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A Fish Population Study of Storm Lake

By EARL T. ROSE

Storm Lake, in Buena Vista County, is one of Iowa's largest inland bodies of water, covering a total of 3,060 acres. It is relatively shallow, with an average depth of about 6 feet, exclusive of a small dredged area along the east shore. The water in the lake is seldom clear due to wave action and heavy blooms of blue-green algae during summer. Spring and fall water conditions are usually good, and in recent years fishing has been excellent during these periods. The present game fish populations have been developed primarily by natural reproduction of indigenous species, and to a lesser degree from annual stocking. Many thousands of pounds of rough fish are removed annually to provide more suitable environmental conditions for the game fishes of the lake.

Modern fish management is becoming an exacting and complicated process involving emphasis on population dynamics and environmental controls to produce good fishing for Iowa anglers. The artificial propagation and regulations formerly stressed are now considered much less important in management of most Iowa lakes and streams. Many states have eliminated closed seasons and creel limits entirely, and are maintaining good fishing in their waters. The pioneering work of Eschmeyer (1944-1945) and Langlois (1944), is an example of this trend.

POPULATION OF GAME FISHES

As in any business enterprise, a knowledge of available stocks and the magnitude of gains or losses is imperative. By utilizing statistical methods it is now possible to obtain an accounting of available supplies of fishes and their harvest by anglers thus providing a basis upon which to intelligently regulate the fisheries involved. In this, a sample of each species is marked, either by removing one of the paired fins, or by various tagging methods. These marked fish are then returned to the water. After an ample period of time to permit adequate mixing with the unmarked population has elapsed, sample catches are made and the ratio of marked to unmarked fish is determined. Population estimates are made from these data by use of formulae which have been developed for various types of studies (Ricker, 1948).

During the winter of 1947-48, a State rough-fish seining crew operated at Storm Lake. Their equipment consisted of a drag seine 4,000 feet long, 12 feet deep, with $2\frac{1}{4}$ inch-mesh (bar

measure). A total of 19 hauls were made under the ice, and 183,000 pounds of rough fish were removed during the operations. A total of 17,282 game fishes were taken from the hauls and returned unharmed to the lake. A sizable sample of each species was fin-clipped and returned to enable population estimates on each during the coming fishing season.

During the 1948 open season for anglers, a creel census was taken and the data obtained from the catches used to estimate the game fish populations. The census was conducted with a census clerk, cooperation of all boat liveries and the local conservation officer. Angler's catches were examined for clipped fins, and the catches recorded on cards which were later tabulated for catch and population estimate purposes.

METHODS

Population estimates were made by using the Peterson (1896) method which involves essentially a straight proportion. In this the population P , is determined by multiplying the total number of each species caught, A , by the total number of marked (fin-clipped) fish in the lake at the start of the sampling, B , and the product is divided by the total number of marked fish observed in the catch, C ; or $P = \frac{AB}{C}$. The total catch, A , is considered a random sample

of the species in the lake, and C , is the portion bearing a distinguishing mark in the sample catch. Sampling error is involved in the estimate and is determined by the convenient methods devised by Ricker (1937), for calculation of 95 per cent fiducial limits.

Fin-clipping operations terminated on March 1, 1948, giving all species ample time to freely intermingle with the unmarked population prior to the opening of the fishing season on May 15th. Thus it was assumed that anglers catches constituted random samples of all adult game fishes, and that recruitment or other systematic errors were negligible. These factors, of course, contribute toward erroneous calculations in every estimate, and care must be exercised in avoiding as many as possible. This was pointed out by Carlander and Lewis (1948), Ricker (1948) and other investigators.

The rate of harvest was determined by dividing the number of recaptured fin-clipped fish, C , by the total number of fin-clipped fish in the lake at the start of the season, A . This number is expressed as a percentage, u , in Table 1.

All of the pertinent information in the census and population study is presented in Table 1. The number of fin-clipped fish in

Table 1

Number marked, recaptured, caught, harvest rate, population estimates, fiducial limits and weights of Storm Lake fish.

