

# AN EVALUATION OF NINE TYPES OF COMMERCIAL FISHING GEAR IN KENTUCKY LAKE<sup>1</sup>

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Kentucky Lake is a man-made impoundment, formed in 1945 by a multi-purpose dam across the Tennessee River at a point 22 miles above its confluence with the Ohio River. The lake has an area of 260,000 acres and extends southward from the dam at Gilbertsville, Kentucky, a distance of 184 miles through western Kentucky and Tennessee. Maximum width is two miles and an average depth of 23 feet is maintained at conservation pool level. The maximum elevation in 1952 was 359.37 feet above sea level. Annual water level fluctuation was eight feet or less. The lake is subject to considerable wind action and often for short periods is unsafe for small boats.

The water is seldom clear, usually having a Secchi disc reading of approximately two feet. The lake does not stratify, having less than a 3°F temperature variation between surface and bottom at any given time during the year. The dissolved oxygen content is high and varies less than 1 p.p.m. from the surface to depths of 70 feet or more. Except for this feature, the lake is primarily of the eutrophic type.

On June 19, 1951, an investigation was initiated on Kentucky Lake to determine whether or not a rough fish problem existed. Preliminary findings indicated a need for further study and on November 19, 1951, the present investigation was begun and was to encompass the following three primary objectives:

1. To compare the general efficiency of different types of gear and the extent to which each type is selective for rough fishes; these comparisons to be made with respect to different depths and bottom types.
2. To investigate the present status of the fish population of this lake.
3. To determine the value of rotenone sampling as an indicator of the harvestable fish population in these waters.

At the end of the first 18 months of netting it was evident that game species, particularly white crappie, comprised a large percentage of the fish population. Because of the importance of the crappie to the sports fishery of Kentucky Lake, and its increasing popularity there, an age and growth study of the white crappie was made (Carter 1953).

A study of migration and percentage of harvest of the major game species was begun in January, 1953, and is nearly completed. The results will be published later.

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field operations and Mr. Minor E. Clark gave valuable assistance in the planning of these investigations.

## MATERIALS AND METHODS

Nine types of commercial fishing equipment were used during the course of this investigation. These include hoop nets, fiddler nets, wing nets, gill nets, trammel nets, wire baskets, wood baskets, lead nets and heart-lead nets. Two of these types, hoop nets and fiddler nets, are legal for use by licensed commercial fishermen at the present time.

These nine net types may be grouped into four basic types. Hoop and fiddler nets differ only in size, and wing nets are of either type but with addition of wings for the purpose of increasing mouth area of the net. Gill and trammel nets are both straight nets and hold the fish by entanglement. Wire baskets and wood baskets differ in materials used in construction and, although not collapsible, are much the same as hoop nets. Lead and heart-lead nets are like hoop nets with the addition of wings and a lead.

The hoop nets used were of one-inch mesh and larger. Net sizes varied from three to five feet in diameter at the mouth and tapered to a minimum diameter of two feet at the tail. They were composed of heavy twine cord woven around wooden supporting hoops, or in some cases, hoops fashioned from light metal rods. Most were equipped with two funnel-shaped throats. These nets were set at depths to 30 feet. Oil cake, a by-product of cotton seed oil meal preparation, was used as bait in an effort to increase the catch of carp.

Fiddler nets were constructed in the same basic pattern as the hoop nets, but were always less than 2½ feet in diameter at the mouth. They were provided with either one or two throats. The most common mesh size was one inch. The fiddler net, like the hoop, is a deep water net and was often set in water up to 30 feet in depth.

The wing nets, or fyke nets, varied from three to five feet in diameter at the mouth and were never of less than one-inch mesh at the tail. The last hoop varied from two to four feet. Occasionally a variation of the standard wing net was used, in which one portion of the first supporting hoop is flat, forming a  $\Omega$ -pattern. This  $\Omega$ -wing type has more stability and less tendency to roll in rough, shallow water, and is less likely to be shifted from proper position.

Wings of these nets were never more than 20 feet long, and ranged from three to seven feet in depth, depending upon the size of the net to which they were attached. Mesh of the wing varied from one and one-half to four inches and was larger in each case than the mesh in the tail. Some nets were equipped with a small "hood" over the wing adjacent to the first hoop, to prevent fish from moving up and over the wing, since most sets were made in water of sufficient depth to cover the net.

Gill nets usually were 300 feet in length, although occasionally a 100-foot net was used. Other dimensions were varied, depths ranging from four to ten feet and square mesh measure from one to five inches.

Trammel nets were placed in stationary sets rather than as part of drifting procedures and they were never used in conjunction with other equipment. Mesh sizes ranged from one to four inches, length from 50 to 300 feet, and depth from four to ten feet.

Wire baskets were constructed in the same form as hoop nets, with the supporting hoops covered with one-inch poultry wire. Most were of two-throat design and the diameter varied from three to five feet. These nets are not collapsible but remain in stretched position.

Wood baskets were cylindrical and not more than two feet in diameter. The wooden strips or slats were spaced one inch apart and each slat extended the entire length of the net. Wood baskets do not collapse, and are slightly bulky.

The lead net is a wing net with a straight lead or seine used to "lead" fish to a point between the wings. The lead may vary in dimensions but in this case was 100 feet long, six feet deep and had a mesh of 1.5 inches. This net is best used adjacent to the shoreline.

The heart-lead net is a three-piece set, much like the simple lead, except that it includes a wing net for each end of the lead. The wing nets are set facing each other, usually at a distance of 200 feet, depending on the length of the lead.

In addition to the above mentioned types of gear, rotenone was employed in sampling six areas.

## NETTING AREAS AND SAMPLING PROCEDURES

Netting areas were selected to vary as much as possible in depth of water, shoreline characteristics, bottom types and distinctions as to cove, main lake channel, or main lake shelf areas in Kentucky Lake, where the study was carried on. These areas were selected after 37 bottom samples were taken by means of an Ekman dredge. Seventeen areas were considered from which five were selected and netted, these areas being diversified in characteristics, yet typical in many ways of this section of Kentucky Lake (Fig. 1). The five areas are listed below with an outline of principal physical characteristics.

Area I is a typical shallow cove area. Area II is a deeper cove with more diversity of netting sites. This area has a shallow channel which was heavily netted and produced good catches, and also has shelf formations to which sets of the heart-lead net were readily adapted.

Area III has a distinct bottom type and a greater variety in depths. It was difficult to maneuver the more complicated sets in this space because of the extreme variation in bottom contour. Area IV consisted of a variety of bottom and depth conditions. It was about one-half mile from shore and included both shelf and channel areas as well as the "second bank" of the original river channel.

Area V is primarily a channel area, although a shallow cove is within its bounds and several net days were logged in shallow water.

All net types were used in as many of the areas (Table 2) and in as many different sites within each area as feasible. Each net was regarded as a separate set for each calendar month. If a net was held over from one month to the next, it was regarded as a new net after the first day of the succeeding month in order to correlate the catch with the season.

