

## SEASONAL VARIATION IN HOOP NET CATCHES AT LAKE GLENDALE

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The rise and fall in hoop net catch with change in season has been studied on a year-round basis by Roach (1942) and Hansen (1951), and on a more limited basis by Wickliff and colleagues (1944 and 1946), Barnickol & Starrett (1951), and Harrison (1951). In the present study, hoop net catches were as much as 10 or 15 times heavier at one time of year than at another, and seasonal trends in the rate of catch differed widely for different species. For these reasons it is obvious that when hoop nets (or other trap nets) are used in quantitative sampling, the date of sampling is of critical importance.

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### COLLECTION OF HOOP NET DATA

Lake Glendale, the site of this netting study, is a comparatively new lake of 82 acres in southern Illinois (Pope County). The Glendale dam was completed in 1939 and the lake has been open to hook-and-line fishing since 1942. Largemouth bass<sup>1</sup>, bluegill, green sunfish, and

warmouth were the species most regularly caught by the anglers and by netting. The warmouth, however, did not appear in either angling or net catches until 1943.

The netting observations were made at Lake Glendale at about 1- to 2-month intervals, extending from early spring to late fall (March to November) during two years and for shorter periods in two other years. The operations during any one month most often consisted of three consecutive days of netting with either six or seven hoop nets. The nets were set at scattered points around the edge of the lake, mainly in the east half. The map (fig. 1), shows locations of the six nets used on the last eight trips, from August 1945 through September 1946. In general the locations of nets on earlier trips were the same as shown in fig. 1 with the exception of one or two nets per trip whose locations differed slightly from those shown. For example, Net 4 was sometimes used on the opposite side of the lake, 100 feet from its location on the map, and Net 6 was occasionally set on one side or the other of the big bay just west of its map location. In 1943, an additional net, making seven nets in all, was set half-way between nets 4 and 5 on the north side.

No special effort was made to set nets where good catches could be expected. A number of stations, in

<sup>1</sup>The Glendale species referred to by their common names are the bluegill (*Lepomis m. macrochirus* Rafinesque), the green sunfish (*Lepomis cyanellus* Rafinesque), the warmouth (*Chaenobryttus coronarius* (Bartram)), the largemouth bass (*Micropterus salmoides* (Lacépède)), and the black bullhead (*Ameiurus m. melas* (Rafinesque)).

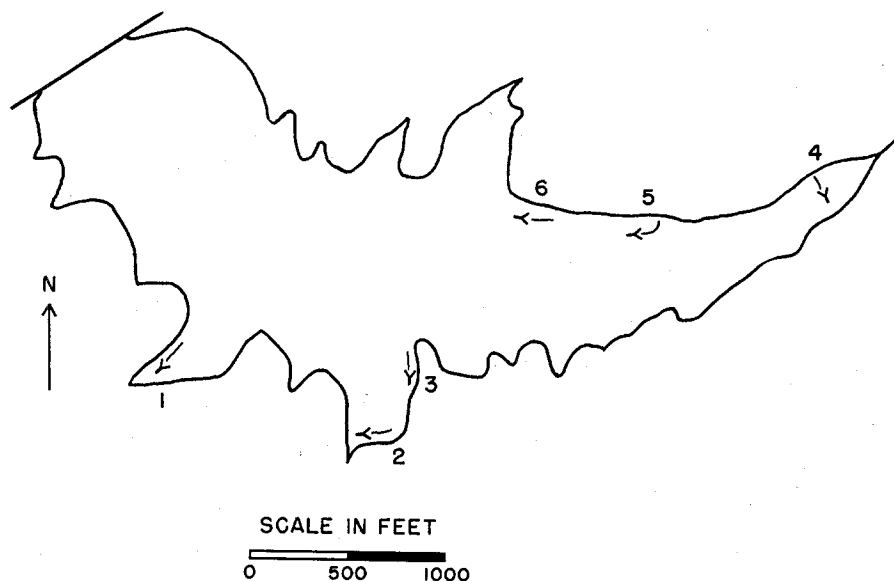


Fig. 1.—Outline map of Lake Glendale showing locations of the six netting sites used from August 1945 through September 1946 and in most of the earlier operations.