Species	Number Marked <i>B</i>	Number Recaptured <i>C</i>	Total Catch <i>A</i>	<i>u</i> %	Population Estimate	Fiducial Limits		Average Weight Pounds	Total Pounds
					$\frac{AB}{C}$				
White Bass	849	58	3,584	6.8	52,462	40,571	68,042	1.35	70,823
Yellow Perch	144	7	1,207	5.0	24,829	12,415	57,936	0.76	18,870
Crappie	2,000	134	5,414	6.7	80,806	65,563	95,823	0.63	50,908
Yellow Pikeperch	1,397	118	5,568	8.4	65,919	55,166	78,571	1.53	100,856
Channel Catfish	606	32	227	5.3	4,299	3,057	6,256	3.60	15,476
Black Bullhead	521	10	18,423	1.9	959,838	544,243	1,919,876	0.60	575,902
Largemouth Bass	31	0	2	--	----	----	----	--	----
Northern Pike	51	1	53	1.9	2,713	453	16,975	--	----
Bluegill	83	0	12	--	----	----	----	--	----

Estimated Total Game Fish Population—1,190,866.

Estimated Total Weight of Game Fish Populations—832,835 Pounds.

the lake, recaptured fin-clipped fish, total catch, harvest rate, population estimates and their 95 per cent fiducial limits are included for each species considered. The total pounds were calculated on the basis of the estimated population multiplied by the average weights of each species considered. An estimate of the total number of game fish in the lake is included by adding all estimates that could be determined.

No estimate could be made for the largemouth bass and bluegill since there were no recaptures of marked fish recorded in the census. The sampling error is so great for the single recapture in the northern pike, that the estimate can be given little credence as shown by the divergence in the confidence limits.

It is readily apparent that none of the game fishes considered in Table 1, are being harvested by the anglers at a satisfactory rate. Harvests should be considered as a removal of surpluses which otherwise would perish due to old age. A 25 percent harvest would much more efficiently handle these surpluses than the low percentages reported here. This coincides with the research conducted in other states, notably in Ohio (Langlois, 1944), Indiana (Ricker, 1944), Tennessee (Eschmeyer, 1944-1945), and Minnesota (Stoudt and Eddy, 1939).

STATUS OF MAJOR SPECIES OF GAME FISHES

The status of each species of game fish in the lake and their population and harvest data is considered separately in the following discussion.

White Bass

The estimated adult population of 52,462, comprises about 4 per cent of the total population of all species of game fishes. The 1948 harvest of 3,584, was only about 7 per cent of the estimated adult white bass population.

From the small number of scale samples selected and examined, it is apparent that the 1943 and 1946 year classes dominate the adult population. Growth and weight increments are high. Sample examinations show white bass at approximately two years of age (1 year and 8 months) attain lengths of nearly 12 inches and a weight of nearly one pound. Subsequent growth rates are slow by comparison, indicating the advisability of early harvest. Some 6 year old white bass (5 years and 8 months) were 15 inches in length and weighed about 1.7 pounds, which appears to be about average for the lake.

The peak harvest period occurs from May 15 through the month

of June, and tapers off sharply around July 1 to again improve during late August.

The population of white bass is maintained entirely by natural reproduction.

Yellow Perch

The yellow perch has been relatively unimportant in the fish populations in Storm Lake. It represents only about 2 per cent of the total game fish of the lake. The harvest in 1948 was but 5 per cent of the estimated yellow perch population. Creel census and survey records indicate that they are increasing considerably.

Crappies

Both the black and white crappies inhabit Storm Lake. The records indicate that about 80 per cent of the population is composed of white crappies. They are considered jointly here since the anglers make no distinction in reporting the catches.

The population estimate of 80,806 comprises about 7 per cent of the entire game fish population in the lake. The catch of 1948 by anglers was low in comparison with the last few years representing but 6.7 per cent of the estimated crappie population.

Creel census records show that of the 5,414 caught in 1948, 3,891 were caught between May 15 (opening day) and June 4. In other words 72 per cent of the catch was made in the first 19 days of the 1948 day season. In 1947, about the same condition prevailed, in which 81 per cent of the total catch was made in the first 41 days of the same length season.

