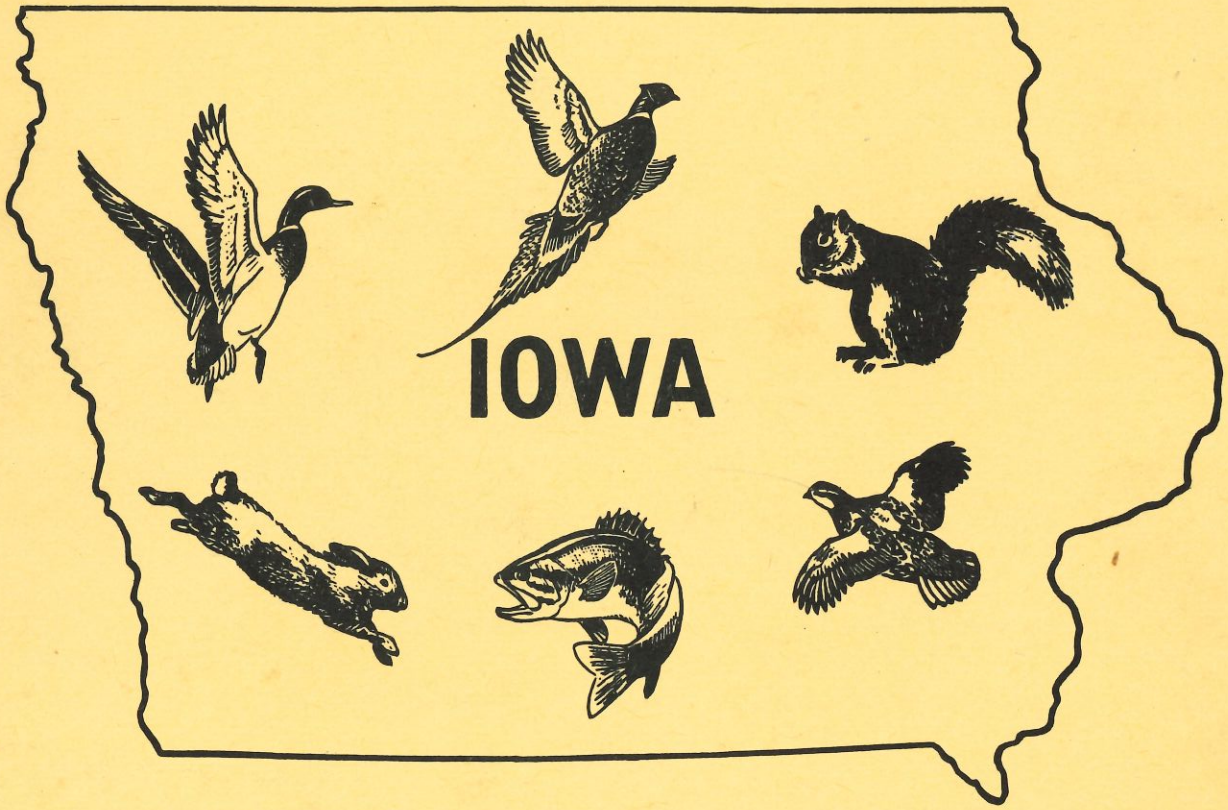
1960 Complete

QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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ABSTRACTS OF QUARTERLY BIOLOGY REPORTS

RESULTS OF THE 1959 SHOTGUN SEASON FOR DEER

by

Eldie W. Mustard
Game Biologist

The 1959 deer season was state-wide in scope, and was of the any-deer type. Six thousand permits were issued to shotgun hunters.

A total of 2,731 deer were harvested; shotgun permit holders accounting for 1,935, bow permit holders 255, and non-permit hunters 541 deer. Shotgun hunters had a hunter success of 33.1 percent, and reported hunting an average of 37.2 hours for each deer bagged.

The shotgun hunters reported a sex ratio of 280 males; 100 females, and an age ratio of 30 fawns; 100 adults. Data obtained at deer check stations revealed a sex ratio of 132 males: 100 females, and an age ratio of 62 fawns: 100 adults.

Other data obtained from the hunter return cards (99 percent of the shotgun permit holders returned their cards) includes information on kill by county, hours spent hunting, number of deer sighted, and occupation of permitees.

SEX RATIOS OF PHEASANTS AS DURING WINTER COUNTS-1960

Richard C. Nomsen
Game Biologist

Officers recorded a total of 30,883 pheasants during the census compared with 74,078 in 1959. Fewer birds were reported from the northern Iowa pheasant range during the winter count because of unfavorable checking conditions. The observed statewide sex ratio was 3.0 hens per cock which was similar to the ratio of 3.1 obtained a year ago. The ratio revealed that 61 percent of the ringnecks were shot during the season which was favorable considering the adverse hunting conditions. The most efficient harvest occurred in northeast Iowa where 67 percent of the roosters were killed. The kill percentage in north central Iowa was 55 percent and was low for the state. These results indicated that the increased shooting hours did not adversely effect Iowa's pheasant population. Sex ratios have consistently shown that a higher proportion of cocks could be harvested each year.

ROADSIDE INDICATIONS OF COVER PREFERENCE BY COTTONTAILS IN BENTON COUNTY, IOWA

Paul Kline
Game Biologist

Observations of cover types used by cottontails through the seasons was carried on in conjunction with experimental roadside surveys in Benton County, Iowa, during the period February 24, 1957, to August 11, 1959. A 30 mile route was driven at early morning, near sunrise, 180 times during the research. In all, 484 cottontails were observed in cover types during the summer period, June 1-July 31: In Winter, November 1-March 31, 287 were observed.

Cover adjacent to the route was divided into twelve types, and measured linearly. A use index, representing percent total cottontails seen in any one cover

type divided by percent total cover which the type represented was obtained for each season. Use indices for summer indicated rabbits preferred the farm building, oats, woods and brushland, wild forbs, peas, sweet clover, and wheat types over corn, pasture, hay, and soybeans. In winter they preferred farm buildings, woods and brushland, and wild forbs (weeds) over all other types. Farm building sites were very important to wintering rabbits. Fully 35.8 percent were found in that type in winter. The study points up the importance of winter cover to cottontail welfare. Wild forbs had the highest use index. This would indicate preservation of weed patches near food sources, such as corn fields, would rate as an excellent management tool for rabbits.

AGE OF IOWA QUAIL SHOT BY HUNTERS

M. E. Stempel
Game Biologist

Officers, cooperating hunters and the biologist collected wings from quail shot during the 1959 open season. Ages of the young were determined by a study of primary feather growth. The sample of 1,432 wings indicated that the peak of quail hatching was July 15, A second, smaller peak occurred in August. Quail in the 120-day-old category made up the largest group harvested. Adult quail had not completed wing moult by December.

A REVIEW OF INFORMATION CONCERNING THE DISTRIBUTION OF BANDED GEESE RECOVERED IN IOWA

James Sieh
Game Biologist
(No Abstract)

A BRIEF SUMMARY OF QUANTITATIVE CREEL CENSUS DATA FOR THREE DICKINSON COUNTY LAKES 1956 -- 1960

Tom Moen
Fisheries Biologist

Quantitative methods of estimating angler harvest have been used on Spirit Lake since 1956 and on East Okoboji and West Okoboji Lakes since 1957.

In spite of a bullhead dominated fishery the fishing in East Okoboji Lake has been average or better for the past three years, producing an average of nearly 70 pounds per acre each year. During the 1958 season fishermen caught 10,000 walleyes weighing over eight tons.

Fishing success has gradually improved in Spirit Lake over the past four open water fishing periods; fishing pressure has dropped somewhat during this same period. Winter fishing made up twelve per cent of the total hours of fishing during the four year period. Bullheads made up 52 percent of all fish taken.

Bullhead, yellow perch, and bluegill dominated the open water fishing in West Okoboji during the past three seasons. Total harvest of fish from this lake averaged over 56 pounds per acre each year.

The quality of winter fishing declined in both Spirit and West Okoboji Lake. There is little or no winter fishing on East Okoboji Lake.

PRELIMINARY GROWTH STUDIES OF SOME MISSOURI RIVER SAUGER

Delmar Robinson
Fisheries Biologist

Ages of 41 sauger pike were determined by the scale method. Total lengths at the time of the formation of each annulus were determined by the use of the tag boards and nomograph.

The growth of fish in this sample was good, with sauger attaining calculated total lengths of 7.6, 13.1, 16.7, and 18.6 inches at age I, II, III and IV respectively.

FALL FISH POPULATIONS BY SHOCKING CENTRAL IOWA STREAMS 1954 through 1959

Harry Harrison
Fisheries Biologist

Fish living in the Des Moines, Raccoon, and Boone Rivers were surveyed by electrical shocker. The information coming from this work is presented in Tabular form by reaches of river having very similar environmental characteristics.

The results indicate that rough fish dominate in central Iowa streams. Their population varied between 82 percent in the main stem of the Des Moines River to 98 percent in the Boone.

Channel catfish made up the majority of game fish. Walleye pike were second in abundance. Crappie and small mouth bass followed, but were present only in very small numbers.

LITTLE CEDAR RIVER FISH ERADICATION STACYVILLE, IOWA

by
Davis, Moen and Tate

Following a thorough local public relations preparation, the Fish were eradicated from a ten mile reach of the Little Cedar River above Stacyville, Iowa. Test fish indicated a satisfactory kill approximately one week after the initial application of toxaphene at a concentration of 0.15 p.p.m. The application was continued for 45 hours and was made by means of a dispenser comprising two tanks connected through a pressure regulation. One tank was changed with toxaphene, the other with compressed air. The flow of chemical was adjusted by selecting the connect nozzle orfice and adjusting the pressure regulator.

Five small feeder streams entering the Little Cedar in the treatment zone were successfully treated with sponges saturated with toxaphene.

CARRYING CAPACITY OF AN IOWA TROUT STREAM

R. E. Cleary
Fisheries Biologist

A pre-improvement, carrying capacity based on a 3-year study was established for French Creek in Allamakee County. This figure of 216 lbs. of fish per-mile of stream of which 67 pounds were trout, will be used to evaluate the effects that

future stream improvement devices and watershed control, have on increasing trout-holding capabilities of French Creek.

*carrying capacity being the total weight of fish a stream is capable of supporting at anyone time of year.

WINTER CARRY-OVER AS AN EXPRESSION OF WINTER ANGLING AND/OR NATURAL MORTALITY OF TROUT

R. E. Cleary
Fisheries Biologist

It was determined that natural mortality or fish loss amounts to 35% in an over-wintered Iowa trout population. The combined effects of winter angling and natural mortality cause an average reduction of 48% on a given group of fish. It was estimated that at least 40% of the trout normally lost through natural causes in the winter are being harvested by winter anglers. These fish are almost all the product of our hatcheries and complete utilization would be desired, since our hatcheries and not residual "brood" fish in the stream are the determinant of future trout fishing populations.

A COMPARISON OF THE GROWTH OF FOUR SPECIES OF FISH IN THREE DIFFERENT TYPES OF IOWA ARTIFICAL LAKES

James Mayhew
Fisheries Biologist

Growth of largemouth bass, bluegill, black crappie, and white crappie in 50 Iowa artifical lakes and reservoirs was studied. The lakes were classified into three groups according to similar physical, chemical and biotic characteristics. Maximum, minimum, and mean growth was compared for each species of fish in each type of impoundment.

A total of 9,963 scale samples were used in the study. The number of samples of each species was as follows: Largemouth bass, 2,932; bluegill, 2,932; black crappie, 2,260; and white crappie, 2,029.

All species of fish attained the best growth in Group I-lakes. With the exception of white crappie, growth was better in Group II lakes.

RESULTS OF THE 1959 SHOTGUN SEASON FOR DEER

by
Eldie W. Mustard
Game Biologist

INTRODUCTION

Iowa's 1959 deer season was the seventh consecutive open season, and was of the any-deer type. All counties were open for deer hunting during the two-day season, December 12 and 13, with hunting, using slugs and shotguns of 20 gauge or larger, allowed from 8:00 A.M. to 4:00 P.M. daily.

As in past years, 6,000 shotgun permits were allowed, with landowners, tenants, and their children allowed to hunt without permits on their own or leased property.

METHODS

Data pertaining to the deer harvest were obtained from three sources: compulsory hunter card returns; Conservation Officers' tagged, farm-killed deer reports; and Conservation Officers' estimates of untagged, farm-killed deer reports.

Hunter report cards were received from 5,937, or 99 per cent, of the 6,000 permit holders. A total of 146 returns indicated that their sender did not participate in the 1959 deer season which left 5,854 who reportedly took part in the hunt.

1/ For the results of the 1959 bow season for deer see Mustard (1959a).

RESULTS

TOTAL DEER KILL

The indicated total deer harvest for 1959 was 2,731 animals which was slightly below the three-year mean (1956-1958) of 2,791 (Table 1). As indicated in Table 2, deer comprising the 1959 harvest were obtained as follows: shotgun permit holders (1,935); tagged, farm-killed deer (223); and untagged, farm-killed deer (318). Mustard (1959a), reporting on the results of the 1959 bow season, stated that bow hunters reported bagging an additional 225 deer.

SEX AND AGE RATIO

The sex ratio of the harvested deer, as reported by the hunters, and based on 1,425 males and 508 females, was 280 males, 100 females. Data obtained from deer check stations during the 1959 open season, and based on a sample of 531 deer, indicated a sex ratio of 132 males, 100 females.

Our check station data are based on a sample of about 25 per cent of the harvested deer, and it is doubtful if it is in error. This I say because, statistically, a 25 per cent sample is a rather large one, and the data were collected by trained personnel who can tell a male deer from a female deer.

The difference between the two sex ratio figures undoubtedly stems from at least one, or perhaps a combination of all of the following: (1) some hunters cannot tell a female from a male deer; (2) some hunters may have a prejudice against killing, or at least against reporting that they killed a female, which is deeply enough ingrained to cause them to falsely report the sex of their kill; (3) some may report falsely because they did not, or did not want to, save the reporductive organs of female deer as requested by literature in their license packet. The data presented in Table 3 would tend to indicate that many hunters have purposefully falsely reported the sex of their deer since the advent of the request to save the reporductive tracts of female deer they may kill. Apparently the hunter feels that anything included in his license packet is a requirement, not a request. In the future we should evaluate quite carefully anything sent out to the hunter under the official letterhead.

Shotgun hunters reported harvesting 440 fawns and 1,476 adults for an age ratio of 30 fawns, 100 adults. This ratio differed greatly from the 62 fawns, 100 adults obtained from information gathered at deer check stations during the course of the two-day open season. The reasons for this difference are unknown at this time, however, it is easily conceivable that hunters unknowingly classify many fawns as adults. This could be corrected, to a degree, by seeing to it that hunters are given certain criterion on which to base the age of their deer, or at least to place it in the fawn or adult class.

DEER OBSERVED WHILE HUNTING

Gun hunters reported sighting 30,838 deer while engaged in their sport, with the average hunter sighting 5.3 deer during the season, or about 0.43 deer per hour of hunting effort. It required 2.33 hours of hunting for the average gun hunter to observe a deer.

HOURS OF RECREATION

Holders of shotgun permits reportedly hunted a total of 71,975 hours during the 1959 season, for an average of 12.3 hours of hunting per hunter. This amounts to almost 9,000 eight-hour days of recreation.

During 1959, licensed deer hunters, both shotgun and bow, reported hunting a total of 134,428 hours, or the equivalent of 16,803 eight-hour days. This would amount to over 46 years of eight-hour days of recreation supplied by the Iowa deer herd to Iowa sportsmen.

DAY KILLED AND TIME OF DAY

Hunters reported taking 977 deer during the first day, and 958 during the second day of the deer season. Essentially this amounts to about 50 per cent of the harvest being taken on each day of the two-day season.

Time of day, morning versus afternoon, which deer were harvested seemed to slightly favor the morning hours, with 52.7 per cent of the deer killed in this period, and 47.3 per cent in the afternoon period.

HUNTER MOBILITY

Shotgun permit holders reportedly hunted in an average of 1.14 counties. This differs only slightly from the 1.16 reported in 1958.

OCCUPATIONS AND SUCCESS OF THE VARIOUS OCCUPATIONAL GROUPS

Farmers led all occupational groups numerically, with over 33 per cent of the permit holders reporting they were farmers. This group had a hunter success ratio of 39.0 per cent. Persons classified as laborers made up 30 per cent of the permit holders, and had a hunter success ratio of 31.7 per cent.

Table 4 includes a summary of the occupations, and the hunter success of the various occupational groups.

COMPARISON WITH PAST SEASONS

A comparison of the 1959 shotgun season, with past seasons of comparable duration and scope, is given in Table 5. The data tend to indicate that the shotgun portion of the 1959 season was definitely below par.

The weather over much of the State was typified by fog and rain which soon made roads in some areas impassable. Lack of snow cover undoubtedly hindered deer hunters both in sighting and tracking deer. Undoubtedly weather, not a deteriorating deer herd, was the factor most responsible for the poor season. It is apparent that with our short, two-day season the deer hunter is completely at the mercy of the vagaries of weather.

SUMMARY

1. Hunter report cards were received from 5,937 of the 6,000 licensed shotgun hunters who received deer permits for Iowa's 1959 season.
2. The total deer harvest of 2,731 was only slightly below the mean-harvest of the preceeding three-years of record.
3. The deer in the 1959 harvest were accounted for as follows: shotgun permit hunters (1,935), bow permit hunters (255), and non-permit hunters (541).
4. Shotgun permit holders had a hunter success ratio of 33.1 per cent.
5. The sex ratio of deer in the harvest, as reported by the shotgun permitees, was 280 males, 100 females, while deer check station data indicated a sex ratio of 132 males, 100 females.
6. Shotgun hunters reported an age ratio of 30 fawns, 100 adults, but deer check station data indicated an age ratio of 62 fawns, 100 adults.
7. Gun hunters reported sighting an average of 5.3 deer per hunter during the season, or about 0.43 per hour of hunting effort.
8. Holders of shotgun permits hunted 71,975 hours, or almost 9,000 eight-hour days. All permit holders (shotgun and bow) reported hunting a total of 134,428 hours, or the equivalent of 16,803 eight-hour days.

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TABLE ONE:

TOTAL LEGAL DEER KILL, ALL HUNTING, IOWA, 1953-1959

Year	Deer Kill
1953	4,008
1954	2,992
1955	3,062
1956	2,678
1957	2,805
1958	2,891
1959	2,731
TOTAL	21,167
Six - year mean (1954 - 1958)	3,073
Three - year mean (1956 - 1958)	2,791

TABLE TWO: PERMIT AND NON-PERMIT DEER KILL, BY COUNTY, IOWA, 1959, with a COMPARISON OF TOTAL DEER KILL, BY COUNTY, 1958 and 1959.

		Permit		Non-Permit		Totals	
	County	Shotgun	Bow	Tagged	Untagged	1959	1958
1.	Adair	9	0	0	1	10	9
2.	Adams	7	0	1	0	8	8
3.	Allamakee	157	3	6	6	172	295
4.	Appanoose	2	0	0	2	4	6
5.	Audubon	0	1	0	0	1	11
6.	Benton	12	3	2	1	18	22
7.	Black Hawk	26	9	1	9	45	50
8.	Boone	7	3	1	1	12	9
9.	Bremer	23	4	2	9	38	39
10.	Buchanan	12	2	1	3	18	16
11	Buena Vista	42	5	3	5	55	37
12	Butler	22	0	3	8	33	29
13	Calhoun	1	0	0	2	3	2
14	Carroll	4	0	0	1	5	11
15	Cass	0	0	1	0	1	8
16	Cedar	9	0	0	3	12	8
17	Cerro Gordo	3	0	0	0	3	5
18	Cherokee	45	3	7	8	63	43
19	Chickasaw	9	0	2	6	17	45
20	Clarke	2	1	2	2	7	12
21	Clay	41	1	7	2	51	49
22	Clayton	79	13	2	15	109	145
23	Clinton	13	2	5	1	21	20
24	Crawford	13	0	5	8	26	38
25	Dallas	10	1	2	2	15	15
26	Davis	3	1	0	1	5	0
27	Decatur	20	0	2	3	25	21
28	Delaware	26	11	1	2	40	38
29	Des Moines	11	3	1	0	15	15
30	Dickinson	7	3	2	0	12	21
31	Dubuque	9	1	0	2	12	15
32	Emmet	31	1	11	2	45	23
33	Fayette	43	3	3	5	54	55
34	Floyd	36	7	2	0	45	16
35	Franklin	6	0	2	5	13	9
36	Fremont	13	0	3	0	16	17
37	Greene	8	1	1	2	12	7
38	Grundy	0	0	0	0	0	0
39	Guthrie	40	3	4	3	50	27
40	Hamilton	8	3	2	0	13	17
41	Hancock	7	0	0	1	8	5
42	Hardin	13	9	2	0	24	27
43	Harrison	47	3	7	30	87	54
44	Henry	4	0	0	1	5	8
45	Howard	15	4	5	6	30	24
46	Humboldt	12	3	1	1	17	20
47	Ida	2	0	1	1	4	1
48	Iowa	17	1	1	2	21	42
49	Jackson	56	5	3	20	84	108
50	Jasper	8	2	1	3	14	27

TABLE TWO CON'T.

51.	Jefferson	4	0	1	1	6	11
52.	Johnson	11	4	1	1	17	30
53.	Jones	21	2	1	5	29	21
54.	Keokuk	9	0	0	7	16	21
55.	Kossuth	9	3	1	0	13	88
56.	Lee	10	2	0	1	13	7
57.	Linn	20	3	0	2	25	35
58.	Louisa	17	1	0	1	19	12
59.	Lucas	28	4	2	3	37	35
60.	Lyon	44	5	4	3	56	31
61.	Madison	25	2	1	1	29	28
62.	Mahaska	9	2	2	5	18	7
63.	Marion	14	1	2	0	17	24
64.	Marshall	6	1	2	0	9	26
65.	Mills	12	2	0	2	16	22
66.	Mitchell	30	3	4	0	37	44
67.	Monona	69	11	14	9	103	88
68.	Monroe	30	4	4	1	39	32
69.	Montgomery	8	2	0	1	11	11
70.	Muscatine	7	2	0	0	9	10
71.	O'Brien	18	2	1	1	22	24
72.	Osceola	0	0	0	0	0	0
73.	Page	4	1	0	0	5	6
74.	Palo Alto	24	0	10	0	34	12
75.	Plymouth	31	3	3	0	37	13
76.	Pocahontas	5	0	2	2	9	8
77.	Polk	8	4	1	4	17	10
78.	Pottawattamie	119	27	13	20	179	187
79.	Poweshiek	2	0	0	1	3	1
80.	Ringgold	1	0	1	0	2	0
81.	Sac	4	3	4	2	13	8
82.	Scott	3	4	3	1	11	10
83.	Shelby	49	6	0	12	67	75
84.	Sioux	14	3	5	0	22	24
85.	Story	4	0	4	0	8	6
86.	Tama	11	4	0	2	17	38
87.	Taylor	2	0	0	0	2	3
88.	Union	11	0	0	0	11	9
89.	Van Buren	1	0	2	3	6	13
90.	Wapello	9	2	0	0	11	11
91.	Warren	24	3	2	1	30	24
92.	Washington	18	1	5	5	29	41
93.	Wayne	1	0	0	0	1	1
94.	Webster	5	2	2	10	19	23
95.	Winnebago	9	5	0	0	14	8
96.	Winneshiek	117	3	6	11	137	138
97.	Woodbury	57	9	8	13	87	53
98.	Worth	9	1	3	1	14	18
99.	Wright	2	3	1	1	7	0
	TOTALS	1,935	225	223	318	2,731	2,891

TABLE THREE: COMPARISON OF SEX RATIO DATA OBTAINED FROM HUNTER REPORT CARDS AND DEER CHECK STATIONS, IOWA, 1953 - 1959

Year	Sex Ratio Based on 1/ Hunter Card Returns	Check Stations	Difference
1953	115	116	1
1954	120	137	17
1955	133	110	23
1956	132	118	14
1957	120	113	7
1958 2/	177	112	65
1959	280	132	148
Means	154	120	39

1/ Data presented as males: 100 females.

