QUARTERLY BIOLOGY REPORTS

FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

QUARTERLY BIOLOGY REPORT

VOL. XXV | October, November, December | No. 4

1970

Submitted by
Biology Section

Eugene D. Klonglan
Assistant Superintendent

Jim Mayhew
Assistant Superintendent

Not for Publication
Without Permission

State Conservation Commission
Fred A. Priewert, Director

Fish and Wildlife Division
Harry M. Harrison, Chief

State Office Building
300 Fourth Street
Des Moines, Iowa

TABLE OF CONTENTS

Table of Contents (continued)

GAME

AGE COMPOSITION OF THE 1970 AND 1971 DEER HERD

Lee Gladfelter
Game Biologist

Ages of 1,336 deer were determined from the 1969 gun harvest with 1,806 deer aged in 1970. Life tables were constructed for the state-wide deer herd and the five hunting zones. A high percentage of fawns (47.5% in 1969 and 46% in 1970) were harvested during the period covered by this report. Mean expectation of life is lower than in past years indicating heavier harvest and resulting in fewer deer being produced per 1,000 deer in the herd. Zone 2 had the lowest mean expectation of life in the various age classes with zones 4 and 5 showing some improvement in age structure. It is obvious that the present deer herd in Iowa is composed of more young and fewer old deer than in previous years.

AGE OF QUAIL TAKEN BY IOWA QUAIL HUNTERS 1970 SEASON

M. E. Stempel
Game Biologist

Wings from 1,047 quail shot by Iowa hunters were collected from 17 counties during the 1970-71 season. Eighty-seven percent were juveniles. The hatch as determined from wings and from coveys seen in summer, began in May, peaked in June and remained high through most of August. After an early start, a high rate of hatch was soon reached and maintained over a long period with a resulting high fall population.

QUAIL STUDIES ON TWO AREAS IN SOUTHERN IOWA, 1970

M. E. Stempel
Game Biologist
and
Gene Hlavka
Game Biologist

Quail counts were continued on two study areas, Wapello and Decatur-Wayne, in 1970. The 1970 spring brood stock on both areas consisted of 44 coveys. The average for the preceding 5 years (1965-69) was 34 coveys. More than 12 weeks of significant quail calling indicated good reproduction in 1970. Eighty coveys were located on both areas during fall 1970. This was 5 coveys more than last year and 14 more than the 1968-69 average. The hours per covey flush in fall 1970 of 1.19 compared to 0.94 hours for the previous year. It took more time to flush a covey in 1970 because of unharvested grain fields, rainy weather and muddy fields. Quail hunting activity on 10 farms of the two study areas varied from 21% for October (8 days), 36% for November, 38% for December to 5% for January.

PHEASANT NESTING AND PRODUCTION ON THE HANCOCK COUNTY WILDLIFE RESEARCH AREA (Progress Report)

Richard C. Nomsen
Game Biologist

The study to evaluate the effects of additional secure nesting cover for pheasants on an intensively farmed area was continued in 1970. There were 80% more hens available for the 1970 nesting season according to the winter census. A very mild April-May period prompted early nesting activity and field work progressed rapidly. Nest density and production increased considerably in the retired hay fields. Chick production in retired hay ground averaged 235 chicks per 100 acres compared to 26 chicks per 100 acres in the newly seeded fields that were retired.

IOWA'S 1970 RUFFED GROUSE HUNTING SEASON

Bob Sheets
Game Biologist

The 1970 Iowa Ruffed Grouse hunting season took place from October 31 through November 29. This four-week hunting season allowed hunting from 8:00 A. M. to 4:30 P.M. each day with a daily bag limit of 2 birds and possession limit of 4 birds. The hunter postcard survey revealed only 5.8 hunter hours were expended to bag a grouse in 1970 compared to 7.4 required in 1969. Hunter contacts revealed 11.7 grouse were flushed per hunting party compared to 8.6 grouse flushed in 1969. Percent flushed that were bagged and crippling rate remained the same as 1969 at 18 percent and 14 percent, respectively. Age data analysis showed an increased young per adult ratio; 1969 data showed 1.2 young per adult while 1970 information gave a ratio of 1.5 young per adult. Food habits analysis based on a grouse crop collection during the hunting season revealed that ironwood catkins comprised 46% of both the total content weight and frequency of occurrence. Other food items comprising a 10% occurrence or more included "Vetch" - 46.1%, "White clover" - 23.1%, insects and arachnids - 23.1%, "tick trefoil" - 15.4%, "Hog peanut" - 15.4%.

SOUTHERN IOWA "McGRAW" MALLARD PROJECT (Progress Report)

Richard Bishop
Waterfowl Biologist

Jack Coffey
Management Biologist

A research project was designed to study the possibility of establishing a breeding population of mallards on southern Iowa impoundments. Mallard hens were obtained from the McGraw Wildlife Foundation in Illinois and 400 of these birds were released to the wild on April 3, 1970, on Colyn, Browns Slough and Rathbun Reservoir. These hens mated with wild drakes and approximately 100 young mallards were produced on Rathbun Reservoir. It is hoped that the young produced will come back to this natal area and attempt to nest. The ultimate goal is a self-sustaining mallard breeding population in this area.

1970 WATERFOWL AND DOVE BANDING PROGRAM

Richard Bishop
Wildlife Biologist

The 1970 banding operations consisted of five projects. The projects were broken down as post-season banding of wintering mallards, banding of young birds on the breeding grounds, banding of pre-season populations of flying birds, experimental banding, and the banding of mourning doves. Post-season banding accounted for 1,934 mallards and 1,231 birds were banded on the breeding grounds. Pre-season banding, mainly of blue-winged teal and wood duck, produced 3,062 birds. Experimental banding consisted of 101 Canada geese and 400 McGraw mallards. A total of 2,347 doves were banded. A grand total of 9,079 birds was banded in Iowa in 1970.

RADIO TELEMETRY FOX STUDIES IN NORTH IOWA

Ron Andrews
Game Biologist

During the past 5 years, the Iowa Conservation Commission has been conducting a movement and mortality study on the red fox in the north Iowa area. Capturing, ear tagging and releasing pups at their natal dens was the major phase of the project. Radio telemetry completed the 5-year study during the fall of 1970. Radios and tracking equipment were provided by the University of Minnesota. Iowa provided the man-power for capturing, radioing and tracking the fox as well as the major portion of the airplane rental time necessary for the project.

Radios were placed on 23 red fox including 11 juvenile males, 10 juvenile females and 2 adult males. Five animals were closely monitored as they dispersed. Partial data was gathered from four other dispersing fox. This report discusses each fox closely monitored and the route it took while dispersing.

FISHERIES

STURGEON HARVEST IN THE MISSISSIPPI RIVER BORDERING IOWA

Don R. Helms
Fisheries Biologist

The ranges in the commercial harvest of sturgeon in Iowa since 1954 was 58,591 lbs in 1958 and 5,249 lbs in 1962. The 10-year mean for 1960 through 1969 was 12,625 lbs which had a market value of $2,746.86 to the fishermen. Maximum value was $9,960.47 in 1958.

DISTRIBUTION, ABUNDANCE AND MORTALITY RATES OF LARVAL AND POST-LARVAL GIZZARD SHAD IN RED ROCK RESERVOIR

James Mayhew
Fisheries Research Supervisor
and
Catherine Toft

Sampling to determine the distribution, abundance and mortality rates of larval and post-larval gizzard shad were initiated in 1970. Meter net tows were made on weekly replications at four surface stations and three depth levels. Eleven species of larval and post-larval fish were captured. Shad had homogenous distribution at all stations and depths. There was significant difference in catch success of larval shad in replications. Three distinct periods of shad spawning was observed. The shad population density increased until mid-July then declined at a steady rate. Growth of age 0 shad showed the typical exponential rate achieving a mazimum of about 150 mm during the season. Instantaneous mortality rate after mid-July was estimated at 0.20. The numerical estimates of the population density of larval and post-larval shad ranged from 8.7033×10^7 to 7.0276×10^6. Standing crop of age 0 shad was estimated at 3.2 ± 0.7 lbs per surface acre.

AGE AND GROWTH OF CARP IN RED ROCK RESERVOIR, 1970

Gaige Wunder
Fisheries Biologist

Carp were exploited in an experimental fishery at Red Rock Reservoir in 1970. Scale samples were collected from randomly chosen individuals for age and growth studies. The usual methods were used to prepare and age the scale samples. Length-weight relationship for 181 carp was best described by the equation $\log_{10}Y = -3.193 + 2.861 \log_{10}X$. Condition factors ranged from 40 - 57 with a mean of 45. The body scale regression was estimated by the quadratic equation $Y = 3.2 + 1.3\ YX + 0.12X^2$.

Estimated body length by summation of increments for the first 10 years of life was 5.5, 8.4, 10.6, 13.4, 15.8, 16.9, 18.5, 19.8, 21.4 and 23.7 inches, respectively.

CORALVILLE RESERVOIR CRAPPIE INVESTIGATIONS PART 2: POPULATION ESTIMATES

Larry Mitzner
Fisheries Biologist

Population estimates of crappie populations by a multiple census method were conducted at Coralville Reservoir in 1968 and 1969. In 1968, a total of 966 fish were marked by removing a pelvic fin. Later examination of 2,381 fish contained 37 recaptured fish. Estimated population density was 31,900 with 95% confidence intervals of 23,390 and 50,509. In 1969 and 1968, crappie were marked in a sub-segment of the reservoir. During subsequent netting, 1,983 crappies were examined, of which 115 were recaptures. The final estimate was adjusted for movement of crappie out of the study area. The estimated population density in 1969 was 9,913 $\pm$ 3,587.

CREEL CENSUS RESULTS FROM VARIOUS IOWA LAKES 1968-1970

Terry Jennings
Fisheries Biologist

Creel census data for the 1968-69 fishing seasons at Spirit Lake, East Okoboji, and West Okoboji are presented. Seasons were separated into open water and ice fishing. At Spirit Lake, in 1968 during the open water season, an estimated 151,145 fish weighing 103,053 lbs were taken. Bullhead and yellow perch comprised 89% of the catch. During the winter, 3,942 fish were caught. Yellow perch and walleye made up 99% of this fishery. During 1969, 81,345 fish weighing 52,207 lbs were caught from Spirit Lake in open water. Bullhead and yellow perch comprised 89% of the harvest. Ice fishing added an additional 36,235 fish with yellow perch making up about 92% of this number. During the two years about 34 lbs of fish per acre were removed by angling. At West Okoboji, anglers caught an estimated 113,839 fish in 1968 during the open water period. Yellow perch comprised 71% of this fishery. In the winter fishery, 56,623 fish, of which perch made up 92%, were taken. Approximately 21 lbs per acre were harvested from West Okoboji. Total harvest of fish from East Okoboji was estimated at 87,094 fish weighing 46,251 lbs. Bullhead made up 64% of the numerical catch. About 25 lbs of fish per acre were harvested from the lake in 1968. there is no important winter fishery at East Okoboji Lake.

AGE COMPOSITION OF THE 1970 and 1971 DEER HERD

Lee Gladfelter
Game Biologist

The use of age data is considered very important in evaluating the structure and vitality of a deer herd. Age data has been collected by field personnel since the first deer season in modern times in 1953. Since that time, age data has been utilized in substantiating the high productivity rate in the Iowa deer herd as well as demonstrating the constricting age structure of the herd due to heavy deer harvest.

The data for this paper was collected during the 1969 and 1970 deer seasons. During these seasons the state was divided into 5 hunting zones (Figure 1). This made it possible to collect specific data for different regions of the state.

METHODS

Field personnel were assigned a 2 - 4 county area of responsibility in which they visited all locker plants processing deer harvested during the hunting season. Where possible, the deer were aged using the standard tooth wear and replacement method. Deer were also aged in the field during the hunting season when possible. A record form was maintained by each individual which listed the sex and age of each deer and the license number of the individual obtaining the deer. Also the county and zone of kill were recorded and double checked with the license number. The last number of the license number indicates the zone in which the shotgun license was issued.

The record forms were returned to the author shortly after the hunting season. Sex and age data were compiled for each of the various zones and on a statewide basis.

RESULTS

In 1969, there were 11,582 deer harvested by Iowa hunters with 1,336 of these deer being age by Commission employees. In 1970, there where 1,805 deer aged from an estimated harvest of 13,500 deer. The largest sample of deer aged came from zone 2 during both years. Sample size is considered adequate on a statewide basis but may not be adequate for several of the zones with small harvests.

A high percentage of the harvest in 1969 and 1970 was composed of fawns (Table 1). In 1969, 47.5% of the harvest was fawns while in 1970, 46.5% of the harvest was fawns. This high fawn harvest eliminates future breeders from the herd and thereby limits the rate of herd increase. The percentage of fawns in the harvest was lower during the years when the deer herd was growing rapidly - 1953 to 1963. During these years the average fawn harvest was 39.4% of the total harvest. During the years 1964 to 1970 the average fawn harvest jumped to 45.6% of the total harvest. This heavy harvest of the fawn population has stabilized the growth of the deer herd or possibly

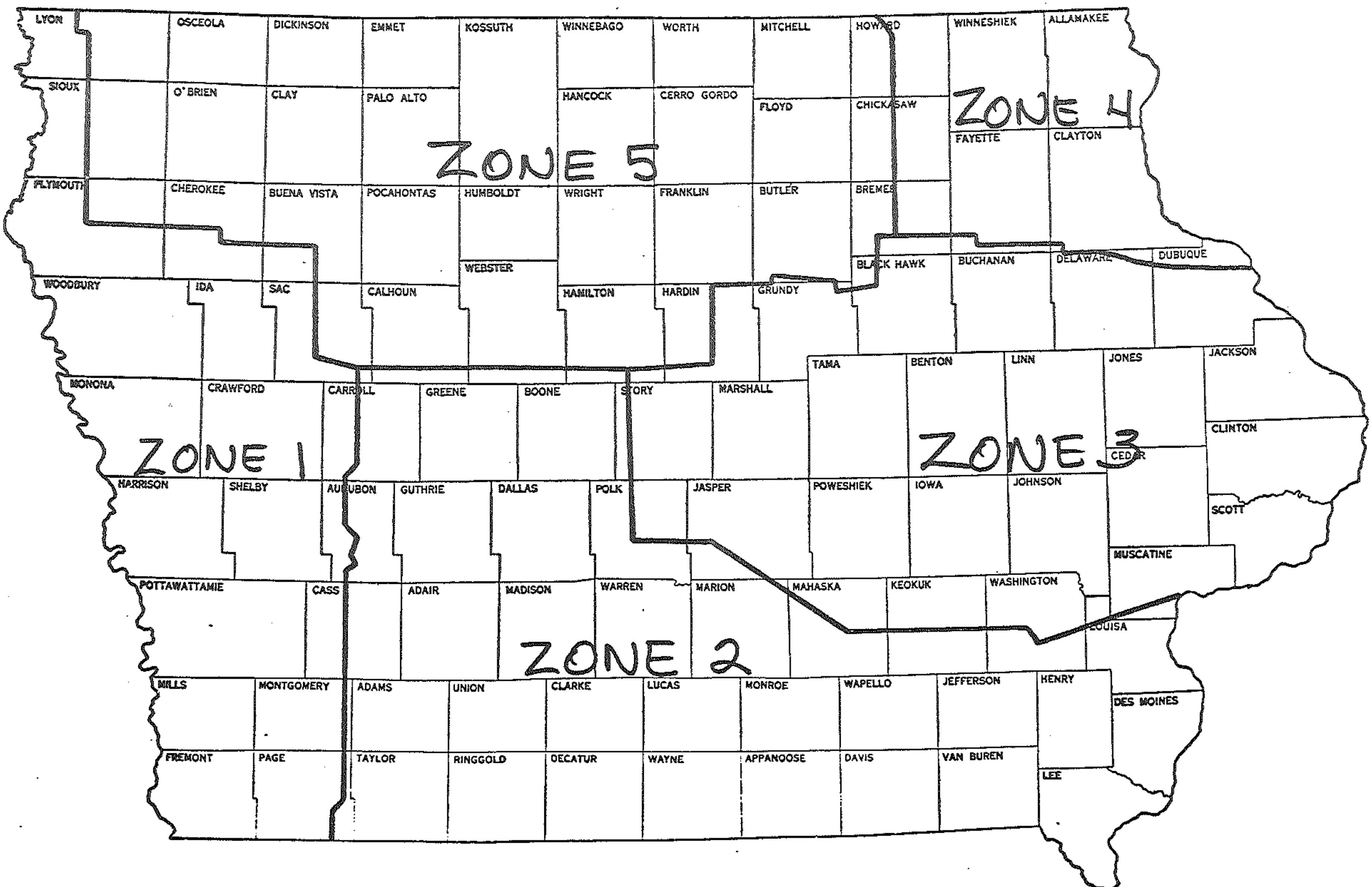


Figure 1. The five hunting zones for the 1969 and 1970 deer seasons.

caused decreases in certain areas. According to Larson (1970) a safe level of harvest is obtained when the fawn harvest is bwtween 38% and 42% but an overharvest occurs when this percentage reaches 44.75%. Using these guidelines, there has been an over-harvest of deer in Iowa for the past three years.

Mean expectation of life for each age class has been declining in recent years. For example the mean expectation of life for a fawn was 1.40 years in 1969 and 1.46 years in 1970 (Table 1). This compares to 1.52 years for fawns in 1968. The meaning of life expectation can be demonstrated in the following way. In a sample of 1000 fawns taken from the deer herd in 1968 there would be a mean expectation of life of 1.52 years. These deer would produce young for an average of 1.52 years at a potential reproductive rate of 1.7. A formula can be developed which shows the number of fawns produced by this sample of deer. The 1,000 deer X 1.52 (mean expectation of life) X 1.7 (reproductive rate) = 2,584 fawns producted during the life time of the original sample. If this process is repeated for a sample of 1,000 deer in 1969 only 2,380 fawns are produced (1,000 X 1.40 X 1.7 = 2,380); 204 fawns less than was produced by 1,000 deer the preceding year.

Mean expectation of life varies by hunting zone (Tables 2-6). Zone 2 has the lowest mean expectation of life indicating heavy harvest in southern Iowa. The other 4 zones show some variation between the two years covered by this report but zone 4 and 5 seem to have improved deer populations.

Table 7 compares the age composition of the deer herd for 1953, 1954 through 1962, 1967, 1968, 1969, and 1970. It is obvious that the present deer herd in Iowa is composed of more young and fewer old deer than in previous years.

DISCUSSION

The age data collected in Iowa indicates a shrinking mean expectation of life which will result in less deer produced per 1,000 deer. This may result in a stabilized to decreasing deer herd in the next few years, if this trend continues.

The high percentage of fawns in the harvest substantiates a high reproductive rate in Iowa deer. It also may indicate an increased vulnerability of this age class to the gun.

Hunting certainly has been responsible for these changes in the age structure of the deer herd. With increasing interest in deer hunting and a stable to decreasing deer herd there may have to be changes in hunting regulations to decrease hunting pressure on the herd.

LITERATURE CITED

Kline, P. D. 1965. Status and management of the white-tailed deer in Iowa, 1954-62. Proc. Iowa Acad. Sci. 72:207-217.

Larson, K. D. 1970. The significance of age distributions of exploited white-tailed deer populations. Ph. D. Thesis, Iowa State University, Ames, Iowa.

Sanderson, G. C. and E. B. Speaker. 1954. Results of Iowa's first deer season in recent years. Proc. Iowa Acad. Sci. 61:615-630.

Table 1. Life Tables Based on Deer Aged in 1969 and 1970, Statewide

Age Class	Number Aged 1969	Number Aged 1970	Number of Deaths per 1,000 1969	Number of Deaths per 1,000 1970	Survivors Per 1,000 1969	Survivors Per 1,000 1970	Death Rate Per 1,000 1969	Death Rate Per 1,000 1970	Mean Number Alive Between Age Classes 1969	Mean Number Alive Between Age Classes 1970	Mean Expectation of Life (in Years) 1969	Mean Expectation of Life (in Years) 1970
Fawn	634	840	475	465	1,000	1,000	475	465	762.5	767.5	1.40	1.46
1½	366	469	274	259	525	535	522	484	388.0	405.5	1.20	1.29
2½	232	321	174	177	251	276	693	641	164.0	187.5	0.97	1.03
3½	63	119	47	66	77	99	610	668	53.5	66.0	1.05	0.97
4½	26	41	19	23	30	33	633	697	20.5	21.5	0.90	0.92
5½	14	12	10	7	11	10	909	700	6.0	6.5	0.59	0.90
6½	1	3	1	2	1	3	1,000	667	0.5	2.0	0.50	0.83
8½	0	1	0	1	0	1	0	1,000	0	0.5	0	0.50

Table 2. Life Tables Based on Deer Aged in 1969 and 1970, Zone 1

Age Class	Number Aged 1969	Number Aged 1970	Number of Deaths per 1,000 1969	Number of Deaths per 1,000 1970	Survivors Per 1,000 1969	Survivors Per 1,000 1970	Death Rate Per 1,000 1969	Death Rate Per 1,000 1970	Mean Number Alive Between Age Classes 1969	Mean Number Alive Between Age Classes 1970	Mean Expectation of Life (in Years) 1969	Mean Expectation of Life (in Years) 1970
Fawn	125	216	450	440	1,000	1,000	450	440	775.0	780.0	1.43	1.46
1½	85	142	306	289	550	560	556	516	397.0	415.5	1.18	1.22
2½	45	87	162	177	244	271	664	653	163.0	182.5	1.04	0.93
3½	13	34	47	69	82	94	573	734	58.5	59.5	1.10	0.89
4½	6	7	21	15	35	25	600	600	24.5	17.5	1.90	0.98
5½	4	4	14	8	14	10	1,000	800	7.0	6.0	0.50	0.70
6½	0	1	0	2	0	2	0	1,000	0	1.0	0	0.50

Table 3. Life Tables Based on Deer Aged in 1969 and 1970, Zone 2

Age Class	Number Aged		Number of Deaths per 1,000		Survivors Per 1,000		Death Rate Per 1,000		Mean Number Alive Between Age Classes		Mean Expectation of Life (in Years)	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
Fawn	245	305	507	498	1,000	1,000	507	498	746.5	751.0	1.33	1.37
$1\frac{1}{2}$	127	155	263	253	493	502	533	504	361.5	375.5	1.18	1.23
$2\frac{1}{2}$	80	100	166	164	230	249	722	659	147.0	167.0	0.97	0.98
$3\frac{1}{2}$	16	36	33	59	64	85	516	694	47.5	55.5	1.17	0.90
$4\frac{1}{2}$	9	11	19	18	31	26	613	692	21.5	17.0	0.89	0.81
$5\frac{1}{2}$	6	5	12	8	12	8	1,000	1,000	6.0	4.0	0.50	0.50

Table 4. Life Tables Based on Deer Aged in 1969 and 1970 - Zone 3.