fact, quite consistently produced poor catches. In view of the variation in catch from one net to another found during the present study [the details are not given here] and previously shown by Roach (1942) and by Schumacher & Eschmeyer (1943), the practice of operating the nets at the same stations on all trips is unquestionably the best procedure for this type of study.

The hoop nets were 1-inch-square mesh, two-compartment wing nets of a design used by the Survey for many years. From the beginning of the study through March 1944, the usual collection of nets included two 2½-foot (diameter), two 4½-foot, and either two or three 3½-foot nets; from May 1944, 3½-foot nets were used exclusively. The wings on these nets were approximately 8

feet in length and the separate lead net, constructed like a seine and used in conjunction with each hoop net to guide fish toward the traps, was 60 feet in length. The hoop net proper was set in water deep enough to about cover the hoop, i.e., in water 2½ to 4½ feet deep, depending on diameter of the net. Since the bottom of this lake slopes rather steeply, most of the hoop nets were located close to the shore. For example, in fig. 1, all of the nets and their leads (except net 4) were set approximately parallel with the shoreline and about 25 feet out. Net 4, with its lead, was set at right angles to the shoreline, and the body of the net was 75 feet offshore. Net 5 was consistently set with the lead curved toward the shore. The nets were not baited.

Catches were made at various

stages of water level. Water levels varied in the spring from  $\frac{1}{2}$  inch to 12 inches above the crest of the spillway. In the summer when little water entered the lake, levels dropped from 12 to 18 inches below the crest of the spillway. The collection of November 30-December 1, 1944 was made when water stood 5 feet below the spillway crest. The water had been dropped intentionally to that level in late September.

The nets were emptied the day after they were first placed in the water and on each succeeding day until sampling was completed. As reported in another paper, on one trip some nets were set for 48 hours before emptying, but these catches are not included in the present analysis. The fish taken in the nets were not returned to the water. Thus, the catch on the second day was made from a smaller population than the catch of the first day, but while some conspicuous drops in catch occurred from one day to the next, this was not a consistent trend.

The daily field routine included, in addition to raising the net and examining the catch, measuring the surface temperature of the water and measuring water transparency—the latter by means of a modification of Secchi's disc—in this case the observation was made with a 4-inch diameter steel disc, painted plain white. Temperature was taken with an ordinary laboratory thermometer with bulb held approximately 2 inches below the surface.

#### RESULTS

Total catch of each species and average catch per net day are shown for each collecting date in table 1.

Seasonal trends in netting rate, as observed in different years, are shown for each species taken, except the black bullhead, in figs. 2 to 6. It is, of course, a question as to how well three days of fishing represent an entire month, and this can not be settled at the present time.

Although seasonal trends in catch rate of a species tended to be similar from year to year, the actual rates tended to be high in some years and low in other years. It is possible that this was partly due to changes in population. It has appeared from changes in hook-and-line catch rates based on an intensive creel census at Lake Glendale, that from 1943 to 1946 there may have been a 50 percent drop in abundance of largemouth, a slight drop in abundance of bluegill, and 70 or 80 percent drop in abundance of green sunfish. The warmouth were definitely increasing during these years but this increase cannot be stated on a percentage basis.

The bluegill and largemouth catch rates were highest in March. Largemouth were almost uncatchable through the summer months, while bluegill catch rates dropped off more gradually and reached the lowest point in September. Catch rates of both species picked up slightly from September to November. Black bullheads were taken in very small numbers but it appears that the trend might approximate that of the largemouth and bluegill.