2/ First year permit holders were asked to save reproductive tracts from harvested Female deer.

TABLE FOUR: OCCUPATIONS AND HUNTER SUCCESS OF THE VARIOUS OCCUPATIONAL GROUPS AS REPORTED BY 5,854 SHOTGUN PERMIT HOLDERS, IOWA, 1959.

Occupation	No. of Hunters	Per cent of Total Hunters	No. Deer Harvested	Hunter Success Ratio
Farmer	1,926	32.9	752	39.0
Laborer	1,790	30.5	568	31.7
Merchant	775	13.2	259	33.4
Technician	337	6.5	103	27.3
Student	346	5.9	92	26.6
Professional	204	3.5	74	36.2
Miscellaneous	252	4.3	57	22.6
Female	38	0.7	16	42.1
Unknown	146	2.5	14	
TOTAL	5,854	100.0	1,935	
MEAN HUNTER SUCCESS RATIO.				33.1

TABLE FIVE: COMPARISON OF COMPARABLE SHOTGUN SEASONS FOR DEER, BASED ON INFORMATION FROM HUNTER CARD RETURNS, IOWA, 1956-1959

Item	1956 1/	1957 2/	1958 3/	1959
No. Shotgun Permits	5,440	5,942	6,000	6,000
Kill By Permitees	2,000	2,187	2,141	1,935
Hunter Success Ratio (%)	39.2	36.8	38.4	33.1
Hours Hunted / Deer Bagged	30.4	31.1	30.2	37.2
Deer Seen / Hours Hunted	0.55	0.45	0.64	0.43
Length of Season (Days)	Two	Two	Two	Two

SEX RATIOS OF PHEASANTS AS OBSERVED DURING THE WINTER COUNT 1960

by
Richard C. Nomsen
Game Biologist

The annual winter pheasant count was conducted by conservation officers during January and February to determine the sex ratio of Iowa's pose season pheasant population. The results were used to calculate the per centage of cocks harvested in 1959. Sex ratio figures are also needed to complete the 1960 spring population count and the recent hunter questionnaire survey.

Forms and instructions, similar to those used for previous surveys, were mailed to all conservation officers in time to begin the count January 1, 1960. They were instructed to count birds only during the presence of a complete snow cover. Cards were enclosed so that reports could be made each two week period.

Few birds were counted during the first half of January because of insufficient snow cover. However, this condition ended very abruptly in the southern two thirds of the state as record depths of snow covered this area. Northern Iowa, which includes most of our primary pheasant range, escaped the extremely heavy snow, and counts were restricted to short periods of adequate snow cover.

Officers recorded a total of 30,883 pheasants during the census compared to 74,078 in 1959, and 26,387 in 1958. The observed sex ratio was 3.0 hens per cock which was similar to the ratio of 3.1 obtained a year ago.

More than 60,000 pheasants checked in the northern third of the state a year ago, but only about 12,000 in 1960 thus was believed to be due to poor checking conditions. Because of the excellent snow cover in the southern two thirds of Iowa, the number of birds reported increased from 11,000 to 19,000 pheasants. This comparison again points out the importance of snow cover for this survey and also the danger of comparing total birds seen for population trends.

The post-hunting season sex ratio of 3.0 hens per cock indicated that 61 per cent of the cocks were shot last fall compared with 64 per cent during the 1958 season. Considering the adverse hunting conditions last fall, which included heavy snow, large unpicked corn fields and frigid temperatures, Iowa hunters harvested an ample proportion of the surplus cocks. It is important to note that although shooting hours increased substantially during the past two seasons, harvests of the rooster population each year were similar to previous seasons when fewer hours of hunting per day were permitted. These results indicated that the shooting hours were not restrictive and that the increased opportunity to hunt did not adversely effect Iowa's pheasant population. Winter sex ratios have consistently shown that a higher proportion of cocks could be harvested each year.

Although checking conditions were unfavorable in northern Iowa, adequate samples were obtained from all agricultural districts (Table 1).

Table 1. Observed sex ratios of pheasants reported from agricultural districts, 1960.

Districts	Hens	Cocks	Sex Ratio
Northwest	3,005	1,056	2.9
North central	2,630	989	2.6
Northeast	3,282	929	3.6
West central	5,101	1,624	3.1
Central	4,774	1,709	2.8
East central	1,869	552	3.3
Southern 3 districts	2,532	831	3.0
Total for state	23,193	7,690	3.0

Sex ratios the past winter showed less variation among the districts than in 1959 (Table 2). The ice covered roads probably limited hunters to local areas last fall. Hunting pressure was lighter than normal for opening weekend because of the disagreeable hunting and road conditions. The sex ratio in northeast Iowa revealed that 67 per cent of the cocks were killed in that area. The harvest was 65 per cent in the east central district which was also above the state average. The kill per centage in north central Iowa was 55 per cent which was low for the state. Hunting pressure apparently was much lower in this area of Iowa's prime pheasant range.

Table 2. Comparison of observed sex ratios by agricultural districts 1957-60

	Observed sex ratios			
Districts	1957	1958	1959	1960
Northwest	3.4	2.1	2.5	2.9
North central	2.5	2.0	3.0	2.6
Northeast	4.1	2.4	4.9	3.6
West central	3.9	2.0	3.0	3.1
Central	4.7	3.1	3.0	2.8
East central	3.7	3.1	3.3	3.3
Southern 3 districts	2.5	2.0	3.6	3.0
State average	3.3	2.3	3.1	3.0

Sex ratios obtained by winter counts continue to show that Iowa hunters harvest about two thirds of the available roosters each season. The harvest of the ringneck population has been most favorable in northeast Iowa during recent years. The per centage of cocks killed in north central and northwest Iowa remains lower than the state average. These two districts contain the major portion of Iowa's pheasant population and more cocks could and should be removed each year from this area.

ROADSIDE INDICATIONS OF COVER PREFERENCE BY COTTONTAILS IN BENTON COUNTY, IOWA

by
Paul D. Kline
Game Biologist

Cover has been recognized as a determining factor of cottontail rabbit welfare. Various types of cover provide food, nesting and resting sites, escape from predators, and shelter from inclement weather. Changes in cover type composition within cottontail home ranges affect rabbit activity. In summer, when vegetation is rank and dense, rabbits have diversified cover almost everywhere. In an agricultural area, such as in Iowa, fields of oats, corn, and soybeans provide practically all cover requirements. But in winter when corn is picked and mashed flat, when soybeans and oats have been combined with only short stubble remaining, then the rabbits are much more confined to the weed and brush patches, woodlands, and other types remaining within their home ranges. Even these are not as beneficent as during summer. And in winter, there can be little doubt that rabbits suffer accordingly.

Knowledge of the relative use of cover types by cottontails through the seasons can be of value to game managers. Because, once the use of a type is known relative to its abundance within a locality, then the manager's task of remedying deficiencies is easier. Heavy use of any one cover type indicates one of two things: Either the cottontails prefer the particular type; or they use it because they are offered nothing better.

It is difficult to distinguish between use by preference from use by necessity. It is necessary to know relative abundance of particular cover types and then measure cottontail use before deciding the preference. For instance, 20 per cent of all rabbits in a given locality may be found in corn fields. But no true picture of cottontail use of these corn fields can be projected unless it is also known that corn comprises 40 per cent of cover in the locality. Then by dividing cover use (per cent of rabbit occurrences) by per cent of the type availavle we have an index which can be compared to indices of use for other types.

METHODS

In the present study data are presented which show the relative use of cover types between contrasting seasons and at slightly varying times of observation. The study was carried on supplementary to research aimed at improving the roadside rabbit surveys used in Iowa during the past ten years. This research on the roadside surveys was started in Benton County on February 24, 1957, and continued through August 11, 1959. During that time a predetermined survey route, 30 miles long, was driven by the writer 180 times total, always during early morning hours. Each survey was driven by auto at a speed of 20 miles per hour. This speed and the 30 mile-long route gave a survey time of one and one-half hours per trip.

Starting on opposite ends of the survey route on alternate trips, each cottontail observed was recorded within the mile in which it occured. Also, for each rabbit a record was made regarding cover type or types in which it was seen. For instance, a rabbit seen in a cornfield alongside the road was recorded as two observations in corn. If seen in the roadway, whether ditch or traveled portion, the rabbit was recorded by occurrence of adjacent cover types. Should corn be on one side and oats on the other then the rabbit was recorded once for corn and once for oats. If oats occurred on both sides at that particular site, the two observations for oat cover were recorded. This method gave twice as many observations as actual rabbits seen, but it did alleviate the uncertain determination of which cover type attracted a particular rabbit. Oftentimes a rabbit seen in the road seemed to be traveling from one side to another. From feeding in a cornfield to cover in a farm yard. Hence, recording of two observations per rabbit seemed justified.

Originally, all surveys started at one-half hour before sunrise. After 101 trips it was decided to change starting times, determined by season. Thereafter, all trips made during the winter (November 1-March 31) season were started one hour before sunrise. By that time, March 5, 1958, it was established that rabbit activity lessened as sunrise approached. More rabbits were seen per trip as a result of the change. Also, the change in time resulted in data which indicated varying use of cover types as sunrise approached.

For summer counts (June 1 - July 31) a different modification was initiated after approximately the first year and a half. All summer counts beginning June 5, 1959, were started at sunrise. Greater rabbit activity after sunrise during summer months forced this change. For fall and spring, August 1 - October 31, and April 1 - May 31 respectively, too few rabbits were observed during the research surveys to justify conclusions from the data. Therefore, data from those seasons were not included in this paper.

Roadside cover (cover in adjacent fields) was measured for summer and winter each season during which the research continued. This was accomplished by use of an auto. Fields of various types were measured linearly alongside the survey roads by use of the speedometer. As the route was 30 miles long, 60 miles of cover types (30 for each side of the road) were recorded for each season. For each type, this was then expressed as per cent of total cover. For instance, if corn bordered the route for 15 miles (including both sides then it became easy to express the importance of corn as a cover type as 25 per cent. In other words, using this example, corn fields made up 25 per cent of allvegetation bordering the survey route at the particular season.

Fourteen cover types were recognized during the survey. Due to difficulty in separating the two, woodland and brushland were lumped together. The same was true for red clover and alfalfa - they were lumped as hay. This gave 12 cover types recorded in this paper. Farm buildings as a distinct type included the lawns about farm buildings, feed lots, adjacent gardens, shelterbelts, machinery yards, etc.

Several types, though recorded, were of little consequence as far as abundance goes. Wild forbs (weed fields), sweet clover, fall fallow (fall ploughing), peas, and wheat fell into this class. However, some of these seemed relatively important to the rabbits as indicated in the data following.

Road ditch cover was given little consideration in this study. Alongside the gravel roads used for the survey route, ditches were all narrow and supported little cover except short bluegrass. During summer they were mowed by local farmers. County road crews regularly sprayed these ditches with weed killer chemicals. From observation, the writer felt road ditch cover offered little to attract and hold the cottontails. Aside from this, the cover in road ditches was fairly homogenous. It varied little throughout the route. Therefore, differences in numbers of rabbits seen in portions of the route should have reflected other factors, such as cover in adjacent fields.

RESULTS

SUMMER

Based on 968 observations during the three summers which the survey was run, more (21.9 per cent) cottontails were seen in or adjacent to corn fields than any other type. This can be easily explained by the relative abundance of corn. Fully 33.1 per cent of all roadside cover was composed of adjacent corn fields (Table 1). However, the use index (per cent of observations, per cent of total cover) was only 0.66. This means rabbits used corn about two thirds as much as if they were scattered at random through coverty pev. Corn therefore, was not a preferred cover type even in summer.

Fields of oats attracted nearly as many rabbits as corn, 18.2 per cent of all observations. And the use index was 1.34, which means oat fields received much more use than they should if rabbits were randomly scattered. Oats were a preferred cover type.

Pasture (17.2 per cent), wood and brushland (15.0 per cent), farm buildings (13.0 per cent), and hay (10.8 per cent) received considerable use. The use index gave farm buildings (1.33) and wood and brushland (2.33) a preferred rating; while pasture (0.80) and hay (0.86) received less than average use. Pastures in the area were generally closely grazed and offered less than desirable rabbit cover. Hay fields seemed to be used intensively before they were cut, but received little use when freshly moved, therefore, reducing the use index.

Wheat, wild forbs, peas, and sweet clover received high use index ratings, but because of their relative scarcity they were not judged overly important to rabbits in summer. Apparently the rabbits did prefer these types over corn, pasture, and hay whereever they were available.

Starting time of summer surveys varied. During the first two summers all counts began one-half hour before sunrise. Sunrise was the starting time during the third summer.

Differences in cover preferences with these times did appear judging from use indices (Table 2). But the writer sees little to interpret from these differences. Farm building, oats, and hay were preferred to a greater extent during the early counts than those that started at sunrise. In contrast, wood and brushland received a higher use index from counts starting at sunrise.

WINTER

Winter observations (574 total) indicated the farm builders type was extremely important to rabbit welfare (Table 1). Fully 35.8 per cent of all observations were made there, even though only 9.7 per cent of all cover was composed of this type. The use index was 3.69, higher than that from any other type except wild forbs (8.67). Forbs were not judged especially important as only 0.3 per cent of all cover was composed of this type.

Woods and brushland, corn, and pasture yielded 17.1, 16.4, and 14.3 per cents respectively of all observations. However, their use indices were not comparable. Woods and brushland received a use index of 2.38; while corn and pasture received 0.53 and 0.64 respectively. Soybeans and fall fallow gave use indices of 0.14 and 0.06 respectively. Apparently these types attracted wintering cottontails but little.

A shift in cover type use from feeding areas to escape cover or shelter was revealed by data from differing starting times (Table 2). Corn, oats, pasture, and hay all received higher use indices when surveys started one hour before sunrise than when they started one-half hour before. On the other hand, use indices for farm buildings, woods and brushland, and wild forbs - all cover areas - received higher use indices with the later starting times. For farm buildings the index was 3.46 when counts started one hour before sunrise; 4.39 when they started one-half hour before.

During the surveys the writer noted that rabbits became less active as daylight approached. While still quite dark outside, the rabbits were to be seen distributed far out in pastures, picked corn, etc. And they moved around to a considerable extent at that time. As daylight approached they drew near farm buildings, weed and brush patches, and other places of shelter. Also, they became noticeably more quiet. After sunrise, most rabbits observed would be sitting quietly in their forms or outside burrows in the snow, or in other places of refuge.

DISCUSSION

The data presented here gives some insight into the use of varying cover types by cottontails through the seasons. It reveals, to some extent at least, what types are preferred. Especially, it gives some clues to game managers regarding cover deficiencies for wintering cottontails. Obviously, those preferred cover types would be the ones which should be considered for expansion in a management program.

Of the twelve types listed in this study only three, farm buildings, woods and brushland, and wild forbs, achieved a preferred rating for winter. All offer shelter or escape cover not found in the other nine types. Farm building sites attract cottontails because of the innumerable holes, nooks, and crannies, where rabbits can hide and keep warm. There, they can burrow beneath buildings, hide behind machinery or evergreen plantings, or seek out piles of brush or weed patches. Food is usually nearby in the form of spilled corn, fruit tree prunings, etc. Over one-third of all rabbits seen during winter surveys were observed near farm buildings. Their one nemesis is farm dogs. Despite the dogs, rabbits seek out farm building sites, in many cases, because they offer the only available winter cover.

Wild forbs (weed patches) received a higher use index in winter than any other type. Apparently rabbits prefer the type. The data indicates that preservation of weed patches adjacent to corn fields, or other food sources, would be good rabbit management. Woods and brushland achieved a high use index both for winter and summer. Obviously, use of the forest edge type offers a clue to tree and brush plantings in rabbit management.

The data reveals considerable strain on cottontails results from crop harvest. Corn, oats, hay, soybeans, peas, and wheat totaled 71.7 percent of all summer cover. With harvest much of this cover is lost to cottontails as revealed by their lessened activity in this types. Pasture, too, offers less cover in winter than in summer. Hay fields, soybeans, and peas are mowed or combined so as to offer practically nothing. Some of the corn, wheat and oat lands are fall plowed. And the rabbits have little use for fall plowing as indicated by the extremely low use index of 0.06.

Some types offer little as cover in winter-time but do furnish food. Corn fields and oats fall into this category. Waste corn and oats, and young red clover usually planted in the oats, seemed to attract rabbits during the feeding periods of early morning.

During summer, of all types, corn achieved the lowest use index. Pasture, hay, and soybeans were all below average. The writer belives this is probably due to short pastures, periodic mowing, and slow growth of soybeans during early summer. If pastures were allowed to grow rank, hay remained unmoved for longer periods, and soybeans reached full growth early in June, then these types would offer much more to rabbit welfare.

SUMMARY

1. Evidence of cover use and preference by cottontails was obtained from 180 roadside surveys over one route in Benton County during the period February 24, 1957 to August 11, 1959.

2. During the study, cover use by 484 rabbits were recorded for the summer studies, June 1 to July 31. During the winter period, November 1 to March 31, 287 were recorded in various cover types.

3. Linear measure of cover adjacent to the 30 mile survey route was recorded once for each summer and winter while the research was in progress. This cover was recorded by auto speedometer readings, and was measured in 1/20ths of miles.

4. Twelve cover types were classified: Farm buildings, corn, oats, pasture, hay (alfalfa & red clover), woods and brushland, soybeans, wild forbs (weeds), peas, sweet clover, fall fallow and wheat.

5. Date for cover types were expressed as percentages of all cover. Cottontail use of the cover types was expressed as percentages of total observations. By dividing percentage of observations in the various types by percentage of total cover available for each type, a use index was obtained. The use index was used to express cover preference. When the index was above 1.00 the cover type was judged as preferred.

6. During summer, rabbits preferred the farm buildings, oats, woods and brushland, wild forbs, peas, sweet clover and wheat types. Other types, corn, pasture, hay and soybeans all received use indices less than 1.00 and apparently were not preferred.

7. In winter with cover changed by frost and harvest, cottontails preferred farm buildings, woods and brushland and wild forbs. All other types had use indices of under 1.00. Farm buildings were revealed as a very important cover type during winter. Wild forbs received the highest use index, but the type was relatively scarce, comprising only 0.3 percent of all cover for the season.

8. By comparing winter counts which began one hour before sunrise with counts which began one-half hour before sunrise a shift in cover use from early to late morning was revealed. Cottontails were found more in feeding areas, such as corn, oats, pasture, and hay, very early in the morning. Later, they moved to cover areas, such as farm buildings, woods and brushland and wild forbs.

9. The study emphasizes the need for winter cover for cottontails. Weed patches standing near corn fields or other feeding areas should be considered as a management requirement. Despite farm dogs, and human molestation, fully 35.8 percent of all cottontails observed during winter were within the farm building type.

Table 1. Comparison of summer and winter cover use.

Cover type	Summer Observations			Winter Observations		
	Percent of total Cover	Percent Total Observations	Index Cover Use	Per cent Total Cover	Per cent Total Observations	Index Cover Use
Farm Buildings	9.7	13.0	1.33	9.7	35.8	3.69
Corn	33.1	21.9	0.66	30.7	16.4	0.53
Oats	13.5	18.2	1.34	11.7	7.0	0.60
Pasture	21.3	17.2	0.80	22.2	14.3	0.64
Hay	12.4	10.8	0.86	10.9	6.1	0.56
Woods & Brushland	6.2	15.0	2.23	7.2	17.1	2.38
Soybeans	2.5	2.4	0.92	2.1	0.3	0.14
Wild Forbs	0.5	0.6	1.20	0.3	2.6	8.67
Peas	0.1	0.2	2.00			
Sweet Clover	0.4	1.0	2.50	0.3	0.0	
Fall Fallow				5.0	0.3	0.06
Wheat	0.1	0.5	5.00			

Based on 968 summer and 574 winter observations.

Obtained by dividing per cent of observations by per cent of cover type.

Table 2. Relationship of cover use and time surveys started: Winter and summer.

Cover Type	Index of Cover Use			
	Winter		Summer	
	One Hour before Sunrise (148)	One-Half Hour before Sun rise (426)	One Half Hour before Sun-rise (646)	Start at Sunrise (322)
Farm Buildings	3.46	4.39	1.42	1.18
Corn	0.60	0.35	0.67	0.64
Oats	0.66	0.39	1.48	1.05
Pasture	0.78	0.36	0.74	0.80
Hay	0.57	0.38	0.90	0.80
Woods and Brushland	2.31	2.80	1.89	3.53
Soybeans	0.17		0.66	2.55
Wild Forbs	1.75	27.00	1.20	1.20
Peas			3.00	
Sweet Clover			2.50	
Fall Fallow	0.05	0.12		
Wheat			1.60	

Numbers in parenthesis represent in each instance numbers of observations for that particular time of start.

AGE OF IOWA QUAIL SHOT BY HUNTERS

by
M. E. Stempel
Game Biologist

Wings of some of the Iowa quail shot by hunters have been collected by officers and the biologists each open season since 1946. This project was begun to obtain data on the young to adult ratio. In recent years, the study was extended. This yielded additional information which enabled us to point out the most productive hatching periods. When analyzed, these data supplemented data already gathered on wintering, pairing, nesting, and on the production and survival of young. Thus some knowledge was gained on the results of abnormally long, or short hatching periods. The study reflected the expected June and July brooding, and the additional benefits from earlier or later nesting.

METHOD

As in the past, before the 1959 quail shooting season, letters of instruction and envelopes for gathering wings were supplied to conservation officers. On the wing containers, spaces were provided for entering the name of the county where birds were shot, also the date of kill and the sex of the birds.

In some counties, there were hunters who shot large numbers of quail. These individuals were personally contacted by the officer and the biologist in charge of the project before the open season.

Hitherto, it was urged that wings be collected during early November, because after that date it was usual for many of the young to have fully matured flight plumage and these could not be aged. In 1959, an additional sample was gathered in December because many birds matured late.

In some cases only a few wings were accumulated. It was requested that these be mailed to the biologist in Ottumwa at the end of the season. If a large number of wings was acquired it was asked that they be mailed or delivered immediately. Some cooperators shot quail more than once each week. These were contacted often by the biologist.

When a sufficient number of wings had been accumulated at Ottumwa, they were examined and classified as described in the Quarterly Biology Report for July 1959. First, each wing was placed in one of three categories: these were; (1) young, (2) adult, (3) unidentifiable because of damage or lack of distinguishing characteristics.

No hatching date could be determined for the young over 150 days old. A hatching date was established for each bird that was less than 150 days old. Stage of moult in adults was also noted. Another small group has characteristics of both young and adults.

RESULTS: STATEWIDE

From all portions of the quail range in southern, eastern and in western Iowa, a total of 1,432 quail wings was collected during the 1959 quail shooting season. For 939 of these the date of kill was recorded. In this number, 800 were young, 139 were adults. There were 100 cocks per 77 hens.

Additional winger were gathered on unrecorded dates: of this group, 422 were young, 71 were adults. The per centage of young (86%) was similar to the amount of young that appeared in the 1957 hunter take of quail.

In the group of wings that was collected on known dates, back dating indicated that the hatch was progressing very well by June 15 and it was at a peak by July 15. There was a second smaller production peak about August 15. Nesting ended in October. The oldest bird appeared to be over one year old. The youngest was less than two months old.

Only eleven wings could not be aged because of damage from shot. The median age of quail taken in 1959 is indicated below. (Table 1).

Table 1. Median Age of Iowa Quail, 1959

Median Age in Days	Per cent of Quail
60	13
90	11
120	35
150	27
Adults	15

In addition to the above, eight birds were less than 46 days old.

