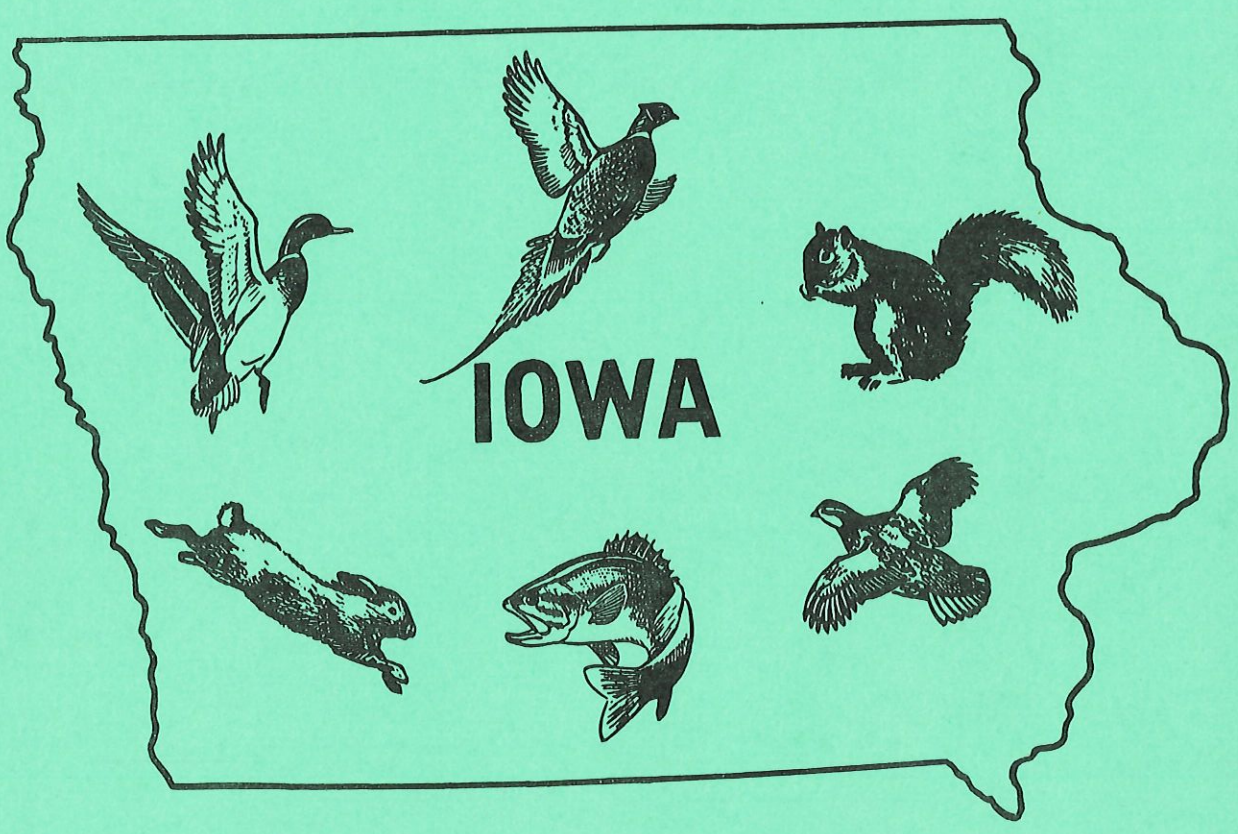
1969

QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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Submitted by
Biology Section

Harry M. Harrison
Superintendent

Eugene D. Klonglan
Assistant Superintendent

Jim Mayhew
Assistant Superintendent

State Conservation Commission
Fred A. Priewert, Director

Fish & Game Division
Earl T. Rose, Chief

State Office Building
300 4th Street
Des Moines, Iowa

TABLE OF CONTENTS

- ABSTRACTS OF PAPERS -

GAME

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

Richard C. Nomsen
Game Biologist

The purpose of this study was to evaluate the effects of additional safe nesting cover for pheasants on intensively farmed land. It was also designed to compare the relative wildlife benefits between land retired for one year (Annual Program) and for several years (Long-Term).

Production in the long-term fields averaged 1.1 - 1.5 chicks per acre compared to none in the newly seeded retired fields. Production in regular oat fields was poor in 1969 but excellent in 1968.

RESULTS OF THE 1969 RUFFED GROUSE SEASON

Lee Gladfelter
Game Biologist

Information on the 1969 grouse hunting season was obtained from the hunter postcard survey, hunter contact survey, and the wing and tail survey. A total of 2112 grouse, or 18% of the fall population, was harvested by 1549 hunters in 1969. It took an average of 7.1 hours of hunting to bag one grouse. Many birds were flushed (.75 grouse per hour) but hunting success was low at 18%. Crippling rate was a minimum of 14%. There was a preponderance of males in the grouse kill and 1.2 juveniles per adult, indicating low production for 1969.

FINAL STOCKING OF "FRENCH-STRAIN" REEVES MADE IN 1969

Gene Hlavka
Game Biologist

The Reeves pheasant was first introduced into Iowa in 1963, with the original stock being obtained from Ohio. From 1963-66, 4,611 Reeves were stocked in Lucas and Monroe Counties. From 1965-67, 15 brood reports were received, two of which were unverified. In 1968 no broods were reported; sightings of birds were few. Reeves behavior has been sedentary and tame. In 1966, 27 "French-Strain" Reeves were obtained from Tennessee; in 1967, 45 "French-strain" Reeves came from Missouri. From 1968-69, 570 progeny from the Tennessee and Missouri birds were stocked in the Stephens State Forest in Lucas County. No broods were reported in 1969. The outcome from the "French-strain" stocking most likely will be no different from earlier results. Approval has been received for terminating the Reeves pheasant stocking program.

MINK POPULATION STATUS NORTHWEST IOWA

Ron Andrews
Game Biologist

This report represents the results of a study designed to determine if the mink population in northwest Iowa is increasing, decreasing or stable over the past 30 or more years. A mink trapper questionnaire, impressions of commission personnel, trapping harvest figures from state game management areas in northwest Iowa and fur harvest figures from biennial reports (1939-1969) were tabulated and summarized. The results of the trapper questionnaire indicated that 70 percent of those contacted felt the mink population was stable or increasing. Eleven of sixteen commission personnel indicated that the mink population in northwest Iowa was relatively stable fluctuating from year to year with water levels, food availability and with muskrat populations to a lesser degree. State game management area harvest figures and statewide fur harvest figures indicate these same yearly fluctuations.

From the qualitative data available it was concluded that the mink population is relatively stable in northwest Iowa despite an overall deterioration of habitat. Recommendations concerning mink harvests and trapping season lengths are included.

1969 WATERFOWL AND DOVE BANDING PROGRAM IN IOWA

Richard Bishop
Game Biologist

The 1969 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 2,094 mallards and 1,138 birds were banded on the breeding grounds. Pre-season banding, mainly of blue-winged teal, produced 1,275 birds. Experimental banding consisted of 53 young Canada geese. A total of 1,859 doves were banded. A grand total of 6,373 birds was banded in Iowa in 1969, by Conservation Commission personnel.

IOWA QUAIL POPULATION, 1969

M. E. Stempel
Game Biologist

The various quail surveys taken from spring through late summer of 1969 showed that Iowa's hunters will find another bumper crop of quail in the field for the 1969 season. Counts were all quite similar to those of last year - one of the best years in recent times for quail shooters. In fact, sight records from the various censuses made in July and August showed that 23 per cent more birds were seen in 1969 compared to 1968, with the best increases in the primary range of southern Iowa. Northern Iowa experienced a relatively severe winter from the standpoint of quail, and a decline occurred here. However, this part of the state is of little significance for quail hunting.

AGE OF QUAIL TAKEN BY IOWA QUAIL HUNTERS, 1969-70

M. E. Stempel
Game Biologist

Wings from 1,438 quail shot by Iowa hunters were collected from 20 counties during the 1969-70 season. Eighty-seven per cent were juveniles. The hatch as determined from wings and from coveys seen in the summer, began in May, peaked in June and July; then it diminished, but peaked again in 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, 1969-70

M. E. Stempel
Game Biologist

Gene Hlavka
Game Biologist

On the Wapello and Decatur-Wayne Areas late winter covey counts, bi-weekly summer roadside whistling cock counts and the early fall covey counts were conducted in 1969. The covey counts were conducted with the aid of dogs. The brood stock for both areas consisted of 43 coveys; the 1967-68 average was 38. More than 12 weeks of significant quail calling indicated good production in 1969. Seventy-five coveys were located on both areas in October 1969. This was more than the 1967-68 average. The hours per covey flush for both areas in October was 0.94, and this was also better than the 1967-68 average. Sixteen percent of the quail hunting activity on both study areas was in October (6 quail hunting days). November, December and January had 38, 24 and 22 percent of this activity respectively.

FISHERIES

FIFTEEN INCH SIZE LIMIT PROPOSAL FOR CHANNEL CATFISH IN THE MISSISSIPPI RIVER

Don R. Helms
Fisheries Biologist

This report is an explanation of why a 15-inch size limit has been recommended for the upper Mississippi River. Raising the size limit is expected to expand channel catfish production to a more optimum level. Commercial harvest would consist of fewer, but larger, fish having a higher total value, while sport harvest would increase significantly in both number and size of fish. Projected changes in sport and commercial harvest are presented in tabular form for two sample pools.

MOVEMENT CHARACTERISTICS OF CARP, CARPSUCKER, BIGMOUTH BUFFALO AND CHANNEL CATFISH IN CORALVILLE RESERVOIR

Larry Mitzner
Fisheries Biologist

A description of movement pattern and characteristics within a 10-mile study area was determined for carp, carpsucker and bigmouth buffalo. Distribution movement of these species from point of release was approximately a normal curve. Standard deviation for carp, carpsucker and bigmouth buffalo were 1.05, 2.06, and 1.13 miles. Movement of channel catfish between two study areas, 15 miles apart, showed a standard deviation was greater than 3.12 miles. This information was used to determine the percent of marked fish leaving the area of capture. Population estimates can then be corrected for dilution of marked fish in the study area due to movement.

AGE AND GROWTH OF BLACK CRAPPIE IN SPIRIT LAKE, IOWA

Terry Jennings
Fisheries Biologist

In 1967 and 1968 a study was conducted at Spirit Lake to determine the age and rate of growth of black crappie. The first year 303 lengths and weights were recorded. The length-weight relationship was log W = -1.2773 + 3.0663 log L. In 1967 and 1968, 296 scale samples were aged. The body-scale relationship was computed to be L = 1.22 + 1.099 R. Calculated total lengths in inches at ages 1 through 5 were 2.8, 5.7, 7.8, 9.9, and 11.0 respectively.

LENGTH-WEIGHT RELATIONSHIP OF 3 SPECIES OF FISH IN RED ROCK RESERVOIR

Gaige Wunder
Fisheries Biologist

Compilation of life history data on the major species commercially valuable fish in the Red Rock Reservoir portion of the Des Moines River. In this paper are presented length-weight relationships and body condition factors for carp, channel catfish and river carpsucker, a calculated from data collected during eleven bi-weekly periods of intensive netting during 1969. Because this is a new reservoir without previous fisheries investigations, it is of considerable importantance that initial data on the reservoir fishery be obtained.

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

Richard C. Nomsen
Game Biologist

INTRODUCTION

The primary purpose of this study is to evaluate the effects of additional secure nesting cover for pheasants on an intensively farmed area. Another aim is to compare the relative production potential of land retired for several years (long-term) versus land retired for only one year.

Land use changes have occurred in recent years that affected the pheasant's natural environment. These trends have resulted in a persistent decline in pheasant nesting cover. During this same period, Federal Land Retirement Programs have retired 1.5 to 3.0 million acres of cropland in Iowa each year to reduce the surplus of corn.

Basically, there have been two types of land retirement programs. The first, and most often used, has been the annual program. Fields are seeded down with oats in the spring and clipping is permitted to control weeds. Production of pheasants is usually poor in these fields because of late seeding and frequent disturbance.

Long term land retirement such as the Conservation Reserve and Cropland Adjustment Program provided excellent undisturbed nesting cover for pheasants. This study was initiated to determine the extra wildlife benefits that could be obtained from a long term land retirement program.

METHODS

All farmers on the 5-section study area were contacted 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 were signed in 1969 for a total of 147.5 acres of new seeding and 282.6 acres of hay ground.

Population surveys were begun in 1968 to measure the population on and off the area. A preliminary nest search was made in 1968 to determine methods to be used and help estimate the time required to search each cover type.

RESULTS

Winter Population: Snowfall was very light on the area during the winter of 1968, which made censusing very difficult. From the results of various attempts to get a total count, it was estimated that about 100 hens were present. Census conditions were excellent in 1969 and a total count of 127 hens and 45 cocks was recorded.

Spring Crowing Count: An average of 14.7 calls per stop was recorded in 1969 compared to 14.1 calls per stop in 1968.

August Roadside Count: 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. Several counts were made each year and the best 3 counts were averaged to give these results:

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

Nest Search: Nests were located in the various cover types by a systematic search by a crew of at least three men (Table 1). Roadsides were walked twice - once in late May and again in July. Hayfields were searched at the time of mowing and again after the hay was raked into windrows. Oat fields were walked soon after cutting and raking into windrows.

The fields retired under the Federal Farm Program in 1968 were sampled by walking through the cover before mowing. No nests were found although farmers reported seeing nests and broods later in July when the fields were cut.

It was decided that a more positive method was needed to search the retired acres. In 1969, a tractor and rotary chopper were rented to remove the cover ahead of the men searching for nests. While one drove the tractor, the other two rode in a grain wagon pulled behind the chopper and closely observed the exposed ground. When a nest was spotted, one would jump off the wagon and record the necessary information.

Roadsides: There were 29 pheasant nests located in roadsides in 1968 compared to only 4 in 1969 but the number of successful nests in roadsides was the same each year - three. These results were very surprising and unexpected and illustrates the extreme variations that are possible in such a study.

Hay: Nest density was high in hay both years, with 10-12 per cent hatching success. Although the eggs hatched, it is misleading to record them as successful - 52 newly hatched chicks were killed by mowers in 1969 along with 14 hens.

Oats: The variation in nesting and production in oats was almost unbelievable between the two years. In 1968, oats was the primary production cover on the study area but dropped to near zero in 1969. Planting and development of oats was early in 1968 but wet fields delayed planting in 1969. It is also possible that the additional preferred nesting cover available in 1969 reduced the number of nests in oat fields.

Table 1. Results of nest search on Hancock County Wildlife Research Area 1968-69

	1968 - Preliminary Nest Search			
Crop	Acreage	No. Nests	No. Nests Successful	Percentage of Total Production
Roadsides	(12.5 mi.)	29	3	15%
Oats	301 A.	23	13	65%
Hay	232 A.	34	4	20%
(New) Diverted	226 A.	None found		
(Old) Diverted	76 A.	None found		

	1969 - Results of Nest Search			
Crop	Acreage	No. Nests	No. Nests Successful	Percentage of Total Production
Roadsides	(12.5 mi.)	4	3	7%
Oats	247	0	0	-
Hay	224	60	7	17%
(New) Diverted	147.5	0	0	-
(Old) Diverted	282.6	57	32	76%

Diverted (New Seeding): New seeding of diverted acres was delayed in 1969 - same as oats. Although no nests were found either year, it was believed a limited amount of nesting occurred in 1968.

Diverted (Old Seeding): The majority of this type of nesting cover was planted to alfalfa, red clover, and a small amount of sweet clover. Nest density was high and production excellent in these hay fields retired under the Farm Program. Nests established in this cover contributed about three-fourths of the total production on the area.

Renesting also was noted as 5 additional active nests were recorded in 105 acres chopped. Two hens and one chick were killed during the chopping procedure.

Summary: Extreme variation in weather and field conditions between the two years makes it very difficult to analyze the data concerning nesting and production on the study area. It was quite obvious that the additional secure nesting cover improved production considerably. The use of the rotary chopper made it possible to completely search the heavier cover found on the diverted land.

Pheasant chick production in retired hay fields averaged 1.1 chicks per acre compared to no production in new seeded fields. Production would have increased to 1.5 chicks per acre if we could assume that the active nests would have hatched successfully.

RESULTS OF THE 1969 RUFFED GROUSE SEASON

Lee Gladfelter
Game Biologist

The 1969 ruffed grouse hunting season was open from November 1 to November 16. To evaluate the results of the season, three separate surveys were conducted. These surveys were the hunter postcard survey, hunter contact survey, and the collection of grouse wings and tails for a sex and age survey.

HUNTER POSTCARD SURVEY

Ruffed grouse were included in the 1969 annual hunter postcard survey which randomly samples approximately 3% of the Iowa hunters. The results of this survey are provided in Table 1 and are compared to the results of the 1968 hunting season.

Approximately 1549 hunters participated in the grouse season which represents 0.5% of all licensed Iowa hunters. Grouse provided over 15,000 hours of hunting during a total of over 3300 hunter days. During the 16-day season, the average hunter pursued grouse for a total of 10 hours on two separate days. It is estimated that 2112 grouse were taken during the 1969 season. This is almost three times the 720 birds taken in 1968. The average hunter bagged 1.4 grouse during the entire season, which breaks down to 0.6 birds taken per day or 0.14 birds per hunting hour. It required 7.1 hours of hunting to bag one grouse during the season which indicates the difficulty of grouse hunting. This does not mean that grouse are not available because many birds are seen, but their ability to escape the hunter provides for some very interesting excuses on why a flushed bird was not bagged.

The postcard survey also indicated distribution of hunting pressure by county and the county of residence of the grouse hunters. About 64% of the hunting effort took place in Allamakee County, with 28% in Clayton and Winneshiek, and the remaining 8% in surrounding counties. Fifty per cent of the grouse hunting was done by residents of counties open to hunting with the other 50% coming from elsewhere in the state. About 60% of the hunting was done exclusively on private land and 23% on state land with the remaining hunting being on both private and state land.

HUNTER CONTACT SURVEY

This survey involves the contacting of hunters in the field during the season by Commission personnel to obtain detailed information on many aspects of grouse hunting.

Information on actual hunter performance was obtained from 121 hunters involving 46 party days of grouse hunting, with the average party size being 2.6 hunters. Each party contacted on a different day was considered a separate hunting trip in arriving at the total of 46 party days of hunting. Some hunters were contacted more than once during the season. The total number of party hunting hours was 187 with a total of 529 gun hours.

Table 1. Results of the 1968 and 1969 hunter postcard survey

ITEM	YEAR 1968	1969
Statewide bag	720	2,112
Number of grouse hunters - statewide	1,150	1,549
Per cent of all Iowa hunters	0.4	0.5
Total hours hunted	8,510	15,490
Total days hunted	2,070	3,309
Average days per hunter per season	1.8	2.1
Average hours per hunter per season	7.4	10.0
Average hours per hunter per day	4.1	4.7
Average bag per hunter per season	0.6	1.4
Average bag per hunter per day	0.3	0.6
Average bag per hunter per hour	0.08	0.14
Average hours to bag one grouse	11.8	7.1

The hunters checked had good success flushing grouse, and during the 529 hours of hunting 395 birds were flushed. This flushing rate of 0.75 grouse per hour or 1.3 hours per grouse is higher than the 1968 flushing rate of 1.9 hours per grouse. The average number of grouse flushed per party during the season was 8.6 with a grouse flushed on the average of each 30 minutes of party hunting.

There were 70 grouse bagged by this sample of hunters for an average of one bird killed for each 7.6 man hours of hunting (or .13 grouse per hour). Since 70 of the 395 birds flushed were bagged, grouse hunters realized an 18% rate of hunting success. In 1968 hunters did better by obtaining a 23% hunting success rate.

Available data on crippling loss shows that 10 birds were crippled while 70 were successfully bagged for a 14% crippling rate. However, this is a minimal estimate. Difficulty was experienced in evaluating the results of shots taken at birds because of the heavy cover.

The difficulty of hunting grouse in northeast Iowa is shown by figures on the number of shots fired at grouse. Information obtained from 18 parties shows that 122 grouse were flushed, 66 shots were fired and 8 birds were bagged. Thus an average of 8.3 shots was fired to bag one bird. Performance of some parties was much poorer than this while others did better.

The results of the 1969 grouse hunter contacts are compared with 1968 in Table 2. Fewer hunters were interviewed in 1969 but average party size was larger than in 1968. Hunters in 1969 flushed more grouse but bagged fewer and crippled a larger percent.

WING AND TAIL SURVEY

When possible, one grouse wing and the tail were collected from birds killed by hunters. These samples were collected by Commission personnel in the field or sent to the Commission by cooperators who were provided a mailing envelope.

Sex of birds was determined by length and color patterns of the central rectrix. Age was determined from the diameter of the calamus of the 9th primary and central rectrix, length of 9th primary and central rectrix, and the length of the rectrix barb.

A total of 46 grouse was collected for the sex and age sample. Of these, 15 were adult males, 6 adult females, 13 juvenile males, and 12 juvenile females. A sex ratio of 156 males: 100 females occurred in the sample which showed a preponderance of males and compares to 100 males: 100 females found in the 1968 sample (42 birds). A ratio of 1.2 juveniles per adult was found in the 46 birds and is lower than the 1.5 juveniles per adult found in the 1968 sample.

Color phase was determined for 41 grouse, with a total of 26 red phase, 11 gray phase, and 4 intermediate phase. This provides a ratio of 63 : 27 : 10 out of 100.

It is difficult to establish any trends in color phase or sex and age ratios with such small samples. This sample size will hopefully be increased in following years.

Table 2. Results of 1968 and 1969 grouse hunter contacts

ITEMS	1968	1969
Number of party days	81	46
Total hunters	172	121
Average party size	2.1	2.6
Party hours of hunting	278	187
Total gun hours	595	529
Total grouse flushed	321	395
Flushing rate-hrs/grouse	1.9	1.3
Grouse flushed/party	4.0	8.6
Total grouse bagged	75	70
Average kill - hrs/grouse	7.9	7.6
Percent flushed that were bagged	23%	18%
Crippling rate	8%	14%
Shots fired	193 (46 parties)	66 (18 parties)
Average shots to bag 1 bird	5.4	8.3

DISCUSSION

Fall estimates, as determined from the spring breeding population (measured with the roadside drumming count), put the grouse population in northeast Iowa at about 12,000 birds. In 1969 the postcard survey indicated that 2112 birds were bagged which represents 18% of the fall population. This certainly is not overharvesting our grouse population and as long as a harvestable surplus exists, hunters should be allowed to hunt this "trophy" bird. An effort must be made, however, to increase the sample size of the hunter postcard survey. At the present, a 3% sample of Iowa hunters is sufficient for more abundant game birds but not for isolated populations such as grouse. In the future a survey must be attempted to reach more of the grouse hunters to give us data that has higher confidence limits.

