Stocking of muskellunge and walleye as a panfish control practice in Clear Lake, Sawyer County. Report 38 1968

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RESEARCH REPORT 38

STOCKING OF MUSKELLUNGE AND WALLEYE AS A PANFISH CONTROL PRACTICE IN CLEAR LAKE, SAWYER COUNTY

By
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Madison, Wis.

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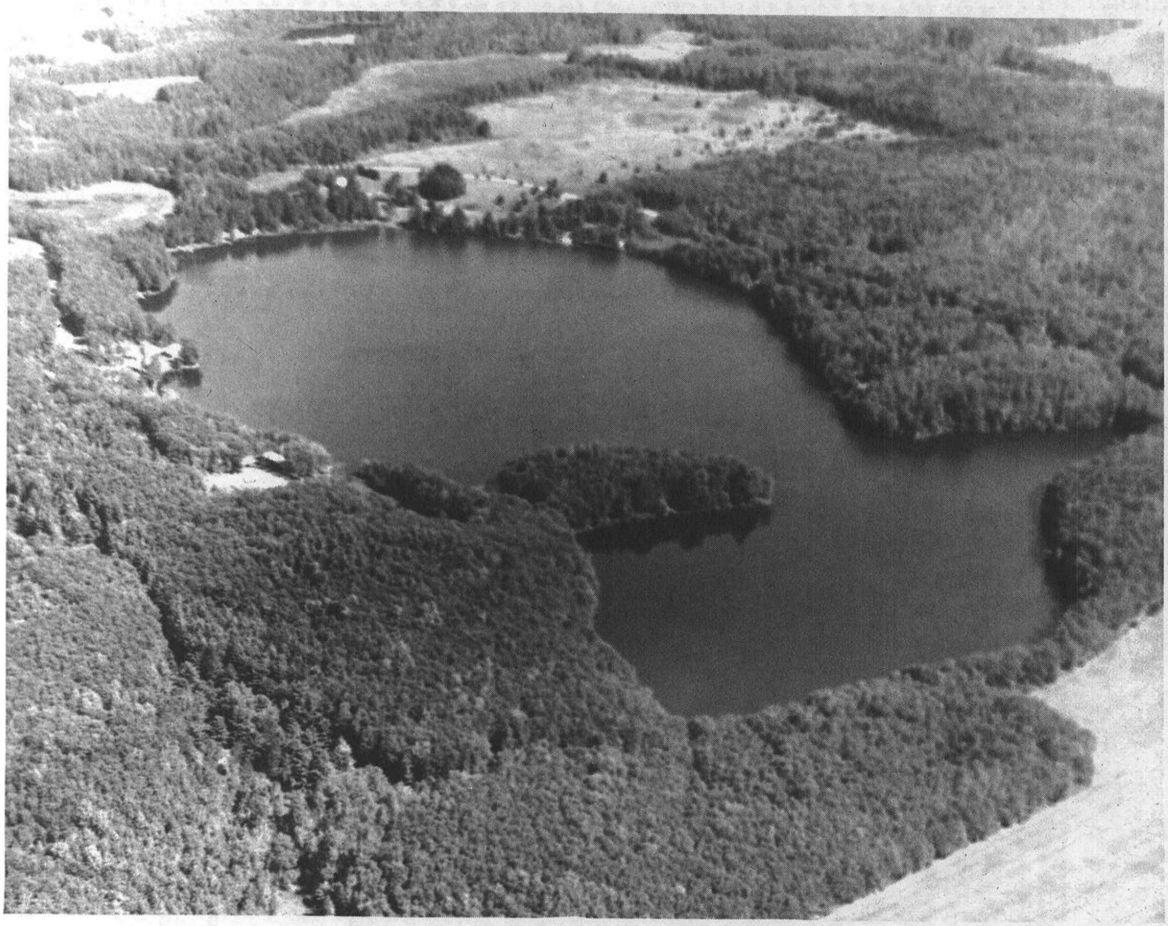


Aerial photo of Clear Lake looking toward the northeast.

INTRODUCTION

This report reviews the results of stocking muskellunge and walleye fingerling in a lake containing an extremely abundant and slow-growing bluegill population.

Slow-growing panfish have been a statewide problem for many years. In 1959, the Bureau of Research formulated plans to sample representative lakes to provide more background information on the status of fish populations which exhibited varying degrees of growth. The lake selected for a study of very slow growth was Clear Lake, Sawyer County, Wisconsin. The present study began in October, 1960, and since the Bureau of Fish Management began stocking muskellunge the same year, the study also developed into an evaluation of muskellunge and walleye stocking as a panfish control practice. This paper summarizes the results the first eight years after stocking.

DESCRIPTION OF LAKE

Clear Lake, Sawyer County is a 77-acre seepage lake with a maximum depth of 32 feet and a shoreline distance of 2.2 miles (Fig. 1). Of the total acreage, 27 percent is over 20 feet and 9 percent is less than 3 feet in depth; total volume is 1,076 acre-feet. About 80 percent of the shoreline consists of sand, 10 percent gravel and 10 percent muck. Aquatic vegetation is relatively sparse but is found in scattered areas along the shore and in the south bay. The lake has one resort and from 15 to 20 private cabins or residences. Water samples collected in 1958, 1964 and 1965 indicate a pH range of 6.8-7.8 and methyl purple alkalinity range of 27 to 35 ppm.

METHODS AND TECHNIQUES

All fish used for growth studies were captured by electrofishing. Total length measurements to the nearest 1/10 inch were made on all fish sampled. Scales were collected in a stratified manner, usually from one to five fish sampled per 1/10-inch group. Several scales were removed near the tip of the pectoral fin from which plastic impressions were made and examined with a binocular microscope at a magnification of 35 diameters. All ages presented in this paper represent the number of annuli. Since all samples were collected in October, the number of growing seasons actually is one more than the ages indicated.

Data used to evaluate angling returns of stocked muskellunge were obtained from the local resort operator who kept voluntary records from 1964 to 1967. In 1964 and 1965 only the length was recorded, while in 1966 and 1967 length and finclip data were obtained.