Seasonal trends in the catch rates of green sunfish and warmouth differed considerably from year to year, but rates tended to rise from March to September (most pronounced in the warmouth). This 7-

Seasonal Variation in Catch by Hoop Net

TABLE 1.—NUMBER OF FISH CAUGHT, AND AVERAGE CATCH PER NET AT DIFFERENT TIMES OF THE YEAR AND UNDER DIFFERENT CONDITIONS OF WATER TEMPERATURE AND TRANSPARENCY AT LAKE GLENDALE

Dates of net raises (inclusive)	No. of hoop net catches <sup>1</sup>	Catch										Water observations					
		Largemouth		Bluegill		Green sunf.		Bluegill X gr. sunf. hybrid		Warmouth		Black bullhead		Surface temperature degrees F.	Transparency, inches		
		No.	Rate	No.	Rate <sup>2</sup>	No.	Rate	No.	Rate	No.	Rate	No.	Rate				
<b>1943</b>																	
Mar. 20-22...	20	147	7.4	1,329	66.5	11	0.6	3	0.1	.....	.....	.....	.....	.....	.....	48°	4
May 14.....	7	29	4.1	427	61.0	28	4.0	2	0.3	.....	.....	.....	.....	.....	.....	64°	14
July 25-27...	21	3	0.1	134	6.4	3	0.1	12	0.6	.....	.....	.....	.....	.....	.....	88°	96
<b>1944</b>																	
Mar. 26-31...	12	16	1.3	338	28.2	4	0.3	.....	.....	.....	.....	.....	.....	.....	.....	49°	12
May 16-18...	18	2	0.1	183	10.2	18	1.0	10	0.6	.....	.....	.....	.....	.....	.....	80°	23
July 28-29...	12	.....	.....	53	4.4	19	1.6	6	0.5	.....	.....	.....	.....	.....	.....	81°	62
Sept. 7-9.....	18	.....	.....	30	1.7	38	2.1	5	0.3	.....	.....	.....	.....	.....	.....	77°	62
Nov. 30-Dec.1	12	7	0.6	98	8.2	57	4.8	3	0.2	.....	.....	.....	.....	.....	.....	44°	48
<b>1945</b>																	
Mar. 7-9.....	18	68	3.8	1,332	74.0	17	0.9	2	0.1	.....	.....	.....	.....	.....	.....	46°	7
May 16-19...	24	4	0.2	575	23.9	15	0.6	4	0.2	.....	.....	.....	.....	.....	.....	65°	20
July 25-27...	18	1	0.1	273	15.2	14	0.8	10	0.6	.....	.....	.....	.....	.....	.....	88°	90
Aug. 15-17...	18	.....	.....	208	11.5	6	0.3	4	0.2	.....	.....	.....	.....	.....	.....	82°	63
Sept. 6-14...	44	.....	.....	80	1.8	50	1.1	5	0.1	.....	.....	.....	.....	.....	.....	81°	102
Nov. 28-30...	18	8	0.4	132	7.3	8	0.4	1	0.1	.....	.....	.....	.....	.....	.....	45°	17
<b>1946</b>																	
Mar. 14-15...	12	1	0.1	391	32.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52°	12
June 9-11...	18	.....	.....	424	23.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	79°	40
July 20-22...	18	1	0.1	212	11.8	5	0.3	3	0.2	.....	.....	.....	.....	.....	.....	84°	98
Aug. 21-23...	18	2	0.1	33	1.8	9	0.5	3	0.3	.....	.....	.....	.....	.....	.....	80°	60
Sept. 20-22...	18	2	0.1	8	0.4	18	1.0	3	0.2	.....	.....	.....	.....	.....	.....	75°	82

<sup>1</sup> The sum of the number of nets raised on successive days.

<sup>2</sup> The average catch per net in 24 hours—generally referred to as the catch per net-day.