The large increase in birds bagged in 1969 (almost three times the 1968 bag) cannot be explained except that our postcard survey improved by increasing from a $1\frac{1}{2}$% to a 3% sample of all licensed hunters. The hunter contact survey does indicate that hunters were more successful in the field, per hour expended, which would be expected during the second open season on a species. This improved hunter ability is evident but should not account for such a large increase in the number of birds bagged. A careful analysis of future hunting seasons will be necessary to determine more closely the status of our grouse populations.

The age data from 1969, although a small sample, indicates that production was poor during the year. This may have been caused by the very wet spring which was experienced in Iowa, especially in the northeast corner.

Grouse hunting in Iowa does furnish many hours of recreation for Iowa hunters. The unique chance of bagging a ruffed grouse in northeast Iowa draws hunters from all over the state and promises to establish a grouse hunting tradition with many hunters.

FINAL STOCKING OF "FRENCH-STRAIN" REEVES MADE IN 1969

Gene Hlavka
Game Biologist

INTRODUCTION

The Reeves pheasant was first introduced into Iowa in 1963 adjacent to the Cedar Creek Unit of the Stephens State Forest in Lucas County. The primary objective of this stocking experiment was to establish surviving populations of a pheasant species in woodlands where the ringneck is absent or at a low population level. From 1963-66, 4,611 "Ohio-strain" Reeves were stocked in Lucas and Monroe Counties. The releases on September 15, 1966 liberated the last of the "Ohio-strain" stock. The introduction, propagation, stockings, sightings, brood reports, survival and behavior of these Reeves have been documented in the Quarterly Biology Reports (Klonglan and Hlavka 1964, Hlavka 1965, Hlavka 1966, Hlavka Klonglan 1968).

Because a "wild-strain" was needed, 27 "French-strain" juvenile Reeves (7 cocks and 20 hens) were obtained from Tennessee in September 1966. In November 1967, 45 adult Reeves (6 cocks and 39 hens) of the same "French-strain" were obtained from Missouri. The original, wild Reeves were brought over from France to the United States in 1959. Thus, progency stocked in 1969 were 10 generations removed from the wild.

PROPAGATION OF "FRENCH-STRAIN" REEVES

In April 1967, 18 hens were on hand. Only 11 eggs were laid during the entire spring. One chick was hatched. Obviously no progeny were available for stocking in 1967. In the spring of 1968, 50 hens (Tennessee and Missouri birds) were on hand. Of the 816 eggs laid, 451 hatched. Of the 437 chicks placed into brooders, 247 were raised for release and brood stock. As of October 1, 1968, 125 "French-strain" Reeves (25 cocks and 100 hens) were on hand as 1969 brood stock. On April 10, 87 hens were on hand. From these, 1260 eggs were set and 663 chicks hatched.

As of September 1, 1969 Wildlife Research Station records indicated that 590 Reeves (104 adults and 486 juveniles) were on hand (Inter Departmental Communication, September 19, 1969). Adults were transferred from the laypens to the same range that confined the juveniles. Just before the release date, a gate was left open and a considerable, but unknown number of birds escaped (Inter Departmental Communication, October 28, 1969). There is no way of knowing how many young birds were raised in 1969. Some of the escaped birds were probably adults. No count of adults or juveniles was kept when the birds were crated for release. Of the estimated 100 birds that escaped, about 50 were recaptured by the end of October. Recaptured birds will be wing-clipped and released into the large range to observe survival and reproduction, if any does occur.

STOCKING OF "FRENCH-STRAIN" REEVES

On September 30, 1969, 180 juvenile Reeves (82 cocks and 98 hens) were released in the northwest corner of the Chariton Unit of the Stepehns State Forest ($SW\frac{1}{4}$ sect. 26, T - 73 N,

R - 20 W, Lucas County, Iowa). On October 23, 1969, 390 Reeves (167 cocks and 223 hens) were stocked at the same site used last year. About 75 percent of the 390 were believed to be juveniles. The October 23rd release was the final release for the Reeves stocking experiment and raised the number of "French-strain" Reeves stocked to 570.

STIGHTINGS AND BEHAVIOR OF "FRENCH-STRAIN" REEVES

From October 1 to December 31, 1968 (after the stocking of 180 Reeves), 7 sighting reports concerning 45 individual Reeves were noted. After January 1, 1969, 8 sighting reports concerning 35 Reeves were recorded. No Reeves broods were reported in 1969. From October 24 to December 15, 1969 (after the stocking of 390 Reeves), 5 sighting reports concerning 74 individual Reeves were recorded. However, more than twice as many Reeves were stocked in 1969 as in 1968.

The "French-strain" Reeves have exhibited the same tameness and sedentary behavior as the "Ohio-strain" Reeves. On October 2, 1968 Forestry Section personnel sighted 7+ Reeves near the west entrance to the Chariton Unit. The men reported that the birds would hardly get out of the way of the truck. On November 21, 1969 one farmer stated that "birds from the last group (October 23 release) were more tame than the other birds." He had to get off the tractor to chase one bird out of the way when fall plowing.

DISCUSSION

The 390 "French-strain" Reeves released on October 23rd have apparently dwindled away to less than 50 birds by December 15, 1969. The loss of Reeves after the first few days (perhaps hours) had to be considerable. Furthermore, the outcome of this final stocking most likely will be no different from earlier results.

Approval has been received for terminating the Reeves pheasant stocking program one year earlier than originally programmed (Inter Departmental Communication, October 6, 1969). We will not necessarily have proved that the Reeves pheasant as a species cannot be established in Iowa, but we will have proved that releasing pen-reared, "domesticated" Reeves under the type of program we used can not establish surviving populations. The habitat we have that appears most suitable for them. It is doubtful that releases of much larger numbers of birds would have given any different results. Direct transplanting of wildstock might succeed but the problems in obtaining such birds out weigh the need for a new species in southern Iowa. I believe our native game birds should be promoted. Quail and pheasant hunting in southern Iowa is now good. Turkeys are increasing at both the Shimek and Stephens State Forests. Trapping and transplanting of grouse is being programmed again. And who knows? Some day Iowans may be hunting doves.

SUMMARY

1. The Reeves pheasant was first introduced into Iowa in 1963 adjacent to the Cedar Creek Unit of the Stephens State Forest.

2. From 1963-66, 4,611 "Ohio-strain" Reeves were stocked in Lucas and Monroe Counties.

3. From 1965-67, 15 brood reports were received, 5 for each of the 3 years. In 1968 no brood reports were noted.

4. Reeves behavior has been sedentary and tame.

5. In September 1966, 27 "French-strain" Reeves were obtained from Tennessee. In November 1967, 45 Reeves of the same "French-strain" were procured from Missouri.

6. From 1968-69, 570 "French-strain" Reeves (as much as 10 generations removed from the wild) were stocked at the northwest corner of the Chariton Unit of the Stephens State Forest.

7. No broods were reported in 1969. Sightings of birds were few.

8. "French-strain" Reeves behavior is similar to that of the"Ohio-strain" birds.

9. Approval has been received for terminating the Reeves pheasant stocking program.

LITERATURE CITED

Klonglan, E. D. and G. Hlavka
1964. Reeves pheasant introduction into Iowa. Quarterly Biology Reports, Iowa Conservation Commission. (16) 4:4-9.

Hlavka, G.
1965. Reeves pheasant sightings and stockings, 1963-65. Quarterly Biology Reports, Iowa Conservation Commission. (17) 3: 3-7.

Hlavka, G.
1966. Reeves pheasant stockings and observations, 1966. Quarterly Biology Reports, Iowa Conservation Commission. (18) 3: 71-77.

Hlavka, G. and E. D. Klonglan
1968. "French-strain" Reeves renew stocking experiment in 1968. Quarterly Biology Reports, Iowa Conservation Commission. (20) 3: 5-7.

MINK POPULATION STATUS IN NORTHWEST IOWA

A BIOLOGICAL REPORT

Ron Andrews
Game Biologist

INTRODUCTION

This report represents the results of a study designed to determine if the mink population in northwest Iowa is increasing, decreasing, or stable over the past 30 or more years.

Previous studies on mink have dealt primarily with food habits and feeding behavior, (Dearborn 1932, Hamilton 1936, 1940, Korschgen 1958, Sealander 1943, Waller 1962) aging and sexing criterion (Elder 1951, Errington 1936, 1939, Greer 1957, and Petrides 1950) and mink predation (Dearborn 1932, Errington 1938, 1943, 1954 and 1961).

Very little data have been published on mink population densities. Bennett and Nagel (1937) estimated the breeding reserve of minks in Missouri to be about 12,000 animals and the annual trapping take as 24,000. Errington (1938) took 200 mink from 12 square miles in South Dakota. If he took half the mink,than there would have been a mink for approximately every 20 acres before trapping began. (Seton (1929) estimated that there was a pair of mink to a square mile in Manitoba a few years following 1900. According to the 1967 national annual are harvest (Wildlife Leaflet 482) there appears to be a very gradual decrease in the take of mink pelts. This is probably reflective of lower pelt prices and fewer mink trappers. Errington (1938, 1943, 1961) determined some of the qualitative dynamics of mink populations and their releationships to food items and other environmental factors. Marshall (1936) devised four censusing steps for determining mink populations on a localized basis in southern Michigan. Errington and most of the mammal experts can conclude only general statements concerning mink population dynamics. Very little concrete quantitative data is available.

ACKNOWLEDGEMENTS

I wish to express my thanks to the numerous conservation officers, game managers, and mink trappers who assisted in gathering the information and for their impressions on the mink population in their particular areas.

STUDY AREA

The study area involves 19 counties in northwest Iowa bounded by the southern border of Monona county east through Calhoun county and north to the Iowa-Minnesota border with the Missouri and Big Sioux Rivers on the west (Figure 1). The country is generally rolling topography interspersed with streams, marshes, timber pastureland and cropland. As is true with much of northern Iowa, many of the sloughs, swamps and marshes have been drained by tiling and many of the meandering streams have been cleared of brush and straightened.

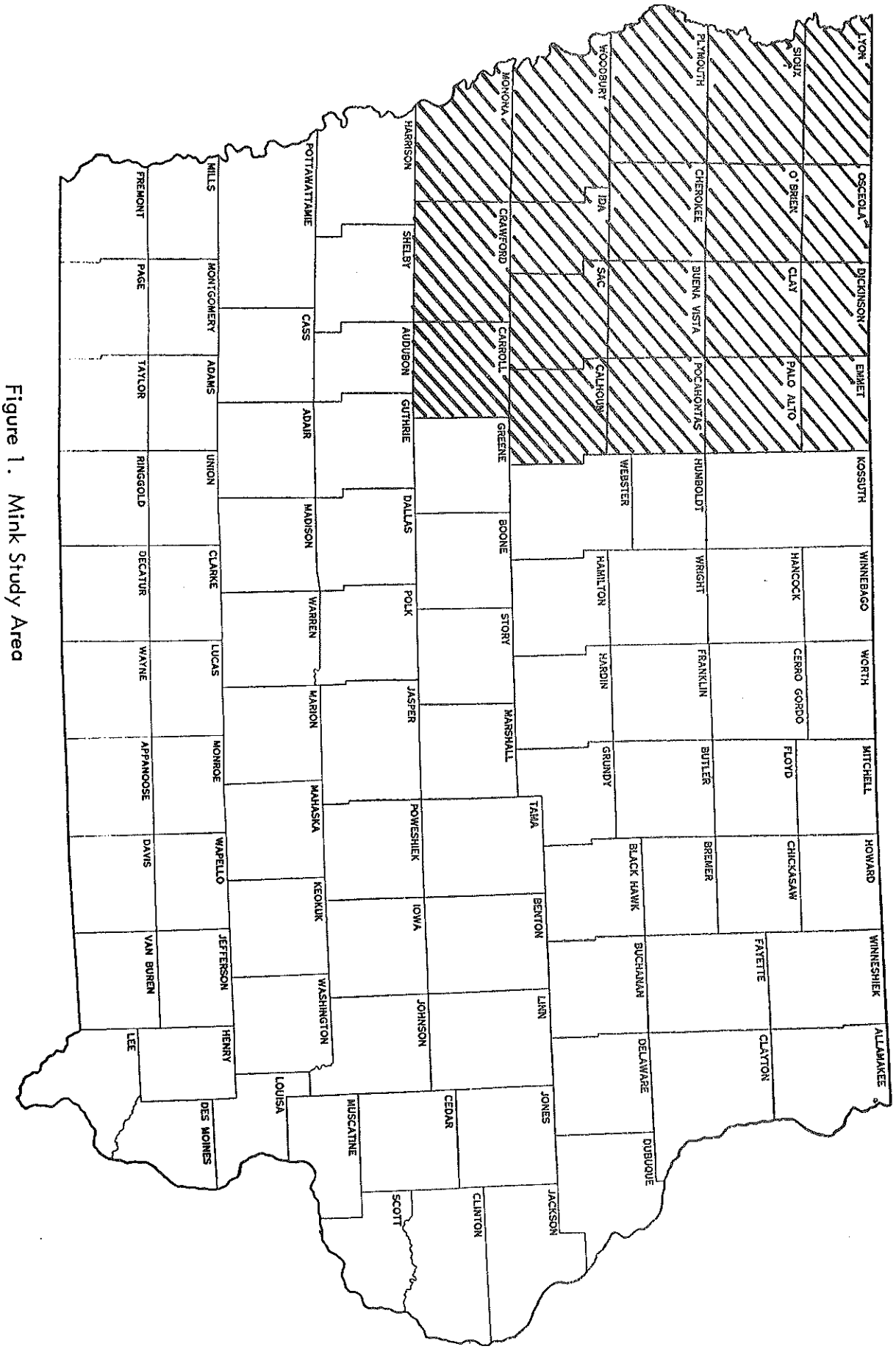

Figure 1. Mink Study Area

METHODS

Mink are animals of the water's edge and are thus likely to be found near streams, ponds, lakes or marshes. The habitat can thus be used in censusing mink populations.

Marshall (1936) established the following criterion in southern Michigan for the mink census taker:

(1) Conduct census work in late winter or early spring, when there are 1 to 4 inches of snow on the ground and when the temperature is not below 15° F.

(2) Run the census lines across the countours, making the stream or lake shores the focal point, investigating at least an area $\frac{1}{4}$ mile wide on each side of the stream or this same distance back from the pond or marsh.

(3) Take samples each $\frac{1}{4}$ mile, and consider tracks crossed at each sampling point as belonging to a different individual, except where the evidence clearly indicates otherwise.

(4) Conclusions as to whether females are living in localized areas and also whether a male may simply be following along a stream for several miles, should be checked by following trails sufficiently far to determine these points.

When a sample of a total area is investigated, the findings on the sample should be applied to the entire area on the basis of lineal extent of watercourses or ponds and marshes rather than on the basis of total area in acres or square miles.

Improper timing, impracticality and inadequate manpower makes the above census method unfeasible as far as determining mink population densities in northwest Iowa. Sealander (1944) also sees some fallacies in Marshall's method of censusing mink.

After considerable thought and discussion I decided to attempt four avenues of approach to assess the mink population in northwest Iowa:

(1) Mink Trapper Questionnaire (see attached questionnaire)
(2) Impressions of Commission personnel
(3) Trapping Harvest Figures from State Game Management Areas (1960-1968).
(4) Fur Harvest Figures from Biennial Reports (1939-1969).

Because of the environmental overlapping of muskrat and mink (Errington 1961), some consideration of muskrat populations and harvests also has to be made. The best muskrat marshes are usually the best mink marshes.

Commission personnel in northwest Iowa selected the names of some 69 mink trappers in their territory. They also forwarded their impressions regarding whether they felt the population was increasing, stable or decreasing. Trapping harvest figures from Ingham-High Game Unit and Ruthven Game Unit were compiled by game managers Howing and Jones. Fur harvest figures were tabulated from Biennial reports (1939-1969).

RESULTS

Mink Trapper Questionnaire

Forty-three (62%) of the 69 mink trappers responded to the questionnaire. The results are briefly summarized in the attached questionnaire.

MINK TRAPPER QUESTIONNAIRE

(1) Do you specialize in mink trapping?

Yes	No
50%	50%

(2) How many years have you been trapping mink:

Average	30 years
Range	10 to 62 years

(3) What type of habitat do you trap mink in? Streams? Marshes? Both? Explain.

Streams	Marshes Only	Both
17 Trappers	1 Trapper	15 Trappers

(4) What proportion of your total mink catch is males?

Average 64% males

(5) Do you feel that the mink population is increasing, decreasing or stable over the last 10 years: Since you began trapping? Explain.

Increasing	Stable	Decreasing
3 Trappers	27 Trappers	13 Trappers
70%	%	30%

(6) If the mink population is decreasing, what do you attribute this too:
Reason 13 trappers gave for decreasing in their respective areas in order of incidence:

(1) Pollution
(2) Illegal trapping
(3) Trapping denning sites
(4) Low water levels
(5) Reduced habitat
(6) Predators - foxes, dogs and owls.

(7) Do you trap mink for sport or fur value?
In the 1940's and 1950's for fur value. The last 10 years for sport and fur value.

(8) Do you have any record of number of mink you trapped during the last several years. If yet please write it down. Indicate if your trapping effort was considerably different from year to year.

Very little concrete data on records available. Everything here was mentioned in terms of generalities.

(9) Suggestions and or comments on other items pertaining to mink populations and trapping season etc.

Two-thirds of the trappers responding indicated they were satisfied with present season or one opening up anytime after November 15 and closing somewhere around December 31.

Most mammal biologists believe that mink are caught incidental to muskrat trapping. On the questionnaire 50 per cent of the trappers indicated they specialized in mink trapping. The other half indicated that their mink were trapped in conjunction with muskrat trapping. Of the 43 responding trappers most of them have been trapping an average of 30 years with ranges from 10 to 62 years. About half the trappers indicated they trapped mink in stream habitat and half in both stream and marsh habitat. Few trappers trapped mink in marshes only.

It is normally conisdered that when you trap more than 50 percent female mink you are not leaving adequate "seed" to sustain next year's mink population. In Missouri there were between 61 to 65 percent males in sample counts of harvests from 1951 through 1957 (Schwartz 1959). Forty-one Iowa trappers indicated they averaged 64 percent male mink on their traplines. There is undoubtedly some brag bias involved but a good mink trapper will not set traps near female denning areas, particularly late in the season. Also because of the natural habit of male mink to travel more widely than females, there are apt to be more males in the trapper's take than females.

The results of question number 5 which is the crux of the entire study indicated that 30 (70%) of the 43 trappers questioned felt that the population was stable or increasing while the remaining 13 (30%) felt the mink population was decreasing. The 30 percent who indicated a population decrease may be very much correct about their particular localized trapping area.

Impressions of Commission Personnel

Eleven of sixteen commission personnel indicated that the mink population in their area of the state fluctuated from year to year with water levels, food availability and with muskrat populations to a lesser degree. Five commission personnel indicated a downward trend in the population which could again be reflective of localized areas.

Trapping Harvest Figures From Game Management Areas

Table 1 gives a breakdown of the muskrat and mink population on the Ruthven and Ingham-High Game Units. The data involved here deals with state-owned marshes and does not consider stream habitat. Because the environmental overlapping of muskrats and mink on marshes is prominent, Errington (1954) determined that mink show a special responsiveness to epizootic's in muskrat populations. This seems to be reflected in harvest figures of both game management units. When the muskrat harvest is high, the mink harvest is also up and vice versa.

Mink and Muskrat Harvest Figures, Season Lengths and Total Number of Licenses Trappers 1939 thru 1969

Mink and muskrat harvest figures, season lengths, and total number of licensed trappers, 1939 through 1969, are tabulated in Table 2. It is important to remember that these are

statewide figures and not figures for the northwest Iowa study area only; however, the same trends should apply to northwest Iowa. Average pelt prices for mink are also shown. As mentioned earlier, there is an environmental overlapping of muskrat and mink populations and this is reflected in the harvest of both species. Also note how the mink take fluctuates with increases and decreases in pelt prices. In the biennial reports of different biennium, mention is made of drought years versus nondrought years and this appears to be an important factor as far as mink populations and harvests are concerned. Season lengths have also varied from year to year with some zoning of seasons occuring before 1960. Total number of trappers appears to be gradually decreasing. The fur resource is not as important a part of many people's economies as it once was.

DISCUSSION

The most significant result of this survey may be the fact that very little work has been done on mink population densities. This particular animal, as is the case with many fur bearing species, is difficult to assess as far as population densities are concerned. The extreme variability within the area, the size of the area, and the timing of this particular project (Marshall 1936) do not make actual field study feasible.

The questionnaire, combined with the Commission personnel impressions, the state game management area's fur harvest figures, and the state fur harvest figures have given an indication that the mink population has not decreased substantially over the past 30 years but that has remained releatively stable with some year to year fluctuations. Although mink harvests have declined since the early 1940's, this is probably reflective of changes in today's social and economic structure. Also competition from mink ranchers has reduced pelt prices of native mink considerably. Total number of trappers has declined, and thus fewer people are taking mink and this in turn reduced harvest figures.

In good or poor mink country there seem to be fairly definite population thresholds (Errington 1961). Most mink are by nature solitary animals over most of the year. Apart from the times that mature males and females are together during the breeding season, about the only close association that wild mink tolerate are those of mother and young family groups in the summer. The lack of toleration for one another may account for the natural self-limiting that occurs in mink populations. Thus we see that nature does not stockpile mink. However, mink will tolerate more of their own kind when living under conditions of ease and plenty.

The variety of food taken by mink helps to explain their ability to survive where land has changed from wilderness to agricultural use (Trippinsee 1953). Their food varies from frogs, fish, mice, rats, cottontails and other aquatic fauna and with the season of the year. Such things as low water levels, pollution, disease, parasites, predators of mink such as dogs, foxes, hawks, owls, and trapping pressure very considerably from one mink habitat to the next as well as within one particular habitat and from one year to the next. Since 1940 mink habitat has probably deteriorated to some degree and there are localized areas where mink populations have dwindled while in other areas they remain stable or have increased.

MANAGEMENT

Furbearers should be managed for sustained yield and pelt primeness or maximum fur value.

TABLE 1. TRAPPING HARVEST FIGURES FOR INGHAM-HIGH AND RUTHVEN GAME MANAGEMENT UNITS

Game Unit	Year								
Ingham-High	1960*	1961**	1962	1963	1964	1965	1966	1967	1968
Muskrats Trapped	No data available			33,411	8,046	6,184	7,932	7,034	2,069
Mink Trapped	No data available			147	29	58	84	130	51
Ruthven									
Muskrats Trapped	1,614	4,983	27,140	27,510	12,253	7,721	7,376	7,464	3,766
Mink Trapped	21	33	78	190	31	35	32	182	54

*Quotas set for certain areas

** Some areas closed to trapping

Table 2. Mink, Muskrat Harvest Figures, Season Lengths Mink Fur Value and # of Licensed Trappers, 1939 thru 1969.