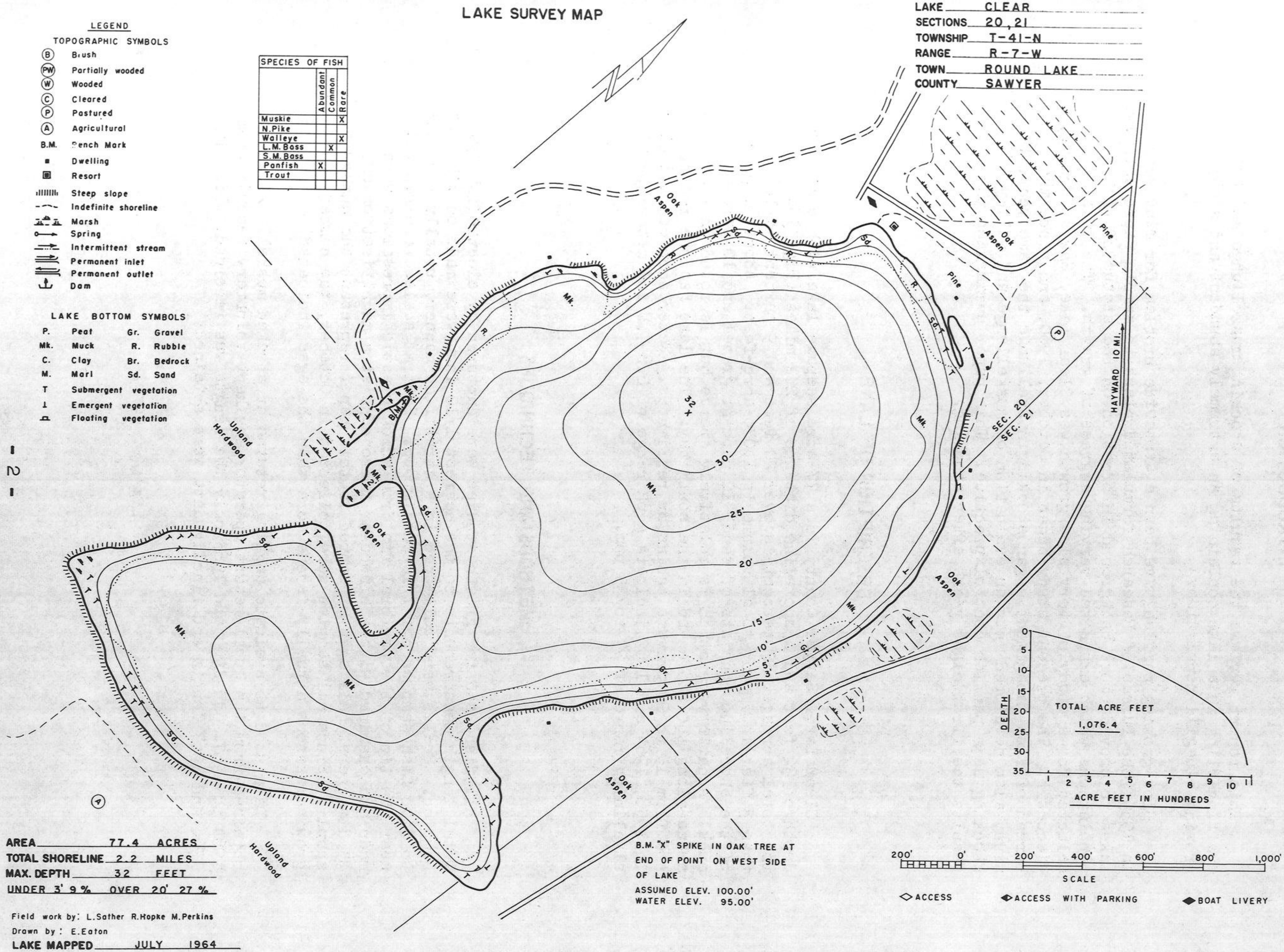


FIGURE 1. Hydrographic map of Clear Lake, Sawyer County.

Electrofishing surveys were made each October from 1960 to 1967. The same 3000-watt boom shocking unit was used each year except in 1967 when a new 3500-watt unit was used. A three-man crew with two men dipping fish was used at all times. During the first 45 to 90 minutes of shocking one man used a fine-mesh bobbin-netting dip net and the other a 3/8-inch bar mesh net so that all sizes of fish could be captured. In the remaining 60 to 90 minutes of the shocking period only the larger size mesh was used and usually all species other than bluegills were collected. Each survey began about dusk and was concluded between 10:30 p.m. and 1:00 a.m. except the first survey in 1960 when one round of the lake was completed before dark. The entire shoreline was shocked from 1-1/2 to 2 times during each survey. Throughout the study period the water temperature at the time of sampling varied from 46 to 49°F.

The means of evaluating the impact of muskellunge stocking on the panfish population was by comparison of growth rates and relative abundance of the most abundant species, the bluegill. All muskellunge and walleye stocked were finclipped for future identification.

MANAGEMENT HISTORY

Essentially Clear Lake has been a bass-panfish lake and from 1938 to 1953 the lake was managed on this basis. During this period 200 to 3,000 largemouth bass fingerling were stocked every year except 1939 and 1951. Prior to and during that management period there have been occasional stockings of crappie, bluegill and sunfish and also 50 smallmouth bass in 1946. From 1953 to 1959 no fish were stocked in Clear Lake. In 1959, 90 adult largemouth bass (10 to 17 inches) were removed from the lake for stocking in other waters.

For several years complaints had been received about an overabundant panfish population in Clear Lake and a 1958 fyke-net survey verified this complaint. Subsequently, from 1959 to 1961, walleye and muskellunge were stocked. The 1958 survey indicated the presence of a remnant population of large walleyes, and we thought that a very small population of muskellunge was also present before they were stocked in 1960, probably the result of illegal introductions of legal-sized fish by private parties. The stocking program for 1959 to 1961 consisted of 5,748 walleyes (75 per acre) from 3.0 to 9.0 inches long in 1959; 365 muskellunge, 8-12 inches in 1960; and 300 similar - sized muskellunge in 1961.

From 1961 through 1966 no fish were stocked in Clear Lake. In August, 1967, 2,000 walleye fingerlings were stocked. Three of these ranging in length from 3.7 to 4.0 inches were captured in the October, 1967 survey.

