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Charles J. Di Costanzo
Iowa State College

Richard L. Ridenhour
Iowa State College

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By Charles J. Di Costanzo and Richard L. Ridenhour

Introduction

Clear Lake is a large (3,643 acres), shallow (20 feet, maximum depth) eutrophic lake located in north central Iowa. Most warm-water game fishes common to the Midwest are found in this lake (Bailey and Harrison, 1945). The Iowa Cooperative Fisheries Research Unit initiated a creel census in 1953 to determine the harvest of fish by anglers at Clear Lake. During the last four years several changes have been observed in the catch composition and fishing effort.

Methods

The estimate of total harvest was obtained from two types of information: catch per unit of effort and total effort. The catch by individual fishermen per hour of fishing was obtained directly from the fishermen. Each summer several thousand fishermen were contacted while they were fishing (Table 3). The total effort expended by fishermen during a given season was more difficult to estimate. A count of anglers fishing on the lake at any one time was made periodically throughout the census period following a schedule similar to a Latin square. The total fishing time of any one group of anglers (boat, dock, shore or wader) could be estimated by multiplying the average number of anglers in a given group per count by the average length of the fishing day and by the number of days in the census period. Another estimate of the total fishing time of boat anglers was derived from the ratio of livery boats to all boats recorded during the angler counts and the records of boat rentals obtained from the livery operators. This latter estimate was a better measure of the length of the fishing trip while the former only estimated the actual time spent in fishing. A thorough discussion of the principles and methods use in the Clear Lake creel census has been presented by Di Costanzo (1956a, 1956b).

Catch Composition

At least 13 species of fish were caught by anglers at Clear Lake during the census periods (Tables 1 and 2). Yellow bass *(Roccus*

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mississippiensis) and bullheads (mostly *Ictalurus melas)* were generally the most abundant species in the catch.

Yellow bass have been important in the catch each summer and comprised 38 to 53 per cent of the catch in 1953 and 1955 but only 14 per cent in 1956. A mortality was noted in November 1955 when large numbers of dead yellow bass were observed in shallow water. The effect of that mortality, which largely eliminated the older fish from the population, was quite evident in 1956 when the catch of yellow bass dropped to about one-tenth of what it was during the summer of 1955.

Bullheads have consistently contributed a large portion of the catch. Although the percentage that this species contributed to the catch has been variable, the catch has been numerically quite constant. Even though some fishermen do not consider the bullhead a sporting fish, a surprising number of anglers fish exclusively for this species.

Bluegills *(Lepomis macrochirus)* have shown very definite increases since 1953, principally because of strong 1951 and 1952 year classes (Di Costanzo, 1957). Some of the changes in the total catch of this species, such as the drop during the summer of 1956, might be related to the changed fishing characteristics of the fishermen caused by the reduced availability of yellow bass. During the fall of 1954 and the summer of 1955 much of the fishing effort for yellow bass was concentrated in the bullrush areas where many bluegills were caught by persons fishing for yellow bass. However, in 1956, less fishing effort for yellow bass was concentrated in these rush areas and the catch of bluegills also declined. The bluegill was the most important species to waders in 1954 and 1956. In 1955, waders caught more yellow bass since apparently they were preferred and readily available.

Yellow perch *(Perca flavescens)* have declined steadily in the catch each summer since 1953. During the summer of 1953 they ranked third in total numbers among all species but in 1956 they contributed less than one per cent of the total catch. The cause of this decline is not definitely known.

The catch of crappies, both black *(Pomoxis nigro-maculatus)* and white *(P. annularis)* being considered together, has been quite stable. During certain times of the year, especially in the spring, this species is very popular among the dock fishermen.

Two of the most sought after game fish, walleyes *(Stizostedion vitreum)* and northern pike *(Esox lucius),* have contributed relatively little to the total summer catch. They are usually taken in some numbers in May and early June. They have contributed one per cent or less of the total numbers of fish caught each summer since 1953. Walleye catches have been quite stable during the last

four summers although, in the past, there have been years when "everybody caught walleyes." Northern pike catches have undergone considerable variation. Most of the variation was caused by stocking large numbers of northern pike in the fall of 1953 (Ridenhour, 1957). The effect of this stocking was to increase the catch tremendously in 1954 and, to a lesser extent, during 1955. By 1956 the effect of the stocking on the catch apparently had been eliminated by the large catches and two mortalities which occurred August 1954 and May 1955.

Other species were caught in such small numbers during the summer fishing season that definite statements concerning their status could not be made. Catches of channel catfish *(Ictalurus punctatus)* were considered good in 1954 and 1955. Largemouth bass *(Micropterus salmoides)* apparently were caught in larger numbers during the summer of 1956 than previously. Smallmouth bass *(M. dolmieui)* recently have been rare in Clear Lake and are seldom caught. White bass *(Roccus chrysops)* were caught sporadically although recent successful spawnings indicate a possible comeback by this species. Pumpkinseeds (*Lepomis gibbosus*) probably were more numerous in the catch than was indicated by the creel census since many anglers cannot distinguish them from bluegills and reported them as that species. Few fishermen actually fish for carp *(Cyprinus carpio)* and they are usually caught incidentally while fishing for other species.