Year	Season Length	Muskrat Harvest	Mink Harvest	Average Mink Pelt Prices	Total Value	Number of Licensed trappers
1938-39	Nov.10-Jan.10	308,015	27,783	$ 7.25	$201,426.75	10,195
1939-40*	Nov.10-Jan.10	46,003	2,877	6.25	17,981.25	5,665
1940-41	Nov.10-Jan.10	350,700	38,817	7.30	283,364.10	11,108
1941-42	Dec.1-Dec.30	262,007	33,650	6.75	227,137.50	14,211
1942-43	Dec.1-Jan.10	262,562	23,297	6.15	143,276.55	7,704
1943-44	Nov.10-Jan.10	722,360	52,760	12.50	659,500.00	13,045
1944-45	Nov.10-Jan.10	457,573	47,040	6.75	317,520.00	14,397
1945-46	Nov.10-Jan.10	418,417	48,145	28.16	1,335,763.20	13,613
1946-47	Nov.10-Jan.10	387,614	60,397	18.14	1,095,601.58	18,540
1947-48	Dec.10-Jan.10	17,059	27,638	29.73	821,677.74	7,168
1948-49	Nov.25-Dec.15	164,736	16,571	18.30	303,249.30	9,695
1949-50	Nov.25-Dec.15	171,820	17,973	12.15	218,371.95	11,384
1950-51	Nov.25-Dec.9	117,051	17,001	23.50	399,664.50	8,234
1951-52	Nov.25-Dec.9	263,563	23,257	17.48	406,532.36	10,226
1952-53	Nov.10-Dec.9	393,440	27,222	16.40	446,440.80	13,710
1953-54	Nov.10-Dec.9	355,451	30,459	13.49	380,891.91	12,070
1954-55	Nov.20-Dec.4	143,886	20,051	17.59	352,697.09	9,165
1955-56	Nov.20-Dec.4	80,414	10,548	18.03	190,180.84	8,165
1956-57	Dec.1-Dec.15	79,108	9,706	15.09	146,463.54	7,115
1957-58	Dec.1-Dec.15	65,969	9,838	12.50	122,975.00	6,092
1958-59	Nov.20-Dec.15	130,668	13,308	14.31	190,437.48	7,865
1959-60	Nov.20-Dec.31	164,458	16,942	16.63	281,745.46	6,823
1960-61	Dec.1-Dec.31	144,119	10,033	10.38	104,142.54	10,097
1961-62	Nov.11-Dec.15	351,822	16,365	10.20	166,923.00	9,886
1962-63	Nov.10-Dec.9	467,985	14,312	11.08	158,576.96	12,136
1963-64	Nov.9-Dec.8	555,055	21,032	10.90	229,248.80	9,780
1964-65	Nov.14-Nov.30	259,908	14,394	8.73	125,659.62	9,241
1965-66	Nov.20-Dec.12	261,549	13,105	7.83	102,612.15	7,352
1966-67	Nov.12-Dec.31	389,242	16,269	7.84	127,548.96	8,209
1967-68	Nov.10-Dec.31	231,811	13,509	8.08	109,152.70	6,764
1968-69	Nov.9-Dec.31	232,133	12,974	11.44	148,421.56	

* Trapping Mississippi River only. Rest of State closed.

** Until 1954-55 some zoning occured with season lengths varying from one zone to the next. After 1954 the entire state was open.

Season lengths and openings should thus be set accordingly. Two-thirds of the trappers contacted indicated they were satisfied with the present season.

Mink are reasonably resistant to the effects of trapping or killing. Errington (1938) noted, however, declines in mink populations in South Dakota after 1922. He attributed this to the change from trapping with steel traps to a system of locating the animals with specially trained dogs and digging them out of their dens. Iowa Code, Section 109.90, prohibits den destruction. This measure in itself may make the difference between taking more mink than are produced and thus not maintaining a sustained yield. With ordinary protection mink can usually get along.

There is no practical methods of managing mink food supply (Korschgen 1958). A check of the important food items does, however, reveal a clue to the appraisal of good mink habitat. These foods are normally associated most abundantly with or near water. Land areas adjacent to water and from which vegetation has not been overgrazed, burned or cut therefore seem to provide excellent habitat for terrestial prey species such as mink. If this clear cutting, burning, tiling and overgrazing were reduced there would be more and better quality mink habitat.

RECOMMENDATIONS

(1) Continued trapping season statewide within the framework dates of November 1 to January 15 concurrently with the muskrat season. Because nature doesn't stockpile mink, a closed season will not increase mink populations substantially. Decreases in mink trappers and lower prices of mink pelts usually re-regulate trapping pressure on mink populations.

(2) Encourage trappers to avoid female mink denning areas. (A conscientious trapper will do this regardless).

(3) Encourage less clearing, burning, and grazing of stream banks (Economics, does not merit this in many situations).

(4) Where possible, reduce or curtail water pollution.

(5) Continue trapper postcard and fur buyer report surveys on all fur bearing species as a means of maintaining a constant measure on these species.

LITERATURE CITED

Bennitt, R., and Werner O. Nagel. 1937. A survey of the resident game and furbearers of Missouri. Univ. Mo. Studies 12 (2).

Biennial Reports. 1939-1969. Compiled by State Conservation Commission, Des Moines, Iowa.

Dearborn, N. 1932. Foods of some predatory fur-bearing animals in Michigan. Univ. Mich. School Forestry and Conserv. Bull. 1:30-34.

Elder, W. H. 1951. The baculum as an age criteria in mink, Mustela vision. J. Mamm. 32:43-50.

Errington, P.L. 1936. Sex ratio and size variation in South Dakota mink. J. Mamm. 17:287

_____.1938 The decline of a mink population. J. Mamm. 19:250-251.

_____.1943. An analysis of mink predation upon muskrats in North Central United States. Res. Bull. 320, Iowa Ag. Exp. Sta. :797-924.

_____. 1954. The special responsiveness of minks to epizootics in muskrat population. Ecol. Mono. 24:377-393.

_____. 1961. Muskrats and marsh management. The Wildlife Management Institute. Pennsylvania.

Greer, K. R. 1957. Some osteological characters of known age ranch minks. J. Mamm. 38:319-330.

Hamilton, W. J., Jr. 1936. Food habits of mink in New York. J. Mamm. 17:169.

_____ 1940. The summer food of minks and raccoons on the Montezuma Marsh, New York. J. Wildl. Mgmt. 4:80-84.

Iowa Conservation Laws. 1968. State Conservation Commission, Des Moines, Iowa.

Korschgen, L. J. 1958. December food habits of mink in Missouri. J. Mamm. 39:521-527.

Marshall, W. H. 1936. A study of winter activities of mink. J. Mamm. 17:382-392.

Petrides, G. A. 1950. The determination of sex and age ratios in fur animals. Amer. Midl. Nat. 43:355-382.

Sealander, J. A. 1943. Winter food habits of mink in southern Michigan. J. Wildl. Mgmt. 7:411-417.

_____. 1944. A criticism of Marshall's method of censusing mink. J. Mamm. 25:84-86.

Seton, E. T. 1929. Lives of game animals. Doubleday and Company, Inc. New York.

Schwartz. C. W. and E. R. Schwartz. 1959. The wild mammals of Missouri. Univ. of Missouri Press. Columbia, Missouri.

Trippensee, R. D. 1953. Wildlife Management Vol. II Fur bearers, Waterfowl and Fish, McGraw-Hill Book Company Inc. New York.

Waller, D. W. 1962. Feeding behavior of minks at some Iowa marshes. State Univ. of Science and Technology. Ames, Iowa.

Wildlife Leaflet 482. Annual fur catch in the United States, 1967. U. S. Fish and Wildlife Service.

1969 WATERFOWL AND DOVE BANDING PROGRAM IN IOWA

Richard Bishop
Game 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 compliment 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 built up 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. A large wire trap was built over the ditch with drop doors. The birds were baited in with corn and when significant numbers were present the doors were dropped.

In 1967, 1,762 mallards were banded in 12 days. In 1968, 1,658 mallards were banded in 10 days in January (Table 1). Mild weather prohibited the filling of the quota. In 1969, 2,094 mallards were banded. Snow and bad weather aided the operation in 1969.

BREEDING GROUNDS BANDING

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

Breeding populations were improved in 1969 and production was better than in the previous 2 years. Water levels were high compared to the last two years. Many marshes that were too low to band in 1968 looked ideal in 1969. However, the low water level in 1968 resulted in dense growths of cattail and bullrush along the shorelines. This vegetation provided ideal escape cover for young ducks and many avoided the banders by swimming into this vegetation. Many shorelines were too heavily vegetated to operate the boat thus catches were lower than what was expected for the number of birds present. Production on many areas appeared quite good from evening observations but the young ducks were not found by the night-lighters. Success of this technique depends on production, water levels and vegetative conditions.

Eleven species of ducks were captured. These were mallard, green-winged teal, blue-winged teal, shoveler, pintail, woodduck, redhead, ring-neck, ruddy, lesser scaup, and canvasback (Table 2). Blue-winged teal made up 49 percent, wood ducks 20 percent, and mallards 15 percent. These three species are the main breeding birds in Iowa, therefore, they make up the bulk of the birds banded. In 1968 blue-winged teal made up 57%, wood ducks 27%, and mallards 11%.

Approximately 75% of the birds were classed as locals, young birds still unable to fly and known to have been reared in the vicinity of where they were taken (Table 3). Immatures made up 14% and adults 10%. In 1968 about 60% were locals, 10% immatures, and 30% adults.

Fifty-three young Canada geese were banded as part of an experimental project of 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-wing teal and wood ducks. The birds were captured by bait traps of the style described in the 1966 banding report.

A total of 1,275 birds was banded during this period compared to 3,115 in 1968 and 3,713 banded in 1967. These birds were 84% blue-winged teal and consisted of 7% adults and 93% immatures (Tables 7 and 8). The blue-winged teal banded in 1967 were 80% immatures and 87% in 1968.

More emphasis was placed on the pre-season banding of wood ducks than in the past years. A total of 191 were bait trapped, most of which were banded at Rice Lake and Elk Creek Marsh. Most units had difficulty locating wood duck loafing areas where traps could be placed. High water along the Mississippi River and other areas created additional problems. The wood ducks banded at the Rice Lake Unit were banded at roosting sites. Previous attempts to band wood ducks at roosting sites were generally unsuccessful but fair success was experienced by this method at Rice Lake. More effort will be expended on trapping wood ducks in 1970.

MOURNING DOVE BANDINGS

In a cooperative project with the U. S. Fish and Wildlife Service, state personnel banded 1,859 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.

SUMMARY

Post-season banding of wintering mallards in southwest Iowa accounted for 2,094 mallards.

The breeding grounds banding project in north central and northwest Iowa produced 1,138 birds, captured by night-lighting. Blue-winged teal made up 49% of the total, woodducks 20% and mallards 15%.

Pre-season banding of blue-winged teal by bait traps was lower than normal. A total of 1,275 birds was banded and 84% were blue-winged teal.

Fifty-three Canada geese were banded as part of experimental project.

A total of 1,846 doves was banded in Iowa by state personnel. These birds were captured mainly by bait traps.

A grand total of 6,373 birds was banded in 1969 by Conservation Commission personnel.

Table 1. Post-season duck banding results, southwest Iowa, 1969

County	Name of area	AHY-M	AHY-F	HY-M	HY-F	Totals
Fremont	Knox Basin					
	Mallards	622	407	663	402	2074
	Black Ducks	5	1			6
	Pintails				1	1
	Totals	627	408	663	403	2101

Table 2. Total bird banded during breeding grounds waterfowl banding operations - 1969

County	Name of Area	Canada Goose	Mallard	G. W. Teal	B. W. Teal	Shoveler	Pintail	Wood Duck	Redhead	Canvasback	Ring-neck	Lesser Scoup	Ruddy Duck	Totals
Calhoun	S. Twin Lake		3		3			5						11
Cerro Gordo	Ventura Marsh		26	1	146	23		3	46					245
Clay	Dan Green Sl				2									2
Clay	Mud Lake		1		13			2						16
Dickinson	Center Lake							5						5
Dickinson	Grovers Lake		10		4			2			1		4	21
Dickinson	Hottes Lake		1		5									6
Dickinson	Jemmerson Sl		36		100			20					1	157
Dickinson	Marble Lake				1			9						10
Dickinson	Sandbar Sl	1			4			9						14
Emmet	Cunningham Sl		23		48		1	10						82
Emmet	High Lake		26		32			65	4					127
Emmet	Ingham Lake	48	8		19			8	10			1		94
Emmet	Palsons Slough	4	8	1	63	1		3	3					83
Hancock	Eagle Lake				2				3					5
Hancock	East Twin Lake		1						10	3				14
Monona	Badger Lake		1	1	9		1	9						21
Palo Alto	Five Island Lake							11						11
Palo Alto	Rush Lake		24		79		8		4				1	116
Palo Alto	Silver Lake		3		7									10
Pocahontas	Little Clear Lake				1									1
Story	Hendrickson Marsh				20									20
Tama	Otter Creek		5											5
Winnebago	Myre Slough							59*						59
Wright	Big Wall Lake							3						3
	Totals	53	176	3	558	24	10	223	80	3	1	1	6	1138

* These 59 woodies were transplanted to Myre Slough in an attempt to increase nesting pairs of wood ducks on the area.

Table 3. Age and sex composition by species - all areas - breeding grounds - 1969

SPECIES	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Canada Geese		1			21	31		53
Mallards	5	4	7	2	71	86	1	176
G. W. Teal	1		1				1	3
B. W. Teal	39	15	49	32	203	212	8	558
Shoveler		2	1	2	12	7		24
Pintail			6	4				10
Wood Duck	6	11	8	15	92	86	5	223
Redhead	6	4			36	34		80
Canvas					2	1		3
Ringneck	1							1
Lesser Scaup								
Ruddy Duck	6							6
Total	65	37	72	55	437	457	15	1138

Table 4. Mallard age and sex composition by area - breeding grounds banding, 1969

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Calhoun	South Twin Lake		1	2					3
Cerro Gordo	Ventura Marsh		1	3		10	12		26
Clay	Mud Lake			1					1
Dickinson	Jemmerson					13	23		36
Dickinson	Hottes Lake		1						1
Dickinson	Grovers Lake	1				5	4		10
Emmet	Ingham Lake	3				2	3		8
Emmet	High Lake		1			10	15		26
Emmet	Palson Sl.					4	4		8
Emmet	Cunningham Sl.					12	11		23
Hancock	East Twin Lake	1							1
Monona	Badger							1	1
Palo Alto	Rush Lake					13	11		24
Palo Alto	Silver Lake			1	2				3
Tama	Otter Creek					2	3		5
	TOTALS	5	4	7	2	71	86	1	176

Table 5. B. W. Teal age and sex composition by area - breeding grounds banding, 1969

COUNTY	NAME OF AREA	HY-M	AHY-F	AHY-M	HY-F	LM	LF	LU	TOTALS
Calhoun	So. Twin Lake					4	3		7
Cerro Gordo	Ventura Marsh	7	6	27	15	45	46		146
Clay	Dan Green Sl.	2							2
Clay	Mud Lake			7	6				13
Dickinson	Jemmerson Sl.	2	3	1	1	43	50		100
Dickinson	Hottes Lake					2	3		5
Dickinson	Sandbar Sl.					2	2		4
Dickinson	Marble Lake					1			1
Dickinson	Grover's Lake	1				2	1		4
Emmet	Ingham Lake	8	1			4	6		19
Emmet	High Lake	1				12	19		32
Emmet	Palson Slough	4	2			30	27		63
Emmet	Cunningham Sl.	3	1			26	18		48
Hancock	Eagle Lake					1	1		2
Monona	Badger Lake			1				8	9
Palo Alto	Rush Lake	10	2	6	3	27	31		79
Palo Alto	Silver Lake					4	3		7
Pocahontas	L. Clear Lake				1				1
Story	Hendrickson Marsh	1		6	4	4	5		20
	TOTALS	39	15	48	30	207	215	8	562

Table 6. Wood duck age and sex composition by area - breeding grounds banding, 1969

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Calhoun	S. Twin Lake		1	3	1				5
Cerro Gordo	Ventura Marsh				2	1			3
Clay	Mud Lake			1	1				2
Dickinson	Jemmerson Sl	1	4			9	6		20
Dickinson	Center Lake					3	2		5
Dickinson	Sandbar Slough		1			4	4		9
Dickinson	Marble Lake	2				4	3		9
Dickinson	Grovers Lake		2						2
Emmet	Ingham Lake	1				1	6		8
Emmet	High Lake	2				33	30		65
Emmet	Palson Slough					2	1		3
Emmet	Cunningham Sl		1			5	4		10
Monona	Badger Lake		1		3			5	9
Palo Alto	Five Island Lake			4	7				11
Winnebago	Myre Slough		1		1	28	29		59
Wright	Big Wall Lake					2	1		3
	TOTALS	6	11	8	15	92	86	5	223

Table 7. Total birds banded during pre-season waterfowl banding operations - 1969

COUNTY	NAME OF AREA	B.W. Teal	Wood Duck	Mallards	Totals
Bremer	Sweet Marsh	3	65		68
Cerro Gordo	Ventura Marsh	486			486
Emmet	East Slough	159			159
Emmet	West Swan	210			210
Palo Alto	Oppedahl Tract	195	6		201
Winnebago	Rice Lake	3	94	12	109
Worth	Elk Creek Marsh	16	26		42
TOTALS		1072	191	12	1275

Table 8. B. W. Teal age and sex composition by area-pre-season banding, 1969

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	TOTALS
Bremer	Sweet Marsh			1	2	3
Cerro Gordo	Ventura Marsh	41	6	219	219	486
Emmet	East Slough	9	1	103	47	159
Emmet	West Swan	8		119	83	210
Palo Alto	Oppedahl Tract	3	11	55	126	195
Winnebago	Rice Lake			9	7	16
Worth	Elk Creek Marsh			1	2	3
TOTALS		61	18	507	486	1072

*Other species not adequate enough to sample

Table 9. Wood duck age and sex composition by - pre-season banding, 1969

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	TOTALS
Bremer	Sweet Marsh	3	2	29	31	65
Palo Alto	Oppedahl Tract			2	4	6
Winnebago	Rice Lake	28	22	21	23	94
Worth	Elk Creek Marsh			10	16	26
TOTALS		31	24	62	74	191

Table 10. Total mourning doves banded, Iowa - 1969

COUNTY	NAME OF AREA	NESTLINGS	ADULTS	IMMATURES	TOTALS
Bremer	Sweet Marsh		50	23	73
Butler	Big Marsh		1	4	5
Clay	Deweys Pasture		111	166	277
Clay	Ruthven Area		47	92	139
Emmet	Jack Creek		14	2	16
Emmet	Wallingford Area		72	25	97
Fremont	Forney Lake		86	152	238
Guthrie	Bays Branch		96	54	150
Hancock	E. Twin Lake		10	6	16
Lucas	Brown's Slough		139	41	180
Lucas	Colyn Area		277	66	343
Marion	Red Rock Game Area		22	9	31
Pottawattamie	Wilson Island		16	5	21
Tama	Otter Creek		18	3	21
Warren	Hooper Area		3	4	7
Winnebago	Rice Lake	1	1		2
Worth	Elk Creek Marsh		130	91	221
Worth	Manly Area	22			22
TOTALS		23	1093	743	1859

Table 11. Total birds banded - 1969

SPECIES	BREEDING GROUNDS	PRESEASON	WINTER TRAPPING	TOTALS
Black Duck			6	6
Mallards	176	12	2094	2282
G. W. Teal	3			3
B. W. Teal	558	1072		1630
Shoveler	24			24
Pintail	10		1	11
Woodduck	223	191		414
Red Head	80			80
Canvasback	3			3
L. Scaup	1			1
Ruddy Duck	6			6
Ring Neck	1			1
Canada Goose	53			53
Mourning Dove	1859			1859
TOTALS	2984	1275	2101	6373

IOWA QUAIL POPULATION, 1969

M. E. Stempel
Game Biologist

The July count of whistling cock quail is the primary means of determining breeding quail populations. A resume of this procedure is given in the 1963 July-September Quarterly Biology Reports. The method as initiated in Iowa is based on 97 10-stop routes distributed throughout the state.

Additional information used in calculating the prospective fall population is obtained each year from other game surveys on which quail are recorded. These censuses are taken from April through August. Information from all these counts gives a fairly complete picture of post-winter survival, summer adult populations, and of the production up to late summer.

Favorable weather preceeding pairing and nesting is necessary so that breeding quail will be in prime condition. In this respect, in the primary quail territory the 1968-69 winter had no excessive snowfall, and weather was mostly favorable to quail survival. Even the long period of ice cover in January did not appear to greatly affect quail numbers. Spring populations were high. March weather was moderate, though sometimes wet; June and July were wet. Our records as of late September indicate that quail production was fairly high throughout the summer.

The censusing system and changes in the system are described in the Quarterly Biology Reports for July-September 1964 and for July-September 1967.

RESULTS

Whistling Quail Census: Statewide

This July count measures annual variations in the number of Iowa breeding quail (Table 1). The 1969 count was made on 88 routes. On the total of 880 stops, 1,429 cocks were heard calling. This amounted to a mean of 1.62 per stop, which was similar to the 1.69 for 1968.

In prime quail range (south-central and southeast) there was an 8 per cent decrease. In the areas which border the prime quail range (central, east and southwest) there was little change from 1968; however, these areas have relatively few quail. In northern Iowa counts were lower than in 1968, but since the number of quail is small a precise measure of the population change is difficult to obtain. Northern Iowa did experience some severe winter weather, however, which likely reduced quail survival in that area.

Wapello and Decatur-Wayne County Research Areas

Sunrise whistling activity in quail begins in late March or in April. It ends by September. This activity is checked about once each two weeks; the number of calling males is recorded along a 10-stop route at sunrise when the sky is clear and wind is moderate. This is the same procedure used on the statewide routes.

In 1969, as heard on these two research routes, sun-up calling began in April, peaked in June, with calling high into August. It continued fairly high to mid-August, then slowed thereafter.