Data relevant to net description, dates of setting and removal, area number and description were recorded on the form shown in Fig. 2. The following information was recorded for each specimen: Date of capture, total length in inches and tenths of inches, weight in pounds and tenths of pounds, sex, degree of maturity, and the apparent general physical condition. Scale samples were taken from the crappies and the white bass.

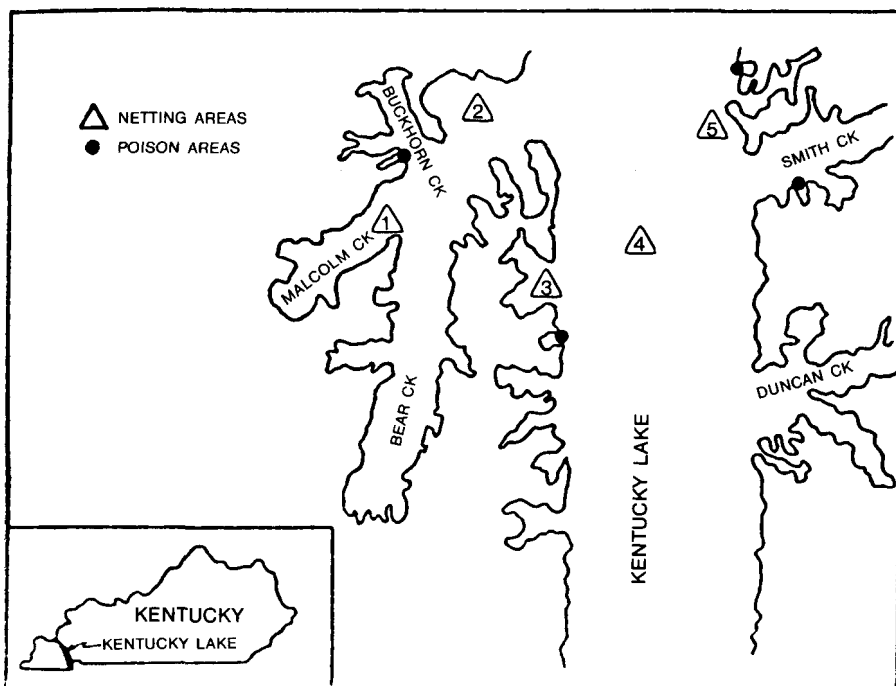


Fig. 1. Location of netting areas and rotenone sampling areas in Kentucky Lake.

Figure Legend:

Area I. Confluence of Malcolm Creek with Big Bear Creek

Depth..... 8 to 12 feet

Bottom..... Clay muck, relatively free of stumps

Location..... Shoreline to 300 yards from shore

Shore..... Loose sandstone and depleted soil, timber

Area II. Confluence of Big Bear Creek with Main Lake

Depth..... 6 to 15 feet

Bottom..... Blue clay and sand, relatively clear of stumps

Location..... Shoreline to 0.25 mile from shore

Shore..... Eroded soils, sandstone

Area III. Scout's Cove

Depth..... 5 to 15 feet

Bottom..... Sand and gravel, stumps and roots

Location..... Shoreline to 100 yards from shore

Shore..... Sand and gravel, broomsedge, second growth timber

Area IV. Middle of Main Lake

Depth..... West 4 to 12 feet; East 16 to 30 feet

Bottom..... Fine sand, clay or loam muck

Location..... One-half to one mile from shore

Area V. East Shoreline Below Smith's Creek

Depth..... 4 to 24 feet

Bottom..... Sand and/or clay muck

Location..... Shoreline to 100 yards from shore

Shore..... Lime rock formation, gravel, timber

## COMMERCIAL FISHERIES STUDIES

AREA NUMBER     II     NET NUMBER     12      
 TYPE OF NET     Wing     DEPTH OF WATER     8 ft.      
 BOTTOM TYPE     Blue clay and sand      
 DESCRIPTION OF AREA     Mouth of Big Bear Creek    

Net: Diameter mouth 4 ft., diameter tail 3 ft., mesh tail 2 in.  
 Wings: Length 12 ft., depth 4 ft., mesh 2½ in.

Date	Species	Lgth.	Wt.	Tag no.
4-17-52	1 w. crappie	7.5	0.2	1508 U
	1 w. crappie	12.4	1.1	1525 U M
	1 w. crappie	11.8	0.7	1523 U M
	1 bluegill	6.7	0.2	U M
	1 yellow bass	7.0	0.2	U R
4-18-54	1 w. crappie	9.9	0.4	1506
	1 w. crappie	11.1	0.7	U M
	1 b. crappie	10.6	0.6	I M
	1 bluegill	6.4	0.2	U R
	1 bluegill	6.6	0.2	U M
4-18-54	Net removed			
	U - Unharmd			
	I - Injured			
	M - Mature			
	R - Ripe			

Fig. 2. Sample field data sheet.

Nets were raised daily, pertinent data recorded and the fish released. This procedure was followed seven days per week for 116 days, except during hazardous weather conditions. After that period nets were raised each day during the week with the exception of Saturday and Sunday with no apparent change in catch due to this change in schedule.

Grouped sets such as the lead and heart-lead nets are considered a single piece of equipment.

A net day is one 24-hour period for each net set.

Reference to "game" fish include both game and pan fishes, grouped as in Table 8. Forage and trash fishes are treated as one group.

## SPECIES HARVESTED

Table 1 lists the 36 species of fish taken during 26 months of continuous netting, plus two species, the log perch and Mississippi threadfin, which were taken in population samplings only.

All species taken are common throughout this section of Kentucky with the exception of the northern pike which was introduced into Kentucky Lake in March, 1953, by the Kentucky Department of Fish and Wildlife Resources.

In the remainder of the text and tables the yellow bullhead, brown bullhead, and black bullhead have been grouped under the common heading of bullhead.

Of the 38 species, 15 are considered game and pan fishes, 16 are considered commercial fishes and seven, including the log perch and Mississippi threadfin, are classed as forage and trash species. These groupings are shown in Table 7.

## RELATION OF CATCH TO EQUIPMENT TYPE

In Tables 2, 3 and 4 the catch of each net type is shown in total pounds, in pounds per net day, in pounds per area, and the numbers of fish in each category. Since catch composition varies with each net type, the nets are considered separately.

Figure 3 is a graphic record of the poundage caught in each net type per net day.

Hoop nets are one of the two net types easiest to use and are adaptable to almost any type of set. These nets were used in all areas and accounted for 1,761.9 pounds of fish, as shown in Table 2. The highest yield for hoop nets was recorded in Area II. The highest yield per unit of effort for this net was taken in Area IV, as shown in Table 3. It may also be noted from Table 3 that the commercial fishes predominated in the catch in every area except Area I in which game and pan fishes were taken more frequently. Table 4 indicates the hoop net is more successful in the taking of commercial fishes than for other species, since commercial types represented 79.18% by weight of the catch in this net.