RESULTS BY DISTRICTS

The southeast and the south-central districts of Iowa have the best quail range, the highest population of birds, and cooperators take large numbers of quail during the shooting season. These areas lie in a strip fifty miles wide from north to south and they extend from the Mississippi river westward to Creston.

Data from wings indicate that the earlest hatch was in south-central Iowa. Both areas had a second hatching peak in August. Some information is available on production in other areas: the section of this paper which pertains to counties contains these data.

In the south-central district 473 wings were collected. Of these, 86 were adults; this was 18 per cent. Of the yound, 308, or 80 per cent were over 150 days old. Twenty per cent of the hatch occurred in June with the best hatching period from July 1 to 15 when 30 per cent of surviving young were brought off. The peak production was about July 15. There was a noticable decline by July 31. The hatch remained at the ten per cent level through September 15 then ceased soon after.

Southeastern Iowa hatching was determined from a kill of 141 birds on which there was information on the place and the date of kill. Twenty-two, or 15 per cent were adult quail. One hundred sixteen were under 150 days old: this was 79 per cent of the young.

In the southeast, ten per cent of the hatch was in June. The production peak (24%) of hatching was in the period from July 16 to 31. There was a noticable second hatching peak about August 20.

RESULTS BY COUNTIES

The number of wings collected is in proportion to the number of willing cooperator-hunters. There was good response in the following counties:

Clark
Decatur
Davis
Madison
Marion
Monroe
Van Buren
Warren
Wayne

Of all the wing collections examined in the office of the biologist in Ottumwa, a sample from Van Buren county was the most unusual in that there was only one adult for 53 young. Most of these young were mature in appearance. The sample was taken between December 3 and 14.

A sample from Wayne county indicated that the earliest hatch for the quail range occurred in that area. There was extensive production from July 1 to 15. The late summer production was also good.

There were some examples of very young quail. These were small birds with immature flight feathers. In Decatur county there was one immature young to 60 that were of mature size. In Jasper county, two immature young were taken for a total kill of 23 full size young. In Poweshiek county, there was one immature young to 23 that were matured in size.

There is variation in the age of the young quail bagged by gunners. The proportion taken from various age groups is shown below. (Table 2.)

Table 2. Quail Shot During the Month of November

Year	Age of Quail in Days		
	under 120	121-149	Over 150
	Number of quail		
1959	230	76	89
1958	230	81	112
1957	101	79	164

The quail represented in the above table were taken in the following counties: Appanoose, Clarke, Davis, Decatur, Lucas, Monroe, Van Buren, Wapello, Wayne.

ADULT QUAIL

Over the entire quail range, throughout the hunting season, October 31 through December 14, 1959, a total of 210 adult wings was collected. In many of those shots between October 31 and November 15, the moult and replacement of primary flight feathers was incomplete. Sixty five per cent had not yet shed the outer feather or the number ten primary. From November 16 to 30 the number ten feather had not been shed by 30 per cent.

From December 1 to 14, twenty-seven per cent had not yet shed the outer or number ten primary. Some of the other adult wings showed an intermediate stage of moult. Fully matured plumage was found on 41 per cent. The latter sample (December 1 through 14) was small.

INDIVIDUAL RECORDS

Two hunters volunteered to keep the wings of quail which they sot on typical hunting trips. In these records is evidence of the variation in the age of quail which were shot during an open season.

The first example is from records of an Ottumwan who did most of his hunting in Appanoose county. His report on quail hunting was: In trips made on November 2, 6, 21 and on December 5, eighteen birds were killed and retrieved. Five were adults. The birds were hatched in June, July, August and September. Most of the young quail were hatched in July. The average age of young was 127 days.

The second hunter reported on trips made by himself and a friend. Dates were not recorded, but the trips were distributed throughout the open season on quail. A total of 25 birds was shot and retrieved. Four were adults. Most of the wings were from quail that were over 150 days old and could not be aged; hence, hatching dates could not be determined.

A REVIEW OF INFORMATION CONCERNING THE DISTRIBUTION OF BANDED GEESE RECOVERED IN IOWA

by

James G. Sieh
Game Biologist

In recent years, large numbers of wild geese have been banded and released in continental North America. Recoveries of banded waterfowl provide information vital to their intelligent management. Only in recent years have sufficiently large numbers of wild geese been banded to initiate adequate studies of segments of the population. Large gaps still exist in the cooperative endeavor of the Mississippi Flyway Council to adequately band and study representative samples of Canada geese, expecially on the northern breeding grounds in Canada. Mr. Harry Lumsden of Ontario has been gathering information on nesting geese in that province. Charles Shanks of Missouri and George Arthur of Illinois are undertaking summer banding of Canada geese in northern Manitoba under the auspices of the Candad Goose Committee of the Mississippi Flyway Council. Harold Hansen of the Illinois Natural History Survey Division is reportedly approaching a break-through in his diligent and painstaking efforts to evaluate his research on Canada geese. Graham Cooch of the Canadian Wildlife Service has made a singularly spectacular contribution to the study of blue and snow geese while working on the breeding grounds and banding some 17,319 snows and 7,541 blues during recent summers.

Recovery reports of all banded birds in North America are housed at the Bird-Banding Office, Patuxent Research Refuge, Laurel, Maryland. Under the "Master Permittee System", Iowa receives a copy of each recovery report of a duck or goose taken in Iowa. Canada geese recovered in Iowa indicate a widespread distribution of the species throughout the state (Figure 1, Appendix Tables 1 and 2). It is clearly illustrated that the so-called "Horseshoe Lake Flock" constitute the major source of recoveries along the Mississippi River. Geese banded at Swan Lake, Missouri constitute the major source of Canadas recovered elsewhere throughout the state. There is an obvious lack of recoveries from Canada geese banded on the breeding grounds. There is no indication of a major concentration point for Canada geese in Iowa.

It is noteworthy that five recoveries of the Little Canada goose (Branta C. Hutchins) were all banded at Sand Lake, South Dakota, and four of the five recovered were taken near the Missouri River in Iowa. The absence of recoveries of the larger subspecies of Canada along the Missouri River probably indicate a lack of banding of the Canadas using our western border areas; and, corroborate general information indicating a small total kill of Canada geese annually along the Missouri River in Iowa. During the fall, large flights of geese often pass southward down the Missouri River Valley without stopping in Iowa. This situation results partly from a lack of suitable rest areas or refuges along the entirety of the Missouri River in this state. Figuratively and literally, every suitable sand bar in the river has a duck or goose blind, and gun pressure rapidly forces the geese downriver toward Sqaw Creek Refuge in Missouri. The new federal refuge at DeSoto Bend sill alleviate this situation somewhat, but refuge effectiveness cannot be predetermined. After sixty years of intensive gunning along the Missouri River in Iowa, the effectiveness of a newly created refuge cannot be fully evaluated until the geese have become accustomed to the area over a period of years.

Blue and snow geese banding data indicate widespread, but more westerly distribution in Iowa (Figures 2 and 3). These species do concentrate in the western portions of the state, especially along the Missouri River. There are considerable numbers of these

geese already using our small rest areas in Iowa, (Plum Creek, Forney's Lake, etc.), and the potential development of larger, more suitable refuges on or near the Missouri River could develop into one of the major fall concentration areas for blue and snow geese in the midwest.

Migration data indicate that in some years, blue and snow geese will concentrate in large numbers during the fall, especially during years of late breeding phenology; however, under some weather conditions, mass flights may move populations across the continent almost non-stop. Our small refuges along the Missouri have been effective in holding small numbers of blue and snow geese, and in my opinion, the expansion of the Forney's Lake Area and the development of other refuge sites into more adequate and larger refuge systems can increase the concentration of all species of waterfowl, and increase the potential harvest of ducks and geese in Iowa.

An example of the effectiveness of a small refuge under ideal conditions is illustrated by the kill of geese near Five Island Lake near Emmetsburg, Iowa during the fall of 1956. Exposed mud flats and open water on the refuge portion of the lake attracted and held several hundred blue and snow geese. Eight recoveries from blue geese taken north of Emmetsburg from October 25-27 represent only a small fraction of the total kill resulting from this local concentration. The lack of recoveries near this refuge in subsequent years demonstrate refuge ineffectiveness under unsuitable conditions. Most of the refuge portion of the lake has been dry, and consequently unsuitable in recent years.

DISCUSSION

Populations of wild Canada geese in North America are assumed to be in satisfactory numbers with a few exceptions. The older Indians in Ontario report larger numbers of Canada geese within recent years, than during any period within their memory. Evidence collected by the U. S. Fish and Wildlife Service indicate far more Canadas present during the 30's. These optomistic reports indicate at least a degree of successful goose management in the past.

At present, excessive kills of Canada geese from large concentrations in the proximity of some refuges are jeopardizing the numerical increase of segments of the Canada goose population within the Mississippi Flyway. Heavy kills of Canadas during the fall of 1959, forst near Horicon Refuge in Wisconsin and later near Horseshoe Lake in Illinois, may well have cut back the population advance of the so-called "Horseshoe Lake Flock", at least temporarily. Unusually heavy kills of Canadas near Swan Lake Refuge in Missouri during the fall of 1958 and again in 1959 may have jeopardized the numerical advance of the so-called Swan Lake Flock. Crippling losses at Swan Lake, approximating 1500 known cripples found during one search within the refuge, provide some indication of local gun pressure and its effect. Iowa depends largely upon the Canada geese from the Swan Lake flock.

One of the greatest hazards to good goose management within the flyway results from the creation of tremendous concentrations of geese on refuges, and the subsequent failure to adequately regulate the local harvest of such a concentration which may represent a large segment or proportion of a flyway population. It is known all too well that Canada geese under the "influence" of concentrated numbers do not react as typical "wild" geese. The harvest of geese near any man-made concentration point can only be considered legitimate, if the kill does <u>not</u> jeopardize the reasonable anticipated biological increase of any segment of a flyway population. Good goose management depends upon adequate and immediate regulation to curtail over-harvest.

Local concentrations of geese providing an opportunity to over-harvest should not in any way be misconstrued to grant license to over-harvest unintentionally or otherwise.

Another case history of over-harvest involves the little Canada goose near Sand Lake Refuge, South Dakota. Since the advent of this refuge, this subspecies has forsaken much of its former dispersal during the fall migration. The species has in some years concentrated in large numbers at Sand Lake Refuge resulting in unusually heavy kills. There is little doubt that this subspecies has suffered serious setbacks as a result of over-harvest in the past, and without adequate safeguards, this will happen again.

The Mississippi Flyway Council is endeavoring to assist in the solution of this difficult problem, but the final responsibility for action remains with the Bureas of Sport Fisheries and Wildlife to initiate adequate and timely safeguards based upon past experience.

The blue and lesser snow geese (Chen Caerulescens) populations in North America are reportedly not in any jeopardy whatsoever. The overall abundance of these species coupled with a small annual harvest still permits a bag limit of five birds. Under these conditions, the development of refuges in Iowa to increase the potential harvest of these birds is desirable. The design and precaution to aviod local over-harvest should be an integral part of any intelligent refuge development.

TABLE I FREE-FLYING CANADA GEESE RECOVERED IN IOWA, BANDED ELSEWHERE

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
1	498-72872	Horseshoe L. Ill.	1/6/52	-	-	McCausland	10/13/56	Shot
2	508-34973	Barstow, Ill.	12/28/55	-	-	Miss. R./Comanche	6/23/56	Released
3	508-93809	Swan L. Ref.	12/13/55	Ad.	F	New Hampton	10/10/57	Shot
5	508-67166	Swan L. Ref.	11/26/54	Ad.	F	Creston, Iowa	10/30/56	Shot
7	498-72335	Horseshoe L. Ill.	1/7/53	Sub. Ad.	- M	Thurman, Ia.	11/3/54	Shot
13	44-808377	Horseshoe L. Ill.	11/10/50	Imm	M	Clinton, Ia.	10/22/54	Shot
19	518-01439	Squaw Creek Ref. Mo.	12/5/58	Imm	-	Bartlett, Ia.	10/10/59	Shot
20	518-31605	Swan L. Ref.Mo.	11/1/57	Imm	F	LaPorte City Ia.	10/15/59	Shot
22	498-74609	Springfield Colo	1/31/53	Ad.	-	Mt. Ayr Lake, Ia.	12/5/57	Shot
28	518-35782	Swan L. Ref.Mo.	12/4/56	Imm	F	Clinton, Ia.	10/5/58	Shot
29	508-94178	Swan L. Ref.Mo.	12/21/55	Ad	M	Milton, Iowa	10/24/58	Shot
30	518-36293	Swan L. Ref.Mo.	1/13/59	Ad	M	7 mil S. of Cumberland, Ia.	10/4/58	Shot
31	518-36811	Swan L. Ref.Mo.	12/2/57	Ad	M	Prairie City, Ia.	10/4/58	Shot
33	498-47346	Swan L. Ref.	11/7/50	Ad	F	Little Sioux Riv. Correctionville	10/31/58	Shot
34	498-50115	Swan L. Ref.	11/16/50	I	F	Little Sious Riv. Correctionville	10/25/58	Shot
35	518-63155	Horseshoe L.Ref.	2/17/58			Wapello, Iowa Lake Odessa	10/20/58	Shot
40	518-15276	Swan L. Ref.	10/14/58	Ad	M	Near Union Slough Kossuth Co. Ia.	10/13/59	Shot
43	508-67180	Sumner, Iowa	11/27/54	I	M	3 mi. S. of Cherokee	10/7/57	Shot
44	518-35723	Sumner, Iowa	12/3/56	I	F	4 mi. NW of Ruthven	10/5/57	Shot
45	508-37032	Horseshoe L. Ill.	1/5/57	I	-	Between Hopkinton & Manchester, Ia.	10/26/57	Shot
46	508-37249	Horseshoe L. Ill.	1/9/57	I	-	Between Hopkinson & Manchester, Ia.	10/26/57	Shot
47	508-94330	Swan L. Ref.	12/23/55	Ad	F	Des Moines Riv. Eddyville, Ia.	10/56	Shot
48	518-35250	Swan L. Ref.	11/15/56	Ad	F	Mo. R. W. of Onawa	10/13/57	Shot
49	508-41327	Swan L. Ref.	11/11/53	I	M	Silver Lake Ayrshire, Ia.	10/5/57	Shot
59	508-24871	McAlester, Okl.	5/56	-	-	Varina, Iowa	7/15/57	Checked & Released
60	508-93809	Swan L. Ref.	12/13/55	Ad	F	New Hampton	10/10/57	Shot
61	508-93741	Swan L. Ref.	10/25/57	I	M	Skunk River Searsboro, Ia.	10/25/57	Shot
64	508-41348	Swan L. Ref.	11/24/53	I	F	North of Creston	11/1/57	Shot
66	508-67166	Swan L. Ref.	11/26/54	Ad	F	Creston, Ia.	11/12/56	Shot
67	508-93262	Swan L. Ref.	11/7/55	I	M	4 mi. S. of Menlo, Iowa	10/11/56	Shot
68	508-93820	Swan L. Ref.	12/13/55	Ad	M	1½ mi.NW Iowa L.	10/7/56	Shot
69	508-94083	Swan L. Ref.	12/21/55	Ad	M	4 mi. S of Menlo	10/11/56	Shot

TABLE I FREE-FLYING CANADA GEESE RECOVERED IN IOWA, BANDED ELSEWHERE (Cont.)

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
70	508-94156	Swan L. Ref.	12/21/55	Ad.	M	2 mi. S of Tripoli	11/8/56	Shot
71	508-94242	Swan L. Ref.	12/21/55	Ad	M	S. Skunk Riv., Newton	10/24/56	Shot
73	518-35182	Swan L. Ref.	11/8/56	I	F	Marble Rock	11/15/56	Shot
74	518-35905	Swan L. Ref.	12/5/56	I	F	Jefferson, Ia.	5/7/57	Picked up, now at Lake View
76	498-27815	Squaw Creek Ref.	11/30/55	Ad	-	Red Oak, Ia.	11/56	"Taken"
77	498-46631	Swan L. Ref.	12/12/49	I	F	Humeston, Ia.	10/17/56	Shot
78	498-46864	Swan L. Ref.	10/23/50	I	F	Odebolt	11/1/56	Shot
79	498-47270	Swan L. Ref.	11/6/50	Ad	M	Greenfield	11/6/56	Shot
80	498-50790	Swan L. Ref.	11/28/50	Ad	F	35 mi. S. of Des Moines	10/3/56	Found dead in road
86	498-59792	Swan L. Ref.	11/27/51	I	M	6 mi. E. of Marshalltown	11/22/56	Shot
87	498-60310	Swan L. Ref.	10/20/52	I	F	3 mi. NW of Keosauqua	11/1/56	Shot
88	498-60361	Swan L. Ref.	10/21/52	Ad	F	10 mi. S. of Cedar Rapids	11/24/56	Shot
89	498-67586	Horseshoe L. Ill.	1/19/56	Sub Ad	M	Conesville, Ia.	10/25/56	Killed
92	498-87024	Swan L. Ref.	12/17/52	Ad	F	3 mi. N of Storm Lake, Ia.	10/28/56	Shot
93	498-87370	Swan L. Ref.	10/31/53	Ad	T	Lake Park, Dickinson Co., Ia.	10/19/56	Shot
94	508-01538	Govan Sask. Can.	8/6/54	Local		2½mi. S of Westfield, Ia.	11/2/56	Shot
95	508-42256	Squaw Creek Ref.	11/18/54	I	M	New Market, Ia.	10/14/56	Shot
99	518-36150	Swan L. Ref.	11/6/57	I	F	Fredrika, Ia.	10/4/58	Shot
100	508-93352	Swan L. Ref.	11/8/55	I	F	Ladora, Ia.	10/4/58	Shot
103	508-93012	Swan L. Ref.	10/22/55	Ad	M	Renwick, Ia.	10/4/58	Shot
104	518-36586	Swan L. Ref.	10/25/57	I	F	3mi. N of Jesup, Ia.	10/4/58	Killed
105	518-36691	Swan L. Ref.	11/27/57	I	F	10½mi. S of New Hampton	10/4/58	Shot
106	508-37658	Horseshoe L. Ill.	1/12/57	I	-	Pool #13, Clinton, Ia.	10/5/58	Shot
107	518-13176	Horseshoe L. Ill.	2/14/58	Ad		Oxford Jct., Ia.	10/9/58	Killed
108	508-42346	Swan L. Ref.	11/20/54	Ad	M	Norway, Ia.	10/4/58	Shot
109	508-58015	Puxico, Mo.	12/22/54	I	M	Ingham-High L.	10/9/58	Shot
110	498-44419	Swan L. Ref.	11/19/49	Ad	F	Big Marsh, Ia.	10/4/58	Shot
111	508-94932	Swan L. Ref.	10/30/56	Ad	F	1mi. S of Storm L.	10/5/58	Shot
113	498-60892	Swan L. Ref.	12/9/52	I	M	May City, Ia.	10/6/58	Shot
114	518-35858	Swan L. Ref.	12/5/56	I	M	2mi. SW of Russell, Iowa	10/12/58	Took
115	508-93536	Swan L. Ref.	12/2/55	-	-	2mi. S. of Kalona, Ia.	10/4/58	Shot
116	518-35784	Swan L. Ref.	12/4/56	I	F	Garner, Ia.	10/4/56	Shot
118	508-36109	Horseshoe L. Ill.	12/10/56	Ad	-	Donahue, Ia.	10/22/59	Shot
119	518-01367	Squaw Cr. Ref.	11/30/58	Ad	-	Sheffield, Ia.	10/11/59	Shot

TABLE II LITTLE CANADA GEESE RECOVERIED IN IOWA

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
36	597-62100	Sand Lake Ref. Columbia, S. D.	10/26/58	I	F	Cresent, Ia.	1958	Shot
37	597-62117	Sand Lake Ref. Columbia, S. D.	10/26/58	Ad	M	Cresent, Ia.	1958	Shot
75	587-35070	Sand Lake Ref.	10/23/56	Ad	M	Between Akron-Wesfield on Sioux R.	11/18/56	Shot
101	527-39474	Sand Lake Ref.	10/12/56	I	M	Bayard, Ia.	10/15/58	Shot
102	597-42079	Sand Lake Ref.	10/20/57	Ad	F	2mi. S of Sloan, Ia.	10/23/58	"Killed"

TABLE III SNOW GEESE RECOVERED IN IOWA

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
1	587-54618	Squaw Cr. Ref., Mo.	10/26/58	Imm		Hinton, Iowa	10/13/59	Shot
2	587-54031	Squaw Cr.Ref. Mo.	12/2/57	Ad		Creston, Iowa	10/16/59	Shot
3	597-60230	Squaw Cr.Ref. Mo.	10/31/58	Imm		Clinton, Iowa	10/15/59	Shot
4	527-56442	Boas Riv. Delta	8/4/56			Thurman, Iowa	10/21/59	Shot
5	587-60675	E. Bay, Southhampton Island	7/20/57			Gladbrook, Iowa	10/19/59	Shot
6	527-55508	Boas River Delta	8/4/56			Creston, Iowa	1958	Shot
7	587-54125	Squaw Cr.Ref., Mo.	11/7/57	Imm		McPaul, Iowa	11/5/58	Shot
8	597-40018	E. Bay, Southhampton Island	7/22/57			Hamburg, Iowa	10/57	Shot
9	597-40157	E. Bay, Southhampton Island	7/22/57	Ad	M	Colwell, Iowa	10/20/59	Shot
10	587-50549	Squaw Cr.Ref.,Mo.	12/2/56	Ad		Creston, Iowa	10/19/59	Shot
11	527-59158	Boas Riv. Delta	8/4/56			Sloan, Iowa	10/7/59	Shot
12	587-61443	E. Bay, Southhampton Island	8/1/57			Sabula, Iowa	11/16/58	Shot
13	597-41232	E. Bay, Southhampton Island	8/1/57			Mo. Valley, Iowa	10/23/58	Shot
14	527-23068	Boas River	8/1/52	Ad		Britt, Iowa	10/30/58	Shot
15	587-18597	Squaw Cr.Ref.,Mo.	11/23/56	Imm		Chariton, Ia.	11/1/59	Shot
16	597-71670	McConnell Riv.,Can.	7/29/59			Ruthven, Iowa	10/9/59	Shot
17	527-55824	Boas Riv. Delta	8/4/56			Ayrshire, Iowa	10/9/59	Shot
18	597-12891	Columbia, S. D.	10/16/58	Ad	M	Mo. Valley, Iowa	10/29/59	Shot
19	597-40436	E. Bay, Southhampton Island	8/1/57			Thurman, Iowa	11/1/59	Shot
20	597-73819	McConnell Riv., Can.	9/2/59			Percival, Iowa	11/2/59	Shot
21	597-13777	Columbia, S. D.	10/16/58	Imm	M	Bartlett, Iowa	11/11/59	Shot
22	527-40292	Boas River	7/12/53	Sub.Ad.		Modale, Iowa	10/15/54	Shot
23	527-46502	Boas River	8/1/53	Ad		Little Sioux, Ia.	10/15/53	Shot
24	527-24469	Boas River	8/1/52			Sioux City, Ia.	10/26/54	Shot
25	527-46456	Boas River	8/1/53	Ad.		Imogene, Ia.	10/19/54	Shot
26	527-42699	Boas River	7/31/53			Hampton, Ia.	10/15/54	Shot
27	527-49866	McConnell Riv.,Can.	7/31/54			Olin, Iowa	10/17/54	Shot
28	527-49109	McConnell Riv.,Can.	7/30/54			Sioux City, Ia.	10/9/54	Shot
29	527-21967	Boas River	7/23/52			Glenwood, Ia.	10/21/54	Shot
30	527-45460	Boas River	7/31/53			Greenfield, Ia.	10/20/54	Shot

TABLE III SNOW GEESE RECOVERED IN IOWA (Cont.)