Age Class	Number Aged		Number of Deaths per 1,000		Survivors Per 1,000		Death Rate Per 1,000		Mean Number Alive Between Age Classes		Mean Expectation of Life (in Years)	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
Fawn	34	67	442	475	1,000	1,000	442	475	779.0	726.5	1.72	1.42
$1\frac{1}{2}$	18	36	234	255	558	525	419	486	441.0	397.5	1.68	1.26
$2\frac{1}{2}$	11	25	143	177	324	270	441	656	252.0	181.5	1.53	0.98
$3\frac{1}{2}$	7	8	91	57	181	93	503	613	135.5	64.5	1.35	0.89
$4\frac{1}{2}$	3	5	39	36	90	36	433	1,000	70.5	18.0	1.20	0.50
$5\frac{1}{2}$	3	0	39	0	51	0	765	0	31.5	0	0.74	0
$6\frac{1}{2}$	1	0	12	0	12	0	1,000	0	6.0	0	0.50	0

Table 5. Life Tables Based on Deer Aged in 1969 and 1970, Zone 4

Age Class	Number Aged		Number of Deaths per 1,000		Survivors Per 1,000		Death Rate Per 1,000		Mean Number Alive Between Age Classes		Mean Expectation of Life (in Years)	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
Fawn	48	90	449	439	1,000	1,000	449	439	775.5	780.5	1.41	1.58
1½	32	51	299	249	551	561	543	444	401.5	436.5	1.16	1.43
2½	19	37	178	180	252	312	706	577	163.0	222.0	0.94	1.18
3½	4	15	37	73	74	132	500	553	55.5	95.5	1.00	1.10
4½	4	9	37	44	37	59	1,000	746	18.5	37.0	0.50	0.84
5½	0	2	0	10	0	15	0	667	0	10.0	0	0.83
8½	0	1	0	5	0	5	0	1,000	0	2.5	0	0.50

Table 6. Life Tables Based on Deer Aged in 1969 and 1970, Zone 5

Age Class	Number Aged		Number of Death per 1,000		Survivors Per 1,000		Death Rate Per 1,000		Mean Number Alive Between Age Classes		Mean Expectation of Life (in Years)	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
Fawn	65	93	436	419	1,000	1,000	436	419	782.0	790.5	1.41	1.57
1½	41	58	275	261	564	581	488	449	426.5	450.5	1.11	1.34
2½	36	45	242	202	289	320	837	631	168.0	219.0	0.69	1.03
3½	6	18	40	81	47	118	851	686	27.0	77.5	0.64	0.94
4½	1	6	7	27	7	37	1,000	730	3.5	23.5	0.50	0.91
5½	0	1	0	5	0	10	0	500	0	7.5	0	1.00
6½	0	1	0	5	0	5	0	1,000	0	2.5	0	0.50

Table 7. Comparison of Age composition of Deer Herds for 1953[1], 1954-62[2], 1967, 1968, 1969 and 1970

Age Class	Percent of Total Sample					
	1963	1954-62	1967	1968	1969	1970
Fawn	30.0	41.7	41.0	45.9	47.5	46.5
1½	21.3	25.5	32.0	26.1	27.4	25.9
2½	23.5	18.1	15.0	15.9	17.4	17.7
3½	12.9	8.9	7.5	6.7	4.7	6.6
4½	8.4	3.7	3.6	3.8	1.9	2.3
5½ & older	3.9	2.1	0.9	1.6	1.1	1.0

1 from Sanderson and Speaker, 1954

2 from Kline, 1965

AGE OF QUAIL TAKEN BY IOWA QUAIL HUNTERS 1970 SEASON

M. E. Stempel
Game Biologist

The Iowa quail wing study began in 1946. It is based on information obtained from wings of quail shot by hunters. Hatching dates of quail under 150 days old are determined during this work; further, it is a means of learning how various weather patterns affect hatching. From it has been learned which age groups are most often taken by hunters and eventually it should show whether long hunting seasons take excessive numbers of quail that would otherwise live until another production period. These data can be compared to summer whistling quail counts since both studies indicate progress of hatching. The current report is based on results of the 1970 wing survey with supplemental data from roadside and field surveys. Comparisons are made with similar data for 1969.

METHODS

A number of cooperators are contacted each year before the hunting season; these are both Conservation Commission personnel and licensed quail shooters who live in southern Iowa where they can collect large numbers of wings. Procedures are further discussed in the Quarterly Biology Reports for October-December 1965.

RESULTS

A total of 1,047 wings was collected in October and November of 1970. These were from 17 counties and the number was more than enough to establish production periods of the young (Haugen and Speake, 1958). Eighty-seven percent were from young birds in 1970 and in 1969. There were 89 hens per 100 cocks in this sample. Other information is presented in Tables 1 and 2.

Most of the wing collection was made before November 15th. The open season was October 24 to January 31, 1970. In 1969, the corresponding collection of wings was made during a similar period.

While hunters took the most birds from the more numerous young segment, the true proportion in the field may not be represented. The quail wing sample which is obtained from hunters must be regarded as a sample of the most available birds which are large enough to be acceptable to hunters, since some do not shoot the "squealers" or very small quail. Opportunity to kill quail is influenced by many factors. As an example, any quail, adult or young, which have fully developed flight plumage, and are thus capable of strong flight, are less liable to be shot than mature-appearing quail with short or immature flight feathers. Hence, it is possible that the kill of the strong flying quail would be less than that of the weaker flyers, even though the better developed birds (either young or old) might be more numerous than is shown in the kill.

Quail hatching distribution in 1970:

Seventy percent of the wings of quail taken early in the season were from quail under 150 days old, and the approximate age of these could be determined by growth stage of primaries. For this segment, the hatch began in June, continued high through August and ended in October (Figure 1). The graph represents mostly birds shot in October since as the season progressed a higher percentage exceeded 150 days of age.

Adults:

About 13% of the take was adult quail (over one year old). They moult all 10 of the wing primaries while the young usually shed only the inner 8 flight feathers. None of the adults taken in October had moulted completely; i.e., the primaries were not all replaced with new feathers.

Supplementary data from broods sighted in the summer:

No exact hatching date can be assigned to young quail over 150 days old because flight feather growth is completed and all primaries are full length. However, we have information on the age of 24 broods sighted during summer. I observed some of these, while others were reported by officers, biologists, farmers and dog trainers. These began to hatch in May. The broods seen were hatched in May (10), June (7), July (6), and August (1).

DISCUSSION

About 65% of the birds under 150 days old were nearing maturity when taken by gunners. The number of other young quail (over 150 days old) represent a good early hatch. Many adults were still in early moult when shot, and this indicated that there was good late production as well as early production, since moult follows nesting activity. Altogether, after an early start, a high rate of hatch was soon reached and good success was maintained, with a resulting high fall population.

The 1969 production was estimated from the collection of 1,438 wings from 20 counties in southern Iowa quail range. Seventy percent were young (under 150 days old) that could be aged. Thirty percent of young (over 150 days old) had fully matured flight feathers. None of the adults collected in October had fully developed wing plumage. Additional information was gleaned from observation of 35 broods in summer.

In 1968, production pattern was estimated from the collection of 1,247 wings from 21 counties in southern Iowa quail range. Seventy percent were young (under 150 days old) that could be aged. Their hatching dates were established. Thirty percent of young (over 150 days old) had fully matured flight feathers. None of the adults collected in October bore fully matured wing plumage. Additional information was gleaned from observation of 26 broods in summer.

In 1967, good production was indicated by comparable data from 1,216 wings.

Wings from more than 1,047 quail shot by Iowa quail hunters during the 1970-71 season were collected from 17 counties in late October and early November. Eighty-seven percent were juveniles. The hatch as determined from wings and from coveys seen in the summer, began in May, peaked in June and remained high into August. As far as we can ascertain by December, the 1970 production was similar to that of 1969. Quail production in 1970, however, was more uniform than the previous season.

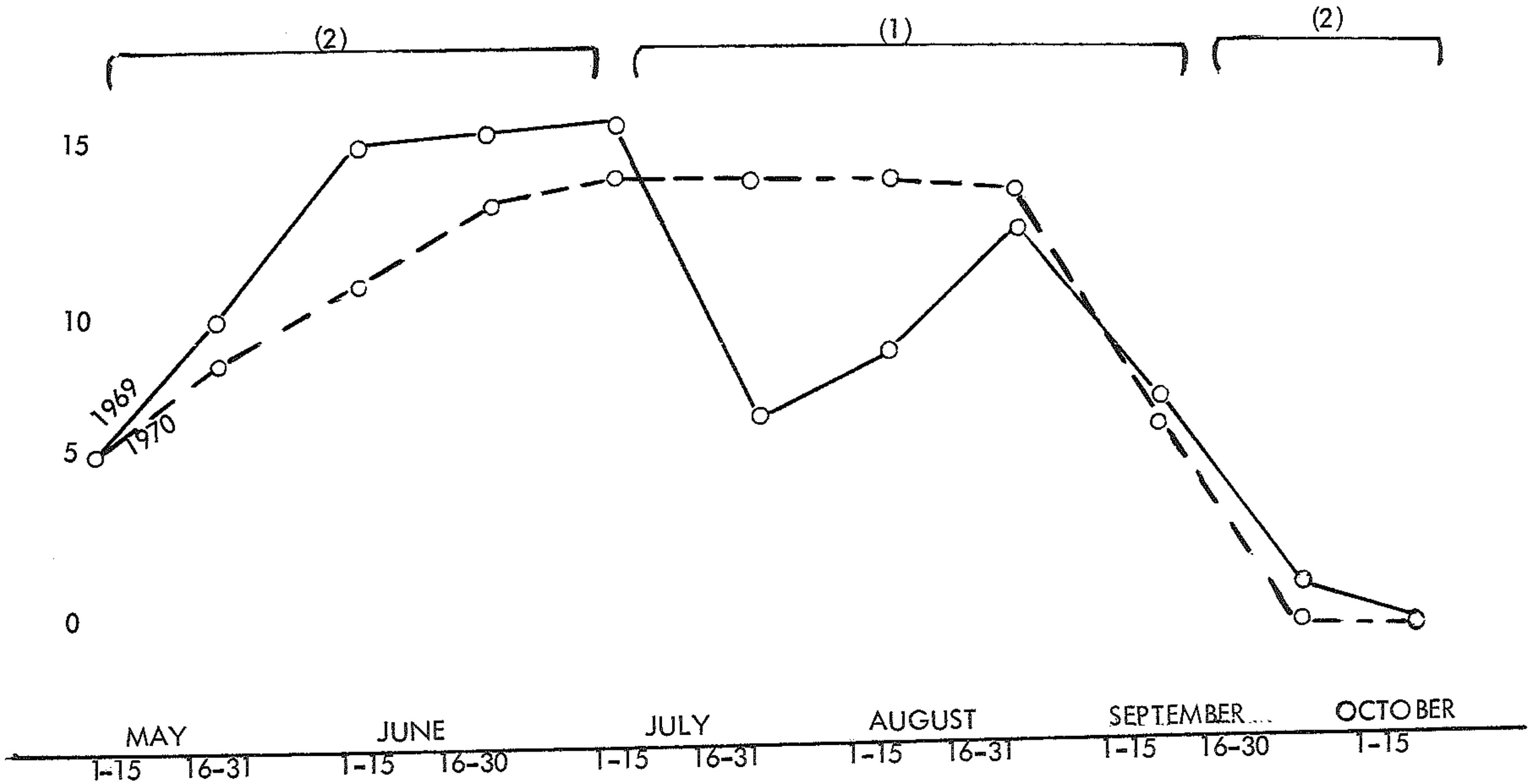


Figure 1. Comparison of 1970 and 1969 quail hatching date distribution

(1) Data from ageable wings taken through early November.

(2) Based on wing samples, broods seen and aged, research area call counts and other calling quail counts, few wings can be aged from birds hatched prior to July when the season open in November. In 1970 and 1969, the season opened October 24 and 25 respectively and wings could be aged back to early July and late June.

Nineteen counties were represented. Seventy percent of the young (under 150 days old) could be aged and their hatching dates established. No adults bore fully matured flight feathers. Additional information came from 38 conveys sighted in the summer of 1967.

The 1969-70 quail shooting began October 25th; the 1968 season began October 26th. Early seasons are of considerable help in getting better production information from a sample of birds harvested.

LITERATURE CITED

Haugen, Arnold). and Daniel W. Speake.
1958. Progress report on Alabama bobwhite quail wing study. Proc. Twelfth Am. Conf. S.W. Assoc. of Game and Fish Commissioners.

Table 1. A tabular compilation of data from Iowa quail wings collected in 1970 and 1969

	1970	1969
1. Number of wings	1,047	1,438
2. Number of wings accompanied by useable information	1,047	1,438
3. Number of counties represented	17	20
4. Percent of young in sample	87	87
5. Percent of young that were mature or nearly so (90 days old or older)	72	71

Table 2. The percent young in quail bagged in Iowa, 1956-70

Year	% young in quail bagged	Number of wings in sample*
1956	87	352
1957	87	613
1958	80	1,253
1959	85	939
1960	90	656
1961	89	560
1962	88	576
1963	89	1,380
1964	86	1,639
1965	85	1,364
1966	86	1,436
1967	81	1,248
1968	86	1,247
1969	87	1,438
1970	87	1,047

* Some wings collected are not included as they were not accompanied by data on place and date of kill; some were damaged; some arrived late.

QUAIL STUDIES ON TWO AREAS IN SOUTHERN IOWA, 1970

M. E. Stempel
Game Biologist

and

Gene Hlavka
Game Biologist

Two quail study areas are located south of Highway 34 in Iowa's primary quail range (see January-March 1966 Quarterly Biology Reports). The Wapello Area is situated southwest of Ottumwa in Adams, Green and Center Townships of Wapello County. Little Soap Creek drains the Wapello Area. Bottomlands and ridgetops are in grain or hay. Slopes are in brush or timber. The Decatur-Wayne Area comprises parts of Clay and Jefferson Townships in western Wayne County in addition to parts of High Point and Woodland Townships in eastern Decatur County. This former Iowa State University quail study area is located about 8 miles north of the Iowa-Missouri boundary in south Central Iowa. Steele's Creek ditch drains this area. Grain crops are raised in the flood plain. For the most part the terrain in both areas is sloping to hilly, the soils are somewhat acid. There are numerous small ponds. "Up-and-down-hill" farming still continues; many gullies are caused by erosion. Tree and brush removal is occurring, coupled with a shift in land husbandry toward livestock grazing.

On the two study areas, late winter covey counts, summer roadside whistling cock counts, and early fall covey counts are conducted each year. Some of this survey data can be compared to statewide counts. In addition, a field record is kept of the number of rabbits and pheasants sighted.

METHOD OF CENSUSING

Game biologists conduct the early fall and late winter covey counts with the aid of dogs. The fall counts commence when most of the soybeans are harvested and some of the corn fields are opened up. Covey searches are limited primarily to grain field edges and adjoining travel lanes or cover patches. Abandoned farmstead grounds are also scouted. When snow cover is present, coveys can be located by their trails. Other quail sign (calling, roosts, feathers, droppings, or tracks) and the actual walking time of the counts are recorded. Farmers are also asked for their estimates of the number of coveys on their farms.

From May through August at two-week intervals standard roadside whistle counts are conducted on each study area. The number of different cock quail heard calling at each of 10 stops (listening points) on a pre-selected route is recorded. Quail sightings while conducting the counts are also noted.

After each month of the quail hunting season, five farmers on each study area are interviewed about hunting activity on their farms. Questions are asked about the number and size of the hunting parties using the farm.

RESULTS OF 1970 STUDIES

Winter studies:

Late February-early March covey counts were conducted with the benefit of snow cover for about 2 hours. Forty-four coveys were located on both study areas in 1970 (Table 1). Forty-two coveys was the average for the preceding 2 years.

Weather review:

April 1970 was notable for rapid transition from winter to advanced spring. A large portion of Iowa measured the last freeze on May 2. The mildest April-May period since 1965 hastened crop planting and emergence. Only thrice in the 20th century had April-May periods been significantly warmer than 1970, those occurring in 1955, 1941, and 1934. June was noteworthy for its dryness, particularly over the western two-thirds of Iowa. Rainfall deficiencies after early June caused corn and oats to stress and pastures to decline sharply by early July. During the second half of July showers produced above normal precipitation over most of Iowa. Heavy rain falls also occurred in August with Chariton measuring 8.78 inches of precipitation in 7 days. The corn blight outbreak almost immediately followed this wet spell. September was cloudy and wet. In southeast Iowa precipitation through September exceeded any annual amount reported since 1858. October was noteworthy for its exceedingly cloudy, wet weather. During the past 98 years, only in 1881 and 1941 had October been much wetter across Iowa (Climatological Data - Iowa, for months concerned). The rate of grain harvest in southern Iowa lagged considerably behind the rest of the state. Many soybean fields were still unharvested by mid-November.

Spring and Summer studies:

In 1970 the quail calling pattern built up to a peak in July, stayed at a high level until mid-August and then fell off (Figure 1). In 1969 this pattern peaked in June, fell off slightly in early July, reached a smaller peak in late July and remained fairly high through August. During both years cock quail were calling at a significant rate for more than 12 weeks.

In 1970, 20 quail per 100 miles were sighted on both study area census routes. In 1969, this fugure was 19 quail per 100 miles. Sample size is too small for accurate comparisons.

Autumn studies:

On the Decatur-Wayne Area, the fall covey count began on October 19 and was completed December 2. Similar dates for the Wapello Area were October 25 to November 6. Because the counts are geared to the rate of crop harvest and the weather, they are usually completed after the opening day of the quail season. In 1970, frequent rains coupled with a much delayed grain harvest in southern Iowa impeded the survey and made it much more difficult.

On the two areas 80 coveys were located (Table 2). This was 5 more coveys than last year and 14 more than the 1968-69 average. It took 1.19 hours to flush a covey. This was slightly longer than the 1968-69 average of 1.02. The farmers' estimates of 46 coveys was 18 more than last year and 15 more than the 1968-69 average.

HUNTING ACTIVITY

The 1970-71 quail season of 100 days opened on October 24 and closed on January 31. This was the fifth consecutive year that the season length extended to around 100 days. The average of the preceding 5 years (1965-66 to 1969-70) was 97 days. Nearly 21% of the hunting activity on 10 farms on the two study areas occurred in October (Table 3). November, December and January was 36%, 38% and 5% of this activity, respectively. On the Decatur-Wayne Area, the presence of ringneck pheasants is an added incentive to hunting. Some hunting without permission was reported on both areas.

DISCUSSION

From 1965-66 to 1969,70, the winters in southern Iowa have been characterized by light snow cover. During these 5 winters the brood stock on both study areas increased from 32 to 44 coveys. Spring weather in 1970 was favorable for quail. Heavy rains after mid-July did not seem to affect the hatching pattern. This was the fifth consecutive year with over 12 weeks of significant quail calling. Fall quail populations have remained at a high level during each of the past 5 years.

Each fall there is some handicap in locating coveys because of heavy cover and unharvested grain fields. During fall 1970 the observers believed it took more time to locate a covey because of the additional hindrance of rain and muddy fields.

SUMMARY

1. Quail counts were continued on two study areas, Wapello and Decatur-Wayne, in 1970.

2. The 1970 spring brood stock on both areas consisted of 44 coveys. The average for the preceding 5 years (1965-69) was 34 coveys.

3. More than 12 weeks of significant quail calling indicated good reproduction in 1970.

4. Eighty coveys were located on both areas during fall, 1970. This was 5 coveys more than last year and 14 more than the 1968-69 average.