Fiddler nets are small, easy to use and may be set in either shallow or deep water. These nets took 769.0 pounds of fish in 601 net days, an average of 1.28 pounds per net day. They were more efficient with two throats than one, as were all barrel-type nets. Fiddler nets, like hoop nets, were more successful in the taking of commercial species, these fishes making up 86.09 percent of the total harvest in fiddler nets. Area I is the only exception; here game and pan species dominated the catch.

Table 1. A List of species taken in experimental commercial netting equipment and by rotenone sampling in Kentucky Lake.

Common name	Scientific name
Paddlefish.....	<i>Polyodon spatula</i> (Walbaum)
Longnose Gar.....	<i>Lepisosteus osseus</i> Rafinesque
Bowfin.....	<i>Amia calva</i> Linnaeus
Mooneye.....	<i>Hiodon tergisus</i> LeSueur
Gizzard Shad.....	<i>Dorosoma cepedianum</i> (LeSueur)
Mississippi Threadfin.....	<i>Dorosoma petenense</i> Evermann and Kendall
Blue Herring.....	<i>Pomolobus chrysochloris</i> Rafinesque
Bigmouth Buffalo.....	<i>Megastomatobus cyprinella</i> (Valenciennes)
Black Buffalo.....	<i>Ictiobus niger</i> (Rafinesque)
Smallmouth Buffalo.....	<i>Ictiobus bubalus</i> (Rafinesque)
Quillback.....	<i>Carpiodes cyprinus</i> (LeSueur)
River Carpsucker.....	<i>Carpiodes carpio</i> (Rafinesque)
Spotted Sucker.....	<i>Minytrema melanops</i> (Rafinesque)
Redhorse.....	<i>Moxostoma</i> spp.
Carp.....	<i>Cyprinus carpio</i> Linnaeus
Channel Catfish.....	<i>Ictalurus punctatus</i> (Rafinesque)
Blue Catfish.....	<i>Ictalurus furcatus</i> (LeSueur)
Flathead Catfish.....	<i>Pilodictus olivaris</i> (Rafinesque)
Black Bullhead.....	<i>Ameiurus melas</i> (Rafinesque)
Brown Bullhead.....	<i>Ameiurus nebulosis</i> (LeSueur)
Yellow Bullhead.....	<i>Ameiurus natalis</i> (LeSueur)
Chain Pickerel.....	<i>Esox niger</i> LeSueur
Northern Pike.....	<i>Esox lucius</i> Linnaeus
White Bass.....	<i>Lepibema chrysops</i> (Rafinesque)
Yellow Bass.....	<i>Morone interrupta</i> Gill
Eastern Sauger.....	<i>Stizostedion c. canadense</i> (Smith)
Log Perch.....	<i>Percina caprodes</i> (Rafinesque)
Largemouth Bass.....	<i>Micropterus salmoides</i> (Lacepede)
Kentucky Bass.....	<i>Micropterus punctulatus</i> (Rafinesque)
White Crappie.....	<i>Pomoxis annularis</i> Rafinesque
Black Crappie.....	<i>Pomoxis nigro-maculatus</i> LeSueur
Warmouth.....	<i>Chaenobryttus coronarius</i> (Bartram)
Rock Bass.....	<i>Ambloplites rupestris</i> (Rafinesque)
Bluegill.....	<i>Lepomis macrochirus</i> Rafinesque
Green Sunfish.....	<i>Lepomis cyanellus</i> Rafinesque
Orangespotted Sunfish.....	<i>Lepomis humilis</i> (Girard)
Longear Sunfish.....	<i>Lepomis megalotis</i> (Rafinesque)
Freshwater Drum.....	<i>Aplodinotus grunniens</i> Rafinesque

Wing nets were used more than any other type and were responsible for the capture of greater numbers of fish than any other type. During 1,429 net days, 2,491.5 pounds were taken, an average of 1.74 pounds per net day. Game and pan species predominated in the harvest from each area and comprised 82.07 percent by weight of the total harvest of these nets.

Table 2. Total catch per type of gear in each area.

	Area I		Area II		Area III		Area IV		Area V		Total	
	No.	Wt. (lbs.)	No.	Wt. (lbs.)	No.	Wt. (lbs.)	No.	Wt. (lbs.)	No.	Wt. (lbs.)	No.	Wt. (lbs.)
Net	321	188.9	684	891.5	286	355.8	139	220.2	37	105.5	1,467	1,761.9
Hoop	125	42.8			276	285.8	102	154.1	303	286.3	806	769.0
Fiddler	1,594	1,134.2	596	642.7	602	329.2	210	178.8	332	206.6	3,334	2,491.5
Wing	147	242.3	193	497.6	51	176.0	9	106.1	93	137.0	493	1,159.0
Gill	42	19.3	270	187.8	15	21.8	550	254.5	47	50.6	924	534.0
Trammel					131	36.9	330	110.0	121	20.8	667	202.1
Wire basket	7	4.7	85	34.4	24	7.2	4	8.5	13	38.2	63	69.4
Wood basket	28	17.2	327	361.1							355	378.3
Lead	271	292.7	2,427	3,273.4	158	268.5	125	201.5	122	173.9	3,103	4,210.0
Heart-lead	2,535	1,942.1	4,957	5,899.3	1,543	1,481.2	1,469	1,233.7	1,068	1,018.9	11,212	11,575.2



Table 3. Comparison of catcy by net type per area in pounds per net day.

Type	Net days	Type	Area I 1,023	Area II 1,447	Area III 1,193	Area IV 800	Area V 884	Total lbs./net day
Hoop	1,227	Game and Pan	0.50	0.24	0.28	0.51	0.05	0.30
		Commercial	0.39	1.53	0.85	1.78	1.04	1.14
		Trash	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.89	1.77	1.13	2.29	1.09	1.44
Fiddler	601	Game and Pan	0.66	0.00	0.12	0.10	0.12	0.17
		Commercial	0.05	0.00	1.33	1.60	1.00	1.10
		Trash	0.01	0.00	0.00	0.03	0.00	0.01
		Total	0.72	0.00	1.45	1.73	1.12	1.28
Wing	1,429	Game and Pan	2.46	1.36	1.01	0.63	0.79	1.43
		Commercial	0.20	0.56	0.09	0.15	0.47	0.28
		Trash	0.06	0.01	0.01	0.03	0.00	0.03
		Total	2.72	1.93	1.11	0.81	1.26	1.74
Gill	727	Game and Pan	1.30	0.08	0.22	0.00	0.07	0.17
		Commercial	1.25	0.99	0.74	0.94	0.50	0.81
		Trash	3.22	1.33	0.03	0.01	0.16	0.61
		Total	5.77	2.40	0.99	0.95	0.73	1.59
Trammel	421	Game and Pan	0.10	0.27	0.17	0.65	0.55	0.38
		Commercial	0.13	0.78	0.20	0.81	0.14	0.51
		Trash	0.04	0.54	0.07	0.67	0.13	0.38
		Total	0.27	1.59	0.44	2.13	0.82	1.27
		Game and Pan	0.00	0.41	0.94	2.74	0.50	0.80

