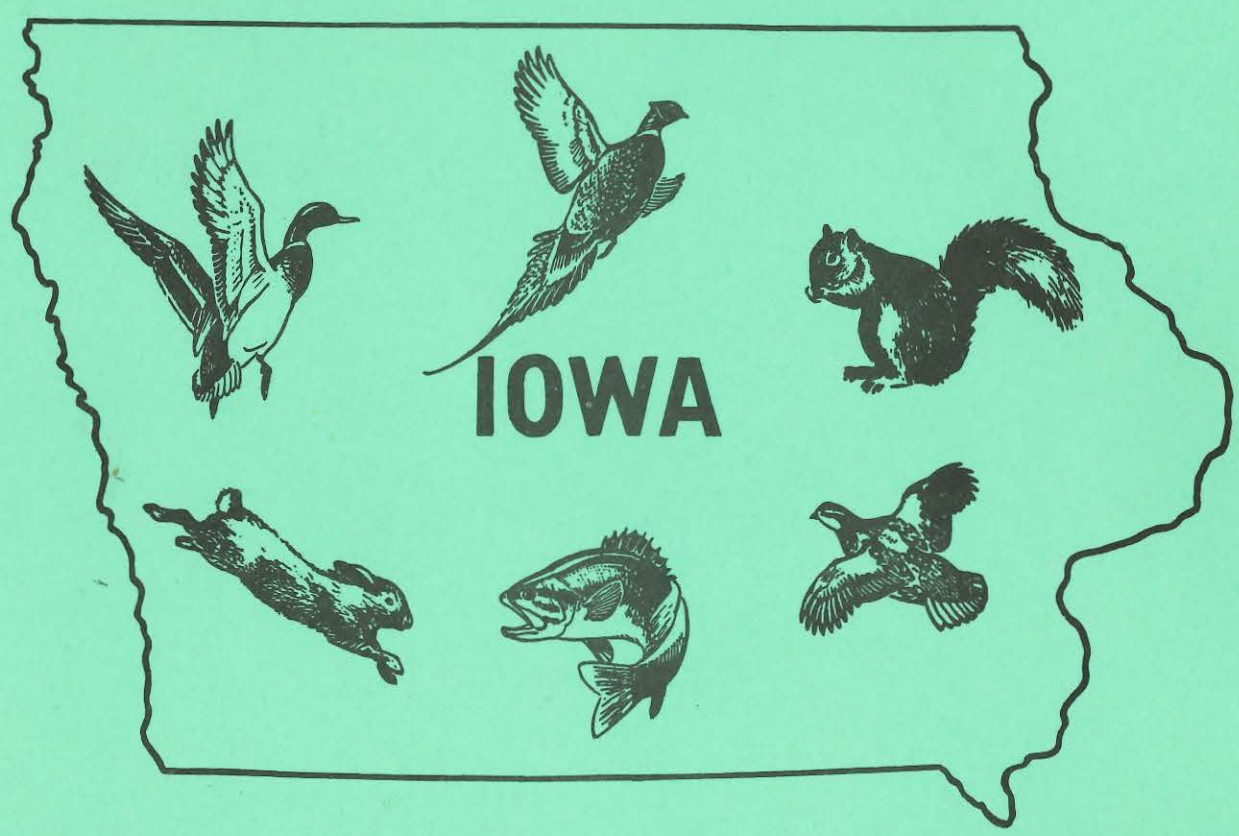
1968

QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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FISHERIES

MOVEMENT OF CHANNEL CATFISH IN CORALVILLE RESERVOIR

Larry R. Mitzner
Fisheries Biologist

In an effort to determine the movement of channel catfish in Coralville Reservoir 2,544 individuals were internally tagged. Subsequent recapture of these fish indicated there was an average downstream movement of 0.35 miles with a standard deviation of 2.37 miles. Fish traveling more than 25 miles were rare and 90% remained within 5 miles of the release point. Maximum dispersion occurred within 100 days. A tendency of homing exists when channel catfish are physically removed from an area after drawdown of water levels. The dam of the reservoir acts as an effective barrier for movement.

PRELIMINARY INVESTIGATIONS ON THE BAIT PREFERENCE OF CHANNEL CATFISH AND CARP IN BAITED HOOP NETS

Don Kline
Fisheries Biologists
and
J. K. Mayhew
Asst. Supt. of Biology

Preliminary studies to determine bait preference of channel catfish and carp were initiated during 1968. Cheese and soybean cake were used as bait in two nets and one net was unbaited as a control. The catch success of channel catfish was consistent during the three netting blocks, but the highest catch success was recorded with soybean cake in the first period. Cheese and soybean cake caught more channel catfish than no-bait, but at a non-significant rate. Carp were not attracted to cheese, soybean cake or no-bait but no evidence indicates they were repelled by bait.

AQUATIC HABITAT OF THE MISSISSIPPI RIVER BORDERING IOWA

Don R. Helms
Fisheries Biologist

The aquatic habitats of the Mississippi River bordering Iowa were mapped according to a habitat classification proposed by the UMRCC. Habitat was found to consist of 0.6% tail water, 16.6% main channel, 13.9% main channel border, 10.7% side channel, 16.2% slough, 41.6% lake and 0.3% pond. Maps of individual pools were reproduced on legal size sheets for field use.

AN EVALUATION OF WALLEYE FRY AND FINGERLING STOCKING IN BLACK HAWK LAKE - 1956 - 1968

Terry Jennings
Fisheries Biologist

Walleye fry and fingerling stocking is a major part of Black Hawk Lake walleye management. Until this study the success of these programs in this lake had not been evaluated.

Walleye fry were stocked in 1956, 1965, 1967, and 1968. Generally, more young walleye were captured during stocking years than non-stocking years. However, with one exception, the increases would not influence future adult populations.

During the fall of 1964 and 1965 marked fingerling were stocked. Survival of the 1964 stocking was poor. The 1965 planting increased that year class 80% and contributed 58% and 45% to the 1967 and 1968 adult population.

GAME

CONSERVATION AND THE BIOLOGY TEACHER

M. E. Stempel
Game Biologist

(This material will be printed in the Science Teachers' Journal)

Number of U. S. schools increased along with expansion of commerce. Today, most of our land, water and air space is utilized; and we have 43,000,000 pupils in elementary and secondary schools. The pupils deserve to know of the results of over-exploitation. The Conservation Commission can supply information on how to retain and enjoy lakes, parks and hunting grounds; a biology teacher can present this material most effectively in outdoor classes.

IOWA'S 1968 WATERFOWL AND DOVE BANDING PROGRAM

Richard Bishop
Game Biologist

The 1968 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 handling of mourning doves. Post-season banding accounted for 1,658 mallards and 1,178 birds were banded on the breeding grounds. Pre-season banding, mainly of blue-winged teal, produced 3,115 birds. Experimental banding consisted of 35 mallards banded and 91 young Canada geese. A total of 1,650 doves were banded. A grand total of 7,723 birds was banded in Iowa in 1968.

QUAIL STUDIES ON TWO AREAS IN SOUTHERN IOWA, 1968

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 1968. The covey counts were conducted with the aid of dogs. The brood stock for both areas consisted of 40 coveys; the 1966-67 average was 32 coveys. More than 12 weeks of significant quail calling indicated good production in 1968. Fifty-seven coveys were located on both areas in October 1968. This was 2 more that the 1966-67 average. The hours per covey flush for both areas in October was 1.1, the same as the 1966-67 average. Nearly 30 percent of the quail hunting activity on both study areas was in October (6 quail hunting days). November, December and January had 40, 16 and 14 percent of this activity, respectively.

MISCELLANEOUS DEER MORTALITY, 1967

Paul D. Kline
Game Biologist

Reports of deer mortality other than legal hunting totaled 1,451 in 1967. The majority of these (1,273) were victims of traffic accidents. This is a 19.3% increase in reported deer-vehicle collisions since 1966. Average damage to vehicles in these collisions was $99.26. The reports of miscellaneous deer kills does not give a true picture of non-hunting mortality as there can be little doubt that many deer die from accidents, disease, etc. and are not brought to the attention of officers who make these reports. It is believed the greatly increased numbers of deer reportedly killed on highways in recent years does reflect greater numbers of deer. However, use of these data as an indicator of annual population changes is not wise as other variables are involved and cannot be measured.

TRENDS IN MAJOR CULTIVATED CROPS IN IOWA 1954-1967

R. C. Nomsen
Game Biologist

Considerable changes have occurred in farming techniques and cropping practices in Iowa during the past 15 years. Many farm units have doubled or tripled in size and cash grain farming has replaced the diversified farms that were common several years ago. These changes have been more pronounced on the very fertile soils. Safe nesting cover has declined considerably. The percentage of Iowa cropland harvested for oats has decreased from 17.3 per cent in 1954 to 5.3 per cent in 1967. Corn acreage has remained about the same but soybeans increased from 2,091,000 acres in 1954 to 5,136,000 in 1967. Fall plowing reduces field cover so that blowing snow is not stopped until it reaches the winter cover. Drifts soon fill the marginal wintering areas. Potential nesting sites along roadsides are sometimes covered by drifting soil.

FALL MOURNING DOVE MIGRATION PATTERNS IN IOWA - 1967 & 1968

Eugene D. Klonglan
Asst. Supt. of Biology

Roadside counts of mourning doves were made on routes in northern, central and southern Iowa during August, September and October of 1967 and 1968. Both morning and evening counts were taken. The highest number of doves was counted in August, with a peak reached the third week. Number of birds sighted declined rapidly after mid-September. The earliest permissible opening date for a hunting season on doves is September 1; thus resident birds are already moving out of the state before that time occurs in the form of birds migrating through state from areas north of us. Only slight differences were found in counts made at different latitudinal levels of the state during the 3 - month survey period, with a small teend toward higher counts as one progressed southward. Evening counts averaged lower in number of birds sighted compared to morning counts, particularly early in the period.

MOVEMENT OF CHANNEL CATFISH IN CORALVILLE RESERVOIR

Larry R. Mitzner
Fisheries Biologist

Channel catfish movement and dispersion in river environments have been studies in Iowa by Harrison (1953), Muncy (1958) and Welker (1967). Similar studies have been conducted elsewhere by McCammon (1956), McCammon (1961), Hubley (1963) and Humphries (1965). Houser (1960) has studied channel catfish movement in the large reservoirs of Oklahoma. Movement determinations in farm ponds have been made by Stevens (1961).

Proposed flood control impoundments in Iowa will inundate rivers which presently have excellent catfish habitat. It is, therefore, essential to outline the life history of this species from their displaced enviroment to aid in the determination of management policies for flood control reservoirs. The objective of the report is to describe the movement of channel catfish in a flood control reservoir determined by a tagging study initiated in 1965 at Coralville Reservoir.