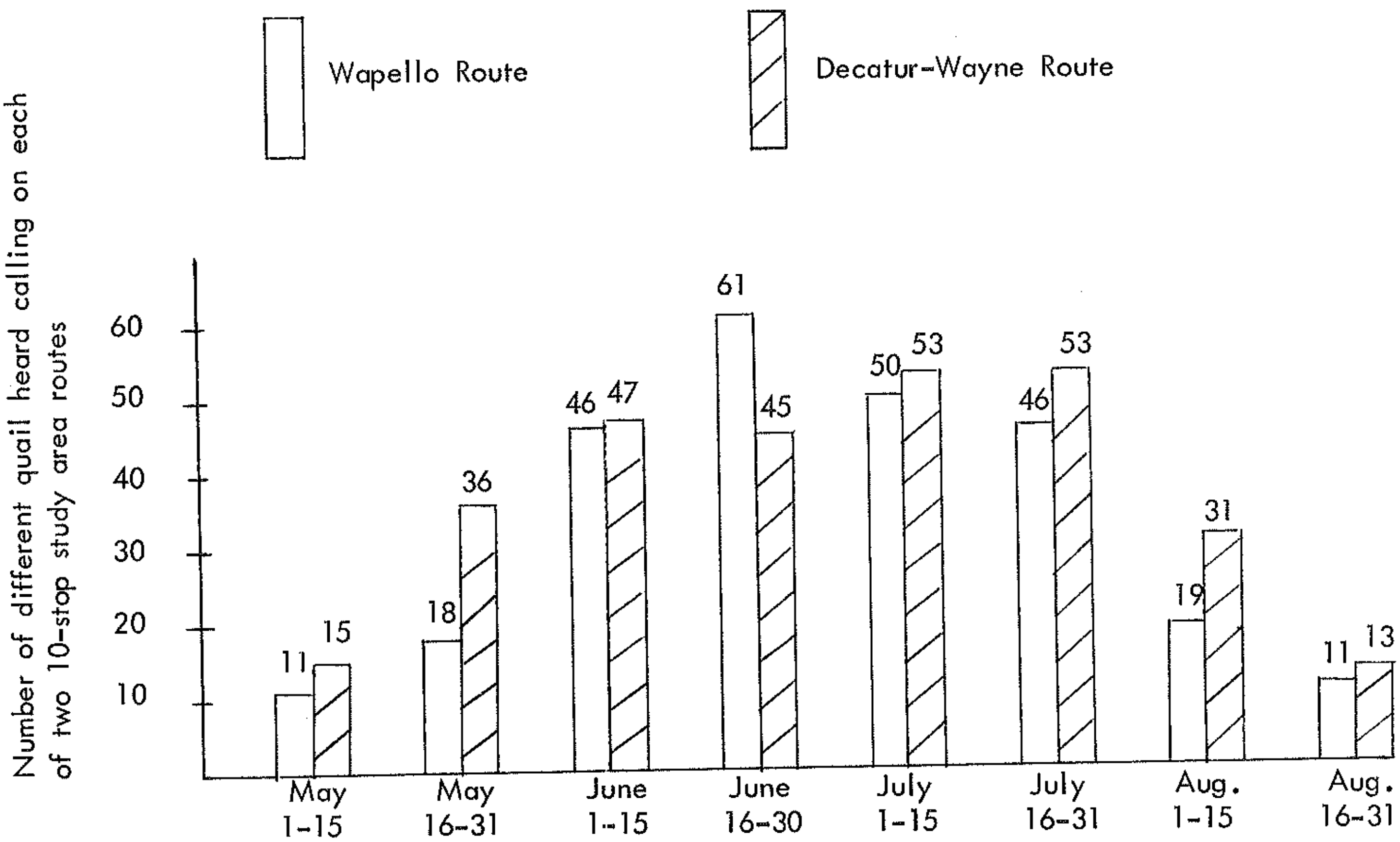


Figure 1. The length and peak of the quail calling period as recorded by different observers on the Wapello and Decatur-Wayne Areas, 1970

Table 1. Results of winter 1970 quail counts on the Wapello and Decatur-Wayne Areas compared to the 1968-69 average of both areas

	1970*			1968-69 Average
	Wapello Area	Decatur-Wayne	Both Areas	Both Areas
Number of Coveys located	26	18	44	42
Flush	7	18	25	
Sign	19	0	19	
Number of quail estimated	198	231	429	524
Flush	36	205	241	
Sign	162	26	188	
Number of hours spent walking	12.6	21.5	34.1	33.5
Hours per covey flush	1.8	1.2	1.4	1.4
Farmers' estimates of number of coveys	4	14	18	13

* On both study areas light snow cover useful for about 2 hours of survey

Table 2. Results of fall 1970 quail counts on the Wapello and Decatur-Wayne Areas compared to the 1968-69 average of both areas

	1970						1968-69 Average
	Wapello Area		Decatur-Wayne		Both Areas		Both Areas
Number of coveys located		47		33		80	66
Flush	14		29		43		
Sign	33		4		37		
Number of quail estimated		546		479		1025	875
Flush	51		421		472		
Signs	495		58		553		
Number of hours spent working		12.6		38.7		51.3	44.3
Hours per covey flush		0.90		1.33		1.19	1.02
Farmers' estimates of number of coveys		16		30		46	31

Table 3. Summary of quail hunting activity reported at five farms on each of two areas - Wapello and Decatur-Wayne, 1970-71

	Wapello Area		Decatur-Wayne Area		Both Areas		% Hunting Activity on both areas Parties	
	Number of Parties	Number of Hunters	Number of Parties	Number of Hunters	Number of Parties	Number of Hunters	1970-71	1969-70
October *	1	4	7	19	8	23	21	16
November	2	4	12	28	14	32	36	38
December	5	10	10	26	15	36	38	24
January	0	0	2	4	2	4	5	22
TOTALS	8	18	31	77	39	95	100	100

* October 1970 had 8 quail hunting days

PHEASANT NESTING AND PRODUCTION ON THE HANCOCK COUNTY WILDLIFE RESEARCH AREA (Progress Report)

Richard C. Nomsen
Game Biologist

The study to evaluate the effects of additional secure nesting cover for pheasants on an intensively farmed area was continued in 1970. The project is also designed to compare the relative production potential of land retired for several years (long-term) versus land retired for only 1-year.

Methods used were the same as in 1969, as discussed in Vol. 21 of the Quarterly Biology Reports. All farmers were contacted before "sign up" and informed of the proposed study. Landowners were to be paid an extra $10 per acre for hay ground to be retired and $3 per acre for new seeding provided certain requirements were met. Ten agreements involving a total of 493 acres were signed in 1970 (Table 1).

Nests were located in the various cover types by a systematic search by a crew of at least three men. Roadsides were searched twice; hay fields were searched at the time of mowing and again after the hay was raked into windrows; out fields were walked soon after cutting and raking into windrows.

The rotary chopper was again used on a sample of fields retired under the Federal Farm Program to remove the cover ahead of the men searching for nests.

Population surveys were continued to measure the population in winter, spring and late summer.

RESULTS

Winter Population:

Census conditions were excellent for the winter survey in 1971. Results for 1969-71 are presented in the following table.

	Hens	Cocks	Total
1969	127	45	172
1970	232	58	290
1971	227	46	273

Although production on the study area was much higher in 1970, the winter population of hens remained about the same. Unfortunately, the 1971 winter census was conducted after a severe snowstorm on January 3rd and 4th. Some storm loss occurred as several farmers reported dead birds brought to the farmstead by dogs. Other storm kills were reported in the vicinity.

Spring Crowing Count:

Spring corwing counts have shown only slight variation on the area. An average of 14.4 calls were heard in 1970 compared with 14.7 in 1969 and 14.1 in 1968. These figures compare fairly well with the number of cocks observed during the winter counts.

August Roadside Count:

Several roadside counts were made and the best three counts were averaged to compare with results obrained in previous years. The 30-mile August count was divided so that 12 miles of the route were run on the study area and 18 miles in the surrounding vicinity.

On Study Area	1968	2.2	birds per mile
	1969	2.7	birds per mile
	1970	2.9	birds per mile
Off Study Area	1968	1.0	birds per mile
	1969	1.0	birds per mile
	1970	0.4	birds per mile

This survey revealed a noticeable increase on the study area and a substantial decrease in the surrounding territory.

RESULTS OF NEST SEARCH (Table 1)

Roadsides:

There were 10 pheasant nests located in roadside cover during the 1970 search compared to 4 in 1969. Four of these nest hatched successfully.

Hay:

Nest density was high in hay ground - one next per 3.9 acres, but none were successful in 1970. Hatched nests were found in hay during 1968 and 1969 but chick mortality was very high. Twenty hens were killed by mowers.

Oats:

The planting and development of oat fields was on schedule in 1970, which thus provided adequate nesting cover in late spring. There were 15 nests in this cover type with a hatching success of 33%. One hen was killed during harvest. The acreage of oats harvested for grain continued to decrease in 1970 - only 5% of the farmland was planted to oats.

Diverted (new seeding):

The seeding of first-year diverted acres was also on schedule and production was similar to regular oat fields. The density of nests was somewhat lower but hatching success improved as a result of delayed cutting.

Diverted (old seeding):

Nest density increased considerably in the retired hay ground. One nest per 2 acres was found in 1970 compared to one per 5 acres in 1969. Nests in this cover type contributed 85% of the total production on the area. Renesting was noted again in 1970. There were seven known active nests located and three hens were killed during the chopping procedure in August. One hen returned and successfully hatched her nest after being flushed by the rotary chopper.

Summary:

A very mild April-May period prompted early nesting activity in 1970 and field work progressed rapidly. Unfavorable weather conditions had delayed field work in 1969. There were 80% more hens available for the 1970 season according to the winter census. Production increased considerably in the retired hay ground. Nesting hens apparently found the residual cover in these fields very attractive for nesting sites early in the season. Chick production in retired hay ground averaged 235 chicks per 100 acres compared to 26 chicks per 100 acres in the newly seeded fields.

Table 1. Results of pheasant nest search on Hancock County Wildlife Research Area, 1968-1970

	Roadsides (12.5 Mi.)			Oats			Hay			Diverted (New Seeding)			Diverted (Old Seeding)		
	1968	1969	1970	1968	1969	1970	1968	1969	1970	1969	1969	1970	1968	1969	1970
Acreage	50	50	50	301	247	171	232	224	172	226	148	194	76	283	299
Number of Nests	29	4	10	23	0	15	34	60	44	*--	0	11	*--	57	146
Number of Successful Nests	3	3	4	13	0	5	4	7	0	*--	0	6	*--	32	86
Percentage of Total Production	15%	7%	4%	65%	0	5%	**2%	17%	0	*--	0	6%	*--	76%	85%

* Diverted fields not chopped in 1968.

** Many chicks killed during hay harvest.

IOWA'S 1970 RUFFED GROUSE HUNTING SEASON

Bob Sheets
Game Biologist

Results of the 1970 fall hunter surveys indicate Iowa Ruffed Grouse are confronting an increasingly popular hunting season each year. Not only does the number of grouse hunters appear to be building but their ability to bag grouse appears to be on the rise also.

For the past several decades, Iowa ruffed grouse have inhabited only the northeast corner of the state. At present their best stronghold appears to be the rugged watersheds corrugating the unglaciated limestone bedrock in Allamakee, Clayton and Winneshiek Counties. Although the legal hunting range includes 9 counties, grouse hunters have recognized this terrain as best. Approximately three-fourths of them have concentrated in these 3 counties each year since the grouse season was initiated 3 years ago. This year a 4-week hunting season (30 days, 5 weekends) was initiated, compared to the 2-week seasons (16 days, 3 weekends) of the first two years. It ran from October 31 through November 29. Daily hunting hours were from 8:00 A.M. to 4:30 P.M., with a bag limit of 2 birds daily and 4 in possession, the same as during the first two seasons. The following information yields some insight into hwat took place in "grouse country" during this time.

HUNTER POSTCARD SURVEY

Table 1 depicts computed results of the 1970 grouse season and compares them to previous years. Popularity of grouse hunting seems to be gaining. This year 2,658 hunters took part and devoted roughly 24,000 hours attempting to bag a grouse. The increased season length resulted in a harvest increase from 2,240 birds in 1969 to 4,083 in 1970. The skill of the Iowa grouse hunter seems to be on the rise, for his success was better. Although the average number of days hunted increased from 2.1 in 1969 to 2.7 in 1970, the amount of the hunter hours each day decreased. Also, the average time spent each day decreased from 4.7 hours in 1969 to 3.3 in 1970 while the average bag per season rose from 1.4 in 1969 to 1.5 in 1970. Perhaps the most vital statistic for success lies in the category, "average hours to bag one grouse". This decreased considerably from 11.8 in 1968 and 7.4 in 1969 to 5.8 in 1970. The 1970 postcard survey indicates that hunter ignorance concerning grouse is wearing off; hunters are learning how and where to hunt, and the number of hunters is increasing.

Table 1. Results of the 1968, 1969 and 1970 hunter postcard survey on ruffed grouse hunting seasons in Iowa

Items	Year 1968	1969	1970
Statewide bag	720	2,240	4,083
Number of grouse hunters - statewide	1,150	1,642	2,658

Table 1 (continued)

Items	Year 1968	1969	1970
Percent of all Iowa hunters	0.4	0.5	0.8
Total hours hunted	8,510	16,430	23,836
Total days hunted	2,070	3,510	7,122
Average days per hunter per season	1.8	2.1	2.7
Average hours per hunter per season	7.4	10.0	8.9
Average hours per hunter per day	4.1	4.7	3.3
Average bag hunter per season	0.6	1.4	1.5
Average bag per hunter per day	0.3	0.6	0.6
Average bag per hunter per hour	0.08	0.14	0.17
Average hours to bag one grouse	11.8	7.4	5.8

HUNTER CONTACT SURVEY

An effort to increase the size of the hunter contact survey was made last fall. Commission Personnel were asked to submit the names and addresses of known grouse hunters in their area. Eight by twelve inch mailing envelopes were then sent to each recommended hunter. The back side of the envelopes displayed a printed questionnaire to obtain hunter performance data. The envelopes were also to be used to return one wing and the tail of a single grouse. These body parts were then used to compute sex and age information. Letters will be sent to all new 1970 cooperators asking for names and addresses of other grouse hunters for next year. The geometric progression of this method should add greater accuracy to our grouse management program each year. With the initiation of this method last fall, the 1970 envelope return was more than double the 1969 return.

In addition to mailing efforts, hunters were interviewed in the field. When vehicles were found unoccupied, a survey envelope was placed on the windshield.

HUNTER PERFORMANCE

No major changes in hunter performance were revealed as a result of the survey size increase (Table 2). Total number of hunters contacted rose from 121 in 1969 to 219 in 1970. Correspondingly, the number of party hunting hours used to compute averages rose from 187 in 1969 to 400 in 1970, with a bag increase from 70 to 157 birds. Despite this fact, percent of total grouse flushed that were badded and crippling rate remained the same from 1969 to 1970. Interestingly enough, each party flushed 11.7 birds in 1970 compared to 8.6 in 1969. This could be due to an increasing hunter effort since the average hours per hunter per trip for this group rose from 3.4 in 1968 to 4.3 in 1969 and more recently to 5.4 in 1970.

Table 2. Results of 1968, 1969 and 1970 Grouse Hunter contacts

Items	Year 1968	1969	1970
Number of party days	81	46	76
Total hunters	172	121	219
Average party size	2.1	2.6	2.8
Party hours of hunting	278	187	400
Total gun hours	595	529	1,201
Average hours/hunter/season	3.4	4.3	5.4
Total grouse flushed	321	395	887
Flushing rate-hrs/grouse	1.9	1.3	1.4
Grouse flushed/party	4.0	8.6	11.7
Total grouse bagged	75	70	157
Average kill-hrs/grouse	7.9	7.6	7.6
Percent flushed that were bagged	23%	18%	18%
Crippling rate	8%	14%	14%
Hunter Interviews			
Shots fired	193 (46 parties)	66 (18 parties)	84 (5 parties)
No. grouse bagged	35.7	8	16
Average shots to bag 1 bird	5.4	8.3	5.2

SEX AND AGE DATA

Upon the return of the hunter survey envelopes, the wing and tail were allowed to dry for one month. The sex of the bird was then determined by measuring the length and color pattern of the central rectrix, and the length of the rectix barbs. In the case of occasional birds not definitely fitting any age class, comparison keys based on the above measurements were used.

The 1970 collection of 79 usable envelopes resulted in a tally of 43 males and 36 females, for a sex ratio of 1.2 males to 1 female. Forty-seven immature grouse compared to 32 adult birds this year resulted in a age ratio of 1.5 young per adult, an increase over the ratio of 1.2 young per adult in 1969 (Table 3).

Table 3. Results of 1968, 1969 and 1970 ruffed grouse wing and tail surveys

Items	1968 No.		1969 No.		1970 No.	
Number of envelopes returned	46		62		108	
Number of usable envelopes	31		46		79	
Banded Birds	1		1		2	
		Occurrence %		Occurrence %		Occurrence %
Adult Males	10	32.2	15	32.6	20	25.3
Adult Females	3	9.6	6	13.0	12	15.1
Immature Males	8	25.8	13	28.2	23	29.1
Immature Females	10	32.2	12	26.0	24	30.3
Unknown	--		6		17	
Sex Ratio	1.4 males/females		1.5 males/females		1.2 males/females	
Age Ratio	1.4 young/adult		1.2 young/adult		1.5 young/adult	
Red color phase	15	48.3	26	63.4	50	64.1
Gray color phase	10	32.3	11	26.8	16	20.5
Intermediate color phase	6	19.3	4	9.8	12	15.4

Color phase occurrences remained nearly the same as 1969. Red-phased birds accounted for 63% of the survey in 1969; in 1970, 64% were red phase. Gray-phased birds comprised 27% of the survey in 1969 compared to 21% in 1970. An intermediate color phase occurred in 10% and 15% for the same respective years.

FOOD HABITS

During the four week 1970 fall grouse season, 13 grouse crops were collected and frozen as a beginning effort to learn what food items grouse utilize in Iowa. Collecting took place during the hunting season which ran from October 31 through November 29. Crops came from birds bagged in Allamakee and Clayton Counties. Hunting locations were chosen only by the hunters' ability to select grouse habitat. This was usually based on where good hunting had been encountered before, and not according to scientifically selected areas producing known grouse food items. All food material was air-dried for one month. Total dried crop contents weighed 75.90 grams.

Table 4 presents a breakdown of food items found according to percent weight and percent occurrence. With the exception of ironwood and corn, most plant species listed are known grouse food items for southern range grouse. Ironwood catkins were the most abundant items found. Nearly all catkins were intact. Three of the birds had selectively gorged their crops with ironwood catkins, indicating it was highly palatable. Late winter reports from a northeast Iowa State Forester indicated continued use of ironwood throughout March. A more traditional grouse food, hazelbrush catkins, appeared in several crops but constituted very little bulk weight. The moderate occurrence of insect matter may have indicated the exploratory diet of young birds existing through fall. The single crop containing corn was taken from a bird flushed from the edge of a ridge-top corn field. Timbered ravines were on either side of the field. Other grouse were seen flushing from such areas.

Table 4. Grouse food habits analysis, Fall 1970

Food Species Identified	Weight	% Total Weight	# Crops Appearing	% Frequency
1. Geum canadense "Avens" or "Vetch"	3.70	4.87%	6	46.1%
2. Rhus typhina "Sumac" (seeds)	Trace	-----	1	7.7%
3. Corylus americana "Hazelbrush" (catkins)	.50	.66%	3	23%
4. Circea quadrisulcata "Enchanters Nightshade"	.20	.26%	1	7.7%
5. Populus grandidentata "Bigtooth Aspen" (buds)	4.10	5.40%	1	7.7%
6. Ostrya virginiana "Ironwood" (catkins)	36.65	46.96%	6	46%
7. Phryna leptostachya "Lop Seed"	.10	.13%	1	7.7%
8. Cornus racemosa "Dogwood" (seeds)	.10	.13%	1	7.7%
9. Zea mays "Corn"	8.00	10.54%	1	7.7%
10. Grossularia ribes "Gooseberry"	.10	.13%	1	7.7%
11. Desmodium glutinosum "Tick Trefoil" or "Beggarweed" (seeds)	3.00	3.95%	2	15.4%
12. Amphicarpa bracteata "Hog Peanut" (seeds)	.10	.13%	2	15.4%
13. Trifolium repens "White Clover" (leaves)	2.00	2.64%	3	23.1%
14. Lonicera prolifera "Honeysuckle"	.65	.86%	1	7.7%
15. Crataegus "Hawthorn"	Trace		1	7.7%
16. Balium "Bedstraw"	.20	.32%	3	23.1%

Table 4 (continued)

Food Species Identified	Weight	% Total Weight	# Crops Appearing	% Frequency
17. Insects and Arachnids	.25	.32%	3	23.1%
18. Miscellaneous Twigs, leaf particles and soil	17.25	22.7%	---	-----

* Identification of many plant particles was accomplished by Mr. Garrett Davidse, graduate assistant, Botany Department, Iowa State University.

DISCUSSION

The hunter postcard survey this year revealed that the grouse hunters' ability to find and bag grouse is increasing with only 5.8 hours need to bag 1 grouse in 1970, compared to 7.4 hours in 1969 and 11.8 hours in 1968. Although a trend appears evident it must be kept in mind the postcard survey samples only 3% of all licensed Iowa hunters on a state-wide basis. As mentioned, grouse and grouse hunting are found in only the northeast corner of the state and although more grouse hunters are occurring each year, their numbers are still extremely small. As a result the survey return is relatively limited and should be judged accordingly so far as precision of measurement is concerned. Results of the 1970 hunter contact survey showed no extreme variation from 1969 despite its size being increased. However, the wing and tail sample coupled with survey is yielding insight into the birds' population structure, and efforts to increase the survey will continue. Laboratory determination of age ratios is based on criteria developed for ruffed grouse in northern states and may not be completely representative of growth rates in Iowa. Consequently, an effort should be made to trap, band, and re-cover birds to develop a known age key for Iowa grouse.

The food habits inventory conducted during the 1970 hunting season was small but did lend information concerning the birds habits and food availability and preferences during November. Ironwood is commonly considered an undesired forest understory plant due to its shade tolerant ability to out-compete more desired plant species. But it should also be recognized as a desired fall grouse food. The scope of Iowa grouse food habits analysis needs to be increased in order to determine the birds' year around requirements.

As a result, research plans for grouse include more food preferences study, determining how much suitable grouse habitat exists in eastern Iowa, and finally deciding where they might be stocked. Transplants to these areas will then be made.

SOUTHERN IOWA "McGRAW" MALLARD PROJECT
(Progress Report)

Richard Bishop
Waterfowl Biologist

Jack Coffey
Management Biologist

A research project was designed to study the possibility of establishment a breeding population of mallards on southern Iowa impoundments. One avenue of thinking was to use adult breeders to produce a generation of young mallards that were imprinted to southern Iowa habitat. These young birds, hopefully, would provide the nucleus stock for the new breeding population.

Wild mallard hens of the number needed would be quite difficult to obtain. Several other problems could be foreseen if wild hens were used. If wild hens could not be obtained, the next best approach would be to get semi-wild mallard hens with good genetic background. These birds would lack a migration tradition and probably remain on the release areas. It was reasoned that these hens would pair with wild drakes; thus, producing young with high genetic qualities. It is hoped that young birds produced from these hens would home back to their natal area and establish a nesting population.

The Max McGraw Wildlife Foundation at Dundee, Illinois offered to supply the birds for this project. The majority of the birds were 1-year-old birds. They were 3/4 genetically wild birds that had been raised under wire for just less than a year. Experience-wise, the birds were quite inadequate; however, it was projected that some of these birds would nest successfully and produce young. The adult hens would be used strictly as a means to an end. After the production season, they would be of little value to us. Hopefully, these adult birds would enter the hunters' bag during the season.

PROCEDURE

McGraw mallards were decided upon and about 400 birds were picked up at the McGraw Foundation on April 2nd and transported by truck to Russell, Iowa. The birds were held in crates for about 36-hours with only two losses. Exactly 400 birds were banded, nasal tabbed, and released on April 3rd. There were 350 hens and 50 drakes. All were banded with U.S. Fish and Wildlife Service bands and the ducks were adorned with red poly-vinyl nasal saddles. A sample of 185 birds had primary feathers pulled to check difference in movements and survival.

The birds were released in three areas:

Colyn Area	100 hens and 20 drakes
Browns Slough	100 hens and 15 drakes
Rathbun Reservoir	150 hens and 15 drakes

The Colyn area is 770 acres located in Lucas County. It is about one-third lake and marsh. The lake is shallow and most of it is open water. Some emergent and shoreline vegetation is present. The water area is surrounded by timber and brush. This area has limited nesting habitat and a high predator population.

Browns Slough is about 3 miles east of Colyn Area and is about 934 acres. This area is roughly 1.3 marsh and lake and the rest is timber and uplands. The uplands are mixed grassland, crop fields, and brush. Only limited nesting cover is available at Browns Slough.

The Rathbun Area is a large newly flooded impoundment in Appanoose County. Upland nesting cover was extensive in 1970. The best conditions for survival and nesting were in the vicinity of Rathbun Reservoir.

Numerous observations were made from the time of release through August.