Sight Records in Conjunction with other Counts

On Spring Pheasant Counts: A measure of quail survival over the winter is obtained from the numbers of quail sighted on the April-May spring roadside pheasant surveys. In 1969 this covered 1,560 miles of 10-mile routes with 80 quail being seen, which was an average of 5.13 per 100 miles. In 1968 along 1,700 miles 98 quail were seen, which was an average of 5.76 per 100 miles. For the years 1967 back to 1962 the figures were 4.31, 2.89, 2.15, 3.01, 2.83, 1.20.

On Rabbit Counts: Quail are also counted on the regular July rabbit counts. These are made along roads that were selected because they are in rabbit territory, which in southern Iowa is also quail range. The procedure is described in the 1963 July-September Biology Reports in the rabbit report. In 1969 this count was made on 2,730 miles of routes throughout the state. Altogether, 198 quail were reported seen for an average of 7.25 per 100 miles (Table 2). In 1968 the figure was 7.37; in 1967, 5.77; while in 1966 it was 6.88 and in 1965 and 1964 results were similar to each other at 3.85. The number of coveys seen should be an indicator of the state of production; in this respect, young quail were seen on 9 routes in 1969; in 1968 on 11; in 1967 none were seen; 3 in 1966, 2 in 1965, and 3 in 1964. Until this year if coveys were not recorded as such, any report of 9 or more quail having been at one place was considered as a covey. In 1968 for the first time young quail were counted and recorded separately from adults.

On August Roadside Pheasant Count: A late summer roadside pheasant count is made in August, with quail sighted also being counted. Along 5,160 miles of route, 459 quail were seen. This was an average of 8.90 per 100 miles, which is more than the 6.54 for 1968 (Table 3) and it is above the 7.03 for 1967. Of the six districts there was increase throughout the southern group; this territory alone has significant numbers of quail during any recent year.

On Calling Quail Surveys: Records are also kept of quail seen on whistling quail routes. In 1969, 121 were seen along routes comprising 880 miles, which was 13.75 per 100 miles (or more correctly per 100 listening stops)since some stops are more than one mile apart (Table 4). In 1968, 124 were seen along 970 miles or 12.78 per 100 miles (or more correctly per 100 listening stops) (Table 4). In 1967 the figure was 7.37; in 1966, 9.79. In 1965, it was 4.01.

DISCUSSION

In April and May the first count is made of the adult quail which eventually produce the new coveys. This is done in conjunction with the spring pheasant survey. This year it indicated that quail survived the 1968-69 winter in about the same number as in 1967-68. Next to be taken is the whistling cock quail count in early July and this count showed

a population similar to that of 1968. On this same census 53 cooperators said they thought there were as many quail as in 1968. Fourteen thought the population was higher. Six thought there were less. These six were all outside the Iowa quail range; i.e., to the north of good territory. The June, July and August calling quail counts were made again this year on the Wapello and Decatur-Wayne Research sites. On these sites we now have 4 years data, and the 1969 record shows the May through August calling was nearly the same as in 1968. Overall, this indicates production at least as good as in 1968. Early July quail counts along rabbit survey routes indicated good numbers.

Because of the relatively small number of quail sighted on the quail, rabbit and pheasant surveys made during the summer by Commission personnel, it is likely a better idea of the over-all quail picture can be obtained by combining data from these three counts. When this was done, it was found that 8.87 quail were seen per 100 miles in 1969, compared to 7.19 in 1968, 6.67 in 1967, 8.38 in 1966, 5.68 in 1965, and 4.84 in 1964 (Table 4). Many of the birds counted are adults, and thus still must be classed as brood stock.

The August pheasant surveys show a higher proportion of young, and it is possible the change in numbers does to an extent reflect changes in production periods as well as annual fluctuations in production. Since 1960, there has been a succession of similar production periods, and quail numbers have increased slightly, or at least remained at similar levels. Changes of 20 per cent or less are usually not noticed by the average shooter. However, a few more year's data on these recently revised quail counts will be necessary before their relative worth can be fully evaluated.

An always present difficulty in setting up censuses and making changes in censuses is illustrated in an experience of this summer. To better sample the late June calling cock quail peak, instructions and forms for the count were mailed earlier. This was done in late June; usually the counts are made in July. However, the 1969 season was very wet and most counts were again made in July. Had more been taken in late June, the count of calling males would have been much higher; this was true on the two Research routes.

SUMMARY

The various quail surveys taken from spring through late summer of 1969 showed that Iowa's hunters will find another bumper crop of quail in the field for the 1969 season. Counts were all quite similar to those of last year - one of the best years in recent times for quail shooters. In fact, sight records from the various censuses made in July and August showed that 23 per cent more birds were seen in 1969 compared to 1968, with the best increases in the primary range of southern Iowa. Northern Iowa experienced a relatively severe winter from the standpoint of quail, and a decline occurred here. However, this part of the state is of little significance for quail hunting.

Table 1. July whistling quail counts, Iowa 1969

Region of state	No. of routes	No. of stops	No. of whistling cocks	No. of whistling cocks per stop	1968 mean per stop	Per cent change from 1967
N. W.	13	130	12	0.09	0.20	- 55
N. C.	12	120	1	0.01	0.01	0
C	16	160	273	1.71	1.66	+ 3
E.	16	160	307	1.92	1.81	+ 6
S. W.	11	110	149	1.35	1.39	- 3
S.C. & S. E.	20	200	687	3.39	3.69	- 8
Statewide	88	880	1,429	1.62	1.69	- 4

Table 2. Quail observed on the July rabbit count Iowa, 1969

Region of state	No. of routes	No. of miles	No. quail seen	Quail seen per 100 miles	1968 no. per 100 miles	Per cent change from 1968
N. W.	15	450	0	0.00	0.00	0
N. C.	14	420	0	0.00	0.22	- 100
C.	15	450	3	0.67	3.56	- 81
E.	16	480	34	7.08	7.83	- 10
S. W.	12	360	40	11.11	9.72	+ 14
S. C. & S. E.	19	570	121	21.23	18.03	+ 18
Statewide	91	2,730	198	7.25	7.37	- 2

Table 3. Quail sighted on the August pheasant count, Iowa, 1969

Region of state	No. of routes	No. miles driven	No. quail seen	No. quail seen/100 miles	1968 no. quail seen /100 miles	Per cent change from 1967
N. W.	30	900	0	0.00	0.34	- 100
N. C.	25	750	0	0.00	0.00	0
C.	28	840	37	4.40	1.73	+ 154
E.	30	900	81	9.00	8.61	+ 5
S. W.	22	660	83	12.58	6.38	+ 97
S. C. & S. E.	37	1,110	258	23.24	16.42	+ 42
Statewide	172	5,160	459	8.90	6.54	+ 36

Table 4. Quail sighted on whistling quail counts, Iowa, 1969

Region of state	No. of routes	No. miles driven	No. quail seen	No. of quail seen/100 miles	1968 no. quail seen /100 miles	Per cent change from 1967
N. W.	13	130	0	0	2.14	- 100
N. C.	12	120	0	0	1.53	- 100
C.	16	160	12	7.50	10.00	- 25
E.	16	160	33	20.63	13.50	+ 53
S. W.	11	110	13	11.82	14.66	- 19
S.C. & S.E.	20	200	63	31.50	26.82	+ 17
Statewide	88	880	121	13.75	12.78	+ 8

Table 5. A summary of combined results of quail sighted on calling quail census, rabbit count and pheasant survey, July and August, Iowa , 1969 and 1968

Region	1968				1969				
	No. Routes	No. Miles	No. quail seen	Quail seen 100/miles	No. Routes	No. Miles	No. quail seen	Quail seen 100/miles	Per cent change 1968-69
N. W.	58	1,460	6	0.41	58	1,480	0	0	- 100
N. C	52	1,300	3	0.23	51	1,290	0	0	- 100
C	59	1,430	47	3.29	59	1,250	52	3.59	+ 9
E.	76	1,880	167	8.88	62	1,540	148	9.61	+ 8
S. W.	46	1,160	95	8.19	45	1,130	136	12.04	+ 47
S. C & S. E.	84	2,080	375	18.03	76	1,880	442	23.51	+ 31
STATEWIDE	375	9,310	669	7.19	351	8,770	778	8.87	+ 23

AGE OF QUAIL TAKEN BY IOWA QUAIL HUNTERS 1969 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 affected 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 1969 wing survey with supplemental data from roadside and field surveys. Comparisons are made with similar data for 1968.

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 1,438 wings was collected in October and November of 1969. These were from 20 counties and the number was more than enough to establish production periods of the young (Haugen and Speake , 1958). Eighty-seven per cent were from young birds; the comparable figure was 86 in 1968. There were 76 hens per 100 cocks in the sample. Other information is presented in Tables 1 and 2.

Most of the wing collection was made before November 15; whereas the open season was October 25 to January 31, 1970. In 1968 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 young 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 1969

Sixty-nine per cent 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, peaked in early July, hit

Table 1. A tabular compilation of data from Iowa quail wings collected in 1968 and 1969'

	1969	1968
1. No. of wings	1,438	1,255
2. No. of wings accompanied by useable information	1,438	1,247*
3. No. of counties represented	20	21
4. Per cent of young in sample	87	86
5. Per cent of young that were mature or nearly so (90 days old or older)	71	76

* Some wings came in late. Some were not accompanied by information.

Table 2. The per cent young in quail bagged in Iowa 1956-69

Year	% young in quail bagged	No. 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

* Some wings are not included as they were not accompanied by data on place and date of kill; some were damaged; some arrived too late while others were sealed in plastic bags or other air-tight containers. In air-tight bags, the wings decayed.

a low in late July, then increased to another high in August; thence the hatch tapered off 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 per cent 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 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 35 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 late May. The broods seen were hatched in May (7), June (10), July (12), August (4) and September (2).

DISCUSSION

About 55 per cent 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 1968 production pattern was estimated from the collection of 1,247 wings from 21 counties in southern Iowa quail range. Seventy per cent were young (under 150 days old) that could be aged. Their hatching dates were established. Thirty per cent 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. Nineteen counties were represented. Seventy per cent 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 coveys sighted in the summer of 1967.

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

Wings from more than 1,438 quail shot by Iowa quail hunters during the 1969-70 season were collected from 20 counties in late October and early November. Eighty-seven per cent 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. On the whole, the 1969 production exceeded that for 1968 with a resulting 1969 fall population which was greater than that of the previous year.

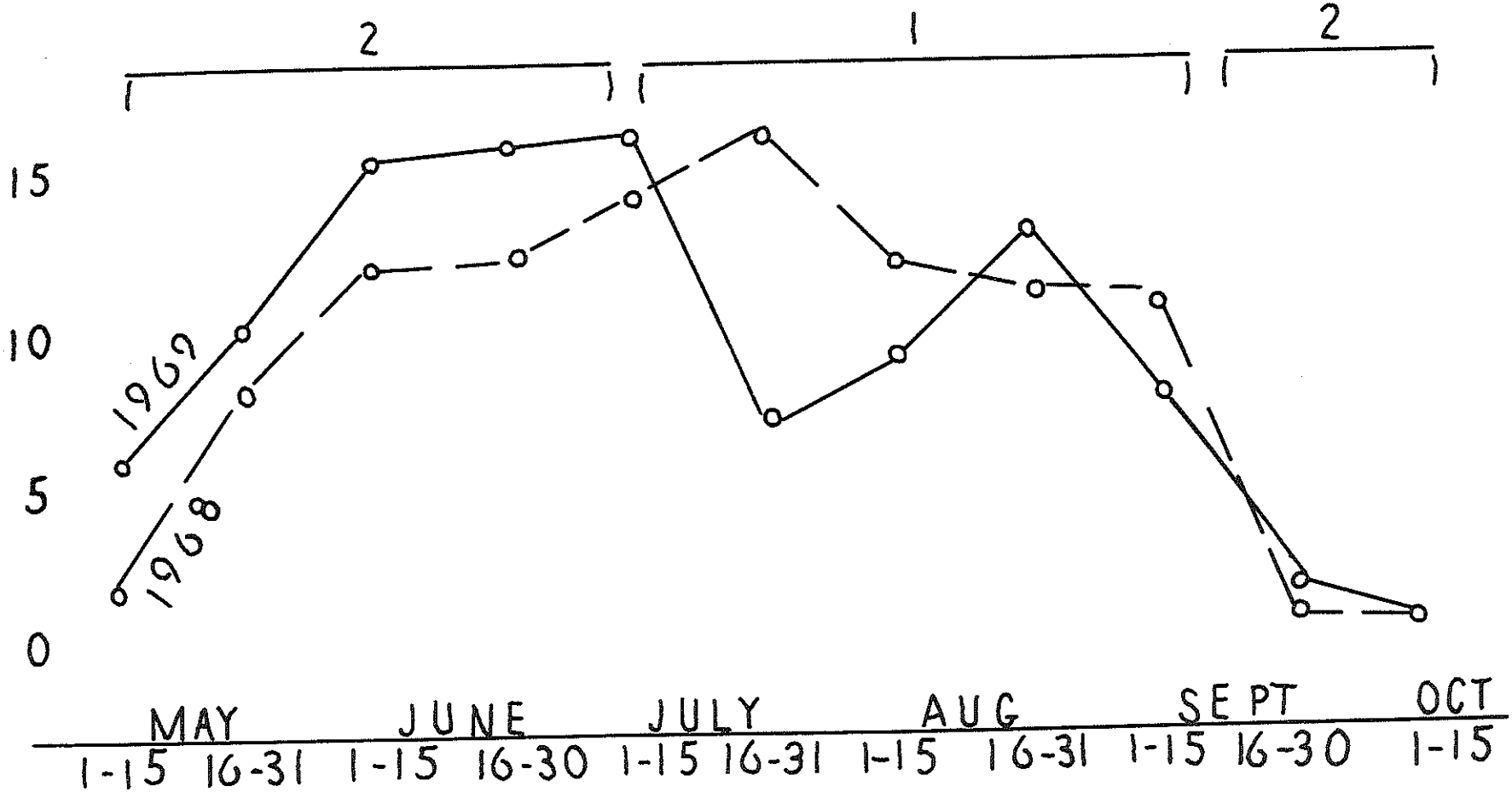

Figure 1. Comparison of 1969 and 1968 quail hatching date distribution.

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 opens in November. In 1969 and 1968 the season opened October 25 and 26 respectively and wings could be aged back to early July and late June.

LITERATURE CITED

Haugen, Arnold O., 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.

QUAIL STUDIES ON TWO AREAS IN SOUTHERN IOWA, 1969

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 Jan.-Mar. 1966 Qtrly Biol. Rpts.). 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 floodplain. 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 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.

METHODS 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 1969 STUDIES

Winter Studies

Late February-early March covey counts were conducted without the benefit of snow cover on the Wapello Area. On the Decatur-Wayne Area there were patches of snow cover.

Forty-three coveys were located on both study areas in 1969, as compared to 40 coveys in 1968. Thirty-eight coveys was the average for the preceding 2 years.

Spring and Summer Studies

April 1969 was moderate after a cold winter. May was cloudy with temperatures near normal. June was cool, cloudy and wet with extensive rainfall which continued into July and July was a rainy humid month. August was mostly moderate, September was also moderate, while October was cold, cloudy and wet. (Climatogical Data - Iowa, for months concerned).

Although weather tended to be wet most of the peak production period, quail production was high in 1969. Calling by cock quail at a significant rate over a period of 14 to 16 weeks indicates continuing nesting effort at a high level from mid-June to July; then there was a temporary drop, but with a recovery later (Figure 1). This calling period of 14 to 16 weeks was longer than that of 1967 and 1968. And 1966, 1967 and 1968 have all been years of outstanding quail production.

In 1969, 19 quail per 100 miles were sighted on both study area census routes. From 1966-69 the number of quail sighted per 100 miles varied from 9 to 22. The average for this 4-year period was 16 per 100 miles. These sightings were recorded during the first hour after sunrise, a prime sighting period.

Autumn Studies

On the Decatur-Wayne Area the fall covey count began on October 20 and was completed November 18. Similar dates for the Wapello Area were October 9 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.

On the two areas 75 coveys were located (Table 2). This was 18 more coveys than last year and 21 more than the 1967-68 average. It took 0.9 hours to flush a covey and this is better than the 1967-68 average. The farmer estimate of 28 coveys was 6 less than last year and 11 less than the 1967-68 average.

HUNTING ACTIVITY

The 1969-70 quail season of 99 days opened on October 25 and closed on January 31. This is the fourth consecutive year that the season length extended to around 100 days (98 in 1968-69, 100 days in 1967-68, 102 days in 1966-67). Nearly 16 percent of the hunting activity on 10 farms on the two study areas occurred in October (Table 3).

November, December and January had 38, 24 and 22 percent 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 1966-69 the winters in southern Iowa have been characterized by light snow cover. During these three winters the brood stock on both study areas increased from 32 to 43 coveys. Spring weather in 1969 was highly favorable for the most part; although it was preceeded by cold weather, and in late June there was much rainfall. Nevertheless there were over 12 weeks of significant quail calling during each of the past 4 years. Quail population levels have been outstandingly high. From 1966-69 the number of quail sighted per 100 miles on the study areas routes varied from 9 to 22. This variance of the sighting data does not correlate with quail population levels, no doubt because of the very small sample size.

Each fall there is some handicap in locating coveys because of heavy cover, and unharvested grain fields. Furthermore, it is not always possible to use the same dog.

From 1966-70 the quail hunters have had expanded opportunities through the 100-day (more or less) quail seasons. We now have 5 years of data to evaluate our techniques and some factors associated with quail populations. A more comprehensive report will be prepared for the entire period.

SUMMARY

1. Quail counts were continued on both study areas, Wapello and Decatur-Wayne, in 1969.

2. The 1969 spring brood stock on both areas consisted of 43 coveys, compared to 40 in 1968, 36 in 1967, 32 in 1966 and 20 in 1965.

3. More than 12 weeks of significant quail calling indicated good production in 1969.

4. Seventy-five coveys were located on both areas during fall 1969. This was 18 coveys more than last year and 21 more than the 1967-68 average.

5. The hours per covey flush in fall 1969 was 0.94 compared to 1.1 for the previous year.

6. Quail sighted per 100 miles driven on the study area census routes varied from 14 in 1966, 22 in 1967 and 9 in 1968 to 19 in 1969. Sample size is too small for accurate comparisons, however.

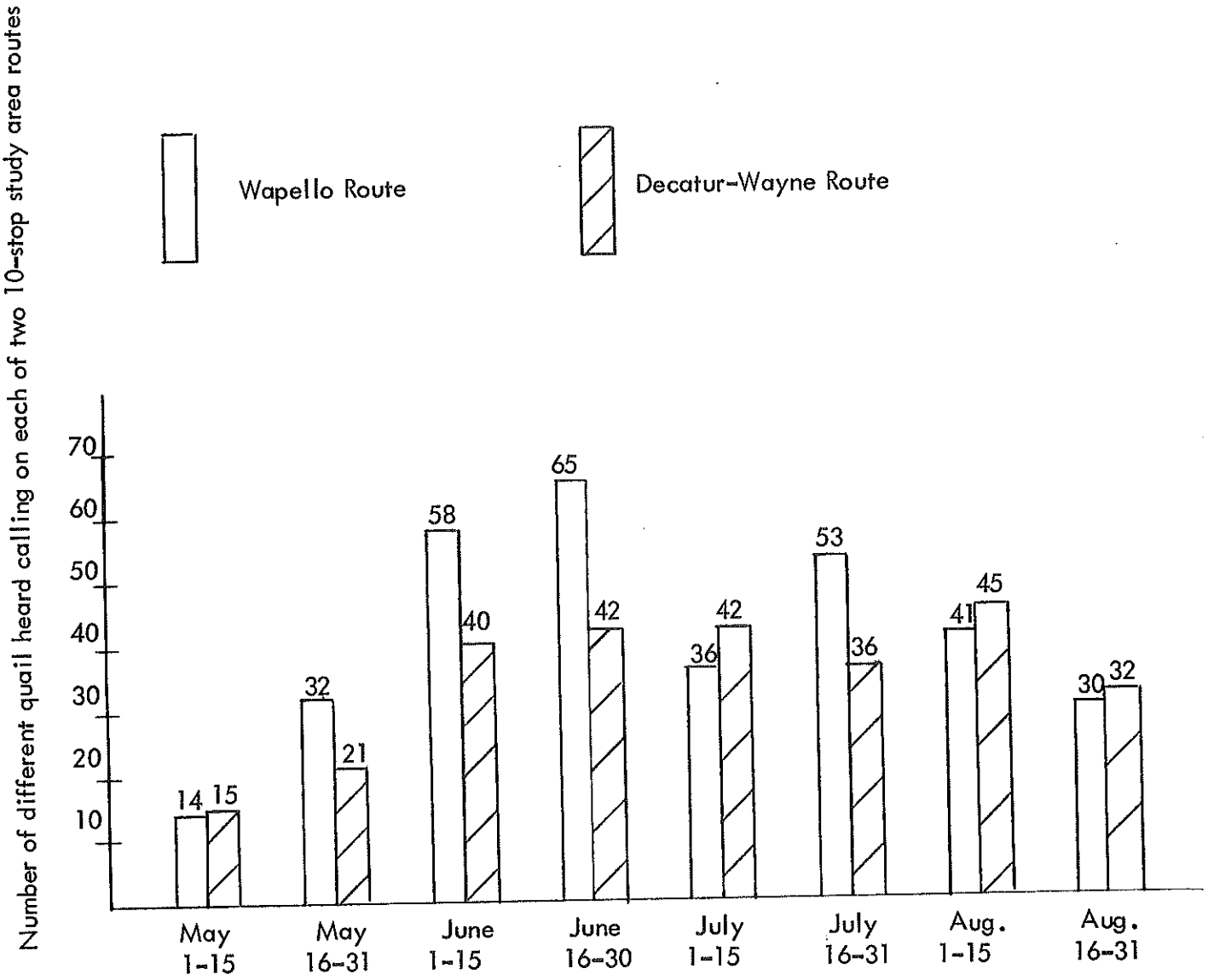

Figure 1. The length and peak of the quail calling period as recorded by different observers on the Wapello and Decatur-Wayne Areas, 1969.