STUDY AREA

Coralville Reservoir is located five miles upstream from Iowa City, Johnson County, Iowa. The dam and reservoir are operated by the Rock Island District, Corps of Army Engineers. From June 15 to September 15 the water is held at elevation 680 msl, except when flood waters are being stored. At this level the conservation pool has a surface area of 4,200 acres. During flood stages the pool may increase to a maximum storage capacity of 24,800 acres at 720 msl. From February 1 to June 15, in anticipation of spring floods, the pool is gradually lowered to elevation 670 msl. The impoundment contains 1,820 surface acres at this level. From September 15 to February 1 the level is raised to 683 msl for management of waterfowl.

Discharge rate from the dam is regulated by the volume of water stored in the reservoir. Maximum discharge is slightly in excess of 10,000 cfs. In dry seasons, outflow is regulated to maintain 150 cfs through Iowa City, for pollution control purposes.

Tagging effort was concentrated in four specific areas, which are listed as follows:

1. A two mile section of river 47 miles upstream from the dam.
2. A three mile section of river 22 miles upstream from the dam.
3. The lower 12 miles of the permanent pool.
4. A three mile section of river below the outlet structure.

Area 1 and 2 are arbitrarily designated as headwaters, area 3 is the pool and area 4 is the tailwaters.

METHODS

Tagging was accomplished by inserting a numbered aluminum tag into the body cavity as described by Welker (1967). Tagged fish were marked externally for subsequent identification by removing the adipose fin.

Data recorded was total length, location captured, location released, date, and comments on any visible deformities and injuries. Weights were taken periodically on a representative sample of recaptured fish caught for the first time. In some cases, recaptures were tagged a second time and returned to the water. If the adipose fin had completely healed it was assumed that the fish had sufficient time to recover its normal behavior and was sacrificed.

Slat nets were the primary means of capturing fish in all areas, but 3/4 inch mesh bait nets were also used in the head and tailwaters. All gear was baited with cheese or soybean cake.

The netting and tagging operations for the head and tailwaters areas were completed from June 1, to August 31, 1965; then attention was given to the pool area until November 10, 1965. Tagging in the pool was again started on May 1 and completely terminated on June 7, 1966. As was stated above, recaptures were sacrificed throughout the tagging operations and through November 1, 1968.

RESULTS

The permanent pool contained 2,544 marked individuals followed by 1,090 in the headwaters and 191 in the tailwaters. These marked fish yielded 323 recaptures or 8.4% return.

The number of days the fish carried their tags was analyzed to determine if the dispersion rate was related to time (Figure 1). There are four modes of frequency which represent four fishing seasons. The period of 0 to 200 days represents fish tagged in 1965 and recaptured the same year. Similarily, 201 to 500 days is the period these individuals were recaptured in 1966. The other periods are 501 to 850 and 851 to 1150 days. The first two years following tagging were the most successful for obtaining recaptures; 87.6% were taken in 1966 and 1967.

The four time modes were used as convenient intervals to determine if time was a factor in dispersion. Variance was calculated for the distribution of fish during each time interval and compared by the chi-square test for homogeniety of variances as suggested by Steele (1961). The result was not significant (X^2 of 6.86 $X < .05$, 3 df of 7.82), and the conclusion is that maximum dispersion had occurred by the median of the first mode, or 100 days.

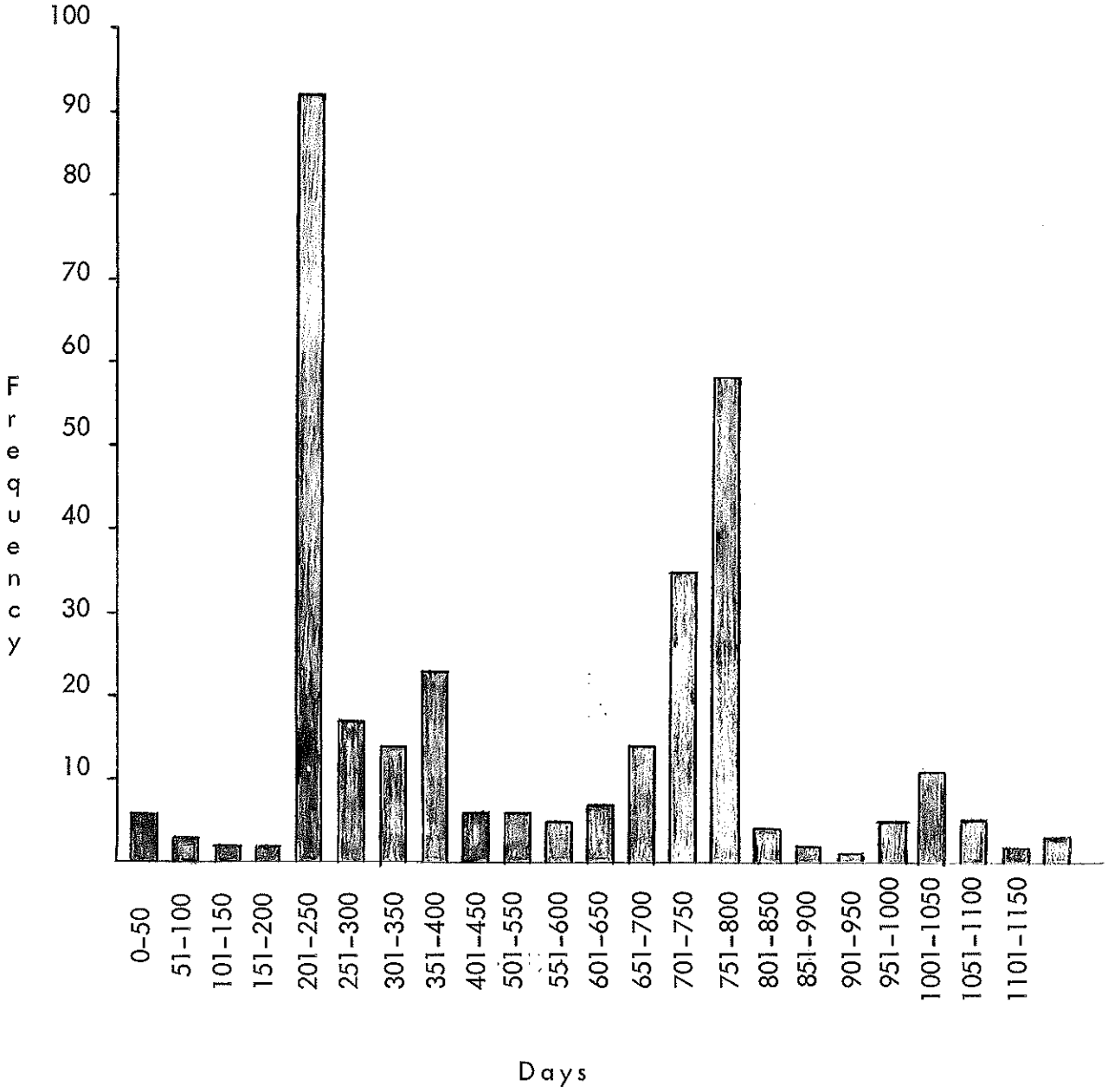
100
90
80
70
60
50
40
30
20
10
Frequency
0-50
51-100
101-150
151-200
201-250
251-300
301-350
351-400
401-450
501-550
551-600
601-650
651-700
701-750
751-800
801-850
851-900
901-950
951-1000
1001-1050
1051-1100
1101-1150
Days

Figure 1.

The dispersion during the first 200 days had a standard deviation of 2.26 miles and a mean gross movement of 0.45 miles upstream. From 201 to 500 days the movement was 0.52 miles downstream with a standard deviation of 2.18 miles. The mean movement for the period, 501 to 850 days, was 0.15 miles downstream; the standard deviation was 2.47 miles. The last period had a movement of 0.23 miles downstream and a standard deviation of 3.12. The pooled data had an average downstream movement of 0.35 and a standard deviation of 2.37 miles (Figure 2).

Fish that were recaptured within 5 miles of their release point were most common; 89.7% were recaptured within this distance. As many as 22.4% of the fish were located within one-half mile of their release. Some fish did travel great distances; one individual was recaptured 78.5 miles upstream. However, this was a rare instance and only 4.7% of the fish traveled more than 25 miles from point of release.

Movement was random as reported by Harrison (1953), Muncy (1958), McCammon (1961) and Humphries (1965). There was no indication of asymmetrical movement as was found by Hubley (1963) and Welker (1967).

Many catfish were tagged and released in Hoosier Creek, a major tributary to the reservoir, located ten miles upstream from the dam. During the February drawdown this creek is usually dry and the fish that inhabit it must move into the reservoir. When fish could again move into the area it was found that of all the recaptured catfish that were marked in Hoosier Creek, 40.3% had returned to that area. Of those that were recaptured at Hoosier Creek, regardless of where they were released, 50.3% were originally from Hoosier Creek. This would indicate 40.3 to 53.0% of the fish that were naturally displaced, returned to the same area.

It was possible for marked fish to go through the outlet structure at the dam, however, no fish were recaptured below the dam that had been marked in the pool and conversely, no movement was evident from the tailwaters to the pool. The dam acts as an effective barrier to channel catfish movement.

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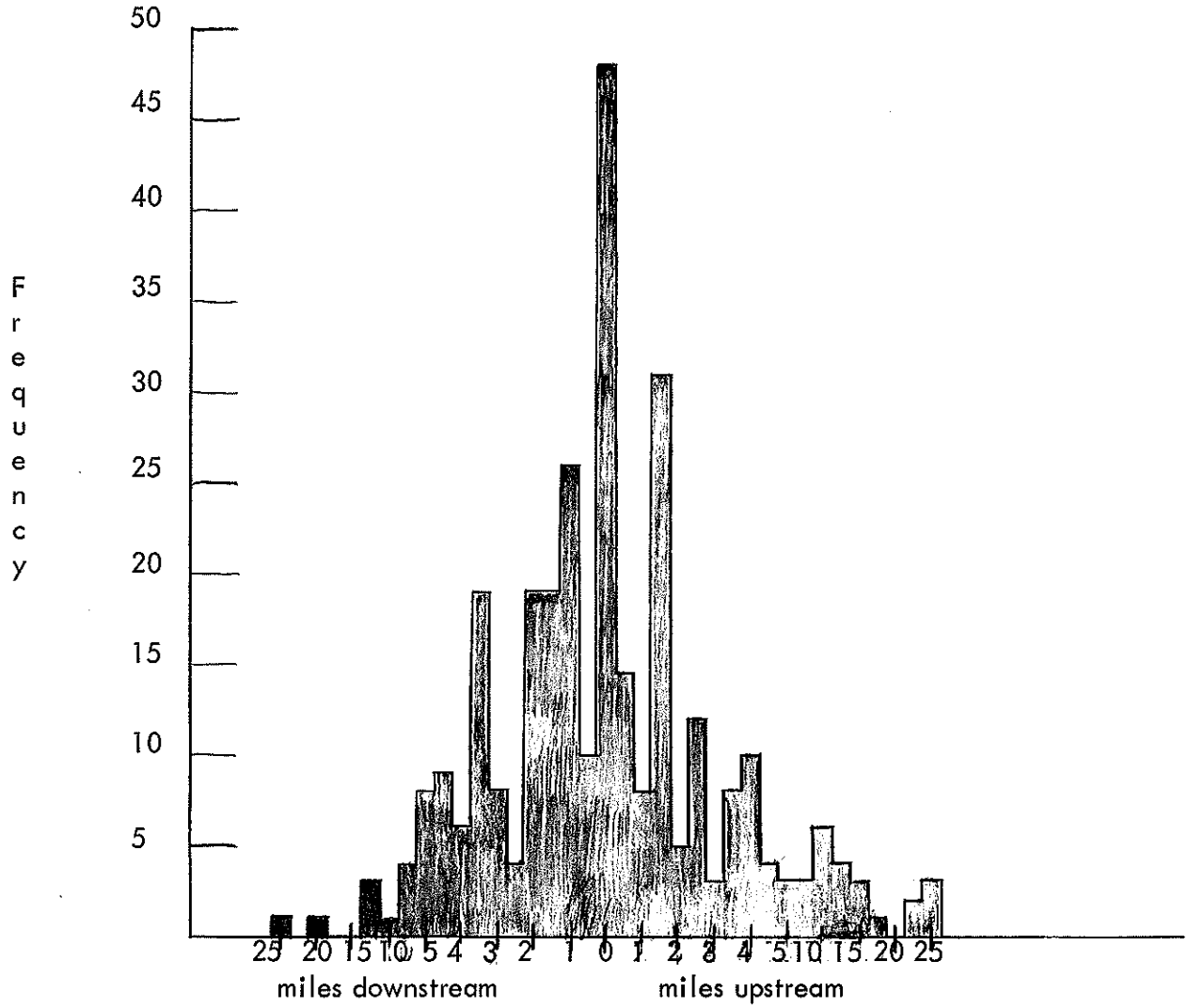
50
45
40
35
30
25
20
15
10
5
Frequency
25 20 15 10 5 4 3 2 1 0 1 2 3 4 5 10 15 20 25
miles downstream
miles upstream