RESULTS AND DISCUSSION

Tagged birds were observed frequently through the month of April. After April the number of sightings declined. Tagged hens were commonly observed with wild drakes and many of the hens were paired with wild drakes 1 week after release. Survival was better than expected. On May 6th, 63 marked birds and 25 wild drakes were observed on the Colyn Area. Other sightings also indicated good survival.

Observations on Browns Slough and Rathbun were more difficult to make. Emergent vegetation on Browns Slough and the large area with shoreline vegetation at Rathbun made data gathering quite difficult. Several sightings showed that the semi-wild drakes could not compete for the hens and when conflict arose, the tagged drakes were driven away. We observed several bachelor groups of marked drakes in May, indicating that they had not successfully paired with the hens. We found a few pairs of marked birds but most hens were accompanied by wild drakes.

Behavior of the marked birds was much different than was expected. The birds were very spooky and many of the birds could not be approached within 100-yards. Most of the birds that were shy to humans were in the company of wild drakes. Some groups of marked hens flushed when observers tried to approach within 60-yards.

After June 10th, a few groups of apparently non-mated birds were seen loafing along the shoreline of Browns Slough and Colyn. A few pairs were observed off and on during late June and July. Birds dispersed around the release areas and observations decreased after early June.

Three nests were found in mid-May. Two nests were in artificial nest baskets on

Browns Slough. They contained 17 and 11 eggs on May 15th. The third nest was 400 yards from a pond adjacent to the Colyn Area. The nest was located in tall grass in a pasture and contained 7 eggs plus one small abnormal egg. This nest had hatched by June 22. The two nests in nest baskets were both destroyed by avian predators. These were the only nests found; however, several hens were believed to be nesting near farm ponds in the vicinity of Colyn and Browns Slough. Nesting at Rathbun occurred but due to the extensive upland area, no nest searches were conducted.

Only one brood was sighted on the Colyn and Browns Slough areas. This brood of four young was observed on the pond close to the tall grass pasture nest on June 25th. This hen was last observed on July 15 with one half-grown duckling.

Several broods were seen while night-lighting on Rathbun Reservoir. Brood sightings were as follows:

July 28	Tagged Hen	10 + 2 young half grown - caught and banded 7
July 28	Tagged Hen	8 young - too small to band
July 28	Tagged Hen	8 + 2 - banded 3
July 28	Tagged Hen	4 young - too small to band
July 28	Tagged Hen	6 young 2/3 grown - banded 6
July 28	2 Tagged Hens	15 young - too small to band
July 28	Hen Unknown	8 young 2/3 grown - banded 5
July 29	Wild Hen	7 young - too small to band
July 29	2 Tagged Hens	14 + 2 young 2/3 grown - banded 5
July 29	1 Tagged Hen	4 young - banded 1
July 29	1 Tagged Hen	6 young - too small to band
July 29	1 Hen	7 young - too small to band - probably brood spotted night before
August 18	1 Tagged Hen	8 young - caught 2 and both were banded
August 18	1 Tagged Hen	2 young - banded 2
August 18	No Hen	6 young - banded 3
August 18	No Hen	8 young - caught 2 but already banded
August 20	Hen Unknown	8 young - quite wild - couldn't catch any
August 20	Tagged Hen	4 young - banded 3
August 20	Hen Unknown	6 young - could not catch any

(21 broods observed during night-lighting; some may be duplicates)

Generally speaking the broods of ducks flushed during night-lighting were quite wild and exhibited characteristics close to those of wild mallards. A few broods appeared tame but this sometimes happens with wild broods also. Young birds were wilder than marked hens.

A total of 45 young mallards was banded on Rathbun Reservoir during night-lighting activities. More young birds (those too small to band in July) would have been banded in August but high water levels made banding more difficult. The birds were then spread over a greater area.

Band return information should shed some light on movements and mortality rates of both the marked adults and banded young. To date, 13 bands have been reported but more should come in during the year. The project is slated to continue for 2 more years. At the close of this project, banding data should disclose some interesting facts about these birds.

Due to the success of the pilot stocking more detailed observations will be made in 1971. It will be of interest to note if any 1970 marked hens or banded young return to the Rathbun vicinity in 1971.

This is a brief progress report and is not meant to be a complete evaluation of field data on the project.

1970 WATERFOWL AND DOVE BANDING PROGRAM

Richard Bishop
Wildlife Biologist

The banding of migratory birds is a basic tool of game management. Although each of the various phases of the overall banding program is designed to provide specific information, it can generally be said that banding provides basic data on migrations, population distribution, mortality, and other factors essential to the management of the various species. Iowa's banding program is designed to supplement and complement a master banding program for the entire Mississippi Flyway. Since migratory game birds are not confined by political boundaries, it is essential that banding programs be coordinated with all agencies.

Banding in Iowa is essentially a five-point program, running from the end of one hunting season to the beginning of the next. The five broad categories into which our banding program is divided consist of:

1. Banding of post-season wintering populations of mallards.
2. Banding of young birds on the breeding grounds.
3. Banding pre-season populations of flying birds.
4. Banding of waterfowl used in experimental projects.
5. Banding of mourning doves.

POST-SEASON BANDING

The past several years, large numbers of mallards have concentrated late in the season in southwest Iowa near Forney's Lake in Fremont County. A portion of these birds (as many as 70,000) have been wintering in that vicinity on a warm water drainage ditch.

A post-season banding program was designed to capture a quota of 2,000 birds. The birds were captured in a large bait trap on the warm water drainage ditch.

In 1967, 1,762 mallards were banded in 12 days. In 1968, 1,658 mallards were banded in 10 days. Mild weather prohibited the filling of the 2,000 quota. In 1969, 2,094 mallards were banded. There were 1,934 mallards banded in 1970 (Table 1).

BREEDING GROUNDS BANDING

The summer banding program is designed to catch local ducks on their natal marshes. During the last 4 years, the birds have been captured by night-lighting. In 1967, 983 ducks and coots were banded by 4 crews using this technique. In 1968, 4 crews banded 1,104 ducks and coots, and in 1969 3 crews banded 1,138 ducks. A total of 1,231 ducks was captured by 4 crews in 1970. The night-lighting unit and operation are explained in the 1966 banding report.

Production of wood ducks and mallards was higher in 1970 than in the preceeding 5 years. However, the blue-winged teal breeding population was down slightly and production was poor.

Twelve species of ducks were captured. These were mallards, green-winged teal, blue-winged teal, shoveler, pintail, wood duck, redhead, ringneck, ruddy, lesser scaup, gadwall and widgeon (Table 2). Blue-winged teal made up 43%, wood ducks 20%, and mallards 19%. These 3 species are the main breeding birds in Iowa; therefore, they make up the bulk of the birds banded. In 1969, blue-winged teal comprised 49%, wood ducks 20%, and mallards 15% of all ducks banded.

Approximately 78% of the birds were classed as locals, young birds still unable to fly and known to have been reared in the vicinity where they were taken (Table 3). Immatures made up 10% and adults 12% of the total. In 1969, about 78% were locals, 14% immatures, and 10% adults. The age and sex composition were tabulated separately for mallards, blue-winged teal and wood ducks (Tables 4, 5 and 6).

One hundred and forty-three Canada geese were banded as part of an experimental project aimed at establishing a breeding flock of the giant Canada goose in the vicinity of Ingham Lake in Emmet County.

PRE-SEASON BANDING

This phase of the banding program is aimed primarily at banding a sample of blue-winged teal and wood ducks prior to the hunting season. The birds were captured by bait traps and cannon nets.

A total of 3,062 birds were banded during this period (Table 7) compared to 1,275 in 1969 and 3,113 banded in 1968. These birds were 69% blue-winged teal and 23% wood ducks. Sex and age ratios are given in Tables 8 through 11 for blue-winged teal, wood duck, green-winged teal and mallards, respectively. The blue-winged teal banded in 1967 were 80% immatures, compared to 87% in 1968, 84% in 1969 and 86% in 1970.

Emphasis was placed on the pre-season banding of wood ducks as in 1969. A total of 689 wood ducks was banded during this period. Cannon netting was incorporated into the pre-season banding operation in 1970. Cannon netting was very effective for catching mallards and in some cases, wood ducks. An expanded program of cannon netting will be put into operation in 1971. Cost per bird banded on Ventura Marsh using cannon nets in 1970 was lower than with bait traps in 1969.

MOURNING DOVE BANDING

In a cooperative project with the U.S. Fish and Wildlife Service, state personnel banded 2,347 doves in Iowa. Although Iowa has no mourning dove season at the present time, it is believed that our cooperative efforts in this program will result in a better overall understanding of this potential game species.

EXPERIMENTAL BANDING

A research project in southern Iowa using semi-wild "McGraw" mallards was initiated in 1970. A total of 400 mallards were banded and released in the vicinity of Rathbun Reservoir, Browns Slough and Colyn Area in an attempt to establish a breeding population of mallards in southern Iowa. It is hoped that young mallards produced from these released birds will home back to their natal areas and begin a new tradition and a new mallard population.

SUMMARY

Post-season banding of wintering mallards in southwest Iowa accounted for 1,934 mallards.

The breeding ground banding project in north central and northwest Iowa produced 1,231 birds, captured by night-lighting. Blue-winged teal made up 43% of the total, wood ducks 20% and mallards 19%.

Pre-season banding was directed toward blue-winged teal and wood ducks. A total of 3,062 birds were banded of which 69% were blue-winged teal and 23% were wood ducks.

One hundred and forty-three Canada geese and 400 McGraw mallards were banded as a part of experimental projects.

A total of 2,347 doves was banded in Iowa by state personnel. These birds were captured mainly by bait traps.

A grand total of 9,079 birds was banded in 1970.

Table 1. Post-season duck banding results -- southwest Iowa, 1970

County & Area	Species Banded	NUMBER BANDED AHY-M	AHY-F	HY-M	HY-F	TOTALS
Fremont -						
Knox Basin	Mallard	425	109	834	566	1,934
	Black Duck	1	1			2
	Pintail				1	1
	Snow Goose			1		1
TOTALS		426	110	835	567	1,938

Table 2. Total birds banded during breeding grounds waterfowl banding operation - 1970

COUNTY	NAME OF AREA	Canada Goose	Mallard	B. W. Teal	Shoveler	Pintail	Wood Duck	Redhead	G. W. Teal	Ringneck Duck	Lesser Scaup	Ruddy Duck	Gadwall & Baldpate	Total
Appanoose	Rathbun		48		1		1			1				51
Buena Vista	Little Storm						1							1
Calhoun	South Twin			3			11							14
Cerro Gordo	Clear Lake						8							8
Cerro Gordo	Ventura		21			3	*54	19				9		106
Clay	Dan Green			2								1		3
Clay	Mud Lake		20	77			30	32	6	6	1	7		179
Dickinson	Center Lake			5			3							8
Dickinson	Christopherson		1	13			8	6						28
Dickinson	Garlock			8			5							13
Dickinson	Grovers			17				2						19
Dickinson	Horseshoe		1	27										28
Dickinson	Hottes		2	20				7			1			30
Dickinson	Jemmerson	1	5	84								3		93
Dickinson	Lily Lake			18			3	19		1	1			42
Dickinson	McClellands		9											9
Dickinson	Sandbar		11	7			19							37
Emmet	Cunningham	6	35	32			58							131
Emmet	East Slough	10	10	52		9	8		5				1G	95
Emmet	High		12	68			4	1						85
Emmet	Ingham	25	9	4			1							39
Emmet	Kirkegard		3	13			6							22
Emmet	Torreson		19	55			20	3						97
Emmet	12 Mile Lake		15				6							21
Hancock	East Twin		5	9				13				8		35
Osceola	Rush			1		2		3					1B	7
Palo Alto	Virgin Lake			4										4
Palo Alto	Silver Lake		7											7
Pocahontas	Little Clear Lake		3	8										11
Worth	Silver Lake Marsh		2	6										8
TOTALS		42	238	533	1	14	246	105	11	8	3	28	2	1,231

* Transplant from northwest Iowa to Ventura Marsh

Table 3. Age and sex composition by species - all areas - breeding grounds, 1970

Species	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Canada Goose	5	3		1	14	19		42
Mallards	7	15	18	17	83	98		238
B. W. Teal	27	30	35	23	225	193		533
Shoveler			1					1
Pintail		1	5	5	1	2		14
Wood Duck	22	16	19	5	93	90	1	246
Redhead	2	7			44	52		105
G. W. Teal	2	2	1		2	4		11
Ringneck	2				4	2		8
Lesser Scaup		2			1			3
Ruddy Duck	1				15	12		28
Gadwall				1				1
Baldpate	1							1
TOTALS	69	76	79	52	482	472	1	1,231

Table 4. Mallard age and sex composition by area - breeding grounds banding, 1970 (Night Lighting)

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Appanoose	Rathbun	2	1	5	8	18	14		48
Cerro Gordo	Ventura		*9			3	9		21
Clay	Mud Lake		2			5	13		20
Dickinson	Jemmerson Sl			2	1	1	1		5
Dickinson	Hottes						2		2
Dickinson	Sandbar	1				5	5		11
Dickinson	McClellands					4	5		9
Dickinson	Horseshoe						1		1
Dickinson	Christopherson					1			1
Emmet	East Slough	1		4	1	1	3		10
Emmet	Ingham		1	4	4				9
Emmet	High					6	6		12
Emmet	Cunningham					17	18		35
Emmet	12 Mile Lake					8	7		15
Emmet	Torreson					9	10		19
Emmet	Kirkegard					2	1		3
Hancock	East Twin			3	2				5
Palo Alto	Silver Lake	3	1			1	2		7
Pocahontas	Little Clear Lake					2	1		3
Worth	Silver Lake Marsh		1		1				2
TOTALS		7	15	18	17	83	98		238

* Seven of 9 AHY-F were caught on the nest and had red nasal tabs placed on them. Two of the 7 nasal tabed mallards were caught at night.

Table 5. B. W. Teal age and sex composition by area - breeding grounds banding, 1970 (Night Lighting)

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Calhoun	South Twin Lake	1	1				1		3
Clay	Mud Lake	10	7			36	24		77
Clay	Dan Green					1	1		2
Dickinson	Hottes	2	1	4		6	7		20
Dickinson	Grovers	1	1			3	12		17
Dickinson	Sandbar		3			1	3		7
Dickinson	Horseshoe		2			12	13		27
Dickinson	Center Lake					3	2		5
Dickinson	Jemmerson		4	6	13	36	25		84
Dickinson	Christopherson	2	2			6	3		13
Dickinson	Lily Lake	2				8	8		18
Dickinson	Garlock					3	5		8
Emmet	East Slough	6	3	14	6	12	11		52
Emmet	Torreson			10		22	23		55
Emmet	Cunningham					20	12		32
Emmet	High	1				41	26		68
Emmet	Kirkegard					6	7		13
Emmet	Ingham						4		4
Hancock	East Twin					6	3		9
Osceola	Rush		1						1
Palo Alto	Virgin Lake		1			1	2		4
Pocahontas	Little Clear Lake	1	4			2	1		8
Worth	Silver Lake Marsh	1		1	4				6
TOTALS		27	30	35	23	225	193		533

Table 6. Wood Duck age and sex composition by area - breeding grounds banding, 1970 (Night Lighting)

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Appanoose	Rathbun				1				1
Buean Vista	Little Storm Lake		1						1
Cerro Gordo	Clear Lake				1	7			8
Cerro Gordo	Ventura *	3	2	19	2	7	21		54
Clay	Mud Lake	3	6			13	8		30
Calhoun	South Twin Lake	3				4	4		11
Dickinson	Sandbar	11	3			5			19
Dickinson	Center Lake					1	2		3
Dickinson	Lily Lake	1				2			3
Dickinson	Garlock					3	2		5
Dickinson	Christopherson	1				3	3	1	8
Emmet	High					3	1		4
Emmet	Cunningham					25	33		58
Emmet	Ingham					1			1
Emmet	East Slough		3			1	4		8
Emmet	12 Mile Lake					2	4		6
Emmet	Torreson		1		1	10	8		20
Emmet	Kirkegard					6			6
TOTALS		22	16	19	5	93	90	1	246

* Transplanted from northwest Iowa

Table 7. Total birds banded during pre-season waterfowl banding operations, 1970

COUNTY	NAME OF AREA	B. W. Teal	Wood Duck	Mallard	Pintail	G. W. Teal	TOTALS
Bremer	Sweet Marsh	7	72				79
Cerro Gordo	Ventura *	483	26		2	43	554
Clay	Dan Green	170	9			5	184
Clay	Trumbull	567	47			11	625
Emmet	Ingham	648	6				654
Emmet	Ingham *		230	174			404
Green	Goose Lake	47					47
Louisa	Odessa		200	1			201
Tama	Otter Creek		29				29
Winnebago	Rice Lake	194	54				248
Worth	Silver Lake		16	21			37
TOTALS		2,116	689	196	2	59	3,062

* Cannon Netting

Table 8. B. W. Teal age and sex composition by area - pre-season banding, 1970

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTAL
Bremer	Sweet Marsh			2		3	2		7
Cerro Gordo	Ventura *	88	85	134	175			1-Ad	483
Clay	Dan Green	4	14	82	70				170
Clay	Trumbull	11	36	285	235				567
Emmet	Ingham	14	44	316	274				648
Green	Goose Lake		3	29	15				47
Winnebago	Rice Lake			111	83				194
TOTALS		117	182	959	852	3	2	1	2,116

* Cannon Netting

Table 9. Wood Duck age and sex composition by pre-season banding, 1970

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTAL
Bremer	Sweet Marsh	9	8	24	30	1			72
Cerro Gordo	Ventura *	3	2	18	2		1		26
Clay	Dan Green	1	2	2	4				9
Clay	Trumbull	16	1	13	17				37
Emmet	Ingham		1	4	1				6
Emmet	Ingham *	62	55	59	54				230
Louisa	Odessa	1	1	19	17	56	104	2	200
Tama	Otter Creek			10	13	3	3		29
Winnebago	Rice Lake	8	7	17	22		5		54
Worth	Silver Lake		1	4	6	1			16
TOTALS		100	78	170	165	61	113	2	689

* Cannon Netting

Table 10. G. W. Teal age and sex composition by pre-season banding, 1970

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTAL
Cerro Gordo	Ventura *	24	8	5	6				43
Clay	Dan Green		1	2	2				5
Clay	Trumbull	3		2	6				11
TOTAL		27	9	9	14				59

* Cannon Netting

Table 11. Mallard age and sex composition by pre-season banding, 1970

County	Name of Area	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTAL
Emmet	Ingham *	8	15	81	70				174
Louisa	Odessa				1				1
Worth	Silver Lake			8	5	5	3		21
TOTAL		8	15	89	76	5	3		196

* Connon Netting

Table 12. Total Mourning Doves banded in Iowa, 1970

County	Name of Area	Nestling	Adults	Immatures	TOTAL
Bremer	W Sweet Marsh		72	39	111
Clay	Smiths Slouth	1	114	395	510
Emmet	Ingham Lake		120	92	212
Fremont	Forneys Lake		156	152	308
Guthrie	Bays Branch		70	171	241
Hancock	Goodell Pits		4	121	125
Lucas	Colyn		283	79	362
Lucas	Red Haw			4	4
Louisa	Cone Marsh	1	20	33	54
Marion	Red Rock		14	2	16
Marion	Pella Area		1	2	3
Pottawattamie	Wilson Island		41	13	54
Tama	Otter Creek		69	23	92
Warren	Hooper Area		5	4	9
Winnebago	Rice Lake		96	118	214
Worth	Elk Creek		4	2	6
Jackson	Cooks Island			12	12
Story *			10	4	14
TOTALS		2	1,079	1,266	2,347

* Study area near Ames, ISU project

Table 13. Experimental projects -- McGraw Mallards, 1970

County	Name of Area	AHY-M	AHY-F	TOTALS
Appanoose	Rathbun	15	150	165
Lucas	Browns Slough	15	100	115
Lucas	Colyn	20	100	120
TOTALS		50	350	400

Table 14. Cannon netting, 1970

County	Name of Area	Species	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Cerro Gordo	Ventura	Wood Duck	3	2	18	2		1	1-ad	26
Cerro Gordo	Ventura	B.W. Teal	88	85	134	175				483
Cerro Gordo	Ventura	G.W. Teal	24	8	5	6				43
Emmet	Ingham	Mallard	8	15	81	70				174
Emmet	Ingham	Wood Duck	62	55	59	54				230
TOTALS			185	165	297	307		1	1	956

Table 15. Total birds banded in 1970 by Iowa State Conservation Commission personnel

Species	Breeding Grounds	Post-Season	Pre-Season	Experimental	TOTAL
Black Duck		2			2
Mallard	238	1,934	196		2,368
G. W. Teal	11		59		70
B. W. Teal	533		2,116		2,649
Shoveler	1				1
Pintail	14	1	2		17
Wood Duck	246		689		935
Redhead	105				105
Lesser Scaup	3				3
Ruddy Duck	28				28
Ringneck	8				8
Snow Goose		1			1
Canada Goose	42			101	143
Mourning Dove	2,347				2,347
Gadwall	1				1
Baldpate	1				1
McGraw Mallards				400	400
TOTALS	3,578	1,938	3,062	501	9,079

RADIO TELEMETRY FOX STUDIES IN NORTH IOWA

Ron Andrews
Game Biologist

During the past 5 years, the Iowa Conservation Commission has been conducting a movement and mortality study on the red fox in the north Iowa area. During that time nearly 1,500 fox pups have been ear tagged and released at their natal dens. Early analysis of this data indicates that male fox disperse an average of 25 to 30 "straight-line" miles from their natal areas prior to and during the first breeding season, while females average about 1/3 that distance. Mortality data indicates that slightly over 80% of the mortality of red fox occurs from the hunter; 5% to 10% from the trapper; and the remaining mortality includes road kills, pups killed at dens and other miscellaneous mortality. Some of the minor but unusual mortality types included hay mowers, hay choppers and a "weed burner" (high voltage) electric fence. Mortality rates from hunting varied considerably with the hunting conditions. High pelt prices plus good hunting conditions during the past 3 years have greatly increased the hunting pressure placed on these animals.

During the fall of 1970, we began a radio tracking study to determine what type of travel routes were involved, when dispersal was initiated, and rate of dispersal. Radios were placed on 23 fox in the north Iowa area.

Radios and tracking equipment were provided by the University of Minnesota. Iowa provided the manpower for capturing, radioing and tracking the fox as well as the major portion of the airplane rental time necessary for the project.

METHODS AND MATERIALS

About 3 days were spent looking for fox sign, tracks, scattered food remains, etc.. In areas where it was believed fox were present dirt holes were made and scented with lure. After a week, an inspection of the dirt holes was made to determine whether fox were present. If present, small No. $1\frac{1}{2}$ padded traps were placed at the dirt holes to capture any fox present. Eight fox tagged as pups during the spring were captured and radioed. A total of 11 juvenile males, 10 juvenile females and 2 adult males were radioed.