Wire basket	191	Commercial	0.00	0.08	0.35	1.08	0.00	0.24
		Trash	0.00	0.00	0.03	0.11	0.00	0.02
		Total	0.00	0.49	1.32	3.93	0.50	1.06
Wood basket	305	Game and Pan	0.10	0.17	0.02	0.00	0.02	0.05
		Commercial	0.07	0.06	0.05	0.08	1.14	0.18
		Trash	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.17	0.23	0.07	0.08	1.16	0.23
Lead	107	Game and Pan	0.41	3.22	0.00	0.00	0.00	2.43
		Commercial	0.16	1.47	0.00	0.00	0.00	1.10
		Trash	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.57	4.69	0.00	0.00	0.00	3.53
Heart-lead	339	Game and Pan	1.90	31.57	4.21	3.65	2.78	10.55
		Commercial	0.16	3.56	3.68	3.06	1.36	1.85
		Trash	0.00	0.08	0.00	0.00	0.00	0.02
		Total	2.06	35.21	7.89	6.71	4.14	12.42
Total	5,347							

Table 4. Comparative harvest of game, commercial, and trash fish per type of gear.

Net	Game and pan		Commercial		Trash		Total No.
	No.	%	No.	%	No.	%	
	<i>Number</i>						
Hoop	666	45.4	800	54.6	1	0.0	1,467
Fiddler	365	45.3	427	33.0	14	1.7	806
Wing	3,016	90.5	252	7.5	66	2.0	3,334
Gill	84	17.0	173	35.1	236	47.9	493
Trammel	296	32.0	142	15.4	486	52.6	924
Wire basket	647	97.0	13	2.0	7	1.0	667
Wood basket	33	52.4	30	47.6			63
Lead	328	92.4	27	7.6			355
Heart-lead	2,916	94.0	186	6.0	1	0.0	3,103
Total	8,351	74.5	2,050	18.3	811	7.2	11,212
	<i>Weight</i>						
Hoop	366.5	20.8	1,395.0	79.2	0.4	0.0	1,761.9
Fiddler	103.6	13.5	662.0	86.1	3.4	0.4	769.0
Wing	2,044.8	82.1	407.2	16.3	39.5	1.6	2,491.5
Gill	123.1	10.6	589.6	50.9	446.3	38.5	1,159.0
Trammel	159.6	29.9	216.2	40.5	158.2	29.6	534.0
Wire basket	152.2	75.3	45.7	22.6	4.2	2.1	202.1
Wood basket	14.2	20.5	55.2	79.5			69.4
Lead	260.3	68.8	118.0	31.2			378.3
Heart-lead	3,575.9	84.9	627.7	14.9	6.4	0.2	4,210.0
Total	6,800.2	58.7	4,116.6	35.6	658.4	5.7	11,575.2

Gill nets were used in all areas and yielded an average of 1.59 pounds per net day for 727 days. This net type produced 1,159.0 pounds of fish, of which 589.6 pounds, or 50.9 percent, were commercial fishes and the greater part of the remainder were trash species. Areas III, IV and V yielded a greater percentage of commercial fishes to this net type and Areas I and II produced a greater representation of forage and trash types. The fishes taken by gill nets had a mean weight of 2.35 pounds.

Trammel nets harvested 534.0 pounds of fish during 421 net days. The average harvest was 1.27 pounds per net day, with only a slight preponderance of commercial species in the catch. Area V was the only area in which greater poundages of game fishes were taken by the trammel net.

Wire baskets were completely unsuccessful in Area I but took an average of 1.06 pounds per net day during 191 net days in the other four areas. In Areas II through V they harvested more game fishes than other types: 152.2 pounds of game fish of a total catch of 202.1 pounds. Wire baskets harvested the smallest fishes taken in this experiment, the fishes averaging only 0.30 pound per fish.

Wood baskets produced the lowest average return per unit of effort, with only 0.23 pounds per net day for 305 days. Area V produced the largest catch, 38.2 pounds during 33 net days. The total poundage for this net type was 69.4 pounds and 79.5 percent of this amount was made up in commercial types.

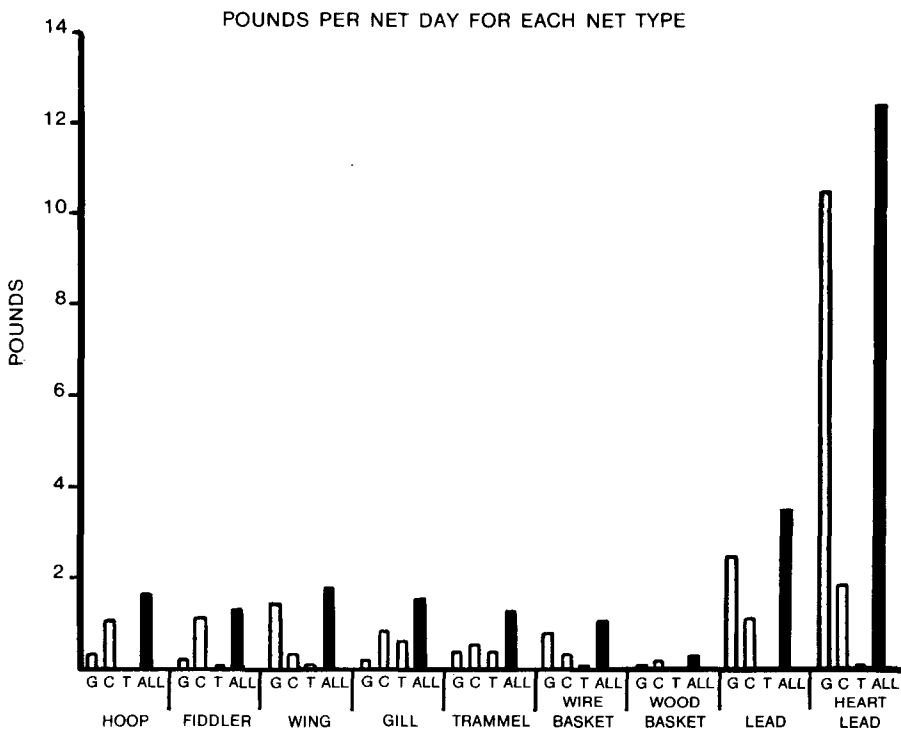


Fig. 3. Pounds of catch per day for each net type. G, game and pan species; C, commercial species; T, forage and trash species.

The lead net was fished in Areas I and II only. Of the 378.3 pounds taken during 107 net days in these two areas, 68.8 percent were game and pan fishes. The lead net produced an average of 3.53 pounds per net day, but was much more successful in Area II than in Area I.

The heart-lead net yielded more pounds per net day than any other net used in the study. This net produced 4,210.0 pounds of fish during 339 net days and it, like the lead net, yielded a better harvest in Area II. Game fishes represented 84.94 percent of the total catch in this net.

#### DIFFERENCES IN CATCH WITH REGARD TO AREA

The average harvest per area was 2,315.0 pounds of which 1,360.0 pounds or 58.75 percent were game fishes, 823.3 pounds or 35.56 percent were commercial species and the remaining 5.69 percent were forage and trash fishes (Table 5).