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
31	527-48289	McConnell Riv.,Can.	7/30/54	Ad		Payne Jct., Iowa	10/23/54	Shot
32	527-49965	McConnell Riv.,Can.	7/31/54			Green Island, Ia.	10/20/54	
33	527-49185	McConnell Riv.,Can.	7/30/54			Hamburg, Iowa	12/54	
34	527-16539	Squaw Cr.Ref.,Mo.	10/24/54			Alden, Iowa	10/10/55	Shot
35	527-21-69	Boas River	7/23/52			Storm Lake, Ia.	10/22/55	
36	527-56581	Boas River	8/4/56			Clarinda, Ia.	11/18/57	Shot
37	587-33953	Columbia, S. D.	10/17/57			Onawa, Iowa	11/30/57	Shot
38	527-57666	Boas Riv. Delta	8/4/56			Thurman, Iowa	10/21/57	Shot
39	527-57455	Boas Riv. Delta	8/4/56			Thurman, Iowa	10/21/57	Shot
40	527-57569	Boas River	8/4/56			Storm Lake, Ia.	10/11/56	Shot
41	587-50593	Squaw Cr.,Ref.,Mo.	12/12/56			Harlan, Iowa	10/25/57	Shot
42	587-39433	E. Bay, Southhampton Island	8/1/57			Percival, Iowa	10/24/57	Shot
43	597-40345	E. Bay, Southhampton Island	7/16/57			Spencer, Iowa	10/7/57	Shot
44	597-39576	E. Bay, Southhampton Island	7/18/57			Percival, Iowa	10/12/57	Shot
45	597-41228	E. Bay, Southhampton Island	8/1/57			Treynor, Iowa	10/16/57	Shot
46	527-48257	McConnell Riv.,Can.	7/30/54	Ad		Hamburg, Iowa	10/30/57	Shot
47	597-40244	E. Bay, Southhampton Island	7/16/57	Ad		Onawa, Iowa	10/29/57	Shot
48	587-61472	E. Bay, Southhampton Island	7/1/57			Thompson, Ia.	10/25/57	Shot
49	527-49768	McConnell Riv.,Can.	7/30/57			Humboldt, Ia.	10/28/57	
50	527-47080	Boas River	7/2/53	Ad		Clarinda, Ia.	10/29/55	Shot
51	527-48355	McConnell Riv.,Can.	7/30/54	Ad		Thurman, Iowa	10/18/56	Shot
52	527-55494	Boas River	7/4-6/56			Storm Lake, Ia.	10/19/56	Shot
53	527-57515	Boas Riv. Delta	7/4/56			Sioux City, Ia.	10/26/56	Shot
54	527-57569	Boas River	7/4-6/56			Buena Vista Co. Hays Township	10/11/56	Shot
55	527-45279	Boas Island	6/31/53			Lake Park, Ia.	11/5/56	Shot
56	527-42951	Boas River	6/31/53			Modale, Ia.	10/25/56	Shot
57	527-21590	Boas River	6/23/52			Onawa, Iowa	11/55	Shot
58	527-55867	Boas Riv. Delta	7/4/56			Spirit Lake, Ia.	11/23/58	Shot
59	587-61931	Sand Lake Ref.	10/19/57			Tuttle Lake	10/5/58	Shot
60	587-61927	Sand Lake Ref.	10/19/57			Tuttle Lake	10/5/58	Shot
61	527-40743	Boas River	7/12/53			Ralston, Ia.	10/9/58	Shot
62	597-39496	E. Bay, Southhampton Island	7/18/57			Lost Island Lake	10/24/58	Shot
63	587-61243	E. Bay, Southhampton Island	7/16/57			High Lake	10/21/58	Shot
64	527-56169	Boas Riv. Delta	7/4/56			Sioux City, Ia.	10/25/56	Shot

TABLE III SNOW GEESE RECOVERED IN IOWA (Cont.)

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
65	527-55694	Boas Riv. Delta	7/4/56			Forney Lake, Ia.	10/17/58	Shot
66	527-47444	Boas Riv. Delta	7/2/53			Whiting, Ia.	10/9/58	Shot
67	527-24014	Boas Riv. Delta	7/1/52			Whiting, Ia.	10/9/58	Shot
68	47-719428	Sand Lake Ref.	10/27/51			Pleasant Lake Dickinson Co.	10/13/58	Shot
69	587-18565	Squaw Cr.,Ref.,Mo.	11/18/56			Sioux Rapids, Ia.	10/15/58	Shot
70	498-38797	Squaw Cr.Ref.,Mo.	10/24/54			Modale, Ia.	10/12/58	Shot
71	527-57871	Boas Riv. Delta	8/4/56			Modale, Ia.	10/15/58	Shot
72	527-55992	Boas Riv. Delta	8/4/56			Plover, Ia.	10/8/58	Shot
73	527-49796	McConnell Riv.,Can.	7/30/54			Creston, Ia.	10/12/58	Shot

TABLE IV BLUE GEESE RECOVERED IN IOWA

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
1	597-60668	Squaw Cr.Ref.,Mo.	11/10/59	Imm		Forney Lake	11/24/59	Shot
2	587-50788	Squaw Cr.Ref.,Mo.	10/27/57	Ad		Near Forney Lake	11/3/59	Shot
3	597-06112	Delta Station, Manitoba	4/2/58	Ad	M	Sheldon, Ia.	11/9/59	Shot
4	597-60417	Squaw Cr.,Ref.,Mo.	11/5/58	Ad		Forney Lake	11/5/59	Shot
5	587-50711	Squaw Cr.Ref.,Mo.	12/12/56	Imm		Malvern, Ia.	10/19/57	Shot
6	44-823774	Swan Lake Ref.	3/13/49	Ad	F	Princeton on Miss.	11/3/54	Found Dead
7	527-58988	Boas Riv. Delta	9/4-6/56			Elk Lake,Dickins,Ia.		Shot
8	587-39996	E. Bay, Southhampton Island	9/1/57			Thurman, Ia.	10/24/57	Shot
9	587-60980	E. Bay, Southhampton Island	7/22/57			Titonka, Ia.	10/31/57	Shot
10	527-44350	Boas River	7/31/53			Plum Creek Basin McPaul, Ia.	7/57	Found Dead
12	527-16072	Squaw Cr.Ref.,Mo.	10/31/54			N. Emmetsburg,Ia.	10/27/56	Shot
13	527-20115	Boas River	7/23/52			E. Okobojigte Spirit Lake, Ia.	10/20/56	Shot
14	527-22707	Boas River	8/1/52			Near Bradgate Humboldt, Ia.	10/19/56	Shot
15	527-24630	Boas River	8/2/52	Ad		Blenco, Ia.	10/12/56	Shot
16	527-43647	Boas River	7/31/53	Ad		Carroll, Ia.	10/25/56	Shot
17	527-48099	Boas River	8/2/53	Ad		Richland, Ia.	10/18/56	Shot
18	527-56380	Boas River	8/4/56			Emmetsburg, Ia.	10/27/56	Shot
19	527-58824	Boas Riv. Delta	8/4/56			N. Emmetsburg, Ia.	10/26/56	Shot
20	527-58851	Boas Riv. Delta	8/4/56			N. Emmetsburg, Ia.	10/26/56	Shot
21	527-58934	Boas Riv. Delta	8/4/56			N. Emmetsburg, Ia.	10/26/56	
22	527-58936	Boas Riv. Delta	8/4-6/56			Emmetsburg, Ia. No.5 Isl. Lake	10/26/56	Shot
23	527-5890	Boas Riv. Delta	8/4/56			N. Emmetsburg, Ia.	10/26/56	Shot
24	527-58985	Boas Riv. Delta	8/4/56			Emmetsburg, Ia. No.5 Isl. Lake	10/25/56	Shot

TABLE IV BLUE GEESE RECOVERED IN IOWA (Cont.)

Map No.	Band No.	Banded At	Date	Age	Sex	Taken At	Date	Remarks
29	527-46786	Boas River	8/2/53			Bagley, Ia.	10/31/58	Shot
30	527-48137	Boas River	8/2/53			Forney Lake	11/15/58	Shot
31	527-24746	Boas River	8/2/52			Crane Creek Denver, Ia.	10/26/58	Shot
32	587-54269	Squaw Cr.Ref.,Mo.	11/28/57			Forney Lake	10/16/58	Shot
33	527-56350	Boas Riv. Delta	8/4/56			Missouri Valley	10/19/58	Shot
34	597-39344	E. Bay, Southhampton Island	7/20/57			Onawa, Iowa	10/12/58	Shot
35	587-50709	Squaw Cr.Ref.,Mo.	12/12/56			McPaul, Ia.	10/9/58	Shot
36	597-39722	E. Bay, Southhampton Island	7/22/57			Thurman, Ia.	10/18/58	Shot
37	587-54295	Squaw Cr.Ref.,Mo.	11/30/57			Burlington, Ia.	10/25/58	Shot
38	527-48425	McConnell Riv. N.W.T.	7/30/54	Ad		Onawa, Ia.	10/6/58	Shot
39	527-59385	Boas Riv. Delta	11/4/56			Ocheyedan, Ia.	10/7/58	Shot
40	527-22191	Boas Riv. Delta	7/26/52			Whiting, Ia.	11/53	Shot
41	527-43761	Boas Riv. Delta	7/31/53	Ad		Onawa, Ia.	10-15/21/54	Shot
42	527-41136	Boas. Riv. Delta	7/12/53			Creston, Ia. 6mi. NW	10/25/54	Shot
43	527-22595	Boas. Riv. Delta	7/1/52	Ad		Bartlett, Ia.	10/19/54	Shot
44	587-54735	Squaw Cr.Ref.,Mo.	10/26/59			Hamburg, Ia.	10/26/59	Shot
45	587-18060	Squaw Cr.Ref.,Mo.	11/16/56			Davis City, Ia.	11/24/58	Shot
46	587-18070	Squaw Cr.Ref.,Mo.	11/17/56			Rush Lake, Palo Alto, Co.	11/2/58	Shot
47	508-70675	Crex Meadows, Grantsburg,Wisc.	7/10/58			Amana Lily Pond	11/7/58	Shot

A BRIEF SUMMARY OF QUANTITATIVE CREEL CENSUS DATA FOR THREE DICKINSON COUNTY LAKES 1956.- 1960

by
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Fisheries Biologist

Quantitative methods of estimating angler harvest have been used on Spirit Lake since 1956 and on East Okoboji and West Okoboji Lakes since 1957. Detailed outlines and brief summaries of the methods used to collect and process the data have appeared in previous seminars. Tables one through eight present the basic data for these lakes since the comprehensive type of census has been in effect.

For the purpose of this summary the fishing season was separated into open water fishing period and ice covered or winter fishing period. The total catch, both in numbers and pounds, along with the total number of fishing trips (number of anglers), a total hours, fish per man, fish per hour, and pounds per acre removed are also recorded in each table for each period. Detailed information concerning the catch by month, boat and shore fishing, as well as the success of the weekend fisherman as opposed to the week day fisherman, is on file at the biology station at Spirit Lake.

The evaluation of creel census figures is time consuming, detailed work, but is also a basic need in present day fish management. A thorough evaluation requires a knowledge of factors other than how many men caught how many fish. Water levels, weather, species composition, year class strength, and quantity of potential food are but a few of these factors. Only a few features concerning the data and related factors will be pointed out for each lake.

EAST OKOBOJI LAKE

A severe winter mortality of fish in East Okoboji Lake during 1955-56 brought about a decided change in the fish populations of this lake. The 1956 year class of bullheads that developed has dominated the fishery to the present date. The removal of over 500 pounds of bullheads per acre during the past season has improved the growth rate those remaining. Results of this management should show up in an increased reproduction of other species of game fish that have been depressed during the past four years. The larger size of the bullheads should bring about an increased harvest by fishermen.

This 1400 acre lake furnished over 500,000 hours of fishing recreation during the past three years, or about 120 hours per acre per year. In spite of a bullhead dominated fishery the fishing on East Okoboji Lake has been average or better for the past three years that comprehensive census data has been collected (Table 1.) The relatively small size of the bullheads caused the fishing pressure to drop each year during the past three years but in spite of this the lake produced an average of nearly 70 pounds per acre per year in hook and line harvest. One of the highlights of the past three seasons was a harvest of some 10,000 walleyes weighing over eight tons during the 1958 season, representing a 10 pound per acre harvest from a predominately bullhead lake.

Winter fishing success gradually improved over the past three seasons, due mostly to an increased catch of bluegills. Bluegills have increased from about eight per cent of the winter catch in 1957-58 to nearly fifty per cent of the catch in each of the last two periods. The walleye catch dropped from an average of about 5,000 per winter season to 2,500 in 1959-60. Apparently perch fishing has remained nearly constant through the three seasons although the average size of the fish declined somewhat. The catch of northern pike has shown a steady decline for the open water period.

Over the three year period of 1957 through the winter of 1959-60 West Okoboji Lake has been one of the key spot in the conflict between speed boats and the fishermen. In spite of this, the total hours of boat fishing on this lake increased from 188,000 hours in 1957 to 224,000 hours in 1958 then dropped off to 158,600 hours in 1959. The drop in boat fishing in 1959 can be related directly to inclement weather during the last three months of the open water period (September, October, and November), months that normally show a relatively high number of hours of boat fishing (Table 9). In comparing the number of boat fishing hours for the months of June, July and August, the period of greatest speed boat use, we find the greatest variation in the month of July. There was an increase of 15,000 hours of boat fishing in July of 1958 overthat of 1957 and a 13,000 hour decrease for the same period in 1959. Similar variations occured in the other two months from one year to the next but not of that magnitude. Hours of boat fishing for the three months as a single period of fishing indicated a 20 per cent increase from 1957 to 1958 and a 26 per cent decrease from 1958 to 1959.

Recreationwise the lake furnished well over one million hours of fishing in the past three years, winter and summer combined; over half of these hours were recorded as boat fishing hours.

There is little or no winter fishing on this lake, therefore, no ice fishing records were kept.

SPIRIT LAKE

Iowa's largest natural lake (5,684 acres) was the first to have comprehensive creel census methods applied to estimate the total angler harvest. This method was inauguarated in the summer of 1956.

Although 1956 will be remembered by many as having the best walleye fishing in the last 6 or 7 years, the average fisherman caught only 0.6 fish per hour and 1.7 fish per trip during the open water period, (Table 2). The nortoriety of the walleye fishing resulted from fifty per cent of the 31,000 walleyes taken during the open water period of 1956 being taken during the month of June.

Fishing success, as meas ured by the average number of fish per hour, has gradually improved over the past four seasons of open water fishing, reaching a high of 1.60 fish per hour for the 1959 season. Fishing pressure dropped somewhat during the same four year period. The walleye catch has declined each year since 1956. Bullheads made up 52 per cent of the total catch of all fish taken from Spirit Lake in the past four years, including winter fishing. Bullheads made up 69 per cent of the catch for the open water period of 1959. Other species have fluctuated from year to year with no definite pattern shown.

The fish per hour catch during the winter periods remained almost stable during the past four seasons. The total catch increased each season for three periods then dropped drasticly in the 1959-60 season. Walleyes made the greatest gain, particularly in poundage. They made up about two thirds of the total weight of the fish caught during the winter periods of 1957-58 and 58-59. The catch of yellow perch was relatively constant during the first three seasons but dropped to about one-seventh of the former seasonal numbers this past winter (Tables 2,3,4, and 5).

Winter fishermen spent 113,946 hours trying to catch fish through the ice during the past four seasons. This represents twelve per cent of the total hours of fishing recorded for Spirit Lake during the past four complete seasons.

WEST OKOBOJI LAKE

Iowa's second largest natural lake (3,939 acres) has produced remarkably constant fishing success during the open water period of the past three seasons (Table 6,7,and 8). There was a slight increase in the success recorded in 1959 in spite of the fact that fishing pressure was somewhat lower than in former years. The catch by species has flucuated relatively little during the open water fishing periods. Three pan fish species, bullhead, perch, and bluegill, in that order of importance, have dominated the hook and line fishery each year during the open water period. The walleye catch was moderate and fairly consistent, varying from approximately 11,000 fish in 1957 and 1958 to 7,000 in 1959. Anglers removed over 217,000 pounds of bullheads during the past three seasons, an average harvest of about 18 pounds per acre per year.

Table No. 2. Total harvest of fish by species, as estimated from quantitative creel census data from Spirit Lake during both the open water and winter fishing Periods of the 1956 - 57 season (May 1956 through February 15, 1957).

	Open Water		Winter	
Species	Number	Pounds	Number	Pounds
Bluegill	345	133	0	0
Crappie	5,926	3,386	667	433
Walleye	31,215	43,399	2,060	3,641
Bullheads	91,097	47,721	0	0
L.M. Bass	609	920	7	35
S.M. Bass	51	68	9	27
White Bass	1,524	1,517	18	27
Northern Pike	609	1,829	66	591
Yellow Perch	17,783	10,052	14,254	8,543
Sheepshead	2,192	2,083	0	0
Carp	62	235	0	0
Totals	151,413	111,413	17,081	13,297
Total Anglers	85,656		8,574	
Total Hours	254,997		29,390	
Fish Per Trip	1.7		1.8	
Fish Per Hour	0.60		0.58	
Per Cent of catch by period	88.8		11.2	
Harvest in pounds per acre	19.2		2.3	

Table no. 1. Total angler harvest of fish from East Okoboji Lake during the summers of 1957, 1958, and 1959 (little or no winter fishing on this lake) as estimated from quantitative creel census data.

	1957		1958		1959	
Species	number	pounds	number	pounds	number	pounds
Bluegill	5,180	2,646	1,842	858	2,967	995
Crappie	1,271	731	2,235	932	5,009	1,875
Yellow Perch	6,367	3,428	4,474	1,855	2,025	730
Walleye	4,703	6,548	9,318	16,366	3,528	7,039
Bullheads	245,950	133,086	115,906	48,746	183,959	48,845
L.M. Bass	238	637	227	591	379	729
S.M. Bass	103	122	48	96	0	0
White Bass	551	170	421	145	246	177
Northern Pike	134	220	108	216	75	127
Channel Catfish	0	0	36	291	0	0
Sheepshead	2,003	2,899	3,163	5,734	1,348	2,931
Totals	266,500	150,487	137,778	75,830	199,536	63,448
Total Anglers	66,780		46,106		34,958	
Total hours	237,150		167,425		119,878	
Fish per trip	3.99		3.00		5.71	
Fish per hour	1.13		0.82		1.67	
Pounds per acre harvested	107		54		45	

Table No. 4. Total harvest of fish by species as estimated from quantitative creel census data from Spirit Lake during both the open water and winter fishing periods of the 1958 - 59 season (May 1, 1958 through February 15, 1959).

	Open Water		Winter	
Species	number	pounds	number	pounds
Bluegill	278	114	0	0
Yellow Perch	49,421	25,920	15,443	9,281
Crappie	5,658	3,127	1,258	785
Walleye	16,716	23,070	8,397	21,936
Bullhead	73,092	33,515	0	0
L.M. Bass	626	1,090	422	771
S.M. Bass	82	166	0	0
White Bass	4,692	3,171	82	70
Northern Pike	478	1,918	190	728
Sheepshead	4,736	6,804	18	65
Totals	155,779	98,895	25,808	33,636
Total Anglers	52,130		12,027	
Total Hours	155,928		39,714	
Fish Per Trip	2.85		2.14	
Fish Per Hour	0.99		0.65	
Per Cent of Catch by Periods	86		14	
Harvest in pounds per acre	17.4		5.9	

Table No. 3. Total harvest of fish by species as estimated from quantitative Creel census data for Spirit Lake during both the open water and winter fishing Periods of the 1957 - 58 season (May 1, 1957 through February 15, 1958).

	Open Water		Winter	
Species	Number	Pounds	Number	Pounds
Bluegill	535	209	0	0
Crappie	17,707	10,646	335	219
Walleye	24,426	21,953	5,694	12,494
White Bass	4,695	3,418	50	64
Northern Pike	405	1,570	112	766
Bullheads	50,489	36,911	0	0
L.M. Bass	254	494	65	220
S.M. Bass	27	40	0	0
Perch	30,922	17,358	13,928	4,874
Sheepshead	5,104	8,053	19	100
Totals	134,464	100,652	20,203	18,737
Total Anglers	70,940		10,007	
Total Hours	204,667		30,147	
Fish Per Trip	1.88		2.0	
Fish Per Hour	0.65		0.67	
Per Cent of Catch by Periods	87		13	
Harvest in pounds per acre	17.7		3.2	

Table No. 6. Total harvest of fish by species as estimated from quantitative creel census data from West Okoboji Lake during both the open water and winter fishing periods of the 1957-58 season (May 1, 1957 through February 15, 1958).

Species	Open Water		Winter	
	number	pounds	number	pounds
Bluegill	55,636	28,224	2,458	1,047
Crappie	9,225	5,252	991	545
Yellow Perch	110,917	58,701	17,915	8,143
Walleye	10,903	17,009	4,894	8,910
Bullheads	122,667	82,466	135	67
White Bass	5,079	2,390	50	89
L.M. Bass	511	927	129	223
S.M. Bass	3,151	6,324	188	416
Northern Pike	4,089	8,180	3,925	8,596
Sheepshead	8,168	12,863	48	58
Totals	330,346	222,346	30,733	28,094
Total Anglers	81,955		18,176	
Total Hours	270,143		69,001	
Fish Per Trip	4.03		1.69	
Fish Per Hour	1.23		0.45	
Per Cent of Catch by Periods	92		8	
Harvest in pounds per acre	56.4		7.1	

Table No. 5 Total harvest of fish by species as estimated from quantitative creel census data from Spirit Lake during both the open water and winter fishing periods of the 1959 - 60 season (May 1, 1959 through February 15, 1960).

Species	Open Water		Winter	
	number	pounds	number	pounds
Bluegill	501	256	0	0
Crappie	3,338	1,684	84	76
Yellow Perch	54,281	30,263	2,389	1,457
Walleye	16,743	24,582	4,165	6,205
Northern Pike	231	982	18	197
White Bass	2,504	2,441	121	179
L.M. Bass	724	1,660	15	29
S.M. Bass	159	244	20	48
Bullhead	210,039	82,562	0	0
Sheepshead	8,036	13,366	0	0
Totals	296,556	158,040	6,812	8,191
Total Anglers	61,036		4,999	
Total Hours	193,116		14,695	
Fish Per Trip	4.86		1.36	
Fish Per Hour	1.53		0.46	
Per Cent of catch by periods	98		2	
Harvest in pounds per acre	27.8		1.4	

Table No. 7. Total harvest of fish by species as estimated from quantitative creel census data from West Okoboji Lake during both the open water and winter fishing period of the 1958-59 season (May 1, 1958 through February 15, 1959).

Species	Open Water		Winter	
	number	pounds	number	pounds
Bluegill	72,887	28,435	20,318	6,345
Crappie	7,634	3,495	1,392	617
Yellow Perch	106,169	45,607	16,047	6,403
Walleye	10,609	13,953	5,111	10,238
Bullhead-	179,235	84,386	0	0
White Bass	1,845	1,464	249	355
L.M. Bass	579	1,017	189	255
S.M. Bass	3,041	6,881	82	183
Northern Pike	5,023	9,600	1,401	2,312
Sheepshead	11,632	21,804	0	0
Totals	398,654	214,642	44,789	26,708
Total Anglers	94,814		14,872	
Total Hours	322,974		55,259	
Fish Per Trip	4.2		3.1	
Fish Per Hour	1.2		0.8	
Per cent of catch by period	90		10	
Harvest in pounds per acre	54.5		6.7	

Table No. 8. Total harvest of fish by species as estimated from quantitative creel census data from West Okoboji Lake during both the open water and winter fishing periods of the 1959-60 season (May 1, 1959 through February 15, 1960).