Radios consisted of a small batteried collar placed around the animal's neck, with a whip antenna on the backside of the collar. Captured fox were radioed and released on the day of capture. Fox were differentiated by separate radio frequencies as well as different pulse rates or beeps per minute.

"Wired" fox were monitored daily with a mobile receiving unit. Time of day, weather, habitat cover and location to the nearest 40 acres were recorded. When a certain fox turned up missing, antenna and receivers were placed on an airplane and an aerial search for the fox took place. Once located from the air it became a matter of living with the fox while he dispersed at night.

Location "fixes" were recorded on an hourly basis as well as weather, time and other pertinent information. As the fox dispersed the route was mapped on county road maps.

RESULTS AND DISCUSSION

Of the 23 animals radioed, five animals were closely monitored and their dispersal routes were mapped. Their travel routes are shown in Figure 1.

A brief discussion on each fox whose dispersal route was mapped follows:

Fox #1 was tagged as a juvenile male on the Hancock County Pheasant Research Area on September 30. At the time of capture this animal had one non-functional hind leg. Although the leg was present, it hung loose at the hip joint. A portion of the tail was also broken off. We could only speculate, but it appeared the injury was caused by being hit by an automobile. On October 12 the animal was not found. An aerial search pinpointed the animal 5 miles northwest of the release area. The animal was followed 57 miles as shown on the map, making a loop around Bricelyn, Minnesota. On October 17 the fox had settled into a section where it had spent the day two days previously. Twelve weeks later the fox was still present in the same area. On three separate occasions the animal was walked in upon to see the condition of its hind leg and on all three occasions, it still swung loosely at the hip. On December 28 the fox was shot, four miles west of the area where it was checked.

Fox #2 was an adult male radioed near Fertile, Iowa on September 9. On October 15, the animal apparently began dispersing and was found from the air about 10 miles southeast of the release point near the northwest edge of Mason City. On the second night after considerable confusion trying to get around or through Mason City, this fox moved 4 miles northeast. In 3 more nights this fox was monitored for a total of 54 miles including a small loop at the end of his travel route. On January 16 this fox was shot 10 miles southeast of where I last had contact.

Fox #3 was a juvenile female radioed on September 12. This fox began dispersing October 18 and had moved 12 miles when for some unknown reason I lost contact with it on October 20. On February 10 this animal was shot 5 miles north of the original capture site indicating the fox had either made a loop or back-tracked on the original route it had taken when dispersing.

Fox #4 was a juvenile female radioed on September 12 and a litter-mate to fox #3. On October 21 this animal began dispersing and moved 6 miles westward where it remained until October 24 when it moved northward to the city limits at Forest City. This fox made a loop and total route of 37 miles; however, it ended up only 8 miles from its release site. On November 23 this fox was hit by a car.

Fox #5 was a juvenile male ear tagged on May 14. It was recaptured on September 11 and radioed and released. The radio quit working and the fox was recaptured and reradioed on October 13. On November 2 the animal was found 6 miles south of the release point with the mobile unit. It remained in the area for $1\frac{1}{2}$ days and then moved eastward to the Mason City residential area. After some confusion, it returned on the same route it took eastward to the section it had been in the night before. On November 5 the animal began a westward movement down into McIntosh Point on Clear Lake. After considerable time it paralleled the shoreline and moved southward around Ventura Marsh to a point near Alexander, Iowa where it made 4 loops and when contact was last made, a total of 89 miles of movement data had been collected. As of March 1 this animal had not been turned in by a pursuing sportsman.

Besides these 5 animals, partial movement data was gathered on four other fox. In addition to the dispersal data, the telemetry study provided us with some territoriality and home range information.

All of the travel routes showed certain similarities. All animals dispersed at night. They maintained one general bearing, moving around abstacles as they disperse and continuing in their general initial bearing. A total of 12 miles was the longest single night movement. Dispersal apparently begins in October and continues at least into December. Looping patterns are likely a big part of all travel routes. A maximum of 3 mph was the highest dispersal speed of these fox closely monitored.

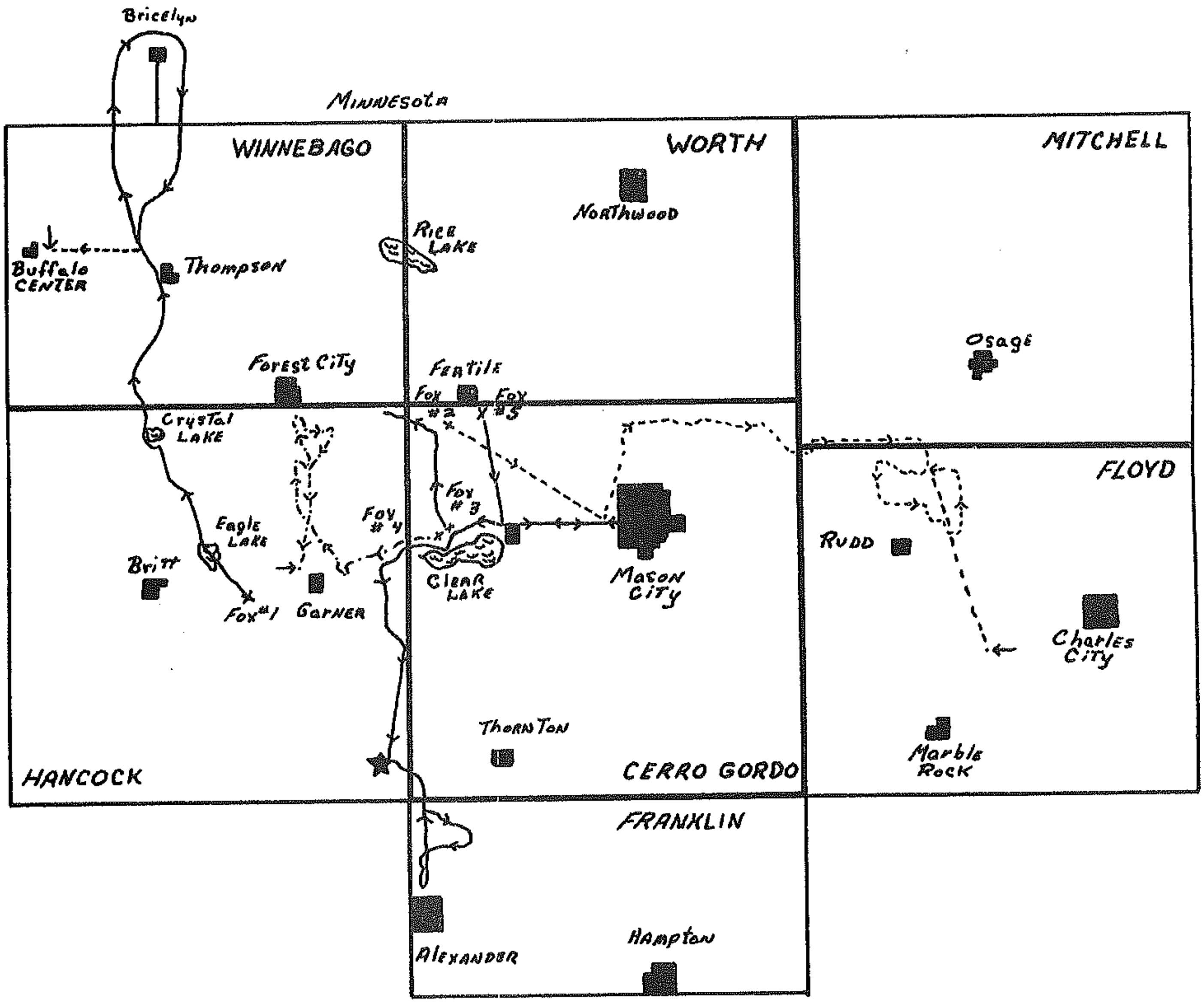
The routes of the two females followed were considerably more an aimless or wandering type of movement and they also tended to disperse at a slower rate. These two fox ended up less than 10 miles from their original capture site.

Of the 23 radioed fox, only 5 (4 females and 1 male) were not yet accounted for on March 1. Three were hit by automobiles, two were trapped, four were found dead, one was electrocuted in a high voltage electric fence and eight were shot by hunters.

The field work on the fox movement mortality study was completed with the end of the telemetry work. All tagging data and analysis will be done by computer at the University of Minnesota. Plans are currently being made for a major publication, written cooperatively with the University of Minnesota, U.S. Fish and Wildlife Service, and the Iowa Conservation Commission.

ACKNOWLEDGEMENTS

The research section wishes to thank all Commission personnel for their assistance in this five-year study. George Good of Randall was very instrumental in the field work of this study. Also numerous interested Iowa sportsmen assisted in locating dens and collecting data for this study.



DISPERSING ROUTES

Fox # 1 ——→——
Fox # 2 - - - → - - - -
Fox # 3 ——→——
Fox # 4 — · — · → · — · —
Fox # 5 ——→——
X starting Point
---------Unmonitored Portion
* Lost Contact with Fox # 5
Killed

Figure 1. Travel routes followed by radio-equipped foxes in north central Iowa.

STURGEON HARVEST IN THE MISSISSIPPI RIVER BORDERING IOWA

Don R. Helms
Fisheries Biologist

Shovelnose sturgeon is a valuable commercial food fish. Most of the harvest is processed by smoking and demand for this product greatly exceeds supply. Proper management of the species is precluded by insufficient knowledge of its abundance and life history. Since such studies are anticipated, Iowa's sturgeon harvest records for the Mississippi River have been compiled and summarized.

Shovelnose sturgeon are legally taken by both sport and commercial methods in Iowa. There are no size or possession limits. Harvest by sport fishermen is insignificant as was demonstrated by the UMRCC 5-year creel censuses conducted in 1962 and 1967 on Pools 11, 13 and 18. During these surveys only one shovelnose sturgeon was observed in the creel.

Commercial harvest information for the period 1954 through 1969 is presented in Tables 1 and 2. It must be noted that since many commercial fishermen report less than actual harvest for income tax purposes and/or fail to report less important species, these figures must be considered minimal. The range in the commercial harvest was 58,591 lbs in 1958 and 5,249 lbs in 1962, while the 1960-1969 10-year mean is 12,625 lbs.

Yearly pool harvest figures exhibit wide variation and offer little in the way of trends. Pools ranked in order of importance by the 10-year mean are: Pools 12, 17, 9, 11, 14, 10, 16, 13, 18, 19, and 15 respectively.

Combined harvests for Minnesota, Wisconsin, Iowa, Illinois and Missouri (Table 2) remain high in 1956 through 1958, but declined from over 100,000 lbs to under 25,000 in 1959. Combined harvests since that time have remained low. Iowa harvest, on the other hand, has shown a recent increase. In 1969, Iowa fishermen reported 62.7% of the total harvest of the Upper Mississippi River.

Price per pound has risen from 15¢ per pound in 1954 to 25¢ in 1969 (Table 3). The greatest calculated value was $9,960.47 in 1958. The 1960-1969 10-year mean is $2,746.86.

Catch by gear for all pools and all years combined were: hoop and trap nets, 44.7%; gill and trammel nets, 31.1%; seines, 18.1% and set lines, 2.6%. Gear was not specified on 3.5% of the catch.

Seasonal distribution of the harvest is bimodal (Figure 1). The major harvest is in May and June, while a secondary peak occurs during September. Harvest during the winter months, under ice cover, is minimal.

Table 1. Sturgeon harvest in the Mississippi River bordering Iowa 1954 through 1969

	POOL											
Year	9	10	11	12	13	14	15	16	17	18	19	Combined
'60-'69 10-yr $\overline{X}$	1,951 (2,546)	832 (1,078)	1,280 (1,332)	2,978 (3,277)	610 (822)	934 (1,225)	143 (213)	656 (1,154)	2,046 (3,007)	590 (1,844)	585 (1,802)	12,625 (18,298)
1969	849 (1,258)	651 (705)	828 (880)	11,736 (11,736)	1,364 (1,364)	644 (1,144)	135 (135)	1,192 (2,105)	5,470 (6,464)	42 (642)	228 (1,848)	23,139 (28,281)
1968	872 (1,508)	416 (507)	145 (175)	5,497 (5,607)	563 (563)	2,140 (2,440)	28 (178)	2,021 (2,024)	1,985 (2,496)	1,056 (2,158)	353 (1,277)	15,076 (18,933)
1967	543 (1,036)	211 (367)	1,527 (1,536)	4,358 (5,203)	1,708 (1,783)	1,178 (1,274)	595 (595)	1,012 (1,175)	2,041 (4,390)	163 (1,361)	----- (1,104)	13,336 (19,824)
1966	2,070 (3,155)	275 (316)	1,090 (1,097)	3,411 (3,791)	634 (1,088)	468 (1,468)	68 (128)	238 (338)	1,305 (4,159)	1,883 (2,483)	314 (2,817)	11,756 (20,840)
1965	186 (283)	178 (237)	3,332 (3,357)	250 (275)	567 (665)	128 (178)	129 (179)	1,062 (2,262)	3,288 (3,988)	316 (3,646)	354 (634)	9,790 (15,704)
1964	221 (541)	1,280 (1,387)	540 (631)	1,536 (1,551)	636 (808)	33 (338)	42 (102)	857 (1,547)	206 (206)	1,115 (2,988)	2,611 (5,009)	9,077 (15,108)
1963	2,220 (3,119)	952 (1,173	511 (727)	1,352 (1,502)	----- (235)	40 (86)	13 (113)	9 (569)	1,575 (1,575)	60 (2,270)	652 (2,454)	7,384 (13,823)
1962	1,916 (2,364)	497 (581)	115 (115)	436 (1,394)	140 (318)	680 (740)	96 (196)	106 (231)	440 (440)	500 (850)	323 (1,477)	5,249 (8,706)
1961	4,073 (5,094)	1,408 (1,997)	2,156 (2,211)	350 (350)	136 (1,213)	980 (980)	18 (198)	8 (838)	480 (2,675)	17 (439)	860 (1,022)	10,486 (17,017)

Table 1 (continued)

Year	POOL 9	10	11	12	13	14	15	16	17	18	19	Combined
1960	6,559 (7,099)	2,455 (3,510)	2,554 (2,591)	850 (1,356)	175 (180)	3,084 (3,598)	310 (310)	252 (451)	3,672 (3,672)	749 (1,602)	153 (378)	20,777 (24,747)
1959	3,173 (3,517)	2,774 (2,877)	618 (696)	130 (540)	607 (1,391)	175 (1,175)	785 (785)	156 (1,372)	2,895 (2,895)	830 (2,322)	1,776 (2,240)	13,919 (19,810)
1958	6,373 (7,373)	5,808 (5,965)	10,694 (10,728)	10,779 (12,800)	4,225 (9,570)	761 (1,837)	----- (80)	2,680 (6,803)	9,858 (9,858)	5,137 (24,807)	2,276 (8,216)	58,591 (97,337)
1957	6,393 (6,920)	594 (701)	7,036 (9,154)	253 (4,900)	699 (5,694)	1,825 (3,405)	----- (240)	2,703 (5,359)	6,218 (6,305)	3,851 (14,285)	622 (11,866)	30,194 (68,829)
1956	843 (1,099	648 (938)	3,525 (4,094	780 (4,345)	1,234 (5,537)	1,226 (6,790)	----- (1,200)	2,608 (7,208)	7,953 (9,079)	9,741 (29,408)	1,381 (30,652)	29,939 (100,350)
1955	1,341	269	2,388	1,126	1,392	393	-----	601	8,824	879	4,001	21,214
	(data for Illinois and Wisconsin not available for this year)											
1954	600	820	9,825	-----	1,800	1,877	-----	-----	4,142	1,546	4,178	24,788

Table 2. Sturgeon harvest by state in the Upper Mississippi River

Year	Minnesota	Wisconsin	Iowa	Illinois	Missouri	Total
1969	(No sturgeon harvest reported for Minnesota0	593	23,139	7,598	5,578	36,908
1968		1,405	15,076	8,143	2,586	27,210
1967		2,239	13,336	8,820	3,117	27,512
1966		1,799	11,756	12,077	785	26,417
1965		325	9,790	10,828	645	12,588
1964		1,713	9,102	13,640	6,346	30,801
1963		4,122	8,359	18,541	4,429	35,451
1962		3,176	6,726	5,444	3,039	18,385
1961		3,344	13,239	5,332	2,399	24,314
1960		2,375	21,214	4,176	2,731	30,596
1959		2,114	13,919	6,830	1,810	24,673
1958		2,341	58,840	43,775	3,684	108,640
1957		3,416	30,572	46,907	6,566	87,461
1956		1,539	30,349	82,149	6,123	120,160
1955 *			21,214			
1954		3,477	25,476	52,506	5,970	87,429

* Data for other states not available for 1955.

Table 3. Commercial value of sturgeon harvested in Iowa 1954 through 1969

Year	Pounds Reported	Price per lb.	Calculated Commercial Value
1969	23,139	25¢	$ 5,784.75
1968	15,076	25	3,769.00
1967	13,336	25	3,284.00
1966	11,756	19	2,233.64
1965	9,790	24	2,349.60
1964	9,077	23	2,087.71
1963	7,384	23	1,698.32
1962	5,249	20	1,049.80
1961	10,486	18	1,887.48
1960	20,777	16	3,324.32
1959	13,919	18	2,505.42
1958	58,591	17	9,960.47
1957	30,194	17	5,132.98
1956	29,939	17	5,089.63
1955	21,214	19	4,030.66
1954	25,342	15	3,801.00

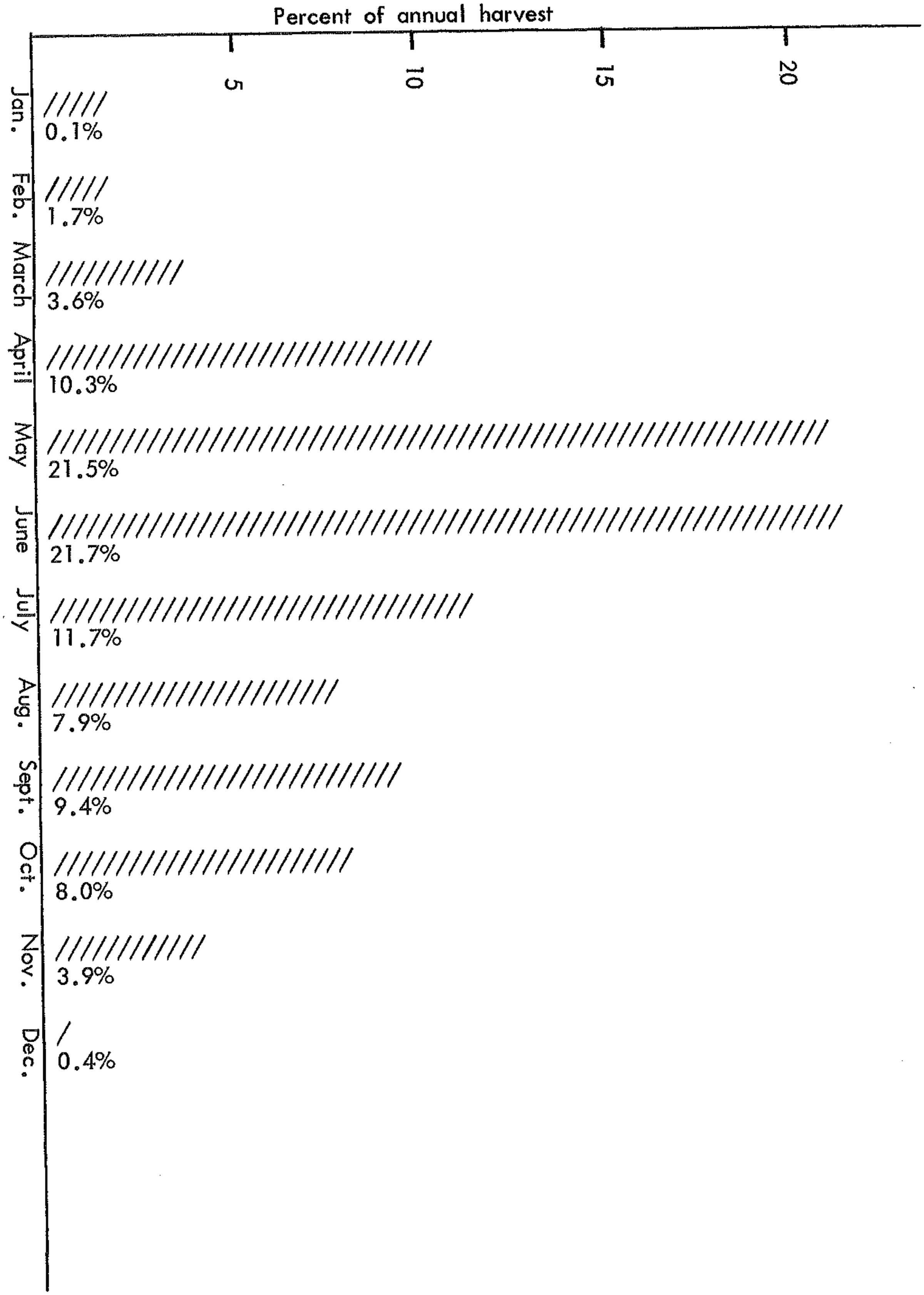


Figure 1. Seasonal distribution of Iowa's Mississippi River sturgeon harvest

DISTRIBUTION, ABUNDANCE AND MORTALITY RATES OF LARVAL AND POST-LARVAL GIZZARD SHAD IN RED ROCK RESERVOIR

James Mayhew
Fisheries Research Supervisor
and
Catherine Toft
Student Investigator

Sampling to determine the distribution, abundance and mortality rates of larvae and post-larvae fishes were begun in 1970. Year class strength in fish populations is usually established during the first year of life. When young-of-the-year fish are not numerous there is little chance the year class will become important to the population structure in subsequent years. Mortality is also greatest in early life stages, diminishing at an exponential decay rate as age increases. Early evaluation of year class abundance and some of the causes of death of young fish are desirable for proper management of this resource. Numerical estimation of larval and post-larval populations by conventional methods are impossible. Before accurate estimates are mathematically extrapolated from a sampling regime, all factors which influence variability in the samples must be minimized or explained. The main objective of this study was to determine the distribution and abundance of larval fishes in Red Rock Reservoir and develop sampling procedures for early estimation or comparisons of population densities. A second objective was to determine the rate of mortality for fish larvae and resolve the major causes for success or failure of year classes. The sampling procedure was designed with enough flexibility so comparisons of catch success and abundance could be evaluated yearly.