Yellow Pikeperch

The population estimate of 65,919 adults comprises about 6 per cent of the game fish population of the lake. The catch by anglers of 5,568 was 8.4 per cent of the estimated yellow pikeperch population (based upon recapture data) and was the highest harvest percentage of any species of game fish. This is understandable since the species is in very great demand by anglers. The lake is especially noted for its exceptionally large pikeperch, and many have been taken in recent years that weighed 11 pounds and over.

The lake is stocked annually with yellow pikeperch fry, averaging about a million fish per year.

Channel Catfish

This species does not appear to be adapted to good reproduction in this lake. Occasionally one or more are obtained in survey hauls

that might have been spawned in the lake. However, it is believed that the present population is entirely from stocking.

It is believed that the catch in 1948 was considerably higher than the census indicates. Most catfishermen fish at night and consequently the catch as recorded came principally from the poorer fishing periods. The population estimate of 4,299 comprises but 0.4 per cent of the game fish populations in the lake.

The best fishing in 1948 occurred from June 1 to July 14. Of the total catch, 72 per cent were taken from May 15 to July 14. This probably coincides with most observations in that pre-spawning catches are greater than post-spawning especially in the catfishes.

Bullhead

The black bullhead is unquestionably Iowa's most popular lake fish. A lake maintaining a good supply will always be a favorite spot for Iowa fishermen.

The population estimate is, I believe, much too high, probably more nearly approaching the lower fiducial limit. There is a plausible reason for this contention, since the clipped fin of the bullhead is not easily detected. The oversight of recaptures by the census clerk and livery operators during rush periods is understandable and it is believed that more recaptures should have been reported from the catches made. The population estimate comprises 80 per cent of the entire game fish fauna of the lake, and less than 2 per cent of the estimated population were caught.

Due to the comparatively high number of bullheads caught and the opportunity for error in detection of marked fish, different methods must be used in the future to obtain data necessary for population studies, that will avoid systematic errors of this type.

Bullhead fishing is invariably best in the spring and early summer as was previously reported by the writer (1947), for several Iowa lakes. After July 1, bullhead fishing is generally poor. In 1948, 70 per cent of the total catch was obtained prior to that date.

Largemouth Bass

As indicated in Table 1, this species is scarce in Storm Lake. No population estimate could be made due to lack of recaptures of marked fish. Approximately 65,000 fingerling and sub-adults have been stocked in the lake since 1936, but have failed to become established sufficiently to be of importance to the fishermen.

Northern Pike

This species is also scarce in comparison with other game fishes

in Storm Lake. The population estimate of 2,713 determined from the one recapture cannot be given much credence due to the high sampling error involved. Needless to say, the population is obviously low since all that were obtained during the winter seining operations were marked (51), which indicates low numbers in the lake. The present estimate suggests that about 0.2 per cent of the game fishes in the lake are northern pike, and that 1.9 per cent of them were harvested during the 1948 season.

Bluegill

In view of the lack of recaptures of fin-clipped bluegills no estimate of the population could be determined. Obviously the population is very low since all that were obtained during the marking program were used (83), which again, as in the northern pike, suggests a low population. The species is considered very valuable not only as a sport fish, but primarily for the forage produced for predatory species.

STATUS OF PRINCIPAL NON-GAME FISHES

Carp and Buffalo

These two species are generally termed "rough-fish" since for the most part they are undesirable from the standpoint of game fishes and particularly in closed bodies of water. It is necessary to keep their numbers reduced by seines, nets or traps, otherwise they invariably become a dominant limiting factor in the maintenance of satisfactory game fish population.

The huge winter-kill of 1935-36 did not eradicate all of the rough-fish in the lake, and from the few survivors, a vast over population soon developed. Since 1942, the Iowa Conservation Commission has operated seines and traps each year in an attempt to control and reduce their populations.

Outlined in Table 2, are the yearly totals of pounds and percentages of carp and buffalo removed from Storm Lake from 1942 to 1948. It would appear from these data that the buffalo are more abundant than the carp. In the 1948 operations, however, carp dominated the catch.

