net A is therefore accepted, as it was in previous evaluation of various net designs.

These data will partially explain the lower-than-expected catch of freshwater drum with the 400-foot lead. By assuming further that the smaller mesh size of the lead resulted in a larger catch of shad, the significant difference in the species composition with the three leads can be explained. Difference in the ratio of industrial and marketable fish taken with various leads would be non-significant if freshwater drum and shad were excluded from the catch.

It was concluded that the most efficient trap net would be one with a floor in the heart and cribs, as in Net C, and with floatation and mesh sizes similar to those described for Net A. The preferred lead would be constructed of 4-inch webbing with floatation as described for the 400-foot lead. A length of 400 feet appears adequate, but further study in this area is needed.

Influences of Gear on Game Fish Catch

To reduce handling and mortality of game fish, only combined weight and species were recorded. Occurrence of game fish in the 175 lifts between September 1965 and July 1967 is shown in table 8. White crappie were taken in 79.4 percent of the lifts, followed by bluegill--40.6, white bass--38.3, and yellow bass--32.6 percent. White crappie was also the dominant game fish accounting for about 95 percent of the total.

Table 9 shows the game fish catch of each net on each cruise. Because the efficiency of the three nets varied, percentages instead of total weights were used to determine whether a significant difference in the catch of game fish could be attributed to the design of the net. A non-parametric sign test indicates no significant difference between Nets B and C, but Net A took a significantly smaller percentage of game fish than the other two (table 10).

The amount of flooring in Net A was intermediate between Nets B and C, mesh size in the heart was smaller, and the floats were smaller but closer together. Since

TABLE 7.

Industrial and marketable fish harvested with trap net having leads of different lengths, September 1966 to May 1967.

	Lead in Feet							
Species	*300*		*400*		*500*		*Total*	
	Industrial	*Marketable*	*Industrial*	*Marketable*	*Industrial*	*Marketable*	*Industrial*	*Marketable*
	———pounds———		*———pounds———*		*———pounds———*		*———pounds———*	
Carp	0.0	19.6	0.0	62.5	0.0	55.0	0.0	137.1
Smallmouth buffalo	83.8	1411.1	53.4	1675.7	41.2	1840.4	178.4	4927.2
Bigmouth buffalo	0.0	89.8	1.5	73.6	0.0	100.6	1.5	264.0
Freshwater drum	2531.2	423.4	61.0	454.4	664.9	1801.6	3257.1	2679.4
Shad[1]	502.9	0.0	1013.6	0.0	493.3	0.0	2009.8	0.0
Channel catfish	0.0	50.5	0.0	87.7	0.0	151.5	0.0	289.7
Blue catfish	0.0	43.5	0.0	49.3	0.0	31.5	0.0	124.3
Flathead catfish	0.0	259.5	0.0	640.7	0.0	135.3	0.0	1035.5
Redhorse[2]	2.1	0.0	8.9	0.0	11.9	0.0	22.9	0.0
Spotted sucker	3.9	0.0	7.7	0.0	10.0	0.0	21.6	0.0
River carpsucker	0.0	41.4	7.0	62.1	9.0	121.9	16.0	225.4
Mooneye	35.3	0.0	35.7	0.0	46.0	0.0	117.0	0.0
Skipjack herring	47.1	0.0	126.6	0.0	101.8	0.0	275.5	0.0
Paddlefish	0.0	58.5	0.0	27.6	0.0	146.0	0.0	232.1
Gar[3]	0.0	0.0	0.0	0.0	5.6	0.0	5.6	0.0
Total	3206.3	2397.3	1315.4	3133.6	1383.7	4383.8	5905.4	9914.7

1. Gizzard and threadfin shad.
2. Golden, black, shorthead, silver, and northern redhorse.
3. Shortnose and spotted gar.

TABLE 8.

Occurrence of game fish in 175 trap net lifts, September 1965 to June 1967.

Species	*Number of Occurrences*	*Percent of Lifts*
White crappie	139	79.4
Bluegill	71	40.6
White bass	67	38.3
Yellow bass	57	32.6
Sauger	19	10.9
Redear sunfish	6	3.4
Black crappie	6	3.4
Warmouth	2	1.1
Longear sunfish	1	0.6
Smallmouth bass	1	0.6

TABLE 9.