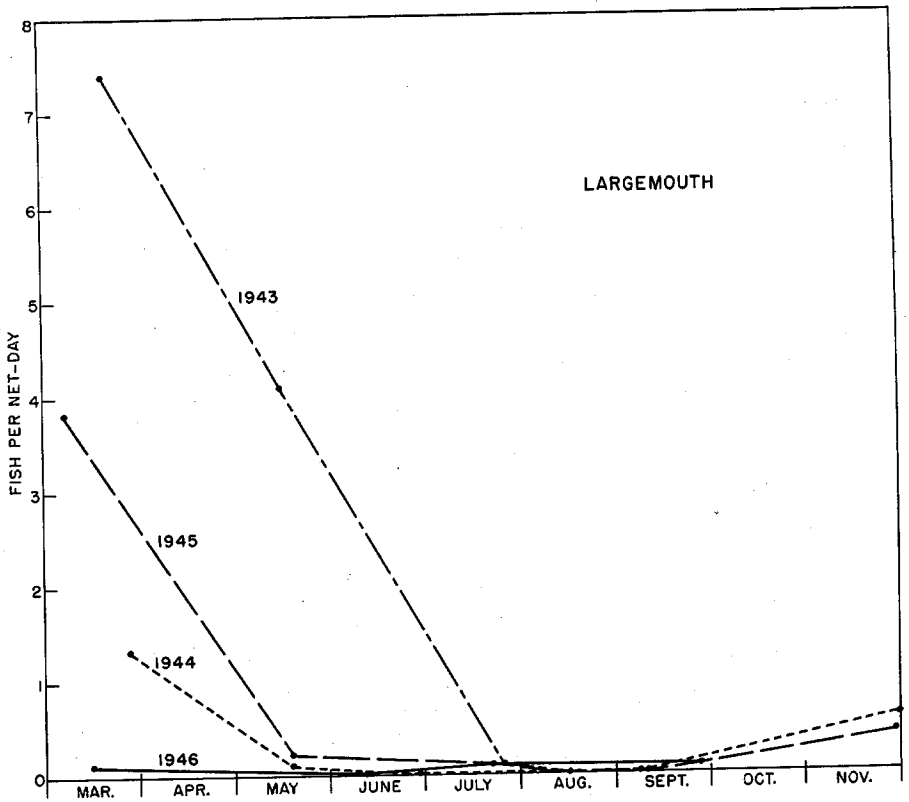


FIG. 2.—Seasonal variation in rates of catch of largemouth bass by hoop net at Lake Glendale.

month trend is opposite the trend outlined for largemouth and bluegill. The trend for the green sunfish and warmouth rates from September to November remains uncertain, since in the two November observations, rates for both species were high one year and low the other. The high rate of catch of green sunfish in May 1943 was possibly not typical; it might have been lower had netting been carried on for more than 1 day in that month. The catch rate of green sunfish showed little variation with season through 1945 and this was true of the largemouth in 1946.

The trend in the catch rate of the bluegill X green sunfish hybrid was different than that of either the bluegill or the green sunfish. From a low in March, the rate increased to a high point in July or August (May in one year) and dropped off in September and November. The increase in rate of catch from early spring to midsummer in the hybrid was marked by more steeply rising curves than those representing the green sunfish. The consistency in the seasonal trends for the catch of hybrids seems remarkable considering the small numbers actually handled.