The graph, Figure 1, has been drawn to show the decrease in yearly tonnages of carp and buffalo removed from the lake. Although it would appear from the graph, that a leveling-off in catches has occurred, this is not the case since the catch-per-unit-effort has declined considerably. In other words, seine hauls and trap operations have been much more extensive since 1947 than in

Table 2

The number of pounds and percentages of carp and buffalo removed from Storm Lake from 1942 to 1948, by seines and traps.

Year	Carp (pounds)	Buffalo (pounds)	Total (pounds)	Percent Carp	Percent Buffalo
1942	290,272	286,597	576,869	50.3	49.7
1943	12,595	195,470	208,065	6.0	94.0
1944	14,060	130,595	144,655	9.8	90.2
1945	33,335	147,490	180,825	18.4	81.6
1946	13,440	115,698	129,138	10.4	89.6
1947	82,242	101,452	183,694	44.8	55.2
1948	100,377	285	100,662	99.1	0.9
Totals	546,321	977,587	1,523,908	35.6	64.4

the previous years. It is anticipated that by future intensive efforts the rough-fish will be reduced to a point whereby game fish populations can be measurably increased. Creel census and population studies must necessarily be continued if this correlation is to be determined.

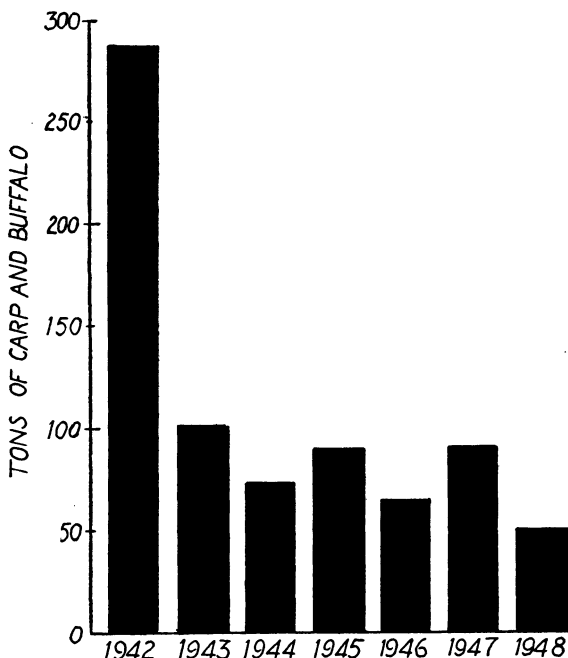


Fig. 1. Yearly tonnages of carp and buffalo removed from Storm Lake by seines and traps.

STATUS OF FORAGE FISHES

Included in this category are the small members of the *Cyprinidae* ordinarily considered as minnows. Minnows are not abundant in Storm Lake, although test seining will always yield a few of the more common species. They are of value in the biota from the standpoint of providing food for the larger predatory game fishes of the lake, and in providing an intermediate link in the forage chain from the small animal forms such as the *entomostracans* to the end product, the mature game fish.

PRELIMINARY CHECK LIST OF THE FISHES OF STORM LAKE

The following list of fishes includes those identified in the survey work from Storm Lake and those known to have been in the lake previous to 1936. The latter species are indicated by asterisks.