Catch of commercial and game fish with Nets A, B, and C.

Date	*Number of lifts*	*Commercial fish*	*Game fish*	*Percent game fish*	*Total catch*
		Net A			
Jan-Feb 1966	10	783.6	248.6	24.1	1032.2
Feb-Mar 1966	7	2193.6	121.1	5.2	2314.7
April 1966	11	1986.6	358.7	15.3	2345.3
August 1966	11	1449.0	491.6	25.3	1940.6
Dec-Jan 1967	11	2978.1	96.5	3.1	3074.6
Mar-Apr 1967	9	2258.6	211.5	8.6	2470.1
May 1967	6	1229.3	17.9	1.4	1247.2
Totals	65	12,878.8	1545.9	10.7	14,424.7
		Net B			
Jan-Feb 1966	3	61.0	106.1	63.4	167.1
Feb-Mar 1966	6	506.4	412.4	44.9	918.8
April 1966	9	641.5	749.8	53.9	1391.3
August 1966	11	537.4	585.8	52.2	1123.2
Dec-Jan 1967	9	585.3	28.1	4.6	613.4
Mar-Apr 1967	10	1709.0	184.3	9.7	1893.3
May 1967	6	745.8	177.5	19.2	923.3
Totals	54	4786.4	2244.0	31.9	7030.4
		Net C			
Jan-Feb 1966	5	651.3	233.1	26.4	884.4
Feb-Mar 1966	4	990.6	73.3	6.9	1063.9
April 1966	11	881.4	532.5	18.8	1413.9
August 1966	10	916.5	967.4	51.4	1883.9
Dec-Jan 1967	11	2971.5	859.4	22.4	3830.9
Mar-Apr 1967	10	2414.7	729.0	23.2	3143.7
May 1967	5	916.9	85.2	8.5	1002.1
Totals	56	9742.9	3479.9	26.3	13,222.8

TABLE 10.
Significance of net design on percentage of game fish taken, January 1966 to June 1967.

Date of Cruise	*Net A*	*Net B*	*Sign*	*Net A*	*Net C*	*Sign*	*Net C*	*Net B*	*Sign*
	percent								
Jan-Feb 1966	24.1	63.4	+	24.1	26.4	+	26.4	63.4	+
Feb-Mar 1966	5.2	44.9	+	5.2	6.9	+	6.9	44.9	+
April 1966	15.3	53.9	+	15.3	18.8	+	18.8	53.9	+
August 1966	25.3	52.2	+	25.3	51.4	+	51.4	52.2	+
Dec-Jan 1967	3.1	4.6	+	3.1	22.4	+	22.4	4.6	-
Mar-Apr 1967	8.6	9.7	+	8.6	23.2	+	23.2	9.7	-
May 1967	1.4	19.2	+	1.4	8.5	+	8.5	19.2	+
Number in sample			7			7			7
Number of minus signs			0			0			2
Probability (two tailed)*			.016			.016			.45

*Taken from "Distribution for the Sign Test," Dixon and Massey, 1957.

flooring was intermediate, it appears that the lower catch of game fish was associated with either the smaller mesh size or the floatation. Which one, or why either should affect the catch of game fish, would be difficult to determine. But these same construction details were considered beneficial for other reasons and were therefore incorporated in the recommended design of a standard net for TVA reservoirs.

CONCLUSION

Modifications of the Wisconsin-type trap net found beneficial in TVA reservoir tests were (1) a floor in both cribs and the heart, (2) 4-inch stretch webbing in the heart, and (3) a 9-foot spacing for floats and weights. A 400-foot lead with 4-inch webbing appears best suited to reservoir conditions. The described method of lifting and handling the gear proved satisfactory and can be recommended.

LITERATURE CITED

Bailey, R. M., E. A. Lachner, C. C. Lindsey, C. R. Robins, P. M. Roedel, W. B. Scott, and L. R. Woods. 1960. A list of common and scientific names of fishes from the United States and Canada. Am. Fish. Soc., Special Publication No. 2, 2nd ed., 102 pp.

Bryan, P., and C. M. Tarzwell. 1941. A preliminary report on the census of commercial fishing in TVA impoundments. Trans. Sixth N. Am. Wildlife Conf., 265-272.