Figure 2.

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PRELIMINARY INVESTIGATIONS ON THE BAIT PREFERENCE OF CHANNEL CATFISH AND CARP IN BAITED HOOP NETS

Don Kline
and
J. K. Mayhew
Fisheries Biologists

Various commercial preparations of bait are used to attract fish into hoop nets. Two of the most commonly used preparations are unmarketable cheese or clippings from cheese processing and soybean cake, a by-product of soybean oil extraction. Observations during intensive netting of commercially valuable fish in the Des Moines River Commercial Fisheries Investigation (Project 4-11-R)[1] indicated wide variation occured in catch success when hoop nets were baited with different preparations. Experiments were initiated during the third year of investigations to determine the preference of different species of fish to different types of bait.

EXPERIMENTAL PROCEDURE

A one-half mile segment of the Des Moines River study area near Knoxville, Iowa was selected for the bait experiments. Environmental characteristics were similar throughout this segment of the stream. One side was bordered with a large sand bar, the other with a high bank. Drifts and fallen trees had diverted river away from the high bank forming a series of small, deep pools.

Three 24-inch hoop nets with 3/4 inch bar measure web were used in all experiments. These nets were set at approximatley 1/8 mile intervals and remained in the same locations throughout the summer. Baiting treatments were conducted in a 3 x 3 Latin Square, where one net was baited with cheese, one with soybean cake and one was unbaited for control. Each type of bait was rotated at one week intervals during a three week netting block. This design minimized the effect of net location and netting period. Fish were assumed to be equally available to all nets during a block of time. Nets were raised at daily intervals, all fish counted and weighed and rebaited. Data were collected in three different netting periods: 30 July - 19 August, 6 September - 27 September and 30 September - 18 October. The nets were fished for a total of 57 net days in the first and second periods, and 63 net days in the third period.

RESULTS

Total catch of fish in the experimental nets for the combined periods was 412 channel catfish, 184 carp and 53 river carpsucker. Evaluation of bait preference was completed

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1 This paper is a contribution of Project 4-11-R; U. S. Bureau of Commercial Fisheries and Iowa State Conservation Commission cooperating.

only for channel catfish and carp because samples of river carpsucker were inadequate and catch success for this species never exceeded 0.5 fish per net day.

Cheese was the most consistent bait for catching channel catfish (Table 1). Catch success for this species for the three netting periods was 3.3, 3.2 and 2.3 fish per net day, respectively. Highest catch rate of channel catfish was recorded with soybean cake in the first experimental block, but after this period catch success declined rapidly to 1.1 and 1.6 fish per net day in the subsequent periods, respectively. Non-baited nets produced the lowest catch rate and ranged from 1.8 channel catfish in the first period to no fish in the third period.

Table 1. Catch rate of channel catfish in experimental hoop nets fished with different type of bait (Catch values are expressed as number of fish caught per net day)

	Type of treatment		
Period	Cheese	Soybean cake	Non-baited
I	3.3	7.6	1.8
II	3.2	1.1	0.4
III	2.3	1.6	0.0

In analysis of variance in catch success revealed non-significant difference between the three experimental treatments (Table 2). Nets baited with soybean cake caught slightly more channel catfish than nets baited with cheese over the entire experiment, but the difference was non-significant at the 0.05 level of probability and resulted mainly from the extraordinarily high catch value of 7.6 fish per net day in the first period. By partitioning the treatment sum of squares suggested by Snedecor and Cochran (1967) F - ratio values of baited nets vs. non-baited nets is close to being significant ($F = 5.13$; $(0.100 < P < 0.025)$, but remained slightly below the level required for rejection of the null hypothesis.

Table 2. Analysis of variance in catch success of channel catfish in hoop nets using different types of habit.

Source of variation	df	Sum of squares	Mean squares	F[1]
Total	8	15.25		
Location	2	0.04	0.02	0.03
Period	2	3.10	1.55	2.77
Baits	2	11.00	5.50	9.80
Residuals	2	1.11	.56	

[1] $F = 19.00$ required for significance at 0.05 level for 2 and 2 df.

Most of the variation in catch success of channel catfish occured between the different types of bait. Net location showed only minor influence on catch success of channel catfish. Variation in catch success between netting periods was also non-significant, mainly because catch success was greater in the first period regardless of the treatment and decreased progressively in each successive period.

The catch of carp in baited hoop nets was rather small in comparison with channel catfish, and consequently it was difficult to reliably determine if this species preferred a certain bait. In general, all three bait treatments caught carp at about the same rate. Non-baited nets caught carp at a rate of 2.9 fish per net day, soybean cake caught 2.8 fish per net day and cheese caught 2.7 fish per net day. Catch success of carp in individual netting blocks was also similar to channel catfish. Highest catch success, with one exception, was recorded in the first block with a systematic decline in catch rate with each successive period (Table 3). The catch of carp in control nets varied from 0.6 to 1.6 fish per net day, soybean cake catch ranged from 0.7 to 1.4 fish per net day and catch with cheese bait varied from 0.7 to 1.3 fish per net day.

Table 3. Catch success of carp in baited hoop nets (Catch success values are expressed in fish per net day)

Period	Type of treatment		
	Cheese	Soybean cake	Non-baited
I	1.3	0.7	1.6
II	0.7	1.4	0.7
III	0.7	0.7	0.6

An analysis of variance (Table 4) in catch success for each bait showed non-significant difference between experimental treatments. Carp were not attracted to cheese or soybean cake, although there was no evidence that bait repelled carp. The location of nets was the most important source of variation in catch success, but most of this was the result of a large catch (43% of the total catch during the first period) of small carp on 18 August in the control net. This large catch undoubtedly affected rate of catch during the first period and accounted for a major proportion of the higher catch success in the control nets.

Table 4. Analysis of variance in catch success of carp in hoop nets using different types of bait

Sources of variation	df	Sum of squares	Mean squares	F[1]
Total	8	1.51		
Location	2	0.42	0.210	0.68
Periods	2	0.27	0.135	0.44
Baits	2	0.20	0.100	0.32
Residuals	2	0.62	0.310	

1 F = 19.00 required for significants at 0.05 level for 2 and 2 df

DISCUSSION

Preliminary results indicated the catch of channel catfish in hoop nets can be increased by using either cheese or soybean cake for bait. However, the increase in catch success is not at a significant rate. Under these circumstances only increased effort would produce a significantly greater numerical catch. Catch success could be increased and sustained for longer periods by alternating different types of bait during different periods of the year, but not at a significant rate.

Carp were not attracted to any type of bait used in this study. Control nets that were not baited caught carp at approximately the same rate as those that were baited. Most carp are apparently caught incidental with natural movement.

Investigations on the bait preference of fishes will continue in this project. In 1968, catch success was greatly reduced in comparison with previous years because of a large fish kill in the study area during the preceeding winter. The similarity in catch success between bait treatments might be attributed to the general lowering of catch success by reduction in population densities.

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AQUATIC HABITAT OF THE MISSISSIPPI RIVER BORDERING IOWA

Don R. Helms
Fisheries Biologist

The Mississippi River is composed of an intricate network of diverse aquatic habitats ranging from back water sloughs and lakes joined by narrow channels to the swift navigation channel and expansive pools above some of the dams. Because of the confusion in nomenclature of habitats, a uniform classification and inventory of the habitat types are essential and basic to biological studies.

The UMRCC has proposed a uniform classification separating aquatic habitats into seven different categories. These are tail waters, main channel, main channel border, side channel, slough, lake and pond. A brief description of each type follows, but detailed descriptions may be found in the Proceedings of the Twentieth Annual Meeting of the Upper Mississippi River Conservation Committee.

Tail Waters

These include areas immediately below the dams which are affected by the passage of water through gates of the dam and out of the locks. These areas change in size according to water stage, and the arbitrary lower boundary for fishery purposed has been set at a distance of one-half mile below the dams.

Main Channel

This includes only the portion of the river through which large commercial crafts can operate. It is defined by combinations of contraction works (wing dams), river banks, islands, and bouys and other markers. It has a minimum depth of 9 feet and a minimum width of 400 feet.

Main Channel Border

The zone between the 9-foot channel and the main river bank, islands, or submerged definitions of the old main river channel. It includes all areas in which wing dams occur along the main channel.

Side Channels

These include all departures from the main channel and main channel border in which there is current during normal river stage.

River Lakes and Ponds

This classification along with slough replaces the old term "back waters". River lakes and ponds in general are open expanses of water with little or no current. Several types of

lakes occur along the Mississippi. These are: lakes of formation due to fluviatile dams, lakes of mature flood plains and lakes due to behavior of higher organisms. Ponds differ from lakes only in size.

Sloughs

This category includes all of the remaining aquatic habitat found in the river. Sloughs often border on the "lake or pond" category on the one side and on the "side Channel" category on the other. They have no current at normal water stage, muck bottoms, and an abundance of submerged and emergent aquatic vegetation.

Member states of the UMRCC are jointly mapping habitats in their respective waters. Iowa personnel completed the habitat mapping on all pools bordering Iowa with the exception of pool 13 which was finished by Illinois. Pools 11 and 18 were the first completed and have been reported on previously (Quarterly Biology Reports, 1968, No. 2). For the sake of completeness, data from the above pools are included in the present report.