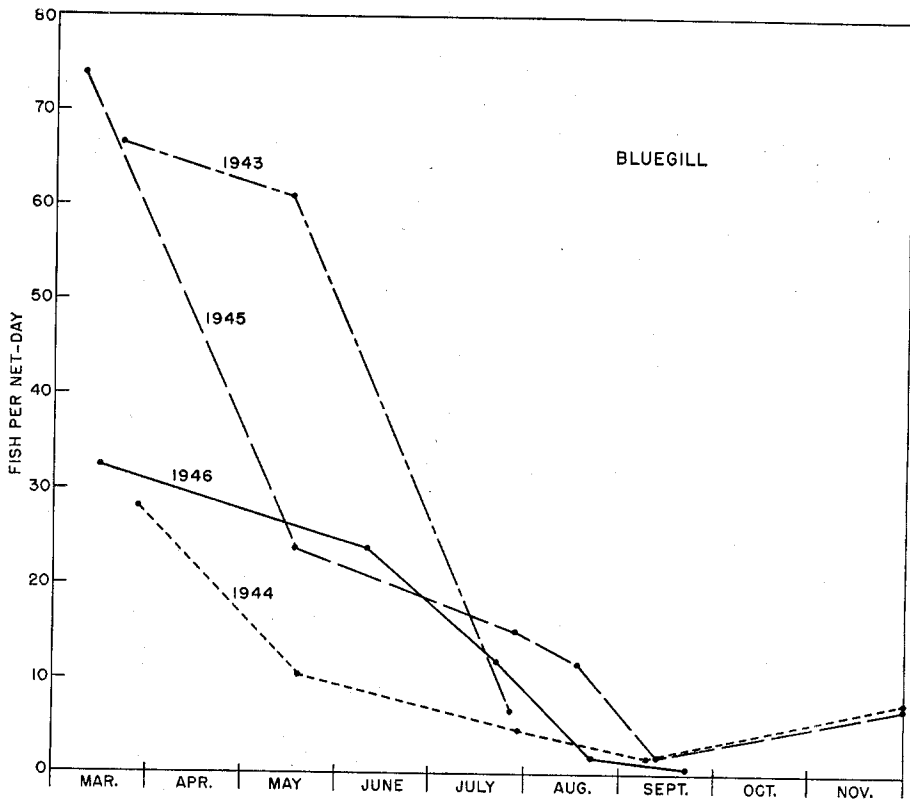


FIG. 3.—Seasonal variation in rates of catch of bluegills by hoop net at Lake Glendale.

As a result of the wide difference in these seasonal trends from one species to another, there was considerable change from one part of the year to another in the percentage composition of species in the net catches, table 2. The maximum difference here will be found between the percentage makeup of March catches and September catches—especially in bluegills, green sunfish, and warmouth. Whereas bluegills made up about 90 percent of the March catches, green sunfish and warmouth were about as abundant as bluegills in the September catches.

#### SOME POSSIBLE REASONS FOR SEASONAL VARIATIONS IN CATCH

Commercial fishermen who have noted rise and fall of net catches with season generally attribute the fluctuations to changes in either temperature or turbidity, or both. It appears that a number of commercially important species netted along the Illinois River, particularly carp and buffalo, are caught best in the cooler months of the year and better in turbid water than in clear water. Some of the river fishermen claim to have seen spectacular improve-