TABLE 1

Eight-year Average Growth of Clear Lake Fish (1960-67)*

Age	No. Fish	Avg. Total Length (In.)	Size Range	No. Fish	Avg. Total Length (In.)	Size Range
Perch				**Black Crappie**		
0	46	2.6	1.9-3.1	-	-	-
I	41	3.6	3.3-4.3	-	-	-
II	43	4.7	3.7-5.9	4	6.4	5.7-7.4
III	47	5.2	4.2-6.7	5	6.6	6.1-7.1
IV	25	6.2	4.9-8.3	10	7.7	6.9-9.0
V	11	7.2	5.0-10.9	13	8.6	7.6-11.9
VI	7	7.2	7.2-7.6	6	9.9	8.5-12.5
VII	1	7.5	7.5	8	9.6	8.5-11.8
VIII	1	9.5	9.5	4	9.9	9.3-11.1
Total	222			50		
Pumpkinseed				**Rock Bass**		
0	-	-	-	2	1.8	1.7-1.9
I	3	2.5	2.3-2.7	9	2.3	2.1-2.8
II	1	3.3	3.3	6	3.9	3.5-4.5
III	10	3.8	3.1-4.2	6	4.9	3.8-6.3
IV	19	4.4	3.9-5.5	1	6.2	6.2
V	12	5.3	4.7-6.0	4	7.2	7.0-7.8
VI	7	5.8	5.1-6.6	4	8.3	6.6-9.6
VII	1	6.2	6.2			
X				1	7.7	7.7
Total	53			33		
Largemouth Bass				**Walleyes**		
0	14	2.2	1.7-3.0	3	3.9	3.7-4.0
I	5	6.5	4.9-7.5	1	12.0	
II	11	8.8	8.2-10.3	1	16.7	
III	13	10.3	7.0-12.4	1	16.0	
IV	14	13.1	11.5-14.9	1	21.0	
V	5	15.2	12.7-16.6	2	21.0	19.5-22.4
VI	3	16.5	15.9-17.3			
VII	3	16.5	15.8-16.8			
VIII	2	18.3	16.8-19.9			
IX	1	18.8	18.8	1	23.4	
X	1	19.2	19.2			
XIII +				1	26.4	
Total	72			11		

*All fish were collected during October each year.

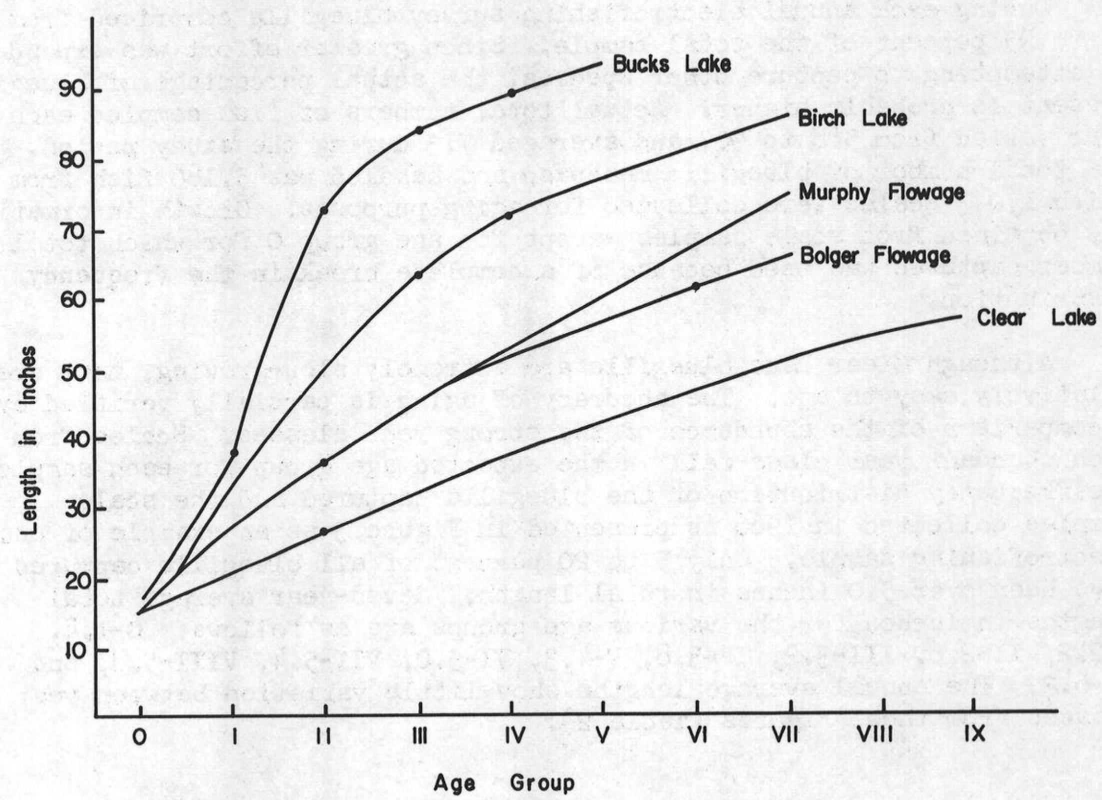


FIGURE 2. Average length of bluegills in five northwestern Wisconsin lakes, October, 1964.

RESULTS

Clear Lake has continually had the slowest growing bluegill population of any of over 15 lakes sampled in northwestern Wisconsin in the past eight years. For example, in 1964 age V bluegills in Clear Lake averaged 3.7 inches and in Bucks Lake, Rusk County, 8.9 inches. All other lakes sampled fell between these two extremes. An example of growth in five lakes including the extremes is shown in Figure 2. Growth of other species present in Clear Lake, which include perch, pumpkinseed, rock bass, crappie and bullhead, was not as slow as that of bluegills. Because only small numbers of other species were collected, growth data for these species were combined into a composite table covering all eight years of the study period (Table 1).

Few largemouth bass were captured electrofishing; however, there is apparently a good population of larger fish present. In 1964 and 1965, 28 bass in the 3-5-1/2 pound category were reported at a local resort. It may be that the bass were in deeper water during the sampling period and therefore were not captured.

Age and Growth of Bluegills

During each annual electrofishing survey bluegills comprised from 85 to 95 percent of the total sample. Since greater effort was expended in attempting to capture other species, the actual percentage of bluegills present is probably higher. Actual total numbers of fish sampled each year varied from 568 to 907 and averaged 713 during the study period. The total number of bluegills measured and handled was 5,180 fish from which 1,043 scales were collected for aging purposes. Growth information was obtained from scale samples except for age group 0 for which total number captured was used because of a complete break in the frequency distribution.

Although Clear Lake bluegills are extremely slow-growing, they are relatively easy to age. The accuracy of aging is partially verified by a comparison of the abundance of the strong year classes. Scales from each abundant year class fall in the expected age group for each sample. The frequency distribution of the bluegills captured and the scale samples collected in 1966 is presented in Figure 3 as an example of one electrofishing sample. Only 5 to 20 percent of all bluegills captured have been over 5.0 inches in total length. Seven-year average total lengths in inches for the various age groups are as follows: 0-1.4, I-2.2, II-2.6, III-3.2, IV-3.8, V-4.3, VI-5.0, VII-5.4, VIII-5.8, and IX-6.3. The annual average lengths show little variation between year classes from these figures (Table 2).