METHODS

The limits of each habitat were determined by field reconnaissance and inscribed on maps having a scale 1-inch: 1,000 feet which show land outline and navigation structures. Each type of habitat was planimetered to determine surface area. Habitats were delineated on smaller scale maps with specific patterns of zip-a-tone and reproduced by Xerox on legal sized sheets for field use.

RESULTS

A summary of the results by pool are provided in Table 1. It should be noted that only portions of pools 9 and 20 border Iowa. Most of pool 9 borders Iowa and separate sets of figures representing the entire pool are presented in the table. Only the portion of pool 20 bordering Iowa is included.

Aquatic habitat in the 312.3 mile segment of river bordering Iowa includes 1,088 acres of tailwater, 29,330 acres of main channel, 24,558 acres of main channel border, 18,916 acres of side channel, 28,490 acres of slough, 73,414 acres of lake and 529 acres of pond.

Total acreages of surface water in each pool were less than those provided by the U.S. Army Corps of Engineers, but were attributed to the inclusion of certain island and land areas in the Corps figures. Changes have also occured in the river since the Corps of Engineers made their survey.

Table 1. Acreage and percentage of habitats present in each pool of the Mississippi River bordering Iowa (% in parenthasis)

Pool	Tailwaters	Main Channel	Main Channel Border	Side Channel	Slough	Lake	Pond	Pool Total
9*	104.4 (0.3)	2,206.3 (7.9)	1,633.1 (5.9)	1,331.6 (4.8)	9,847.1 (35.3)	12,772.7 (45.8)	 (0.0)	27,895.2
9		1,862.2 (7.4)	1,376.1 (5.4)	1,175.4 (4.6)	8,109.6 (32.1)	12,772.7 (50.5)	 (0.0)	25,296.0
10	28.2 (0.2)	3,482.0 (21.8)	2,971.9 (18.6)	1,579.2 (9.9)	5,567.6 (34.8)	2,308.5 (14.4)	64.6 (0.4)	16,002.0
11	50.6 (0.3)	2,334.5 (11.9)	1,750.3 (8.9)	1,504.2 (7.7)	1,952.7 (10.0)	11,895.6 (60.7)	112.7 (0.6)	19,600.6
12	116.9 (1.0)	2,845.5 (24.8)	2,725.6 (23.8)	1,900.2 (16.6)	2,031.2 (17.7)	1,765.3 (15.4)	85.5 (0.8)	11,470.2
13	85.5 (0.3)	2,722.9 (10.1)	2,732.3 (10.1)	1,309.5 (4.9)	2,642.8 (9.8)	17,403.4 (64.5)	70.9 (0.3)	26,967.3
14	71.6 (0.7)	2,470.4 (23.7)	2,314.7 (22.2)	1,286.3 (12.4)	1,941.4 (18.7)	2,326.3 (22.4)	 (0.0)	10,410.7
15	93.5 (2.6)	753.9 (20.6)	477.8 (13.1)	462.4 (12.6)	11.4 (.3)	1,862.6 (50.9	 (0.0)	3,661.6

continued

Table 1. (continued)

Pool	Tailwaters	Main Channel	Main Channel Border	Side Channel	Slough	Lake	Pond	Pool Total
16	97.3 (0.8)	3,025.3 (26.0)	2,753.2 (23.7)	2,692.1 (23.1)	1,719.3 (14.8)	1,344.7 (11.6)	(0.0)	11,631.9
17	108.7 (1.6)	2,264.2 (32.7)	1,763.0 (25.5)	1,749.0 (25.3)	1,034.2 (15.0)	31.2 (0.5)	(0.0)	6,950.3
18	89.7 (0.7)	2,789.9 (22.1)	2,578.3 (20.4)	1,869.9 (14.8)	1,129.3 (9.0)	3,999.7 (31.6)	195.5 (1.5)	12,652.3
19	92.8 (0.3)	4,269.8 (14.1)	2,555.8 (8.4)	3,292.0 (10.9)	2,343.4 (7.7)	17,710.6 (58.5)	(0.0)	30,264.4
20	253.6 (17.9)	509.7 (35.9)	558.9 (39.4)	96.2 (6.8)	(0.0)	(0.0)	(0.0)	1,418.4
Total	1,088.4 (0.6)	29,330.2 (16.6)	24,557.9 (13.9)	18,916.4 (10.7)	28,489.5 (16.2)	73,414.0 (41.6)	529.2 (0.3)	176,325.7

* These figures are for the entire pool and are not included in the column totals.

AN EVALUATION OF WALLEYE FRY AND FINGERLING STOCKING IN BLACK HAWK LAKE

Terry Jennings
Fisheries Biologist

Fry and fingerling stocking is a major part of Black Hawk Lake walleye management. Until this study the success of these programs in this lake had not been evaluated.

Black Hawk Lake is located in Sac County. It has a surface area of 957 acres. Approximately 100 acres at the west end of the lake has been dredged. The maximum depth of this area is 14 feet. The remainder of the lake has a maximum depth of 8 feet. However, much of the lake has a depth of 6 feet or less. Water runoff, wind, and excessive pleasure boating (Moen, 1964; Jennings, 1967) combine to keep the water turbid throughout the open water months. The lake is eutrophic and contains a relatively large population of fish. This population is dominated by gizzard shad. Young shad provide most of the available forage.

METHOD

No definite fry stocking schedule was established for this study. Two million were stocked in 1956 (Table 1). The next stocking occured in 1965 when one million were stocked. Except for the 1966 planting, all fingerlings were seined from nursery lakes during the fall and placed directly into the lake. In 1966, fish were obtained from a federal hatchery in South Dakota and stocked in June as fingerlings one to two inches. More fingerling walleye were stocked during the fall of 1964 and 1965, 10,125 and 18,406 respectively, than during any fall since 1956. These fish were marked so their impact upon the population of these year classes could be observed. Marking was accomplished by excising the right pectoral fin. No other stocked fingerlings were marked. Walleye were aged and assigned to year classes by standard methods. Scales were taken from all marked fish and from all fish which could have been in the 1964 and 1965 year classes.

Table 1. Black Hawk Lake walleye fry and fingerling stocking record - 1956 - 1968.

Year	Fry Stocked	Fingerlings Stocked
1956	2,000,000	0
1957	0	10,000
1958	0	0
1959	0	5,100
1960	0	2,175
1961	0	3,679
1962	0	5,850
1963	0	3,518
1964	0	10,125
1965	1,000,000	18,406
1966	0	19,000*
1967	3,000,000	0
1968	2,500,000	0

* One to two inch fingerlings stocked in June

RESULTS

If fry stocking benefited the walleye population, an increase in the number of young should be evident during stocking years. Increases in yearling and adults should be evident in subsequent years. In 1956, 1.0 young walleye were taken per seine haul (Table 2). This rate of capture is indicative of a high population. However, in 1957, 28 yearling were taken per haul and in 1958 the adult population nearly doubled. The large number of yearling can not be attributed to fingerling stocking. Apparently, fry stocking in 1956 successfully increased the population of that year class. Less success was observed from fry stocking during 1965, 1967 and 1968. No young were captured in 1965. In 1967 and 1968 0.5, and 0.4 young per haul were captured. Young were present during 1965. Apparently they were not abundant enough to be captured by seining. The years of highest reproduction were 1961 and 1962 when 2.0 and 4.67 young were taken per seine haul. These were years of no fry stocking.

Table 2. Average number of young, yearling, and adult walleye captured per mid-summer seine haul from Black Hawk Lake.*

Year	Young captured per haul	Yearling captured per haul	Adults captured per haul
1956	1.0	0	3.0
1957	0	28	3.0
1958	0	0	6.5
1959	0	0	1.75
1960	0.25	0.25	2.25
1961	2.0	2.67	2.00
1962	4.67	0.67	0.67
1963	0	2.67	0.33
1964	0	0	3.0
1965	0	0.33	0.67
1966	0	5.0	1.50
1967	0.5	0	4.00
1968	0.4	0.2	1.80

* Based upon data collected during the last week of July or the first week of August.

In 1957, 10,000 fingerling walleye were stocked. None of these fish were observed in 1958 (Table 2). Between 1958 and 1959 the adult population declined 73%, and indication of little or no recruitment. Apparently survival of these stocked fish was very poor. No reliable conclusion can be made about fingerling stocking between 1959 and 1963. Data in Table 2 indicates few fish in the 1964 year class. The 1965 year class is much more abundant. During June, 1966, 19,000 one to two inch fingerling walleye were stocked. No fish of this year class were observed as young or as yearlings.

Since 1965, 3 walleye of the 1964 year class have been observed (Table 3). One had been marked, or a marked percentage of 33%. From 1966 through 1968, 87 walleye from the 1965 year class were observed. About 80% of these fish had been stocked.

Table 3. Total and total number of marked walleye captured by all methods from the 1964 and 1965 year classes.

	1964 Year Class			1965 Year Class		
Year	Total	No. Marked	% Marked	Total	No. Marked	% Marked
1965	1	0				
1966	0	0		50	42	84
1967	2	1	50	22	18	82
1968	0	0		15	10	67
TOTALS	3	1	33	87	70	80

During 1967 and 1968, 58% and 45% respectively of all adult walleye captured were stocked fish. About 97% of these stocked fish belonged to the 1965 year class.

DISCUSSION

Fry stocking rates have varied between approximately 1,000 and 3,000 per acre. Generally, fry stocking did increase the number of young walleye during stocking years. With one exception, the increase was not large enough to influence future adult populations. The 1956 year class nearly doubled the adult population in 1958.

In order to better understand the contribution made by stocked fingerling walleye to individual year classes and the adult population, marked fish were stocked in 1964 and 1965. This study indicated the addition of larger fish is not the complete answer to maintaining a population. Survival of 1964 stocked fish was poor while the 1965 planting substantially increased that year class and in subsequent years the adult population.

Stocking density was not the principal difference between success and failure of the plantings. No data are available so the reasons for success are only a matter of conjuncture. Two possibilities or a combination of both are evident. First, it is possible survival of the 1965 year class was higher because a larger percentage were in better body condition. Secondly, test netting records indicate a large hatch of yellow bass occured in 1965. The addition of these fish to a forage base dominated by young shad would extend the time suitable forage was available to young predators. Thus with more food available the survival rate could have been higher.

Occasionally, good survival and a large year class results from the stocking program. Considering lake conditions and the fish most readily available for stocking, it is unreal to expect much better results. If summer test netting indicates a lack of young walleye, fall fingerling stocking should continue. Numbers stocked will depend upon the amount of fish available. It is realized that rarely are yearling walleye available for spring stocking; but, if they are, they should be stocked in Black Hawk Lake. Since the first winter is a critical period for young predators in this lake, survival of spring stocked fish should be excellent. Normally, the number of fish available for spring stocking is small. For this reason added benefits could be realized by stocking them into a lake where they would comprise a larger percentage of the population than if they were stocked into a lake with a large walleye population.

