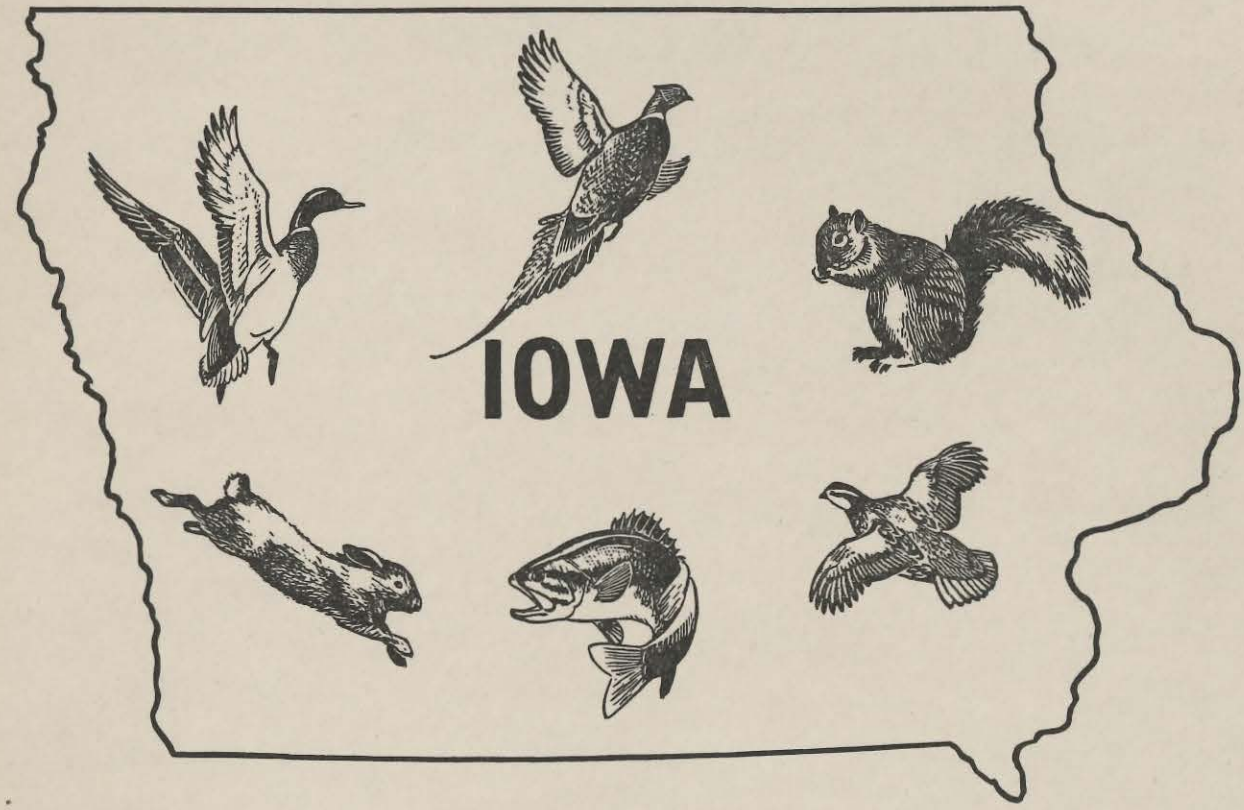
1955

QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

Q U A R T E R L Y B I O L O G Y R E P O R T S

January, February, March 1955

Vol. VI No. 4

Submitted by

Biology Section
Everett B. Speaker, Supt.

State Conservation Commission
Bruce F. Stiles, Director

Fish and Game Division
Ray W. Beckman, Chief

East 7th and Court Streets
Des Moines, Iowa

TABLE OF CONTENTS

Report No. 1 Winter Creel Census pp. 1 - 9
---------- By Earl T. Rose

Report No. 2 The Bluegill, Lepomis Macrochirus, (Rafinesque) In West Okoboji pp. 10 - 19
---------- By Jim Mayhew

Report No. 3 Fishing Success and Effort on Northeast Iowa Streams 1950 - 1954 pp. 20 - 23
---------- By R. E. Cleary

Report No. 4 Further Studies on the Catfish in the Humboldt Area of the Des Moines River pp. 24 - 32
---------- By Harry M. Harrison

Report No. 5 Comparative Food Habits of Carp, Buffalo and Sheepshead From the Same Lakes pp. 33 - 40
---------- By Tom Moen

Report No. 6 A Preliminary Analysis of Bi-monthly Waterfowl Inventories Mississippi Flyway (October 1, 1954-January 15, 1955) pp. 41 - 44
---------- By James G. Sieh

ERRATUM

Please correct an error in Volume IV numb
(October, November, December 1954) of your Qua
Biology Reports in line 18, page 35, "three mi
fry from the hatchery" should be changed to fi
million fry from the hatchery.

WINTER CREEL CENSUS OF IOWA LAKES

By E. T. Rose*

Fishing through the ice has become a well established and popular form of recreation in the northern Iowa lakes region. The past winter was the fifth consecutive season that the Iowa Conservation Commission has permitted winter angling for all lake species until February 15. A census has been conducted each winter to determine the success of anglers on the lakes that have the most intensive fishing pressure. This work has been confined largely to West Okoboji and Spirit Lakes in Dickinson County, since most of the fishing has been done on these two lakes.

In order to keep the data from past winters comparable, the census was conducted as formerly. The census clerk assigned to each lake contacted as many anglers as possible each day and recorded their catch data. Usually the greatest concentration of anglers was found on the lakes between 10:00 a. m. and 7:00 p. m. ; consequently most of the census effort was made during these hours to obtain as large a sampling as possible of the number of fishermen, number and composition of fish caught and to determine the catch per unit effort.

There are advantages and disadvantages in this method of appraising the fishery. The principal criticism is the inability to calculate total harvest from the data since most of the anglers are not through fishing when contacted. On the other hand, techniques used to calculate total harvest by expansion of data from small samples of completed trips are highly complex and far from satisfactory. Intensive research should be directed toward a solution of this important problem.

During the past winter, as customary, the daily catch records were combined in 10 day summaries from the time the ice was strong enough to support anglers until the close of the season on February 15. These records from West Okoboji and Spirit provide most of the data for this report.

West Okoboji

Ice fishing began on December 10, 1954, in Little Emerson's Bay which was the first area to be frozen over. Mild weather prevailed until the 28th of December when the lake froze over entirely and fishing increased in all major regions of the lake.

* Fisheries Biologist, State Biology Bldg., Okoboji, Iowa

As usual, perch and walleyes dominated the catch. Even though good populations of bluegill, crappie and northern pike were present there were comparatively few of them taken during the winter months. The census record as compiled in 10 day and seasonal summaries is included in Table 1.

Table 1. Ten Day and Seasonal Creel Census Summary Lake West Okoboji

SPECIES	Dec. 10-19	Dec. 20-29	Dec.30 Jan. 8	Jan. 9-18	Jan. 19-28	Jan.29 Feb. 7	Feb. 8-15	SEASON TOTALS
CRAPPIE	3	2	1	1	2	9	23	41
PERCH	379	1407	4385	1480	883	501	260	9295
N.PIKE	89	102	82	49	28	19	20	389
L.M.BASS	3	1	2	1	2	2	4	15
WALLEYE	43	91	467	320	226	334	172	1653
S.M.BASS			6	1	3	3	5	18
BULLHEAD				1				1
BLUEGILL	4	3		1		1		9
BUFFALO			1					1
TEN DAY TOTALS	521	1606	4944	1854	1144	869	484	11,422
TOTAL MEN	228	403	1423	864	660	650	341	4,569
TOTAL HOURS	458	830	3256	2147	1834	1941	887	11,353
AVERAGE FISH/MAN	2.28	3.98	3.47	2.14	1.73	1.33	1.42	2.52
AVERAGE FISH/HOUR	1.13	1.93	1.51	0.86	0.62	0.44	0.54	1.00

It is apparent that the best perch fishing occurred in the early part of the season, suggesting greater vulnerability to catch before mid-January; however, this may not be true since fishing pressure on perch may be more a function of weather and depth of ice. During mild weather and thin ice of the early part of the season, fishermen without shanties are numerous and take good catches in the main bays. As the season advances, only the best equipped and hardiest individuals can chisel through the 20 inches of ice and withstand sub-zero temperatures. And too, the shanty fishermen on the major reefs seldom fish for perch, confining their efforts to walleyes particularly late in the afternoon and evening.

Sex ratios, age and length of fish caught

No special effort was made to obtain complete data on sex ratios and other factors in fish caught by the winter fishermen; however, some fish were examined. A total of 56 perch caught by state personnel was 57 per cent females and ranged in total length from 8.5 to 11.5 inches and in age from three to six years. Only 11 walleyes were checked. These ranged from 8.0 to 15.5 inches in length and from zero to four years of age.

Indicated trends from winter angling

A comparison of basic winter fishing census data from the winter of 1950-51 to the past winter, 1954-55, is included in Table 2 and Figure 1. Although obviously the total catch has declined since the first three winters, there has been no decline in angler success. In fact the reverse situation exists as indicated by the average catch per unit effort in the past three winters. This may be due in part, to refinements in techniques by winter anglers; however, basic methods have not changed appreciably.

Table 2. Basic summaries of five winter fishing censuses on West Okoboji.

SPECIES	Winter 1950-51	Winter 1951-52	Winter 1952-53	Winter 1953-54	Winter 1954-55
PERCH	14,150	14,244	15,914	7,284	9,295
WALLEYE	815	999	913	1,837	1,653
N.PIKE	236	133	281	504	389
CRAPPIE	48	3	16	161	41
S.M.BASS	18	8	7	63	18
L.M.BASS	17	7	6	5	15
BLUEGILL	13	2	3	20	9
WHITE BASS	0	1	2	4	0
BULLHEAD	9	1	0	2	1
SUCKER	1	0	0	1	1*
GAR	0	0	0	1	0
TOTALS	15,307	15,398	17,142	9,882	11,422
ANGLERS CONTACTED	7,203	7,074	6,575	4,944	4,569
TOTAL HOURS	21,175	23,230	18,312	10,902	11,353
AVERAGE FISH/MAN	2.12	2.17	2.60	2.0	2.52
AVERAGE FISH/HOUR	0.72	0.66	0.93	0.91	1.00

* Buffalo

The percentages of perch and walleyes in the total catch composition have remained fairly uniform each winter. From the first winter creel census of 1950-51 to 1954-55, these have ranged as follows: 92 and 5; 93 and 6; 93 and 5; 74 and 19; 81 and 14 per cents respectively.

The decline in fishing pressure during the past three winters coincides with the increase on nearby Spirit Lake which has attracted many former Okoboji anglers. However, the data indicates no adverse effects due to possible overfishing from the five years of extended open season. This serves to emphasize the importance of liberalized fishing and supports with concrete evidence that pole and line gear is ineffectual in harvesting crops of fish.

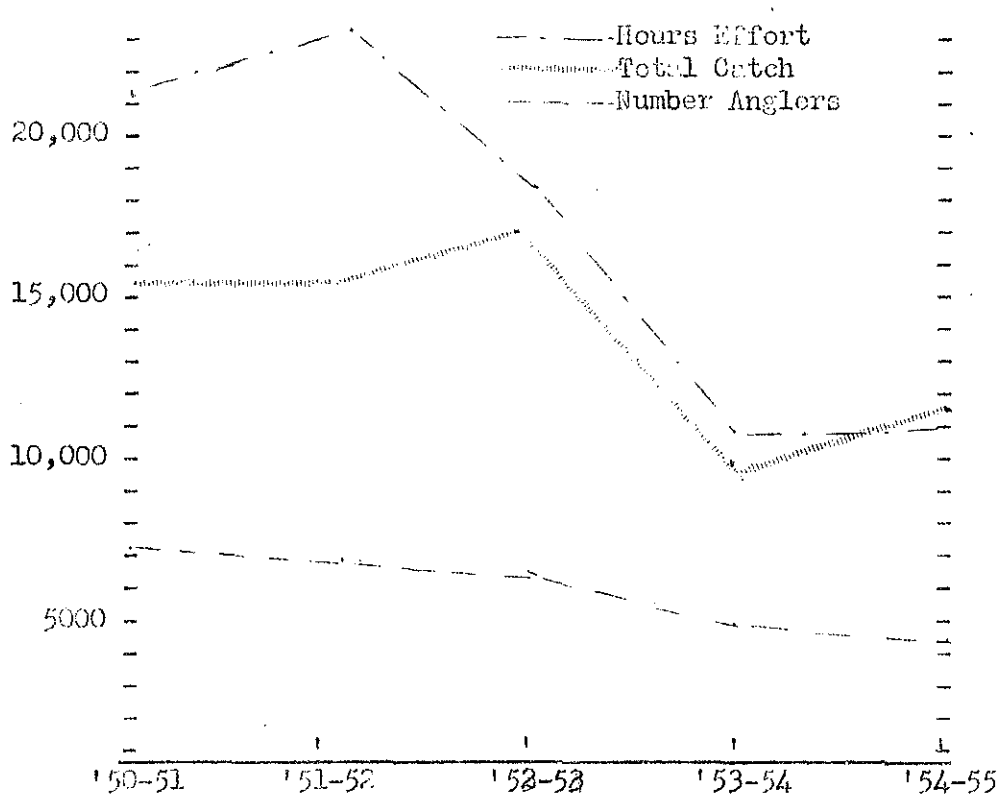


Figure 1. Comparison of winter creel censuses of West Okoboji, 1950-51--1954-55.

Spirit Lake

Because of its comparatively shallow waters, Spirit Lake froze over sooner than West Okoboji and the angling began four days earlier. Most of this early fishing was confined to Angler's Bay, the first region to have "safe ice".

Even though very adverse angling conditions prevailed during much of the season on this lake, the past winter's angling success surpassed all previous records in total catch and in catch per unit effort. The 10 day summaries of the creel census together with seasonal totals are combined in Table 3.