Table 1. Results of winter 1969 quail counts on the Wapello and Decatur-Wayne Areas compared to the 1967-68 average of both areas

	1969*			1967-68 Average
	Wapello Area	Decatur-Wayne	Both Areas	Both Areas
No. of coveys located	23	20	43	38
Flush	5	17	22	
Sign	18	3	21	
No. of quail estimated	340	208	548	462
Flush	74	176	250	
Sign	266	32	298	
No. of hrs. spent walking	11.1	20.6	31.7	33.9
Hrs. per covey flush	2.2	1.2	1.4	1.8
Farmers estimates of number of coveys	5	9	14	10

* On the Wapello Area count conducted without snow cover; on the Decatur-Wayne Area, with patches of snow cover

Table 2. Results of fall 1969 quail counts on the Wapello and Decatur-Wayne Areas compared to the 1967-68 average of both areas

	1969			1967-68 Average
	Wapello Area	Decatur-Wayne	Both Areas	Both Areas
No. of coveys located	39	36	75	54
Flush	12	34	46	
Sign	27	2	29	
No. of quail estimated	484	518	1002	646
Flush	84	489	573	
Sign	400	29	429	
No. of hrs. spent walking	11.5	31.9	43.4	43.2
Hrs. per covey flush	0.96	0.94	0.94	1.2
Farmer estimates of number of coveys	7	21	28	39

Table 3. Summary of quail-hunting activity reported at five farms on each of two areas, Wapello and Decatur-Wayne, 1969-70

	Wapello Area		Decatur-Wayne Area		Both Areas		Percent of Hunting Activity on Both Areas		
	No. of Parties	No. of Hunters	No. of Parties	No. of Hunters	No. of Parties	No. of Hunters	Parties 1969-70	Parties 1968-69	Parties 1967-68
October*	3	6	3	7	6	13	16	30	10
November	1	3	13	24	14	27	38	40	41
December	0	0	9	24	9	24	24	16	31
January	1	1	7	17	8	18	22	14	18
Totals	5	10	32	72	37	82	100	100	100

* October 1969 had 6 quail-hunting days

FIFTEEN INCH SIZE LIMIT PROPOSAL FOR CHANNEL CATFISH IN THE MISSISSIPPI RIVER

Don R. Helms
Fisheries Biologist

INTRODUCTION

At the January 1969 meeting of the UMRCC, the Fish Technical Section recommended the commercial size limit for channel catfish be increased from 13 to 15 inches in the Mississippi River where it borders Iowa and Wisconsin. A size limit of 15 inches presently exists between Wisconsin and Minnesota and in Missouri. Illinois, Iowa and Wisconsin as it borders Iowa has a 13 inch size limit.

The recommendation did not pass. However, the F.T.S. members felt that it's failure was due primarily to lack of prior communications with voting members and a general misunderstanding of the reasoning behind the proposal.

This year, the F.T.S. proposed a similar recommendation to the parent committee. The previous recommendation was ammended to read - the catfish commercial size limit be 15 inches for the entire Upper Mississippi River including all five states.

The following report was presented for the purpose of aquainting them with the proposed change in size limit.

PRESENT STATUS OF THE POPULATION

During the past 10 years, extensive observations have been made on the channel catfish fishery of the Upper Mississippi River by Wisconsin and Iowa. In Iowa, we have examined 40,000 catfish at various markets and landings. Measurements taken show that fish under 15 inches contribute about 70% of the number and about 55% of the weight harvested. During some years, small fish contributed up to 90% of the number in individual pools. Generally, harvest in the downstream pools tend to consist of a greater percentage of small fish than the upstream pools. Causes for these variations are attributed to differences in year class strength and fifferences in relative fishing pressure between pools.

Data from pools 9 and 18 are offered as representatives of length frequency distribution of the harvest. Length frequency distribution is shown as the solid lines in Figure 1 and 2 for pools 9 and 18, respectively. Data for pool 9 represent measurements of 3,300 commercially caught fish sampled monthly during 1964 and 1965 by Wisconsin personnel. Pool 18 data are from2,684 fish sampled in a similar manner by Iowa in 1968 and 1969.

These data show a decrease in numbers at a rate of about 20% for each inch of growth. Thus, with an annual growth rate of three inches total annual mortality appears to be near 60%. Most of this is attributed to commercial harvest.

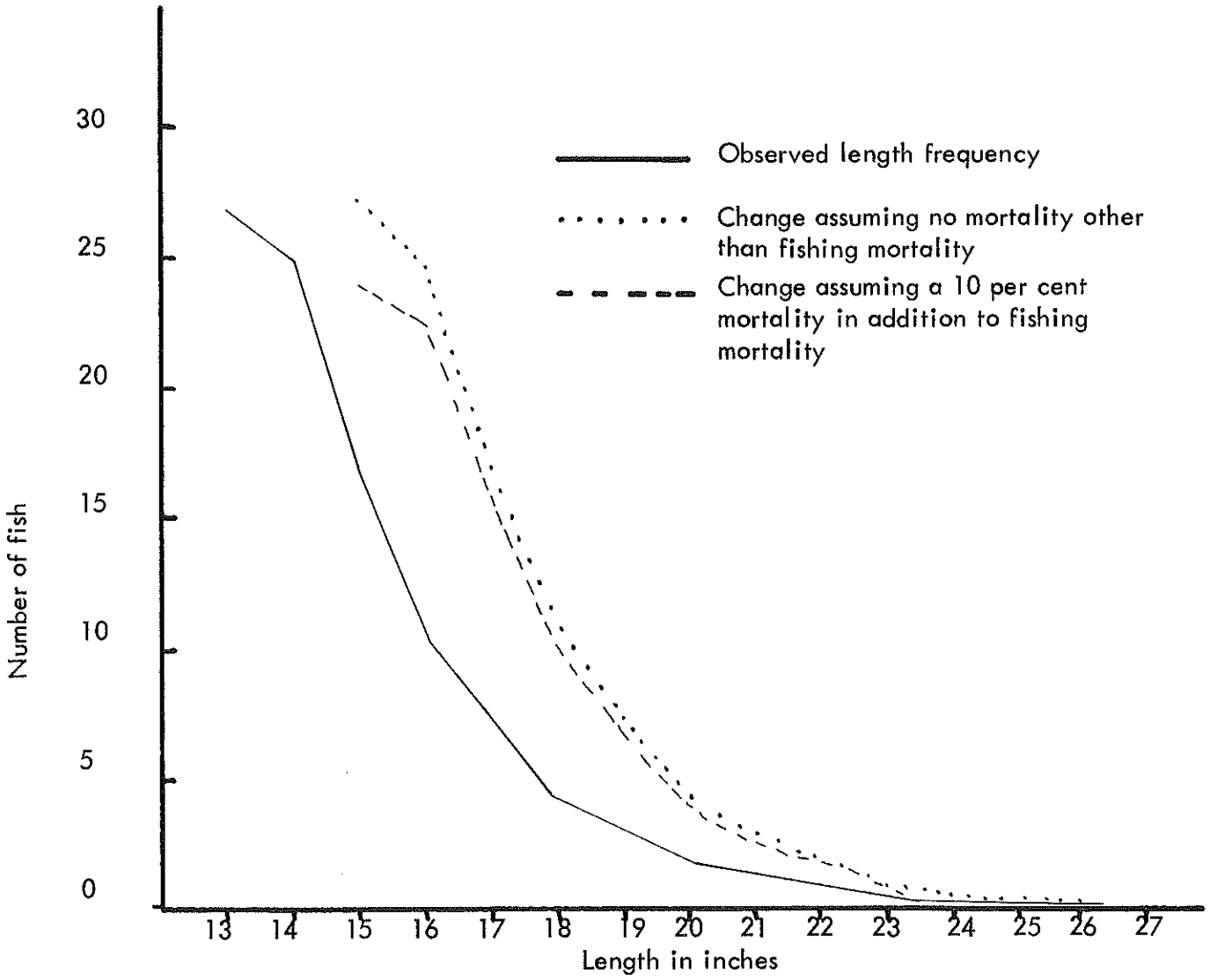

Figure 1. Length frequency of channel catfish harvested in pool 9 and projected change resulting from increase in size limit.

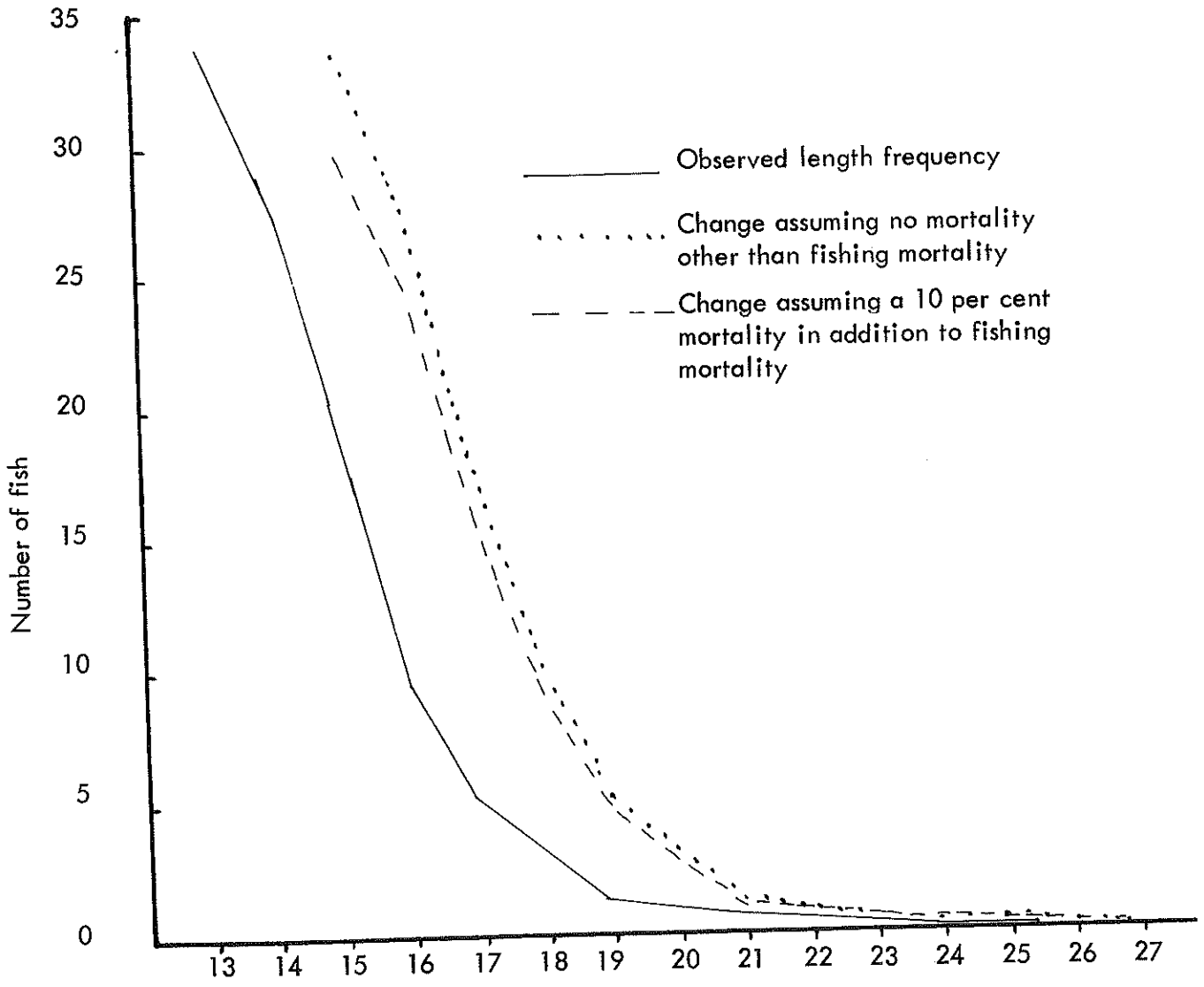

Figure 2. Length frequency of channel catfish harvested in pool 18 and projected change resulting from increase in size limit.

PROJECTED CHANGES

Should the size limit be raised to 15 inches and fishing pressure remain the same, the length frequency curve would retain a similar shape and shift upward two inches (dotted line on Figures 1 and 2.) Assuming mortality from all causes other than fishing to be 15% annually (for fish >13 inches), there would be a 10% loss in numbers during the period it took for the fish to grow from 13 to 15 inches (broken line on Figures 1 and 2). For every 100 available fish over 13 inches with the present size limit, there would be 90 over 15 inches after the increase in size limit. The 90 fish, however, being larger would weigh about 30% more than the original number. Harvest would be at a more optimum level relative to maximum productivity. Transition would be completed before the end of the first growing season.

It has been pointed out that smaller fish are more valuable locally as "individual" sized fish for the restaurant trade. Assuming a 20¢ per pound difference (80¢ for under one pound dressed and 60¢ for larger fish,) there would still be an increase in value of the fishery. Projected changes are shown for pools 9 and 18 in Tables 1 and 2.

Although the extent of mortality from causes other than fishing are not known and can only be estimated at this time, we are confident the 15% annual rate is reasonable. It was further determined that up to 35% annual mortality could be stood without having a negative effect on the commercial value of the fishery.

A mortality rate as great as this, however, seems highly unlikely for fish over 13 inches in length.

An additional benefit would be that year classes overlap more in larger fish. Thus, there would be a reduction in dependancy on individual year classes. As a result, harvest fluctuations caused by poor year classes would be less drastic.

Further, since most catfish do not mature until they reach 15 inches, the increase in numbers of mature fish might reduce spawning failures.

Benefits to the sport fishery would also be significant. Projected increases in numbers and weight of fish over 13 inches available to the sport angler are included in Tables 1 and 2.

SUMMARY

In summary, raising the size limit is expected to increase the productivity of the river for channel catfish to a more optimum level. Commercial harvest would consist of fewer, but larger, fish having a higher total value, while sport harvest would increase significantly in both number and size of fish.

Complete transition would occur during the first season and cause little or no change (positive or negative) in commercial value of the fishery during that year.

Table 1. Projected changes in relative numbers, weights and value of channel catfish to the commercial and sport fisheries associated with a change in size limit in pool 9

	Size of fish (in.)	Number of fish	Weight (lb.)	Dressed Weight	Price per lb.	Value
Present conditions with 13 inch size limit.	13 to 16	69	65	39.0	.80	31.20
	16 and over	31	66	39.6	.60	23.76
	Total (available to sport and commercial)	100	131	78.6		$54.96
Projected changes resulting from 15 inch size limit.	13 to 15	51	45			
	15 to 16	24	28	16.8	.80	13.44
	16 and over	66	142	85.2	.60	51.12
	Total (available to commercial)	90	170	102.0		$64.56
	Total (available to sport)	141	215			

Table 2. Projected changes in relative numbers, weights and value of channel catfish to the commercial and sport fisheries associated with a change in size limit in pool 18

	Size of Fish	Number of fish	Weight (lb.)	Dressed Weight	Price per lb.	Value
Present conditions with 13 inch size limit.	13 to 16 in.	79	73	43.8	.80	35.04
	16 in. and over	21	40	24.0	.60	14.40
	Total (available to sport and commercial)	100	113	67.8		$49.44
Projected changes resulting from 15 inch size limit.	13 to 15 in.	61	53			
	15 to 16 in.	30	35	21.0	.80	16.80
	16 in. and over	60	114	68.4	.60	41.04
	Total (available to commercial)	90	149	89.4		$57.84
	Total (available to sport)	151	202			

MOVEMENT CHARACTERISTICS OF CARP, CARPSUCKER, BIGMOUTH BUFFALO AND CHANNEL CATFISH IN CORALVILLE RESERVOIR

Larry R. Mitzner
Fisheries Biologist

In 1966 an investigation of commercially valuable fish species was initiated to determine and develop proper utilization of this resource. One of the objectives of the investigation was to estimate population magnitude of commercial species. Population estimates at Coralville Reservoir were attempted by mark and recapture for carp, carpsucker, bigmouth buffalo and channel catfish, but reliable estimates were obtained for only the latter. Population estimates in 1969 were again made on the four commercially valuable species.

In a large body of water such as Coralville it was very difficult to mark enough fish in one season and expect adequate recaptures for reliable estimates. In 1969, a study area was used to avoid such ineffectiveness. A new problem arose immediately, the study area was contained by imaginary boundaries on two sides and the population was free to move in or out at will. Such movement would cause the proportion of marked fish in the study area to be constantly decreasing as the experiment progressed. The method of estimation employed was based on a sequential multiple census, which was dependent on marking and recovering fish over an extended period. It was decided movement could be a realistic error in the population estimate and should be accounted for. Design of the estimates were altered to incorporate movement.

METHOD AND PROCEDURE

The lower boundary of the study area was located six miles upstream from the dam. The area above this limit contained 1,979 acres and was subdivided into 10 - one mile segments. Each segment was numbered consecutively from downstream to upstream. Physical characteristics in the area were representative of the entire pool.

Fish were marked only in segments 4, 5, 6 and 7. In segments 4 and 5 they received a left pelvic fin clip as distinguished from fish marked in 6 and 7 with a right clip. Additional capture and recapture was continued in segments 1 - 3 and 8 - 9 to determine dispersal of marked fish from areas 4 - 7. Surface area was 1,188 acres at elevation 680' msl for segments 4 - 7.

Marking, capture and recapture were done concurrently from 8 April through 12 August. Records were made of number caught, recaptured, origin of each recapture, and number marked and released for each segment. Three assumptions were : (1) marked fish in each segment had identical movement characteristics; (2) marked fish in any segment were caught as readily as in other segments; and (3) movement characteristics remained constant throughout the season. There was no evidence that these assumptions were not true.

The recaptured fish were classified to distance from point of release. Possible classifications were upstream 1 - 5 miles, downstream 1 - 3 miles and no movement for segments 4 and

5. Classification of recaptures from segments 6 and 7 were upstream 1 - 3 miles, downstream 1 - 5 miles and no movement. The data were similar for both marking areas and distribution was established by combining left recaptures in segments (s) with right recaptures in segments, s + 2, where s = any segment (1(1) 10) (Table 1).

Table 1. Distribution of recaptured fish from left and right marking areas

Left recaptures in segment:			1	2	3	4	5	6	7	8	9	10
Right recaptures in segment:	1	2	3	4	5	6	7	8	9	10		
Carp	0	0	1	0	9	10	40	1	4	0	0	0
Carpsucker	1	0	3	1	6	2	30	0	2	1	0	3
Bigmouth Buffalo	0	0	1	0	4	1	45	3	4	1	1	0

RESULTS

Of 7,396 carp marked during the experiment, 65 were recaptured in ten segments. The distribution of the sample was approximately normal. Standard deviation of the distribution was 1.05 miles. No upstream or downstream movement was shown.

Carpsucker received 2,100 mark in segments 4 - 7. Of these, 49 were recaptured within the 10 segments. Carpsucker was the only species recaptured in segments 1 and 10. This caused the normal curve to have a flatter dome. The standard deviation was 2.06 miles with a mean of 0.23 miles upstream.

Movement characteristics of bigmouth buffalo were similar to carp. The distribution was based on 8,065 marked individuals of which 60 were recaptured. One standard deviation was 1.13 miles with mean movement of 0.58 miles upstream; buffalo tended to move upstream more than other species.

Channel catfish were marked in the pool and only in segments 4 and 5 with a left pelvic fin clip. Prior to 26 August only 292 fish were marked and 20 recaptures were taken. From 10 September to 4 November 1,082 additional fish were marked yielding a seasonal total of 109 recaptures.

No trapping was done in segments 1 -3 and 6 - 10 because movement characteristics had previously been determined for channel catfish in Coralville Reservoir (Mitzner, 1968). The information from the previous study was to be used to correct the population estimate for movement.

Bait netting in the headwaters started in the 14th period. Pool marked individuals were recaptured in the headwaters at 1% compared to 7% in the pool. The pool and headwaters netting sites were separated by a minimum of 14 miles. This movement was far greater than that computed by the previous study.

Population estimate of channel catfish was attempted in the headwaters for period 14 - 16. Twelve days after marking began in the headwaters, three fish were taken 15 miles downstream in the pool study area. By the end of the season headwaters recaptures were more readily caught in the pool than at the site of their release. The catch rate was 0.5% in the headwaters and 0.7% in the pool.

Recapture data showed that channel catfish moved randomly but over much greater distances and with greater frequency than those in the study by Mitzner (1968). One explanation could be that fish in the previous study were tagged with belly tags and were of necessity larger than those fin clipped in 1969. Smaller individuals may exhibit marked differences in movement habits than larger fish.

Probability (P_n) of a fish remaining within the given distance, n, from which it was marked can be computed from the equation

$$z = \frac{X - m}{\hat{s}_d}$$

where z = unitized distance from the mean of a standard normal curve
X= distance (n) from the mean of the emperical distribution
m = mean of the emperical distribution and
$\hat{s}_d$ = standard deviation of the emperical distribution

The probability, P_n, was derived from tables in which the relationship between z and A are known (Alder and Roesler, 1960) where A is the area under a unitized normal curve for a given a value.

The probability ($P_{.5}$) of left-marked carp remaining in segment 4 is

$$z = \frac{1}{1.05} = 0.95$$

and $P_{.5}$ is 0.329. The probability (P_1) of a fish remaining in segments 4 and 5 is $2(P_{.5})$ or 0.658. Similar computations were made for the marking area plus two and four adjoining segments. Probability (P_2) of a fish remaining in the marking area plus one segment on either side was 0.943; (P_3) for two segments on either side of, and including the marking area was 0.996.

A formula was derived to aid in determining the number of marked individuals remaining in the marking area (Mitzner, 1969). The equation was

$$\sum_{i=1}^{s} N_i \left[0.5 \ (P_{2i-1} + P_{2s-(2i-1)} \right] = \hat{N}$$

where P_{2i-1} = probability of left-marked fish not going downstream farther than segment 4

$P_{2s-(2i-1)}$ = probability of left-marked fish not going upstream farther than segment 7
N_i = number of fish marked in the i^{th} segment
N = number of marked fish remaining in, s, segments
s = number of segments being examined and
i = any, s, segment being examined.

In this experiment s = 2; segments 4 and 5 were considered as one unit with segments 6 and 7 the other unit.

The percent of left-marked carp remaining in segments 4 - 7 was

$$100 \ (0.5 \ (0.658 + 0.996)) = 82.6\%$$

where i = 1 and s = 2. Because of the symmetry in the study area the percent of right-marked carp remaining in segments 4 - 7 was also

$$100 \ (0.5 \ (0.996 + 0.658)) = 82.6\%$$

where i = 2 and s = 2.

Only 0.2% of right-marked carp moved below segment 4 and 17.2% moved upstream past the upper bound of segment 7.

Carpsucker range of movement was greater than carp and proportionately more marked fish left the study area. Computations for P_1, P_2 and P_3 as determined by their standard deviation, were 0.369, 0.668 and 0.856, respectively. These values were used to determine the number of marked carpsucker remaining in the study area or

$$100 \ (0.5 \ (0.369 + 0.856)) = 61.2\%$$

Of the carpsucker marked in segments 6 and 7, 7.2% moved downstream at least past segment 4 and 31.6% moved upstream past segment 7.