ACKNOWLEDGEMENT

The author wishes to thank the Fisheries Section, particularly the personnel at the State Lake Fish Hatchery for their cooperation in making stocking records available and for their invaluable assistance in marking the fingerling walleye.

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IOWA'S 1968 WATERFOWL AND DOVE BANDING PROGRAM

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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.

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 night-lighting. In 1967, 983 ducks and coots were banded by four crews using this technique. In 1968, four crews banded 1,107 ducks and coots (Table 2). The night-lighting unit and operation are explained in the 1966 banding report.

Breeding populations were somewhat improved in 1968 and production was better than in 1967. However, due to low water levels in most of our state owned marshes only a few

more waterfowl were banded than in 1967. Success of this technique depends on production, water levels, and vegetative conditions.

Twelve species of ducks were captured. These were mallard, green-winged teal, blue-winged teal, shoveler, pintail, woodduck, redhead, ring-neck, ruddy, lesser scaup, gadwall, and widgeon (Table 2). Blue-winged teal made up 57 per cent, woodducks 27 per cent, and mallards 11 per cent. These three species are the main breeding birds in Iowa, therefore, they make up the bulk of the birds banded. In 1967 blue-winged teal made up 58%, woodducks 22%, and mallards 11%.

Approximately 60% 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 5). Immatures made up 10% and adults 30%. In 1967 about 59% were locals, 24% immatures, and 17% adults.

PRE-SEASON BANDING

This phase of the banding program is aimed primarily at banding a sample of blue-wing teal. The birds were captured by bait traps of the style described in the 1966 banding report.

A total of 3,115 birds was banded during this period compared to 3,713 banded in 1967. These birds were 99% blue-winged teal and consisted of 13% adults and 87% immatures (Table 9 and 10). The blue-winged teal banded in 1967 were 80% immatures.

EXPERIMENTAL BANDING

Twenty-two semi-domestic mallards were banded for the North Iowa Rod and Gun Club, for a self-sponsored project to increase local mallard production.

An additional 13 wild mallard hens were banded in conjunction with a study on mallard nesting densities.

Ninety-one young Canada geese were banded as part of an experimental project for establishing a breeding flock of the giant Canada goose in the vicinity of Ingham Lake in Emmet County.

MOURNING DOVE BANDING

In a cooperative project with the U. S. Fish and Wildlife Service, unit managers and federal personnel banded 1,650 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 over-all understanding of this potential game species.

SUMMARY

Post-season banding of wintering mallards in southwest Iowa accounted for 1,658 mallards.

The breeding grounds banding project in north central and northwest Iowa produced 1,178 birds, captured by night-lighting. Blue-winged teal made up 57% of the total, woodduck 27% and mallards 11%.

Pre-season banding of blue-winged teal by bait traps was quite successful. A total of 3,115 birds was banded and 99% were blue-winged teal.

Thirty-five mallards and 91 Canada geese were banded as part of experimental projects.

A total of 1,650 doves was banded in Iowa by state and federal personnel. These birds were captured mainly by bait traps.

A grand total of 7,723 birds was banded in 1968. These bandings include 13 species of ducks and 6 species of other birds, including mourning doves. (See Table 13).

Table 1. Post-Season Duck Banding Results, Southwest Iowa, 1968

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	TOTALS
Fremont	Knox Basin					
	Mallards	602	202	563	291	1658
	Black Ducks	3				3
	Baldpate			2		2
	TOTALS	605	202	565	291	1663

Table 2. Total Birds Banded During Breeding Grounds Waterfowl Banding Operations - 1968

COUNTY	NAME OF AREA	Mallard	G.W. Teal	B.W. Teal	Shoveler	Pintail	Woodduck	Redhead	Ring-neck	Ruddy	L. Scaup	Gadwell	Baldpate	Coot	Totals
Calhoun	South Twin Lake	15	2	15		1	10								43
Clay	Mud Lake	18	4	160			11	3							196
Dickinson	Garlock Slough						6								6
Dickinson	Grover's Slough	24	8	129	2	3	53	7				2	1		229
Dickinson	Hottes Lake	8	2	109	1		52								162
Dickinson	Lily Lake	11		3			24					2			40
Dickinson	McClelland's Sl.	17		52			40								109
Emmet	Private Marsh	1													1
Emmet	Ingham Lake	11		87	1		9								108
Emmet	Jensen's Slough	1		1											2
Emmet	12 Mile Lake			27			3			1					31
Hancock	Eagle Lake	4		19			1								24
Hancock	E. Twin Lake	1		5			3*	1	1		1			14	26
Kossuth	Union Slough	2					41**								43
Monona	Badger Lake	3													3
Pocahontas	Little Creek Lk		1	21		2	13								37
Pocahontas	Five Island Lk		1	2			13								16
Palo Alto	Silver Lake						8								8
Tama	Otter Creek						2								2
Winnebago	Myre Slough						17*								17
Worth	Elk Creek			1											1
TOTALS		116	18	631	4	6	296	11	1	1	1	4	1	14	1104

* These woodducks were transplanted to Myre Slough.

** 34 more local woodducks were banded on Union Slough with bands assigned to the refuge.

Table 3. Ratio of young to adult by species * - all areas, breeding grounds banding, 1968

SPECIES	Y/A	Y/AF
Mallard	5.4	14.0
B. W. Teal	2.4	6.0
Wood Duck	2.2	10.0

* Other species not numberous enough to provide an adequate sample.

Table 4. Ratio of young B. W. Teal by area *, breeding grounds banding, 1968

COUNTY	NAME OF AREA	Y/A	Y/AF
Clay	Mud Lake	7.9	10.9
Dickinson	Grover's Lake	1.6	5.0
Dickinson	Hottes Lake	1.4	4.3
Dickinson	McClelland's Sl.	6.4	15.0
Emmet	Ingham Lake	4.5	14.4
Emmet	12 Mile Lake	1.7	5.7
	Average - All Areas	3.9	9.2

* Areas where 25 or more birds were captured.

Table 5. Age and sex composition by species - all areas - breeding grounds banding, 1968

SPECIES	AHY-M	AHY-F	AU	HY-M	HY-F	LM	LF	LU	TOTALS
Mallards	11	7		2	3	47	46		116
G. W. Teal	9	3	1	5					18
B. W. Teal	108	76		42	21	201	182	1	631
Shoveler	3	1							4
Pintail	3	1			2				6
Woodduck	62	28		6	33	84	83		296
Redhead		2				4	5		11
Gadwall		2				1	1		4
R. N. Duck	1								1
Baldpate	1								1
Lesser Scaup	1								1
Ruddy Duck							1		1
Coot			7					7	14
TOTALS	199	120	8	55	59	337	318	8	1104

Table 6. Mallard age and sex composition by area - breeding grounds banding, 1968

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	LM	LF	TOTALS
Calhoun	South Twin Lake	1	1		1	7	5	15
Clay	Mud Lake	3	1			7	7	18
Dickinson	Grover's Lake	2	5	1		9	7	24
Dickinson	Hottes Lake	1		1		3	3	8
Dickinson	Lily Lake					4	7	11
Dickinson	McClelland's Sl.					8	9	17
Emmet	Private Marsh						1	1
Emmet	Ingham Lake	2			2	4	4	12
Hancock	Eagle Lake					2	2	4
Hancock	E. Twin Lake	1						1
Kossuth	Union S. NWR	1					1	2
Monona	Badger Lake					3		3
TOTALS		11	7	2	3	47	46	116

Table 7. B. W. Teal age and sex composition by area - breeding grounds banding, 1968

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	LM	LF	LU	TOTALS
Calhoun	South Twin Lake	7	5	3					15
Clay	Mud Lake	5	13	13	6	63	60		160
Dickinson	Grover's Lake	34	16	13	7	36	23		129
Dickinson	Hottes Lake	29	15	15	3	34	23		109
Dickinson	Lily Lake					1	2		3
Dickinson	McClelland's L	4	3	2	2	21	20		52
Emmet	Ingham Lake	11	5			35	37		88
Emmet	12 Mile Lake	7	3	1		4	12		27
Hancock	Eagle Lake	1	6	4	1	2	4	1	19
Hancock	E. Twin Lake	3	2						5
Pocahontas	Little Clear Lk.	6	6	1	2	5	1		21
Pocahontas	Five Island Lake	1	1						2
Worth	Elk Creek		1						1
TOTALS		108	76	42	21	201	182	1	631

Table 8. Wood duck age and sex composition by area - breeding grounds banding, 1968

COUNTY	NAME OF AREA	AHY-M	AHY-F	HY-M	HY-F	LM	LF	TOTALS
Calhoun	South Twin Lk.	2	1			1	6	10
Clay	Mud Lake	2	1		2	2	4	11
Dickinson	Garlock Slough					5	1	6
Dickinson	Grover's Lake	26	7	1		16	2	53
Dickinson	Hattes Lake	14	5			10	13	42
Dickinson	Lily Lake	1				11	12	24
Dickinson	McClelland's Sl		1			18	21	40
Emmet	Ingham Lake	3	6					9
Emmet	12 Mile Lake	3						3
Hancock	Eagle Lake	1						1
Hancock	E. Twin Lake*					1	2	3
Kossuth	Union S. NWK**	6	5	4	24	1	1	41
Pocahontas	Little Clear Lk.	3	1		1	4	4	13
Pocahontas	Five Island Lk.	2				4	7	13
Palo Alto	Silver Lake					1	7	8
Tama	Otter Creek					2		2
Winnebago	Myre Slough*			1	6	8	2	17
TOTALS		63	28	6	33	84	83	296

Table 9. Total birds banded during pre-season waterfowl banding operations - 1968

COUNTY	NAME OF AREA	G.W. Teal	B.W. Teal	Woodducks	Total
Cerro Gordo	Ventura Marsh		1031	1	1032
Clay	Dan Green Sl.			5	5
Clay	Trumbull Lake		579	5	584
Clay	Mud Lake		189	1	190
Emmet	High Lake		1026	5	1031
Hancock	E. Twin Lake		77		77
Lucas	Colyn Area	11	92		103
Monona	Onawa Material Yard		1		1
Winnebago	Rice Lake		90	2	92
	TOTALS	11	3085	19	3115

Table 10. B. W. Teal Age and Sex Composition by Area - Pre-season Banding, 1968

COUNTY	NAME OF AREA	HY-M	HY-F	AHY-M	AHY-F	TOTALS
Cerro Gordo	Ventura Marsh	489	402	84	56	1031
Clay	Trumbull Lake	238	218	66	57	579
Clay	Mud Lake	77	90	3	19	189
Emmet	High Lake	544	380	74	28	1026
Hancock	E. Twin Lake	28	41	2	6	77
Lucas	Colyn Area	35	49	7	1	92
Monona	Onawa Materials Yard			1		1
Winnebago	Rice Lake	56	26	2	6	90
	TOTALS	1467	1206	239	173	3085

* Other species were not numerous enough to provide an adequate sample.