Larval and post larval fishes are important to the reservoir biota in two ways. First, they form the base for food of young piscivorous predators which sustain the yield of the sport fishery. Food habit studies of several predatory species at reservoirs in other locations (Nelson, Siefert and Swedburg, 1967 and 1969; Henderson, 1967; Applegate, Mullan and Morias, 1966) revealed larval fishes, particularly gizzard shad and cyprinids made up to 94% of the diet of young predators. Second, studies of exploited fish population with commercial food-fish and industrial processing value by Mayhew and Mitzner (1968 and 1969) in a Iowa flood control impoundment and river indicated both species composition of the fishery and catch success in entrapment gear changed as a result of fluctuations of year class abundance within populations. The potential yield of the fishery was wholly dependent upon development of one or more strong year classes of carp, buffalo or channel catfish.

In large flood control pools with great fluctations in water level, the fish population is usually dominated by carp, bigmouth buffalo, river carpsuckers and gizzard shad. Numerous vegetated shallow shoals and bays containing mud bottoms are productive spawning grounds for these species. The almost constant sedementary turbidity from wind action on exposed shorelines and mud reefs suppresses predation by sight feeding fishes. The fish populations of Coralville and Red Rock Reservoirs are estimated to contain up to 90% of these species by weight (Mayhew and Mitzner, 1970).

During the initial sampling program in 1970, at least 11 species of fish larvae and post-larvae were captured. Only gizzard shad and carp were caught in sufficient numbers for statistical treatment of the data, and only the results for the former are contained in this report. Crappie, green sunfish, freshwater drum, river carpsucker, walleye, bigmouth buffalo, channel catfish and several species of unidentified cyprinids and catastomids were also collected. The inadequate numbers of these fish was not a result of sampling error but of low population density from poor reproductive success.

METHODS AND PROCEDURES OF FISH COLLECTION AND DATA ANALYSIS

Sampling for larval and post-larval fish was accomplished by standardized meter net tows. The conical shaped net was constructed with a 5/8-inch steel head ring and 1/32-inch nylon mesh. The mouth of the net was exactly one meter on the inside diameter and was about 10-ft in length. A 16x28-inch depressor was attached to the center of a three point towing bridle with sufficient length to extend below the net while being towed so any turbulents from depressor would not interfere with small fish entering the net.

Samples were collected weekly for 16 periods extending from 10 May through 4 September or netting periods 5 through 13 in the Commercial Fisheries Investigations. Four main sampling stations were established at various locations in the reservoir (Figure 1). Station 2 was located in mid-water approximately 1/4 mile westward from the dam. Maximum depth was 27-ft. Tows were made at the surface and 5 m. The depth levels were designated by Station 2A and 2B, respectively. Station 3 was located in mid-reservoir near the small island off the Wallashuck shoreline. Maximum depth at this station was 33 ft. Tows were made at the same levels as before and were called Stations 3A and 3B. Station 4 was located in the upper portion of the pool near Elk Rock Point. Maximum depth was 23-ft. Samples were also collected at the two depth levels and were designated 4A and 4B. Station 7 was located near the south shoreline of Whitebreast Bay. All tows at this station were made on the surface as close to the shoreline as possible. The main purpose of this station was to determine if larval fishes concentrated in large numbers in shallow waters along shorelines.

The sequence of meter net tows was completely randomized. Sampling was conducted during darkness between 10 PM- 2 AM to diminish the effects of sight schooling by any species. Each meter net haul was five minutes in duration at a speed of 4 mph (875 rpm standard engine speed setting). Total distance for each haul was 566 m. No compensation was made for wind speed or direction because wind velocity after darkness in summer is usually of low magnitude. Depth was controlled by the angle and length of the towing warp. The net was retrieved while the boat was in forward motion at idle speed with a powered winch system. Most of the hauls were made on selected compass headings after starting from a fixed position at each station. The starting point remained in nearly the same location throughout the summer. Bottom depth was monitored constantly by echo-sounding while the net was towed.

Fish from each haul were preserved immediately after capture in 2.5% buffered formalin. Counting and sorting was done in the laboratory. Muscular tissue was cleared

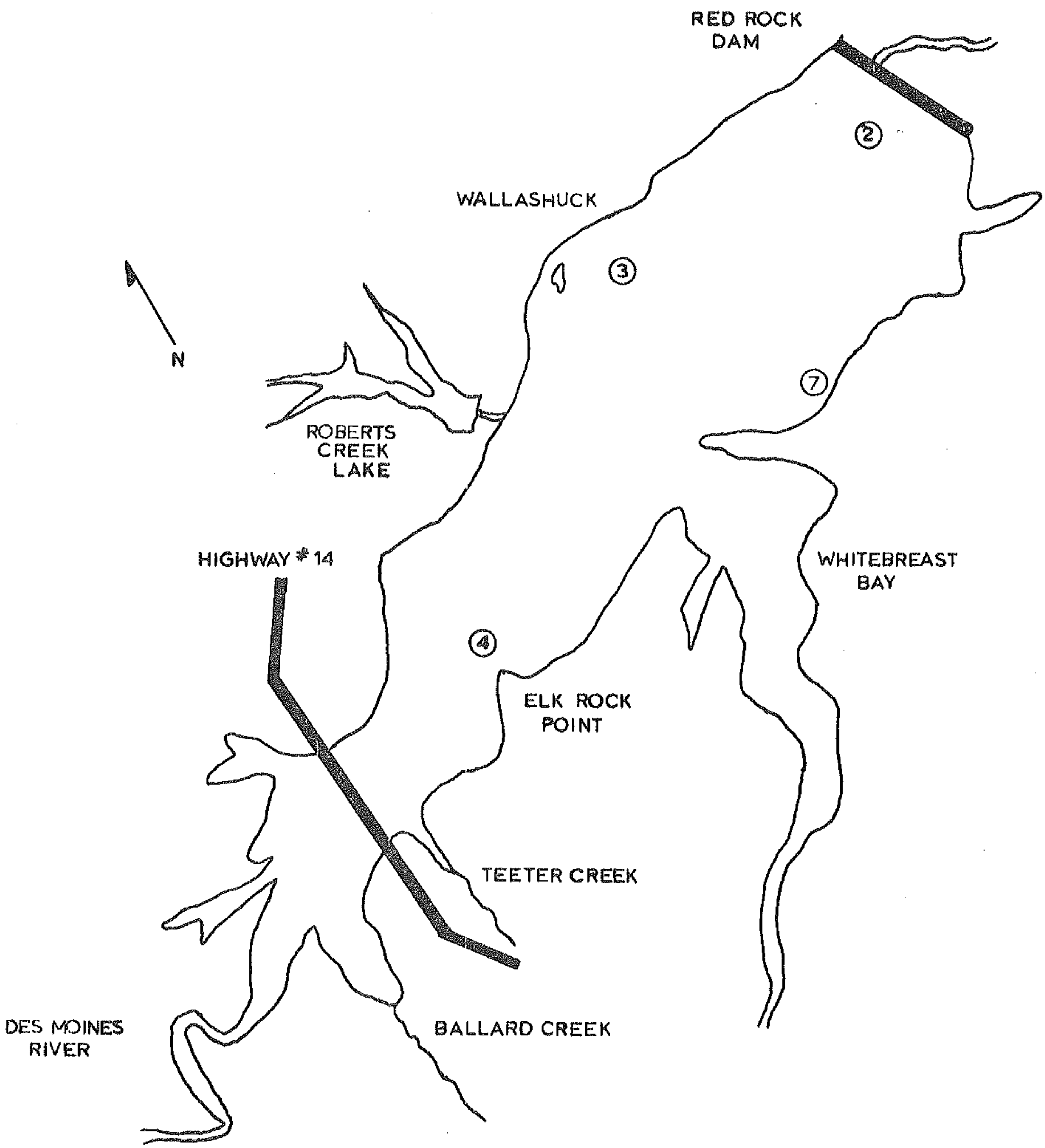


Figure 1. Location of sampling stations for meter net tows in Red Rock Reservoir.

with a 1: 250 solution of trypsin (commercial hog pancreas) and the bony structure stained with Alizarin Red S on specimens which were keyed out by vertebral counting. Fish were identified to family or species according to keys of larval and post-larval fishes by Mansuetti and Hardy (1967) and May and Gasaway (1967). Both keys lacked adequate sections on taxonomic criteria for catastomids, but as sampling progressed and personnel identifying and counting fish became familiar with the separating characteristics, it was quite simple to identify bigmouth buffalo and river carpsucker after a length of 20 mm was attained.

For analysis the mean weekly catches of l arval fish were smoothed by bi-weekly intervals. In this array, the original 16 week-periods were replaced by eight replications. Since the experiment was designated to test the differences in mean catches of larval fish, computation could follow an analysis of variance procedure in both a two-way and factorial classification. These data were transformed into logaritms according to Snedecor and Cochran (1967) by

$$Y_{ijk} = \log_{10} (X_{ijk} + 1)$$

where Y_{ijk} is the resulting transformed value of X_{ijk}, and X_{ijk} is the catch value for the k^{th} replication of the i^{th} station at the j^{th} depth level. Transformation eliminated the zero catches that appeared from tows early in the season and stabilized the bariance so all variable were mutually orthogonal. The transformation would also give the mortality curve a straight line relationship instead of the exponential decay curve.

Differences among surface station 2A, 3A, 4A, and 7 were tested in a two-way classification. The mean squares deviations for the residual was the estimated variation of the transformed catch per tow after the unique effects due to sampling station and replication were removed.

The random effects model was

$$X_{ij} - \mu + \alpha_i + \beta_j + \epsilon_{ij}, \quad i = 4 \text{ and } j = 8$$

where μ represents the overall mean catch, α_i is station effect and β_j stands for replication effect.

Analysis of variance in mean catches of larval fish at surface and sub-surface sampling station 2A, 2B, 3A, B, 4A and 4B was done in a 2^2 factorial contrast. Mean squares deviations for the residual were the same as before except deviation due to depth level were included in the model. The model with k replication.

$$X_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ij}, \quad i = 3, \ j = 2 \text{ and } k = 8,$$

where μ and α are the same as before in the two-way classification, β represents depth effect. Comparisons of all paired means were made by the studentized Newman-Kuel multiple range test with the value of t at the 0.05 level.

DISTRIBUTION AND ABUNDANCE OF GIZZARD SHAD

Total catch of larval and post-larval gizzard shad for the 56 samples was 11,567 with a mean of 206.55 per tow (Table 1). In transformed values the number of shad larvae per haul ranged from 0.1000 at Station 7 in the first replication to 3.7528 at Station 3B in the third interval. There is little evidence larval shad concentrated into one region of the reservoir more than another. Mean catches for the combined stations in transformed values was 2.8280, 3.4284, 3.2314 and 3.1611 for Stations 2, 3, 4, and 7, respectively. Analysis of variance (Table 2) in the two way table showed acceptance of the null hypothesis of no difference in mean catches in surface hauls at the 0.05 level. Further, there was no evidence larval shad were more numerous at one depth level than the other. In the factorial classification analysis of variance, the effect of depth was insignificant ($P > 0.25$), and accounted for only 3% of the mean squares variability. Combined these analyses reveal homogenous distribution of larval and post-larval shad in the reservoir regardless of the location of surface sampling or depth level of the sample.

Table 1. Logarithmic transformed mean number of larval and post-larval gizzard shad in meter net hauls

		Replication							
Station	Depth	1	2	3	4	5	6	7	8
2	A	1.0000	1.7559	1.5563	1.9912	1.9138	2.1584	1.1761	1.3010
	B	0.9031	1.5563	2.4362	2.4393	1.9031	1.0212	1.0531	0.9031
3	A	0.9542	2.1206	2.8609	2.8609	2.3324	1.6201	1.5441	0.8451
	B	1.4150	2.6920	3.7528	3.0086	1.9445	1.8129	1.5441	0.6990
4.	A	0.6990	1.9494	1.9243	1.5789	2.2253	2.5340	2.7987	2.5955
	B	0.6990	1.9191	2.4364	1.4624	2.2095	2.6180	2.4099	2.6990
7		0.1000	2.7860	2.7589	2.0682	1.9445	1.1139	1.6721	1.0170
Replication $\overline{X}$		0.8243	2.1113	2.5194	2.2014	2.0675	1.8372	1.7425	1.4371

A = surface hauls
B = 5 m hauls

Bi-weekly distribution of the combined mean catches (Figure 2) showed a progressive increase from the first through third replication followed by a systematic decline until sampling ceased. In transformed values mean catch was 0.8234 + 0.1509 in the first period and increased to a maximum of 2.5194 $\pm$ 0.2677 in the third sampling interval and decreased to 1.4371 $\pm$ 0.3203 in the last period.

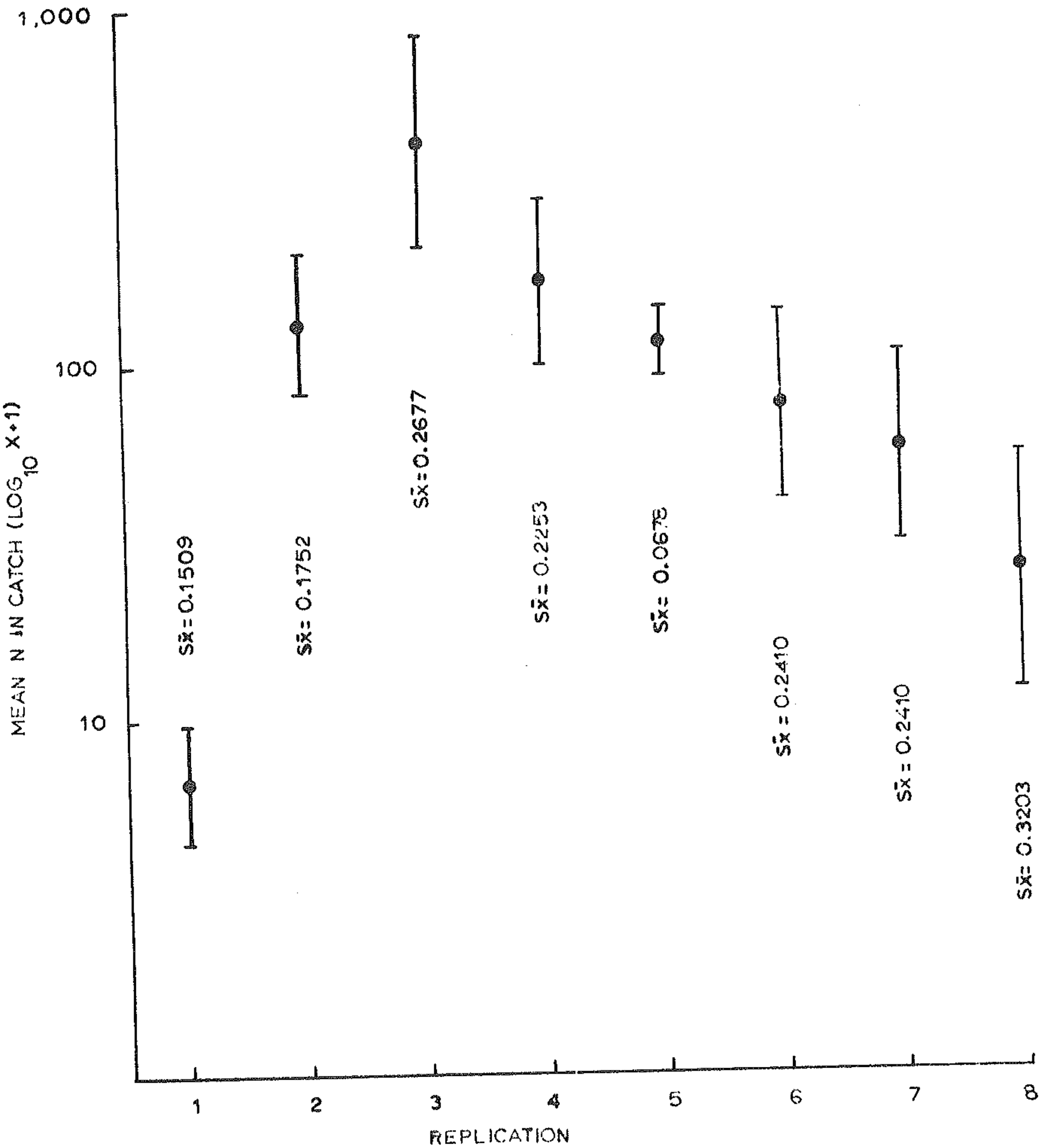


Figure 2. Mean catch of larval and post-larval gizzard shad in meter net tows, Red Rock Reservoir. Brackets denote sample standard error.

Table 2. Analysis of variance in catches of larval and post-larval gizzard shad in leter net hauls

Source of variation	df	Sum of squares	Mean squares	F
Two-Way Classification				
Station	3	1.1101	0.3700	1.04
Replication	7	8.3457	1.1922	3.35 *
Residual	21	7.4712	0.3557	

Newman-Kuel Test of Means

$\bar{X}$ catch arranged from smallest to largest	0.6003	1.2729	1.7347	1.7899	2.0473	2.0622	2.0902	2.2369
Replicate	$\bar{R}_1$	$\bar{R}_2$	$\bar{R}_7$	$\bar{R}_6$	$\bar{R}_5$	$\bar{R}_4$	$\bar{R}_2$	$\bar{R}_3$
Mean difference (not underlined)	———	———						
		———	———	———				
			———	———	———	———	———	———

Factorial Classification				
Replications	7	10.5004	1.5000	4.49 **
Stations	2	0.9187	0.4594	1.38
Depths	1	0.0741	0.0741	0.22
Stations X Depths	2	0.1491	0.3339	0.22

Newman-Kuel Test of Means

$\bar{X}$ catch arranged from smallest to largest	0.8313	1.5070	1.9216	1.9990	2.0881	2.1256	2.2410	2.4033
Replicate	$\bar{R}_1$	$\bar{R}_8$	$\bar{R}_7$	$\bar{R}_2$	$\bar{R}_5$	$\bar{R}_6$	$\bar{R}_4$	$\bar{R}_3$
Mean difference (not underlined)	———	———						
		———	———	———	———	———	———	
			———	———	———	———	———	———

* significant at the 0.05 level
** significant at the 0.01 level

There was significant difference ($P \leq 0.05$) in replications when surface hauls were compared in the two-way table and highly significant difference ($P \leq 0.01$) in replications by factorial combination. The Newman-Kuel test of paired means showed larval shad catches in replications 1 and 2; 6 and 7; and 3 through 8 were not significantly different at the 0.05 level in surface hauls. In the factorial classification paired means for replicated 1 and 8; 4 through 8; and 3 through 7 were not significantly different.

Means of numerical catches of larval shad indicated the population density increased steadily from initial spawning until the third sampling interval. Mortality of young shad during these periods was constantly reducing the numerical population, but production was much greater than loss by death. When spawning activity diminished and finally ceased, mortality continued at the usual exponential decay rate causing the population density to decline which was reflected in mean catch values in meter net hauls.

From the catch data, it is evident initial spawning commenced in early May prior to the first sampling interval. Size distribution of the samples during the first replicate had a range in total body length of 7- 12 mm (Figure 3). By the second period larval shad size range was 7- 16 mm with a mode appearing in the 11- 12 mm class interval. Meter net hauls on 15 June had two distinct size groups indicating additional spawning of shad occurred. The first group, which was attributed to initial spawning, ranged from 25- 30 mm in length while the second group was 7- 18 mm in length with the 9- 10 mm class interval the most numerous. By 29 June, the first group of shad ranged in size from 47- 51 mm and the second group from 7- 14 mm. An intermediate size interval ranging in body length from 37- 40 mm was also present, but they comprised 4% of the total sample.

Samples collected on 13 July indicated spawning activity increased for a third time. Size distribution of larval and post-larval fish captured on this date of 26%, 68+ mm; 62% 35- 56 mm; and 12% 15- 20 mm. At the following sampling period both the first and second hatches of shad were 73+ mm and the latter group ranged from 55- 70 mm. By the sixth replication on 10 August, it was impossible to separate fish by length distribution because all were 75+ mm in length. The maximum length of young shad captured during the summer sampling was 154 mm.

These data would indicate spawning and hatching of young gizzard shad existed from approximately 10 May through 15 July. Within this time interval there were three distinct periods of intensified spawning activity. Estimated dates of peak activity were 20 May, 5 June and 2 July.

GROWTH OF LARVAL AND POST-LARVAL GIZZARD SHAD

Plots of mean body length of fish by bi-weekly intervals (Figure 4) showed typical exponential growth characteristics. Length measurements in the first period ranged from 7- 12 mm with a mean of 10 mm. Mean length of shad captured in the second interval increased to 12 mm and ranged from 7- 17 mm. By the third replication mean length in

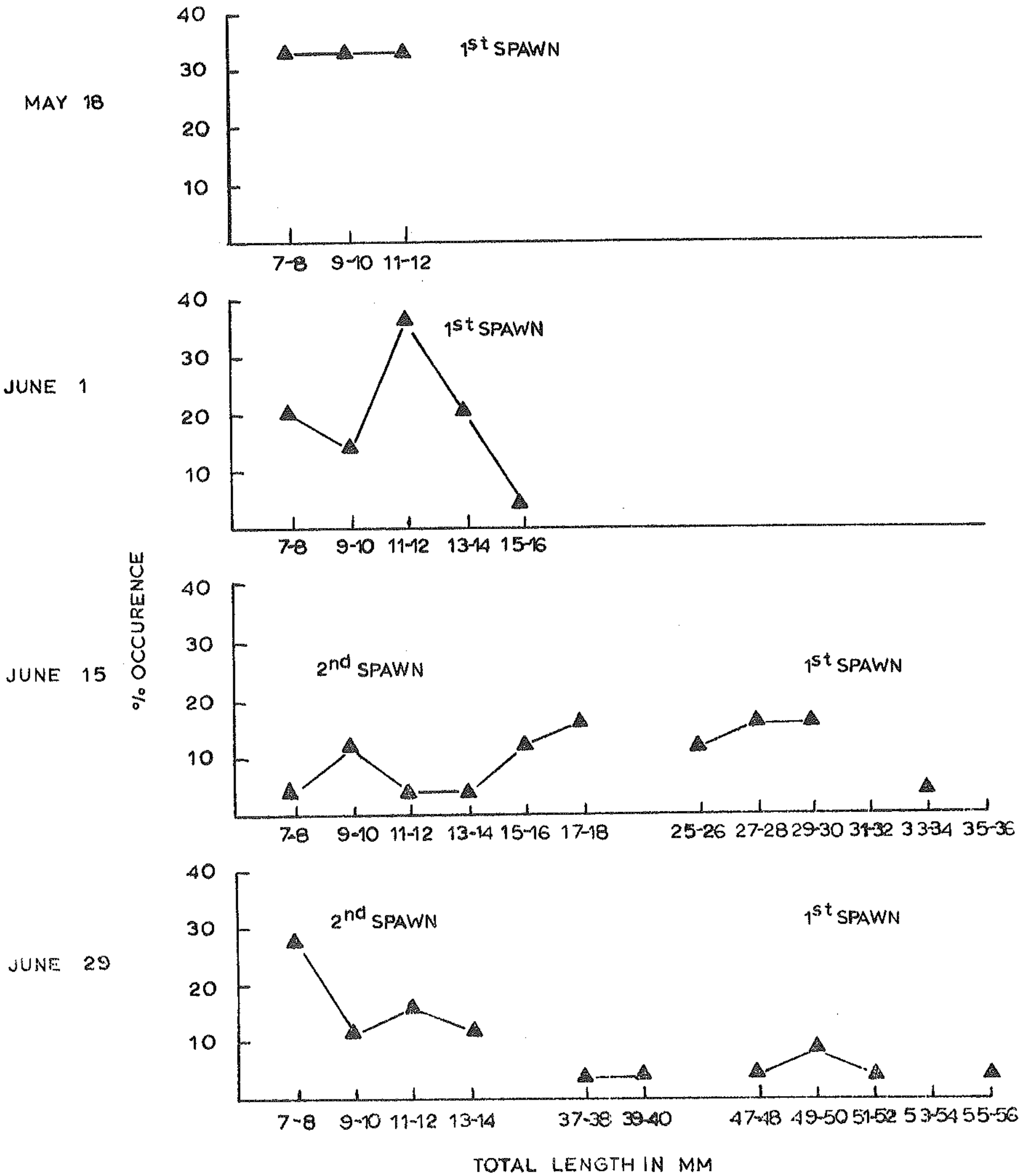


Figure 3. Length frequency distribution of larval and post-larval gizzard shad in meter net haul at Red Rock Reservoir.