Fishing Success

Fishing success at Clear Lake was quite stable at about one fish per fisherman hour until 1956 (Table 3). This is about normal for lakes of this type (Carlander, 1953:pp. 219-220 and 391-393). In 1956 the drop in the catch of yellow bass was primarily responsible for the drop of about 50 per cent in the catch per fisherman hour. During the summer of 1955 when the catch of yellow bass was so high, the catch per fisherman hour was the highest of any of the four years. This again indicates the close relationship between yellow bass and summer fishing success at Clear Lake. Waders, who consistently had the best fishing success, averaged about two fish per fisherman hour while shore fishermen averaged only about one-half of a fish per fisherman hour. This difference in the catch per fisherman hour was probably the main reason for the trend away from shore fishing and toward increased wader fishing since 1953.

Fishing Pressure

Fishing pressure during the summer at Clear Lake was considered to be high in 1953 when it was 60 man hours per acre but it was about 80 man hours per acre in 1954 and 1955 (Table 3). A decided drop occurred in 1956 apparently because of the failure of the yellow

bass fishery. Improvement of the catch of such desirable species as walleyes and northern pike would probably increase the fishing pressure rapidly. Numerous young yellow bass in Clear Lake during the summer of 1956 indicated that the availability of this species possibly will be high in 1957 or 1958 which may also increase the fishing pressure. Even the low fishing pressure of 55.1 fisherman hours per acre in 1956 was fairly heavy compared to that reported from other large natural lakes (Carlander, 1953:pp. 222 and 398).

Table 1

Estimated Total Catch by Species for the Summer Fishing Seasons of 1955-1956, Clear Lake, Iowa

	1953*		1954*		1955**		1956***	
Species	Number	Per-cent	Number	Per-cent	Number	Per-cent	Number	Per-cent
Yellow bass ..	114,000	49.4	122,600	38.3	186,000	53.0	17,400	14.0
Bullheads	65,400	28.3	121,200	37.8	91,000	25.9	75,000	60.2
Yellow perch .	32,700	14.2	16,200	5.1	2,700	0.8	1,100	0.9
Walleye	1,350	0.6	460	0.1	970	0.2	610	0.5
Crappie	8,000	3.5	10,600	3.3	9,100	2.5	4,700	3.8
Bluegill	7,700	3.4	44,800	13.9	59,800	17.0	24,400	19.6
Northern pike	160	0.1	3,000	0.9	340	0.1	80	0.1
Other****	1,300	0.5	1,260	0.4	1,150	0.3	1,200	1.0
Total number .	230,600		320,600		351,000		124,500	
Total weight .	82,400		116,600		128,600		44,900	
Pounds/acre ..	22.6		32.0		35.3		12.3	

*June 20-August 31.
**June 19-September 5.
***June 21-August 31.
****Channel catfish, largemouth bass, smallmouth bass, white bass, pumpkinseeds, and carp.

Total Catch

Like fishing success and fishing pressure, the 1956 total catch dropped well below the catch of the preceding three years (Table 1). Again the relationship of fishing to the yellow bass abundance was quite noticeable. The 1956 summer harvest of 12.3 pounds per acre was only one-half to one-third that of the previous years. The summer harvest in Clear Lake is about equal to the average annual harvest reported from similar lakes (Carlander, 1953:pp. 223-224 and 400).

Fall, Winter, Spring and Night Fishing

The harvest figures given so far consider only the summer daylight fishing. The contribution of the fall and winter fishing to the harvest, although not known, is considered to be quite small. Fishing pressure at Clear Lake drops off abruptly after Labor Day in early September. No data have been collected from September through March but probably few fish are caught during this period in comparison to the rest of the year. In recent year, ice fishing has increased in popularity but still constitutes a small segment of the total fishery.

The early season or spring fishery, which extends from the time

Table 2

Species Composition as Percentage of the Catch for the Summer Fishing Seasons of 1953-1956, Clear Lake, Iowa

	1953**		1954**				1955***				1956****			
Species	Boat	Dock, Shore and Wader	Boat	Dock	Shore	Wader	Boat	Dock	Shore	Wader	Boat	Dock	Shore	Wader
Yellow bass	65.4	1.8	59.8	7.2	10.4	17.7	57.1	44.5	12.1	61.7	13.5	10.0	13.9	26.3
Bullhead	18.7	56.9	27.2	49.6	61.6	26.6	25.4	29.1	58.3	9.9	68.9	61.3	71.8	18.9
Yellow perch	11.0	23.7	2.7	11.9	2.0	—	0.5	1.8	0.6	0.1	0.2	2.1	1.1	0.2
Walleye	0.6	0.6	*	0.3	0.1	0.8	0.3	0.3	0.2	0.1	0.5	0.4	—	0.9
Crappie	2.7	5.8	1.3	6.9	5.0	0.4	1.4	6.2	2.6	1.5	4.8	3.6	0.7	1.7
Bluegill	1.2	9.7	8.5	22.4	16.8	50.2	15.0	17.7	25.0	25.8	11.1	21.7	11.3	50.9
Northern pike	*	0.2	0.4	1.4	2.3	3.1	0.1	0.1	*	0.1	0.1	—	—	0.1
Pumpkinseed	0.3	0.7	*	0.4	1.1	0.8	*	*	*	0.6	—	—	—	0.3
Largemouth bass	*	0.2	—	*	0.4	—	*	0.2	0.3	*	0.7	0.2	1.1	0.6
Smallmouth bass	—	*	*	—	0.1	—	—	—	—	—	—	—	—	—
Channel catfish	*	0.2	*	*	—	0.4	*	*	1.0	0.1	0.1	0.2	—	—
Carp	—	—	—	—	0.1	—	—	—	—	—	0.1	0.1	—	—
White bass	—	—	*	—	—	—	*	*	0.2	*	0.1	0.3	—	—