Table 11. Total Mourning Doves Banded, Iowa - 1968

COUNTY	NAME OF AREA	NESTLINGS	ADULTS	IMMATURES	TOTALS
Clay	Mud Lake	1	179	228	408
Emmet	Jack Creek		4		4
Emmet	Ringstead		58	8	66
Fremont	Forney's Lake		81	29	110
Guthrie	Bays Branch	5	105	199	309
Lucas	Colyn	1 unknown	109	48	158
Lucas	Brown's Slough		72	62	134
Marion	Red Rock		4	3	7
Tama	Otter Creek		32	11	43
Warren	Hooper Area		6	3	9
Winnebago	Rice Lake	2	1		3
Worth	Elk Creek		289	110	399
	TOTALS	9	940	701	1,650

Table 12. Young Canada Geese Banded at Ingham Lake - 1968 Captive Flock Project

DATE	LM	LF
6-11-68	32	38
6-13-68	3	6
7-8-68	2	3
6-11-68*	4	3
TOTALS	41	50

* These seven goslings were captured during drive banding operations in W. Swan Lake.

Table 13. Total Birds Banded - 1968

SPECIES	BREEDING GROUNDS	PRE-SEASON	WINTER TRAPPING	TOTAL
Black Duck			3	3
Mallard	116		1,658	1,774
Gadwall	4			4
G. W. Teal	18	11		29
B. W. Teal	631	3,085		3,716
Shoveler	4			4
Pintail	6			6
Wood Duck	296	19		315
Baldpate			2	2
Redhead	11			11
R. N. Duck	1			1
Ruddy Duck	1			1
Lesser Scaup	1			1
Coot	14			14
Canada Goose		91*		91
Mourning Dove	9	1,641		1,650
R. W. Blackbird	46			46
Y. H. Blackbird	1			1
Quail**	19			19
Mallard, Exp.	35			35
TOTAL	1,178	4,847	1,663	7,723

* Seven of these 91 immature Canada geese were drive trapped on West Swan Lake while the remainder were those geese produced in the goose pen at Ingham-High.

** These 19 quail were banded with State of Iowa Band.

QUAIL STUDIES ON TWO AREAS IN SOUTHERN IOWA , 1968

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Game Biologist

and

Gene Hlavka
Game Biologist

INTRODUCTION

Two quail study areas are located south of Highway 34 in Iowa's primary quail range (Stempel and Hlavka, 1966). 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 the 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 1968 STUDIES

Winter Studies

Late February-early March covey counts were conducted with the benefit of light snow cover on the Wapello Area. On the Decatur-Wayne Area wet, sticky snow cover was provided by a snow squall during the afternoon of February 28. On March 1, two days later, this snow cover had virtually vanished as the temperature climbed into the 40's. Just the preceding day the count was stopped because of the cold (3degrees F).

Forty coveys were located on both study areas in 1968, as compared to 36 coveys in 1967 (Table 1). Thirty-four coveys was the average for the preceding 2 years.

Spring and Summer Studies

Spring came early and quickly to Iowa in 1968. The mean diurnal temperature range was generally 25 to 30 degrees and quite in excess of the March normal. The unseasonable mildness of March continued through the third week of April, thereby producing the mildest March-April period since 1946. The cool, dry and somewhat windy May reversed the unusually warm trend of March and April. June temperatures were above normal the first 10 days but near to or subnormal thereafter. July was cool and sunny. The greatest amount of rainfall recorded near the study areas in July in any one day was just over 2 inches. August temperatures were the warmest since 1962, but no recorded temperatures climbed higher than 100 degrees. Fog was unusually frequent in September, which went without freezing shelter temperatures for the first time since 1905. October was characterized by seasonal temperatures Statewide. The first general freeze was reported on the 4th. (Climatological Data - Iowa, for months concerned).

In spite of varible weather, quail production was high in 1968. Calling by cock quail at a significant rate over a period of 12 to 14 weeks indicates continuing nesting effort with resulting good production. In 1968 calling was underway in early May, remained at a high level from mid-June to the end of July, and continued at a significant rate through August (Figure 1). This calling period of 12 to 14 weeks was similar to that of 1966 and 1967. And 1966, 1967 and 1968 have all been years of outstanding quail production.

In 1968, 9 quail per 100 miles were sighted on both study area census routes. From 1966-68 the number of quail sighted per 100 miles varied from 9 to 22. The average for this 3-year period was 15 per 100 miles. These sightings were recorded during the first hour after sunrise, a prime sighting period.

Table 1. Results of winter 1968 quail counts on the Wapello and Decatur-Wayne Areas, compared to the 1966-67 average of both areas

	1968 *			1966-67 August **
	Wapello Area	Decatur-Wayne	Both Areas	Both Areas
No. of coveys located	26	14	40	34
Flush	13	13	26	
Sign	13	1	14	
No. of quail estimated	346	154	500	394
Flush	186	143	329	
Sign	160	11	171	
No. of hrs. spent walking	12.3	23.0	35.3	33.3
Hrs. per covey flush	1.0	1.8	1.4	2.3
Farmers estimates of number of coveys	6	6	12	7

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

** No snow cover present during both years.

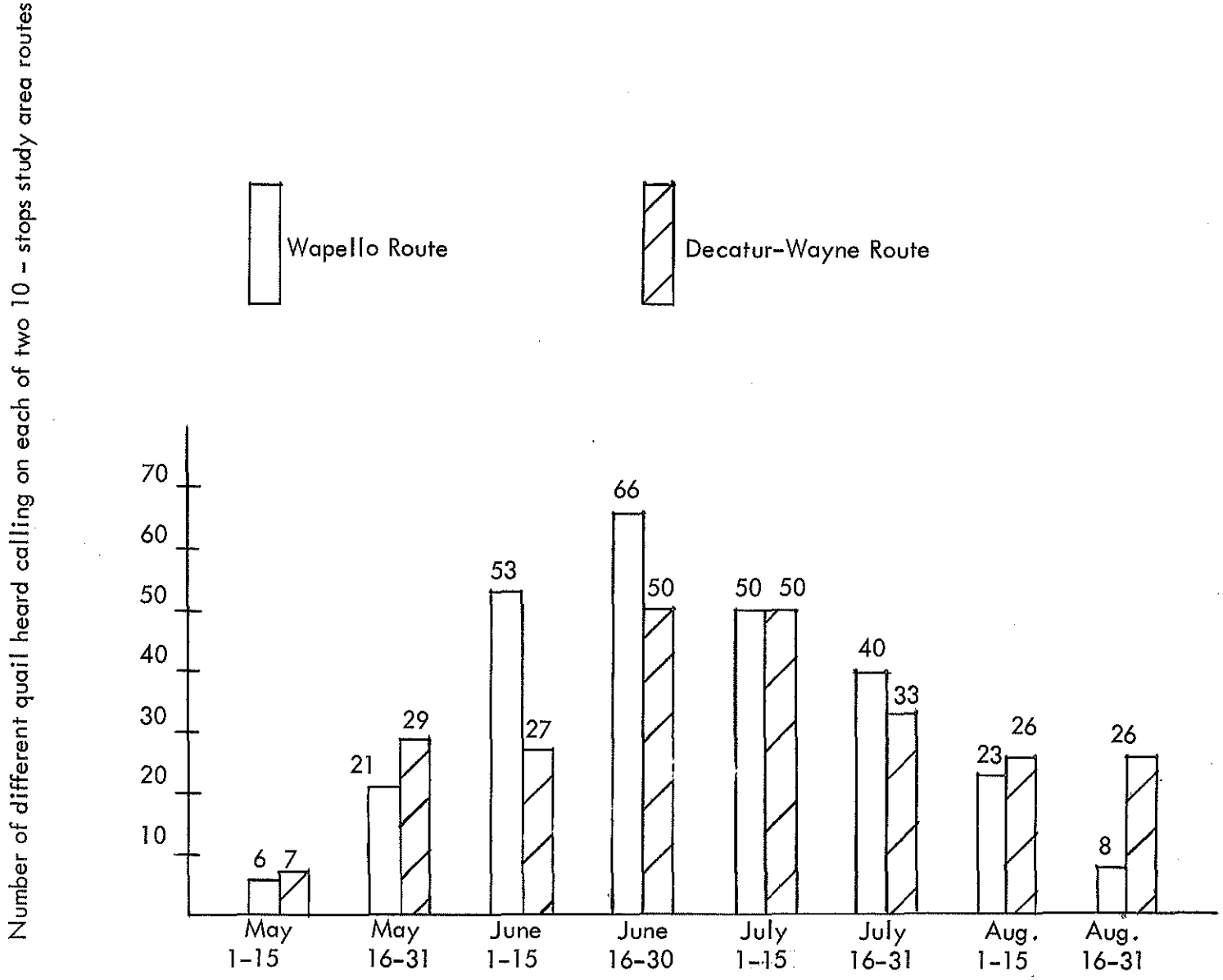

Figure 1. The length and peak of the quail calling period as recorded by different observers on the Wapello and Decatur-Wayne Areas, 1968

Autumn Studies

On the Decatur-Wayne Area the fall covey count began on October 15 and was completed on the 29th. Similar dates for the Wapello Area were October 22 and 31st. Mid-October was too hot and windy for dog work. 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 57 coveys were located (Table 2). This was 7 more coveys than last year and 2 more than the 1966-67 average. It took 1.1 hours to flush a covey, the same as the 1966-67 average. The farmer estimate of 34 coveys was 9 less than last year, 8 less than the 1966-67 average.

HUNTING ACTIVITY

The 1968-69 quail season of 98 days opened on October 26 and closed on January 31. This is the third consecutive year that the season length extended to around 100 days (100 days in 1967-68, 102 days in 1966-67). Nearly 30 percent of the hunting activity at 10 farms on the two study areas occurred in October (Table 3). November, December and January had 40, 16 and 14 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 1966-68 the winters in southern Iowa have been characterized by light snow cover. During these 3 winters the brood stock on both study areas increased from 32 to 40 coveys. Spring weather in 1968 was highly favorable for crops and wildlife. Although spring and summer weather has varied, there were over 12 weeks of significant quail calling during each of the past 3 years. Quail population levels have been outstandingly high. From 1966-68 the number of quail sighted per 100 miles on the study area 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 unharvested grain fields. Furthermore, it is not always possible to use the same dog.

From 1966-68 the quail hunters have had expanded opportunities through the 100-day (more or less) quail seasons. In one more year we will have 5 years of data to evaluate our techniques and some factors associated with quail populations.

Table 2. Results of fall 1968 quail counts on the Wapello and Decatur-Wayne Areas, compared to the 1966-67 average of both areas.