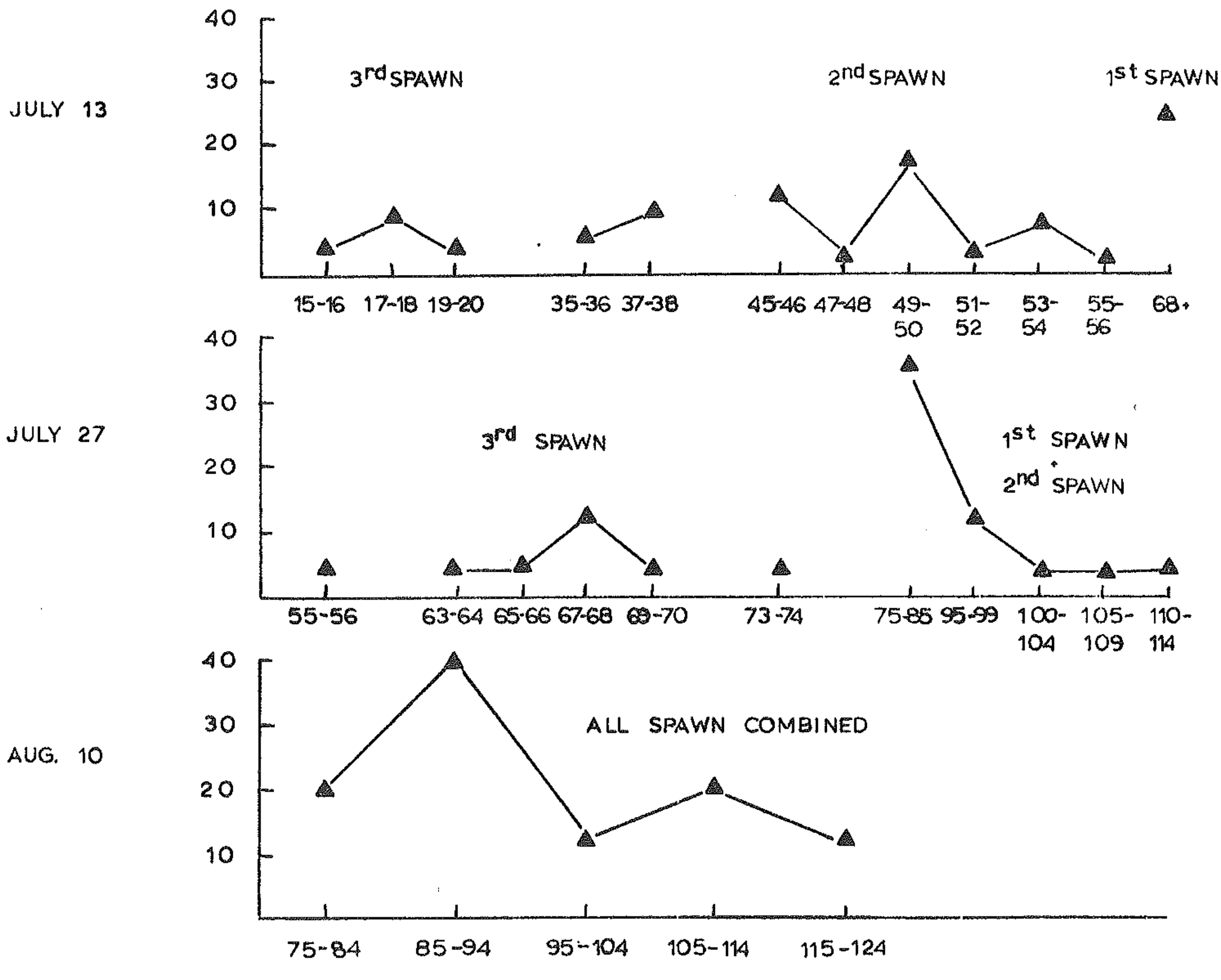


Figure 3. (continued)

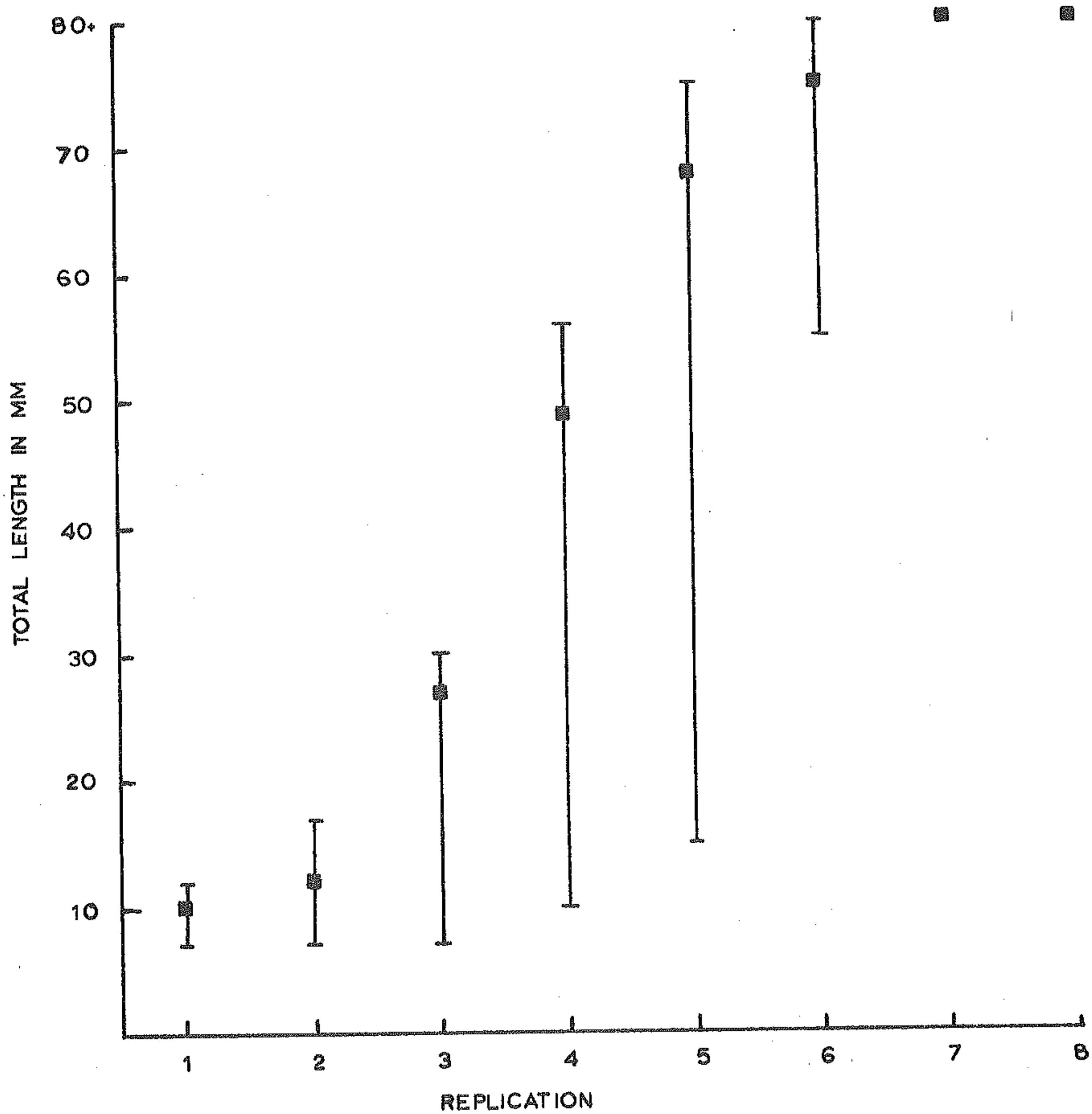


Figure 4. Growth of age 0 gizzard shad in meter net tows. Brackets are size range of sample in mm.

the samples was 27 mm and ranged from 7– 30 mm. In the fourth bi-weekly interval size of the shad varied from 10– 56 mm with a mean of 49 mm. The smaller size groups resulted from secondary spawning activity. Mean length of shad captured in the last three sampling intervals was 68 mm, 75 mm, and 80+ mm. respectively.

Cursory examination of the growth data from age 0 gizzard shad showed body length seldom exceeded 80 mm. Although supplemental information from trawling, small mesh seine hauls and trap netting indicated substantial numbers of shad ranging from 100– 135 mm were present in the population in later sampling periods. Few fish of this size were taken in the meter net tows. Further analysis of these data indicated the true growth characteristics of the shad population were being masked by escapement from the gear by fish 80+ mm in length. Since initial inflection in the growth curve occurred at about 63– 64 mm it was postulated this was the critical size where gear avoidance commenced in significant numbers. As body length increased the physical ability of shad to avoid capture by meter nets also became greater. Growth rates would appear to stabilize or become constant at this point, when in reality shad exceeding this length were merely capable of avoiding capture.

MORTALITY OF LARVAL AND POST-LARVAL GIZZARD SHAD

Mortality in a fish population usually occurs at the maximum rate during the' first year of life, and is highest closest to the time of embryonic development. Estimates of mortality cannot be achieved until a downward trend occurs in numerical abundance of age groups or length groups. For age 0 gizzard shad in Red Rock Reservoir the population density obviously began to decrease in the third sampling period. Although additional spawning and hatching of shad was apparent after this period, it was at this point loss from natural mortality surpassed the numbers recruiting into the population by reproduction.

Estimates of instantaneous mortality of age 0 gizzard shad were made similar to the method presented by Rounsefell and Everhart (1953: 86). Instead of using age frequency a straight line was fitted to the catch distribution curve by the least squares procedure. Only larval shad catches after the third sampling interval were included because this was the period in which the decline in catch commenced. Since the catch values were already transformed by logarithmic terms it was not necessary to make further transformation. If $\log_e$ base transformation is desired it can easily be converted as $1/\log_{10} e = 2.303$, but the results would be similar.

The instantaneous mortality rate of ago 0 shad was computed by the linear function.

$$\log_{10} Y = a + bX$$

where the b value is regarded as an estimate of instantaneous mortality. For the shad data slope was 0.20 ± 0.09. The product moment correlation coefficient of this regression was 0.989.

POPULATION ESTIMATES OF AGE 0 GIZZARD SHAD

Conventional methods of estimating the numerical population density of age 0 shad cannot be used in this study because of their abundance, small size would preclude any type of marking. Since the analysis of variance in both two-way classification and factorial classification showed no significant difference in the distribution of larval and post-larval shad it was assumed the fish were distributed in a homogenous fashion in the reservoir and could be estimated by mathematical extrapolation of the mean catch among samples. Confidence intervals can be set around these estimates in the usual way using the standard error of estimate for each sampling interval.

Mean catch values for sampling periods ranged from 331 in the third period to 27 in the last interval. The age 0 shad population estimate was $8.7033 \times 10^7 \pm 1.0511 \times 10^7$ and $7.0276 \times 10^6 \pm 1.0932 \times 10^7$, respectively (Table 3). Confidence intervals for the last estimate are not reliable becuase of the small sample size and large variation in the samples.

Table 3. Numerical population estimates of larval and post-larval gizzard shad in Red Rock Reservoir

Sampling Period	$\bar{X}$ per tow	Estimated $\hat{N}$	95% Confidence Intervals
3	331	8.7033×10^7	$\pm 1.0511 \times 10^7$
4	159	4.1556×10^7	$\pm 8.8079 \times 10^6$
5	117	3.0579×10^7	$\pm 6.6204 \times 10^6$
6	69	1.7959×10^7	$\pm 8.9797 \times 10^6$
7	55	1.4055×10^7	$\pm 8.9797 \times 10^6$
8	27	7.0276×10^6	$\pm 1.0932 \times 10^7$ *

* Confidence intervals are too large for accuracy because of a small samples size and large variation among samples

During the fifth sampling period, several sub-samples were counted and revealed approximately 1,100 shad were required to weigh 1 lbs. Using this as the mean for the season, the estimated biomass of age 0 shad in the reservoir was calculated at about 3.2 lbs per surface acre. At the 0.05 level this value would not vary more than $\pm$ 0.7 lbs.

LITERATURE CITED

Applegale, R. L., J. W. Mullan and D. I. Morais.
1966. Food and growth of six centrarchids from shoreline areas of Bull Shoals Reservoir. Southern Assoc. Game and Fish Comm. 20th Annual Conf. 469-482.

Applegale, R. L. and J. W. Mullan.
1967. Food of young largemouth bass in a new and old reservoir. Trans. Am Fish Soc., Vol. 96, No. 1. 74-77.

Henderson, P.
1967. Investigations of the food habits of walleye in Canton Reservoir. In Fishery Research in Oklahoma. Oklahoma Department of Conservation, Norman Oklahoma. 36-55.

Munsuetti, A. J. and J. D. Harding.
1967. Development of fishes of the Chesapeake Bay Region. Analysis of egg, larval and juvenile stages. Park 1. Natural Resources Institute, Univ. of Maryland. 201 p.

May, E. B. and C. R. Gasaway.
1967. A preliminary key to the identification of larval fishes of Oklahoma, with particular reference to Canton Reservoir, including a selected bibliography. Oklahoma Fishery Research Laboratory, Bulletin Number 5. 33 p.

Nelson, W. R., R. E. Siefert and D. V. Swedburg.
1968. Studies of the early life history of reservoir fishes. Reservoir Fishery Resources Symposium. Sou thern Division, Am. Fish. Soc. 374-385.

AGE AND GROWTH OF CARP IN RED ROCK RESERVOIR, 1970

Gaige Wunder
Fisheries Biologist

Continuing studies on Red Rock Reservoir (Des Moines River) have established four species of fish with commercial or industrial importance. These species are channel catfish, carp, carpsucker and buffalofish. Populations of these fish have been monitored intensively to measure various biological parameters including growth, age structure, reproduction, relative abundance and predator-prey relationships.

Carp was the most abundant species in the fishing sample, and data collected from these fish were extremely important in assessing its true contribution to the overall experimental exploited fishery. This report will deal with the age structure and growth of carp in the reservoir during the 1970 netting season.

METHOD AND PROCEDURES

Netting and collection of data were similar to those reported for 1969 (Mayhew, 1970). Eighteen bi-weekly periods were sampled from 15 March to 21 November to insure similarity in dating procedures and eliminate repeating descriptions of calendar dates year after year. Intensive sampling was continuous from Period 2 through Period 18. Gear used was gill nets in Period 3, hoop nets in the headwaters in Periods 5, 7, 9, 12 and 14, and pound nets in all intervals except Periods 5 and 14.

The pound nets were constructed of one-inch bar measure mesh on $2\frac{1}{2}$x5 ft frames and $2\frac{1}{2}$ ft hoops with a single lead (60 ft) to shore. Hoop nets were constructed of 3/4" mesh on 2 ft hoops. Gill nets were $1\frac{1}{2}$" bar measure mesh hung on polycore-leadcore lines 200 ft in length.

Carp taken in the hoop net and gill net fishery comprised a relatively small part (< 9.0% and <0.3%) of the overall sample and were combined with the pound net sample for analysis.

All carp collected were counted and weighted in aggregate. Carp netted from Period 6 through Period 18 were removed from the population to simulate the effect of small-scale commercial exploitation. A random sample of carp taken throughout the netting season provided scale samples for calculation of age and growth.

The scale samples were separated into 1" length groups and a random sub-sample of 10 scale samples per inch interval were selected. Aging was done on a micro-projector (17X). Scale radius measurements were recorded at each annulus and to the edge. All age and growth compilation were done by SHAD, a computer system at Iowa State University.

RESULTS

A sub-sample of 181 carp scales was used for the computation of the length-weight relationship. The sample comprised 19 - 1" groups ranging from 6.0" to 25.0" total body length.

The mathematical expression $\log_{10} Y = a + b \log_{10} X$ is the transformed straightline relationship of body weight (Y) in 0.01 lbs on body length (X) in 0.1". In 1970, the resulting equation was

$$\log_{10} Y = -3.193 + 2.861 \log_{10} X$$

Standard deviation of the a and b values were $\pm$ 0.029 and $\pm$ 0.033, respectively. The product moment correlation coefficient (r) for the fit was 0.991 (Figure 1).

Condition factors (C) for carp ranged from 40 to 57 with a mean of 45. This represented a slight decline of condition from a mean of 52 in the 1969 sample.

Normally data analysis of a body-scale relationship involves some linear approximation of total length on scale radius values. These linear fits become reliable estimators through the range of actual field observations of total length, but become extrapolations when extended outside the range of the emperical data. The practice of continuing the straight-line body-scale regression line to its intercept with the Y-axis to obtain values for the mean length at scale formation of post-larval fish for back-calculation procedures necessitates careful scruitiny by the fisheries investigator to insure the linear fit is actually the closest and best approximation available.

The fit of the empirical data in the linear analysis was entirely acceptable and would normally be used in the age and growth analysis. However, in striving to obtain the highest degree of accuracy in fitting the data, especially in the lower values, the examination was extended to a non-linear quadratic fit as

$$Y = a + bX + cX^2$$

where Y is the scale radius in 0.1" and X is the total body length in 0.1".

Comparison of the linear (r = 0.995) and the quadratic (r = 0.999) regressions reveal the latter display a slight curve and correspondingly better fit at the $P < 0.01$ level of significance (Table 1).

Table 1. Comparison of analysis of variance in linear and quadratic regression

Source of Variation	df	SS	MS	F	P
2nd Order Equation (Quad)	2	565.55			
1st Order Equation (Lin)	1	562.10			
Difference	1	3.45	3.45		
Redisual	16	1.74	0.11	31.36	< 0.01

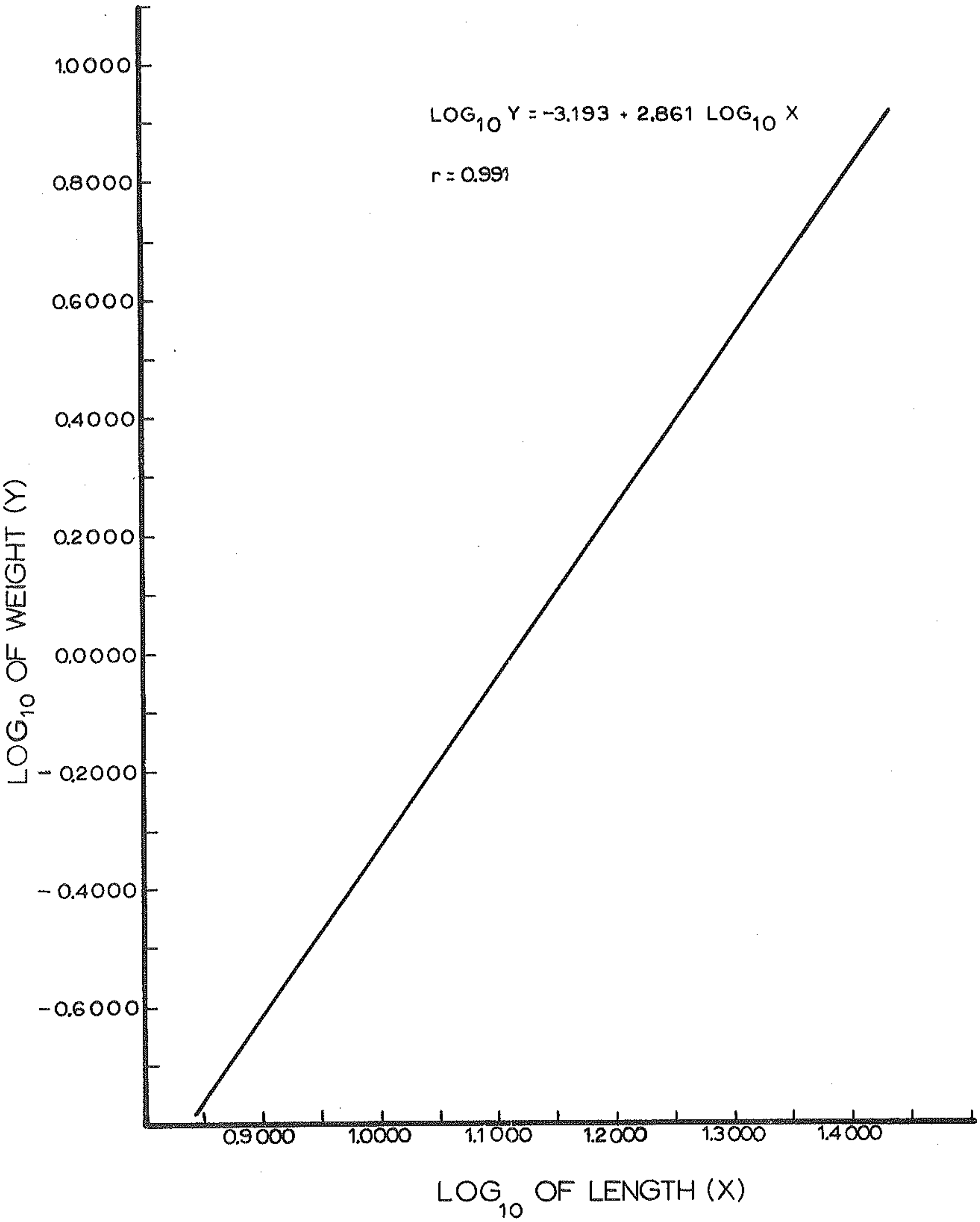


Figure 1. Length-weight relationship of carp in Red Rock Reservoir, 1970

The quadratic expression for the body-scale relationship for card in 1970 was

$$Y = 3.2 + 1.34X + 0.12X^2$$

The standard deviation (S_b) of the a, b and c values were $\pm$ 0.612, $\pm$0.236 and $\pm$ 0.021, respectively. Correlation coefficient was 0.999.