In Area I the harvest of game fishes was slightly above average. Of a total catch of 1,942.1 pounds, 1,516.0 pounds or 78.06 percent were game species. Table III shows that the yield per unit of effort or net day was 1.90 pounds. This area is relatively shallow, lacking a clearly defined channel, and has several shoal areas.

Area II produced 5,899.3 pounds of fish in 1,447 net days for an average of 4.08 pounds per net day, more than twice the yield per unit of effort of any other

Table 5. Catch per area in pounds.

Area	Game and pan		Commercial		Trash	
	Pounds	Percent of total catch	Pounds	Percent of total catch	Pounds	Percent of total catch
Area I	1,516.0	78.06	261.0	13.44	165.1	8.50
Area II	3,841.0	65.11	1,709.2	28.97	349.1	5.92
Area III	630.0	42.53	838.0	56.58	13.2	0.89
Area IV	461.9	37.44	678.4	54.99	93.4	7.57
Area V	351.3	34.48	630.0	61.83	37.6	3.69
Average of all areas	1,360.0	58.75	823.3	35.56	131.7	5.69

area. Also, this is the only area in which netted fishes averaged more than one pound each. Game fish represented 65.11 percent of the total poundage, while commercial types made up 28.97 percent by weight. The "deep water" portion of the area are about nine feet in depth, with a series of channels in which the water is approximately 13 to 15 feet deep. Some of these channels are believed to be much used fish "runs," or paths used by moving schools of fishes.

Area III yielded 1,481.2 pounds during 1,193 net days, or 1.24 pounds per unit of effort. The per day harvest is the lowest of the five areas. Commercial species were predominant in the catch, representing 56.58 percent of the total harvest. Game fish made up 42.53 percent, and forage and trash fishes less than one percent. In this area carp made up 71.4 percent of the commercial catch, a higher percentage than in any other area. This was due in part to the fact that nets were baited for carp. Area III is shallow but has two fairly deep channels within its bounds.

Area IV has one shallow portion four to six feet deep, termed a shelf area since deeper water, in the form of a main lake channel and a secondary channel, surrounds it. These channels are included in the netting area. This area is below average in yield but produced 1.54 pounds per net day, or 1,233.7 pounds total harvest. Commercial types represented 54.99 percent of the catch, game fish 37.44 percent and forage and trash fishes 7.57 percent. Very small differences in catch composition did not warrant separation of the data in accordance with depth differences within the area.

Area V produced the best commercial catch of the five areas. Commercial fishes comprised 61.83 percent of the total pounds taken. This is primarily a deep channel area but many of the channel and flathead catfish taken were caught in shallow water. Game fishes made up 34.48 percent of the total catch of 1,018.9 pounds for the area. These were taken primarily in shallow water.

The average yield for the five areas was 2.16 pounds per net day. Species representation for each area may be found in Table 7.

#### COMPARISON OF CATCH IN LEGAL AND EXPERIMENTAL EQUIPMENT

Only hoop nets and fiddler nets are legal for use in Kentucky Lake by licensed commercial fishermen. These net types were used as control equipment or as a basis for comparison with the following non-legal experimental nets: wing nets, gill nets, trammel nets, wire baskets, wood baskets, lead nets and heart-lead nets.

Table 6 is a comparison of the catch in legal and experimental gear, with respect to catch in total pounds and in pounds per unit of effort.

In Area I both legal and experimental nets produced more pounds of game fish than of other types of fish. In legal gear the harvest of game fish was almost twice that of commercial fish; however, in experimental gear the harvest of game fish was nearly eight times that of commercial types.

In Area II, the commercial fish catch was greater in legal gear and that of game fishes greater in experimental gear. This area shows more distinctly than any other area that experimental nets tend to capture greater numbers of game fish.

Area III produced approximately equal total poundages of fish per net day legal and experimental gear. Legal nets caught 529.7 pounds, or 82.6 percent, commercial fishes while experimental gear caught 518.1 pounds, or 61.7 percent, game species.

In Area IV, which is the main lake, legal net types harvested significantly more pounds per unit of effort than experimental gear, the only area in which this occurred. Legal net types harvested a preponderance of commercial fishes while experimental types harvested slightly more game fish.

Again in Area V commercial fishes were outstanding in the catch in legal net types while a slightly greater poundage of game fish was taken in experimental gear.

Of the total poundage taken by legal nets in all areas, 81.2 percent consisted of commercial fishes while that of experimental nets was 70.0 percent game fishes.

In Figure 3 the catch by net type is presented and shows that the wire basket, lead and heart-lead nets definitely took more poundage of game fish than commercial fish.

## SEASONAL FLUCTUATION IN HARVEST

The high point in the harvest of both game and commercial species occurred in April, 1952, at which time 2,037.0 pounds of game fish and 855.5 pounds of commercial fish were taken (Figure 4).

It is possible that this large harvest was due to a movement of the game fishes toward their spawning grounds in April and the early part of May. A study of white crappie collected during the spring of 1952 shows that 826 of 925 crappie were sexually developed during this period (Carter 1953).

A similar increase in activity of commercial fish during the spawning season seems logical, causing a peak in harvest of this type in April also.

Net harvest of game species declined to 732.3 pounds in May and was less than 100 pounds per month during June, July, and August. This low catch may be due to high water temperatures and consequent lack of fish movement during the summer months.

In September the game fish catch rose to 270.8 pounds. This increase was probably the result of the stimulating effect of cooler water with the coming of fall, causing increased fish movement.

The catch of commercial species declined from the April peak to 372.3 pounds in May, but rose again slightly to 488.7 pounds in June. After a drop to 197.4 pounds in August, the trend followed that of the game fish with a rise to 335.7 pounds in September, thence a steady decline to 40.6 pounds in December.

Table 6. Comparison of total catch in legal and in experimental gear.

Area	Type	Net days		Legal		Experimental		Lbs./net day	
		Legal	Experimental	Total	Total	Total	Total	Legal	Experimental
Area I	Game and Pan			144.9		1,371.1		0.53	1.83
	Commercial			86.1		174.9		0.32	0.23
	Trash			0.7		164.4		0.00	0.22
Area II	Total	272	751	231.7		1,710.4		0.85	2.28
	Game and Pan			119.2		3,721.8		0.24	3.95
	Commercial			771.9		937.3		1.53	0.99
Area III	Trash			0.4		348.7		0.00	0.37
	Total	504	943	891.5		5,007.8		1.77	5.31
	Game and Pan			111.9		518.1		0.22	0.76
Area IV	Commercial			529.7		308.3		1.03	0.45
	Trash			0.0		13.2		0.00	0.02
	Total	514	679	641.6		839.6		1.25	1.24
Area V	Game and Pan			58.1		403.8		0.31	0.66
	Commercial			313.5		364.9		1.69	0.59
	Trash			2.7		90.7		0.01	0.15
Total all areas	Total	185	615	374.3		859.4		2.02	1.40
	Game and Pan			36.0		315.3		0.10	0.59
	Commercial			355.8		274.2		1.01	0.52
Total all areas	Trash			0.0		37.6		0.00	0.07
	Total	353	531	391.8		627.1		1.11	1.18
	Game and Pan			470.1		6,330.1		0.26	1.80
Total all areas	Commercial			2,057.0		2,059.6		1.13	0.59
	Trash			3.8		654.6		0.00	0.19
	Total	1,828	3,519	2,530.9		9,044.3		1.38	2.57