	1968			1966-67 August
	Wapello Area	Decatur-Wayne	Both Areas	Both Areas
No. of coveys located	32	25	57	55
Flush	18	22	40	
Sign	14	3	17	
No. of quail estimated	440	308	748	638
Flush	248	271	519	
Sign	192	37	229	
No. of hrs. spent walking	9.5	35.7	45.2	40.2
Hrs. per covey flush	0.5	1.6	1.1	1.1
Farmer estimate of number of coveys	22	12	34	42

Table 3. Summary of quail - hunting activity reported at five farms on each of two areas, Wapello and Decatur-Wayne, 1968-69

	Wapello Area		Decatur-Wayne Area		Both Areas		Percent of Hunting Activity on Both Areas		
							Parties		
	No. of Parties	No. of Hunters	No. of Parties	No. of Hunters	No. of Parties	No. of Hunters	1968-69	1967-68	1966-67
October*	8	16	3	8	11	24	30	10	19
November	10	23	5	17	15	40	40	41	27
December	4	9	2	2	6	11	16	31	27
January	0	0	5	10	5	10	14	18	27
TOTALS	22	48	15	37	37	85	100	100	100

* October 1968 had 6 quail - hunting days

SUMMARY

1. Quail counts were continued on both study areas, Wapello and Decatur-Wayne, in 1968.

2. The spring brood stock on both areas consisted of 40 coveys 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 1968.

4. Fifty-seven coveys were located on both areas during fall 1968. This was 7 coveys more than last year and 2 more that the 1966-67 average.

5. The hours per covey flush in fall 1968 for both areas was 1.1, the same as the 1966-67 average.

6. Quail sighted per 100 miles driven on the census routes varied from 14 in 1966, 22 in 1967 to 9 in 1968, but the sample size was quite small.

7. Nearly 30 percent of the quail hunting activity on both study areas was in October 1968 (6 quail hunting days). November, December and January had 40, 16 and 14 percent of the hunting activity, respectively.

MISCELLANEOUS DEER MORTALITY, 1967

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Game Biologist

METHODS

Deer mortality by means other than legal hunting has been recorded annually since 1951. Conservation officers are asked to submit a postal card report of each deer killed in their respective territories. Data in this report has been derived from the postal cards submitted in 1967.

RESULTS

Known mortality other than legal hunting totaled 1,451 deer in 1967. Of these, 1,273 were killed in traffic accidents. The remainder were known victims of poaching, disease, dogs, etc.

More deer-vehicle collisions occured in Pottawattamie County (135) than in any other county (Table 1). Pottawattamie County has always been at or near the top in reporting these accidents. Polk County was second with 54, and Dallas County was third with 43.

Estimated damanges resulting from these collisions totaled $126,354.06, or an average of $99.26 per accident. This is a minimum figure as damages were not reported in some cases.

Sex of deer killed by miscellaneous means was reported in 1,333 instances. Of these, 751 were bucks. This gives a buck/doe ratio of 129/100. Many more bucks than does are killed in auto accidents during the autumn rutting season. This probably stems from buck activity during that season and would account for the preponderance of bucks.

Of 1,209 deer killed in vehicle collisions, 888 (73.4%) occurred on state highways, 171 (14.1%) on hard surfaced county roads, and 150 (12.4%) on gravel roads. Probably these data reflect traffic volume and speed and not frequency of deer crossing. Types of crossings, whether or not marked "Deer Crossing", was recorded in 928 instances. Of these, 184 (19.8%) occurred at marked crossings. The remainder happened elsewhere.

The spring deer population was estimated at 25,450 early in 1967. A loss of 1,273 (5.0%) in vehicle accidents is a significant mortality factor. A comparison of miscellaneous deer losses for each year starting in 1951 appears in Table 2. Traffic mortality in 1967 was up 236% since 1959, 41.4% since 1963, and 19.3% over 1966.

DISCUSSION

It would appear that vehicle accidents involving deer are responsible for more deaths than any other cause except legal hunting. However, it must be remembered that every such accident involves people and probably property damage; hence, it will likely be reported. These can be little doubt that may fatal accidents befall deer, including disease and poaching, which never are known to the officers who file these reports.

Since we have had more than three times as many car-killed deer in 1967 as in 1959 it would lead us to conclude that the deer population had more than tripled during the intervening eight years. Possibly it has, but the evidence is not conclusive. This mortality factor is subject to too many variables to be considered an accurate barometer of populations. One of these is the system of reporting. There is no way to measure the totality of reporting or the changes in it through the years.

Probably total highway traffic in miles has increased in recent years. This would increase chances of accidents and may partially account for greater numbers of deer killed on our highways. Most likely the realistic view of these data would be an acceptance of the long term trend of increased mortality as indicative of more deer, but rejection on the yearly trends as measure of increases in the deer population..

Table 1. Miscellaneous deer kills, 1967.

County	Number Reported Killed		
	Traffic	Other	Total
Adair	15		15
Adams	1		1
Allamakee	8	3	11
Appanoose	13	1	14
Audubon	10		10
Benton	4		4
Black Hawk	16	2	18
Boone	18	1	19
Bremer	2	1	3
Buchanan	2	2	4
Buena Vista	7	4	11
Butler	5		5
Calhoun	2	1	3
Carroll	8	3	11
Cass	20		20
Cedar	9	1	10
Cerro Gordo			0
Cherokee	11	4	15
Chickasaw	3	1	4
Clarke	7		7
Clay	1		1
Clayton	5		5
Clinton	15	3	18
Crawford	10	1	11
Dallas	43	3	46
Davis	15	5	20
Decatur	4	1	5
Delaware	5		5
Des Moines	35	6	41
Dickinson	13		13
Dubuque	13		13
Emmet	17	1	18
Fayette	12	2	14
Floyd	12	4	16
Franklin	8		8
Fremont	26		26
Greene	11	3	14
Grundy	1		1

Table 1, continued

County	Number Reported Killed		
	Traffic	Other	Total
Guthrie	11		11
Hamilton	8		8
Hancock	5		5
Hardin	9	3	12
Harrison	28	3	31
Henry	9	2	11
Howard	4		4
Humboldt	5	1	6
Ida	6		6
Iowa	20		20
Jackson	24	3	27
Jasper	8		8
Jefferson	10		10
Johnson	21	1	22
Jones	9	1	10
Keokuk	9		9
Kossuth	13		13
Lee	35	14	49
Linn	6	2	8
Louisa	1	1	2
Lucas	6		6
Lyon	10		10
Madison	20	5	25
Mahaska	6		6
Marion	10	4	14
Marshall	10		10
Mills	27	8	35
Mitchell	7	1	8
Monona	15	4	19
Monroe	11	3	14
Montgomery	14	3	17
Muscatine	3		3
O'Brien			0
Osceola	3	1	4
Page	18		18
Palo Alto	9	1	10
Plymouth	19	1	20
Pocahontas	5	1	6

Table 1. continued

County	Number Reported Killed		
	Traffic	Other	Total
Polk	54	3	57
Pottawattamie	135	10	145
Poweshiek	6	2	8
Ringgold	5	1	6
Sac	5	1	6
Scott	10		10
Shelby	16	1	17
Sioux	8	8	16
Story	10		10
Tama	13	1	14
Taylor	8	1	9
Union	6	1	7
Van Buren	21	7	28
Wapello	7	2	9
Warren	31	2	33
Washington	5	1	6
Wayne	7	2	9
Webster	6	2	8
Winnebago	11	1	12
Winneshiek	17	4	21
Woodbury	28	10	38
Worth	13	1	14
Wright	10	1	11
Totals	1,273	178	1,451

Table 2. A comparison of miscellaneous deer kills 1951 - 1967.

Year	Traffic Mortality	Total Miscellaneous Mortality
1951	120	192
1952	173	256
1953	273	393
1954	229	310
1955	216	306
1956	286	419
1957	261	345
1958	314	438
1959	379	508
1960	546	753
1961	683	839
1962	726	939
1963	900	1,138
1964	914	1,170
1965	1,022	1,224
1966	1,067	1,241
1967	1,273	1,451

TRENDS IN MAJOR CULTIVATED CROPS IN IOWA
1954 - 1967

R. C. Nomsen
Game Biologist

Considerable changes have occurred in farming techniques and cropping practices in Iowa during the past ten years. Cash grain farms have replaced many of the diversified farms that were common several years ago - and most farm units have doubled or tripled in size. These changes have been more pronounced on the very fertile soils. Pheasants are farm game birds and also thrive best in the more fertile regions of Iowa. The long term trend of agriculture in Iowa undoubtedly has had an adverse affect on pheasants. The high cost of farmland plus the increasing production costs demand intensive use of land and modern machinery makes it possible.

The acreage of safe nesting cover has declined considerably. Studies have shown that nests established in oat fields produce over half of the chicks hatched in Iowa. Oats acreage has dropped from 6 million acres in 1954 to only 1.8 million acres in 1967 (Table 1). Only 5.3 per cent of the cropland was harvested for grain compared with 17.3 per cent in 1954 (Table 2). Changes appeared to be greatest in regions 1, 2, 4 and 5. The acreage of oats harvested for grain on the Winnebago Research Area dropped from 402 acres (26.4%) in 1954 to only 65 acres (4.3%) in 1967.

Soybean acreage has increased 3 million acres during this period while corn increased by 1 million. Thus the 4 million acre increase in row crops was about equal to the 4.1 million acre loss of oats.

Changes in cropping practices also affect pheasant numbers and are not revealed in acreage data. One of the most important changes in the northern part of our range concerns the extremely light field cover during the winter. Nearly half of Iowa's 34½ million acres of cropland were planted to row crops in 1967. Soon after harvest, these fields were chopped, disced and plowed. Winter winds whipped the snow across the barren fields and into the available winter cover reducing their value as safe winter areas for pheasants. Marginal areas were soon filled with drifting snow.

Wind erosion of top soil also causes loss of nesting sites in valuable strip cover such as roadside and ditch banks. Considerable excellent early nesting cover along roadsides was filled with wind blown soil during the spring of 1968.

The ringneck pheasant has prospered in Iowa because Iowa is a rich agricultural state. They continue to thrive in areas of the state where diversified farming exists. However, it is quite apparent that many of the more fertile fields are too intensively farmed to provide the basic needs of this farmland game bird.