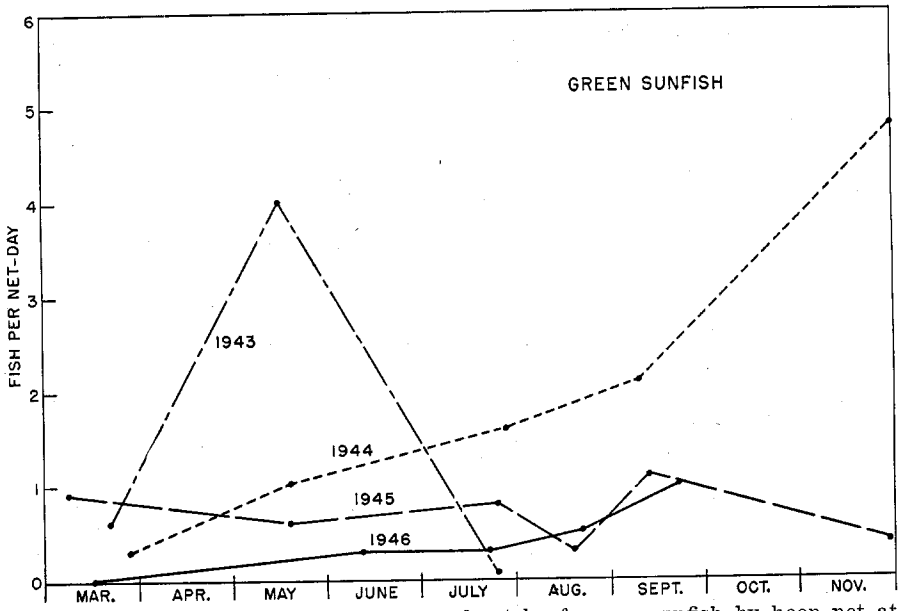


FIG. 4.—Seasonal variation in rates of catch of green sunfish by hoop net at Lake Glendale.

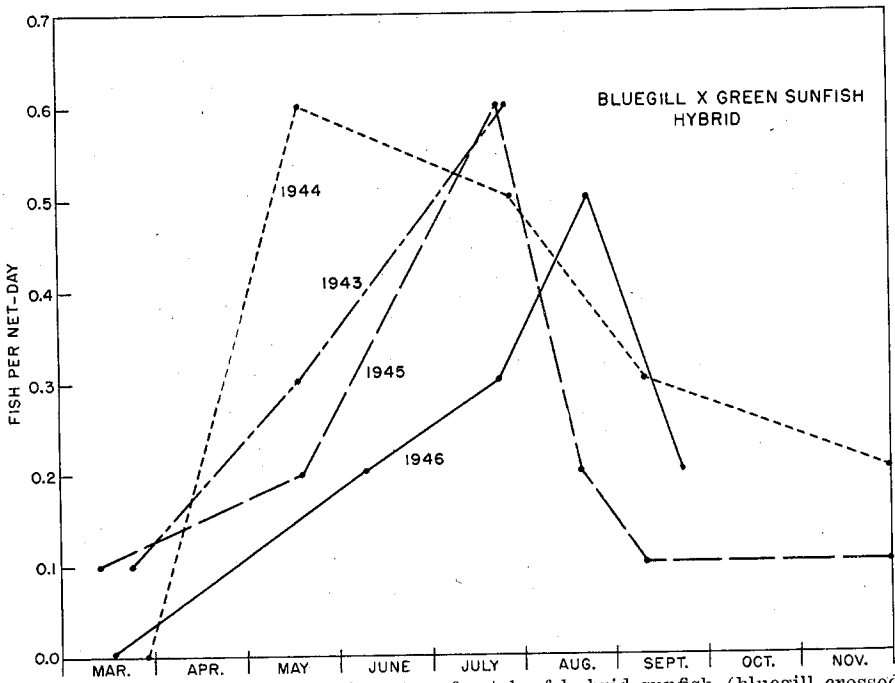


FIG. 5.—Seasonal variation in rates of catch of hybrid sunfish (bluegill crossed with green sunfish) by hoop net at Lake Glendale.