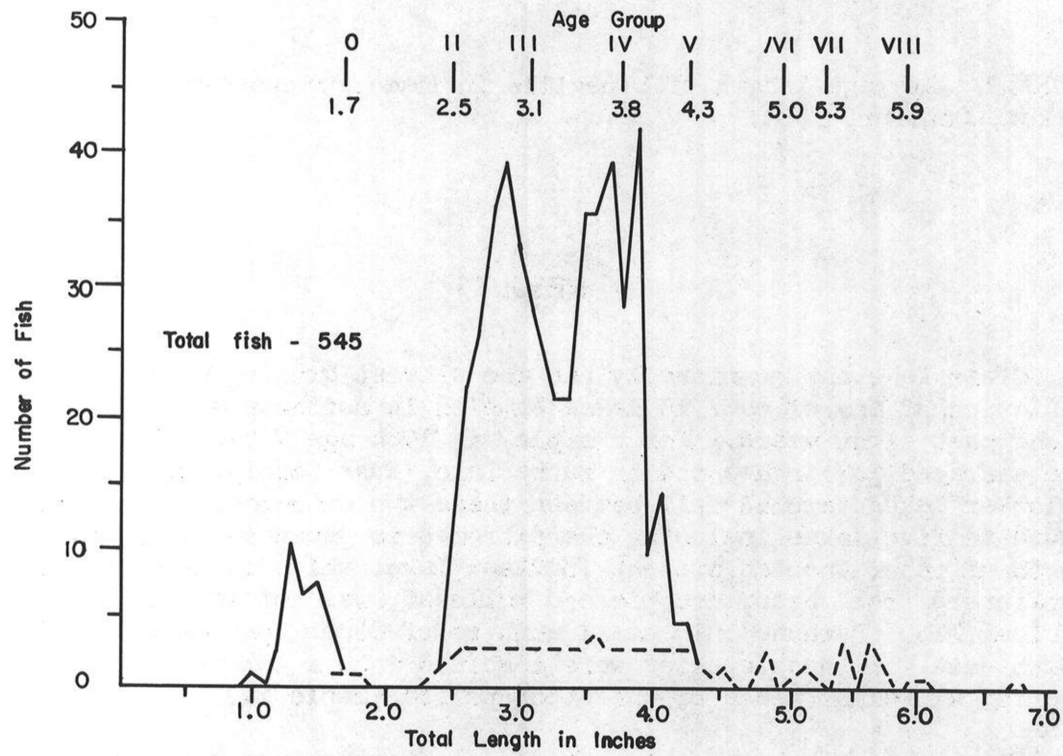


FIGURE 3. Frequency distribution of bluegills captured electrofishing in Clear Lake, October 17, 1966. The dashed line indicates the number of scale samples collected. Average length of the various age groups is shown at the top.

TABLE 2

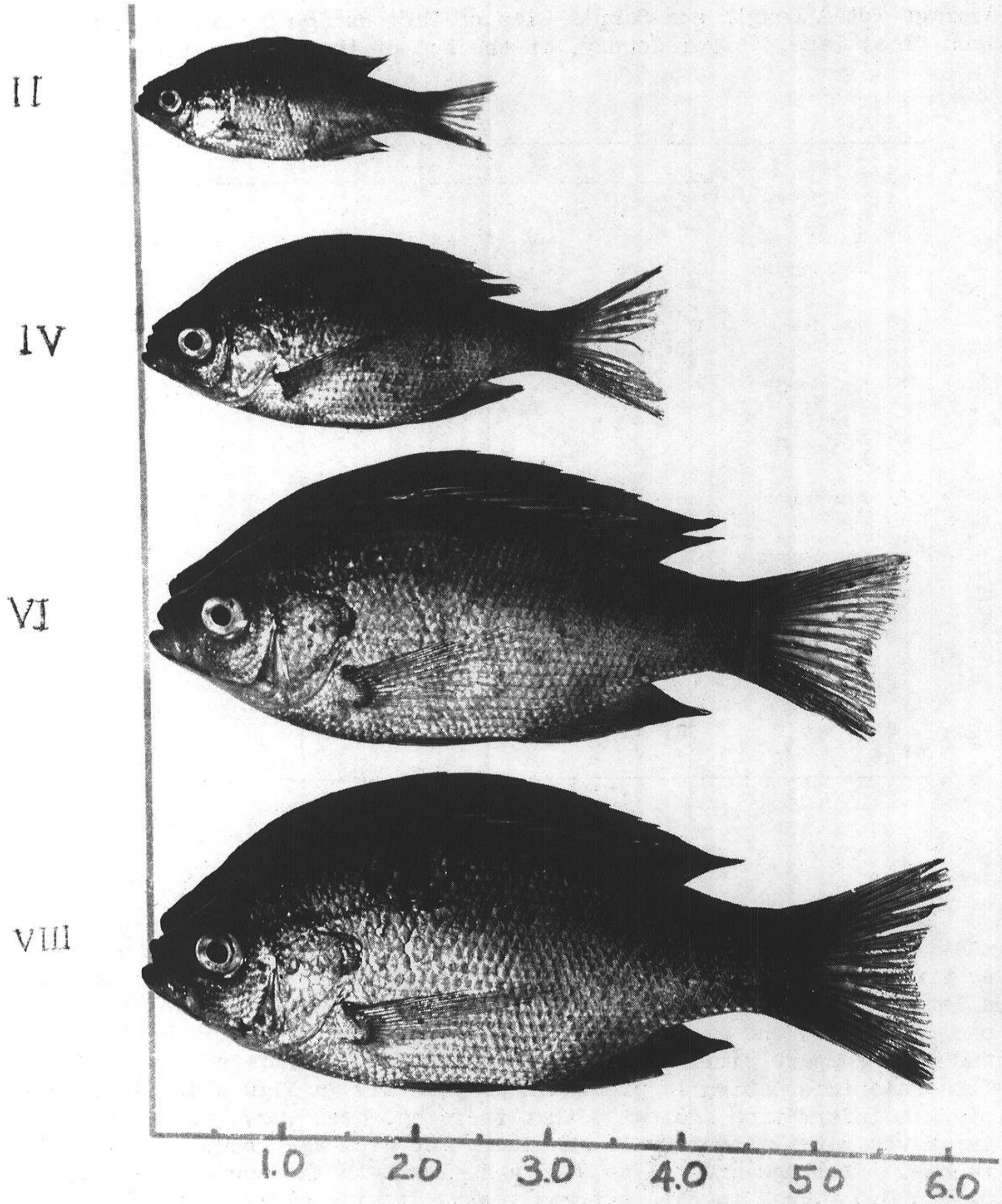
Average Total Length and Sample Size of Various Age Groups of Bluegills from Clear Lake, Sawyer County, at the End of the Growing Season, 1960-67.