Table 3. Ten Day and Seasonal Creel Census Summary Spirit Lake

SPECIES	Dec. 6-15	Dec. 16-25	Dec.26 Jan 4	Jan. 5-14	Jan. 15-24	Jan.25 Feb.3	Feb. 4-15	Season Totals
CRAPPIE	42	94	33	73	37	2	13	294
PERCH	812	2700	2208	4363	2990	1381	1480	15,934
N.PIKE		10	21	28	39	25	13	136
WALLEYE	370	340	553	317	152	84	78	1,894
S.M.BASS*	0	0	3	0	0	0	0	3
BULLHEAD	0	1	0	0	3	1	0	5
BLUEGILL	0	0	2	0	0	0	0	2
10 DAY AND SEASON TOTAL	1224	3145	2820	4781	3221	1493	1584	18,268
TOTAL MEN	529	999	887	963	813	492	505	5,288
TOTAL HOURS	1221	3009	3051	2580	2301	1469	1671	15,302
AVERAGE FISH/MAN	2.31	3.15	2.76	4.96	3.96	3.03	3.12	3.45
AVERAGE FISH/HOUR	1.00	1.05	0.92	1.85	1.40	1.01	0.92	1.19

* No largemouth bass reported caught.

Fishing was generally distributed over the lake after December 16 when the entire lake froze over except for one small area kept open by an estimated 5,000 mallard ducks. As usual, many seams formed on the lake and after a period of high winds some of these opened and joined the open region. These and subsequent hazards curtailed angling very markedly.

By mid-January, 1955, continued high winds increased the size of the open area to approximately 1,000 acres. The wind, exceeding 40 miles per hour, presumably started circulation of warm water from the bottom (theoretically 39.2F.) to the surface, thus enlarging the opening and keeping it open even in zero temperatures. Attesting to the uniqueness of the phenomenon were comments from many long-time residents who agreed that they had never observed similar conditions. The Des Moines Register, Iowa's largest newspaper carried a

lengthy account and a large aerial photo of the huge open area. As may be noted in Table 3, the number of anglers contacted dropped considerably (60 per cent) from January 15 to the 25. This was due to their concern for personal safety. High currents of water under the ice were observed even a mile or more from the open area. These currents wore ice from under shanties, several cars and trucks broke through regions of former safe travel, and minnow pails suspended from fish shanties revolved rapidly in the current. Unquestionably, the season's catch would have been considerably greater had this not occurred.

Annual comparison of catch data

Censuses have been conducted during the past three winters on Spirit Lake and as indicated previously, angling success has improved each winter. A comparison of the three seasons is summarized in Table 4 and Figure 2. Obviously the catch last winter far exceeded the previous seasons in the total catch of perch and the catch per unit effort shows a favorable improvement.

Table 4. Summaries of winter creel censuses on Spirit Lake.

SPECIES	1952-53	1953-54	1954-55
CRAPPIE		186	294
PERCH	7,216	8,417	15,934
N.PIKE	178	220	136
L.M.BASS	0	5	0
WALLEYE	1,085	2,026	1,894
S.M.BASS	19	3	3
BULLHEAD	0	3	5
BLUEGILL	0	0	2
TOTALS	8,498	10,860	18,268
ANGLER CONTACTS	3,937	3,679	5,288
HOURS FISHED	11,785	10,664	15,302
AVERAGE FISH/MAN	2.15	2.95	3.45
AVERAGE FISH/HOUR	0.72	1.02	1.19

If the extended open season and increased harvest of fish had produced a fished-out lake as predicted by a small vociferous minority this condition would certainly have been reflected in the creel census. Here we have observed a steady increase in angler success as measured by the average catch per man and per hour of effort together with a 68 per cent increase in angling pressure during the past winter.

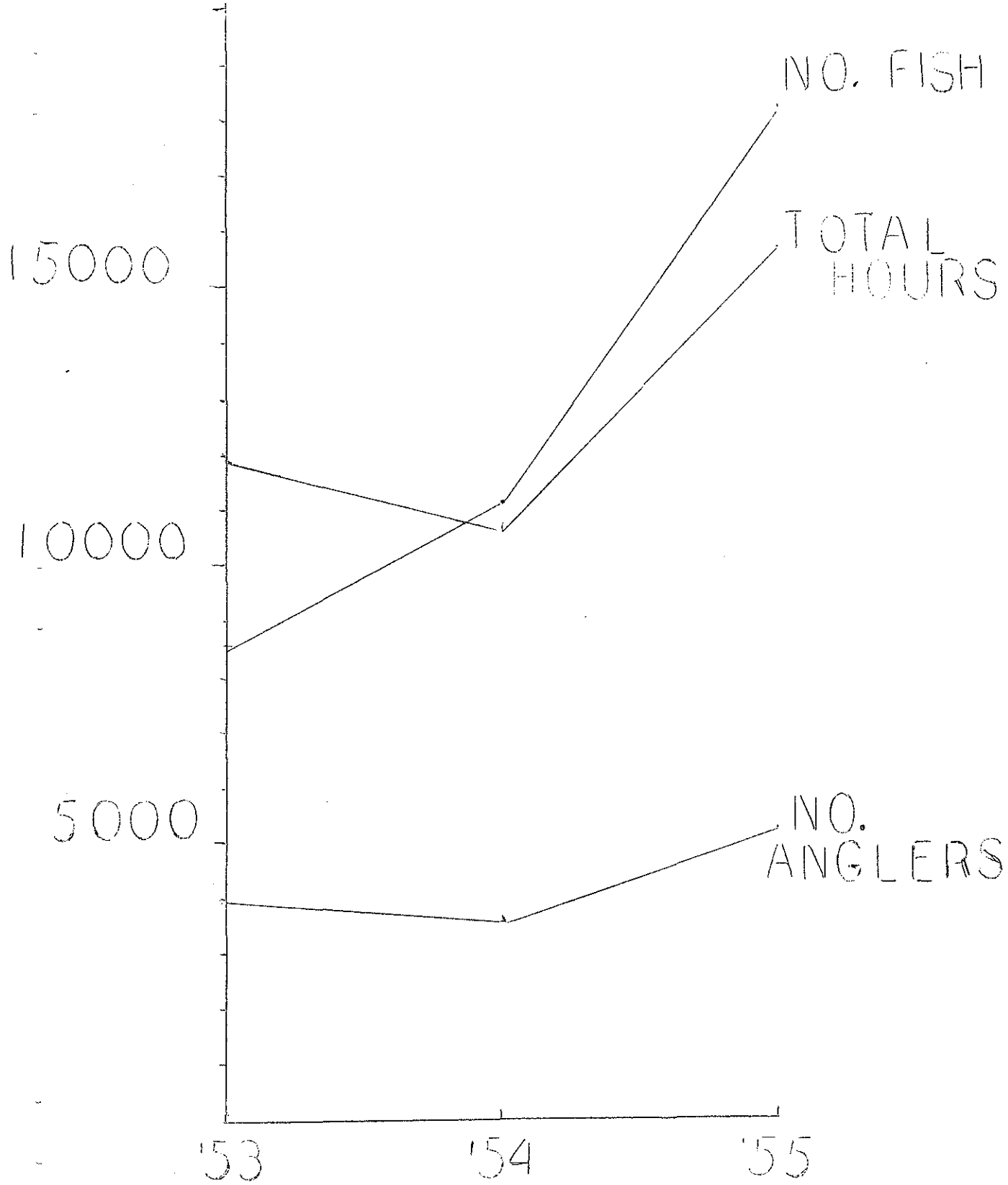


FIG. 2. WINTER ANGLING SPIRIT L.

Size, Sex Ratio and Age of Fish Caught

Most of the perch and walleyes caught were somewhat smaller than those of West Okoboji. A total of 62 perch was examined ranging from 7 to 11 inches in length and from two to four years of age. Of these, 82 per cent were females and 18 per cent males. Most of the perch were of the 1951 year class which was exceptionally abundant. Most of the walleyes caught were from 11 to 15 inches long. The census clerk measured 160 walleyes at random during December and these ranged in total length as follows: 41 per cent 11-12 inches; 35 per cent 14-15 inches and 24 per cent 16-26 inches. Of these, 60 per cent were males and 40 per cent females. This coincides with the limited data collected in past years--most of the walleyes examined have been males and most of the perch, females.

Winter fishing on other Lakes

East Okoboji had fair walleye fishing, particularly early in the winter. The census clerk for West Okoboji checked the East Lake during this period. The summary for the season includes 243 walleyes, two northern pike, two perch, one crappie and one white bass caught for a total of 249 fish. During the season, 150 fishermen contacted had fished a total of 367 hours. This averages 1.66 fish per angler at the rate of 0.68 fish per hour.

Silver Lake in Dickinson County, usually produces good crappie fishing in the winter; however, this year was a poor one comparatively. One angler kept his record for 17 days in which 10 crappies and eight perch were taken in 38.5 hours of fishing (0.47 fish per hour). No routine census was conducted.

Discussions with Conservation Officers brought out comments on other lakes which were not censused. Jack Stevens, reported that Clear Lake in Cerro Gordo County had fair walleye fishing early in the winter, then better than average yellow bass fishing later on. Harold Johnson stated that Five Island Lake in Palo Alto County had its usual good perch fishing except that the fish were very small. Some excellent perch fishing was reported by him from High Lake in Emmet County. There was practically no fishing on Storm Lake this winter according to Frank Starr. Those who tried fishing had very little success, presumably due to the high population of the 1954 class of gizzard shad which has produced excessive forage.

Summary

West Okoboji and Spirit Lakes in Dickinson County were again the most heavily fished lakes in Iowa during the winter of 1954-55. As in previous years, a creel census clerk was assigned to each lake from the time of freeze-up until the

end of the season on February 15. They contacted a total of 9,857 anglers who had caught a total of 29,690 fish in 26,655 hours on the two lakes. As usual, perch and walleyes were the most abundant species in the catch from both lakes. The data from the census of last winter were compared with the previous four winters on West Okoboji and the two on Spirit Lake. These indicate that angling has improved rather than deteriorated since the advent of the extended open season.

THE BLUEGILL, LEPOMIS MACROCHIRUS, (RAFINESQUE) IN WEST OKOBOJI LAKE, IOWA

By Jim Mayhew

INTRODUCTION

This study is concerned with the anglers harvest, age and growth, body-scale relationship, length-weight relationship, coefficient of condition, population trends, spawning activities, and fecundity of the bluegill, Lepomis macrochirus (Rafinesque), in West Okoboji Lake, Iowa. The purpose is to gain a better understanding of the species. The data presented were collected during 1953 and 1954. Perhaps the value of life history studies can be questioned, but if it is kept in mind that these resulting data might directly or indirectly influence management practices they are well worth the effort.

ANGLERS HARVEST

The bluegill has been among the most sought for fish in West Okoboji for many years. Although its popularity is confined primarily to the summer it always affords much pleasure to fishermen. Creel census clerks report that at times 50 to 75 per cent of the fishermen contacted on the lake are fishing for bluegills. This is governed by the catchability at certain periods during the year, attaining highest popularity when they are most easily taken.

The per cent of bluegills caught by anglers in view of the total harvest of fish has almost equalled that of the perch, walleye, and bullhead. The difference in per cent of catch would probably be much greater if the amount of time spent in angling was taken into consideration. Bluegills are taken primarily in the summer; whereas, perch and walleyes are taken in considerable numbers both summer and winter.

A creel census has been operated since 1946 from May 15 to July 1 on West Okoboji. The bluegill catch undoubtedly is approaching its peak during this 45 day period. During the past two years, however, the census has been carried on the year around basis. The bluegill harvest has ranged from 3.0 per cent in 1946 to 16.8 per cent in 1953, (E. T. Rose, State Conservation Commission, Mimeographed reports, 1952, 1953, and 1954). During the past seven years the catch has shown limited variation. The per cent of bluegills caught for the nine years 1946 to 1954 from May 15 to July 1 are presented in Table 1.

Table 1. The recorded catch of bluegills by anglers from May 15 to July 1 in West Okoboji Lake, 1946 to 1954.

Year	Total Number Anglers	Total Fish Caught	Number of Bluegills Caught	Per Cent of Bluegills Caught
1946	3,292	10,422	313	3.0
1947	2,417	9,546	350	3.7
1948	5,860	17,583	1,339	7.6
1949	5,975	18,583	1,601	8.6
1950	3,540	9,187	583	6.3
1951	3,987	16,689	1,280	7.1
1952	4,010	15,418	1,399	9.1
1953	3,466	7,221	1,226	16.8
1954	2,212	7,525	807	10.7

AGE AND GROWTH

A total of 1,199 bluegills, including 971 young-of-the-year, were obtained for age and growth analysis by angling, drag seining, and electro-fishing. Each individual was measured for total and standard length and weighed. The standard length used is the distance in millimeters between the snout and the distal end of the caudal peduncle. Three scales were removed from the fish and transferred to envelopes for futher analysis. In the laboratory the scales were cleaned and dry mounted between microscope slides.

As in most studies, microprojection of the scale image was used to assess the age of individual fish, and each annulus marked on paper tagboard strips. The standard length at each annulus was then determined by a direct proportion nomograph as described by Carlander and Smith (1944).

The mean calculated standard lengths from the first to the seventh annuli were found to be 31, 69, 108, 134, 150, 166 and 183 millimeters. (Table 2).

Table 2. Average calculated standard length at the end of each annulus for 228 bluegills from West Okoboji Lake.

Age Group	No. in Sample	Mean S.L. At Capture	Mean Standard Length at each Annulus 1	2	3	4	5	6	7
I	7	79	41						
II	91	99	26	64					
III	34	123	32	73	105				
IV	23	145	36	73	112	134			
V	46	157	34	73	109	133	147		
VI	23	174	31	68	107	135	152	164	
VII	4	189	27	72	115	132	166	175	183
Mean S.L. at Each Annulus			31	69	108	134	150	166	183
Mean Annual Increment			31	38	42	24	16	12	8

As shown in Table 3 these lengths were found to compare favorably with lakes in other areas, and in only two instances do not fall within the length ranges of these lakes.

Annual growth increments were found to increase until the third year, and then decrease slowly in the later years of life. The mean annual growth increments for the seven year classes were 31, 38, 42, 24, 16, 12, and 8 millimeters.

Table 3. A comparison of average standard lengths of bluegills at each annulus between West Okoboji and other lakes[1].