Dispersion of marked bigmouth buffalo out of the study area was based on probabilities P_1, P_2 and P_3; these were 0.624, 0.923 and 0.992, respectively. The percent of marked buffalo remaining in segments 4 - 7 was

$$100 \ (0.5 \ (0.624 + 0.992)) = 80.8\%$$

Dilution of marked bigmouth buffalo occurred from movement past the outer bounds of segments 4 and 7. Fish bearing right marks decreased 0.4% due to movement past segment 4 and 18.8% from movement past segment 7. Conversely, fish with left farks decreased 0.4% from movement past segment 7 and 18.8% moved past segment 4.

Channel catfish lost from the marking area due to movement could not be calculated because recaptures were not determined at regular intervals from the site of marking. The rate of recapture of pool fish in the headwaters and headwaters fish in the pool showed the standard deviation of movement was substantially larger than 3.12 miles which was determined in a previous study.

Range of movement for carpsucker was greater than that of carp, and bigmouth buffalo but less than channel catfish. Behmer (1969) showed carpsucker were rather sedentary in the Des Moines River, but stated the method of sampling could have caused carpsucker to appear sedentary. His study showed of 102 fish marked 75 did not move farther than 0.4 kilometers, 12 moved 0.4 kilometers, 3 moved 0.8 kilometers, 2 moved 1.2 kilometers and 10 moved farther than 1.6 kilometers. Movement patterns of carp and bigmouth buffalo in Coralville were approximately the same.

LITERATURE CITED

Alder, Henry L. and Edward B. Roessler.
1960. Introduction to Probability and Statistics. W. H. Freeman and Co., San Francisco. 289 pp.

Behmer, David J.
1969. Schooling of river carpsuckers and a population estimate. Trans. Amer. Fish Soc., Vol. 98, No. 3, pp. 520-523.

Mitzner, Larry.
1968. Movement of channel catfish in Coralville Reservoir. Ia. Cons. Comm. Qtr. Biol. Rpts., Vol. 20, No. 4, pp 1-16.

Mitzner, Larry.
1969. Coralville Crappie Investigations. Part I--Movement. Ia. Cons. Comm. Qtr. Biol. Rpts., Vol. 21, No. 4.

AGE AND GROWTH OF BLACK CRAPPIE IN SPIRIT LAKE IOWA

Terry Jennings
Fisheries Biologist

Spirit Lake is located in northwest Iowa. It has a surface area of approximately 5,660 acres. Maximum depth is about 25 feet. The basin was formed by movement of the Wisconsin glacier. The lake is eutrophic and supports a high population of fish.

Although research of Spirit Lake's fish population has been conducted periodically for the past 22 years, most of it has been directed toward the walleye population. Nothing has been published on many of the other game fish - including black crappie Pomoxis nigromaculatus (Le Sueur). In 1967 a study was initiated to investigate the life history, with particular reference to growth rate.

The principle objective of this paper is to record the rate of growth of black crappie in Spirit Lake. The data were collected from fish captured during test seine hauls in 1967 and 1968.

LENGTH-WEIGHT RELATIONSHIP

In 1967, 303 lenghts and weights were recorded. This sample was divided into 1.0 inch length intervals and mean values plotted in Figure 1. The least square procedure was used to compute the equation:

$$\log W = -1.277 + 3.066 \log L,$$

where L = total length and W = weight.

Observed and calculated weights (Table 1) were correlated (r=0.999). C factors ranged from 51 to 67 with a mean of 60.

BODY-SCALE RELATIONSHIP

During 1967 and 1968 a total of 296 black crappie scale samples were aged. All scales were taken from the fishes left side 2 to 4 scale rows below the lateral line and below the origin of the dorsal fin. Aging was accomplished using a microprojector and 32 power magnification.

The sample was divided into 1.0 inch length intervals. Mean total length and corresponding scale radius of each interval were plotted on Figure 2. A straight line was fitted to these plots by using the equation $L = 1.1 + 1.1 R$. An intercept of 1.1 (R = 0) on a straight line nomograph was used to caluclate total length at each annulus.

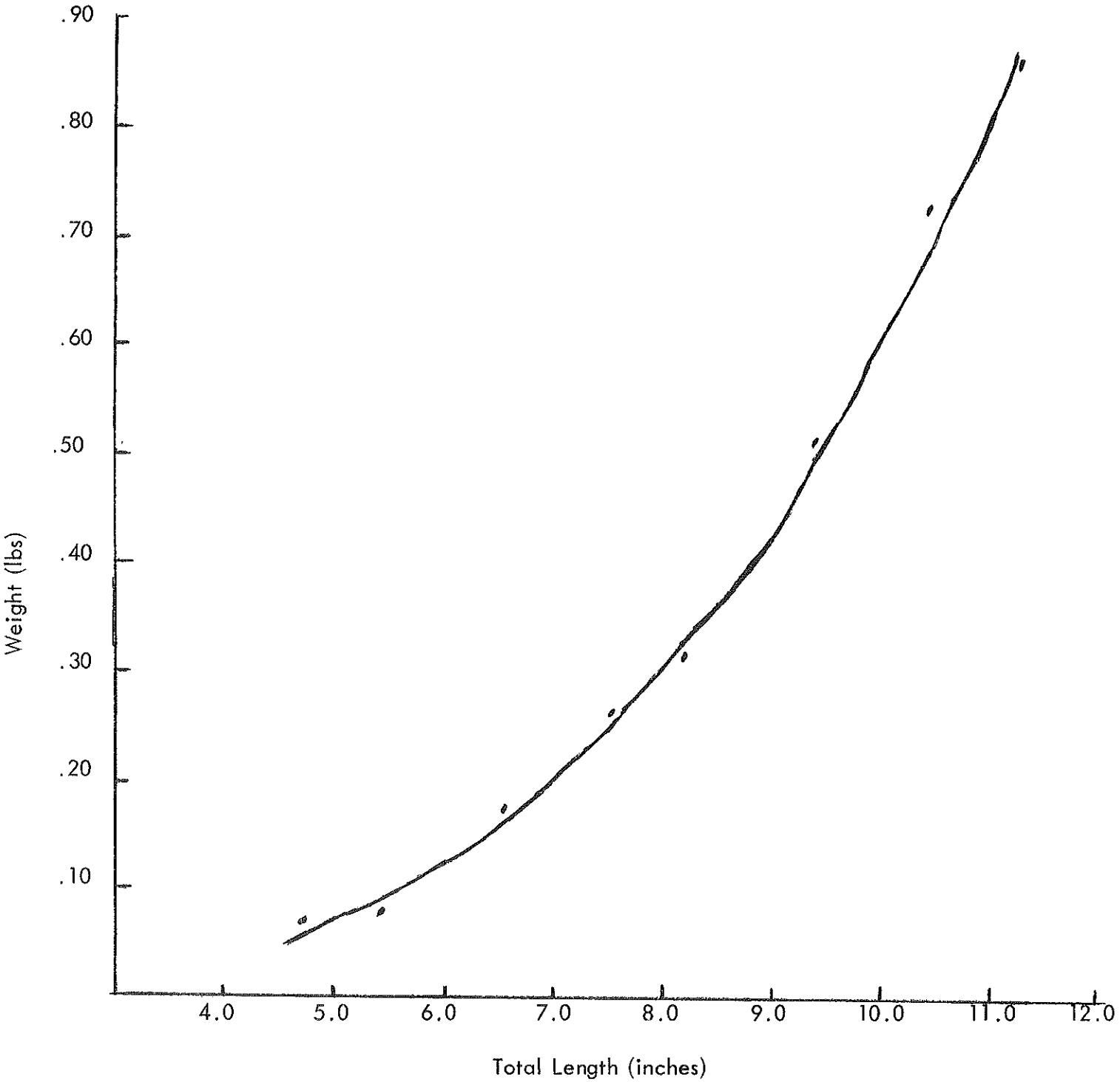

Figure 1. Length-weight relationship of black crappie from Spirit Lake, 1967.

SUMMARY

The length-weight relationship can best be described by the equation log W = -1.27738 + 3.06630 log L.

The body-scale relationship was a straight line with an intercept of 1.1 and a slope of 1.1.

No crappie older than 5 years was observed.

Growth was best the first 2 years of life.

LITERATURE CITED

Bennett, George W.
1945. Overfishing in a small artificial lake, Onized Lake near Alton, Illinois. Illinois. Ill. Nat. Hist. Surv., Bull., 23(3):372-406.

Erickson, J. G.
1952. Age and growth of black and white crappies, Pomoxis nigromaculatus (Le Sueur) and Pomoxis annularis Rafinesque, in Clear Lake, Iowa. Iowa State J. Sci. 26:491-505.

Hall, Gordon E., and Robert M. Jenkins, and Joe C. Finnell
1954. The influence of environmental conditions upon the growth of white crappie and black crappie in Oklahoma waters. Okla. Fish. Res. Lab., Report No. 40, 56 pp.

Neal, Richard A.
1961. White and black crappie in Clear Lake, Iowa, summer, 1960. Proc. Acd. Sci. 68:247-253.

Table 1. Observed and calculated weight of black crappie in Spirit Lake, 1967

Length Group	Mean Length	C	Mean Weight Observed	Mean Weight Calculated	Deviation c/o
4.0-4.9	4.7	67	.07	.06	- .01
5.0-5.9	5.4	51	.08	.09	.01
6.0-6.9	6.5	62	.17	.16	- .01
7.0-7.9	7.5	62	.26	.26	0
8.0-8.9	8.2	58	.32	.33	.01
9.0-9.9	9.4	61	.51	.50	- .01
10.0-10.9	10.4	64	.72	.69	- .03
11.0-11.9	11.2	61	.86	.87	.01

RATE OF GROWTH

The life span of crappie in Spirit Lake is short. None more than 5 years old were observed (Table 2).

Table 2. Calculated lengths of black crappie in Spirit Lake, 1967 and 1968

Age Group	Number in Sample	Mean Length at Capture	Mean calculated total length at each annulus 1	2	3	4	5
I	33	5.3	3.1				
II	153	7.6	2.8	5.7			
III	92	8.7	2.8	5.6	7.9		
IV	15	10.6	3.0	6.2	8.5	9.9	
V	3	11.5	2.8	5.5	7.8	10.0	11.0
Grand average calculated lengths			2.8	5.7	7.8	9.9	11.0
Increments of grand average			2.8	2.9	2.1	2.1	1.1

Calculated total lengths in inches at annuli 1 through 5 were 2.8, 5.7, 7.8, 9.9, and 11.0 respectively. Growth was fastest during the first 2 years of life, with increments of 2.8, 2.9, 2.1, and 2.1 and 1.1 respectively.

At annulus 5, black crappie in Spirit Lake were about 30% longer than Neal reported for this species at Clear Lake, Iowa in 1960. They were about 10% larger by annulus 5 than Erickson reported from Clear Lake in 1952. Spirit Lake crappie were growing at about the same rate as the Oklahoma state average (Hall, 1954). They grew much more slowly than those in Onized Lake, Illinois (Bennett, 1945).

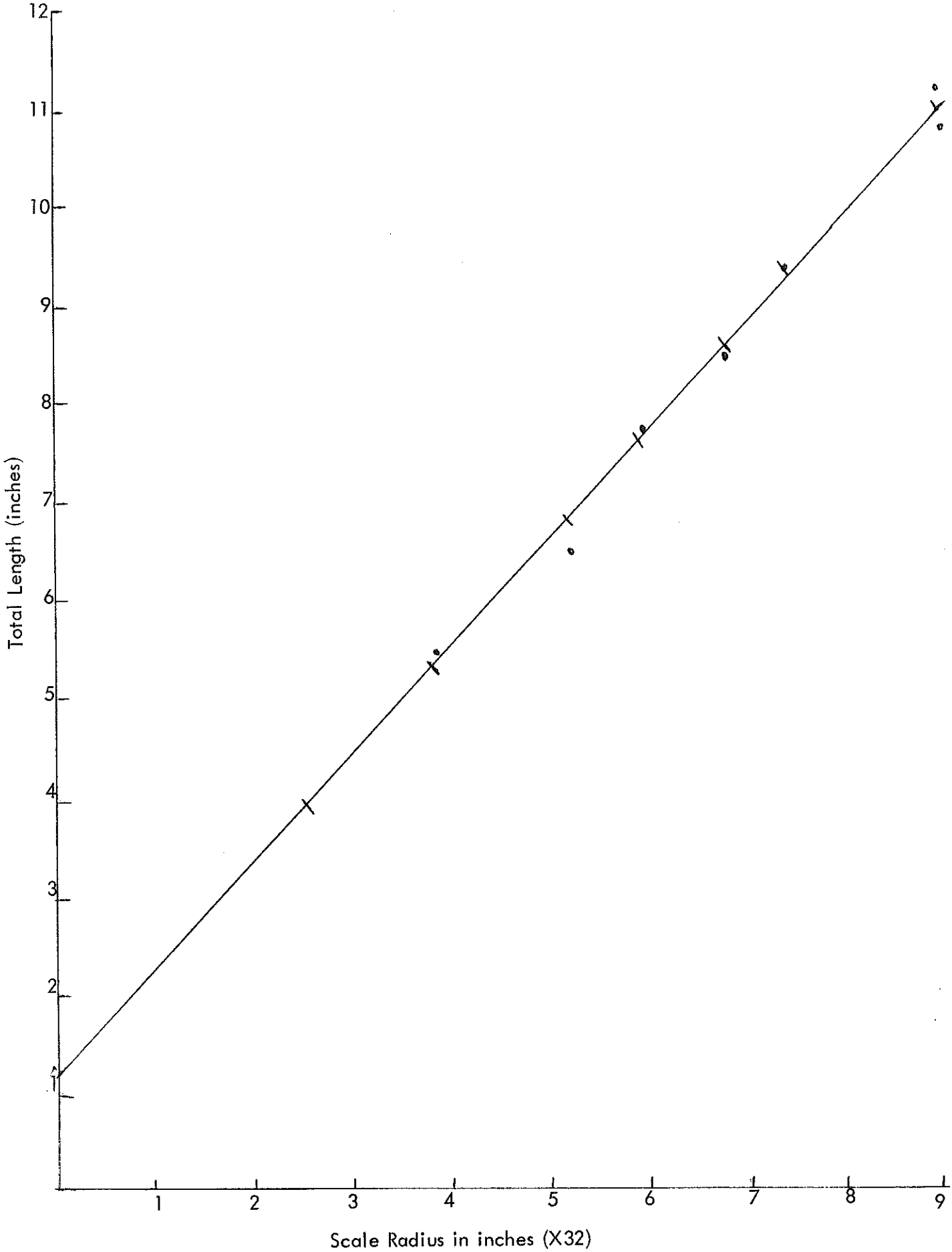

Figure 2. Body-scale relationship of black crappie from Spirit Lake, 1967 and 1968.

LENGTH-WEIGHT RELATIONSHIP OF 3 SPECIES OF FISH IN RED ROCK RESERVOIR

Gaige Wunder
Fisheries Biologist

Impoundment of Red Rock Reservoir near Knoxville began during the first half of April 1969. Because this was a new reservoir without previous fisheries investigations it was of great importance that initial data on the reservoir fishery be obtained.

For three previous years the Biology Section had conducted commercial fisheries investigations in the portion of the Des Moines River extending from the reservoir dam upstream approximately 22 miles to Bennington Bridge. This study area became the conservation pool and headwaters region of the reservoir after impoundment.

As part of these river investigations, life histories of commercially valuable fish species were compiled. Of special interest were length-weight relationships and body condition factors computed from randomly selected samples of these species.

This study presents length-weight relationships and body condition factors for the three principal species of fish with commercial and industrial value present in the initial investigation of the reservoir fishery.

CARP

Lengths and weights from 271 carp were recorded. Lengths were grouped into 0.5 inch intervals and the mean weight determined for each group. A straight line was fitted to the plotted log-log transformed values where weight was used as the dependent variable. The linear model was

$$\log_{10} W = a + b \log_{10} L$$

where, L = total length in inches and W = weight in lbs. Coefficients to satisfy the normal equals were a = -3.096 and b = 2.835 (Figure 1). The standard deviation of b was $\pm$ 0.036.

Calculated weights did not significantly differ from the observed weights at the 0.05 level, with the largest deviations occurring in fish over 20.0 inches (Table 1).

Body condition (C factors) of carp in the sample were computed as the product of the third power of the reciprocal of total length and weight. C factors of carp in 1969 ranged from 36 to 76 with a mean of 52.

CHANNEL CATFISH

The 1969 length and weight measurements were obtained on 281 channel catfish. As with carp, lengths were grouped by 0.5 inch intervals and a mean weight determined for each interval. A straight line was fitted to the log-log transformed values of the two variables in the linear function.

$$\log_{10} W = a + b \log_{10} L$$

where, W and L are the same as before. The regression coefficients were a = -3.611 ±0.050 and b = 3.132 ± 0.045 (Figure 2).

At the 0.05 level calculated weights do not significantly differ from the observed weights. The largest deviations occurred in fish over 17.0 inches (Table 2).

C factors of channel catfish in 1969 ranged from 27 to 48 with an average of 34.

RIVER CARPSUCKER

During the 1969 netting operation a sample of 284 river carpsucker were weighed and measured. The samples were processed similarly to carp and catfish by separating lengths into 0.5 inch groups and computing the mean length and weight for each group. Using weight as the dependent variable a straight line was fitted to the plotted log-log transformed values in the weighed linear regression model

$$\log_{10} W = a + b \log_{10} L$$

where L = total length in inches and W = weight in lbs. Estimated regression coefficients were a = -3.290 and b = 2.966 (Figure 3). The standard deviation of b was ± 0.046.

Observed and calculated weight do not significantly differ from each other at the 0.05 level with the largest deviations occurring in fish over 14.0 inches (Table 3).

Condition factors (C) of carpsucker in 1969 ranged from 42 to 56 with a mean of 47. There is no tendency for progressive change in C with increased size of fish.

SUMMARY

This study presented data collected during eleven bi-weekly periods of intensive netting in Red Rock Reservoir during 1969. Length-weight relationships for three fish species were calculated using the usual least-mean squares method were:

Carp - $\log_{10} W = -3.096 + 2.835 \log_{10} L$

Channel Catfish - $\log_{10} W = -3.611 + 3.132 \log_{10} L$

River Carpsucker - $\log_{10} W = -3.290 + 2.966 \log_{10} L$

Body condition factors computed for the three species were:

	Range	Mean
Carp	36-76	52
Ch. catfish	27-48	34
R. carpsucker	42-56	47

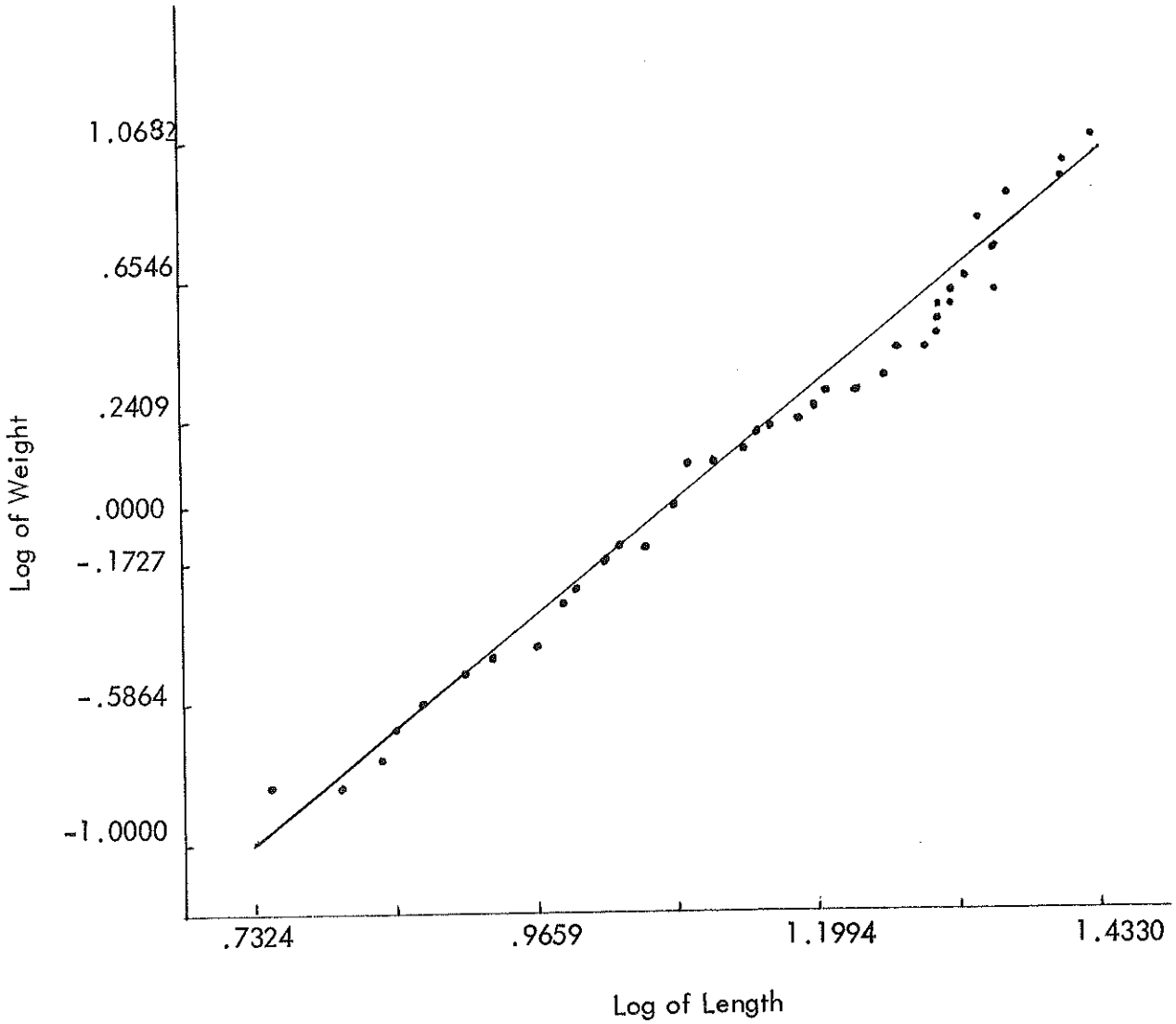

Figure 1. Length-weight relationship of carp in Red Rock Reservoir, 1969.