*Values of less than 0.1 per cent.
**June 20-August 31.
***June 19-September 5.
****June 21-August 31.

Table 3
Estimated Fishing Pressure and Catch per Unit of Effort for the Summer Fishing Seasons of 1953-1956, Clear Lake, Iowa

		1953*	1954*	1955**	1956***
Total fisherman hours		219,300	299,300	289,500	200,800
Fisherman hours/acre		60.2	82.2	79.5	55.1
Catch/fisherman hour		1.05	1.07	1.21	0.62
Boats:	Fisherman hours (total)	130,000	170,800	186,700	113,900
	Fishermen contacted	3,548	3,570	5,725	1,486
	Catch/hour	1.03	1.09	1.19	0.54
Docks:	Fisherman hours (total)		80,200	73,300	62,000
	Fishermen contacted		1,592	1,593	1,009
	Catch/hour		1.09	1.13	0.66
Shore:	Fisherman hours (total)	89,300****	45,700	16,700	14,000
	Fishermen contacted	2,429	738	372	474
	Catch/hour	1.09	0.93	0.74	0.45
Wader:	Fisherman hours (total)		2,600	12,800	10,900
	Fishermen contacted		83	227	338
	Catch/hour		1.68	2.63	1.45

*June 20-August 31.
**June 19-September 5.
***June 21-August 31.
****Combined estimate for shore, dock, and wader fishermen.

of the ice break until mid-June, accounts for a large portion of the annual harvest (Table 4). The incentive of opening day fishing for walleyes and northern pike in mid-May draws large numbers of fishermen to the lake. In 1955, more fish were caught per day during the spring than in the summer. In 1956, almost twice as many fish were estimated caught during the spring census period as in the summer even though the spring census period was less than one-half as long as the summer census period in 1956. The catch per fisherman hour was a little higher in the spring. Bullheads and walleyes were more important in the spring catch while yellow bass and bluegills made up a larger portion of the summer catch.

Night fishing is difficult to sample. No estimate of the harvest by night fishermen was made. However, night fishing probably accounted for a significant portion of the summer catch. Certain waders, fishermen at certain docks, and some boat fishermen fish at night. Most of the night fishing was restricted to two or three hours after dark. Certain species, such as walleyes, catfish, and bullheads, probably were more available just after dark.

The estimates of harvest for the summer daylight season alone are an inadequate measure or index of the total harvest at Clear Lake. It is probable that the annual harvest is somewhat over twice that estimated by the summer creel census. The average annual harvest is probably at least 60 pounds per acre, with 150 man hours of recreation provided per acre. This does not include the boating, swimming and other recreation which the lake provides.

Table 4

Estimated Fishing Pressure, Catch per Unit of Effort and Catch Composition for the Spring Fishing Seasons of 1955 and 1956, Clear Lake, Iowa

	1955*		1956**	
Total:				
Estimated fisherman hours	301,300		152,500	
Fisherman hours/acre	82.7		41.86	
Catch/fisherman hour	1.05		1.60	
Boat:				
Total fisherman hours	177,000		93,300	
Fisherman contacted	6,003		514	
Catch/hour	0.91		1.27	
Dock:				
Total fisherman hours	84,100		4,300	
Fisherman contacted	1,905		255	
Catch/hour	1.27		2.03	
Shore:				
Total fisherman hours	30,000		8,000	
Fisherman contacted	426		79	
Catch/hour	0.74		1.58	
Wader:				
Total fisherman hours	9,700		8,200	
Fisherman contacted	234		40	
Catch/hour	2.75		3.12	
Catch Composition:	Number	Percent	Number	Percent
Yellow bass	83,500	26.45	15,400	6.31
Bullhead	138,600	43.91	186,300	76.29
Yellow perch	7,700	2.44	2,430	1.00
Walleye	2,900	0.92	1,700	0.70
Crappie	29,600	9.38	11,900	4.87
Bluegill	51,100	16.19	25,600	10.48
Northern pike	1,700	0.54	140	0.06
Others***	570	0.18	730	0.30
Total Number	315,700		244,200	
Total Weight	112,900		87,900	
Pounds/Acre	31.0		24.1	

*April 17-June 18.
**May 27-June 20.
***Largemouth bass, white bass, pumpkinseed, channel catfish.

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Department of Zoology and Entomology
Iowa State College
Ames, Iowa