Lake and Location	Year of Life 1	2	3	4	5	6	7	8
East Lake, Ia.	34	73	112	140	150	158		
Minnesota Lakes	46	81	112	140	164	194	227	247
Foots Pond, Ind.	32	82	119	138	138			
Red Haw Hill, Ia.	28	69	123	145	163	172	195	206
West Okoboji, Ia.	31	69	108	134	150	166	183	

[1] Taken from Carlanders Handbook of Fishery Biology.

BODY-SCALE RELATIONSHIP

The body-scale relationship was determined for 228 bluegills from the lake. Three "key" scales were removed from the left side of each individual by counting three scale rows down from the lateral line and ten scales over from the operculum. Standard length was used in all calculations. The scale radius was measured in millimeters from the focus to the anterior edge of the "key" scale.

The body-scale relationship by the least squares can best be expressed by the equation:

$$Y = a + bX$$

where

Y = standard length
X = scale radius (X27)
a and b = mathematically determined constants.

A line having a slope of 1.168 and a intercept of 12.9 on the length axis best describes this relationship (Fig.1). The minor variances of the points representing observed values from the calculated regression line in Figure 1 strongly indicates a straight line relationship.

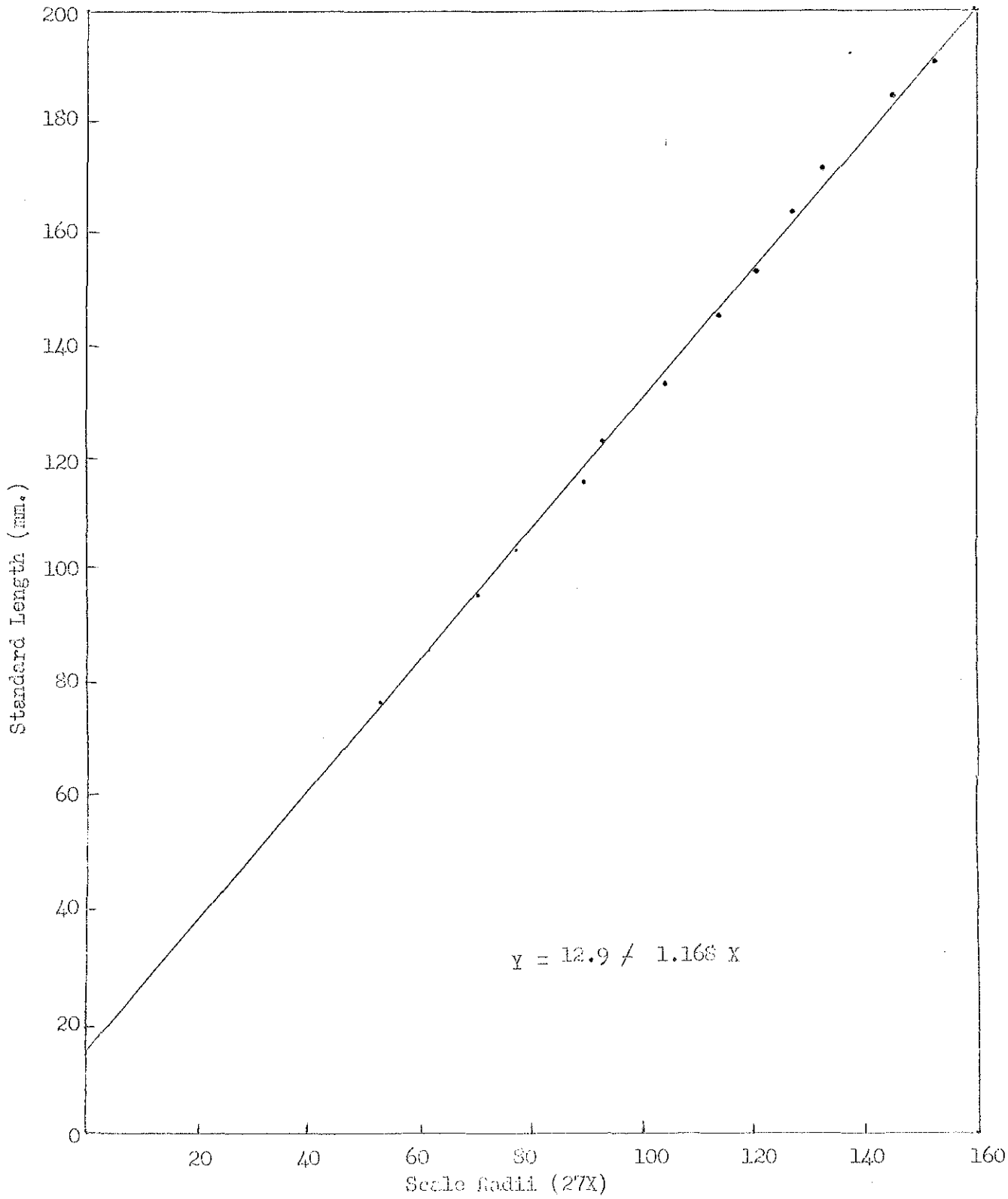


Figure 1. The body-scale relationship of 228 bluegills from West Okoboji.

LENGTH-WEIGHT RELATIONSHIP AND COEFFICIENT OF CONDITION

To determine the length-weight relationship of 1,199 bluegills the total sample was divided into ten millimeter size groups. The mean standard length and weight was determined for each group. This mathematical relationship between length and weight is expressed by the least squares equation

$$W = cL^n$$

or in logarithmic form as

$$\text{Log } W = \text{Log } C + \text{Log } L^n$$

where

W= weight
L= length
c and n= mathematically determined constants.

The length-weight relationship was found to be best described by the equation Log W = - 4.16809 + 2.93521 Log L in West Okoboji.

In graphical representation (Figure 2) the divergence of empirical weights from the calculated parabola is limited except in a few larger size groups. This deviation is attributed mostly to the inadequate sample of the larger fishes. The observed and calculated weights for each size group are given in Table 4.

The coefficient of condition or "K" factor was 5.04 for 228 adult bluegills in the lake.

Table 4. The observed and calculated weights of 1,199 bluegills in West Okoboji Lake.

Size Groups	Mean St. Length	Mean Weight Observed	Mean Weight Calculated	No. in Group
20-29	26	.9	1.0	341
30-39	32	1.1	1.3	630
70-79	77	22	23	8
80-89	86	30	33	13
90-99	96	44	45	36
100-109	104	59	57	32
110-119	116	80	78	25
120-129	124	94	95	9
130-139	133	128	125	15
140-149	145	153	150	16
150-159	154	187	179	30
160-169	165	221	219	25
170-179	173	251	252	13
180-189	184	281	302	3
190-199	191	344	336	3

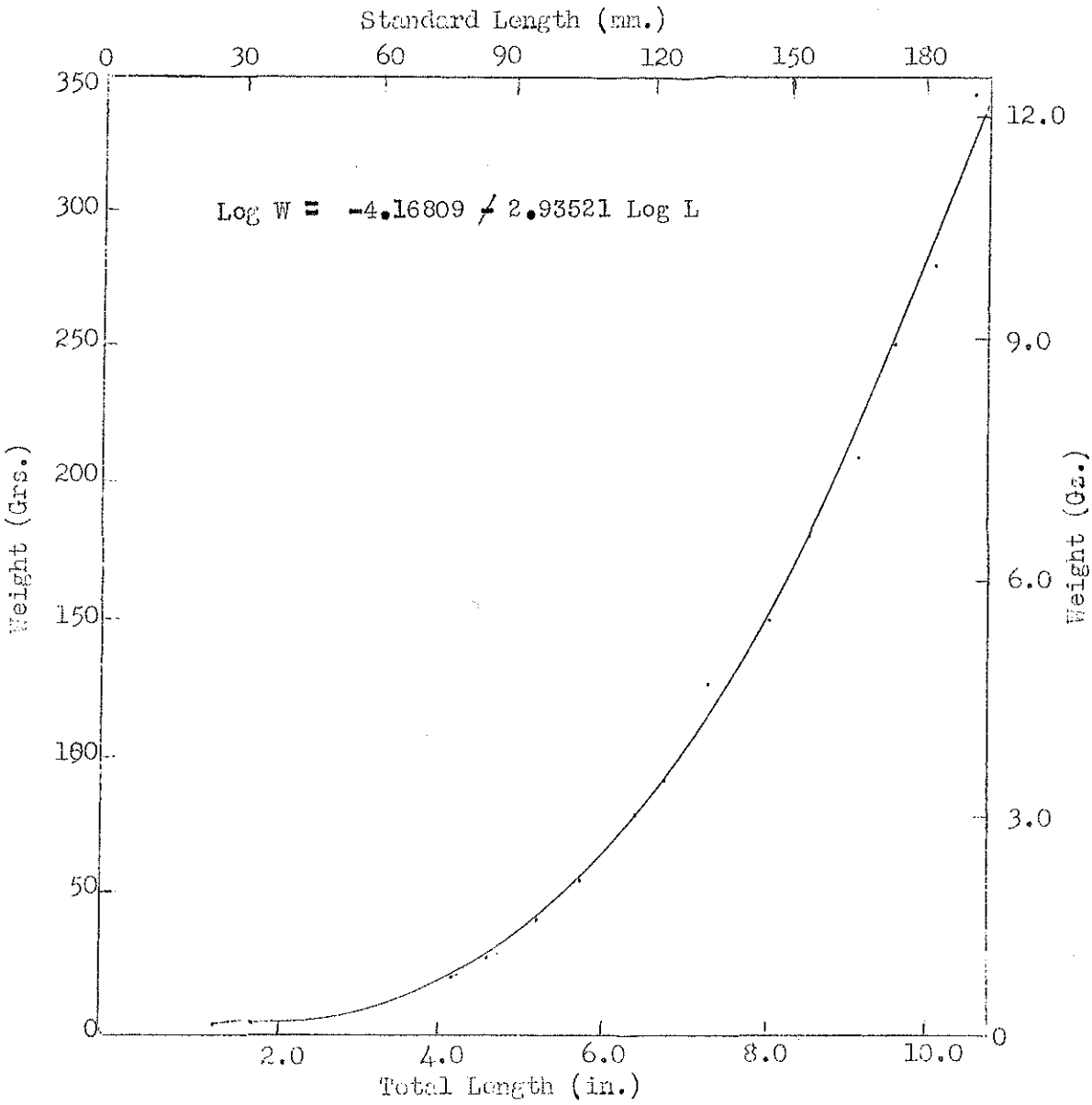


Figure 2. The length-weight relationship of 1199 bluegills from West Okoboji Lake, Iowa. The dots representing empirical lengths and weights.

POPULATION TRENDS

Since 1940 the State Conservation Commission has carried on a yearly fisheries inventory in the major natural lakes. The purpose of this survey is to establish annual population trends, and the magnitude of reproduction during the year. During the first survey 10 stations were designated to be checked each year in West Okoboji with a 500 foot, one-quarter inch mesh (bar measure) drag seine. In the seine hauls each species is counted and several specimens weighed and measured to establish length ranges. In the past few years a September recheck of each station was made because young-of-the-year of late spawners (crappie and bluegills) passed through the web during early summer surveys and as a result were not counted.

The abundance of young-of-the-year has ranged from a low of 911 per haul in 1947 to a high of 2,309 in 1946. During the past seven years survey records reveal a relatively stable catch. These figures would undoubtedly become much higher if the data from the early summer survey were excluded.

Sub-adult and adult bluegill abundance has almost paralleled each other since 1947. High populations of both occurred in 1950, when a mean of 308 sub-adults and 52 adults were taken per seine haul. The period of low abundance was noted in 1947 when an average of 4 sub-adults and 7 adults were taken per haul. The annual catch per seine haul of young-of-the-year, sub-adults, and adult bluegills from 1940 to 1954 is listed in Table 5.

Table 5. Average catch of bluegills per haul with 500 feet, one-quarter inch bar-mesh drag seine in West Okoboji Lake from 1940 to 1954.

Year	No. of Hauls	Number taken per Haul		
		Young-of-the-year	Sub-adults	Adults
1940	4	0	56	41
1941	3	10,333	0	52
1942	3	4,838	152	24
1944	3	0*	58	55
1945	6	10,000	2	18
1946	9	2,309	36	17
1947	12	911	4	7
1948	7	1,429	57	7
1949	6	1,605	597	37
1950	5	0*	308	52
1951	8	0*	129	48
1952	9	2,123	19	15
1953	11	1,357	37	17
1954	14	1,870	64	28

* Young-of-the-year bluegills were noted by the survey crews in large numbers passing through the web, and are not included in the total figures.

SPAWNING ACTIVITIES

A periodic spawning activity check was made at ten day intervals from May to August in 1954. The fish were caught by hook and line and examined internally for the partial absence of eggs from the ovary. At no time when ovaries were examined was a completely spent fish found. It is assumed that a complete emptying of the ovaries probably never occurs. In the course of the examinations it was observed that if the fish was partially spent, the opening of the vent contained fragmentary blood vessels and/or clots, possibly from the interior of the ovary. Examinations after the spawning period revealed that almost all spent females possess this phenomenon.

The first bluegills were taken on May 23 and three of these were females with unripe ovaries. On June 15, a total of 25 adults were examined from a known spawning area. Sixty-six per cent of these were males indicating nest building had started in preparation of spawning. In the following check of this area on June 25, fifteen bluegills were checked and 80 per cent were females. The first partially spent female was found on this date.

On July 5, the sexes were equally divided in a sample of 12 fish. At this time 66 per cent of the females were partially spent. Thus, the peak of the spawning activity occurred between June 25 and July 5. Eight bluegills were examined on July 17 and all females were spent. The sex ratio was even on this date.

One bluegill nest was observed during the spawning period, and on three subsequent visits during the day one adult bluegill was observed. The intense growth of submergent vegetation made direct observations almost impossible.

FECUNDITY AND MATURITY

Volumeteric egg counts were made on five adult female bluegills in 1954. The fish were obtained by angling in the early part of June to assure partial spawning had not taken place. The complete ovary was removed from each specimen, and placed in a 20 per cent formalin solution in order to harden the eggs to prevent breakage while counting and handling.

The ovaries were opened and enough eggs to displace 0.1 cc. of water were placed in a graduated cylinder. These eggs were counted, and the process repeated three times to determine sample ranges. The complete ovary was then immersed in the cylinder and the total volume recorded. The total number of eggs in the ovary was then determined using the 95 per cent confidence interval of individual samples and the total displacement of water.