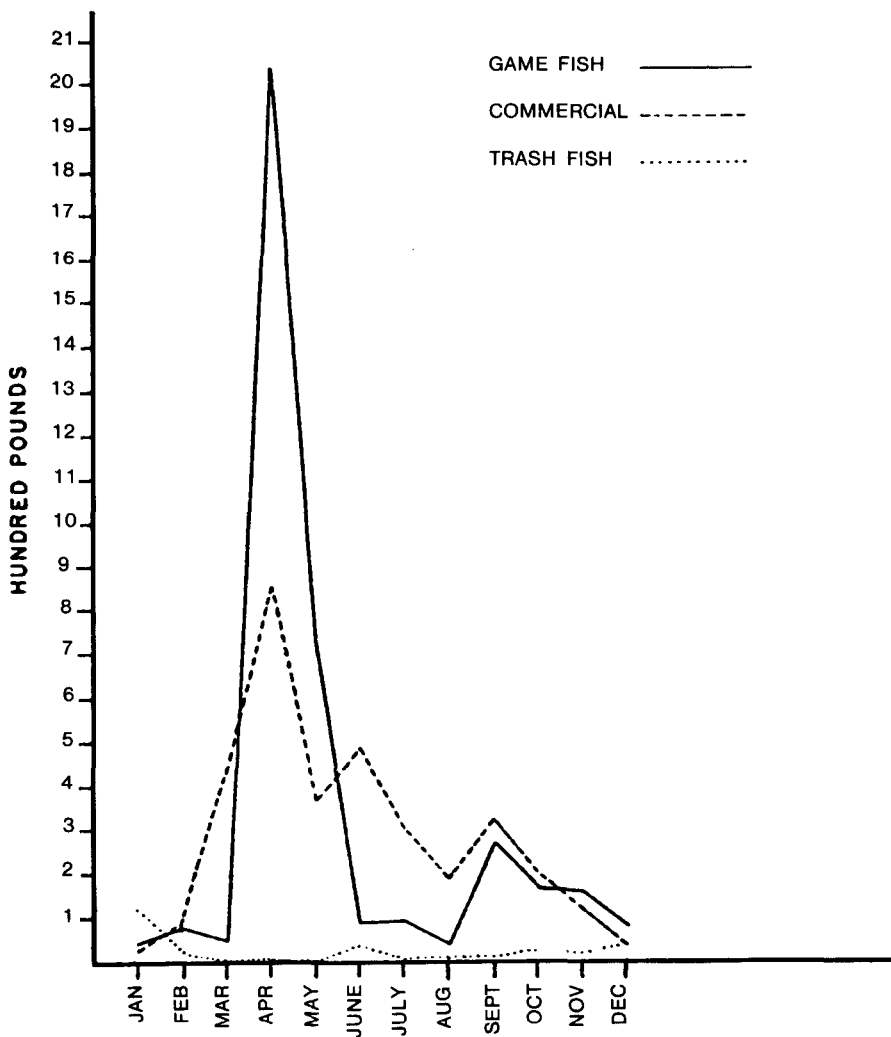


Fig. 4. Monthly fluctuations in harvest from nets.

The game fish harvest was better in shallow-water areas (Areas I, II and III) during the cooler months (January through June, and November and December), but was better in deep water (Areas IV and V) from July through October.

Catch of forage and trash species remained low throughout this study. One month, January, 1952, produced a catch of over 100 pounds, made up chiefly of blue herring. The reasons for this large catch of blue herring are unknown.

#### CATCH COMPOSITION

Table 7 shows the total harvest of each species, in numbers taken and total weight, for each area sampled during the 26-month study.



Table 7. Total catch of each species in each area for 26 months' continuous netting.

Species	Area I		Area II		Area III		Area IV		Area V		Total		% of total			
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.		
Game and Pan																
Northern Pike			1	1.3									1	1.3	0.01	0.01
Chain Pickerel	2	6.9											2	6.9	0.02	0.06
Largemouth Bass	8	22.7	24	98.3	9	42.0	3	2.3	2	7.8			46	173.1	0.41	0.50
Kentucky Bass	9	11.4	11	9.4	21	13.9	31	29.6	55	56.7			127	121.0	0.13	0.15
Sauger	1	4.2	12	17.8	2	4.2	29	23.3	3	7.0			47	56.5	0.42	0.49
White Bass	3	1.9	4	8.1	2	2.0	47	64.9	1	1.3			57	78.2	0.51	0.68
Yellow Bass	189	51.9	44	13.5	145	45.6	66	22.3	15	4.2			459	137.5	0.49	0.11.9
White Crappie	1,341	1,187.5	3,149	3,558.9	599	407.7	630	289.9	361	192.7			6,080	5,636.7	54.23	48.70
Black Croppie	341	167.5	183	122.1	154	79.7	40	23.2	85	50.7			803	443.2	0.716	0.383
Rock Bass	1	0.1											1	0.1	0.01	0.00
Warmouth					1	0.2	1	0.1	2	0.4			4	0.7	0.04	0.01
Bluegill	284	61.1	59	12.7	166	33.2	31	6.3	174	30.4			714	143.7	0.637	0.124
Langear Sunfish	5	0.8	2	0.2	1	0.1							8	1.1	0.07	0.01
Green Sunfish									1	0.1			1	0.1	0.01	0.00
Orangespotted Sunfish					1	0.1			699	351.3			1	0.1	0.01	0.00
Total	2,184	1,516.0	3,488	3,841.0	1,102	630.0	878	461.9	699	351.3			8,351	6,800.2	74.48	58.75
Commercial																
Channel Catfish	9	17.6	18	57.3	11	57.1	26	32.7	104	102.6			168	267.3	0.150	0.231
Blue Catfish			4	46.8	6	41.4	1	6.6	5	5.5			16	100.3	0.14	0.087
Flathead Catfish	7	9.3	17	119.9	7	38.1	10	90.1	23	63.0			64	320.4	0.057	0.277
Bullhead	8	2.9	12	4.0									20	6.9	0.18	0.006
Paddlefish	1	7.5	6	76.4	2	19.0	2	51.5					11	154.4	0.10	0.133
Drum	37	13.1	5	5.3	25	9.1	19	7.1	13	4.4			99	39.0	0.088	0.034
Smallmouth Buffalo	15	37.4	79	199.4	5	15.4	18	59.7	9	27.6			126	339.5	0.112	0.293
Bigmouth Buffalo			2	15.6	1	2.8	3	36.3					6	54.7	0.05	0.047
Black Buffalo	1	2.5	1	2.2									2	4.7	0.02	0.004
Quillback					1	3.6							1	3.6	0.01	0.003
Redhorse			1	0.6					1	1.3			2	1.9	0.02	0.002