		O	I	II	III	IV	V	VI	VII	VIII	IX
1960	Avg. length	1.3	2.2	2.5	3.4	3.9	4.4	5.4	5.7	5.8	
	No. fish	8	2	8	25	2	16	7	3	1	
1961	Avg. length	1.5	2.3	2.8	3.2	3.9	4.8	5.2	6.1	6.8	7.3
	No. fish	23	14	18	31	125	29	56	15	3	2
1962	Avg. length	1.3	2.2	2.8	3.2	3.5	4.3	5.2	5.6	6.0	
	No. fish	23	12	9	16	16	61	14	42	6	
1963	Avg. length	1.3	2.1	2.7	3.3	3.7	4.2	4.8	5.4	6.0	6.9
	No. fish	16	13	18	17	10	19	46	9	9	1
1964	Avg. length	1.5	2.1	2.6	3.1	3.7	4.0	4.5	4.9	5.4	5.7
	No. fish	1	7	11	21	11	7	18	21	3	3
1965	Avg. length	1.6	2.1	2.5	3.1	3.9	3.9	4.9	5.0	5.3	5.8
	No. fish	4	4	24	14	23	8	3	12	11	3
1966	Avg. length	1.7	-	2.5	3.1	3.8	4.3	5.0	5.3	5.9	6.8
	No. fish	3		3	30	15	11	9	8	5	1
1967	Avg. length	1.2	2.1	-	2.7	3.5	4.0	4.8	5.0	5.8	6.0
	No. fish	14	6		1	24	5	12	6	7	1
8 Year Mean	Avg. Length	1.36	2.2	2.6	3.2	3.8	4.3	5.0	5.4	5.8	6.3
	Total Fish	92	58	91	155	226	156	165	116	45	11

A further breakdown of growth data into year classes shows evidence that the present slow-growing bluegill population is similar to that of several years prior to the present study. The 1952 year class had reached a length of only 5.8 inches by 1960 as shown in Table 3. In this table one can follow the growth of a single year class or cohort horizontally and also compare similar age groups collected in different years diagonally. This same information is presented graphically in Figure 4. A comparison of this information indicates that there has been very little variation in growth rates. Average length increment from age group O to I is 0.8 inches. From age group I to VIII annual growth increments are only from 0.4 to 0.6 inches in this extremely slow-growing bluegill population.

Fluctuations in Size Distribution and Abundance of Bluegills

The bluegill samples were collected during October using the same techniques each year so any major changes or trends in the bluegill population should be apparent. However, because of size selectivity of the sampling gear and the lack of population estimates one cannot make valid quantitative measurements on changes in abundance and size distribu-



An example of the slow-growing bluegills from Clear Lake. The average length in inches of the age groups shown are as follows: II 2.6; IV 3.8; VI 5.0; and VIII 5.8.

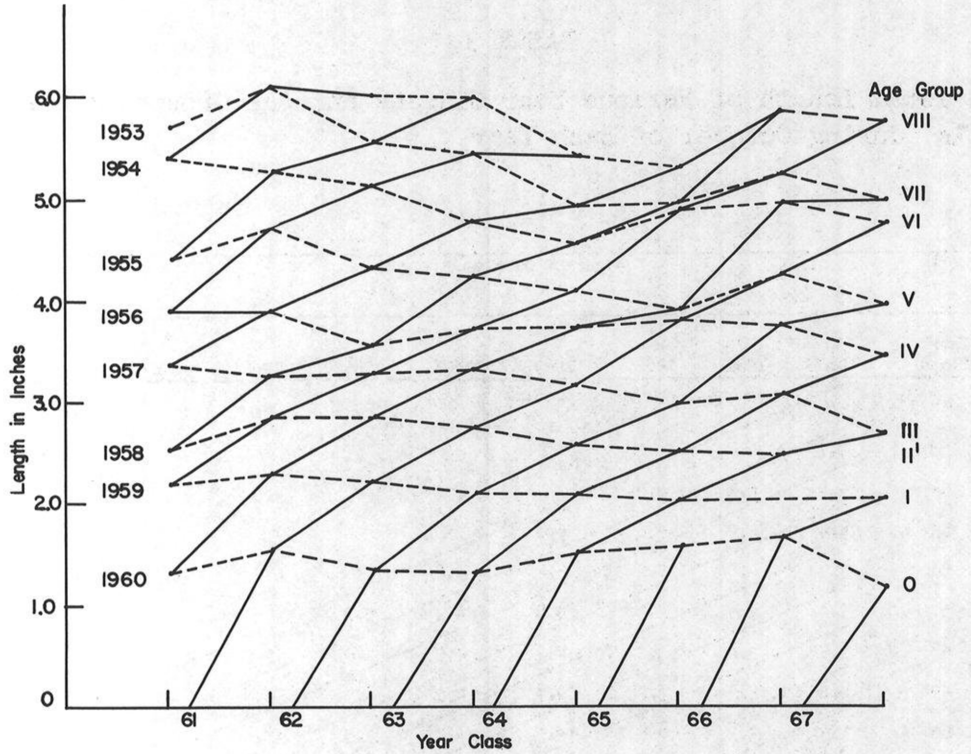
TABLE 3

Average Total Length of Various Year Classes and Age Groups of Clear Lake Bluegills during October of Each Year

Year Class	1960	1961	1962	1963	1964	1965	1966	1967	Age Group
	Year of Sample								
1952	5.8								
53	5.7	6.8							
54	5.4	6.1	6.0						
55	4.4	5.2	5.6	6.0					
56	3.9	4.8	5.2	5.4	5.4				
57	3.4	3.9	4.3	4.8	4.9	5.3			
58	2.5	3.2	3.5	4.2	4.5	5.0	5.9		
59	2.2	2.8	3.2	3.7	4.0	4.9	5.3	5.8	VIII
60	1.3	2.3	2.8	3.3	3.7	3.9	5.0	5.0	VII
61		1.5	2.2	2.7	3.1	3.9	4.3	4.8	VI
62			1.3	2.1	2.6	3.1	3.8	4.0	V
63				1.3	2.1	2.5	3.1	3.5	IV
64					1.5	2.1	2.5	2.7	III
65						1.6	-	-	II
66							1.7	2.1	I
67								1.2	0

tion. The number of bluegills captured per hour of electrofishing averaged 655 and varied from 453 to 799. The collections were so variable that catch per unit of effort could not be used as an indication of overall relative abundance despite efforts to standardize sampling techniques. Environmental conditions such as temperature and wind direction probably affect catch rate to such an extent that it cannot be used as an indication of relative abundance.

Throughout all sampling periods from 65 to 85 percent of all fish fell within the size range of 3.0 to 4.5 inches. Despite this concentration within relatively narrow limits there has been considerable change in the sizes of bluegills captured. The percentage of bluegills over 4.0 inches averaged 54 percent from 1960 to 1963 compared to 21 percent from 1964 to 1967 (Fig. 5). This change in size distribution can in part be attributed to strong 1955 and 1957 year classes (Fig. 6). Further examination of Figure 6, which is simply a distribution of relative abundance of each annual sample by age group and year class, indicates the presence of strong year classes in 1955, 1957, 1961 and 1963. Due to size selectivity



[1]No bluegills from the 1965 year class were captured in 1966 or 1967. Therefore points for age group I in 1966 and II in 1967 are missing.