	Open Water		Winter	
Species	number	pounds	number	pounds
Bluegill	67,620	22,999	19,085	5,795
Crappie	14,736	6,346	772	369
Yellow Perch	94,073	36,097	16,607	6,617
Walleye	6,705	11,221	2,476	4,646
Bullheads	184,591	50,574	17	3
White Bass	422	554	34	40
L.M. Bass	1,255	2,045	283	694
S.M. Bass	3,053	7,388	415	975
Northern Pike	1,253	3,764	499	1,298
Sheepshead	5,056	10,488	0	0
Totals	378,764	151,476	40,188	20,437
Total Anglers	69,114		12,417	
Total Hours	237,419		47,444	
Fish Per Trip	5.48		3.31	
Fish Per Hour	1.6		0.89	
Per Cent of catch by period	91		9	
Harvest in pounds per acre	38.4		5.2	

Table No. 9. Total hours of boat fishing on West Okoboji Lake, tabulated by month for the three year period of 1957-59.

Month	Year		
	1957	1958	1959
May	7,289	12,624	12,182
June	24,149	30,775	21,425
July	35,323	50,787	37,300
August	48,596	47,841	36,193
September	43,520	44,144	29,567*
October	24,532	27,722	16,368*
November	4,303	10,381	5,555*
Totals	187,712	224,274	158,590

* Inclement weather but those hardy enough to take the weather caught 1.9 fish per hour in September, 1.59 fish per hour in October and 1.5 fish per hour in November.

Preliminary Growth Studies of Some Missouri River Sauger

by
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The sauger is rapidly becoming one of the most popular and important game fish species in the Missouri River, with large populations developing in some of the newly created cut-off lakes. For the past three years the sauger has supported a very successful ice fishery in certain of these cut-offs. (Robinson 1959)

This report will serve as a progress report on some of the age and growth studies currently being conducted on selected species of fish from the Iowa waters of the Missouri River.

Sauger scales were collected periodically during routine survey work in the Missouri River and the related cut-off lakes. Scales were also collected during creel census work when such fish were encountered in the fishermens creel. All sauger reported in this study were collected in the segment of the Missouri River from Council Bluffs, to Sioux City.

Total lengths and weights were obtained from all fish collected. All fish were weighed and measured while fresh.

Scales from 41 sauger were selected on a representative basis so as to completely cover the total length and weight range of the fish collected to date. Several scales from each fish were mounted between two microscope slides and "read" with the aid of a microprojection device.

The age of each fish was determined by the presence or absence of annuli. Little difficulty was experienced in determining the respective ages of the fish in this sample.

The procedure recommended by Hile (1948) was followed because many of the scale samples for this study were obrained in January or February from the creels of ice fishermen. This consists of assigning the first of January as the birthday of all fish and crediting all fish taken in the first part of the year with an annulus at the edge of the scale whether it is formed or not.

Calculated total lengths at the time of the formation of each annulus were computed by the use of tagboards and a nomograph in a manner described by Carlander and Smith, (1944). Table 1.

A comparison of growth rates of sauger in other areas with those of the Missouri River shows that growth in the Missouri River may be considered good. In a similiar study on the Mississippi River conducted by the Upper Mississippi River Conservation Committee in 1946, sauger were found to reach calculated dotal lengths of 5.3, 10.8 and 14.5 inches at ages I, II, III and IV respectively.

Van Oosten (1948) found sauger from Lake of the Woods, Minnesota to be even slower growing, reaching an average calculated total of only 10.8 inches at the end of four years of growth.

A study of sauger growth in some newly impounded TVA storage reservoirs by Stroud (1949) showed growth rates slightly better than those of the Missouri River. He found sauger in Cherokee Lake to reach 9.3, 14.7 and 17.4 inches in length at the end of three growing seasons.

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Table I Computed Total Lengths of Sauger at the Time of Formation of Each Annulus.

Age Group	Total Length At Capture	Computed Length at I	Computed Length at II	Computed Length at III	Computed Length at IV
0	4.9	-	-	-	-
0	5.3	-	-	-	-
0	6.1	-	-	-	-
0	7.2	-	-	-	-
0	8.5	-	-	-	-
I	8.5	5.0	-	-	-
I	9.4	6.7	-	-	-
I	9.5	6.8	-	-	-
I	10.3	5.9	-	-	-
I	10.6	7.3	-	-	-
I	10.8	6.3	-	-	-
I	11.6	7.3	-	-	-
I	11.6	5.7	-	-	-
I	12.0	9.6	-	-	-
I	12.1	7.8	-	-	-
I	12.2	7.8	-	-	-
I	12.4	6.0	-	-	-
I	12.4	5.9	-	-	-
I	12.6	9.0	-	-	-
I	12.7	7.0	-	-	-
I	12.8	6.3	-	-	-
I	14.1	7.5	-	-	-
II	12.0	9.0	-	-	-
II	12.3	6.3	12.3	-	-
II	12.4	6.0	11.1	-	-
II	13.6	7.3	12.6	-	-
II	13.6	6.9	12.5	-	-
II	14.1	7.5	12.0	-	-
II	15.5	8.2	13.6	-	-
II	16.4	7.7	12.9	-	-
II	17.2	8.7	12.7	-	-
II	17.3	7.2	13.0	-	-
II	17.5	9.0	14.0	-	-
III	16.0	10.2	13.5	16.0	-
III	17.3	11.3	14.8	17.3	-
III	17.5	7.1	13.6	17.5	-
III	18.0	6.3	14.2	18.0	-
III	19.3	8.0	14.4	17.1	-
IV	18.5	6.5	12.1	15.4	18.5
IV	18.5	7.5	13.8	16.2	18.5
IV	18.8	7.1	12.7	16.1	18.8
Average Total Lengths (Computed)		7.6	13.1	16.7	18.6
Range		5.0-11.3	11.1-14.8	15.4-18.0	18.5-18.8

FALL FISH POPULATIONS BY SHOCKING CENTRAL IOWA STREAMS 1954 THROUGH 1959

by
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Fisheries Biologist

During the fall of 1959, the fish inhabitating several Iowa streams were surveyed by electrical shocking methods. This has been an annual activity since 1954.

The streams surveyed include the Des Moines from the city of Des Moines to its forks in Humboldt county, the East and West Fork of the Des Moines, the Boone, and the North Raccoon rivers.

Equipment used in making the survey consista of a 210 v. alternating current generator mounted in a boat equipped with an outboard motor. Three forward-projecting booms with drop-electrodes introduce an electrical field into the water ahead of the boat. In operating the unit, one man runs the outboard and directs the path of the boat, while the second stands in the bow and logs the fish by species as they appear at the surface.

Areas ranging from approximately one-fourth to one mile in length, and separated from each other by segments of stream varying from 10 to 20 miles, are surveyed each fall. The survey areas are extensive enough to contain in nearly proportionate amount the important habitat types occurring in the stream. Thus the information recorded at a station will apply to the stream both above and below, and the totals from all stations on a particular river will be indicative of the fish population for that stream.

The surveys are conducted in the fall for a number of reasons: (1) during that season water stages are more comparable from one year to the next than at any other time; (2) because water stages are low, fish are confined in the pools and are not likely to escape the electrical field; and (3) by this time of year the forces that establish or limit fish populations have run much of their course. Therefore, fall populations are believed to be representative of the capacity of a stream to produce fish.

In addition to the number and species of fish recorded at each station, data including the amount of shocking time, stream stage (rising, falling, stable), water temperature, turbidity, and other special circumstances that occur are logged.

Counts include only adults and advanced sub-adults. Forage and young fish are excluded from the census since it is impossible to count and identify the vast number of these little fishes as they appear in the electrical field.

In the early stages of the project it was thought best to evaluate the population on the basis of the number and species shocked by units of time, i.e., the number of individuals shocked per minute. As the survey progressed, this measurement was found to be impractical. For reasons unknown, rate of success varied so widely that it was virtually impossible to obtain meaningful results.

Populations are now evaluated by the frequency of occurrence method. In this work the population is based upon the number of times a species appears per thousand fish turned by the shocker; species that occur less than once per thousand are regarded as insignificant to the economy of the stream, and are not reported. With a few reservations, the frequency of occurrance method used in this study shows quite adequately both species composition and trends in the various specific populations.

Because only fish of substantial size (sub-adults and adults) are recorded, the bias of small fish having equal importance to large fish is minimized. It is believed that the exclusion of the small fish from the inventory reflects a truer picture of the standing composition of a stream.

Even though it is recognized that some species respond to shocking differently from others, work employing chemicals to eradicate stream fish (Harrison, unpublished data, 1956 and 1958) indicates that this difference is not as important as formerly suspected. The abundant species (carp, a variety of suckers, and channel catfish) reveal comparable composition both by shocking and chemical treatment.

An exception to this would probably occur in the case of the walleye. We have not treated streams with chemicals inhabitated by walleye pike, but a general knowledge of stream fish populations gained through 15 years of experience leads to a strong suspicion that walleye do not generally compose as large a block of the population as indicated by the shocker.

DATA

The structure of the fall fish population for the years 1954 through 1959, as revealed by electrical shocking in the previously named streams, is given in Tables I through V. These Tables show the number of occurrences of each species or closely related species per thousand fish shocked.

Table 1. Structure of Fish Population By Fall Shocking Boone River; Based on Per Thousand Fish Shocked 1954 Through 1959.

Species	1954	1955	1956	1957	1958	1959
Carp	241	256	360	422	442	479
Carpsucker (Carpiodes)	551	584	604	528	501	379
Redhorse (Moxostoma)	162	145	34	45	49	122
Buffalo	---	---	---	---	---	---
Channel Catfish	29	5	1-	5	6	15
Walleye	---	---	---	1	---	---
Smallmouth Bass	16	9	---	---	2	4
Crappie						

Table II. Structure of Fish Populations By Fall Shocking West Fork of Des Moines River; Based on Per Thousand Fish Shocked 1954 Through 1959.

Species	1954	1955	1956	1957	1958	1959
Carp	748	573		469	394	511
Carpsuckers (Carpiodes)	138	236		373	435	368
Redhorse (Moxostoma)	60	34		77	77	38
Buffalo	4	292		---	---	15
Channel Catfish	26	45		23	32	17
Walleye	19	38		59	55	46
Smallmouth Bass	3	41		---	---	---
Crappie	2	4		---	6	5

Table III. Structure of Fish Populations By Fall Shocking East Fork of Des Moines River; Based on Per Thousand Fish Shocked 1954 Through 1959.

Species	1954	1955	1956	1957	1958	1959
Carp	482	493	504	403	444	386
Carpsuckers (Carpiodes)	332	396	430	432	322	441
Redhorse (Moxostoma)	115	54	40	76	127	108
Buffalo	6	6	4	9	---	11
Channel Catfish	28	15	6	9	44	24
Walleye	28	25	16	52	34	29
Smallmouth Bass	6	---	---	---	22	---
Crappie	1	10	---	17	7	2

Table IV. Structure of Fish Populations By Shocking North Raccoon River Based on Per Thousand Fish Shocked 1954 Through 1959.

Species	1954	1955	1956	1957	1958	1959
Carp	190	394	303	376	333	568
Carpsuckers (Cariodes)	720	480	455	491	420	170
Redhorse (Moxostoma)	30	42	151	193	190	204
Buffalo	20	12	---	1	4	3
Channel Catfish	30	30	78	32	40	43
Walleye	3	29	1	1	1	1
Smallmouth Bass	2	7	8	---	---	2
Crappie	2	1	1	---	3	8
Flathead	4	5	3	5	10	1

Table V. Structure Fish Population By Fall Shocking, Main Stem of Des Moines River, Scott Street Dam, City of Des Moines to Forks in Humboldt County; Based on Per Thousand Fish Shocked 1954 Through 1959.

Species	1954	1955	1956	1957	1958	1959
Carp	279	226	291	324	245	262
Carpsuckers (Carpiodes)	509	455	521	416	477	471
Redhorse (Moxostoma)	99	120	120	181	177	194
Buffalo	10	21	4	5	11	8
Channel Catfish	70	130	40	43	56	37
Walleye	20	19	11	16	17	12
Smallmouth Bass	7	12	5	2	3	2
Crappie	2	3	2	3	4	8
Flathead	5	14	6	9	10	7

DISCUSSION

Analysis of the data point toward several generalizations regarding the fish populations in central and north central Iowa streams.

Stream fish populations are continually dominated by rough fish composed of carpsuckers Carpiodes sp., carp, and suckers largely of the Moxostoma group. These populations vary inversely with one another. Carp and carpsuckers make up the large preponderance of total population. In total, rough fish comprise more than 90% of Iowa's warm water stream fishes.

Game fish populations, principally channel catfish and walleye, remain almost constant but are usually at low levels because of the suppressive effects of the cominant populations of coarse fish. Smallmouth bass, crappie, flatheads, and smallmouth buffalo persist as vestiges; it is postulated that these populations are composed of hardy individuals that have sought out and occupied niches to such an extent that no amount of suppression now exerted by other species can destroy them.

A further point of significance should be mentioned with respect to the low occurrance of game fish; although they constitute only 5 to 10 per cent of the total population, the fact that the rivers reported upon here have fish populations that number in the thousands per miles of stream, indicate that game fish must also occur is substantial numbers in the same distances.

SUMMARY

The data resulting from this work reveals the following; (1) in combination, the ratio of all species of rough fish to all species of game fish remain quite constant from year to year: (2) rough fish dominate the population to an extent in excess of 90% of the total population; (3) game fish populations are generally quite stable and remain at low levels: (4) major variations occuring in stream fish compositions involve principally the carp and carpsuckers (Carpiodes sp.; 5) from the standpoint of abundance, carp or carpsuckers would rank at the top and would be followed in descending order by suckers composed largely of the redhorse Moxostoma sp., channel catfish, and walleye pike; (6) smallmouth bass, crappie, flathead catfish, and smallmouth buffalo persist almost as remnant species.

LITTLE CEDAR RIVER FISH ERADICATION
STACYVILLE, IOWA

by
Ben Davis, Tom Moen, Bill Tate

In February 1960 the Little Cedar River between the Iowa-Minnesota boundary and the village of Stacyville, Iowa was treated with toxaphene. This eradication of the fish population was initiated to reduce the competition for food and space for the desirable fish to be stocked as fry early this spring (1960). The impoundment at Stacyville had been drained during most of 1959 and is being filled to dilute the toxaphene used for fish eradication. The ten miles of stream between the state boundary and the dam at Stacyville had winter-killed heavily during the previous winter leaving a few rough fish. Subsequent reproduction was responsible for a fish population dominated by small carp.

A chemical dispenser consisting of two tanks connected through a pressure regulator was used to introduce the chemical. One tak was charged with toxaphene and the other with compressed air. The correct nozzle orfice and the pressure regulator were adjusted to secure the desired flow of chemical.

Treatment was initiated at 4:00 P.M. on 17 February and continued for a period of 45 hours more or less continously at 0.15 PPM (treatment was stopped at 1:00 P.M. on 19 February). The treatment station was 150 yds. downstream from the state boundary and approximately 10 miles above the dam at Stacyville. Test fish (bullheads) were placed 100 yards below the point of application and immediately above the dam. The rate of flow was measured and the gates of the dam were closed shortly after the treated water appeared at the dam (the average velocity was estimated at 1 ft. per second and flow at the dam at 6 cu. ft. per second.)

The test fish near the treatment site showed definite signs of distress at 3:30 P.M. on 18 February and were all dead (6 fish) at 9:30 A.M. on 20 February. Test fish immediately above the dam were noticeably affected at 11:30 A.M. on the 22 February and 22 of 24 fish were dead at 2:00 P.M. on 24 February, 6 days and 22 hours after treatment was initiated. (The 2 remaining fish were incapable of tactile response and showed barely discensable respiratory movements.)

The chemical dispenser used for this project required servicing every 3 to 4 hours. The chemical tank was charged with 4 to 5 quarts of toxaphene and a portable compression tank borrowed from a service station operator was used to charge the compressed air chamber to a pressure of 150 lbs. per sq. inch. The entire unit was placed under the ice so that the toxaphene did not freeze during application. This device worked well and with refinements of design and enlarged capacity should make winter fish eradication easy and efficient. (A toxaphene dispenser with adequate regulator and $6\frac{1}{2}$ gal. capacity would have to be serviced only every 8 hours when treating streams with a flow of 12 cu. ft. per second or less. Charged compressed air tanks could be carried to the treatment tank and connected by snap-on fittings after the toxaphene tank was filled).

Small feeder streams entering this reach of the Little Cedar River were treated with sponges saturated with toxaphene. The sponges were placed on 12 in. lengths of wire and pushed into the stream bottom in an area where the toxaphene diffused into running water. This treatment was apparently adequate.

The publicity program by the local Conservation Officer was excellent and is summarized below.

Conservation Officer Preparation's for Fish Eradication Project:

As soon as it was officially determined, several months prior to treatment, that we would proceed with a program of complete fish eradication in the Little Cedar River from the Iowa - Minnesota boundary to the dam at Stacyville, field contacts were begun in the area.

At every talk to organized groups, the plan was at least mentioned. Womens groups, of course, did not have the same interest in the project that sportsmen's or other male groups should but many of them did ask good and intelligent questions.

It was thought that even though the group might be a Tuesday Club, Womans Federated Club or some other nonsportsman group, the fact that they had asked the officer to talk to their group showed at least a general interest in Fish and Wildlife Conservation and a brief explanation would result in a more thorough understanding of the reasons for the project and the expected results.

The actual treatment date was set approximately two weeks in advance and a canvass was started immediately of all the farmers and landowners bordering both sides of the river to be treated. The plan was very briefly explained to them and they were advised that it was inconcievable that any damage could occur with treatment to be used and that they were being notified only as an added safeguard. They were asked not to allow stock watering during the time the treated water would be in their area.

The lower portion of the impoundment is adjacent to the town of Stacyville and teh town is host to the usual dogs and children that will, on occassion, play in water regardless of season or temperature. A house to house canvass was out of the question, so, with the very fine co-operation of the local newspapter a very simple block notice was placed in the paper one week before treatment was started. It was a simple notice of what was to be done, when it would start, what precautions could be taken and, where further information could be obtained. The notice advised that as the treatment progressed, anyone having questions could call either the newspaper officer or the local bank. These two places had very graciously consented to act as information outlets for the project. As the project progressed these places were kept up to date with the happenings.

All of the above efforts and arrangements might not have been necessary but, during the treatment period, and just prior to it, the entire project was completely acknowledged locally and was conducted with no evident criticism. The public was aware of what to expect with two local business places acting as call points to dispense timely information. In conjuction with any eradication project it would seem advisable that every effort should be made to carry out a pre-project education plan and establish at least one point that would take calls and give accurate information during the treatment period.

Despite annual variations in abundance in the various categories, the total carrying capacity is surprisingly stable, with the greates variation from the mean only slightly more than 10 per cent.

The sampling area used in calculating the 1956-58 data was reduced from the $3\frac{1}{2}$ mile sample area used in the 1954-55 "trout only" population work to just under 1 mile. This reduction was made with the support of the comparisons between spot checks and extended coverage on the same stream in 1954 and 1955. Indications were that a 20 per cent sample gave the same estimate of abundance as a 70 per cent sample. In addition, each of the three reaches (upper, middle and lower) of the stream was sampled, not in the "once-over" survey technique, but with multiple coverage attempts to remove as many of the fish as possible.

The expressed number of trout, suckers, and larger cyprinids (chubs and stone rollers) in Table 1 are more reliable than the smaller sized cyprinids, darters and sculpins, whose galvanotaxic reactions to the DC current, due to their small size, were not strong enough to insure recovery from under stones and in vegetation.

Further reference to the data in Table 1 reveals that the stream's carrying capacity for trout is not entirely a function of the weight of the other fish in the stream. These data indicate that to increase carrying capacity for trout in this stream may take a two-hase management program:

(1) Provide additional desirable trout habitat.
(2) Reduce non-trout competition, either directly by mechanical or chemical removal, or indirectly by bolstering the trout competitive pressure through the success of phase 1.

Since numerical or weight comparisons between streams are impractical unless they are similar physically and biologically, a qualitative comparison on a major species grouping basis seems the most reasonable approach. Unless the streams compared are of the same general type and in the same area, even this gross comparison is open to serious error.

The Root River system (18 streams) is a renowned trout area in southereatern Minnesota, in the same so-called "driftless area" as is French Creek and only about 30 miles north of the latter. Data as to the per centage by weight by groups as furnished by Smith et al (1946 1/ on the Root are 17% trout, 55% suckers, and 29% other species. For French Creek this qualitative break-down was 31% trout, 43% suckers, and 25% other species, a reasonable close comparison.

1/ Smith, Lloyd L. Jr., Raymond E. Johnson, and Lawrence Hiner. 1946. Fish Populations in Some Minnesota Trout Streams. Trans. Am. Fish Soc., 76: 204-214 (Pub. 1949)

CARRYING CAPACITY OF AN IOWA TROUT STREAM

by
R. E. Cleary
Fisheries Biologist

Iowa trout streams, despite their limited or complete lack of natural trout reproduction, are capable of sustaining a high carrying capacity because of the fertility of their watersheds. This capability, coupled with a realistic hatchery program and a year-around open season, draws many non-resident anglers from states with more publicized trout programs.

Iowa's trout waters are methodically restocked during the season of heavy use with trout seven inches or over in length; therefore it was decieded that an estimate made in late March would give the most reliable figure as to carrying capacity. Very few trout are stocked in Iowa streams in the four-month period prior to the end of March, despite the fact that Iowa has a "year-round" trout season.

The determination of carrying capacity on one of Iowa's better trout streams could serve two purposes. First, it would establish a criterion for future quantitative and qualitative stream comparison; and second, it would furnish a basis for evaluating either watershed management or other forms of stream improvement.

French Creek, in Allamakee County, qualified for this study on both items. The $4\frac{1}{2}$ miles of trout water in the stream contains the proper ecological conditions to rate it as a "good" trout stream. In addition, the Conservation Department had completed the purchase of most of the headwater drainage of the stream in 1954. Plans to stabilize the headwater lands were under way and post-stabilization plans for instream and bank improvements on the remainder of the stream were being considered.

In March of 1955, $3\frac{1}{2}$ miles of the $4\frac{1}{2}$ miles of the stream's trout water was censused with a 120-volt, 1500-watt, DC shocking device. Only counts of trout were made in this survey. An efficiency index, based on the capture of marked fish, was made subsequent to a routine, "once-over" survey, and it was determined that a "one-pass" or "once-over" coverage took only 59 per cent of the trout in the area covered. The original estimate of 91 trout weighing 40.6 lbs. per mile was then adjusted by the efficiency index to 154 trout weighing 68.7 lbs.

The validity of this estimate was substantiated in later attempts to establish a March carrying capacity for French Creek in that the March average wight of trout per mile was calculated at 67.1 lbs. for the years 1956 through 1958.

Table 1. March Carrying Capacity Per Mile on French Creek, 1956-58.

Year	Trout		Suckers		Cyprinids		Others		Totals	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
1956	246	59.8	282	80.0	1004	68.6	229	12.3	1760	221.9
1957	123	35.2	704	105.7	1988	52.8	70	1.8	2883	195.4
1958	352	116.2	334	89.7	668	22.8	---	---	1355	228.3
Aver.	240	67.1	440	91.5	1214	47.5	158	7.0	2058	216.4

WINTER CARRY-OVER AS AN EXPRESSION OF WINTER ANGLING AND/OR NATURAL MORTALITY OF TROUT

by
R. E. Cleary
Fisheries Biologist

Statistics gathered from 1953 to 1956 on trout streams in northeast Iowa provide information as to the effects of winter trout fishing on spring carrying capacities or winter carry-over.

The closed season on trout in Iowa was terminated on March 1, 1954, when year-around fishing became legal. This legislative action also terminated a two-year winter carry-over study in which the magnitude of natural winter mortality was being determined. The project was then altered to attempt a determination of the combined effect on spring density of both natural and angling mortality during the winter months.