Table 1. Observed and calculated weight of carp in Red Rock Reservoir, 1969

Size Group	Mean Length	"C"	Mean Observed (O)	Mean Calculated (C)	Deviation C/O	No in Group
5.0-5.4	5.4	64	.10	.10	-	1
5.5-5.9	5.7	76	.14	.11	-.03	6
6.0-6.4	6.3	60	.15	.15	-	6
6.5-6.9	6.7	60	.18	.18	-	7
7.0-7.4	7.1	59	.21	.21	-	6
7.5-7.9	7.6	62	.27	.25	-.02	9
8.0-8.4	8.2	54	.30	.31	+.01	10
8.5-8.9	8.7	53	.35	.37	+.02	10
9.0-9.4	9.2	49	.38	.43	+.05	7
9.5-9.9	9.8	55	.52	.52	-	10
10.0-10.4	10.0	55	.55	.55	-	7
10.5-10.9	10.7	53	.65	.66	+.01	12
11.0-11.4	11.2	53	.74	.76	+.02	10
11.5-11.9	11.6	49	.76	.83	+.07	12
12.0-12.4	12.2	52	.95	.96	+.01	11
12.5-12.9	12.7	56	1.15	1.08	-.07	11
13.0-13.4	13.2	50	1.15	1.20	+.05	11
13.5-13.9	13.7	50	1.29	1.34	+.05	8
14.0-14.4	14.2	51	1.47	1.48	+.01	15
14.5-14.9	14.6	49	1.54	1.60	+.06	9
15.0-15.4	15.2	49	1.72	1.80	+.08	6
15.5-15.9	15.7	49	1.88	1.97	+.09	14
16.0-16.4	16.2	48	2.04	2.15	+.11	6
16.5-16.9	16.6	48	2.19	2.30	+.11	10
17.0-17.4	17.3	47	2.42	2.59	+.17	6
17.5-17.9	17.7	49	2.74	2.76	+.02	5
18.0-18.4	18.2	47	2.83	2.99	+.16	13
18.5-18.9	18.7	49	3.20	3.23	+.03	8
19.0-19.4	19.2	47	3.32	3.48	+.16	6
19.5-19.9	19.7	51	3.90	3.74	-.16	2
20.0-20.4	20.2	45	3.75	4.02	+.27	2
20.5-20.9	20.8	46	4.10	4.37	+.27	1
21.0-21.4	21.2	46	4.37	4.61	+.24	3
21.5-21.9	21.8	57	5.90	4.99	-.91	1
22.0-22.4	22.2	47	5.17	5.25	+.08	3
22.5-22.9	22.7	36	4.20	5.60	+1.40	2
23.0-23.4	23.1	51	6.30	5.88	-.42	1
24.0-24.4	24.3	56	8.05	6.79	-1.26	2
24.5-24.9	24.5	59	8.70	6.95	-1.75	1
27.0-27.4	27.1	59	11.70	9.25	-2.45	1

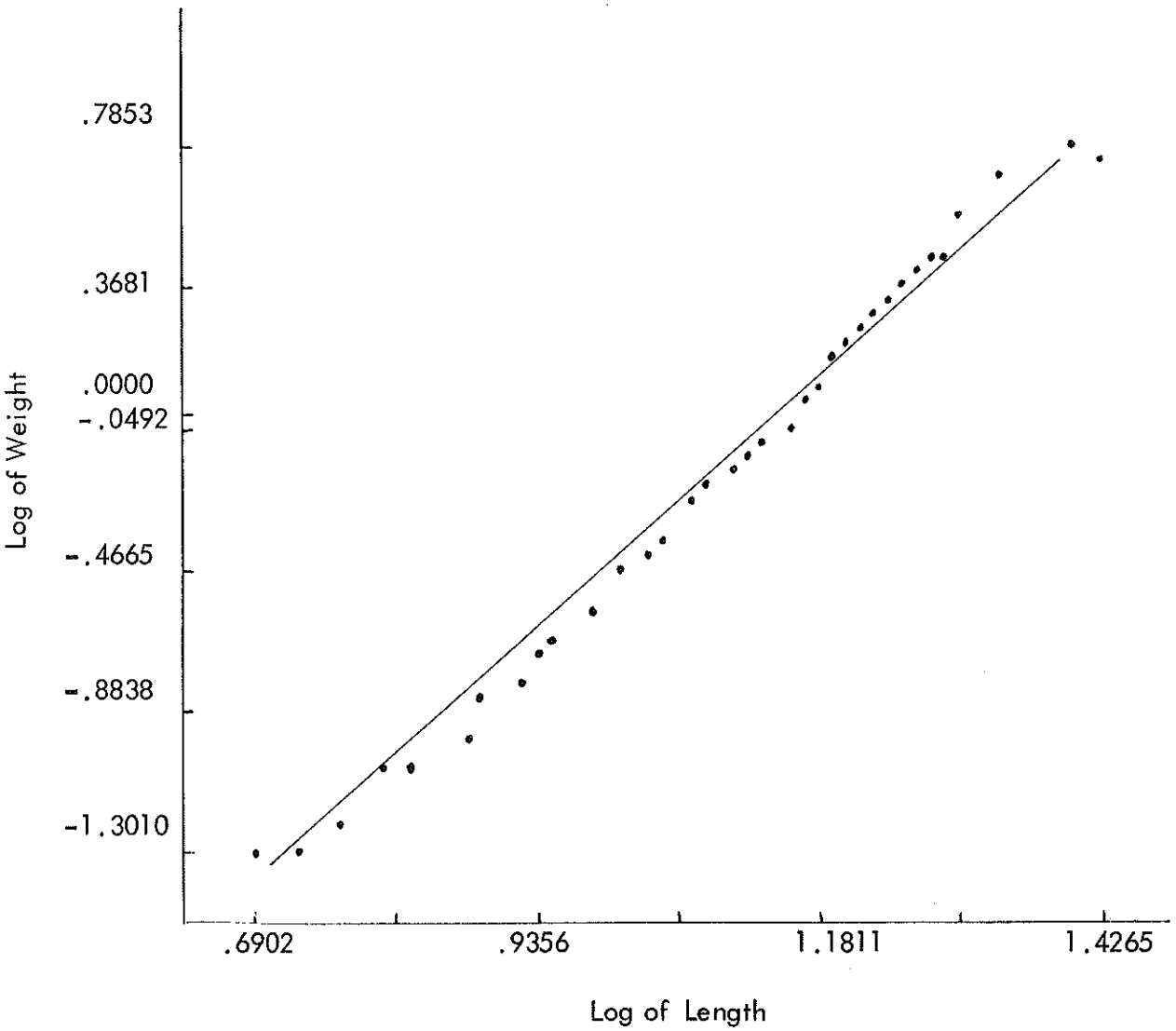

Figure 2. Lenght-weight relationship of channel catfish in Red Rock Reservoir, 1969.

Table 2. Observed and calculated weight of channel catfish in Red Rock Reservoir, 1969

Size group	Mean length	"C"	Mean Weight Observed (O)	Mean Weight Calculated (C)	Deviation C/O	No. in group
4.5-4.9	4.9	42	.05	.04	-.01	2
5.0-5.4	5.3	34	.05	.05		1
5.5-5.9	5.8	31	.06	.06		3
6.0-6.4	6.3	36	.09	.08	-.01	7
6.5-6.9	6.7	30	.09	.09		14
7.0-7.4	7.2	29	.11	.12	+.01	17
7.5-7.9	7.7	31	.14	.15	+.01	14
8.0-8.4	8.1	30	.16	.17	+.01	11
8.5-8.9	8.7	29	.19	.21	+.02	17
9.0-9.4	9.2	27	.21	.26	+.05	26
9.5-9.9	9.7	28	.26	.30	+.04	16
10.0-10.4	10.2	31	.33	.35	+.02	14
10.5-10.9	10.8	30	.38	.42	+.04	14
11.0-11.4	11.1	31	.42	.46	+.04	10
11.5-11.9	11.7	34	.54	.54		9
12.0-12.4	12.2	32	.59	.62	+.03	8
12.5-12.9	12.7	34	.70	.70		7
13.0-13.4	13.2	33	.75	.79	+.04	11
13.5-13.9	13.7	33	.84	.89	+.05	11
14.0-14.4	14.2	32	.93	1.00	+.07	15
14.5-14.9	14.7	36	1.13	1.11	-.02	15
15.0-15.4	15.1	34	1.16	1.21	+.05	5
15.5-15.9	15.7	36	1.40	1.36	-.04	2
16.0-16.4	16.2	38	1.60	1.50	-.10	3
16.5-16.9	16.6	39	1.78	1.62	-.16	7
17.0-17.4	17.2	38	1.93	1.81	-.12	6
17.5-17.9	17.8	37	2.07	2.02	-.05	2
18.0-18.4	18.3	39	2.40	2.20	-.20	1
18.5-18.9	18.8	38	2.55	2.40	-.15	4
19.0-19.4	19.2	40	2.80	2.56	-.24	1
19.5-19.9	19.6	37	2.77	2.73	-.04	3
20.5-20.9	20.9	41	3.70	3.34	-.36	1
22.0-22.4	22.1	46	5.00	3.98	-1.02	1
24.5-24.9	24.6	41	6.10	5.56	-.54	1
26.5-26.9	26.7	28	5.40	7.19	+1.79	1

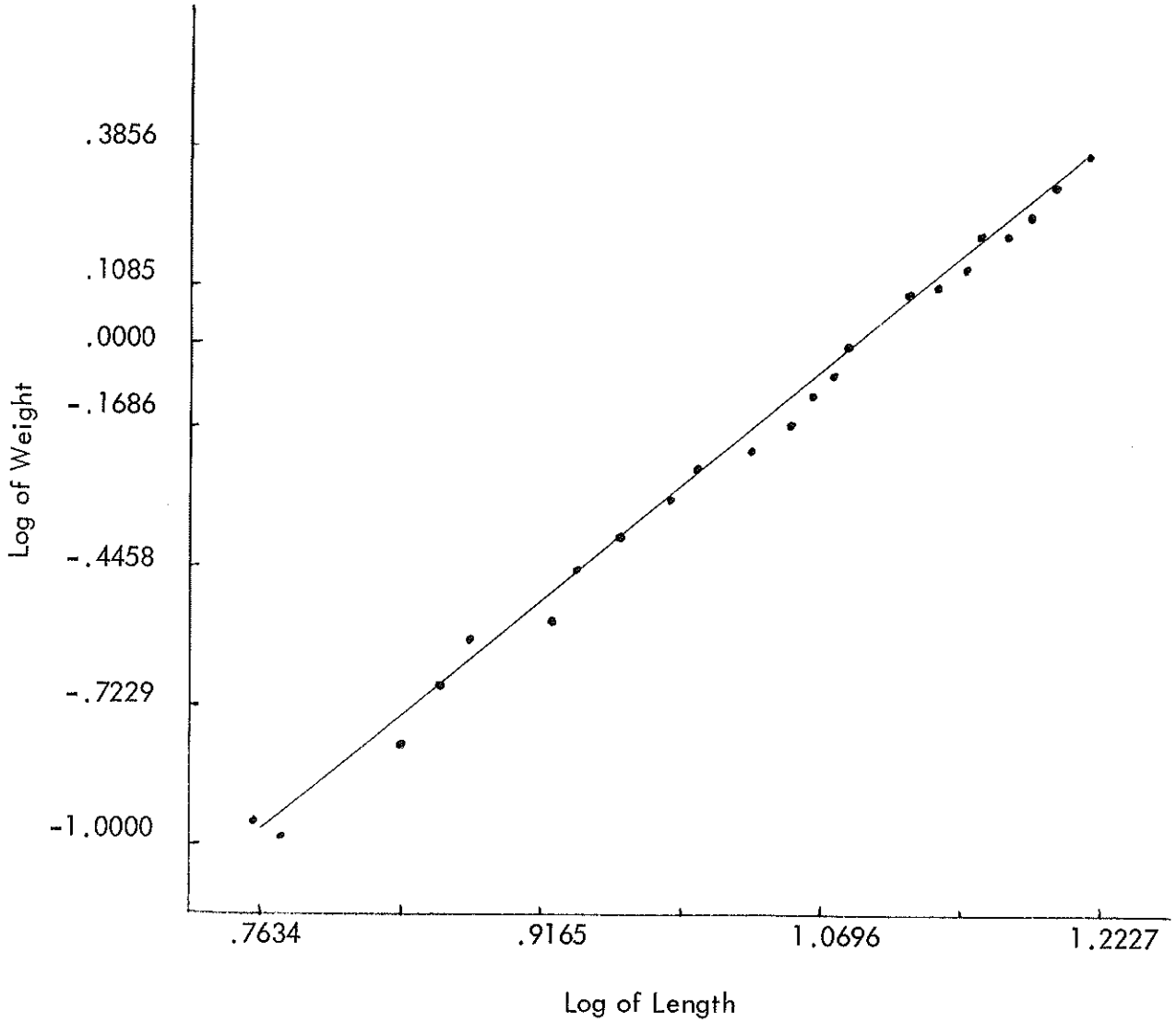

Figure 3. Length-weight relationship of river carpsucker in Red Rock Reservoir for 1969.

Table 3. Observed and calculated weight of carpsucker in Red Rock Reservoir, 1969

Size group	Mean length	"C"	Mean Weight		Deviation C/O	No. in group
			Observed (O)	Calculated (C)		
5.5-5.9	5.8	56	.11	.09	-.02	3
6.0-6.4	6.2	42	.10	.11	+.01	8
6.5-6.9	6.8	45	.14	.15	+.01	12
7.0-7.4	7.2	51	.19	.18	-.01	11
7.5-7.9	7.6	55	.24	.21	-.03	15
8.0-8.4	8.2	45	.25	.26	+.01	15
8.5-8.9	8.7	47	.31	.31		27
9.0-9.4	9.2	46	.36	.37	+.01	14
9.5-9.9	9.7	47	.43	.43	-	26
10.0-10.4	10.1	47	.48	.49	+.01	17
10.5-10.9	10.7	46	.56	.58	+.02	12
11.0-11.4	11.2	47	.66	.66		13
11.5-11.9	11.7	46	.74	.75	+.01	13
12.0-12.4	12.1	46	.81	.83	+.02	8
12.5-12.9	12.7	44	.90	.96	+.06	12
13.0-13.4	13.3	46	1.08	1.10	+.02	13
13.5-13.9	13.7	47	1.21	1.20	-.01	10
14.0-14.4	14.2	46	1.32	1.34	+.02	11
14.5-14.9	14.7	50	1.59	1.48	-.11	7
15.0-15.4	15.2	45	1.57	1.64	+.07	4
15.5-15.9	15.6	47	1.79	1.77	-.02	8
16.0-16.4	16.0	46	1.90	1.91	+.01	1
16.5-16.9	16.7	52	2.43	2.17	-.26	4

Proc. Iowa Acad. Sci. 76: 226-230

Iowa's First Ruffed Grouse Hunting Season in 45 Years

EUGENE D. KLONGLAN[1] AND GENE HLAVKA[2]

Abstract. A 16-day hunting season on ruffed grouse, the first in 45 years, was held in northeastern Iowa in 1968. Season dates were November 2 to 17, inclusive, with a daily bag limit of two and a possession limit of four birds. The 1150 hunters who took part in this season bagged 720 grouse, or 0.6 birds per hunter for the entire season. It took an average of 11.8 gun hours of hunting to bag one ruffed grouse. Birds were flushed at the rate of a bird per 1.9 hours of hunting. An average of 5.4 shots was fired per bird bagged. The sex ratio of 42 birds checked was 50:50. A ratio of 1.5 immatures per adult was found in this sample, with 60 per cent of the take thus being juvenile birds. Color phases of those birds were in the ratio of 50 red: 20 intermediate: 30 gray. Half of all grouse hunting was done in Allamakee County, with 35% in Winneshiek, 15% in Clayton and insignificant amounts in other counties. The estimated take of 720 birds represents a 6% rate of harvest of the estimated fall population of 12,000 ruffed grouse.

Early Hunting Seasons

The ruffed grouse, prized game bird of major importance in many states, was legal game throughout the early history of the State of Iowa. The first mention of ruffed grouse in the game laws of Iowa dates back to the Sixth General Assembly (1856-57) of the Iowa Legislature, when the first game protection law was passed. This law declared illegal the taking, except on one's own premises, of grouse (and several other species) between February 1 and July 15 each year—a period of 5½ months. Prior to this time there had been no restrictions on the taking of grouse, or any other game, in the territory that had only recently become the State of Iowa.

Subsequent General Assemblies periodically made slight changes in the closed season on ruffed grouse, until at the time of the Thirtieth General Assembly (1904) the open season was set at November 1 through December 15. This season of 1½-months duration remained in effect from 1904 through 1923. The Fortieth General Assembly (1923) closed the season on ruffed grouse.

The first game protection laws made no mention of bag limits. It was not until 1878 (Seventeenth General Assembly) that such restrictions were passed. At that time the killing during any one day by a single individual of more than 25 grouse was prohibited. This provision remained in effect with no change until the ruffed grouse hunting season was closed following the 1923 season.

[1] Assistant Superintendent of Biology, Iowa State Conservation Commission, Boone.

[2] Game Biologist, Iowa State Conservation Commission, Chariton.

Current Hunting Season

A 16-day hunting season for ruffed grouse in 1968 gave Iowa sportsmen their first opportunity in 45 years to pursue this often-called "king of upland game birds." The open season set by the State Conservation Commission extended from November 2 through November 17. Legal shooting hours were from 8:00 AM to 4:30 PM. The daily bag limit was two, with a possession limit after the first day of four birds. Hunting was permitted only in that northeastern part of the state bounded on the west by U. S. Highway 63 and on the south by Iowa Highway 3. This area enclosed by these two major highways includes all of the current Iowa grouse range, though grouse are not found in all portions of the demarcated zone.

Two methods were used to measure the results of the 1968 Iowa ruffed grouse season. The first of these involved the contacting of hunters in the field during the season by State Conservation Commission personnel. Detailed information on many aspects of grouse hunting was obtained in this manner. The second method was used to estimate statewide grouse hunting statistics, and involved the use of a post-season statewide hunter survey. Postcard questionnaires are sent to a 2% random sample of licensed hunters each year, and it was only necessary to add ruffed grouse to the list of species covered in the survey.

Field Contacts of Ruffed Grouse Hunters. Information on actual hunter performance was obtained in varying detail from 81 party days of grouse hunting involving 172 hunters. Average party size was thus 2.1 hunters. Some hunters were contacted more than once during the season, as were some parties. Each contact on a different day was considered a separate hunting trip in arriving at the total of 81 parties contacted. These parties had hunted a total of 278 hours at the time of contact (a few were still hunting when checked), or a total of 595 gun hours. The following data were obtained from this sample of hunters.

Those hunters checked were reasonably successful in flushing grouse. There were 321 birds reported flushed during the 595 man-hours of hunting. This flushing rate of 0.54 grouse per man hour (or 1.9 hours per grouse flushed) compares favorably with rates typically reported in recent years in other grouse hunting states. The average number of grouse flushed per party (including a few incomplete hunts) was 4.0. A party flushed a grouse on the average of each 52 minutes (which translates into 1 hour and 51 minutes per individual hunter).

Seventy-five grouse were bagged by this sample of hunters. Thus one grouse was reduced to possession for each 7.9 man hours of hunting (or 0.13 grouse per hour). Since 321 birds were flushed,

the 75 taken represent 23% of the total flushed—so just under one-fourth of the birds seen were bagged.

Data on crippling loss were available from 70 parties. They reported losing 6 crippled birds while successfully bagging 75—a rate of 1 bird lost per 12.5 bagged. This crippling rate of less than 8% would likely be a minimal estimate, however, because of the heavy cover resulting in difficulty in ascertaining whether or not a bird has been hit.

The lack of grouse hunting experience on the part of most Iowa hunters taking part in the 1968 season was well shown by the figures on number of shots fired. The 46 parties for which such information was secured fired a total of 193 shots. Of the 250 grouse flushed by these 46 parties, only 36 were bagged. Thus an average of 5.4 shots was fired to bag one bird. Performance of some parties was much poorer than this; one group of five men flushed 12 grouse, fired 20 shots and bagged only 1 bird, with no cripples lost to their knowledge!

The sex and age of 42 of the 75 birds bagged was ascertained. The overall sex ratio was exactly 50:50, with 21 birds of each sex being recorded. There were 10 adult males and 7 adult females, but 11 juvenile males compared to 14 juvenile females. However, with this small sample size, there would be little sound basis for postulating any sex ratio difference within the population. A ratio of 1.5 immatures per adult was found in the 42 birds, based on 17 adults and 25 juveniles in the available sample. Thus 60% of the sample was composed of young birds.

Color phase was recorded for 38 grouse, with a final tally of 19 red phase, 8 intermediate, and 11 gray phase (ratio of 50:20:30 out of 100). No trend toward one color phase predominating in a given area could be discerned.

Statewide Hunter Post-season Survey. The hunter postcard questionnaire survey made after the hunting season was originally designed primarily for pheasants. Hence the 2% random sample of licensed hunters drawn is smaller than desired for some of the minor species, including ruffed grouse in 1968. Nevertheless, this must serve as the source for determining what transpired during the 1968 season in the open grouse hunting zone.

This "best estimate" indicated that 1150 hunters took part in the grouse season (0.4% of all licensed Iowa hunters in 1968). They harvested a total of 720 ruffed grouse, or 0.6 grouse bagged per hunter for the entire 16-day season (Table 1). Grouse hunting in 1968 provided about 8500 man-hours of recreation involving over 2000 hunting trips (days).

It was readily evident that the ruffed grouse season provided much recreation in relationship to the number of grouse bagged.

The 11.8 hours of hunting required to bag one bird far exceeds the usual rate for other small game, which in Iowa in recent years has varied from about 1.5 to 4.5 hours per individual pheasant, quail, rabbit and squirrel bagged. Since few of the hunters afield during the grouse season had any previous experience with such difficult targets, the low rate of return for the effort invested is not surprising. The estimated take of 720 birds represents only a 6% rate of harvest of the estimated fall population of 12,000 ruffed grouse in northeastern Iowa.

The rate of success shown by the statewide survey was less than that found during the hunter field contacts—11.8 hours to bag a bird vs 7.9 hours from the field contacts, or 0.08 bird per man hours vs 0.13. However, the majority of the field contacts were made early in the season and these were biased in favor of the territory around, and including, the Yellow River State Forest in Southeastern Allamakee County and that along North and South Bear Creeks in northeastern Winneshiek County—two of the best grouse areas.

The hunter survey also provided a crude measure of the distribution, by county, of grouse hunting effort, and of the county of residence of grouse hunters. On this basis, about 50% all grouse hunting effort took place in Allamakee County, with 35% in Winneshiek County and 15% in Clayton County; there was apparently no significant amount of hunting in surrounding counties on the fringe of the grouse range. Seventy-five per cent of the grouse hunting was done by residents of the open hunting zone for grouse, with the other 25% of the hunters coming from elsewhere in the state.

Table 1

Ruffed Grouse Hunting Season Results, Iowa, 1968, as Determined by Post-season Hunter Survey.