FIGURE 4. Growth of bluegills in Clear Lake, Sawyer County by year class and age group 1960-67.

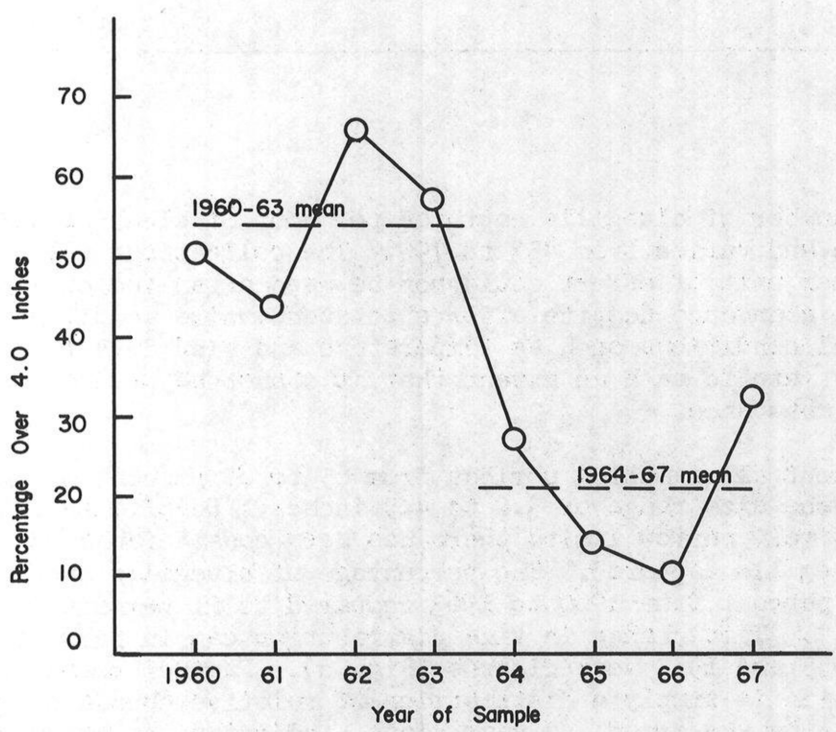


FIGURE 5. Percentage of bluegills over 4.0 inches in length in Clear Lake. Each sample was collected during October each year.

it is not until the fourth summer of life and a size of 2.5 inches or more that large numbers of bluegills are vulnerable to the electrofishing equipment used (Figs. 6, 7). As a result of this delay in detection of year class strength, the 1955 and 1957 year class dominated the catch from 1960 to 1963 and the 1961 and 1963 year classes from 1964 to 1967 even though the strong year classes were undoubtedly very abundant but not vulnerable at earlier ages. Closer examination of Figure 6 reveals a 2-year cycle of abundance with peaks in odd-numbered years from 1955 through 1965 except for 1959 and 1965. There is every indication that the 1959 year class was very weak since it was at a low level in each of eight samples from 1960 to 1967. The bluegills in the 1965 year class would not have been large enough to be fully vulnerable to the sampling gear by the end of the study period; however there is every indication that it is missing or at the most very weak, because no fish were captured from it in 1966 or 1967.

A further observation on year class strength concerns the 1961 group. In contrast to the 1957 year class which dominated the sample for 4 years (1960-63), the 1961 year class dominated the catch for only 2 years. For unknown reasons this group appeared to diminish in numbers in 1966 and 1967.

It is interesting that the extremely slow-growing and abundant bluegill population of Clear Lake, which has exhibited very little change in growth rate, has had considerable and apparently cyclic variation in year class strength.

<u>Muskellunge</u>

Normal stocking quotas for 8.0 to 12.0 inch muskellunge fingerling range from less than one to two fish per acre. These figures vary considerably depending on annual muskellunge production. On this basis Clear Lake, which received 4.7 fish per acre in 1960 and 3.9 in 1961, was stocked at several times the normal rate. Despite the high rate of stocking only 39 muskellunge were captured on our annual electrofishing surveys during the eight-year study period (Table 4). Growth of the stocked fish was good with some fish attaining the legal length of 30.0 inches in the fifth summer. Because of the small number captured it was originally thought that survival of the stocked fish was relatively low. However, in 1964 the local resort proprietor began recording the catch of muskellunge and through 1967, 7 percent of the original number stocked were reported caught as legal fish (Table 5). Since this is a voluntary record and there are several other cabins on Clear Lake it is likely that the actual percentage is higher.

In contrast to this the percentage of legal muskellunge caught in Murphy Flowage, Rusk County with a complete creel census is only 0.7 percent of those stocked over a 12-year period (1955-67). Here 200 large fingerling were stocked annually for 10 years (besides an initial stocking of 1,000 two- to three- inch fingerling at the beginning of the 10-year period). Average length of the muskellunge caught in Clear Lake was 32.0 inches so it is apparent that anglers were cropping them soon