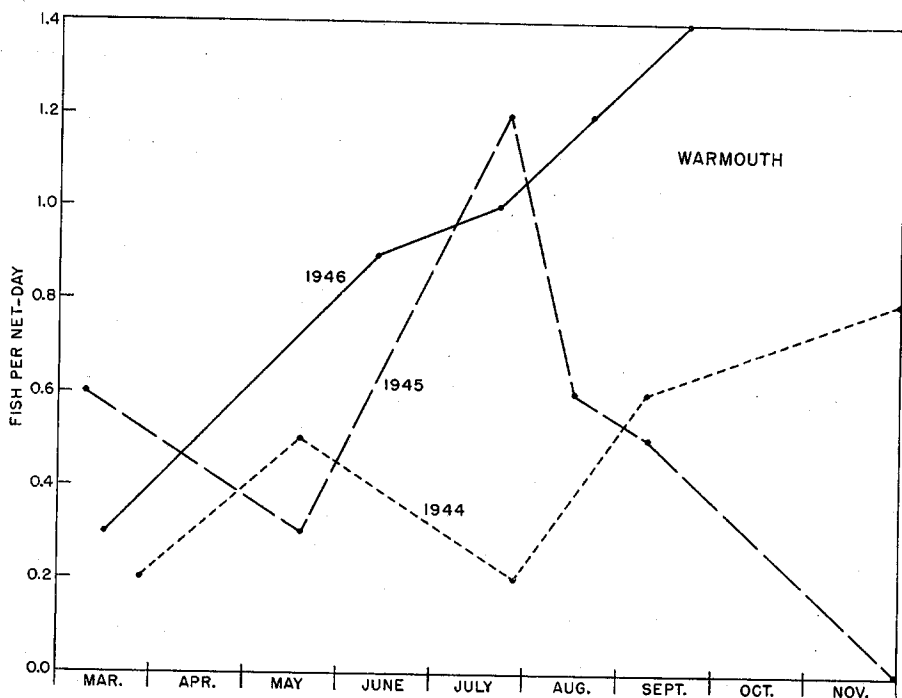


FIG. 6.—Seasonal variation in rates of catch of warmouth by hoop net at Lake Glendale.

ment in their carp and buffalo catches from one day to the next, accompanying a sharp increase in turbidity after heavy rainfall on some part of the upstream watershed. A fisherman at Havana was certain that improved catches after these storms could not be attributed to the accompanying rise in water level. He claimed that a rise in river level at Havana caused by release of clear water from Peoria Lake (by lowering the gates in the dam) was not accompanied by improved net catches. Harrison (1951) points out that any rise in level (turbidity not mentioned) results in better catches of channel cat. Although temperature and water transparency observations were made at the times of the Glendale netting operations, the im-

portance of these as factors determining catch rate of the Glendale fishes is somewhat in doubt.

It will be noticed (see table 1) that for most species the rise and fall in netting rate does not follow the annual cycle of temperature changes. The closest thing to a correlation between the temperature cycle and the catch rate is seen in the hybrid which was caught poorly at low water temperatures in spring and fall, and best at high water temperatures in summer. Largemouth and bluegills were caught much better in March than in November at the same water temperature. And summer catches of bluegills declined steadily irrespective of temperature changes.

TABLE 2.—SPECIES COMPOSITION OF HOOP NET COLLECTIONS AT LAKE GLENDALE

Date	Total No.	Largemouth		Bluegill		Green sunf.		Bluegill X gr. sunf. hybrid		Warmouth		Black bullhead	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1943													
Mar. 20-22	1,495	147	9.8	1,329	88.9	11	0.7	3	0.2	.....	0.0	5	0.3
May 14	486	29	6.0	427	87.9	28	5.8	2	0.4	.....	0.0	.....	0.0
July 25-27	154	3	1.9	134	87.0	3	1.9	12	7.8	1	0.7	1	0.7
1944													
Mar. 26-31	362	16	4.4	338	93.4	4	1.1	.....	0.0	2	0.5	2	0.5
May 16-18	229	2	0.9	186	81.2	18	7.9	10	4.4	9	3.9	4	1.7
July 28-29	80	.....	0.0	53	66.2	19	23.7	6	7.5	2	2.5	.....	0.0
Sept. 7-9	84	.....	0.0	30	35.7	38	45.2	5	5.9	10	11.9	1	1.2
Nov. 30-Dec. 1	175	7	4.0	98	56.0	57	32.6	3	1.7	10	5.7	.....	0.0
1945													
Mar. 7-9	1,440	68	4.7	1,332	92.5	17	1.2	2	0.1	11	0.8	10	0.7
May 16-19	610	4	0.6	575	94.3	15	2.5	4	0.6	7	1.1	5	0.8
July 25-27	321	1	0.3	273	85.0	14	4.4	10	3.1	21	6.5	2	0.6
Aug. 15-17	228	.....	0.0	208	91.2	6	2.6	4	1.7	10	4.4	.....	0.0
Sept. 6-14	157	.....	0.0	80	50.9	50	31.8	5	3.2	22	14.0	.....	0.0
Nov. 28-30	149	8	5.4	132	88.5	8	5.4	1	0.7	.....	0.0	.....	0.0
1946													
Mar. 14-15	396	1	0.2	391	98.7	.....	0.0	.....	0.0	4	1.0	.....	0.0
June 9-11	449	.....	0.0	424	94.4	5	1.1	3	0.7	17	3.7	.....	0.0
July 20-22	242	1	0.4	212	87.6	9	2.1	5	2.1	18	7.4	1	0.4
Aug. 21-23	68	2	2.9	33	48.5	5	13.2	3	4.4	21	30.9	.....	0.0
Sept. 20-22	57	2	3.5	8	14.0	18	31.6	3	5.3	26	45.6	.....	0.0