Item	Statistic
Number of ruffed grouse bagged	720
Number of hunters pursuing grouse	1150
Percentage of all Iowa hunters after grouse	0.4%
Total hunting trips (days) for grouse	2070
Total hours hunting for grouse	8510
Average number of grouse bagged per hunter during season	0.6
Average number of grouse bagged per hunter per trip (day)	0.3
Average number of grouse bagged per hunter per hour	0.08
Average number of hours needed to bag one grouse	11.8
Average number of trips (days) per hunter during season	1.8
Average number of hours per hunter during season	7.4
Average number of hours per hunter per trip (day)	4.1

Discussion

Since the ruffed grouse is restricted to limited areas in the northeastern corner of Iowa, and consequently will never be in abundant supply in the state, hunters will likely treat them as more of a "trophy" bird than, for example, pheasants or quail. Iowa does not have enough remaining suitable forest area for grouse for the species to achieve any importance so far as sheer numbers are concerned. However, as long as a harvestable surplus exists and a season can be set to allow hunters an opportunity at this portion of the population without endangering the maintenance of adequate breeding stock, Iowa sportsmen can have a chance to try their luck at a target regarded by many as the "king of upland game birds"—the ruffed grouse.

Proc. Iowa Acad. Sci. 76: 241-244

Some Observations on the Homing Instinct of the Mourning Dove

GLENN JONES[1]

Abstract. During 5 years, 1964 thru 1968, of bait-trapping and banding of mourning doves, *Zenaidura macroura,* in the Ruthven area of Iowa, significant data have been compiled on the homing instinct and longevity of this bird. During this 5-year period 1,546 doves were banded. Recaptures of doves banded in previous years included 15 in 1966 and reached a high of 55 birds in 1968. Doves banded as close as the Ingham-High Game Unit, only 20 miles northeast, were not recaptured at Ruthven during the last 3 years of the study. Four birds banded in 1964 have been retaken each year. These four birds were banded as adults in 1964, therefore reaching an age of at least 5 years. Several birds were recaptured year after year following initial capture. This study indicates an instinct for the mourning dove to return to the area where hatched. Also, some doves in some areas may be longer-lived than generally thought.

Bait-trapping and banding of mourning doves has been a regular activity of all Game Management Units of the Iowa Conservation Commission since 1964. This is being done in cooperation with the U. S. Fish and Wildlife Service to gain more data on migration patterns, population estimates and mortality rates of this species.

The Ruthven Unit has two conditions favorable to dove trapping with a minimum of effort—a spruce tree windbreak which provides favorable nesting sites for doves, and an open gravel pit one-fourth mile away which attracts doves.

TECHNIQUES

The basic rigid funnel-type traps described by Reeves, Geis, and Kniffin (1968) were used. These are made of 1- by 2-inch mesh, 14-gauge weld-wire. Traps are 36 inches long by 24 inches wide and 10 to 12 inches high. A wire funnel is placed in each side of the trap at opposite ends; that is, the funnels are not opposite each other.

A maximum of ten traps was used—3 in a bare area behind the spruce-Russian olive windbreak, 6 at the gravel pit, and 1 in bare sand near the Smith's Slough cabins.

Traps were visited three times each day—about 1-1½ hours after sunrise, again between noon and 1:00 PM and the third time about one-half hour before sunset. Trapping was conducted each year from about the middle of June to the first week in September.

Baits used were wheat, a mixture of wheat and common millet, and grain sorghum. A handful of salt was also added to the bait. McClure (1943) stated that captive doves liked salt. Mimeo-

[1] Unit Game Manager, Iowa Conservation Commission, Ruthven.

graphed pamphlets from the U. S. Fish and Wildlife Service on trapping and banding of doves also stressed the importance of salt as part of the bait.

Traps were set in bare earth areas. Two tracts of gravel at the gravel pit were kept bare of vegetation by plowing twice during the season. The area behind the windbreak was kept bare with a spring-tooth harrow. When evidence of predation was experienced, the trap involved was removed for a day or two. If trap success decreased, the traps were closed for a day or two but baiting was continued to again attract doves.

Results

In the 5 years, 1964-1968, 1,546 doves have been banded at the Ruthven Game Unit in Clay County. With the exception of 1965, the number banded has been increased each year.

Recaptured banded birds were not recorded in 1965—the second year of banding. However, in 1966 all recaptured birds were checked for band numbers, and it was then noticed that birds banded 1 and 2 years before were being recaptured. Accurate records on recaptured doves have been kept for 3 years (Table 1). The number of recaptures of birds banded in previous years has been increasing each year. The reason for this is not clear. Although techniques used have remained very much the same, trapping efficiency seemingly increased for both first time captures and recaptures.

No doves banded at other stations have been recaptured at the Ruthven Unit during the last 3 years of the study (not recorded first 2 years). About 100 doves have been banded each year for the last 3 years in the Wallingford area at the Ingham-High Unit, located 20 miles northeast. In 1966, 49 doves were banded near Manson, 60 miles to the south. None of these doves have been taken in traps in the Ruthven area.

Homing Instinct. It is of particular interest that some birds return each year. One bird banded in 1964 has been recaptured twice—once in 1967 and again in 1968. Of birds banded in 1965, one individual has been recaptured during each of the succeeding 3 years, 1966, 1967, and 1968. A second bird from the 1965 banding operations has been recaptured twice—once in 1967 and again in 1968. Of the 16 birds which were banded in 1966 and recaptured in 1968, three have been recaptured both in 1967 and 1968.

McClure (1943) stated that during 3 years of banding nestling doves, 1938 to 1940, no banded birds were noted to return to Lewis, Cass County, Iowa. It is not known on what he based this observation since no further statements on live-trapping were made.

Table 1

Three Years of Recapture Data of Doves Banded in Previous Years at the Ruthven Game Unit.

Year of Recapture	Year Banded	Number of Birds Banded that Year	Number of Recaptures	Per cent of Banded Birds Recaptured
1966	1964	254	4	1.6%
	1965	115	11	9.6%
Total:			15	
1967	1964	254	4	1.6%
	1965	115	4	3.0%
	1966	352	20	5.7%
Total:			28	
1968	1964	254	4*	1.6%
	1965	115	2**	1.7%
	1966	352	16***	4.5%
	1967	421	33	7.8%
			55	

* One of these also recaptured in 1967.

** One of these recaptured in 1966 and again in 1967. The second was also recaptured in 1967.

*** Three of these were also recaptured in 1967.

The present study suggests that some doves have an instinct to return to the area where they were hatched.

Longevity. All of the recaptured doves which were banded in 1964 and 1965 were banded as adults. This means that the four recaptured birds from 1964 were at least 5 years old and the two recaptured from 1965 were at least 4 years old.

Table 2

Rate of Recapture of Doves, 1, 2, 3, and 4 Years after Banding. (Expressed as per cent of birds banded that year)

Year of Recapture	One Year after Banding	Two Years after Banding	Three Years after Banding	Four Years after Banding
1966	9.6%	1.6%	—	—
1967	5.7%	3.0%	1.6%	—
1968	7.8%	4.8%	1.7%	1.6%

Table 2 gives the number of doves recaptured on a percentage basis after being banded 1, 2, 3, and 4 years. As can be seen, the percentage of birds recaptured after 1 year was nearly 10% in 1966, dropped to less than 6% in 1967, and rose again to nearly 8% in 1968. This figure is the percentage of the number of birds banded in that particular year (Table 1). For instance, in 1966 the number of birds recaptured which had been banded 1 year was 11. This is 9.6% of the 115 birds which were banded in 1965.

The percentage of birds recaptured 2 years after banding has increased steadily each year during the 3-year period. The percentage of birds recaptured 3 years after banding has held about steady. The percentage of birds recaptured of those banded in 1964 has been the same each year—with four birds out of the 254 banded that year being retaken each year following.

Nearly 2% of the birds banded in 1964 were recaptured in 1968 and thus were at least 5 years old. These records indicate the dove may be a longer-lived bird than generally thought, at least in some areas.

Literature Cited

McClure, H. Elliott. 1943. Ecology and Management of the Mourning Dove, *Zenaidura macroura* (Linn.), in Cass County, Iowa. Research Bulletin 310 Iowa State University, Ames, Iowa.

Reeves, Henry M., Aelred D. Geis, and F. Charles Kniffin. 1968. Special Scientific Report—Wildlife No. 117. U S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. Washington, D.C.

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Removal of Brushy and Wooded Quail Habitat in Three Southern Iowa Counties in Recent Years

M. E. Stempel[1]

Abstract. In southern Iowa there are still remnants of once extensive brushy upland game cover. Cost-share and privately financed brush removal programs, however, are further reducing the amount of remaining game cover. Three counties are considered here. Davis, Monroe and Wapello counties had some federally assisted clearing on 490 farms in the past 4 years. On 14 farms (1,820 acres) in Wapello County, since 1956, 82 acres of woody cover were removed by all methods. This included 25% of the choice quality upland game cover.

Iowa's quail range lies in southern Iowa. The best areas consist of brush and timber adjacent to grain fields; woody cover is rapidly being removed to increase tillable acres, pastures and for other reasons. Most cutting is done to increase income because expenses are high and crop prices are low; income can only be increased by boosting production. Further, 1968 was the seventh consecutive year of land value increase and the 1968 annual tax increase was about 10%.

Quail numbers will diminish eventually due to loss of cover. Examples of previous losses of this type are as follows: Pheasant numbers have declined because of lack of cover when winters were severe; turkeys disappeared when farming became too intensive; prairie chickens vanished when usable habitat decreased to less than one-third of their territory.

Quail need high quality cover as is shown in results of Baker (1940). Stempel (1960) in a report on censusing 40-acre fields indicated quail are most numerous in A-grade land with brushy cover near grain fields.

Programs For Removal of Brush and Timber

Four agencies or units are concerned with removal of brush and timber: the Agricultural Stabilization Conservation Service (ASCS); the Soil Conservation Service (SCS); the Farm Home Administration; the fourth is farmers removing brush at their own expense.

The ASCS administers the Agricultural Conservation Practices (ACP) program. An important practice is grassland management (Practice B3). Pond and terrace building along with land shaping may be associated and all involve brush or tree removal. The agency approves plans for cost-share improvements.

[1] Game Biologist, Iowa Conservation Commission, Ottumwa.

Farmers are encouraged to become cooperators with the SCS which is staffed with experienced field personnel.

FHA programs for grazing associations are limited to farmers with insufficient income. This includes low interest loans and long time financing. ASCS projects are set up to eradicate woody plants to make way for increased forage production.

At their own expense, farmers cut or "blade out" shrubs and trees; this is done to facilitate fence building, to level land and to increase tillable acres. Sometimes farmers remove brush to "improve" appearance. Such work cannot be cost-shared.

Cover Removed in Three-County Area

Federal Programs. Cost-share land renovation comes under ACSC Practice B3 and is titled "Controlling Competitive Shrubs." Approved work must be done by bulldozers. Maximum federal payment is $12 per acre. Land can qualify whether owned by an individual, a partnership or association. Three counties, Davis, Monroe and Wapello, are considered here. Results for the years 1965 through 1968 show 6,334 acres cleared on 490 farms for an average of 1,584 acres per year (Table 1).

An example of how the program works on a smaller scale is the case of Davis County where in 1968 there were 1212 farms. SCS county personnel estimated the amount of renovation done recently. This was done in that manner because most records are sent to

Table 1

Land Cleared Under ASCS Cost-share Programs in Three Southern Iowa Counties, 1965-66-67-68

	Number of Farms Involved			
Year	Davis Co.	Monroe Co.	Wapello Co.	Total
1968	22	51	42	115
1967	20	67	40	127
1966	0	59	38	97
1965	0	112	39	151
Totals	42	289	159	490
	Number of Acres Cleared			
1968	199	683	522	1,404
1967	173	1,102	544	1,819
1966	0	850	326	1,176
1965	0	1,597	338	1,935
Totals	372	4,232	1,730	6,334

Des Moines where they are not readily available at local offices. About 500 farms had some land clearing in recent years, with the peak year of clearing occurring in about 1957.

At the Farmer's Expense. Some clearing work is due solely to farmer effort. The most wide-spread and noticeable land clearing by farmers at their own expense has occurred in association with intensive pasturing by cattle (1966 figures — 25,000 head in Wapello County). Woody plant removal is accelerated by death of most elm trees. This encourages cutting of any nearby brush. Woody vegetation is also being removed as a result of land leveling, sloping and contouring to prepare land for improved pastures. In addition, there is removal as a result of leveling or sloping at sites of old homesteads, schools, churches, roads and railways. Both pond and building construction result in further cover loss.

Fourteen Farms in Wapello County. A description of practices on 14 Wapello County farms provides evidence on habitat loss. Quail and other small game are counted each season on the farms which are a part of a research area.

Over the past 12 years, considerable clearing was done entirely at farmer expense. About 50% of all clearing was cost-shared. Estimates of size of sites are used since most are irregular in outline and thus difficult to measure; a few areas were measured by pacing ("stepping off") distances. Small patches along ditches, fences and near ponds were removed. Large pastures were cleared of scattered scrub trees and bushes (Table 2).

Table 2

Amount of Brush Clearing, 1956 to 1968, on 14 Farms in Wapello County

	All Types of Woody Cover			
Acreage of 14 Farms	Acreage of Woody Cover in 1968	Acreage Cleared in 12 years	Acreage Cleared in 1968	Percent Cleared in 12 years
1,820	203	82	4	29
	Good Grade Woody Upland Cover			
1,820	101	33.5	3	25

Total acreage of the farms studied is 1,820 acres. In 12 years previous to 1969, 29% of all types of brushy habitat was removed; 203 acres remained. The best type of quail habitat is the A-grade brushy environment near grain fields. Twenty-five percent of this was eradicated, leaving 101 acres.

Discussion

The removal of good quality quail habitat will continue as farms grow larger and farming efficiency increases.

Increase in farm size is national in trend. With increasing operating expense, increased intensity of use will follow. For example, in Wapello County, in quail range, 522 acres were cleared of brush in 1968. In one area near Ottumwa, on 14 farms, 25% of the A-grade quail habitat has been removed since 1956. It is thus assumed that throughout the quail area of Iowa, about the same percentage of quail environment was removed. This opinion is bolstered by noting the amount of "renovation" as one drives along roadways.

Quail numbers are highest in suitable woody habitat. In such an area, in 16 southern Iowa counties in 1968, there was an average of 3.7 calling bobwhites per stop on quail census routes of 10 listening stops each. In the eastern part of the state, it was 1.8 and in north-central Iowa 0.01. Southern Iowa has the best quail territory, the east has less, and the north central has a minimum. Even in the same latitude in the east and north central areas, the latter has the lowest counts. Thus, where there is little cover, quail are few.

In another census, of amount of occupancy of 40-acre fields, in A-grade cover (Fig. 1) 63% of the 40's were occupied after the drastic 1960 winter; of C-grade (Fig. 2) or poor areas only 5% were occupied.

Quail research work on 18 farms in the spring of 1969 in Wapello County showed populations as follows: 13 of 14 farms with A-grade habitat were occupied by quail; whereas only 1 of 4 with C-grade environment was used.

In most unfavorable winters, quail do well in A-grade or well-established woody coverts; in less severe winters quail still prefer A-grade range. Thus it is concluded that while quail numbers remain high through several years, as recently they have in spite of removal of 25% of woody plants, the next harsh winter can be expected to deplete populations existing in C-grade environment. Populations will remain highest in the well-established woody habitat.

Habitat conditions certainly deteriorated when over 6,000 acres of woody plants were removed through federally assisted programs. Some ASCS programs, however, do provide for cover restoration. These are numbered A7, A8, C2 and G1; in sequence they are titled, Trees for Forestry; Planting Trees and Shrubs; Cover on Dams, and Other Areas. Ten acres of woody plants were established in 1968 through such efforts. Another restoration practice is termed ACP-A2 (Long Term Seeding); this was carried out on 2,340 acres in 1968. This, however, was for hay, pasture or erosion prevention and does not supply the needed woody plants for long-time quail survival.

Figure 1. A-grade cover has food and cover adjoining. Here, food is waste corn in harvested field.

Figure 2. C-grade territory does not have food and cover adjoining. This grassy field offers neither.

In summary, quail flourish for long periods where suitable oody habitat exists. Winters deplete populations least in the A- rade or good cover consisting of brushy habitat near grain fields. While ACSC projects are primarily for clearing land for improved rage production, they may also provide for some habitat improve- ents. The latter type of programs have received little use to date, owever.

Literature Cited

AKER, MAURICE, F. 1940. Age classes of winter cover used by the eastern bobwhite, *Colinus v. virginianus*, in Southern Iowa. Ia. State Coll. Jour. Sci. 14(1):3-11.

TEMPEL, M. E. 1960. Quarterly Biology Reports. Iowa Conservation Commission. 12(4):34-37.

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Land Use Changes and the Ring-Necked Pheasant in Iowa

RICHARD C. NOMSEN[1]

Abstract. Pheasants are farm game birds and continue to thrive in diversified farming areas. Drastic land use changes in recent years have greatly altered the pheasant's environment. The acreage of safe nesting cover has decreased to only a fraction of its former abundance. Iowa's primary pheasant production cover, oats, dropped from 23% of all cropland in 1948 to only 5% in 1967. Production is poor in alfalfa and many hens are lost during the early cutting of this cover type. Herbicides decreased the value of potential nesting cover along roadsides and ditches. The bare field in winter offers little resistance to blowing snow, whch decreases the effectiveness of available winter cover.

The ring-necked pheasant has prospered in Iowa because Iowa is a rich agricultural state. It continues to thrive in areas where diversified farming exists but many of the fertile and productive fields are now too intensively farmed to provide the basic needs of this popular game bird.

Pheasants are farm game birds. They winter in the farmstead windbreak, nest in fields of small grain and hay, and glean the fields for insects and waste grain. When we speak of wildlife habitat in general, we usually think of rough, brushy thickets or dense, grassy uncultivated strips surrounding the cropland. When we talk of pheasant habitat, we must first discuss the cultivated fields which supply the necessary essentials for the pheasant's welfare.

Many people in Iowa depend directly or indirectly upon the productivity of our soil. Farming is big business—modern agriculture demands intensive use of the land and modern machinery makes it possible. Drastic land use changes occurring in recent years have completely transformed the country side and have greatly altered the pheasant's environment. The trend toward more row crops (corn and soybeans) has accelerated during the past 5 years. In 1967, row crops were planted on 64% of the available crop land compared with 46% in 1948 (Table 1). The acreage of safe nesting cover has shrunk to only a fraction of its former abundance. There has occurred a definite trend toward larger farms and fields and a considerable increase in farm practices such as fall plowing, use of herbicides, and earlier harvest of alfalfa. These changes have been more pronounced on the level fertile farmland included in agricultural districts 1, 2, 4 and 5—the area which lies north of interstate 80 and west of highway 63. This paper will be confined to this region and will discuss the relationship between changing farm practices and the welfare of pheasants.

[1] Game Biologist, Iowa State Conservation Commission, Des Moines, Iowa.

Discussion

The annual production of pheasants determines the population trend (Nomsen, 1964). Studies have shown that nests established in oat fields have in the past produced over half of the chicks hatched in Iowa. Oats acreage, however, has dropped from 3.61 million acres in 1948 to only 0.86 million in 1967, which means that only 5% of the cropland was used for oats in 1967 compared with 23% in 1948 (Table 1). Intensive studies on the Winnebago Research Area revealed that oats acreage decreased from 26% in 1954 to 4% in 1967.

The drastic reduction of primary production cover has been partially offset by Federal Land Retirement programs. Long-term land retirement, such as the Conservation Reserve and the Cropland Adjustment Program, provided a limited amount of excellent nesting cover during this period. Regulations did not require mowing so that the fields remained undisturbed during the nesting season. Annual land retirement programs were the most extensive but production was poor in this type of cover. Normally, these fields were seeded lightly with oats and land owners were required to clip the oats early in July. Beginning in 1968, regulations were changed

Table 1

Percentage of Total Cropland in Row Crops and Oats for Northern Iowa Agricultural Districts 1, 2, 4 and 5, 1948-67

Year	Per cent in Row Crops	Per cent in Oats
1948	46%	23%
1949	48	23
1950	44	24
1951	45	21
1952	45	23
1953	48	21
1954	45	22
1955	48	21
1956	45	18
1957	48	18
1958	50	17
1959	56	16
1960	57	16
1961	51	11
1962	51	10
1963	55	9
1964	55	7
1965	57	6
1966	59	6
1967	64	5

to permit the land owner to delay clipping until late summer if noxious weeds are controlled.

Major changes in hay crops during this period affected pheasant production. Basket (1947) found that nests established in hayfields produced 47% of chicks in 1941. A nesting study on the same area by Klonglan (1955) indicated fair production in hayfields. Results of both studies showed that production in alfalfa fields was much poorer than in red clover, sweet clover or wild hay. Alfalfa has now replaced other types of hay, and the total hay acreage has decreased by one-third. Although nest density is high in alfalfa, production is very low due to the early cutting date preferred by modern farmers. There is also critical loss of hens during the first cutting of alfalfa.

The use of herbicides has increased in recent years and this practice has tended to reduce the quality of potential nesting cover. Strips of cover, such as roadsides and ditch banks, are important production areas. Weed sprays remove much of the cover needed for nest concealment. However, spot spraying of noxious weeds can eliminate the need for mowing and therefore help preserve the nesting site.

Drifts of wind blown soil have in recent years decreased the value of strip cover as nesting sites in much of the primary pheasant range. The trend toward larger fields, increase in soybean acreage, and more fall plowing have developed conditions conducive to soil erosion during wind storms. Strips of this valuable early nesting cover are soon filled with drifting soil during a dust storm.

These same field conditions impose extra strain on available winter cover. Blowing snow is whipped across the bleak and barren landscape and often piled into the windbreak. Drifts soon fill the marginal roosts and decrease the efficiency of the good quality windbreaks. The trend toward larger farms has eliminated about 25% of the farmsteads during this period, further reducing the available winter cover.

Changes in agriculture have resulted in a persistent decline in pheasant habitat. In our efforts to manage this species, we must recognize these changes so that proper recommendations can be made to fully utilize the remaining habitat.

Literature Cited

Basket, T. S. 1947. Nesting and production of the ring-necked pheasant in north-central Iowa. Ecol. Monogr. 17: 1-30.

Klonglan, E. D. 1955. Pheasant nesting and production in Winnebago County, Iowa, 1954. Ia. Acad. Sci. Proc. 62: 626-637.

Nomsen, R. C. 1964. Some aspects of pheasant reproductive success in Iowa, 1948-1963. Ia. Acad. Sci. Proc. 71: 228-234.