Carp	151	148.4	637	1,085.0	343	598.1	153	382.3	175	410.2	1,459	2,624.0	13.01	22.67
Carp Sucker	8	21.0	37	96.7	20	53.4	4	12.1	5	15.4	74	198.6	00.66	01.72
Spotted Sucker	2	1.3									2	1.3	00.02	00.01
Total	239	261.0	819	1,709.2	421	838.0	236	678.4	335	630.0	2,050	4,116.6	18.28	35.56
<b>Forage and Trash</b>														
Longnose Gar			3	10.2	1	2.2					4	12.4	00.04	00.11
Mooneye			2	2.7			1	0.4			3	3.1	00.03	00.03
Bowfin	2	16.0	3	23.7							5	39.7	00.04	00.34
Blue Herring	56	131.7	148	273.0	6	7.2	35	30.2	31	36.5	276	478.6	02.46	04.13
Shad	54	17.4	134	39.5	13	3.8	319	62.8	3	1.1	523	124.6	04.66	01.08
Total	112	165.1	290	349.1	20	13.2	355	93.4	34	37.6	811	658.4	07.23	05.69
<b>Grand Total</b>	<b>2,535</b>	<b>1,942.1</b>	<b>4,597</b>	<b>5,899.3</b>	<b>1,543</b>	<b>1,481.2</b>	<b>1,469</b>	<b>1,233.7</b>	<b>1,068</b>	<b>1,018.9</b>	<b>11,212</b>	<b>11,575.2</b>	<b>99.99</b>	<b>100.00</b>

Game and pan fish represented 58.75 percent of the total catch. White crappie provided 48.70 percent of the total harvest and is quite possibly present in larger numbers than any other game species. In addition, sportsmen harvest large numbers of the commercial types with hook and line and these fishes represented 35.56 percent of the total catch in nets.

The harvest of commercial species represents an industry engaged in by several people in the vicinity of the lake and is a means of livelihood for a large percentage of this group. In 1950, Kentucky licensed 1,460 commercial fishermen who took an average of 1,085 pounds of commercial species, and marketed their catch for \$329,680.00 (Tompkins, Barber and Gerow 1950). Thus the commercial fish of this lake is of considerable economic value.

The trash and forage fishes represented a small portion of the total catch in Kentucky Lake. The entire group made up only 658.4 pounds or 5.69 percent of the total catch. However, this does not include the minnows, the Mississippi threadfin, or young of other fishes which provide a bountiful food supply for the predators and which would not be represented in any netting sample due to their small size.

Game fishes taken during netting studies averaged 0.81 pounds per fish, as may be derived from Table 7. Commercial species averaged 2.01 pounds per fish, while trash and forage fish averaged 0.81 pounds, the same as game types. The average weight for the entire 11,212 individuals was 1.03 pounds per fish.

## POPULATION SAMPLINGS

Population samplings have been conducted in this lake since 1948 as a means of determining species present, relative numbers and spawning success.

A total of six population samplings was conducted in 1952 and 1953 in cove areas adjacent to netting stations II, III, and V. Sites for eradication include two bay areas opening on the main lake and two protected coves lying within another embayment (Figure 1). Two studies are duplications in 1953 of studies conducted the prior year. These cove areas form a combined total of 7.4 acres. The bay to be sampled was treated in each case with three pounds of powdered derris (5% rotenone) per acre foot. A summary of results is shown in Table 8.

Note that with the exception of the Mississippi threadfin, the log perch, and minnows which are too small to be taken in nets, all fish taken in the population studies were also taken during netting operations. Nine species taken during the netting operations were absent in the rotenone samples.

Table 8 shows that game and pan fishes made up 9.33 percent of the total poundage of a typical cove as determined by means of rotenone sampling. This represents 5,884 fish of 12 species, weighing 151.21 pounds. Nine species of commercial fish accounted for 2,117 of the total number, and weighed 257.69 pounds or 15.89 percent of the weight of these samples. Carp represented 4.38 percent of the total poundage. Forage and trash types made up 74.78 percent of the total 1,621.40 pounds taken in the study, and shad alone accounted for 95.11 percent of the total weight of the forage and trash fish.

When allowance is made for differences among species in their reaction to rotenone and in the percent recovered (Ball 1948; Moorman and Ruhr 1951), the population studies probably are a reliable index to the relative abundance and spawning success of the fishes of a typical cove area in Kentucky Lake. However, they are not entirely reliable as an indicator of the harvestable fish population of a typical cove area.

Table 8. Combined summary of six population samplings made during 1952 and 1953 of 7.4 surface acres of cove area.

Species	Number		Weight in pounds	
	Total	Percent	Total	Percent
<b>Game and Pan</b>				
Largemouth Bass	1,328	3.78	58.73	3.62
Kentucky Bass	26	0.07	4.77	0.29
Sauger	20	0.06	4.20	0.26
White Bass	79	0.23	3.09	0.19
Yellow Bass	287	0.82	9.22	0.57
White Crappie	68	0.19	6.83	0.42
Black Crappie	2	0.01	0.10	0.01
Warmouth	10	0.03	1.00	0.06
Bluegill	3,330	9.48	46.70	2.88
Longear Sunfish	546	1.56	13.89	0.86
Green Sunfish	73	0.21	1.61	0.10
Orangespotted Sunfish	115	0.32	1.07	0.07
Total	5,884	16.76	151.21	9.33
<b>Commercial</b>				
Channel Catfish	303	0.86	58.08	3.58
Blue Catfish	44	0.13	1.07	0.07
Flathead Catfish	26	0.07	10.02	0.62
Bullhead	11	0.03	0.10	0.01
Drum	1,588	4.52	89.59	5.53
Smallmouth Buffalo	7	0.02	7.70	0.47
Carp	100	0.29	71.08	4.38
Carp sucker	2	0.01	1.40	0.09
Spotted Sucker	36	0.10	18.65	1.15
Total	2,117	6.03	257.69	15.89
<b>Trash and Forage</b>				
Longnose Gar	3	0.01	0.10	0.01
Mooneye	24	0.07	2.99	0.18
Blue Herring	1,408	4.01	18.42	1.14
Shad	20,562	58.57	1,153.25	71.13
Log Perch	61	0.17	1.05	0.06
Mississippi Threadfin	3,937	11.21	29.71	1.83
Miscellaneous Minnows	1,113	3.17	6.98	0.43
Total	27,108	77.21	1,212.50	74.78
<b>Grand total</b>	<b>35,109</b>	<b>100.01</b>	<b>1,621.40</b>	<b>100.01</b>

#### INJURY AND MORTALITY TO NETTED FISHES

Of the 6,538 fish handled during the calendar year 1952, 356 were killed and 220 were injured as a result of being taken in nets. These 576 fish represent 8.81 percent of the total harvest.