Numerical determinations in all trout stream work during the years 1951-1956 were made through the use of an electro-fishing device having a 120-volt, 1500-watt, DC portable generator as a source of power.

In order to use the 1953-54 data on the streams in Table 1 as an accurate reflection of the winter carry-over of a season with no winter angling, it became necessary to adjust the figures to remove the bias of an April stocking of 500 trout per stream. The counts were adjusted by prorating the stocked fish equally over the stream's length and reducing the figure 35% to allow for natural loss due to winter and spring enviromental stresses. (This reduction figure was established in 1952 and 1953 on a group of eight test streams). The adjusted figures appear in parentheses under the March, 1954 column in Table 1. The adjusted carry-over of 63% closely approximates the 1952-53 area estimate of 65%.

Elk and Buck Creeks were chosen for this discussion because they were the only two streams of the eight used in establishing winter carry-over on which we had three year's continuous data -- before and after the year-around fishing season was established. The same stretches of each stream were sampled in each year under discussion.

Table 1. Winter Carry-over on Two Iowa Trout Streams, 1954 to 1956.

	1953-54			1954-55			1955-56		
Stream	Oct.'53 Count	Mar. '54 Count	Carry-over	Oct.'54 Count	Mar.'55 Count	Carry-over	Oct.'55 Count	Mar.'56 Count	Carry-over
Elk Creek	86	42(30)	49% (35%)	116	64	55%	72	22	30%
Buck Creek	29	53(43)	183%(148%) / 83% 63%	37	29	78% / 61%	35	22	63% / 41%

If we assume the 1953-54 figure of 63% to be a reliable estimate of an "unfished" winter carry-over (as it certainly seems to be), than we can say that the March carrying capacity would be reasonably similar whether the stream was stocked and fished during the winter or not. The average carry-over for the two years (1955 and 1956), having a 12-month open season, was only 19% below that having a 7-month open season.

We can conjecture that the nearly 20 per cent reduction in spring numbers after the population has been dubjected to winter angling is the tangible evidence of angler take. It is also conceivable that a reasonable portion of the balance of the winter fish loss was the result of angling -- at least another 20 per cent!

With a fixed annual loss of 35 per cent, even if the angler utilization is only 20 to 40 per cent of this loss, winter angling is economically justified. These fish are almost all the product of our hatcheries and complete utilization would be desired, since our hatcheries and not residual brood stocks in the stream are the determinants of future trout fishing populations.

A COMPARISON OF THE GROWTH OF FOUR SPECIES OF FISH IN THREE DIFFERENT TYPES OF IOWA ARTIFICIAL LAKES

by
Jim Mayhew
Fisheries Biologist

The ultimate goal of fisheries management is to produce fish of harvestable size in the shortest period of time. Slow growing fish are neither desirable to the angler, nor adventageous to the fish population structure of a lake. Before fisheries management programs can be effective, expectations of maximum and/or minimum growth must be determined. These factors are easily established through limited comparative growth studies in waters of similar physican, chemical, and biotic characteristics.

Since 1944, the annual fisheries inventory of reproduction and adult fish populations has served as the major tool for artificial lake management. Limited studies of growth characteristics of major species of fish are an integral part of these surveys. Approximately 10 or 20 scale samples are taken from representative year classes of fish in each impoundment. These scales are analyzed by microprojection for comparative rapidity of growth. Growth is determined by total length at a given age rather than by mathematical back calculations. Additional scales were also obtained from related projects, such as age and growth studies and creel censuses.

This study is concerned with the growth of largemouth bass, bluegill, white crappie, and black crappie in three different types of southern Iowa artificial lakes and reservoirs. Although this is not a complete list of sport fishes in the artificial lakes, these four are most popular and widespread. Periodically, other species such as channel catfish, bullheads, or perch may comprise a major segment of the fishery, but the number of samples was not sufficient to permit growth studies.

A total of 9,963 scale samples from 50 artificial lakes and reservoirs were used in this study. Samples were separated into lake classifications according to physican, chemical, and biotic characteristics as described by the author in Quarterly Biology Report, December 1959. Total length is used throughout the study. Weight and condition factor were also recorded for fish more than one year old, but are not included in the analysis. Maximum, minimum, and mean growth was calculated for each age group and recorded in graphical form. Lakes included in each group classification are as follows: (County location in parenthases)

Group I Cold Springs (Cass), Wapello (Davis), Nine Eagles (Decatur), Backbone (Delaware), Beed's (Franklin), Springbrook (Guthrie), Geode (Henry), MacBride (Johnson), Ellis, Red Haw Hill, Williamson (Lucas), Keomah (Mahaska), Viking (Montgomery), Dale Moffe (Polk), Union Grove (Tama), Thayer (Union), Lacy-Keosauqua (Van Buren), and Ahquabi (Warren).

Group II Binder (Adams), Upper Centerville (Appanoose), West Osceola (Clark) Fisher (Davis), Rock Creek, (Jasper), Fairfield No. 2 (Jefferson), Morris (Lucas) Diamond (Poweshiek), Loch Ayr (Ringgold), Cherry (Tama) Three Fires (Taylor), Green Valley (Union), Darling (Washington), Allerton, Humeston, and Corydon (Wayne).

Group III Nodaway (Adair), Old Corning (Adams), Lower Centerville (Appanoose), Moulton (Appanoose), Madrid (Boone), East Osceola (Clarke), Fairfield No. 1 Jefferson, Glenwood (Mills), Upper Albia, Lower Albia (Monroe), Mt. Ayr (Ringgold), West Lenox, East Lenox (Taylor), Afton, McKinley (Union), and Seymour (Wayne).

GROWTH

Largemouth Bass

The largemouth bass is a dual purpose species in Iowa artificial lakes. Not only is it important to the angler, but it is also a primary predator. without the predation of bass upon the vast bluegill and crappie populations impalances and stunting would be much more common. In every impoundment which bass populations are high and stable, overcrowding and stunting is relatively infrequent.

A total of 2,736 largemouth bass were used in the growth study. Of this sample 676 fish were captured in Group I lakes. Groups II and III were represented by 566 and 494 scale samples respectively. During the early years of life (age groups I through III) largemouth bass in Group I lakes were consistently longer at a given age than in any other group. After the fish reached four years old there is no significant difference in average total length or length range. (Figures 1,2, and 3).

Bluegill

In general, bluegills are the most abundant and widespread fish in the artificial lakes and reservoirs. It is also the species that causes overcrowding and stunting most frequently. This species was represented by 2,932 individual samples. The number of scale samples obtained from each group of lakes was as follows: Group 1, 1,158: Group II, 948, and Group III, 826. As indicated in Figure 4, bluegill growth, without exception, was greater in Group I lakes than in any other group. Correspondingly, fish in Group II (Figure 5) were larger at each age group than those in Group III (Figure 6) impoundments.

Black Crappie

A total of 2,266 black crappie scale samples were used in the study. Group I lakes comprised 970 of this total; whereas, Groups II and III made up 768 and 528 of the total samples respectively. With the exception of age group 0, there is no definite trend for fish in one group of impoundments to grow more rapidly than another. As an example; black crappie growth at age X may be greatest in one group of lakes, and at an older age be much smaller than the corresponding groups, (Figures 7,8,and 9). This is probably due to wide variations of black crappie ecology in the artificial lakes and reservoirs.

White Crappie

The white crappie is a relatively static species in Iowa artificial lakes and reservoirs. Angling success is definitely correlated with year class abundance. In turn, the success of year class abundance is dictated by the biotic and ecological conditions in each impoundment. One extremely abundant year class of white crappie is capable of supporting the fishery for several years. After the population has been exploited or reduced by angling and natural causes, several years may elapse before this species again becomes abundant.

A total of 2,029 scale samples were used to determine the growth of white crappies in this study. Of this, 750 were from Group I lakes. The other groups were represented by 695 and 584 samples respectively. As figure 10 indicates, maximum growth was attained in Group I lakes. Unlike the other species studied, growth, (except in age group 0) was greater in Group III than in Group II lakes (Figures 11 and 12).

DISCUSSION

There are many factors responsible for growth of fish in one lake exceeding that in another. Basic productivity and fertility are two of these factors. In this study growth of the four species of fish considered was consistently greatest in Group I. Fish in Group II lakes, with the exception of white crappie, also grew more rapidly than those in Group III impoundments. Since there is virtually no difference in the lateral location of these lakes, the difference in growth must be attributed to basic fertility and productivity.

Populations in Group I lakes are much more stable than any of the other groups. Fluctuations in population structures are infrequent, and usually temporary occurrence. The most serious problems are stunting of bluegill or crappie, or in rare cases over exploitation of predators.

The fish populations in Group II lakes have a tendency to flucuate more rapidly and to a greater degree than Group I lakes. However, they are more stable than Group III lakes. Overcrowding and stunting develops rapidly when abundant year classes develop. This is more severe when two successive strong year classes occur.

Adult crappie and bluegill populations are extremely static in Group III lakes. The variations of population density also vary considerably in a short period of time. One species will dominate the population structure for a short period (two or three years), and then be replaced by the other species, or in some instances by a secondary year class. In many cases the stunted year class will be accompanied by a high population of extremely large specimens of the same species. Reproduction of the opposing species is very poor in the meantime. Fisheries management is required constantly in most of the lakes in this group.

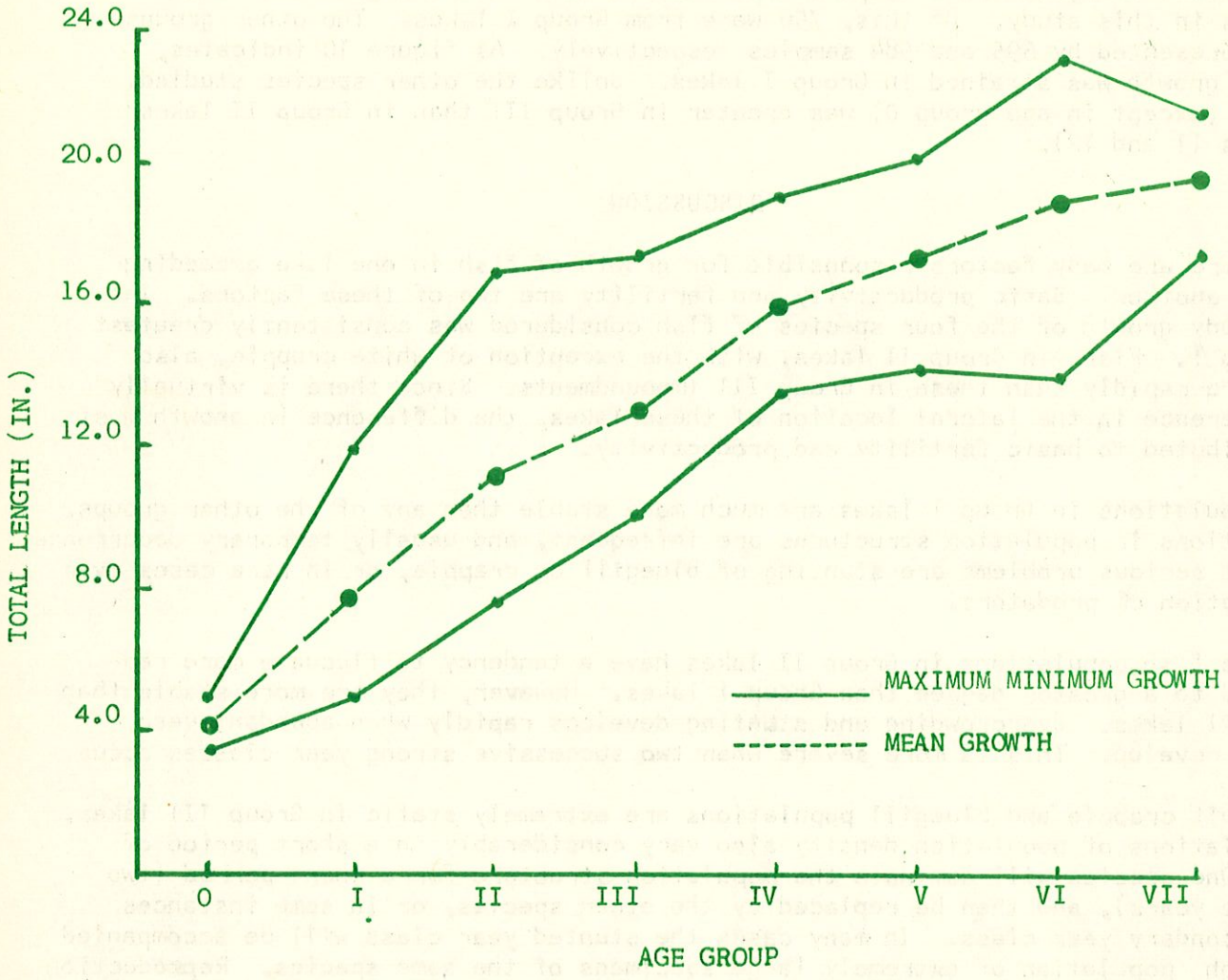


FIGURE 1. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 1,676 LARGEMOUTH BASS FROM GROUP I ARTIFICIAL LAKES.

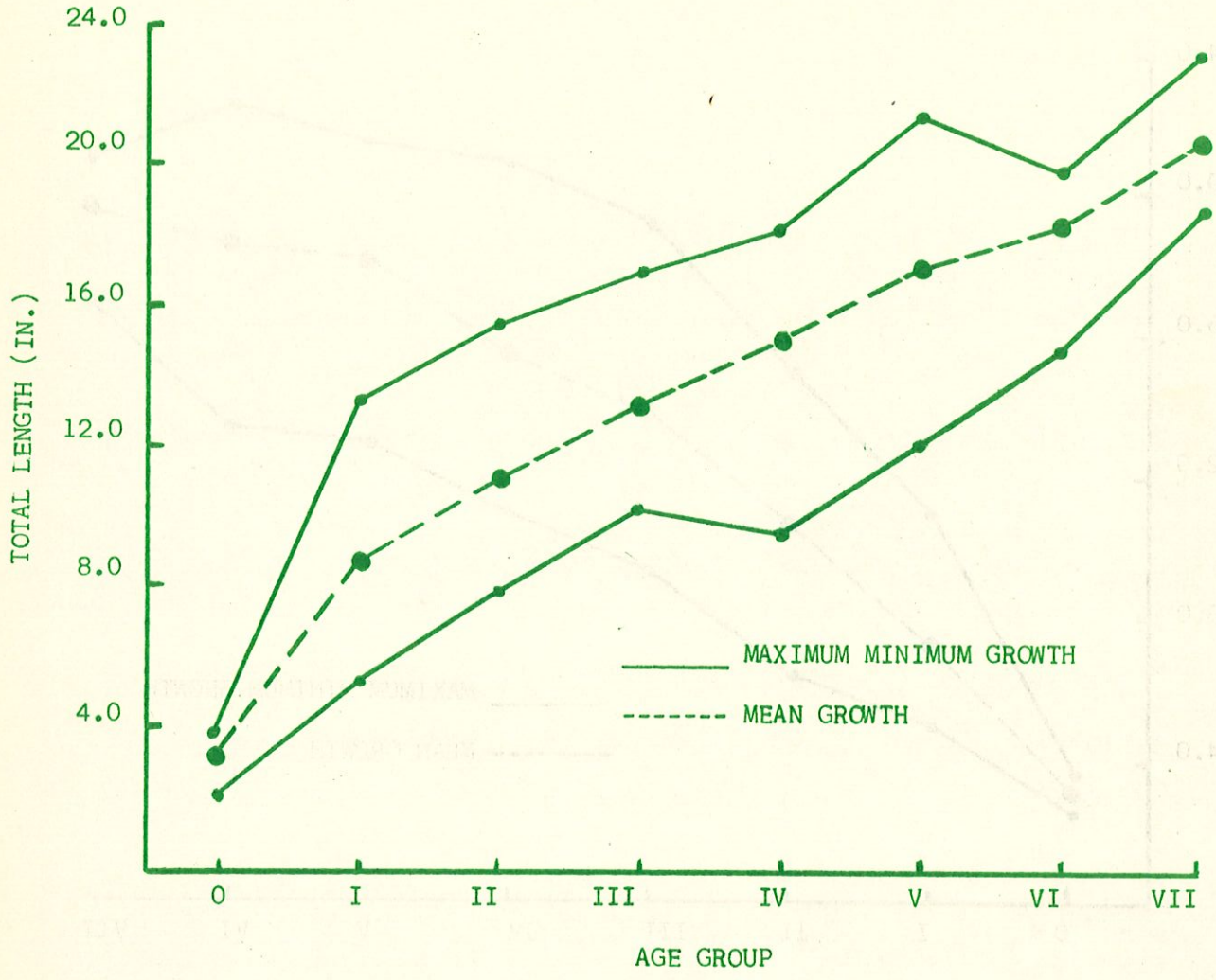


FIGURE 2. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 566 LARGEMOUTH BASS IN GROUP II ARTIFICIAL LAKES.

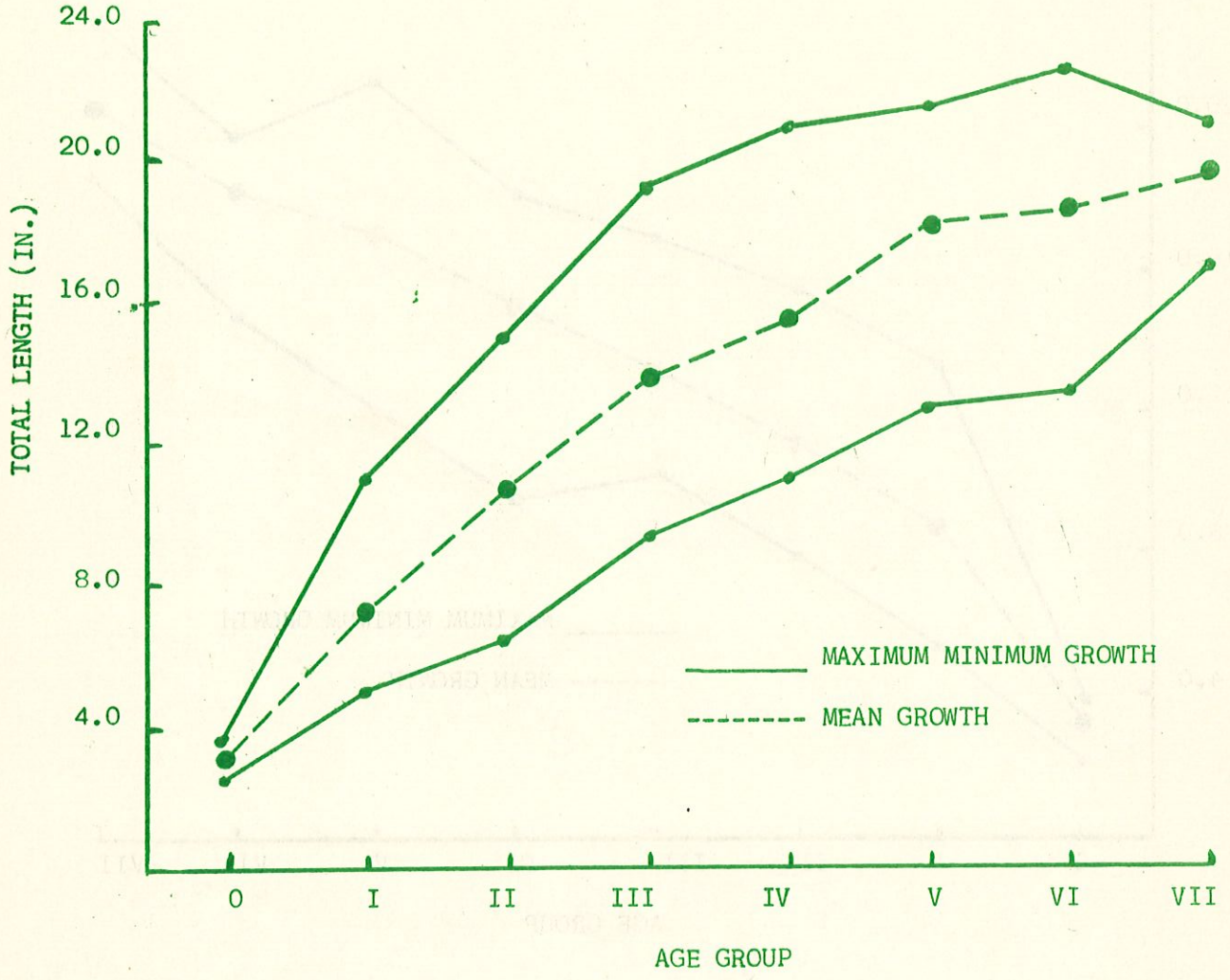


FIGURE 3. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 494 LARGEMOUTH BASS IN GROUP III ARTIFICIAL LAKES.

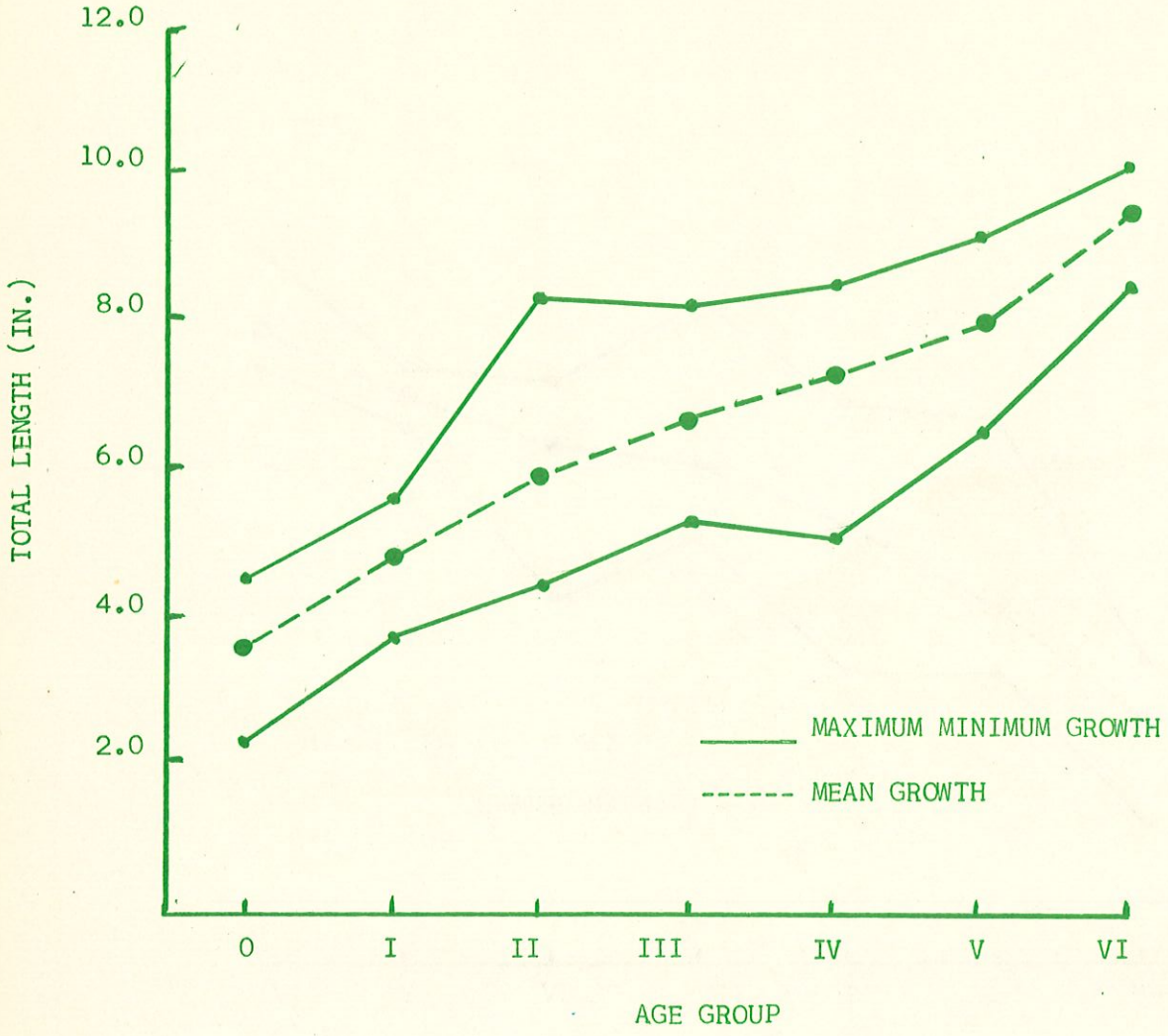


FIGURE 4. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 1,158 BLUEGILLS IN GROUP I ARTIFICIAL LAKES.