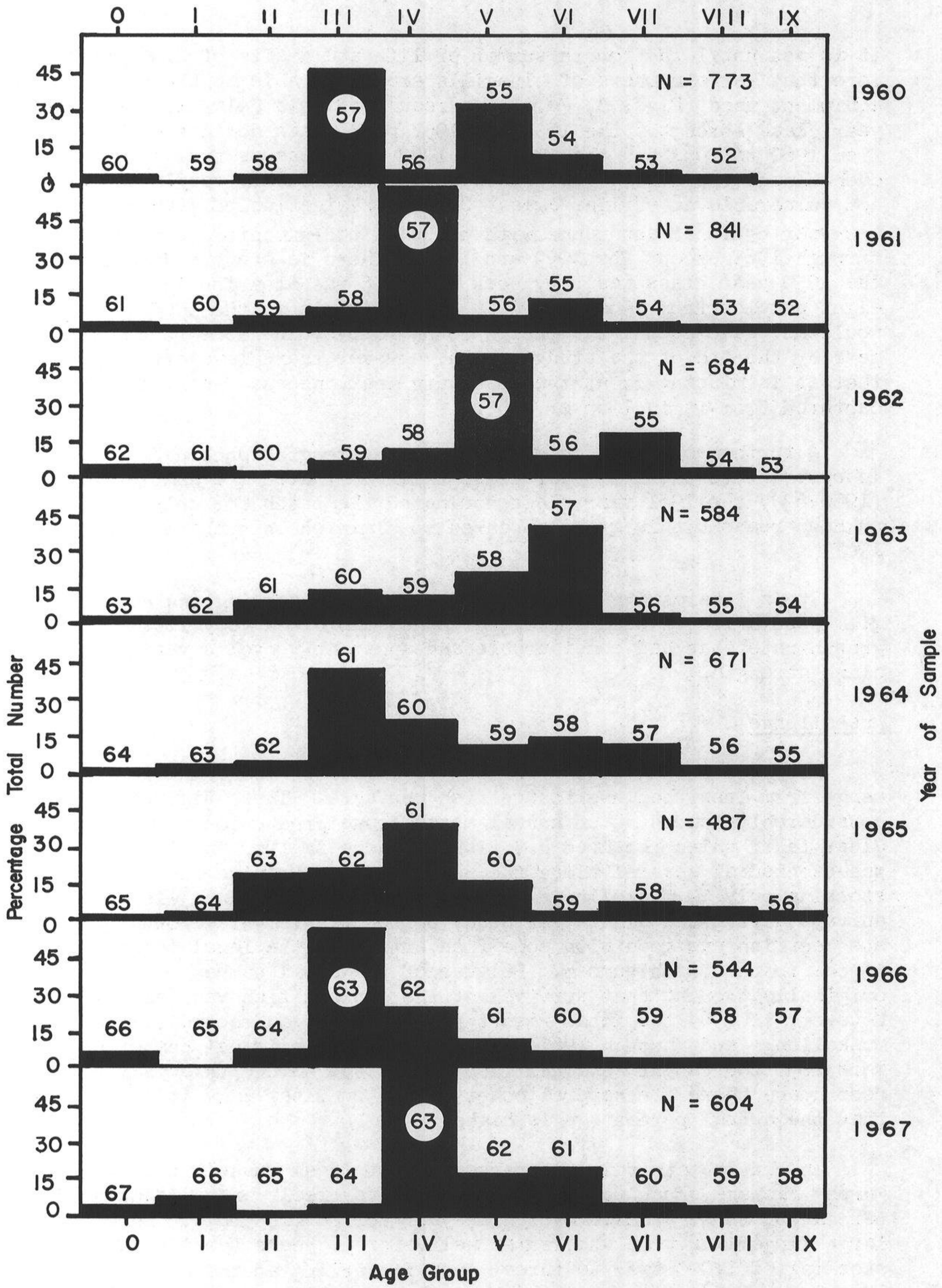


FIGURE 6. Age frequency distribution of Clear Lake bluegills 1960-67. The year class is indicated above each age group of the histogram.

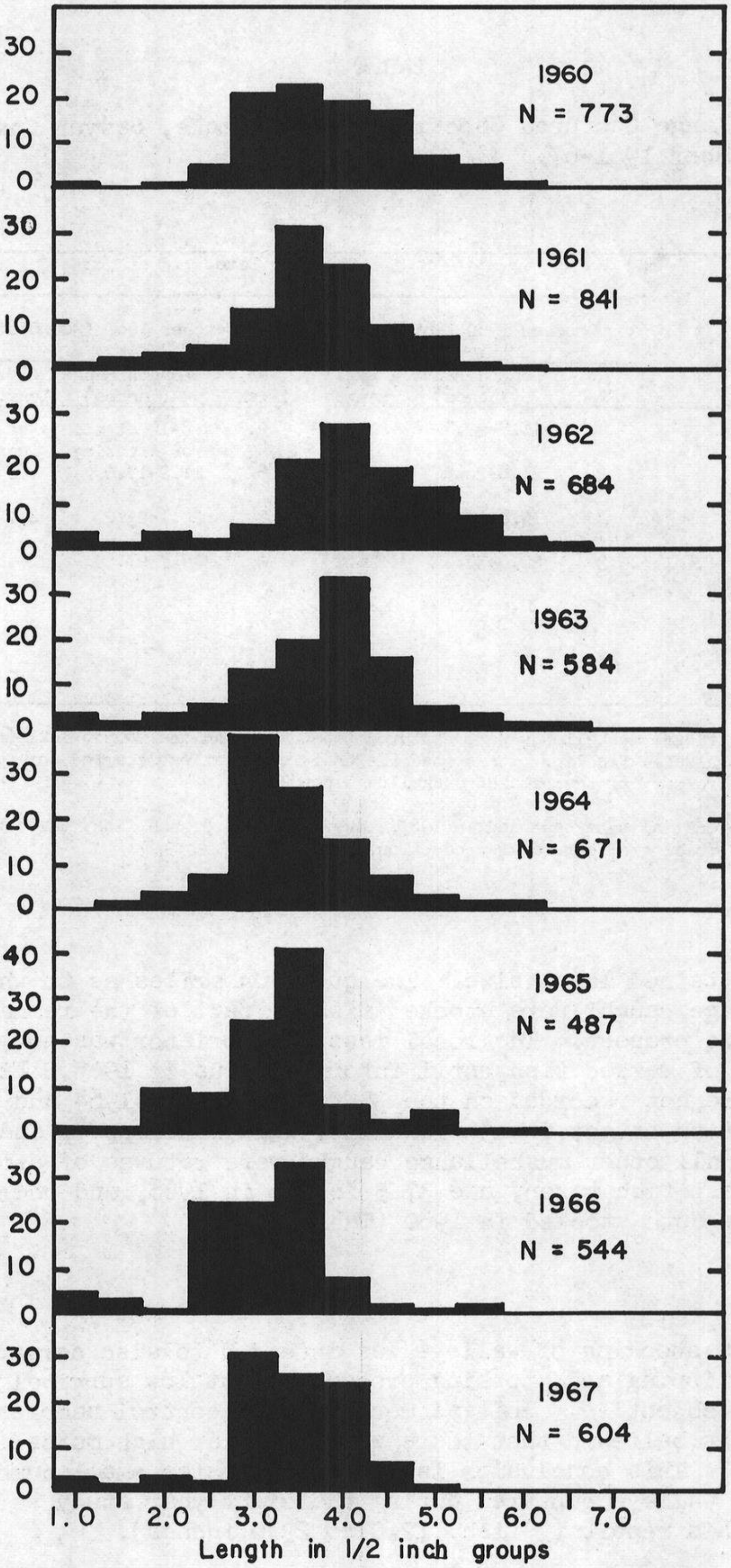


FIGURE 7. Length frequency distribution of bluegills captured electro-fishing in Clear Lake during October each year 1960-67. Lengths are presented in half-inch groups.

TABLE 4

Muskellunge Captured Shocking at Clear Lake, Sawyer County, in October 1961-67.

	Stocking Date							
	October 1960 (365 Stocked)			October 1961 (300 Stocked)				
Year of Recapture	No. Fish	Length Range (Inches)	Avg. Length	No. Fish	Length Range (Inches)	Avg. Length	Total Captured
1961	4	11.8-22.8	16.9	9	8-12 at time of stocking	Not measured	13
1962	3	21.8-28.7	25.3	6	11.2-19.0	16.9	9
1963	3	19.6-27.4	23.3	3	20.1-23.2	21.7	6
1964[1]	3	22.6-30.6	26.2	2	25.7-27.5	26.6	7
1965	2	22.8-31.1	27.0	0	-		2
1966	1	36.0	36.0	0	-		1
1967[2]	-						1

[1] Two additional muskellunge were captured (one 26.8" and one 24.5") in 1964 with no recognizable finclip. It is possible that regeneration occurred, or that these were part of the remnant muskellunge population.