Summation of mean estimated annual growth increments of carp for successive years up to 1970 were 5.5, 8.4, 10.6, 13.4, 15.8, 16.9, 18.5, 19.8, 21.4 and 23.7 inches respectively. As the fish progressed in age the annual increment gradually decreased. Mean total length and annual increments for 10 years growth are listed in Table 2 and 3.

The mean increment of growth for the first two years of life in the quad analysis displayed the greatest disparity when compared to similiar years in the linear analysis. This deviation at the lower end of the body-scale regression results in the increased accuracy derived from using the quadratic function.

Growth coefficients were computed by comparing each years mean growth increment to the overall mean increment and correcting it to a base of 100 (Figure 2). Coefficents range from 146 in 1960 to 79 in 1967. Growth in 1960 through 9162, 1964 and 1969 was above the overall mean. The growth coefficients compiled in 1969 agree very closely to 1970, indicating similiar results for each years scale analysis.

DISCUSSION

Frequency distribution obtained from body length data of fish in randomly selected nets indicate there was little recruitment of young-of-the-year carp into the fishery in 1970. Carp must be a minimum of 5.0 inches total body length to be vulnerable to the pound nets. It is reasonable to assume if no age 0 fish $\leq$5.0 inches total length made a strong appearance in the sample as late as mid-November, the 1970 year class of carp was much slower growing than that of 1969. Recruitment was a result of age I carp not vulnerable to the sampling gear in 1969 becoming large enough to be captured on 1970 causing fluctuation in the 1970 distribution. Catch success in fish per net day also fails to show recruitment of a 1970 year class. Data from scale samples support this premise because many individual fish exhibited little or no detectable growth as late as Period 17.

Population estimates in 1969 indicated 2,854,436 $\pm$ 228,004 carp in the reservoir at the end of the netting season. No visible mortality of catastrophic proportions nor noticeable migration out of the reservoir occurred so it is reasonable to assume the estimate represents the minimum number of fish present at the end of the 1970 netting season. When this population is viewed in relation to water levels it becomes obvious that the reduction in surface area of the reservior ($\geq$65%) from a mean of 26,000 acres in 1969 to a mean of 9,000 acres in 1970 would have a derogatory effect on the fish. Total pounds of carp per serface acre increased from 39 $\pm$ 3 lbs in 1969 to 111 $\pm$ 10 lbs in 1970. Taken as total carp per surface acre of water the figures become 110 $\pm$ 9 fish per acre in 1969 compared with 317 $\pm$ 25 fish per acre in 1970. Obviously this reduction of habitat sharply increases the competition for available food.

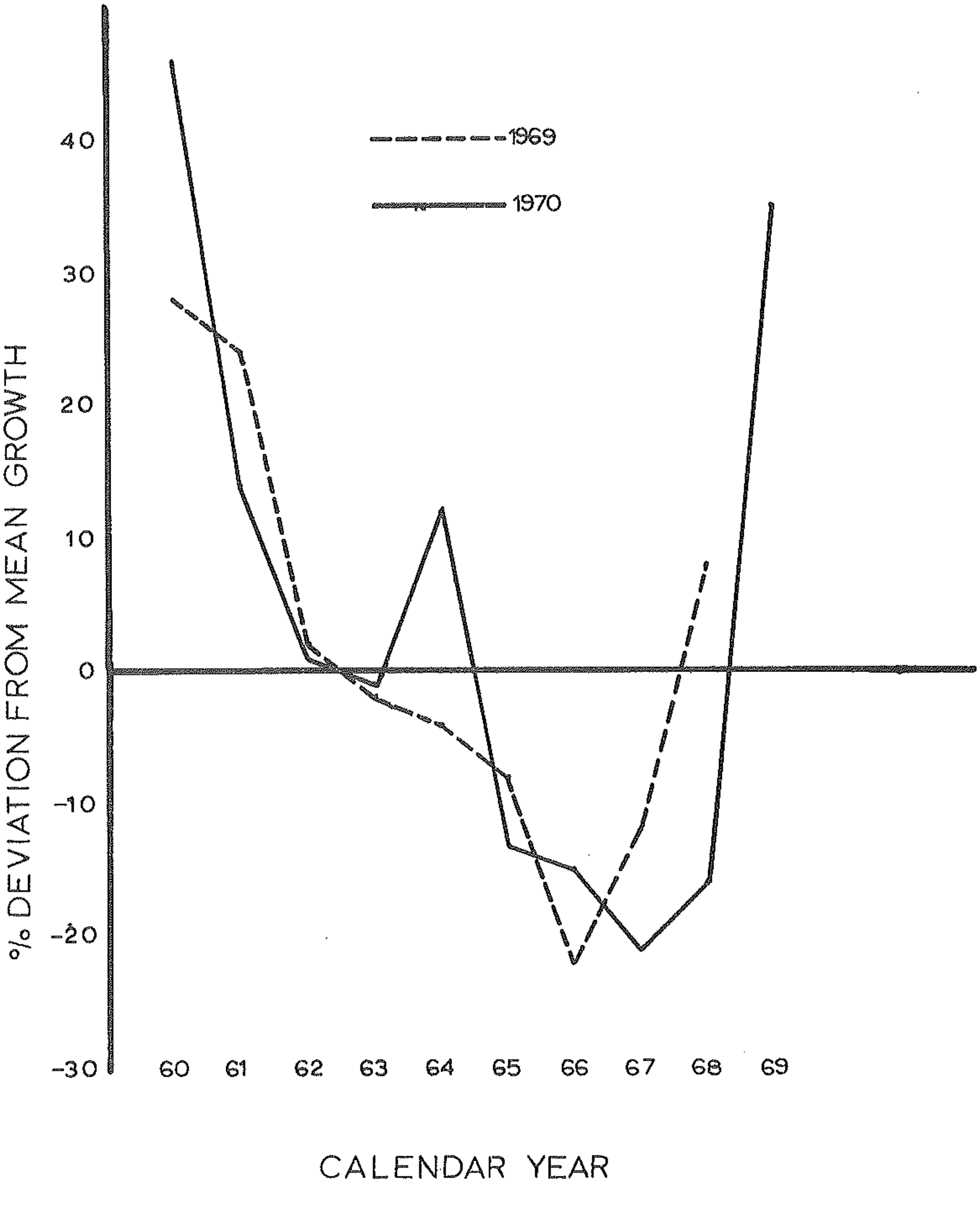


Figure 2. Growth index for ten successive years of life for carp in Red Rock Reservoir, 1970

Additional scale samples were taken from age class II fish to study growth periodicity of carp in the reservoir. The sub-sample ranged from 10.4" to 17.2" total length. Scales were collected from Periods 2 through 18. Growth could not be detected in any sample until Period 8 was so slow in the remaining periods interpretation of the data was extremely difficult and reliable analysis impossible.

Compared to 1969, water level fluctuations in 1970 were minimal. Reduction of mean surface area from 26,000 acres in 1969 to 9,000 acres in 1970 subjected the fish to serious environmental stress. The lack of physical space in the lake exerted a deleterious effect upon fish causing very slow growth and little reproduction.

LITERATURE CITED

Mayhew, J. and L. Mitzner.
1970. Report on the fourth year studies of the Des Moines River and Coralville Reservoir. Biology Section, Commercial Fisheries Report, Project 4-11-R-4, Ia. Cons. Comm. 73pp.

Table 2. Annual estimated growth for ten successive years of life of carp in Red Rock Reservoir, 1970

Year Class	Age Group	Number In Group	1	2	3	4	5	6	7	8	9	10	Growth Index
1969	I	47	8.1										+35
1968	II	70	6.0	13.4									-16
1967	III	21	4.8	7.3	13.9								-21
1966	IV	12	5.1	7.6	10.3	16.5							-15
1965	V	8	5.5	8.1	10.8	13.5	19.5						-13
1964	VI	5	5.4	8.2	10.5	13.2	16.1	19.7					+12
1963	VII	7	5.8	8.9	11.7	14.5	16.9	18.8	20.4				- 1
1962	VIII	10	5.1	7.4	9.7	12.8	15.3	17.4	19.8	21.6			+ 1
1961	IX	1	4.4	7.1	9.1	12.8	13.9	14.6	16.6	18.9	21.7		+14
1960	X	1	5.1	7.7	8.7	10.4	13.1	14.1	17.4	18.9	21.1	23.7	+46
Mean Tot Length			5.5	8.4	10.6	13.4	15.8	16.9	18.5	19.8	21.4	23.7	

Table 3. Estimated growth inceements of carp at the end of each year of life from 1970 samples

Year Class	Number in group	Age Group	Year of Life									
			1	2	3	4	5	6	7	8	9	10
1969	47	I	8.1									
1968	70	II	6.0	9.0								
1967	21	III	4.8	3.8	7.6							
1966	12	IV	5.1	3.7	3.4	6.5						
1965	8	V	5.5	3.7	3.3	2.9	5.7					
1964	5	VI	5.4	3.9	2.9	2.9	2.9	3.3				
1963	7	VII	5.8	4.3	3.3	2.8	2.3	1.7	1.4			
1962	10	Viii	5.1	3.4	2.9	3.5	2.6	2.0	2.1	1.5		
1961	1	IX	4.4	4.3	2.7	4.3	1.1	0.8	1.9	2.1	2.4	
1960	1	X	5.1	3.7	1.3	2.1	2.9	1.1	3.2	1.3	1.9	2.1
Mean Est. Inc			5.5	4.4	3.4	3.6	2.9	1.8	2.1	1.7	2.1	2.1

CORALVILLE RESERVOIR CRAPPIE INVESTIGATIONS
PART 2: POPULATION ESTIMATES

Larry Mitzner
Fisheries Biologist

Population estimates were conducted on crappie in 1968 and 1969 as part of a comprehensive investigation of their life history and population dynamics in Coralville Reservoir. Objectives of the investigation were to determine growth, abundance, physical condition, age structure, movement and importance to the sport fishery. Movement characteristics have been determined and reported by Mitzner (1969). This report will be confined to results of the population estimates of crappie in the reservoir in 1968 and 1969.

Estimates were conducted simultaneously with movement studies in 1968. Consequently estimates were also initiated on 27 March and continued for nine bi-weekly periods. Each period was numbered consecutively from that date. Period numbers will be used in the following text and tables to designate specific census periods.

The method of estimation was sequential of the Schnabel type. Marking and recapture were done concurrently. Crappie marked in a given census period were assumed to disperse by the following period as described by movement. Corrections for movement out of the study area were completed before an estimate was made on the period being examined.

Total sample size was 2,381, of which 37 were recaptured from the 966 originally marked. Loss of marked fish from movement reduced the number available for recapture to 812. The greatest number of recaptures was obtained in period 4 (Table 1). Greatest rate of recapture was also achieved in this interval. Cumulative estimate was relatively stable from the sixth period. The final estimate of 31,900 was considered to be the most accurate. Individual period estimates varied between 8,976 and 69,974 in period 3 and 5, respectively.

Table 1. Population estimates of white crappie in 1968

Census Period	N Caught	N Recaptured	Cumulative N Marked	Cumulative $\hat{N}$	Independent $\hat{N}$
1	245	4	0		
2	77	0	168	5,174	
3	161	4	223	6,105	8,976
4	610	15	285	9,682	11,590
5	593	6	708	22,156	69,974
6	364	4	739	27,622	67,974
7	282	4	812	30,825	57,246

Table 1. (continued)

Census Period	N Caught	N Recaptured	Cumulative N Marked	Cumulative $\hat{N}$	Independent $\hat{N}$
8	20	0	812	31,264	
9	29	0	812	31,900	
TOTAL	2,381	37	812	31,900	

Confidence intervals were based on standard deviation as determined from Ricker (1958). These limits at the 95% level on the final cumulative estimate were 23,300 to 50,509. The study area at elevation 680' msl was 1,111 acres and the density of white crappie per acre was 29 with confidence of +17 to -8.

In 1969, marking started in Periods 2 on 8 April and continued through Period 11. During this census, 1,983 crappie were examined yielding 115 recaptures from an available 1,487 marked fish in the study area. Originally, 1,868 were marked in the study area but 21% were estimated to have emigrated from the area. Fish in segments 4 and 7 moved either upstream or downstream out of the recapture area at a rate of 34.3/100. The movement from the center of the area was less and only 12.7% emigrated from segments 5 and 6.

Samples of recaptures from all segments were combined regardless of where they were taken in the marking area. From movement determinations there was an estimated interchange of right and left marked fish to left and right segments at 19.7% While 20.3% left the study area downstream from segments 4 and 5, only 0.7% traversed their complimentary marking area to leave upstream. Because of the symmetry in the experimental design, fish from segments 6 and 7 were estimated to leave the area in inverse relationship to those in segments 4 and 5. The remaining 59.3% stayed in the respective marking areas from which they were released.

Mean recapture rate during the experiment was 5.8% with greatest rate, 15.6% in Period 9. The most recaptures were taken in Period 6. Cumulative estimates varied from 6,460 in Period 9. The most recaptures were taken in Period 6. Cumulative estimates varied from 6,460 in Period 5 to 9,913 in Period 11 (Table 2). Independent estimates for individual periods were extremely variable ranging from 6,221 in Period 5 to 31,272 in Period 11. The final cumulative estimate of 9,913 was considered to be most reliable.

Confidence limits at the 95% level were computed identically to those in 1968 and ranged from 8,220 to 12,500, indicating good precision of the census. Surface area at elevation 680' msl was 1,188 acres giving density of 8.3 white crappie per acre with confidence of +2.2 and -1.4.

In 1968, 10.4% of the catch were black crappie increasing slightly in 1969 to

15.0%. Total crappie population density in 1968 and 1969 was estimated at 32.3 and 9.8 fish per acre. The decline in numbers was probably caused by a severe winter kill in February, 1969.

Ricker (1958) states eight assumptions which must be considered for valid population estimates using sequential type censusing. All of these assumptions were met or corrected for these estimates.

Table 2. Population estimates of white crappie in 1969

Census Period	N Caught	N Recaptured	Cumulative N Marked	Cumulative $\hat{N}$	Independent $\hat{N}$
2	6	0	0		
3	130	0	5		
4	795	13	108	6,671	6,623
5	120	14	731	6,460	6,221
6	458	47	815	7,402	7,944
7	59	3	1,142	7,989	22,467
8	275	25	1,187	9,231	13,057
9	32	5	1,386	9,214	8,870
10	65	6	1,408	9,535	15,248
11	43	2	1,455	9,913	31,272
TOTAL	1,983	115	1,455	9,913	

Error due to natural mortality, differential, increased mortality of marked crappie and non-randomization of marked fish were not accounted for and may have caused some error. Non-randomization of marked individuals was probably minor because of the long marking period. Any errors from increased mortality of marked crappie, causing the estimate to be larger than actual, and natural mortality of all fish during the census, causing the estimate to be smaller than actual would tend to cancel each other. Systematic errors were either accounted for or tended to correct each other and there was no reason to suspect any gross errors in population estimates.

LITERATURE CITED

Mitzner, Larry.
1969. Coralville Reservoir Crappie Investigations. (Part 1: Movement). Quart. Biol. Rpt., Vol. 21, No. 3, pp. 1-4.

Ricker, W. E.
1958. Handbook of biological computations for fish populations. Fish. Res. Board of Canada. 300 pp.

CREEL CENSUS RESULTS FROM VARIOUS IOWA LAKES 1968-1970

Terry Jennings
Fisheries Biologist

During the 1968-69 fishing season, a comprehensive creel census was conducted on Spirit Lake, West Okoboji, and East Okoboji. Only Spirit Lake was censused during the 1969-70 fishing season. The procedures used for collection and expansion of these data have been thoroughly explained in previous papers. These investigations were made to monitor fish harvest, harvest rate and angler use.

At Spirit Lake and West Okoboji, censusing extended from May 1 through February 15. These data will be separated into an open water fishing period, May through November and an ice fishing period, December through February 15. Creel data was collected from East Okoboji from May 1 through September 30.

SPIRIT LAKE

Open Water Fishing, 1968:

During this period, 151,145 fish weighing 103,053 lbs were harvested (Table 1). Numerically, bullhead, yellow perch, walleye, crappie, and bluegill comprised 75%, 14%, 5%, 4% and 1% of the harvest, respectively. These species also contributed most of the weight for fish creeled.

Ice Fishing, 1968-69:

Yellow perch and walleye totaled 86% and 13% of the 3,942 fish caught (Table 2). Smallmouth bass and white bass were the only other species harvested.

Catch rates averaged 3.1 fish-per-trip and 1.11 fish-per-hour.

For the entire census period, 19 lbs of fish per acre were caught from Spirit Lake. Twenty-one hours of fishing per acre were necessary to produce this fishery.

Table 1. Fish harvest, angler use, and other related statistics from Spirit Lake during open water fishing of 1968

Species	Number	% Number	Weight	% Weight	X Number
Bullhead	113,551	75	77,172	74	0.68
Yellow Perch	21,107	14	12,233	12	0.58
Bluegill	2,176	1	1,022	1	0.47
Crappie	5,576	4	2,514	2	0.45

Table 1 (continued)

Species	Number	% Number	Weight	% Weight	X Number
Walleye	7,509	5	7,865	8	1.05
N. Pike	319	<1	846	<1	2.65
L.M. Bass	60	<1	140	<1	2.33
S.M. Bass	108	<1	176	<1	1.63
White Bass	34	<1	58	<1	1.71
Sheepshead	705	<1	1,027	1	1.46
TOTAL	151,145		103,053		

Angler Trips	44,588
Hours	116,321
Fish per trip	3.39
Fish per hour	1.30
Pounds per hour	0.89

Table 2. Fish harvest, angler use, and other related statistics from Spirit Lake during ice fishing of 1968-69

Species	Number	% Number	Weight	% Weight	X Number
Yellow Perch	3,410	86	2,008	73	0.59
Walleye	512	13	654	24	1.28
S.M. Bass	14	<1	59	2	4.21
White Bass	6	<1	14	<1	2.33
TOTAL	3,942		2,735		

Angling trips	1,265
Hours	3,560
Fish per trip	3.12
Fish per hour	1.11
Pounds per hour	0.77

Open Water Fishing, 1969:

During open water of 1969, 81,395 fish weighing 57,207 lbs were caught from Spirit Lake (Table 3).

Table 3. Fish harvest, angler use, and other related statistics from Spirit Lake during open water fishing of 1969

Species	Number	% Number	Weight	% Weight	X Weight
Bullhead	36,167	44	26,013	45	0.72
Yellow Perch	36,497	45	20,684	36	0.57
Bluegill	250	<1	165	<1	0.66
Crappie	3,840	5	2,099	4	0.55
Walleye	3,079	4	4,528	8	1.47
N. Pike	220	<1	938	2	4.26
S.M. Bass	374	<1	684	1	1.83
White Bass	51	<1	95	<1	1.86
Sheepshead	759	1	1,765	3	2.33
C. Catfish	158	<1	236	<1	1.49
TOTALS	81,395		57,207		

Angling trips	44,195
Hours	117,185
Fish per trip	1.84
Fish per hour	0.69
Pounds per hour	0.49

Numerically, yellow perch were most abundant. Bullhead, crappie, walleye, and sheepshead followed in order. When ranked by weight, bullhead were most important followed by yellow perch, walleye, crappie and sheepshead.

The total number of bullhead caught in 1969 represents a decline of 77,384 from the 1968 catch. The number of walleye harvested during this census period is the smallest total for any corresponding period on record.

An observed catch rate of 0.69 fish per hour is also an indicator of poor fishing success.

Ice Fishing, 1969-70:

During 1969-70, an estimated 36,235 fish were caught through the ice (Table 4). This total is about 27,000 fish greater than the number of fish caught the same period of 1968-69. Yellow perch comprised 92% of the catch. Walleye totaled 7%. Northern pike, smallmouth bass, crappie, and largemouth bass were also caught.

Ice fishermen harvested fish at an average rate of 1.81 fish per hour.

During these two census periods, about 15 lbs of fish were harvested per surface acre.

Table 4. Fish harvest, angler use, and other related statistics from Spirit Lake during ice fishing of 1969-70

Species	Number	% Number	Weight	% Weight	X Weight
Yellow Perch	33,480	92	20,854	81	0.62
Crappie	11	<1	9	<1	0.82
Walleye	2,595	7	4,496	17	1.47
N. Pike	80	<1	137	<1	1.71
L.M. Bass	3	<1	12	<1	4.00
S.M. Bass	66	<1	193	1	2.92
TOTAL	36,235		25,701		

Angling trips	6,319
Hours	19,995
Fish per trip	5.73
Fish per hour	1.81
Pounds per hour	1.30

WEST OKOBOJI

Open Water Fishing, 1968:

During this period, anglers caught 113,889 fish (Table 5). Of these fish, 71% were perch, 15% bullhead, 7% bluegill, 2% crappie, and 1% walleye. The remaining 4% of the catch were northern pike, largemouth bass, smallmouth bass, white bass, channel catfish, sheepshead, and buffalo.

Table 5. Fish harvest, angler use, and other related statistics from West Okoboji during open water fishing, 1968

Species	Number	% Number	Weight	% Weight	X Weight
Bullhead	17,625	15	9,215	17	0.52
Yellow Perch	81,299	71	30,663	56	0.38
Bluegill	8,062	7	3,096	6	0.38
Crappie	2,764	2	1,300	2	0.47
Walleye	1,492	1	3,600	7	2.41
N. Pike	667	<1	2,774	5	4.16
L.M. Bass	569	<1	1,284	2	2.26
S.M. Bass	360	<1	476	<1	1.32
White Bass	495	<1	471	<1	0.95
C. Catfish	225	<1	1,026	2	4.56
Sheepshead	309	<1	379	<1	1.23
Buffalo	22	<1	528	<1	24.00