The egg counts ranged from 7,200 in a fish weighing 142 grams to 38,184 in a fish weighing 234 grams. The fecundity of the five female bluegills examined is presented in Table 6.

Table 6. Egg counts per ovary in five bluegills from West Okoboji Lake using 95 per cent confidence intervals.

Standard Length	Weight	Mean No. of Eggs per 0.1 cc.	95% Con. Interval	Total Volume	No. of Eggs per Ovary
140	142	185	160-214	4.5	7,200-9,630
156	191	183	158-212	8.1	12,798-17,172
159	234	176	152-204	18.7	28,424-38,184
164	184	176	152-204	8.0	12,160-16,320
183	269	173	159-191	19.0	29,210-36,290

Several examinations were made to determine at what age the bluegill matures in West Okoboji. From these examinations it appears a few males and none of the females spawn at two years. At three years both sexes seem capable of spawning.

SUMMARY

The study is concerned with the anglers harvest, age and growth, body-scale relationship, length-weight relationship, coefficient of condition, population trends, spawning activities, and fecundity of bluegills in West Okoboji Lake, Iowa.

Anglers harvest of bluegills was highest in 1953 and lowest in 1946. The catch during the past seven years has been relatively stable.

The mean calculated lengths from the first to the seventh annuli were found to be 31, 69, 108, 134, 150, 166, and 183 millimeters. The annual growth increments were found to be 31, 38, 42, 24, 16, 12, and 8 millimeters for these year classes.

The body-scale relationship for 228 bluegills is best described by the least squares equation $Y = 12.9 + 1.168X$.

The length-weight relationship for 1,199 bluegills was found to be $\text{Log } W = -4.16809 + 2.93521 \text{ Log } L$. The coefficient of condition or "K" factor was 5.04 for 228 bluegills.

The population trends as revealed by annual survey records from 1940 to 1954 are discussed.

The activities of adult bluegills through the spawning period are described.

The fecundity of five adult bluegills from the lake is is discussed.

LITERATURE CITED

Carlander, K. D. 1950. Handbook of freshwater fishery biology. Wm. C. Brown, Iowa. 281 pp.

_____, and L. L. Smith Jr. 1944. Some Use of Nomographs in Fish Growth Studies. Copeia 3:137-162.

FISHING SUCCESS AND EFFORT ON NORTHEAST IOWA STREAMS 1950 - 1954

By R. E. Cleary*

A modified voluntary creel census covering the angling success and effort on northeast Iowa streams was started in 1950. A group of better-than-average fishermen was personally contacted on such a basis as to cover river angling activities, and to report their catch statistics on self-addressed census cards.

As could be expected, even though those anglers were contacted personally by biologists and conservation officers the average return never represented more than 70 per cent of those contacted. The cooperating angler averaged 25 trips during the season over a five-year period. Individual anglers reports ranged from one to 168 trips made during a single season. The trips averaged approximately three hours in length, and despite the fact that these data were reported on a voluntary basis, the anglers indicated that one trip out of four was unsuccessful.

Despite an average annual turnover of 40 per cent** in contacts, which certainly allowed for variation in individual angling skills, the number of fish taken on a per-hour basis fluctuated only slightly over the period of the survey. (See Table 1).

Table 1. Angling Success and Effort in Warm-water Stream Fishing, Northeast Iowa.

Year	Total Hours	Total Fish	Fish/Hr.	Estimated Av. Wt. (lbs)
1950	3757	2878	.77	1.19
1951	4190	3182	.76	1.03
1952	6178	4743	.77	1.10
1953	7202	6359	.89	1.11
1954	5256	5083	.97	1.03

The average weight data in Table 1 are estimated. The angler usually reported his catch as to size of each specimen or gave each an estimated weight. We accepted either figure and assigned our estimate of weight to each of the measured catches.

*Fisheries Biologist, 514 4th St., Independence, Iowa
**Of the original 86 contacts, 20 were still reporting five years later in 1954.

Table 2 indicated trends in stream fishing on a catch-per-hour basis for certain species. The table also gives the average weights for individual species. Since most of these creel census contacts are specialists, they usually direct their angling during a given season toward one, or at the most two, species of fish. Therefore, the data which make up the first four categories in Table 2 are based on trips on which the angling was specific for the indicated species. The Mixed Creel category covers a catch made up of different species of fish taken during one trip. There is no apparent correlation between the catch-per-hour and the average weight of the fish caught.

Table 2. Angling success and Effort for Certain Species in Northeast Iowa Streams.

Species	Year	Hours	Number	No./Hr.	Av. Weight
Trout	1950	1066	1337	1.22	.30
	1951	1168	1425	1.35	.31
	1952	1790	2104	1.18	.38
	1953	2817	2202	1.28	.39
	1954	1593	1708	1.07	.51
Catfish	1950	1348	944	.70	1.48
	1951	2094	1197	.57	1.51
	1952	2592	1584	.61	1.36
	1953	2844	1922	.67	1.44
	1954	2300	1585	.69	1.37
Smallmouth Bass	1950	686	428	.62	1.15
	1951	638	307	.48	1.04
	1952	515	1073	.48	1.20
	1953	964	1479	.65	1.07
	1954	726	486	.67	1.03
Crappie	1950	134	161	1.20	.36
	1951	212	351	1.65	.40
	1952	285	445	1.56	.34
	1953	226	460	2.04	.47
	1954	443	1061	2.40	.40
Mixed Creel	1950	991	917	.93	1.05
	1951	774	848	1.09	.76
	1952	1481	1624	1.09	.93
	1953	1517	2098	1.33	.83
	1954	1044	1379	1.32	1.23

The method of reporting the data over an entire season, lends itself nicely to a comparison of catch on a monthly basis. In like manner it also gives an indication as to angling pressure throughout the year. Table 3 presents the total hours fished and numbers caught on a monthly basis during the five years. Using the fish-per-hour catch as an index to good or poor fishing during a given month, the following facts are indicated:

1. The month of May is the prima month for trout fishing effort. Despite the fact that in 1954 the season opened in March and not May as in previous years, the greatest angling pressure still occurred in May. August, however, is the most remunerative month followed by June and September.

2. Catfishing opens in April but the months of May, July and August are the busiest for the catfisherman. These same three months are the most remunerative if the one abnormal November in the five-year span is discounted.

3. Smallmouth bass fishing reaches a peak in both success and effort during the month of August. September and July are both months of heavy effort and reasonably good success.

4. Crappie fishing presents a tri-modular picture with the months of best success being April, October and August in that order. However, May and June were the months during which the angler expended the most time angling for crappies.

5. Largemouth bass fishing is usually confined to the overflow ponds of the river and behind dams and very few are taken in the river "run". The months of August through October are the best for angling results. While as to be expected, the first complete open month - June - bore the major brunt of the angling effort.

Generally speaking, with the exception of the crappie, the opening month of each of the above species is one of the poorest as a fish producer, of all the months of the season.

Table 3. Average Monthly Angling Success and Effort for Some Major River Fish in Northeast Iowa, 1950-1954.

Species	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Trout								
No. Caught	252	4411	1159	1276	1140	1031	459	213
Hrs. Fished	356	3927	1144	976	793	766	365	182
Fish/Hr.	.71	1.36	1.36	1.31	1.44	1.35	1.26	1.17
Channel Catfish								
No. Caught	547	1334	1118	1786	1283	821	347	103
Hrs. Fished	959	2038	1772	2397	2015	1263	575	111
Fish/Hr.	.56	.66	.63	.75	.64	.65	.60	.93
Smallmouth Bass								
No. Caught	--	113	389	685	869	649	106	25
Hrs. Fished	--	226	851	1189	1312	1015	241	49
Fish/Hr.	--	.50	.46	.58	.67	.64	.45	.51
Crappie								
No. Caught	251	739	398	253	352	224	187	77
Hrs. Fished	112	408	200	167	167	165	87	52
Fish/Hr.	2.26	1.81	1.99	1.53	2.11	1.36	2.15	1.48
Largemouth Bass								
No. Caught	--	48	145	132	155	185	115	--
Hrs. Fished	--	73	283	190	191	181	120	--
Fish/Hr.	--	.66	.51	.69	.81	1.04	.96	--

FURTHER STUDIES ON THE CATFISH IN THE HUMBOLDT AREA OF THE DES MOINES RIVER

By Harry M. Harrison

Introduction

The channel catfish inhabiting the region of the Des Moines River between Humboldt and Rutland have been studied annually since 1949. The intent of the study has been to gather basic facts concerning the life history of the species, and to learn how these may be applied to maintain and improve channel catfish populations in this and similar bodies of water. The initial and early results of the investigation have been reported upon in previous Iowa Conservation Commission Quarterly Biology Reports (see reports for Dec. 1953 and June 1954).

The purpose of the present paper is twofold: First, it sets forth the statistics obtained on the composition and size of the catfish population in the area. Second, it gives information pertaining to their age and growth.

From the earlier reports, mentioned above, it will be recalled that this reach of the Des Moines river bears two names, The Humboldt Area or The Humboldt Impoundment, and that it is quite unique in at least several respects. Among some of the more important of these are the following: (1) The area is short (less than six miles long) and is enclosed by hydro-electric dams on each end. The dams make it virtually impossible for fish to get into or out of the place except at times of extreme high water. Because of its small size and the near impossibility of fish entering the vicinity, we have virtually an outdoor laboratory where it is possible to study stream fish populations without much regard for contamination by movement in or out of the area. In other words, this reach of river offers certain advantages for study seldom found elsewhere in Iowa streams. (2) The area maintains a very large population of fish of which the channel catfish predominates. (3) The catfish population consists of two segments, one of which is composed of a very large number of supposedly slow growing small individuals and the other a good or normal population of large catfish. The latter group ranges in size between 3 and 12 pounds, whereas specimens of the former group seldom attain the weight of a pound.

It is thought that the reason for the occurrence of the two groups may be in some way tied to a feeding threshold or a not understood space factor. To explain, the area is well suited for catfish reproduction which means that in almost every year a large hatch of young is added. Due to

* Fisheries Biologist, Madrid, Iowa

crowding or because of the demand made upon the kind and supply of food present, the small fish grow very slowly. Upon reaching the length of 14 to 16 inches, natural mortality has cut the size of the population, and, in addition the number of kinds of food consumed by fish of this size increases rapidly. In effect, the fish grow into a new environment with plenty of room and an adequate food supply. This situation is thought to be followed by a normal rate of growth.

About the only thing that has been learned of the larger catfish in the area is that they do occur. A few are caught by anglers each year, and in the spring they are taken by the hundreds in our survey nets. Come July however, they seem to disappear and are not found again until the following May or June.

Since work in the Humboldt Impoundment is carried on in the fall, only that segment of the population vulnerable to netting at that time of year can be studied. As mentioned above, the larger fish are not found except in the spring, so it follows that our studies are confined quite largely to the group of smaller catfish in the area. Nonetheless, when the size of this population is considered, it represents a great potential, and all that can be learned about it will be of value.

SIZE COMPOSITION AND POPULATION ESTIMATE

The size composition of the catfish population is given in Table 1. This table is based upon the measurement of 814 specimens taken from the impoundment on November 30, 1954. It breaks the total length measurements into one-half inch intervals and gives the number of individuals falling into the various groups from the sample. In addition, it shows the percentage of the total in each size and the percent of fish equal to or longer than that particular length group.

Creel census work on this and other areas of the Des Moines River show that most fishermen "string" catfish with a minimum length of 10 inches while a few more discriminating anglers are not satisfied with fish less than 12 inches in total length. On the basis of the measurements compiled in Table 1, it is presupposed that 51 per cent of the catfish in the area would be acceptable to most fishermen, whereas 12 per cent of the population would be taken by all anglers.

Table 1. Size Composition Channel Catfish Humboldt Impoundment Fall 1954.

Total Length inch	No. Individuals in group	Per cent of total sample	Per cent individuals equal to or longer than group
5½-6	9	1	99
6-6½	17	2	93
6½-7	16	2	95
7-7½	5	1	94
7½-8	18	2	92
8-8½	65	8	84
8½-9	110	14	70
9-9½	77	9	61
9½-10	27	3	58
10-10½	59	7	51
10½-11	132	16	35
11-11½	86	10	25
11½-12	62	8	17
12-12½	39	3	12
12½-13	27	3	9
13-13½	16	2	7
13½-14	12	1	6
14 or longer	37	5	1

An estimate of the size of the catfish population in the area has been made the past two falls. The 1953 estimate was given in the June Biology Quarterly Report for 1954. That caluclation was made by the well known Petersen method which is based on the recapture ratio of fin-clipped fish. In that work 14,889 individuals were marked, and from the recapture of these, together with the unmarked portion, the population was appraised at 104,597. Since the study area is only five miles long, this estimate was viewed with considerable skepticism in some quarters.

To check the 1953 appraisal and to get further figures on the size or changes in the population a second estimate was undertaken in 1954. In this work it was decided that 25,000 fish would be marked. This number represents approximately 25 per cent of the 1953 estimate, and was believed to be an adequate sample. The capture and fin-clipping of the 25,000 specimens was accomplished in October. After that the population was sampled upon two occassions for the purpose of determining the number of catfish in the area. The Petersen method, (Expressed as: $P = \frac{AB}{C}$, where: A is the number of marked fish,
B is the number of fish taken,
C is the number of marked recaptures.),

was employed for making the estimation. The first estimate was made on a sample of fish secured on November 11, or 13 days after fin clipping had been concluded. In this, 2,051 individuals were netted, of which 96 were marked. Applying these figures to the above formula the population is calculated to be 534, 114 catfish. The second sample collected on November 30, or 32 days after final marking, involved 838 fish of which 63 were marked individuals. These figures show the population to be 332,539 catfish by the Petersen method.

Because of the wide difference in the two estimates it is not possible to put a great deal of confidence on the size of the fall population in the Humboldt Area at this time. However, it can be pointed out that the work falls into a pattern that has been mentioned in some of our previous netting studies. This being that the proportion of marked to unmarked fish increases as the length of time from the date of marking increases. Simply stated, fin-clipped catfish tend to avoid renetting for quite long periods of time. If the pattern persists, netting this spring will give figures of consequence.

The present estimates have some merit in that they show that the 1953 population of 104,597 catfish in the area was not significantly too high.