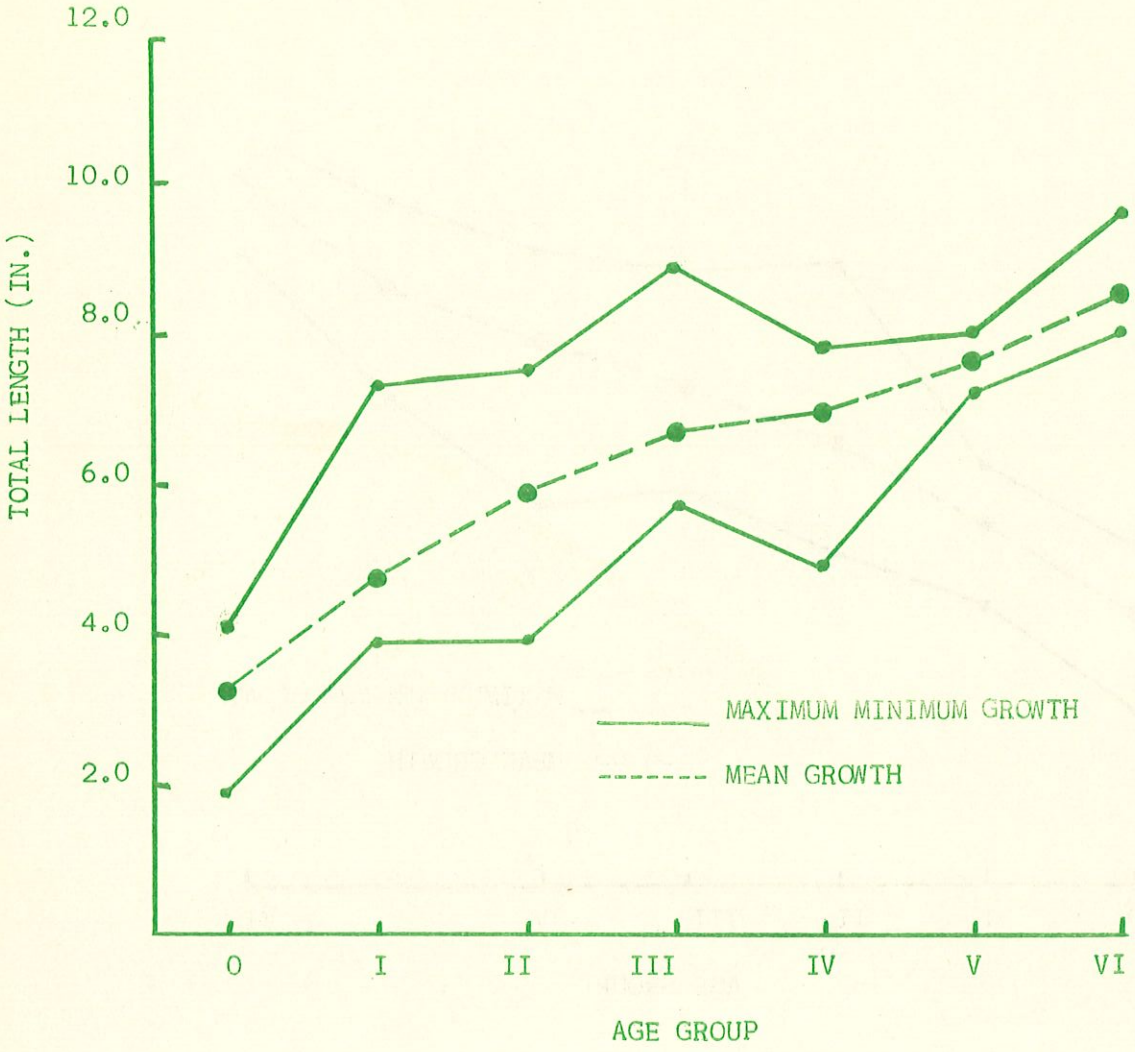


FIGURE 5. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 948 BLUEGILLS IN GROUP II ARTIFICIAL LAKES.

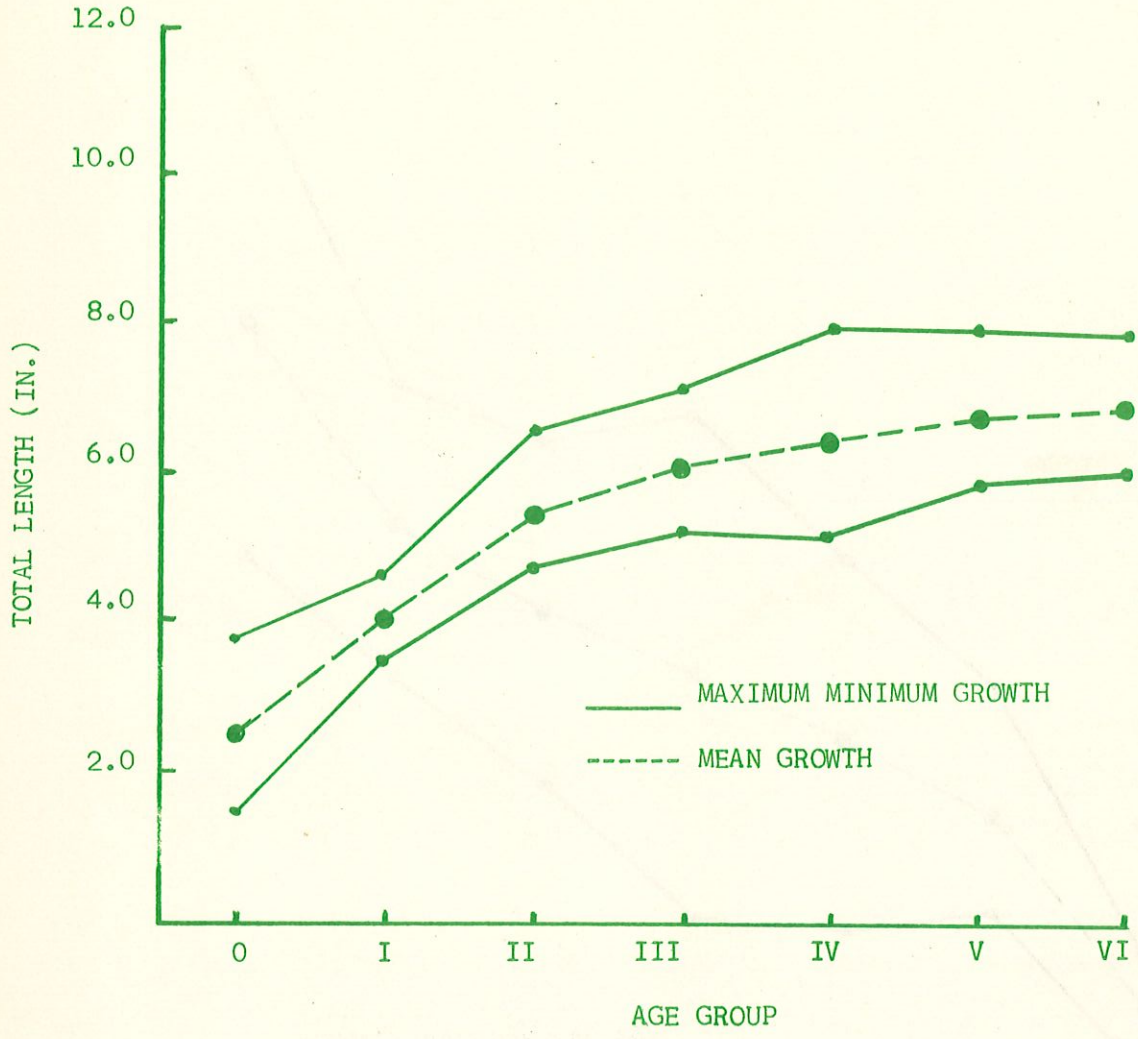


FIGURE 6. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 826 BLUEGILLS IN GROUP III ARTIFICIAL LAKES.

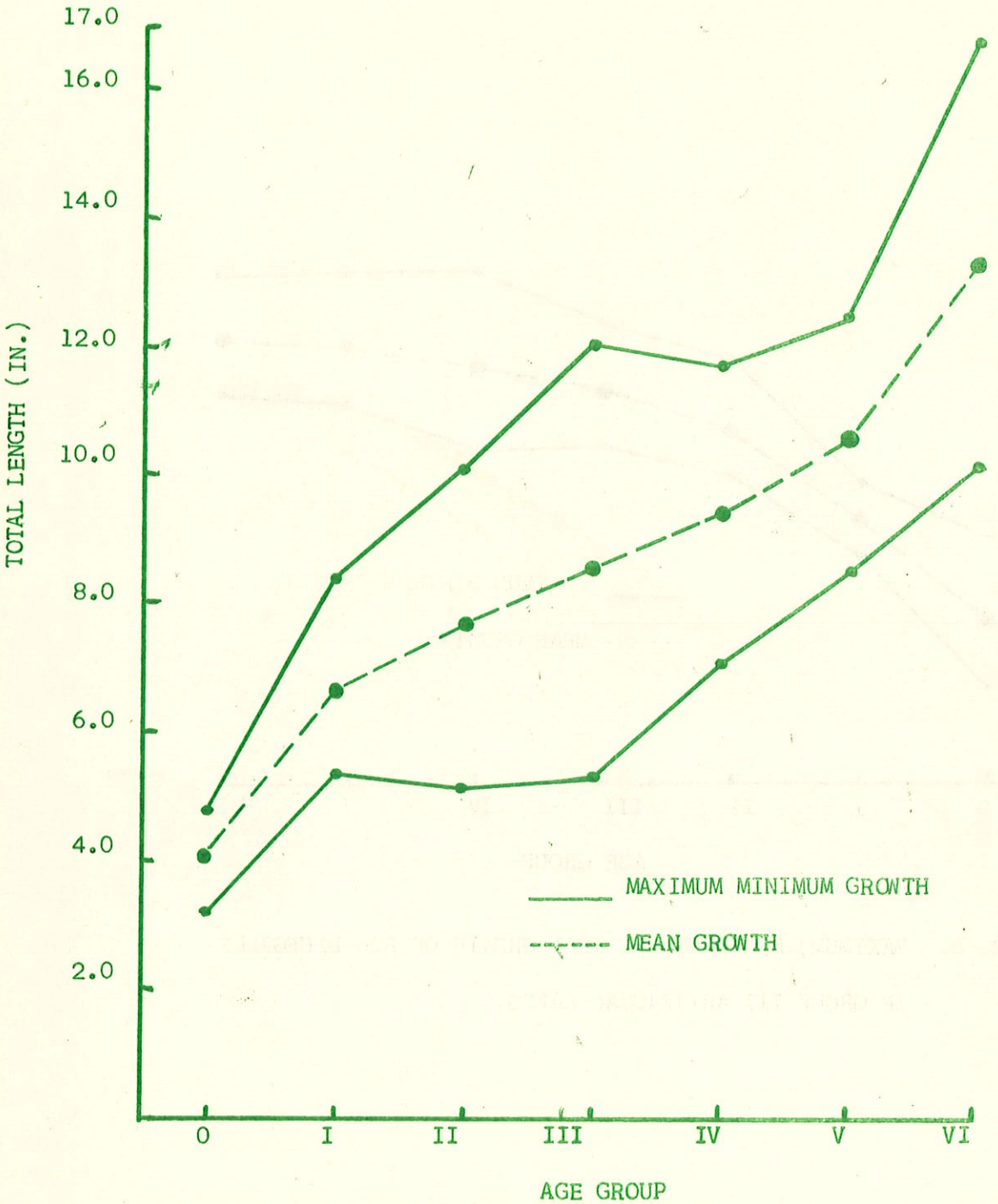


FIGURE 7. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 970 BLACK CRAPPIE IN GROUP I ARTIFICIAL LAKES.

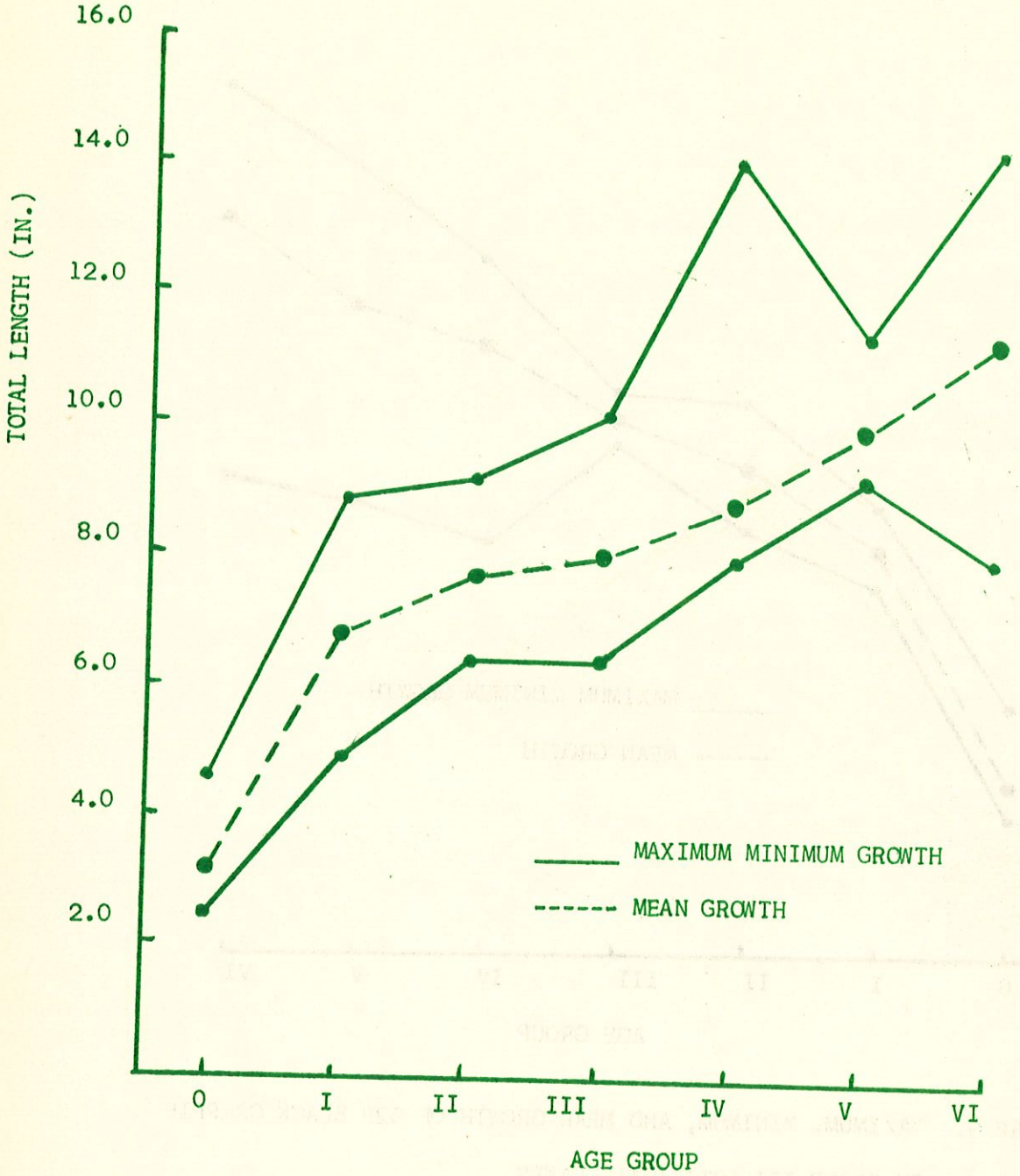


FIGURE 8. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 768 BLACK CRAPPIE IN GROUP II ARTIFICIAL LAKES.

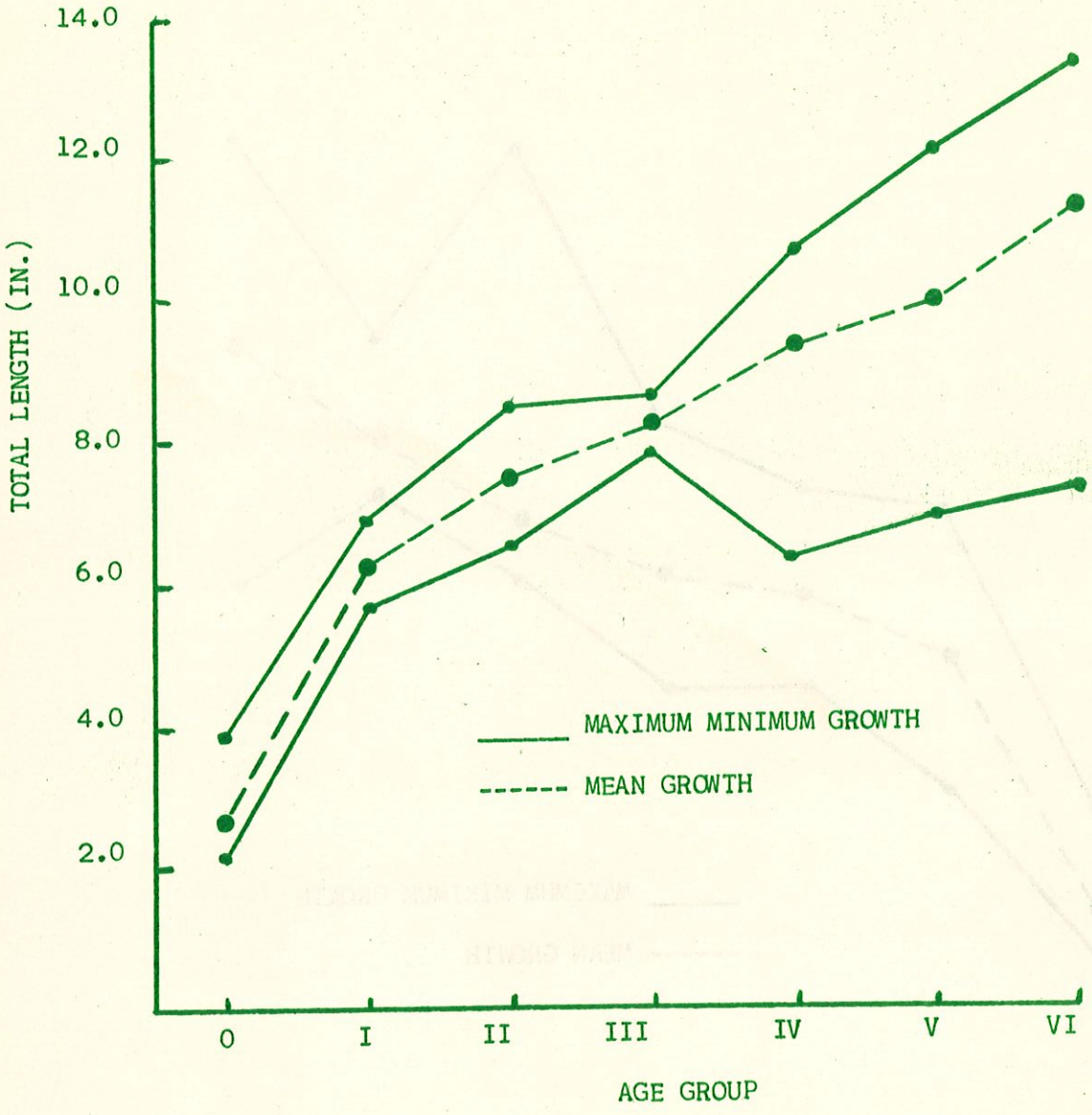


FIGURE 9. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 528 BLACK CRAPPIE IN GROUP III ARTIFICIAL LAKES.

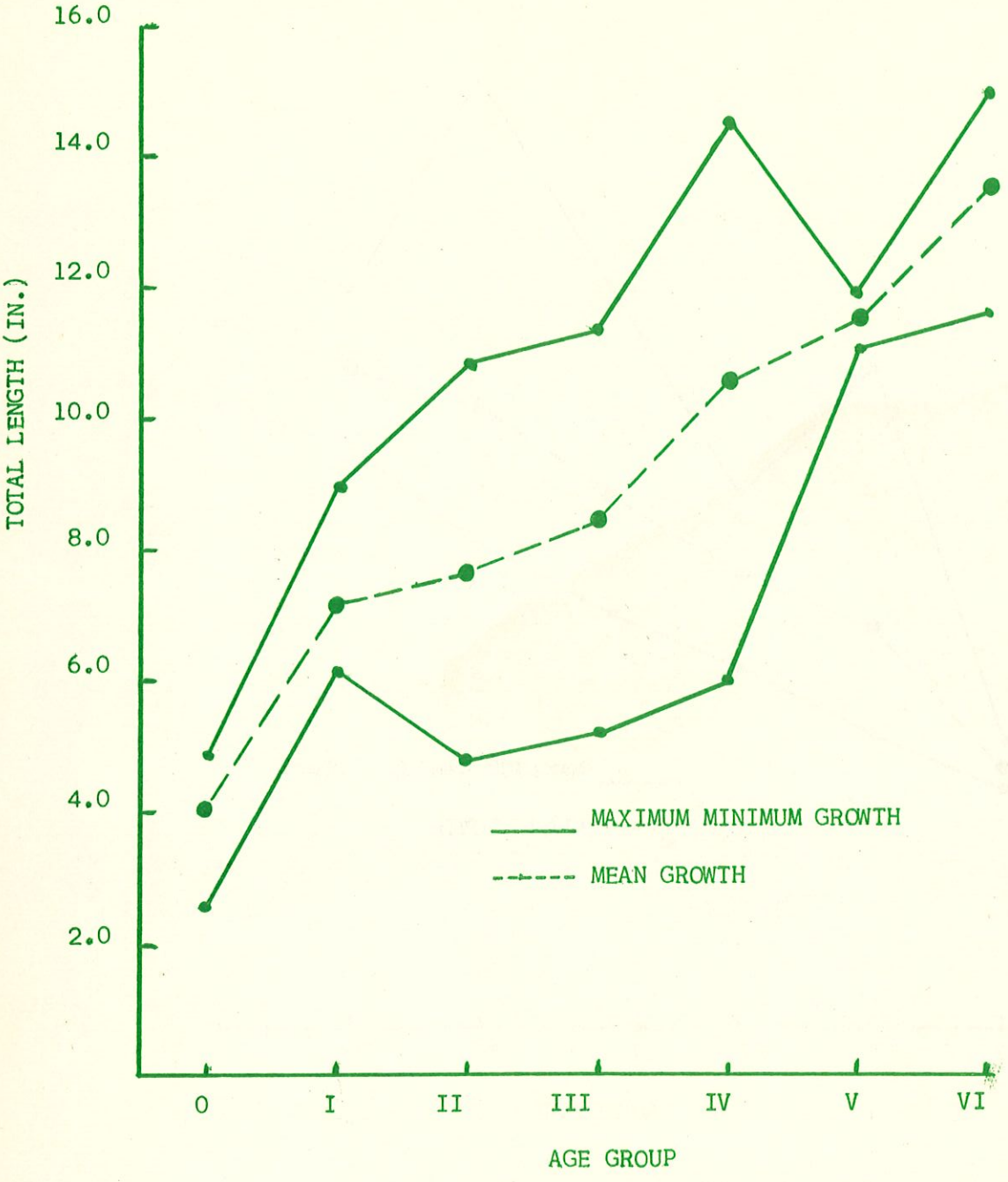


FIGURE 10. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 750 WHITE CRAPPIE IN GROUP I ARTIFICIAL LAKES.