Common Name	Specific Name	Occurrence
Gizzard Shad	<i>Dorosoma cepedianum</i> (LeSueur)	Rare
Bigmouth Buffalo	<i>Megastomatobus cyprinella</i> (Cuiver & valenciennes)	Abundant
Black Buffalo	<i>Ictiobus niger</i> (Rafinesque)	Rare
Common White Sucker	<i>Catostomus commersonii commersonii</i> (Lacepede)	Common
Northern Redhorse	<i>Moxostoma aureolum</i> (LeSueur)	Rare
Quillback	<i>Carpiodes cyprinus</i> (LeSueur)	Rare
Carp	<i>Cyprinus carpio</i> Linnaeus	Abundant
Plains flathead chub	<i>Platygobio gracilis communis</i> (Girard)	Rare
Western golden shiner	<i>Notemigonus crysoleucas auratus</i> (Mitchell)	Common
Northern redbfin shiner	<i>Notropis umbratilis cyanocephalus</i> (Copeland)	Common
Spotfin shiner	<i>Notropis spilopterus</i> (Cope)	Common
Southern Sand Shiner	<i>Notropis deliciosus</i> sp (Cope)	Common
Plains red shiner	<i>Notropis lutrensis lutrensis</i> Baird and Girard	Rare
Northern spottail shiner	<i>Notropis hudsonius hudsonius</i> (Clinton)	Common
Bluntnose Minnow	<i>Hyborhynchus notatus</i> (Rafinesque)	Common
Northern fathead minnow	<i>Pimephales promelas promelas</i> Rafinesque	Common
Southern channel catfish	<i>Ictalurus lacustris punctatus</i> (Rafinesque)	Common
Flathead catfish	<i>Pilodictis olivaris</i> (Rafinesque)	Absent*
Northern black bullhead	<i>Ameiurus melas melas</i> (Rafinesque)	Abundant
Northern Pike	<i>Esox lucius</i> Linnaeus	Common
White Bass	<i>Lepibema chrysops</i> (Rafinesque)	Abundant
Yellow perch	<i>Perca flavescens</i> (Mitchill)	Common
Yellow pikeperch	<i>Stizostedion vitreum vitreum</i> (Mitchill)	Abundant

Central Johnny darter	<i>Boleosoma nigrum nigrum</i> (Rafinesque)	Common
Black crappie	<i>Poxomis nigro-maculatus</i> (LeSueur)	Common
White crappie	<i>Poxomis annularis</i> Rafinesque	Abundant
Largemouth bass	<i>Micropterus salmoides</i> (Lacepede)	Common
Bluegill	<i>Lepomis macrochirus macrochirus</i> Rafinesque	Common
Orangespotted sunfish	<i>Lepomis humilis</i> (Girard)	Rare
Green sunfish	<i>Lepomis cyanellus</i> Rafinesque	Rare
Freshwater sheepshead	<i>Aplodinotus grunniens</i> (Rafinesque)	Absent*

* Previously common or abundant.

The list includes all of the common species and a few that are very rare in Storm Lake. Doubtless other species may be found in future surveys, since the fauna is not stable in the lake. The Plains flathead chub is not considered native to the drainage system, and possibly entered the lake from fishermen's bait buckets. Flathead catfish were occasionally taken from the lake by anglers prior to the winter of 1935-36, at which time most of the fishes in the lake perished due to low dissolved oxygen content of the water, and it is doubtful that any of the flatheads survived. The heavy winter losses completely wiped out a vast population of sheepshead, estimated at 300 pounds per acre, which had dominated the lake for years and had destroyed the environment for all other species in the lake.

SUMMARY

1. A total of 31 species of fish are listed that have been observed from Storm Lake. Two are listed as absent or of doubtful occurrence at this time, the flathead catfish and the sheepshead.

2. Population estimates of the adult game fishes were calculated by means of angler sampling from a presumed randomly distributed number of marked and unmarked fishes. The number of marked fish (fin-clipped) was known, and the ratios of marked to unmarked observed in the catches were used to calculate the populations.

3. The total adult game fish population of Storm Lake, estimated for May 15, 1948, was 1,190,866. The total combined weight of all adult game fishes was estimated at 832,835 pounds, or approximately 272 pounds of fish per acre. This estimate is deemed excessive due to a high magnitude of systematic errors involved in the bullhead population estimate. If the bullheads are eliminated entirely from the picture, by subtracting their estimated total poundage from the estimated total weight of game fish, there still remains a high weight of game fish per acre in the lake, estimated at approximately 256,000 pounds or 85 pounds per acre.

4. The present data indicates there is no overpopulation of any species of game fish in Storm Lake. However, harvests could conceivably be increased to 20 or 25 per cent without endangering brood supplies.

5. The undesirable carp and buffalo are being controlled by seines and traps to provide more food and space for desirable species. A total of 1,523,908 pounds has been removed from the lake since 1942 up to 1948, for an average of 219,129 pounds per year, or about 70 pounds per acre. Evidence tends to show this is not on a sustained yield basis, since annual catches are decreasing and unit-effort has increased considerably since 1947.

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