AGE AND GROWTH OF CATFISH IN THE HUMBOLDT AREA

Suspicion of slow or stunted growth is usually associated with a large population of small fish, and because so many small ones are caught in the area each year, the prevailing opinion has been that the Humboldt Impoundment contains a stunted population of catfish. To ascertain whether or not such a condition exists and, if so, to what extent, an age and growth study was run on a sample involving 655 catfish from the area. With the exception that the spines were read on a standard scale machine, the techniques employed in amking the study followed those described by Sneed (1951).

The specimens used in this study were collected on November 30, which is just prior to winter freeze up, and because catfish become quite dormant under ice cover, it has been assumed that growth for the year was completed. In line with this assumption, the edge of the spine was adjudged as the point of formation of the 1954 annulus. The distance between it and the last annulus has been considered to represent the growth increment for the year.

Table 2 gives the average calculated lengths of channel catfish at the end of each growing season in the Humboldt Impoundment. That table shows it requires five years for catfish in this population to attain a standard length of 8 inches. Converted to total length this would approximate a 10 inch fish which, as stated above, is the minimum size acceptable to most Iowa anglers.

Compared to work in Oklahoma by Finnell and Jenkins (1954), the growth of the Humboldt Area catfish was considerably better than the slowest growing catfish found in Oklahoma but not as good as the average growth made by catfish in that state. Appleget and Smith (1950), studying the growth of Mississippi River catfish near Lansing, Iowa, found catfish to reach 10 inches in the third year of life, and, except for the first year in which growth was about the same as found in the Humboldt fish, the annual increment of the Mississippi specimens between age groups II and VII exceeded that of the Humboldt Area fish of the same age as much as four times.

From the evidence at hand it seems rather conclusive that the channel catfish inhabiting the Humboldt Impoundment are growing abnormally slow.

LENGTH-WEIGHT RELATIONSHIP

Data for determining the length-weight relationship of the Humboldt Area catfish were obtained by arranging the sample of 655 individuals into twenty mm. size groups (Table 3). Calculating the constants and expressing the variables in logarithmic form resulted in the equation:

$$\text{Log } W = -4.79492 + 2.99198 \text{ Log } L,$$

where W is weight in grams, L is standard length in mm.

In this population, the fish appear to follow the calculated parabola (Figure I) in the smaller size groups, but divergence from the calculated line is noticeable in the larger sizes. This is assumed to result, in part at least, from the smallness of the sample in the case of the larger size fish.

Table 2. Grand Average Calculated Standard Length at Time of Annulus Formation in 655 Channel Catfish, Humboldt Impoundment, Fall 1954.

AGE GROUP	No. Fish	Av. St. Lg. Capt.	YEARS OF LIFE I	II	III	IV	V	VI	VII	VIII	IX	X	XI
I	0												
II	46	138	55	138									
III	123	171	76	132	171								
IV	150	187	66	124	156	187							
V	203	237	79	123	167	195	237						
VI	76	241	75	127	160	188	214	241					
VII	40	269	70	122	156	186	214	239	269				
VIII	9	282	76	123	145	174	198	229	256	282			
IX	5	297	79	125	143	159	176	203	226	248	297		
X	2	288	72	121	138	153	167	179	204	225	261	288	
XI	1	350	65	120	174	183	196	204	212	250	285	310	350
Tot. Av. Growth at end each year in mm.			71	125	158	181	204	226	249	276	316	342	382
Equivalent standard length in inches			2.8	4.9	6.2	7.1	8.0	8.9	9.8	10.9	12.5	13.5	15.3
Ave. Growth Increment in mm.			71	54	33	23	23	22	23	27	40	26	40
Equivalent growth Increment in inches			2.8	2.1	1.3	0.9	0.9	0.9	0.9	1.1	1.6	1.0	1.6

Table 3. The Observed and Calculated Weights for 655 Channel Catfish in the Humboldt Area.

Size Group	Mean Standard Length	Mean Weight		No. in Group
		Observed	Calculated	
100-119	113	25	22	12
120-139	128	34	32	23
140-159	154	56	56	19
160-179	169	73	74	156
180-199	187	95	100	65
200-219	210	138	142	150
220-239	227	173	179	94
240-259	247	224	230	52
260-279	265	280	285	33
280-299	286	355	358	31
300-319	301	441	418	4
320-339	329	506	549	4
340-359	350	695	655	1

BODY-SPINE RELATIONSHIP

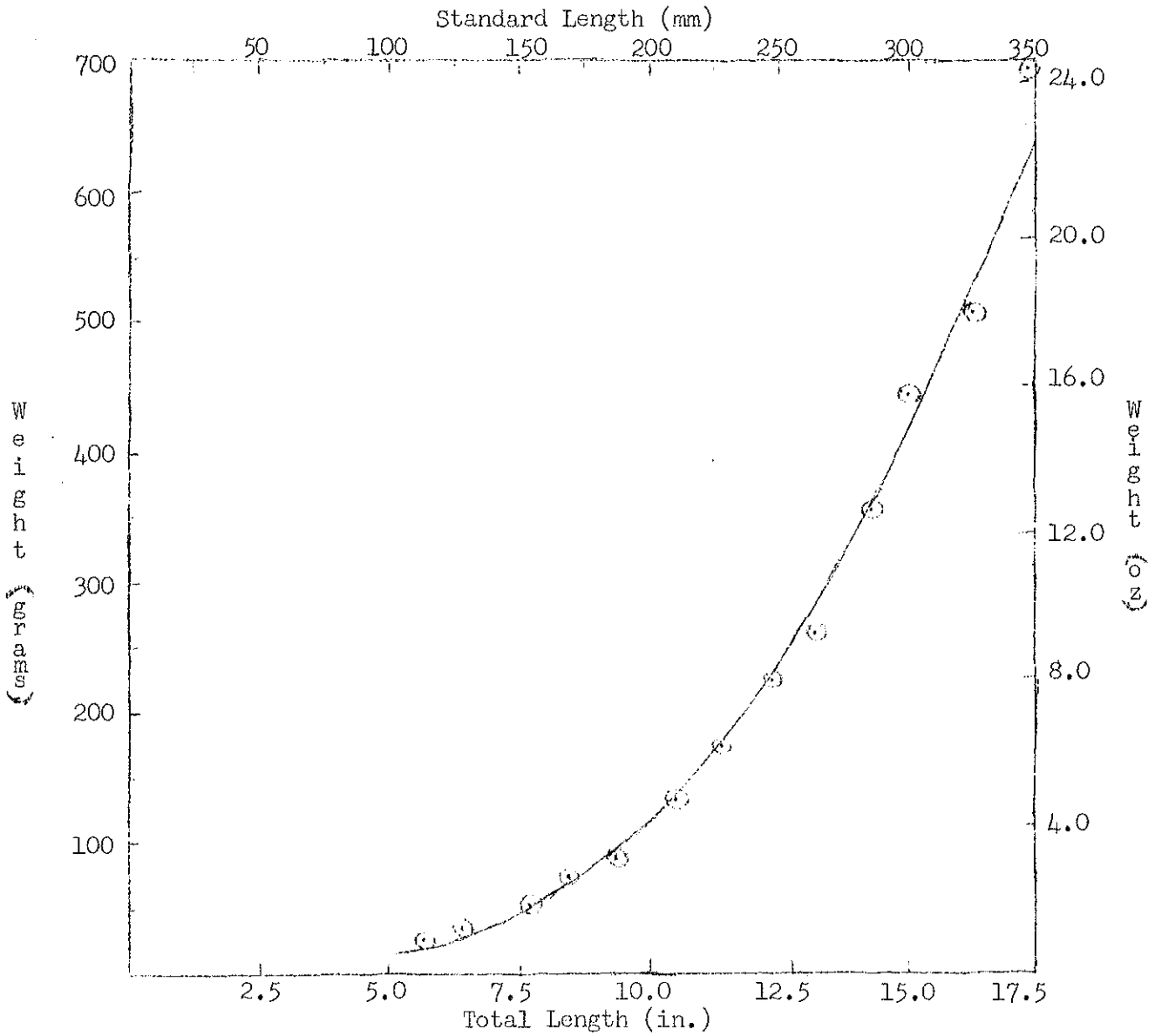
An attempt was made by the method of least squares to plot a line which would show the body length-spine relationship. The results obtained were not considered reliable in that the intercept fell too far to the left. The failure to get a reliable regression line by this method is believed to have resulted from the technique in securing the spine sections. Because the spines were fed into the slicing apparatus manually it was not always possible to take the sections from exactly the same place on the spine, or for that matter, in the same plane. This may have resulted in a considerable variation in the spine radius, and especially so, in that the sections were taken in the area of the spine where the diameter changes rapidly.

SUMMARY

1. A study of the size composition of catfish from the Humboldt Impoundment revealed 51 per cent of the fish would be acceptable to most Iowa anglers, while 12 per cent would be taken by all fishermen.

2. The 1954 fall estimate of the catfish population shows the population to be very large and it lends much support to the estimate made in 1953.

Figure 1 - Length-Weight Relationship of 655 Channel Catfish from Des Moines River Using Observed Weights



3. Age and growth calculations reveal a slow growth by catfish in the impoundment.

4. The body weight-length relationship of the catfish in the area is expressed: Log W = -4.79492 + 2.99198 Log L.

LITERATURE CITED

Appelget, John and Smith, Lloyd L. Jr.

1950 The Determination of Age and Rate of Growth from Vertebrae of Channel Catfish, Ictalurus lacustris punctatus. Trans. Amer. Fish. Soc. Vol. 80. pp 119-139

Finnell, Joe C. and Jenkins, Robert M.

1954 Growth of Channel Catfish in Oklahoma Waters 1954 Revision. Oklahoma Fisheries Research Laboratory Report No. 41 pp 1-37

Sneed, Kermit E.

1950 A Method for Calculating the Growth of Channel Catfish, Ictalurus lacustris punctatus. Trans. Amer. Fish. Soc. Vol. 80. pp 174-183.

COMPARATIVE FOOD HABITS OF CARP, BUFFALO AND SHEEPSHEAD FROM THE SAME LAKES

By Tom Moen*

Although food habits studies determined through stomach analyses have been conducted on many species of fish during the past half century, there have been few instances where the food habits and/or feeding relationships have been determined for more than one species from a body of water during the same period of time. The food of carp, buffalo, and sheepshead from various Northwest Iowa lakes has been reported by individual species and the results recorded in previous Iowa Conservation Commission Quarterly Biology Reports and Proceedings of Iowa Academy of Science (Moen 1953, 54, 55). The individual studies did not discuss in detail or stress competition for food, either with other species of rough fish or with game species. The purpose of this paper is to compare the food consumed by two or more of the three species of rough fish taken from the same lake during similar period of time, usually during one month and not more than a two month interval.

The procedure and methods used in the analyses of the stomach contents of each species has been described in detail in each of the reports (Moen, op.cit.). Description of the lakes from which fish were taken has also appeared in the individual papers. The data from the analyses were separated by season, size of fish, and expressed as percentages of total volume of food and as percentages of occurrence.

Considerable thought was given to the possibility of comparing the food of all three species taken from the same seine haul. An examination of collection notes indicated that although all three species were usually captured in any one seine haul there had been a tendency to select only one species for stomach analyses. The following day or the next week another species may have been selected from a seine haul made in the same locality. Therefore, it seemed expedient to bring together from the original data the analyses of two or more species that had been taken from the same lake within the interval of one month. Where the date of collection indicates a two month interval the fish were taken during a period of less than four consecutive weeks.

* Fisheries Biologist, State Biology Bldg., Okoboji, Iowa

The individual papers have discussed the food of an aggregate of 1,500 carp, buffalo, and sheepshead from 18 northwest Iowa lakes, but for the purposes of the present paper, East Okoboji furnished the only data that could be used for all three species (Table 1). West Okoboji and Spirit Lake supplied comparative data for carp and sheepshead (tables 2 and 3).

Table 1. Food of adult carp, buffalo and sheepshead from East Okoboji in June and July, 1946, and July and August, 1947, expressed as percentages of total volume of food organisms and as percentages of occurence.

Date of Collection	June - July, 1946						July - August, 1947					
Species	Carp		Buffalo		Sheepshead		Carp		Buffalo		Sheepshead	
Number of Stomachs taken	14		18		32		13		10		49	
Per cent of stomachs containing food	86		78		75		100		90		92	
Total volume of food (c.c.)	41.1		Not taken		8.5		578		193.5		46.5	
Weight (lbs) mean	2.7-12.4		1.9-4.6		0.4-3.0		2.3-12.6		1.3-8.2		0.1-1.7	
range	4.8		3.0		0.8		7.4		4.6		1.2	
	Per Vol	cent Occ	Per Vol	cent Occ	Per Vol	cent Occ	Per Vol	cent Occ	Per Vol	cent Occ	Per Vol	cent Occ
ANIMAL	92	91		100	100	100	73	100	95	100	98	100
Fish					8	13					59	54
Game					8	13					23	20
Forage											T	2
Unidentified											35	42
Insects	53	91			82	95	33	85	1	33	32	84
Neuroptera					1	9	T	23			1	4
Ephemeroptera	T	8			12	22					1	1
Odonata					1	4						
Hemiptera	T	25			22	52					2	2
Coleoptera											3	2
Trichoptera	31	66			25	35	16	69			11	57
Diptera	21	50			21	61	17	85	1	33	14	46
Crustacea	2	16		100	2	18	9	100	94	100	7	40
Cladocera	1	8		100			T	46	80	100		
Copepoda				57			T	15	14	66		
Ostracoda							T	7	T	11		
Amphipoda	1	8			2	18	9	77			7	40
Mollusca	37	58			8	13	31	92	T	11		
Gastropoda	37	58			8	13	27	92	T	11		
Pelecypoda							4	23				
Annelida					T	13						
Rotifera									T	11		
PLANT	8	58		7	T	13	27	100	5	90	2	27
Debris	4	58			T	13	3	92	1	33	1	22
Green fragments	4	16					22	92			T	4
Seeds							T	7				
Algae (Blue-green)				7			2	31	4	90		
Algae (filamentous)					T	2						

Competition by rough fish for available food organisms is often cited as one of the principal reasons for their removal, thus making more of these organisms available to more desirable species. A better view of the extent and magnitude of the competition can be gained if we have a better understanding of competition and selectivity of food organisms among the rough fish species. An analysis of the stomach contents of carp, buffalo, and sheepshead from East Okoboji in June-July, 1946, and July-August, 1947, indicates that each species apparently exercises considerable selectivity in feeding when they occupy the same general habitat. Buffalo probably show the narrowest range in food items when given the opportunity, being pelagic feeders almost exclusively, only rarely taking their food from the bottom. At the same time, carp from East Okoboji find their food on the bottom, only occasionally feeding on plankton and other limnetic organisms. Sheepshead appear to be about intermediate between carp and buffalo, taking both benthic and limnetic organisms. Thus these three species tend to be only partially competitive with one another and there appears to be a tendency for each species to visit a separate ecological niche in its search for food.