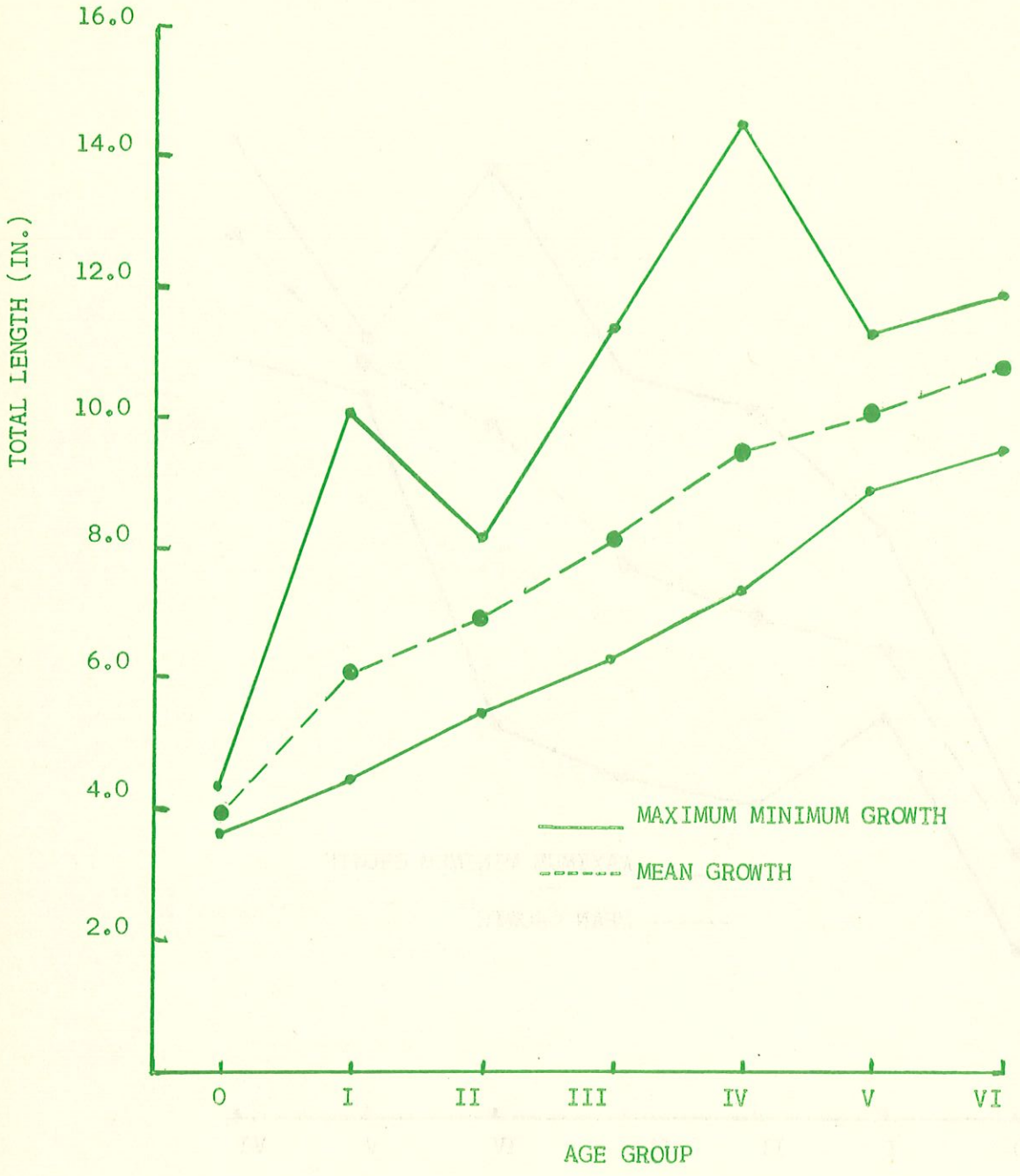


FIGURE 11. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 695 WHITE CRAPPIE IN GROUP II ARTIFICIAL LAKES.

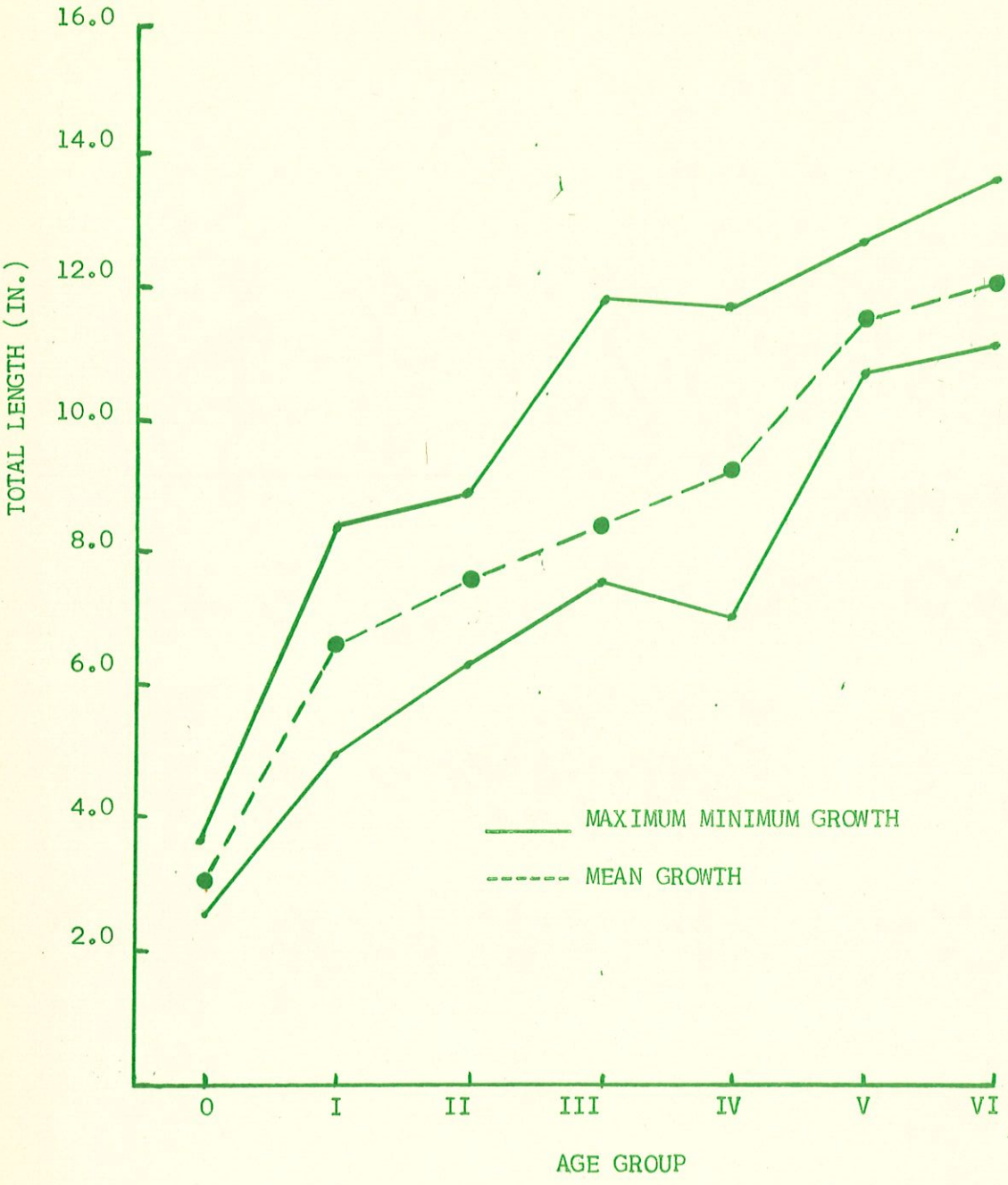
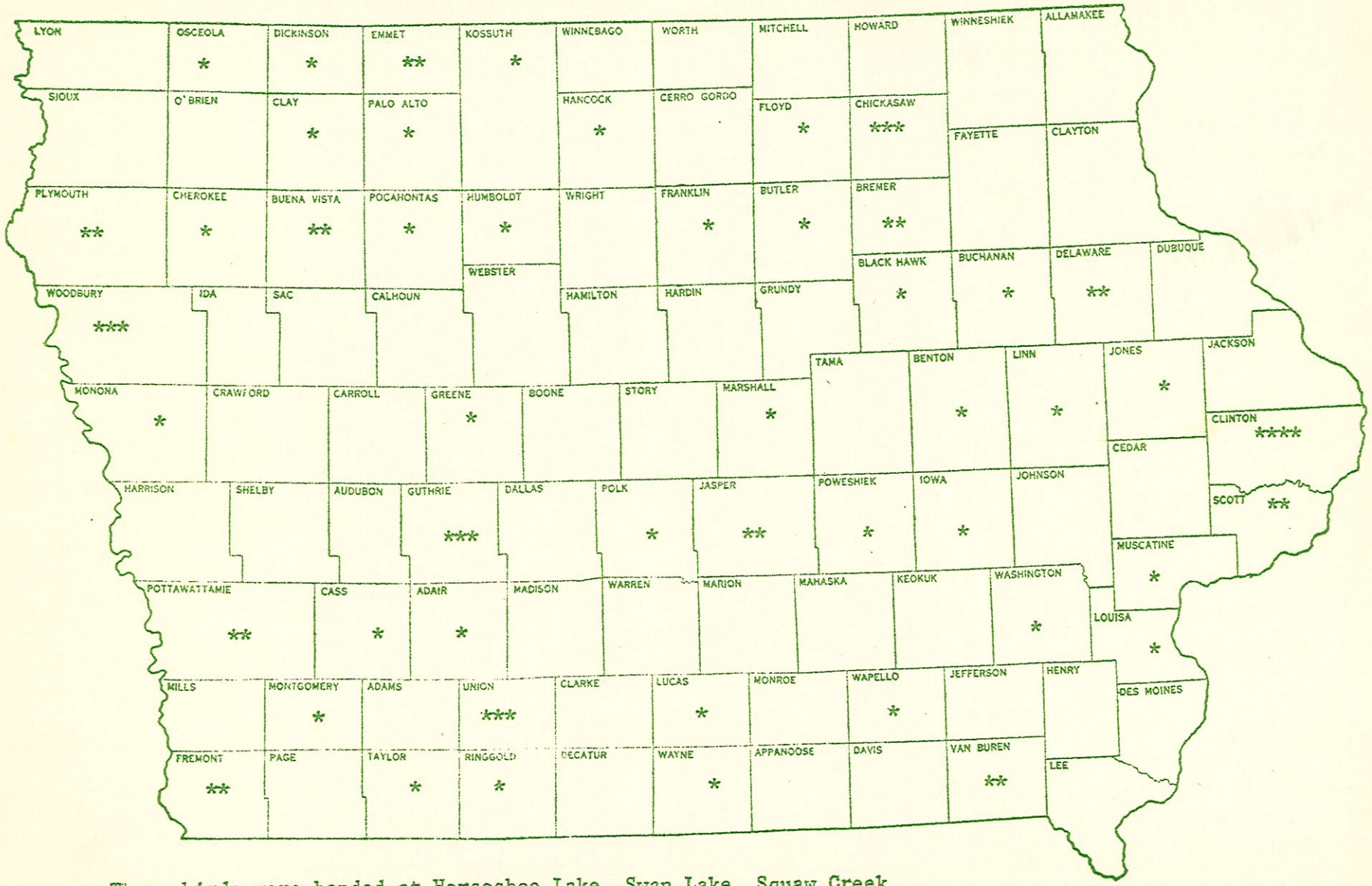


FIGURE 12. MAXIMUM, MINIMUM, AND MEAN GROWTH OF 584 WHITE CRAPPIE IN GROUP III ARTIFICIAL LAKES.

Figure 1. The location, by counties, of Canada Geese recoveries in Iowa



These birds were banded at Horseshoe Lake, Swan Lake, Squaw Creek and Sand Lake.

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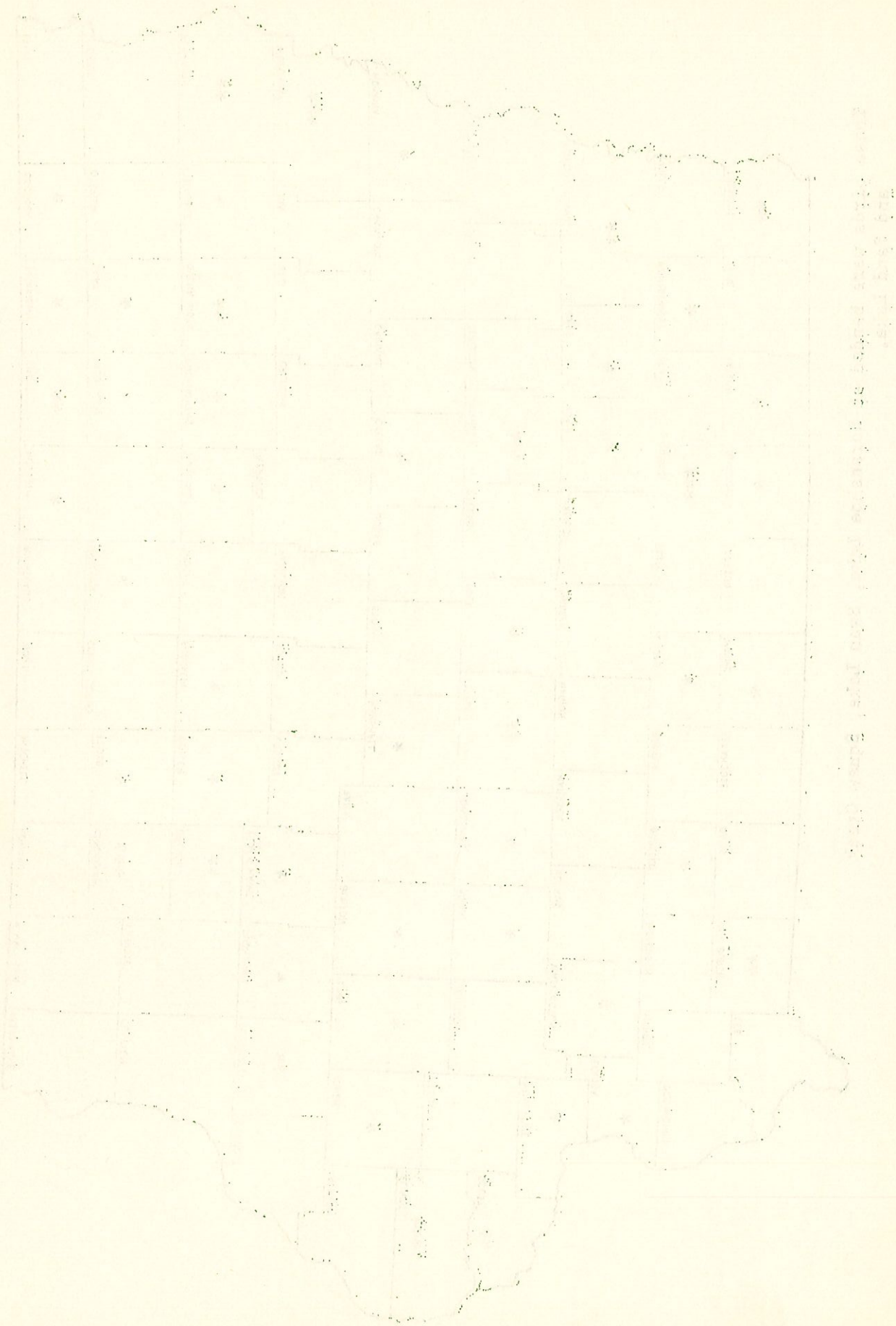
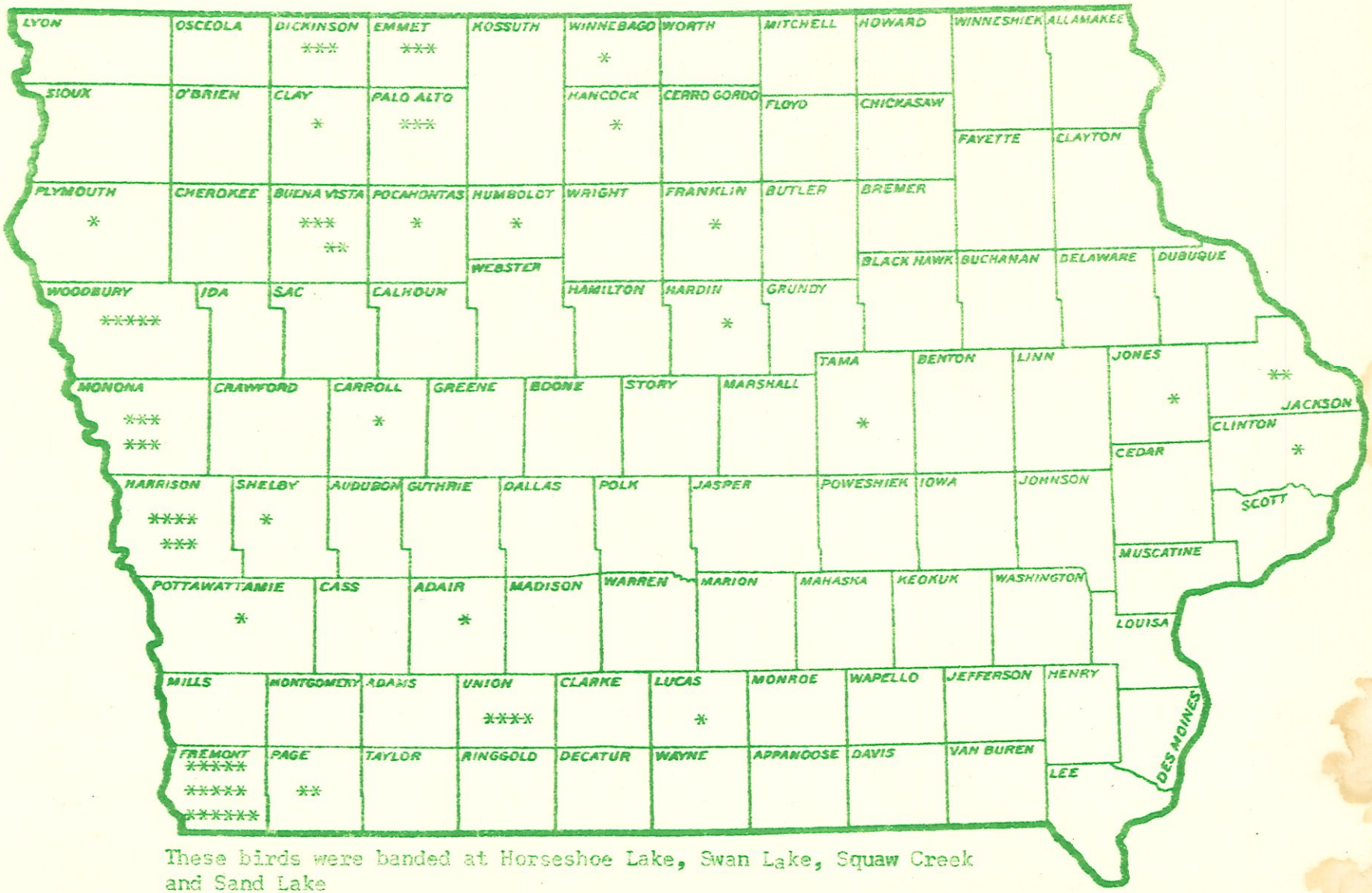
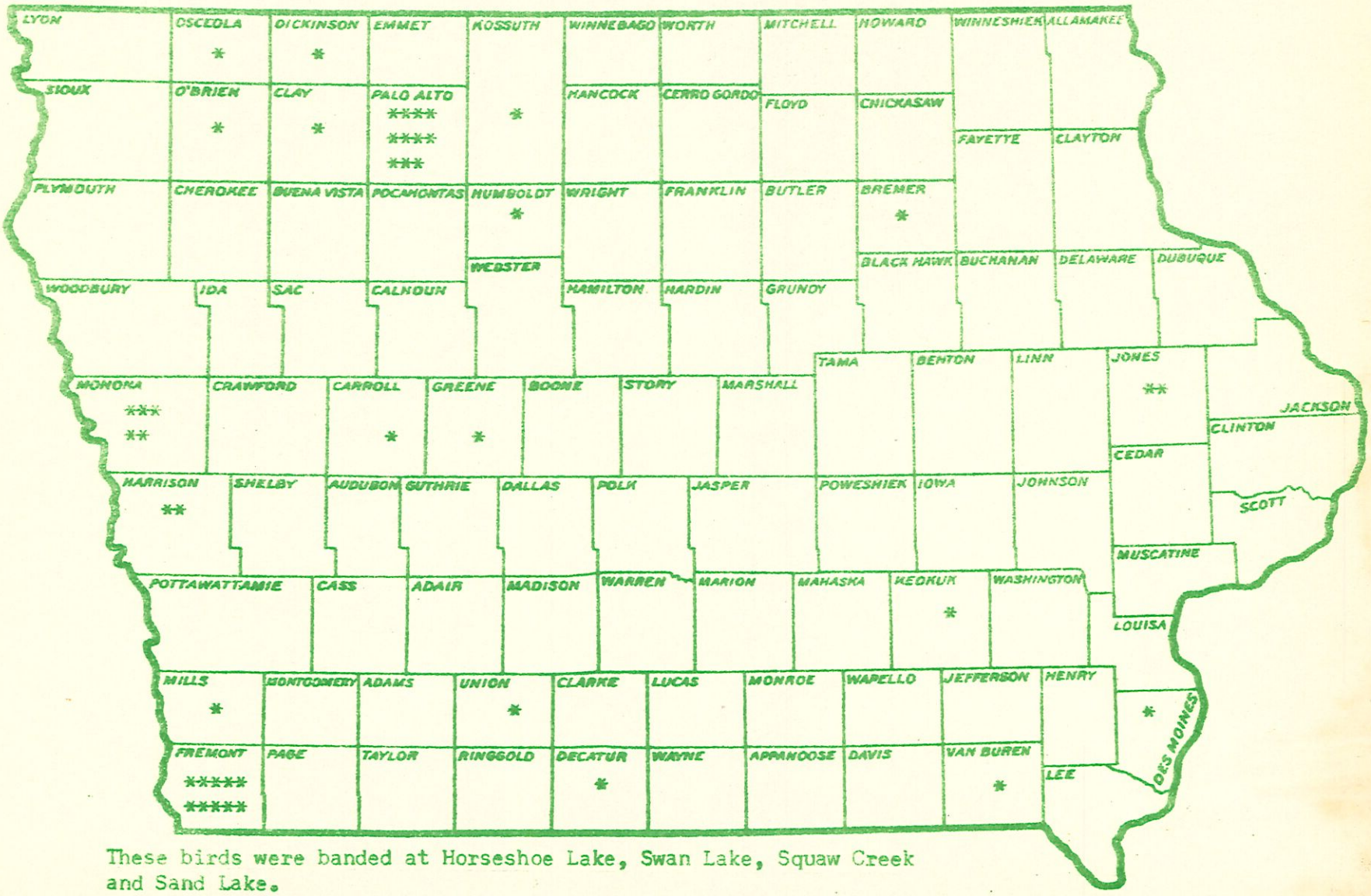


Figure 2. The location, by counties, of Snow Geese recoveries in Iowa



These birds were banded at Horseshoe Lake, Swan Lake, Squaw Creek and Sand Lake

Figure 3. The location, by counties, of Blue Geese recoveries in Iowa



These birds were banded at Horseshoe Lake, Swan Lake, Squaw Creek and Sand Lake.