That the several species of fish in Lake Glendale were caught differently under various combinations of temperature and transparency can be seen in table 1. In the spring when the water was cool and cloudy, bluegills and largemouth were caught in relatively large numbers while green sunfish, warmouth, and hybrids were caught in small numbers; on the other hand, in middle and late summer when the water was warm and clear, bluegills and largemouth were caught with difficulty while the others were caught with more success.

The commercial fishermen claim that warm summer temperatures cause fish to descend into deeper, cooler water than that occupied through the spring months; they also claim that fish are less active in warm water than in cool water, and therefore are less likely to be caught, and that certain species are more wary of nets in clear water (where nets are plainly visible) than of the same nets set in muddy water. These explanations cover summer declines in netting rates—not summer improvement.

Cady, Dendy, and Haslbauer (1945) have presented evidence of seasonal depth changes in largemouth bass, based on gill net operations at Norris Lake. In contrast to the net fisherman's apparent notion that there is a general movement of the entire population to deeper water during hot weather, the Norris Lake study instead shows that the largemouth population covered a wider range of depths in summer than in spring. Some bass were found in shallow water from March to October, but occurrences of bass

in water more than 20 feet in depth were rare except in summer, and possibly fall. Few of the Norris Lake bass descended deeply enough during hot weather to get into water cooler than that at the surface. In other words, most of them remained in the warm water above the thermocline, even though the cooler water within the thermocline was well supplied with oxygen. Obviously, the Glendale catch records do not suggest that green sunfish, warmouth or hybrids move to deeper water in summer.

Other reasons for changing depth with season might be preference for certain light conditions, a preference for certain foods, or preference for a certain spawning depth.

It is not yet possible to verify the fisherman's claim that activity declines with rise in water temperature. Fry (1947) concluded that cold-blooded animals at least are capable of greater activity at high temperatures than at low temperatures, but this does not constitute a demonstration that they actually are more active.

Theoretically, there are other ways in which high turbidity may work to improve catch, in addition to the idea that turbidity helps to overcome fish wariness. One is that muddiness may stimulate fish to greater activity, possibly in an effort to find clean water—presuming that some species may have that preference. And high turbidity may interfere with fishes' efforts to escape from nets. Moderate turbidity, however, may not constitute a serious handicap to escapement (Hansen, 1944).

There remains one more possibly important reason for seasonal fluctu-

ations in netting rates. These fluctuations may be caused by real increases and decreases in the number of fish of nettable size. Scale studies by Hansen (1951) showed that the summer decline in catches of white crappies in hoop nets in Lake Decatur was mainly the result of heavy spring or summer mortality among

the older fish. Again at Lake Decatur, a large increase in fall netting rate was found in certain years to be caused by the capture of large numbers of fish in their second year of life which previously had been too small to hold in the nets or for some other reason had not been caught.

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