The highest rate of injury occurred during May (106 in a total catch of 1,070; see Figure 5). This high injury rate may be related to their weakened condition resulting from spawning. The highest mortality rate (64 in 141) occurred in January and was due to the relatively large number of easily killed blue herring in the catch.

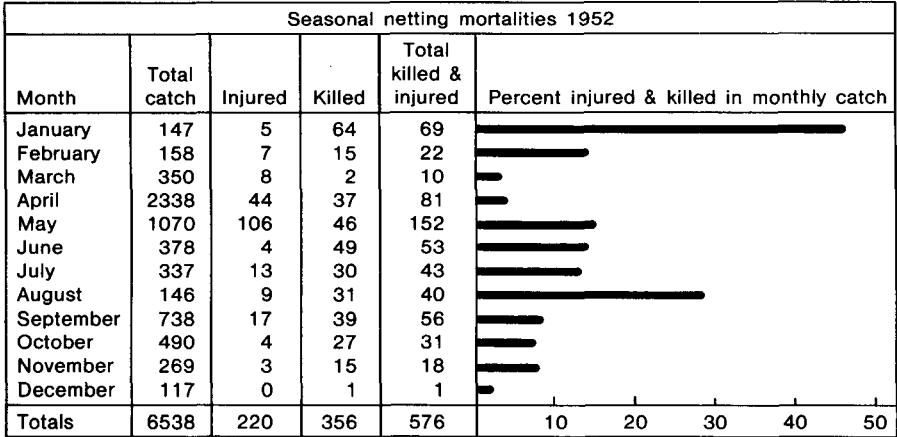


Fig. 5. Deaths and injuries from nets, by months.

Figure 6 shows the number of fish killed, the number injured and the percent of deaths and injuries for each net type.

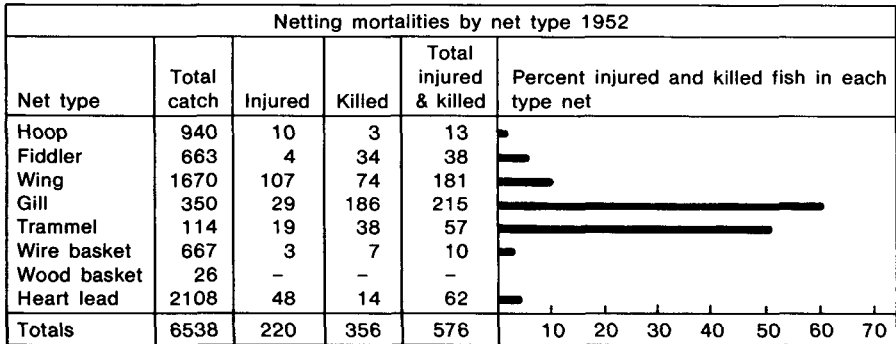


Fig. 6. Deaths and injuries from nets, by net type.

Gill nets were the most injurious, causing injury or death to 61.4 percent of their catch, and trammel nets were almost as injurious, killing or injuring 50.0 percent.

Every effort was made to prevent mortality or injury by handling. The fish were kept in large tubs, processed as quickly as possible, and returned to the lake. Even so, this loss represents 12.95 percent of the total pounds caught. Many of

the mortalities were large forage fishes, such as shad and blue herring, which often died in nets when these same nets were not injurious to more hardy species.

## SUMMARY AND CONCLUSIONS

During experimental use of nine types of commercial netting equipment, in five representative areas of Kentucky Lake, 36 species of fish were taken, of which 15 were game and pan fishes, 16 were commercial species and five were forage and trash fishes. Two additional forage species were taken in population samples made with rotenone. during 5,347 net days, 11,212 fish were taken, weighing 11,575.2 pounds.

Of the nine types of equipment, hoop nets are easiest to use and took predominantly commercial species. Wing nets took more fish, numerically, than any other type, but the catch was 82.07 percent game and pan fishes. Any of the seven barrel-type nets used were more successful when constructed with two throats.

Gill nets were inefficient in mesh sizes over three inches, and were selective for game fish in mesh sizes under three inches. Trammel nets were slightly more successful in taking commercial species. Wire baskets took the smallest fishes; however, 75.30 percent were game fish. Wood baskets produced the lowest average return per unit of effort, but harvested 79.5 percent commercial fishes.

Heart-lead nets caught a greater total poundage and also more pounds per net day than any other type. Lead nets were the second most successful types. Both, however, were rather selective for game fishes, which comprised 84.94 and 68.8 percent respectively of the poundage take of these nets.

Area I, shallowest of the areas, produced the highest percentage of game and pan fishes. Area II, with several secondary channels, yielded 4.08 pounds per net day, more than twice the yield per unit of effort of any other area. This is the only area in which all netted fishes averaged more than one pound.

Area III, a shallow main lake cove area, produced more carp than any other area. Area IV, including a main lake shelf and main channel, produced 1.54 pounds per net day. Area V, a channel area, produced the best commercial catch of the five areas. Game fish harvest in commercial gear was negligible when nets were set in deep water channel areas.

Evaluation of total catch by net types shows 81.2 percent of the catch in legal (hoop and fiddler) nets was composed of commercial fishes, while experimental nets harvested 70.0 percent game fishes.

The greatest harvest in nets occurred in April, 1952, for both game and commercial fish types, probably as a result of fish movement toward spawning areas. Catch of both types declined in the summer as fish moved little or sought deep water. Cooler waters and consequent increased fish movement brought a slightly increased catch in September.

The total harvest consisted of 58.75 percent by weight game and pan species, 35.56 percent commercial species, and 5.69 percent forage and trash species. The white crappie accounted for 82.89 percent of the game fish and carp composed 22.67 percent of the commercial group. Carp are not considered overabundant. Nets were baited in an effort to insure a representative catch of this species.

Six population samplings by use of rotenone were conducted in coves adjacent to netted areas. Results of these samplings showed 9.33 percent by weight game

and pan species, foremost of which is the largemouth bass. Commercial types made up 15.89 percent of the sample, drum producing the greatest weight of the commercial species. Forage and trash types made up 74.78 percent of the total weight of the combined rotenone samples, and shad accounted for 95.11 percent of this weight.

Discrepancies between the harvest from nets and that from rotenone can be due to at least three different factors. First, rotenone sampling of necessity was confined to shallow cove areas while nets were used in more open locations. Thus, different habitats were involved. Second, the rotenone killed many of the smaller forage fishes which were not taken in netting operations. Thus the ratio of game to forage fishes differ markedly when the two methods are compared. A third factor to be considered is the relative selectivity of the two methods for certain species. This is suggested by the gizzard shad, which comprised almost three-fourths of the total poundage harvested by rotenone but only slightly more than one percent of the total poundage from nets.

Of the total harvest in 1952, 8.81 percent of the fish captured in nets were killed or injured. Gill nets caused injury to 61.4 percent of their catch. Injuries and deaths were more prevalent among less hardy species, such as the blue herring. Since this fish was abundant in the January catch, the netting mortality was greatest in this month.

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