[2] No stocked fish were captured in 1967; however one 24.0 inch fish, which was assumed to be from natural reproduction, was captured.

after they attained legal size. The question arises as to whether all the muskellunge caught were stocked fish or part of the remnant population believed to be present. The local resort proprietor was not aware of the presence of marked fish until informed by us in 1965. Finclips were therefore not recorded on the 35 fish taken in 1964 and 1965; however all fish caught in 1966 and 1967 were finclipped, and it is assumed that all other muskellunge caught were returns of stocked fish. The two largest fish taken, one 37.5 inches in 1966, and one 40.0 inches in 1967, were both stocked in 1960 (Table 5).

Walleye

The 1959 stocking of walleye was intended to also serve to evaluate various finclipping and stocking procedures but low survival precluded meeting that objective. Initial mortality of control samples was very high and it is believed that there was a similar high mortality of the stocked fish. This conclusion is supported by the small number of the 1959 stocked walleye captured during the eight-year study period (1960-67) covered in this report (7 fish, 12.0 to 23.0 inches).

TABLE 5

Muskellunge Caught by Anglers in Clear Lake

	Year of Capture			
Size Group	1964	1965	1966	1967
30.0 - 30.9	2	6	2	2
31.0 - 31.9	3	8	5	
32.0 - 32.9	3	5		
33.0 - 33.9	3	-		
34.0 - 34.9		2		
35.0 - 35.9	1	1		1
36.0 - 36.9		1		
37.0 - 37.9			1	
40.0 - 40.9				1
Totals	12	23	8	4

DISCUSSION

Clear Lake, which is predominately a bass-bluegill lake exhibited no apparent improvement in growth of the bluegills over a period of 8 years after muskellunge and walleye were introduced. Studies by Gammon and Hasler (1965) and Schmitz and Hetfield (1965) have shown increasing growth rates of perch accompanied by decreases in numbers after muskellunge were introduced in two bass-perch bog lakes in northern Wisconsin. Different lake types, species composition, and intensity of predator-prey relationship at the time of stocking, however, make it difficult to compare the results of these two studies.

The muskellunge stocked in Clear Lake were large enough at the time of stocking to utilize the fingerling bluegills. By the middle of the second summer the majority of the bluegill population was suitable prey for the fast-growing stocked muskellunge. There is little doubt that the bluegill population was utilized because it was of suitable size and abundance (85 to 95% of the total population).

The large numbers of extremely slow-growing bluegills in Clear Lake are an indication of very intense intraspecific competition. Since there was no appreciable change in growth and no drastic changes in abundance, there is no reason to believe that muskellunge stocking altered this competitive relationship even though muskellunge were stocked at several times the normal level. It may be that predator stocking never could be high enough, before other factors such as disease intervened to reduce the intensity of the intraspecific competition to the point where there is less competition, more food per fish and faster growth. This study suggests that when the density of a bluegill population is above a certain unknown level, predator stocking can exert little if any control on the population.

Another consideration is the possible high initial mortality of stocked muskellunge. Johnson (pers. comm.) found a range of 20 to 80 percent mortality within three weeks of stocking in several northern Wisconsin lakes. Annual mortality thereafter averaged 50 percent. Since the return of legal muskellunge to the creel was high in Clear Lake it can be assumed that initial mortality was relatively low. The abundance of stocked fish can ultimately and often very rapidly become drastically different than that originally intended at the time of stocking.

The most notable change in size distribution is the decline in abundance of bluegills over 4.0 inches in length after 1963 (Figs. 4, 6). This can be attributed mainly to the weak 1959 year class which would have been over this length by 1964, and the strong 1961 year class which apparently diminished in numbers faster than usual in 1966 and 1967. It may be that size selectivity in the feeding pattern of the muskellunge was a factor in this decline of bluegills over 4.0 inches particularly the 1961 year class, because it was the most abundant.

Further interesting observations on relative abundance can be made by a comparison of relative year-class strength. The most apparent departure from an assumed two-year cycle peaking in odd numbered years is the weak 1959 year class (Fig. 6). This year class was suitable prey for the walleye and muskellunge which were stocked. Between August 19 and October 1, 1959 5,748 walleyes averaging from 2.9 to 7.9 inches in length were stocked and if present in large enough numbers could have reduced the abundance of the 1959 year class of bluegills as fingerlings in 1959 or yearlings in 1960. However, evidence from examination of other year classes, relative survival of the stocked fish, and the literature tend to reject this hypothesis.

From 1961 to 1967 no predator fish were stocked, yet the 1965 year class was either missing or very weak. As pointed out previously the survival of stocked walleyes was believed to be very low as indicated by the control samples. The apparent poor survival of the stocked walleyes make their importance as a predator species in Clear Lake questionable.

Further evidence of the poor control of prey species by stocked walleye fingerlings was reported by Threinen (1960). In only one lake of ten valid trials in Wisconsin was the stocking of walleyes termed beneficial for both walleyes and panfish. The one successful plant was in a lake in which perch was the dominant panfish. In all other lakes bluegill was the dominant species.

The 1959 year class of bluegills was also vulnerable to the muskellunge stocked in 1960 and 1961. However, since several other year classes were vulnerable at the same time there is no reason to postulate that the stocked muskellunge could have caused a decline of one year class more than another. The same situation is true, although to a greater degree because of size and age difference, for the weak 1965 year class.

It is difficult to interpret the results of the introduction of predator species on the abundance of prey species, particularly the variations in year class strength of bluegills as described in this study. One of the principal causes of variation in population abundance and year class strength is the large variation in survival of young fish as pointed out by Le Cren (1965). Cycles of abundance such as observed at Clear Lake are very likely determined at an early age, probably within a few days or weeks after hatching and before the predator species were stocked as a proposed control measure. Therefore it is likely that the stocking of muskellunge in 1960 and 1961 and walleyes in 1959 had little if any controlling effect on the variation in year class strength of bluegills in Clear Lake.

SUMMARY

Clear Lake, predominately a bass-bluegill lake with extremely slow-growing bluegills, was stocked with walleyes in 1959 and muskellunge in 1960 and 1961. From 1960 through 1967 annual surveys were made to estimate growth, changes in size distribution, and relative year-class strength. Throughout the study period there were no significant changes in growth rate of the bluegill which comprised from 85 to 95 percent of all samples. Bluegill year-class strength varied in an apparent 2-year cycle. Minimum return to the creel of 7 percent of the initial number of muskellunge stocked indicates above-average growth and survival.

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