Evidence of separate niches was particularly noted in a closer examination of the insects taken as food. Insects contributed a maximum of one per cent of the diet of buffalo and were taken infrequently. In June-July, 1946, insects made up 53 and 82 per cent of the diet of carp and sheepshead respectively. Nearly all (98 per cent) of the insects taken by carp were caddis and midge larvae. These two groups made up 46 per cent of the sheepshead diet, the remaining 36 per cent consisted primarily of mayfly and corixid nymphs, two groups that occupy a limnetic habitat (no burrowing mayflies were noted). Crustaceans were taken in about equal amounts by both carp and sheepshead. One of the more interesting comparisons is noted in the fact that snails were nearly five times as important in the diet of carp as compared with that of the sheepshead.

In the July-August period the following year (1947) the general habitat of East Okoboji was presumed to be unchanged except for the presence of proportionately more young-of-the-year fish due to sampling approximately one month later in the season. Fish in the diet of sheepshead increased from eight per cent in June-July, 1946, period to 59 per cent in July-August, 1947. Insects were taken in nearly equal amounts by carp and sheepshead during this period with carp taking all of their insect food in the form of caddis and midge larvae. These were the most important insects in the food of sheepshead but again part of the insect diet (21 per cent) was of other orders such as Hemiptera. Crustaceans were again of about equal importance as food. Sheepshead in this collection had taken no mollusks while 27 per cent of the diet of carp was gastropods and four per cent fingernail clams.

Table 2. Food of adult carp and sheepshead from West Okoboji Lake in July-August, 1947, expressed as percentages of total volume of food organisms and as percentages of occurrence.

Date of collection	July-August, 1947			
Species	Carp		Sheepshead	
Number of stomachs	5		17	
Per cent of stomachs containing food	100		88	
Total volume of food (c.c.)	233.4		41.1	
Weight (lbs) mean	5.0		1.8	
range	3.3 -6.5		0.8- 5.0	
	Per cent		Per cent	
	Vol.	Occ.	Vol.	Occ.
ANIMAL	99	100	100	100
Fish			69	27
Game			61	14
Forage			7	7
Unidentified			1	7
Insects	46	100	11	80
Neuroptera	T	20		
Ephemeroptera			8	53
Hemiptera			T	7
Coleoptera	T	20		
Trichoptera	6	20	5	47
Diptera	40	100	1	40
Crustacea	3	100	5	27
Ostracoda	T	20		
Amphipoda	3	100	T	7
Decapoda			5	14
Mollusca	49	100	14	33
Gastropoda	47	100	14	33
Pelecypoda	2	20		
PLANT	1	60	T	14
Debris	1	60	T	7
Green fragments			T	7
Seeds	T	20		

A collection of five carp and 17 sheepshead from West Okoboji, July-August, 1947, represent fish from two seine hauls in the same area about one month apart. Insects and mollusks contributed 95 per cent of the food of the carp while the sheepshead selected fish as their principal food (69 per cent). Nearly all of the insect food of carp was composed of Tendipedidae larvae; mayfly nymphs were the most important among the insect food of the sheepshead. Mollusks were even more important than insects in the food of carp, contributing 49 per cent of the total food. Only one-third of the sheepshead has eaten mollusks making up fourteen per cent of the total food for the group. Gastropods were the only mollusks found in the sheepshead stomachs. About five per cent of the mollusks in the carp diet were fingernail clams.

There were no Spirit Lake buffalo examined at the same time that carp and/or sheepshead were taken. Three buffalo taken in June of 1948 contained plankton organisms that were about equally divided between entomostracans and blue-green algae. Six carp and ten sheepshead were taken in May, 1946; the carp and all but three of the sheepshead were from the same seine haul. There were no fish in the sheepshead stomachs at this time. Caddis fly and midge larvae contributed 100 per cent of the insect food and 78 per cent of the total food of the carp. Insect larvae were less important in the diet of sheepshead with caddis and midge larvae totaling 57 per cent of the total food. Small amounts of the orders Neuroptera, Ephemeroptera, and Odonata also appeared in the sheepshead stomachs. Crustaceans, largely amphipods, were taken frequently by the carp but made up only seven per cent of the total volume of food. Two sheepshead had consumed enough crayfish to account for 38 per cent of the total volume of food for the group.

The food of four carp (only two containing food) and 13 sheepshead from Spirit Lake in July 1946, can hardly be considered in a comparison due to the relatively few carp. At this time the sheepshead have turned to fish for a substantial portion of their food (28 per cent) while the carp continued to utilize midge larvae. Trichoptera larvae and mayfly nymphs contributed 58 and 11 per cent of the sheepshead diet respectively. The two carp had taken only two per cent caddis fly and no mayfly nymphs.

Later in the season as the young fish become more abundant the sheepshead selected an even greater portion of their food from this source, as indicated in comparing a collection of 10 carp and 12 sheepshead taken in July-August, 1947. At this time 66 per cent of the diet was fish. The remainder of their diet was about an even spread between Trichoptera and mollusks. Again, by comparison the carp diet was composed of 18 per cent mollusks with 14 per cent for the

Table 3. Food of adult carp and sheepshead from Spirit Lake, May, 1946 July, 1946, and July-August, 1947, expressed as percentages of total volume of food and as percentages of frequencies of occurrence.

Date of Collection	May 1946				July 1946				July-August 1947			
Species	Carp		Sheepshead		Carp		Sheepshead		Carp		Sheepshead	
Number of Stomachs taken	6		10		4		13		10		12	
Per cent of stomachs containing food	83		90		50		100		100		83	
Total volume of food (cc)	87		52.2		11.8		56.1		427		50.3	
Weight (lbs) mean	5.9		4.1		4.0		5.0		6.0		4.2	
range	4.9-9.6		1.4-5.9		3.3-4.5		1.5-8.0		3.1-12.2		1.4-7.3	
	Per cent		Per cent		Per cent		Per cent		Per cent		Per cent	
	Vol	Occ	Vol	Occ	Vol	Occ	Vol	Occ	Vol	Occ	Vol	Occ
ANIMAL	96	100	100	100	100	100	97	100	95	100	100	100
Fish							28	54			66	100
Game							20	38			57	80
Forage							7	8			1	10
Unidentified							1	8			8	30
Insects	78	100	59	77	93	100	69	100	43	100	20	70
Neuroptera			1	22								
Ephemeroptera			T	22			11	38	T	40		
Odonata			T	11								
Hemiptera									T	10		
Trichoptera	19	60	23	55	2	50	58	85	14	80	20	70
Diptera	59	80	34	55	91	100	T	15	29	100		
Crustacea	7	60	38	44	3	50	T	23	33	100		
Cladocera					2	50			T	40		
Copepoda									T	10		
Ostracoda									T	40		
Amphipoda	7	60	T	22	1	50	T	15	32	100		
Decapoda			38	22			T	8				
Mollusca	5	60			4	50	T	8	18	100	14	70
Gastropoda	5	60			4	50	T	8	17	100	14	70
Pelecypoda									1	40		
Annelida			3	22			T	15			T	10
Turbellaria									T	20		
Unidentified	6	40										
PLANT	4	60	T	11	T	100	3	8	5	90	T	20
Debris	4	60			T	100	3	8	2	90		
Green fragments			T	11					3	40		
Seeds									T	50		
Algae, filamentous			T	50							T	20

sheepshead. Seven per cent of the mollusks (one per cent of the total food) found in the carp stomachs was fingernail clams. No pelecypods were noted in the sheepshead stomachs.

The discussion above has considered only the animal food of these fish. Plant food items were usually a small part of the total food in all three species. Buffalo stomachs contained blue-green algae as the principal plant items but exceeded five per cent of the total volume only in the case of the two fish from Spirit Lake. Sheepshead stomachs contained a maximum of three per cent vegetable matter. Carp consumed plant material consistently but the volume seldom exceded 10 per cent with a maximum of 27 per cent recorded for one collection. Much of the plant material in carp stomachs was debris, apparently taken while feeding on the bottom. This brief comparison only serves to emphasize the point made earlier that carp, buffalo and sheepshead from the same lake at the same time, seek their food among organisms occupying slightly different habitats or ecological niches, providing the general habitat offers a choice.

Summary

Previous papers did not discuss in detail the use by carp, buffalo, and sheepshead of available food. Competition for this food is often given as a reason for removal of rough fish where management is practiced. A better understanding of this competition can be gained by determining its extent among the rough fish species in the same lake at about the same time.

This paper presents data from the original analyses of two or more species that had been collected from the same lake within an interval of one month. East Okoboji furnished the only data that could be used for all three species; West Okoboji and Spirit Lake supplied comparative data for carp and sheepshead.

Among the three species the buffalo show the greatest selectivity of their food items, being pelagic feeders almost exclusively. Carp taken at the same time from the same lake found their food on the bottom and only occasionally feeding on plankton and other limnetic organisms. The sheepshead appear to be intermediate between carp and buffalo as they take both benthic and limnetic food itmes. Thus these three species are only partially competitive with one another with a tendency to visit separate ecological niches in search of food.

Plant material in the stomachs was usually of minor importance but its presence emphasized the fact that each species fed in a slightly different habitat.

Literature Cited

Moen, Tom 1953. Food Habits of the Carp in Northwest Iowa Lakes. Proc. Ia. Acad. Sci., 60: 665-686

Moen, Tom 1954 Food of the Bigmouth Buffalo, Ictiobus cyprinellus (Valenciennes), in Northwest Iowa Lakes. Proc. Ia. Acad. Sci., 61: 561-569

Moen, Tom 1955 Food of the Freshwater Drum, Aplodinotus grunniens Rafinesque, in Four Dickinson County, Iowa, Lakes. Proc. Ia. Acad. Sci., 62 (in press).

A PRELIMINARY ANALYSIS OF BI-MONTHLY WATERFOWL INVENTORIES MISSISSIPPI FLYWAY (OCTOBER 1, 1954 - JANUARY 15, 1955).

By James G. Sieh*

The Technical Section of the Mississippi Flyway Waterfowl Council requested the 14 states within the flyway to inventory waterfowl present within their respective boundaries on the first and fifteenth of each month from October 1, 1954 through January 15, 1955. Field personnel of the 14 states coordinated their efforts to simultaneously count and estimate numbers of waterfowl present. Theoretically, the census figures obtained should indicate total population estimates of wildfowl species within the flyway on each date of inventory. This attempt to gather total population data for the Mississippi Flyway is an experiment designed to provide valid estimates of existing populations at a given time. If this experiment shows promise in the Mississippi Flyway, and in other flyways, it is probably that valid estimates of continental populations of waterfowl may result. Coupled with adequate kill statistics and banding data, these inventory studies should provide a much better understanding of the supply, migration, and harvest picture of waterfowl in North America.

Bi-monthly waterfowl censuses indicated that 4.8 million mallards were present within the geographic boundaries of the Mississippi Flyway on December 15, 1954 (Table 1). It is assumed that this was a minimum peak figure because it was a physical impossibility to count all the waterfowl present. The estimates were based upon actual counts by field personnel well acquainted with their respective territories. No attempt can be made to assign a specific degree or per cent of error. Error does exist, but the experimental result does indicate the workability and practicability of a flyway-wide inventory; furthermore, the census data provided a measure of the mallard population, or a segment of that population heretofore unobtainable by any other method. These inventory data provide a working basis upon which refinements can be made.

* Game Biologists, State Biology Bldg., Okoboji, Iowa.

Table 1. Mallard Population Estimates (in thousands) within the Mississippi Flyway Based Upon Figures Obtained During Bi-monthly Waterfowl Inventories (1954-55).

Date of Inventory	Oct.15	Nov.1	Nov.15	Dec.1	Dec.15	Jan.1	Jan15
Alabama	1	-	26	36	73	80	24
Arkansas	-	-	555	667	1242	1100*	-
Illinois	31	533	1603	1736	2150	1500*	1347
Indiana	-	4	33	88	334	-	-
Iowa	30	86	157	200	164	49	39
Kentucky	.1	3	39	5	6	50	-
Louisiana	1	148	207	266	420	488	-
Michigan	55	101	46	96	26	24	6
Minnesota	64	26	57	18	-	-	-
Mississippi	-	4	50	50	50	50	-
Missouri	8	90	120	330	140	100	-
Ohio	23	11	39	51	39	22	-
Tennessee	.5	137	126	152	143	96	-
Wisconsin	27	75	15	22	20	150	-
Total Estimates Miss. Flyway in millions.	.25	1.2	3.1	3.7	4.8	3.7	-**

* Figures obtained by interpolation
** insufficient data for a total figure

The evaluation of census figures such as these may explode myths and misconceptions in the minds of many. For instance, it is noteworthy that the state of Illinois accounted for almost one-half of the mallards present within the flyway from November 15, 1954 until January 1, 1955. This focuses attention upon the abundance of mallards in that state during the 1954-55 open season. It must be further pointed out that Illinois does have one of the most effective waterfowl census systems operating in the country. Consequently, their estimates would be expected to be high; however, there is no indication that their figures were out of proportion.

The data indicated that the build-up of mallards within the flyway began about October 15, and increased from a quarter of a million to over a million birds in two weeks. From November 1-15, approximately two million more mallards were added to the flyway totals. The peak population of almost five million was reached by December 15, and thereafter a decrease in mallard population was observed. The decrease amounted to approximately a million mallards from December 15, 1954 to January 1, 1955. This decrease would logically result from mortalities, and birds moving out of the flyway without recruitment from the north.