________, and C. E. White, Jr. 1958. An economic evaluation of the commercial fishing industry in the TVA lakes of Alabama during 1956. Proc. S.E. Assn. of Game and Fish Comm. 1958, 128-132.

Bureau of Commercial Fisheries, Branch of Inland Fisheries; Branch of Exploratory Fishing and Gear Research. 1965. Missouri River reservoir commercial fishing investigations, documentation of 1963-64 activities and findings. (mimeo.), 74 pp.

Carroll, B. B., G. E. Hall, and R. D. Bishop. 1963. Three seasons of rough fish removal at Norris Reservoir, Tennessee. Trans. Am. Fish. Soc., 92(4): 356-364.

Dixon, W. J., and F. J. Massey, Jr. 1957. Introduction to statistical analysis. McGraw-Hill Book Co., Inc., N. Y., 488 pp.

Hargis, H. L. 1967. Development of improved fishing methods for use in southeastern and south central reservoirs: haul seine and trap net development based on related biological fishery research in Tennessee Reservoirs. Tenn. Game and Fish Comm. (mimeo), 34 pp.

Houser, A., and A. W. Ghent. 1964. An experimental gill net based on the principle of latin square. Trans. Am. Fish. Soc., 93(3): 233-242.
Lambou, V. W. 1961. Efficiency and selectivity of flag gill nets fished in Lake Bistineau, Louisiana. Proc. S.E. Assn. of Game and Fish Comm. 1961, 319-359.
Langlois, T. H. 1954. The western end of Lake Erie and its ecology. Edwards Brothers, Inc., Ann Arbor, 479 pp.
Tarzwell, C. M. 1944. The possibilities of a commercial fishery in the TVA impoundments and its value in solving the sport and rough fish problems. Trans. Am. Fish, Soc., 1943, 73: 137-157.

THE CATCH OF WIRE TRAPS IN OLD HICKORY RESERVOIR, TENNESSEE

By Norval F. Netsch[1]
Tennessee Game and Fish Commission
Nashville, Tennessee

ABSTRACT

One by two-inch mesh wire fish traps were fished for 5,135 trap days in Old Hickory Reservoir between August 1, 1963 and June 30, 1964. Of the 2,661 fish caught, 83.2 percent were commercial fish, 16.2 percent were sport fish and 0.6 percent "other" species. Carp (*Cyprinus carpio*) constituted 61.6 percent of the catch. Crappie (*Pomoxis* sp.) made up 12.0 percent of the total catch.

Deep baited sets had the highest catch rate (1.17 commercial fish per trap day) and also the highest percentage of commercial fish in the catch (98.7 percent). Unbaited traps had the lowest catch rate (0.06 commercial fish per trap day regardless of depth), with 56.5 percent and 76.9 percent of the catch consisting of sport fish in deep and shallow sets, respectively. The average size of the fish caught was small. It was concluded that wire traps could be legalized in Old Hickory Reservoir for local residents to catch fish for home consumption without adversely affecting sport fish populations.

INTRODUCTION

In 1962 and early 1963, local residents expressed considerable interest in legalizing the use of wire fish traps in Old Hickory Reservoir. While a limited commercial fishery existed (consisting mostly of part-time commercial fishermen), the main interest was from people who wanted an inexpensive method to catch fish for their own consumption.

Before making any recommendations, the Tennessee Game and Fish Commission felt it was necessary to determine possible effects of the traps on the sport fish population, and catch rates of commercial fish.

DESCRIPTION OF STUDY AREA AND METHODS

Old Hickory is a mainstream reservoir located on the Cumberland River in central Tennessee. The dam is at river mile 216.2 which is about 25 miles upstream from Nashville. The reservoir extends upstream for 100.8 miles, encompassing 22,500 acres at full pool elevation. It is relatively shallow (average depth 18.7 feet) with very little water level fluctuation.

Twenty-eight traps were constructed of 1 x 2-inch mesh welded wire. Each trap was 6 feet long, 2 feet in diameter, with one funnel tapered to a 6-inch opening. An 8 x 12 inch opening with a hinged wire door was cut in the side near the base to remove trapped fish. The wholesale cost of material was $4.23 per trap.

[1] Present address: South Central Reservoir Investigations, Bureau of Sport Fisheries and Wildlife, 113 South East Street, Fayetteville, Arkansas.