This still leaves several important discrepancies to be explored. First, the loss of a million mallards from the flyway during a two-week period is a tremendous decline. It appears improbable that hunting mortalities would total a million birds in two weeks, although this could happen. This loss may represent an important shift of mallards out of the Mississippi Flyway and into the Central Flyway south of Illinois.

Some interesting comparisons result from studying the inventory data for species other than mallards (Table 2.) Here again we can visualize how early the blue-winged teal move down the flyway, and how quickly their numbers dwindle as the birds leave the United States. In contrast, a more continuous build-up of green-winged teal throughout the inventory period was noted. Early fall movements of pintails into and down the flyway were indicated. Reasonably constant numbers of wood ducks counted throughout the period give an inkling of what the wood duck population compared with other species may be. Interesting census figures for the less abundant species within the flyway, such as shovelers, redheads, buffleheads, and ruddies provide a part, but not all of the true population perspective for these species.

Some idea of comparative numbers of canvas-back, scaup, and ring-necked duck can be gleaned from the inventory data, but other important aspects of continental populations must be considered. Many of the canvas-back and other divers were reported from Michigan and the other Great Lake states, as were the black ducks. The waterfowl distribution pattern within and throughout the flyway is a complex and important part of the experiment, and somewhat too detailed for discussion in a preliminary study.

In the Mississippi Flyway approximately 350,000 Canada geese were censused (Table 2). Most of these birds were in Illinois, Missouri, Michigan, and Wisconsin. Blue and snow geese totaled 375,000 birds during the fall inventory. Only a few thousand white-fronted geese were reported.

The ever increasing demands of the un-enlightened hunter, increased duck stamp sales, better firearms and ammunition, and better transportation facilities coupled with rapidly decreasing waterfowl habitat demand adequate information concerning trends and populations. Accurate production trend data on the breeding grounds, valid population data during spring and fall migrations, more accurate harvest statistics coupled with a better understanding of mortalities will help us convert a new generation of waterfowl hunters into a bulwark of enlightened public opinion. Without adequate information and distribution of this information, we will continue to struggle along without the support of many , and with the enmity of a few. If we enjoy waterfowl hunting the responsibility is ours.

Table 2. Waterfowl Species Estimates in thousands within the Mississippi Flyway Based Upon Figures Obtained During Bi-monthly Waterfowl Inventories (1954-55): Fourteen States Reporting.

Date of Inventory	Oct. 15	Nov. 1	Nov. 15	Dec. 1	Dec. 15
Species:					
Mallard	243	1196	3081	3755	4789
Black Duck	85	129	143	191	199
Gadwall	24	149	246	141	156
Baldpate	112	158	73	25	45
GW Teal	89	171	325	253	269
BW Teal	146	17	6	1	2
Shoveller	39	50	43	59	70
Pintail	210	322	411	261	346
Wood Duck	72	68	65	45	71
Redhead	61	71	55	20	37
Canvas-back	66	304	202	136	130
Scaup	369	811	746	330	218
Ring-necked	25	170	153	109	87
Ruddy	7	15	17	16	28
Golden-eye	-	13	20	39	37
Buffle-head	-	1	2	2	2
Mergansers	-	26	41	57	68
Unidentified Ducks	-	114	106	21	21
TOTAL DUCKS IN MILLIONS	1.5	3.7	5.7	5.4	6.5
Species:					
Canada Geese	131	250	344	320	228
Blue Geese	31	293	314	3.5	295
Snow Geese	23	79	44	45	31
Blue and Snow*	53	378	374	369	334
White-fronted	14	9	6	6	5
Unidentified Geese	-	1	3	-	-
TOTAL GEESE IN THOUSANDS	198	638	727	695	567
Species:					
Coot	835	408	377	143	460

* Some states did not separate blue and snow geese so the total of the combined species is higher.

THE 1954 IOWA QUAIL SEASON

By M. E. Stempel*

Harvest is an integral part of the management of any wildlife species, and for this reason the average success of Iowa quail hunters is studied each fall. The present paper sets forth the information assembled in respect to this problem for 1954.

In 1954 the quail hunting season began on November first. It was opened for 45 days in 44 counties and 15 days in 16 others. Shooting hours were from 8:30 a.m. to 4:30 p.m. As it has been for the previous five years, the bag and possession limit was set at six birds.

The data are compiled from census cards provided conservation officers by the Biology Section. These cards were filled out by the officers as they contacted hunters in the field. The information sought from the individual hunter included: the number of hunters in each party, number of hours hunted, number of coveys seen, birds taken, the party's opinion of how the season compared to the last, date of hunt, county hunted, distance hunters were from home, and whether a dog was used. The minimum number of contacts requested from each officer was 20 for each county in the long season area, and 10 in the short season district.

Results

Statewide Success

An average party size of 2.3 hunters was indicated by data from 423 report cards returned in 1954. The season was described as the same as in 1953 by 34 per cent of the hunters, 56 per cent thought it better and ten per cent believed it poorer than the year before. In 1953, 289 cards indicated that the average party contained 2.3 hunters, of whom only 23 per cent thought that the season was better than in 1952. Results of party hunting are given in table one below.

Table 1- Party Hunting Success, 1953 and 1954 Quail Hunting Seasons.

Season	Hr. per Covey	No. Coveys Flushed	Birds Shot per Covey	Hr. per Quail	Birds Taken per Trip
1953	2.0	1.8	2.8	.7	5.0
1954	1.8	1.9	2.7	.6	5.3

* Game Biologist, 446 So. Schuyler, Ottumwa, Iowa

There is a noticeable 1954 increase in birds bagged per trip while there is a slight decrease in birds killed per covey flushed.

Success per Period

Because there is a progressive deterioration of quail cover due to cold weather, the hunting season will be considered by 15 day periods. During the first of these, from November first to 15, there was continued freezing, and grass, weeds and leaves were withering. Cover generally was thinning. At this time officers found quail hunters easiest to locate, and about one-half the total number of 423 parties were interviewed. These 220 parties were afield 740 hours, took 1,160 quail, and they spent an average of 1.5 man hours per bird.

Quail cover was further reduced between the dates of November 16 and 30 as frost collapsed weeds and grass, and most shrubs lost their leaves. At this time as quail cover became more restricted, the officers interviewed 109 parties who had been afield for 349 hours, and taken 557 quail. In this period they averaged 1.4 hours per bird.

From December first to 15, available shelter was reduced to its lowest during the hunting season. The only remaining coverts were composed of woody plants. Apparently birds spent most of the day in the vicinity of these easily identifiable areas, and at this time 94 parties were contacted they reported spending 347 hours, and bagging 511 quail. Getting one bird required 1.6 man hours.

Two possible reasons for the lack of more change in hunting success are; first, the shrinkage of range makes about the same number of birds per hunting hour available to a party, and second, there may always be some areas not previously hunted.

Hunting Success by Districts

South central and southeastern Iowa have the best quail coverts of all agricultural districts where there is quail hunting, and 1954 bird shooting was equally good in both sections. During 866 party hours 622 men flushed 530 coveys to take 1,453 quail. East central Iowa had 169 party hours of hunting while 102 men flushed 95 coveys to get 255 quail. Border counties had 401 party hours during which 275 men flushed 195 coveys and took 520 quail.

The areas of the state ranked as follows in hunter hours per bird: southeast and south central Iowa, 1.4; east central 1.5; and the border counties, 1.8 hours per bird.

In the south central, the southeast, and in border counties the majority of hunters felt that hunting was better in 1954 than in 1953, in the east central, 45 per cent of the hunters believed that 1954 was better.

Hunting success has been studied by districts and seasons since 1950. Table 2 gives the results of this work.

Table 2. Hunting Success in Hunter Hours per Quail by Agricultural Districts- 1950 to 1954.

Dist.	1950	1951	1952	1953	1954
SC	1.5	2.1	1.3	1.7	1.4
SE	1.5	2.4	1.3	1.4	1.4
EC	1.2	2.1	3.5	2.1	1.5
Border Counties (Low pop.)	2.5	2.6	1.8	1.8	1.8

In the main range, areas having light bird populations showed the most fluctuation in hunting success. The south and southeast provided fair hunting locally even in the adverse year of 1951 when much of the territory provided few young, and the hunting was generally poor.

Counties Recently Opened to Hunting

During the past two years, seven additional counties have been opened for two weeks of quail hunting. In these it was reported that a few quail were taken in Cass, Story, and Pottawattamie, while little or no hunting was reported from Mills, Montgomery, Chickasaw, and Howard.

Officers found that when some of these areas were opened both hunters and farmers feared that all quail would soon be shot. Since hunters actually took a very few birds, the sentiment has changed, and now it is generally accepted that scattered quail populations can be pursued without destroying seed stock.

Results of Using Dogs in the Quail Harvest

Dogs were used by 262 parties interviewed in 1954. These were composed of 827 hunters who during 1,218 party hours flushed 716 coveys and killed 1,975 birds. Average size of parties using dogs was 2.5 men. Seventy-nine per cent were using dogs in 1954 while 78 per cent used dogs in 1953.

Hunters not using dogs made up 88 parties in which there were 172 men. They worked for 218 party hours to flush 104 coveys and get a total of 253 quail. Average party size was two men. Success in quail hunting was lower for this group in both 1953 and 1954.

During the hunting seasons of 1952 and 1954 hunting success for those using dogs, and not using dogs varied a few tenths. This difference was greater in 1953, probably it was due to weather conditions. In table three below, the all hunter column does not show this extreme variation because the percentage of hunters not using dogs is small; there would have to be considerable change before this could be reflected.

Table 3. Quail Hunting Success in Hours per Bird for Hunters Using Dogs, Hunters not Using Dogs, and for all Hunters Taking Quail, 1952 to 1954 Inclusive.

Year	Hunters Using Dogs	Hunters not Using Dogs	All Hunters
1952	1.4	1.7	1.4
1953	1.4	2.9	1.6
1954	1.5	1.7	1.5

Summary

1. Data from 423 quail hunting report cards filled out by conservation officers indicate that the average party took 5.3 quail per trip, and the majority thought the 1954 season was an improvement over 1953.

2. Success was highest the last two weeks of November.

3. South central and southeast Iowa had the best shooting.

4. Gunning for quail was very light in seven recently opened counties.

5. Hunters using dogs had better success than those not using dogs.

6. Early in the season it required 1.5 man hours per bird, 1.4 hours in the November 16 to 30 period, and in the final two weeks 1.6 hours per quail.

SEX AND AGE RATIOS OF SQUIRRELS IN THE BAG AND HUNTER SUCCESS AS REPORTED BY HUNTERS, 1954

By Glen C. Sanderson*

INTRODUCTION

A squirrel project was initiated with the aid of hunter cooperators in 1950 and has been continued each year since. More than 400 individuals were contacted in 1953. Last fall only new prospects and hunters who had collected information in previous seasons were contacted, all others were dropped from the list.

All potential cooperators were contacted by letter the week prior to the opening of the squirrel hunting season. Forms and instructions were similar to the ones used in 1950. In addition, each received a mimeographed summary of the results of the 1953 project.

This report includes the results of the 1954 squirrel season, the hunter's ideas on abundance, distribution of hunting effort and average success during various periods, sex ratios in the bag, and age ratios of squirrels killed, as determined from leg bones saved by cooperating hunters. Comparisons were made with similar information collected from the previous four years.

Unfortunately, an accident resulted in the destruction of most of the record sheets and leg bones collected from last fall. A substitute janitor found the box in which the biology secretary had carefully stored the leg bones and reports as they came into the Des Moines office.This janitor threw out this "junk" along with the wastepaper. By the time the box was missed the wastepaper had been burned. The only data sheets and squirrel bones available this year were those that came in after this happened and those that were mailed directly to the writer in Marion, Iowa.

RESULTS

Because of the more selective list, a much greater percentage return was expected last fall than had been received in the past. However, since many reports were destroyed, there was a decline in both the number and percentage of hunters whose records were available. This year only a few squirrel humeri were received instead of the radii and ulnae asked for, but little or no improvement was noted regarding the collection of feet instead of leg bones.

* Game Biologist, 2662 11th Ave.N. E., Marion, Iowa

Several people continued to send in feet rather than leg bones and again some cut the leg bones so short that they were of no value to the project. This happened in spite of the fact that each year the letter of instructions warns against both these mistakes and each person who saved the wrong bones or cuts the leg bones too short was informed of his mistake by letter.

Population - Twenty-two hunters replied to the question "Do you think there are MORE or FEWER squirrels than there were last year?" Nearly 64 per cent answered more, while slightly more than 27 per cent said there were fewer, and nine per cent said there were the same number as last year (Table 1). This table indicates that the majority of the cooperating hunters have felt that squirrel numbers have been increasing each year since the project was begun.

Table 1. Hunter's replies as to whether there were more or fewer squirrels than there were last year.

	1950	1951	1952	1953	1954
No. of hunters reporting	92	48	60	63	36
No. of hunters answering the question	74	39	47	42	22
% who said MORE squirrels than last year	47.3	53.8	59.6	59.5	63.6
% who said FEWER squirrels than last year	37.3	30.8	17.0	23.8	27.3
% who said SAME number as last year[1]	14.9	15.4	23.4	16.7	9.1

1 The question asked was "Do you think there are more or fewer squirrels than there were last year?"

Kill Data - Table 2 reveals that in 1954, as in past years, slightly more than half the squirrel hunting was done during the first one-third of the season. Information in this table also indicates that the percentage of squirrels bagged during a particular period corresponds closely to the amount of hunting done during the same time.

Table 2. Percentage of the total hunting trips made and percentage of total kill made during the first, middle and last thirds of the open season, 1950-54 seasons.

YEAR	Number of trips[1] and % of total: Sept. 15 Oct. 4	Oct. 5 Oct. 25	Oct. 26 Nov. 15	Sea-son	Number of squirrels[2] and % of total: Sept. 15 Oct. 4	Oct. 5 Oct. 25	Oct. 26 Nov. 15	Sea-son
	55.53	29.4	15.1	530	54.7	29.2	16.1	1,875
1950	294[4]	156	80		1,025	548	302	
	52.7	28.1	19.2	260	48.3	33.4	18.3	969
1951	137	73	50		468	324	177	
	51.3	25.1	23.6	407	53.7	21.2	25.1	1,366
1952	209	102	96		734	290	342	
	51.7	31.9	16.4	317	53.4	30.2	16.4	791
1953	164	101	52		422	239	130	
	54.2	28.3	17.5	177	56.0	26.7	17.3	577
1954	96	50	31		323	154	100	

1 No. trips by a hunting party whether one or a number of hunters.
2 Both fox and gray squirrels.
3 Per cent of total.
4 Number of trips or squirrels.

Table 3 shows that during the entire season an average of 1.2 squirrels was bagged for each hour a party spent afield. This is 0.3 squirrel per hour higher than the average reported for 1953 and is nearly as good as the hunting success reported for 1950 and 1952. It is still somewhat lower than the average success reported for the 1951 season (Table 4). An average of 3.3 squirrels was bagged by each party each time they went hunting last fall. Comparisons with previous seasons are shown in Table 4.

Table 3. Hunter success, number of hunters per party, hours hunted, and number of hunting trips made during the first, middle, and last parts of the open season.

	Sept. 15 Oct. 4	Oct. 5 Oct. 25	Oct. 26 Nov. 15	Sept. 15 Nov. 15
Total number squirrels bagged[1]	323	154	100	577
Av. no. bagged per party per hour	1.3	1.1	1.3	1.2
Av. no. bagged per party per trip	3.4	3.1	3.2	3.3
Av. no. seen per party per hour	2.9	2.3	3.1	2.8
Av. no. seen per party per trip	7.7	6.6	7.7	7.4
Av. no. hours hunted per party per trip	2.6	2.9	2.5	2.7

1 Both fox and gray squirrels.

Table 4. A comparison of the hunter success, number of squirrels seen per hour, and the sex and age ratio of fox squirrels bagged--1950-54 seasons.

	YEAR				
	1950	1951	1952	1953	1954
Av. no. bagged per party per hour	1.3	1.7	1.3	0.9	1.2
Av. no. seen per party per hour	2.7	3.2	2.8	2.2	2.8
Av. no. bagged per party per trip	3.5	3.7	3.2	2.5	3.3
Per cent females in the bag[1]	43.4	45.7	46.3	46.7	44.1
Per cent juveniles in the bag[1]	57.2	56.4	56.4	59.0	53.2

1 Fox squirrels only.

The average number of hours spent per trip was 2.7 in 1954, the same as in 1953 but more than the 2.5 in 1952. Information from this and other years indicates that when hunting success declines, the Iowa squirrel hunter stays in the timber longer. Thus, last fall average hunting success was about the same during the first and last thirds of the season and the average hunting periods were essentially the same length for both. On the other hand, during the middle third of the season, success declined somewhat and the average time spent on each trip increased. It appears that the average squirrel hunting party in Iowa was satisfied with three to three and a half squirrels per trip and that they adjusted the length of time they hunted accordingly. In unusually good years, such as 1951, they bagged more than this, while in years of difficult hunting, like 1953, the average party quit with fewer than three animals killed.

The extremely dry weather conditions that prevailed over much of the state during the two previous seasons were not present in 1954. Record breaking rains fell over much of Iowa during the month of August and this moisture plus subsequent precipitation made moisture conditions about "normal" last fall. Thus, the increased average hunting success for 1954 was probably at least partly a result of improved weather conditions rather than an increased population level although hunter reports and limited information from other sources do indicate that squirrels were abundant in 1954. Indications are that there was a good "carry over" after the season closed.

Sex Ratio--Cooperators reported 44.7 per cent females among 530 fox squirrels identified as to sex. To state this another way, there were 123.5 males per 100 females in the fox squirrel bag checked in Iowa last year (Table 5). The percentage of female fox squirrels had shown a slight but consistent increase since this project was begun until this year. The percentage reported for 1954 was intermediate between the ratio reported for 1950 and 1951, and was slightly lower than the five year average shown in Table 5.

Females comprised 43.1 per cent of 51 gray squirrels reported as to sex, or 128 males per 100 females; however, the number reported is too small for the figures to have much meaning. This figure is intermediate between the low of 37.0 per cent females reported for 1953 and the figures reported for the previous three seasons. Females comprised 45.5 per cent of the gray squirrels reported during the past five years.

Table 5. A comparison of the sex ratios, age ratios, and percentage of fox and gray squirrels in the reported bag-1950-54 seasons.

	FOX			GRAY			Per cent
SEASON	%FF	%Juvs	Juvs/Ad F	%FF	%Juvs	Juvs/Ad F	fox squirrels
1950	1,623[1] 43.4	545[1] 57.2	3.4	201[1] 46.8	63[1] 54.0	2.4	89.1
1951	770 45.7	242 52.5	2.4	115 47.8	55 50.9	2.2	87.2
1952	1,230 46.3	566 56.4	2.8	97 46.4	21 38.1	1.3	92.6
1953	750 46.7	639 59.0	3.1	54 37.0	32 59.4	4.0	94.4
1954	530 44.7	485 53.2	2.6	51 43.1	37 48.6	2.3	93.8
1950-54 average	4,903 45.2	2,477 56.2	2.8	518 45.5	208 51.4	2.3	91.4

1 Number aged or sexed.

The percentage of females killed during the first, second, and last thirds of the season fluctuates for fox squirrels (Table 6). During the past four seasons the percentage of female fox squirrels killed has increased during the middle period and then declined to near or below what it was for the first part of the season. This was reversed during the past year with females decreasing during the middle one-third and then increasing during the final third to a point higher than during the opening days. The five year average as shown in Table 7 does indicate a slight increase in females harvested during the middle part of the hunting period.

Table 6. Sex ratio of squirrels bagged during the first, middle, and last part of the open season, 1954.

	FOX				GRAY			
	MM	FF	%FF	MM/100 FF	MM	FF	%FF	MM/100 FF
Sept. 15 Oct. 4	155	128	45.2	121.1	19	15	44.1	126.7
Oct. 5 Oct. 25	88	59	40.1	149.2	4	5	--	--
Oct. 26 Nov. 15	33	36	52.2	91.7	3	0	--	--
Sept. 15 Nov. 15	276	223	44.7	123.8	26	20	43.4	130.0

Table 7. Sex ratios of squirrels bagged during the first, middle, and last part of the open season-1950-54 seasons combined.

	FOX			GRAY		
	MM	FF	%FF	MM	FF	%FF
Sept. 15 Oct. 4	1,477	1,188	44.6	150	124	45.3
Oct. 5 Oct. 25	676	593	46.7	86	70	44.9
Oct. 26 Nov. 15	509	414	44.9	50	45	47.4
Sept. 15 Nov. 15	2,662	2,195	45.2	286	239	45.5

Age Ratio- Leg bones saved by hunters indicate 53.2 per cent juveniles among 485 fox squirrels bagged (Table 5). This is somewhat higher than the 59.0 per cent juveniles reported for 1953 and is lower than any of the previous four years except 1951. The five year average is 56.2 per cent juveniles. Table 4 appears to indicate an inverse ratio between average hunting success and the percentage of juveniles in the bag.

Table 5 shows 2.6 juveniles per adult female fox squirrel bagged compared to 3.1 for the previous year. These figures are computed using the sex ratios reported by the hunters. Only in 1951 when hunting success was the best of any during the five year study period, were there fewer young per adult female in the bag than there were last fall.

Juveniles comprised 48.6 per cent of 37 gray squirrels aged; however, the number examined was quite small. This is only slightly less than the five year average.

Species Composition- As usual, fox squirrels predominated in the hunter's bag in all sections of Iowa; however, in northeastern Iowa gray squirrels accounted for slightly more than one-third of the squirrels reported. Gray squirrels increased considerably in the bag of east central Iowa hunters in 1954 making up more than 20 per cent of the kill. Over the state as a whole, fox squirrels comprised 93.8 per cent of the bag. This is slightly higher than the five year average (Table 5).

Type of Gun- The .22 rifle continued to be the popular choice of Iowa squirrel hunters. Eighteen, or 75 per cent, of the 25 hunters who replyed to the question regarding type of gun used, chose the .22 rifle. Shotguns, mostly .410's, were used by five hunters, and one hunter used a .22 rifle and .410 shotgun combination.

SUMMARY

1. The squirrel project with the aid of hunter cooperators has been continued each year since its inception in 1950.

2. Approximately 64 per cent of the reporting hunters think that there were more squirrels in 1954 than there were the previous fall.

3. Slightly more than half the squirrel hunting was done during the first one-third of the open season, less than a third of the hunting was done during the middle third, and the remainder during the final third.

4. The percentage of squirrels bagged in each part of the open season corresponds closely to the percentage of hunting done in the same part.

5. An average of 1.2 squirrels was bagged per party per hour compared to an average of 0.9 in 1953 and 1.3 in 1952.

6. An average of 3.3 squirrels was bagged per party per hunting trip in 1954 compared to an average of 3.5, 3.7, 3.2 and 2.5 in 1950, 1951, 1952 and 1953 respectively.

7. Females comprised 44.7 per cent of 530 fox squirrels reported as to sex compared to 46.7 per cent in 1953.

8. Females comprised 43.1 per cent of 51 gray squirrels reported as to sex.

9. Leg bones indicate 53.2 per cent juveniles among 485 fox squirrels aged compared to 59.0 per cent juveniles for 1953.

10. Leg bones reveal 48.6 per cent juveniles among 37 gray squirrels aged.

11. Fox squirrels comprised 93.8 per cent of the squirrels bagged and 89.3 per cent of the squirrels seen.

OBSERVED SEX RATIOS AS SHOWN BY WINTER PHEASANT COUNTS

By Richard C. Nomsen*

The observed sex ratio of Iowa's post-season pheasant population was again determined from counts made by conservation officers and rural mail carriers. Results of the winter survey were used to estimate the percentage of cocks killed last fall and will be needed to complete the spring brood stock population count.

Observed sex ratios were used because a complete census of all birds would be necessary to determine the true sex ratio. This would be impossible to check on a statewide basis. In order to decrease the amount of error, counts were made only when the ground was completely covered with snow. A complete snow cover is necessary to concentrate the birds so that a large number can be checked. The behavior of cocks and hens also differ less during periods of severe winter weather.

Conservation Officers Winter Count

Conservation officers were instructed to record their observations of pheasants from January 1, through February 28 when conditions were favorable. Reports were made every two weeks, but weather and cover conditions were best for this census during the last two weeks of January and the first half of February. Therefore, only observations made in these two periods are included in this report.

Conservation officers checked a total of 30,927 hens and 8,609 cocks for an observed sex ratio of 3.6 hens per cock. The ratio of hens to cocks obtained this year was the highest ever recorded since the initiation of this survey. The previous high of 2.9 hens per cock was taken in 1950 and 1951. Results of the 1954 survey indicated a ratio of 2.8 hens per cock.

The higher proportion of females in our winter population indicates that a greater percentage of the roosters were harvested last fall. From these results, it was estimated that hunters shot 70 per cent of the cocks during the 1954 season. In 1953, the kill was 64 per cent and only 55 per cent in 1952. The harvest was 63 per cent and 65 per cent respectively for the 1951 and 1950 seasons. These figures were based on an estimated preseason sex ratio of 1.1 hens per cock.

* Game Biologist, R. R. # 2, Hampton, Iowa

A kill of 70 per cent is not excessive and will not adversely affect reproduction during 1955. Studies have shown that even though 90 per cent of all cocks on a certain area have been shot, fertility has remained unchanged.

The sex ratio and number of birds reported from each agricultural district are listed in Table 1. Previous reports on sex ratios included only the first six districts, however, adequate snow cover in southern Iowa last winter made it possible to include districts seven and eight.

Table 1. Observed Sex Ratios and Pheasants Reported by Agricultural Districts - 1955.

District	Hens	Cocks	Sex Ratio
1 Northwest	5,272	1,837	2.9
2 North Central	6,488	2,427	2.7
3 Northeast	6,911	1,563	4.4
4 West Central	4,779	1,166	4.1
5 Central	2,736	571	4.8
6 East Central	1,274	283	4.5
7 Southwest	2,883	586	4.9
8 South Central	584	176	3.3
STATE	30,927	8,609	3.6

Results from individual districts varied considerably. Table 2 lists the observed sex ratio for each district and the state average for the past three years. District one, or northwest Iowa, recorded a decrease in the sex ratio figure while results from east central Iowa remained the same as in 1954. Reports from the other areas of the state indicate a substantial increase in the proportion of hens to cocks in our winter pheasant population. The lower hen per cock ratios in districts one and two were probably due to a lighter harvest during the first part of the open season. A great deal of unpicked corn remained in the fields which made hunting difficult.

Table 2. Comparison of Observed Sex Ratios by Agricultural Districts.

	Sex Ratios		
District	1953	1954	1955
1 Northwest	2.0	3.1	2.9
2 North Central	2.1	2.0	2.7
3 Northeast	2.7	2.6	4.4
4 West Central	2.5	2.5	4.1
5 Central	3.1	3.3	4.8
6 East Central	3.2	4.5	4.5
7 Southwest			4.9
8 South Central			3.3
STATE	2.2	2.8	3.6

The results of this years survey will be used later to complete the spring population count. The crowing cock count is a census of cock birds only and the sex ratios will be applied to indicate total population.

Rural Mail Carriers Winter Count

The rural mail carriers winter survey was made by 483 carriers during the week of January 27, through February 2. Weather and cover conditions were satisfactory for the count at this time.

The sex ratio obtained from this survey was also higher than the results of any previous count. They reported a total of 50,404 pheasants with a ratio of 3.3 hens per cock. Table 3 lists the birds reported in each district and the sex ratio.

Table 3. Birds reported and Observed Sex Ratios by Agricultural Districts, 1955.

	Rural Mail Carriers		
District	Hens	Cocks	Sex Ratio
1 Northwest	3,770	1,607	2.3
2 North Central	9,223	3,391	2.7
3 Northeast	13,504	3,705	3.6
4 West Central	2,718	878	3.1
5 Central	3,242	862	3.8
6 East Central	3,614	777	4.6
7 Southwest	1,587	250	6.3
8 South Central	929	233	4.0
9 Southeast	76	38	2.0

Although the results of the carriers winter pheasant count are not used directly as such, they serve as an important check on the conservation officers winter survey. Trends in sex ratios for both surveys have been similar each winter.