TABLE 1. ACREAGE SUMMARY, IOWA, OF FARM CROPS IN THOUSANDS OF ACRES, 1954 - 1967

Year	Corn	Soybeans	Total Row Crops	Oats	All Hay	Pasture
1954	10,409	2,091	12,500	5,971	3,697	9,428
1955	10,659	2,229	12,888	5,734	3,872	9,200
1956	10,015	2,481	12,496	4,915	3,309	9,238
1957	10,153	2,813	12,966	5,122	3,500	8,775
1958	9,979	3,089	13,068	4,740	3,790	8,570
1959	12,360	2,328	14,688	4,284	3,524	8,390
1960	12,485	2,564	15,049	4,045	3,451	8,160
1961	10,254	3,364	13,618	3,204	3,241	8,105
1962	10,068	3,365	13,433	2,923	3,441	8,143
1963	10,982	3,545	14,527	2,737	3,244	8,047
1964	10,231	4,204	14,435	2,305	3,165	7,868
1965	10,358	4,756	15,114	1,971	2,884	7,753
1966	10,603	4,924	15,527	1,951	2,897	7,590
1967	11,622	5,136	16,758	1,835	2,705	7,521

TABLE 2. COMPARISON OF OATS ACREAGE BY AGRICULTURAL DISTRICTS 1954-1967
PER CENT OF CROPLAND IN OATS

District	1954	1967
1. N W	24.0%	5.6%
2. N C	21.1%	5.1%
3. N E	17.2%	8.3%
4. W C	19.6%	5.0%
5. C	18.8%	4.7%
6. E C	16.2%	7.4%
7. S W	15.1%	4.0%
8. S C	10.3%	3.6%
9. S E	12.1%	4.0%
STATE	17.3%	5.3%

Fall Mourning Dove Migration Patterns in Iowa - 1967 & 1968

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INTRODUCTION

The mourning dove is an important resident game species in Iowa, which at present is not being utilized by the hunters of this state. Since it is a migratory species, it is, however, subjected to hunting pressure in all states to the south of Iowa. Attempts have been made at various times in recent years to have the dove placed on the "open season list" but these have always failed. Because of the importance of the mourning dove on the national hunting scene, plans are being made on both federal and state levels to place increased emphasis on dove research - primarily as part of a program of accelerated research on all non - waterfowl migratory species (doves, snipe, rails and woodcock are the ones included that are of interest to Iowa). States that do not hunt some of these species are taking part in the program, as well as those that do hunt them. Funds for this program have been quite limited because of budgeting problems on the national level. However, the interest already aroused has resulted in preliminary efforts by many states toward increasing emphasis in these species.

The Migratory Bird Treaty Act provides that a hunting season on mourning doves cannot begin earlier than September 1. It is general knowledge that doves are already "on the move" in Iowa at that time and that their migration out of the state is practically completed by the end of October. Thus any hunting season held on doves in Iowa would necessarily involve a period when the birds are already leaving the state, and thus only a portion of the birds resident here during the summer would be subjected to hunting pressure within this state. However, no extensive quantitative measurements of this movement have been made. This need for more and better facts on one aspect of the status of doves in Iowa prompted a preliminary study aimed at obtaining a better estimate of mourning dove fall migration patterns in the state.

PROCEDURE

Beginning August 1, 1967, a series of roadside mourning dove counts was initiated. It was felt that this survey method was the best available, considering the season, sample that could be obtained, time involved, and personnel able to work such counts into their schedule. These counts were made during August, September and October of both 1967 and 1968. Five routes, all 30 miles in length, were used in 1967 - one in north central Iowa, two in central Iowa, and two in southern Iowa. A sixth route, in north central Iowa, was added in 1968 - thus giving two routes each in northern, central and southern Iowa. In this manner it was hoped to detect migration time differences in a north - south direction through the state.

The 1967 survey was based primarily on evening counts. The objective was two counts per week for each route if possible, with one definitely to be made. Several morning counts were also to be made in order to measure the difference between numbers of doves seen on the same route at the two different times. In 1968 this scheme was reversed, based on the 1967 findings, with counts to be made in the morning. One count was to be made

per week on each route, with several evening counts to be made for comparative purposes.

Evening counts were begun 90 minutes before sunset, with the 30 - mile route being completed close to sunset. Morning counts were started at sunrise. The car was driven at about 20 miles per hour. Counts were not to be made on days that were excessively windy, raining or with threatening weather conditions that might inhibit activity of doves and tend to prevent their appearance along the road. Records were made at the start and end of each count of the time, temperature, % cloudiness, sun shining or not, wind velocity and direction, precipitation during the preceding 12 hours, and the general weather pattern since the last count was made. The number of doves sighted was recorded by mile. In 1968 records were kept of doves observed as singles, pairs or flocks. Numbers of other game species sighted were also recorded (particularly pheasants, quail and rabbits).

RESULTS

During the 2 years, 167 roadside dove counts were made - 84 in 1967 and 83 in 1968. In 1967, there were 9 counts made in the morning and 75 in the evening. In 1968, there were 64 taken in the morning and 19 in the evening. Since the ratio of evening to morning counts for the same periods each year was nearly equal, the data from the 2 years were combined to give a composite picture of dove migration for the August through October period.

The highest number of doves was counted during August, with the peak being reached during the third week of the month (Table 1). However, the number sighted during the second and fourth weeks was only slightly below the peak level. A secondary peak occurred during the second week of September, probably as a result of migrating birds moving through the state. It should be kept in mind that the population of birds sampled during each weekly period was a constantly shifting one. Thus birds present in the area during one counting period may have departed, only to be replaced by incoming migrants by the next period. This would then give the impression, from the figures shown, that the population was relatively static. From a hunter's standpoint this would essentially be true, since he would be encountering a similar number of birds in the field during such periods.

From mid-September on the decline in number of doves observed each weekly period was quite noticeable. By the end of October, mourning doves were essentially gone from the state. A few doves do remain over winter, particularly in southern Iowa, so it would be possible to see a bird or so on counts after October. The number of doves sighted in September was only 80% of that seen in August, while the October average was only 18 % of the August mean, and only 22% of the September average. It is thus evident that peak dove numbers in Iowa would actually be reached before the earliest date a hunting season could begin (which is September 1).

When the survey data were analyzed separately for northern, central and southern Iowa, the differences found were rather small (Table 2). The number of doves sighted was nearly identical for all three regions in August. In September there was an increasing number of doves counted as one progressed from north to south. A similar trend would have been shown in October, except for one unusually high count (66 birds - most seen in only 4 miles) in the central region. If this count were not included, the October mean for that region would have been 6.2. The weighted means for the entire period show slightly more doves as we

Table 1. Mourning dove roadside survey results, 1967 & 1968 combined, statewide.

Period	No. of Counts	No. of Miles	Total Doves	Doves per Count	Doves per Mile
August 1 - 7	15	450	624	41.6	1.39
8 - 15	15	450	759	50.6	1.69
16 - 23	14	420	727	51.9	1.73
24 - 31	14	420	689	49.2	1.64
	58	1740	2799	48.3	1.61
Sept. 1 - 7	13	390	560	43.1	1.44
8 - 15	14	420	671	47.9	1.60
16 - 23	11	330	408	37.1	1.24
24 - 30	10	300	225	22.5	0.75
	48	1440	1864	38.8	1.29
Oct. 1 - 7	10	300	208	20.8	0.69
8 - 15	7	210	42	6.0	0.20
16 - 23	8	240	37	4.6	0.15
24 - 31	8	240	4	0.5	0.02
	33	990	291	8.8	0.29
Totals	139	4170	4954	35.6	1.19

move south, but it is evident that hunters would be likely to find doves throughout the state during any hunting season that might be set.

A comparison of evening versus morning counts showed that the former averaged only 61 per cent of the latter for the entire 3 - month period (Table 3). There was a distinct trend toward evening counts being a higher percentage of the morning counts as one progressed from August to October. The relationship between the two was more consistent early in the period and became quite erratic late in the period. For example, in October, the higher ratio of evening to morning surveys hinged entirely on one evening count in which a single flock of 76 birds was observed. Chances of seeing, or failing to see, such flocks on a single count are probably greater later in the period, when no doves at all are sighted on many miles as compared to earlier in the period when birds are seen most miles.

Analysis of effects of those weather conditions that were measured in conjunction with the surveys will be done following completion of the third, and final, year of this project.

Table 2. Comparison of dove survey statistics for northern, central and southern Iowa *

Period		Northern Iowa No. Counts	Northern Iowa No. Doves	Northern Iowa Doves/ Count	Central Iowa No. Counts	Central Iowa No. Doves	Central Iowa Doves/ Count	Southern Iowa No. Counts	Southern Iowa No Doves	Southern Iowa Doves/ Count
August	1 - 7	4	169	42.2	7	369	52.7	4	86	21.5
	8 - 15	5	220	44.0	5	240	48.0	5	299	59.8
	16 - 23	3	163	54.4	6	290	48.3	5	274	54 8
	24 - 31	3	174	58.0	5	186	37.2	6	329	54.8
		15	726	48.4	23	1085	47.2	20	488	49.4
Sept.	1 - 7	3	115	38.3	5	162	32.4	5	283	56.6
	8 - 15	3	113	37.7	6	305	50.8	5	253	50.6
	16 - 23	2	52	26.0	6	214	35.7	3	132	44.0
	24 - 30	2	51	25.5	4	87	21.8	4	87	21.8
		10	331	33.1	21	768	36.6	17	755	44.4
Oct.	1 - 7	2	21	10.5	5	122	24.4	3	65	21.7
	8 - 15	2	8	4.0	1	3	3.0	4	31	7.8
	16 - 23	3	30	10.0	2	4	2.0	3	4	1.3
	24 - 31	3	0	0.0	2	0	0.0	3	4	1.3
		10	59	5.9	10	129	12.9	13	104	8.0
TOTALS		35	1116	31.9	54	1982	36.7	50	1847	36.9
$\bar{X}$ of Means				29.1			32.2			33.9

*Northern routes near Garner (run by Dick Nomsen) and Clear Lake (run by Ron Andrews)
Central routes near Ames (run by Gene Klonglan) and Nevada (run by Don Hackbarth
Southern routes near Chariton (run by Gene Hlavka) and Ottumwa (run by Elden Stempel)

Table 3. Comparison of mourning dove roadside counts made in evening vs. those made in morning.

Item	Aug.	Sept.	Oct.	Total
No. of "paired counts" compared	13	9	4	26
No. of doves on morning counts	1013	517	81	1611
No. of doves on evening counts	545	339	100	984
Ratio - doves in p.m./doves in a.m.	1.0:1.9	1.0:1.5	1.0:0.8	1.0:1.6
Per cent - doves in p.m. of doves in a. m.	54%	64%	123%	61%
No. times p.m. count higher than a.m.	1 of 13	2 of 9	2 of 4	5 of 26
Percent p.m. higher than a.m.	8%	22%	50%	19%

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Reprinted from TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY
Vol. 98, No. 1, January 1969
pp. 118–121

Age and Growth of Flathead Catfish in the Des Moines River, Iowa

J. K. MAYHEW

Age and Growth of Flathead Catfish in the Des Moines River, Iowa[1]

INTRODUCTION

Flathead catfish, *Pylodictis olivaris* (Rafinesque), occur in varying abundance in Iowa streams. Harlan and Speaker (1956: 112) listed this species as quite common in the Mississippi and Missouri rivers and large tributary streams in regions of highly oxygenated water. Cleary (1956: 309) found them distributed in the Des Moines, Cedar, Iowa, Wapsipinicon, Raccoon, Chariton, and Grand River systems. They were also recorded in several Iowa lakes and reservoirs.

Life history information on flathead catfish is limited. Muncy (1957) attributed this mainly to the difficulty in obtaining adequate numbers of fish. Even under optimum sampling conditions large catches of flathead catfish are infrequent. Annual fishery survey reports of the Iowa Conservation Commission reveal flathead catfish in streams comprise $< 1\%$ of the sample number and weight. Their catch comprised $\leq 2\%$ of the commercial fish harvest in the Mississippi and Missouri rivers bordering Iowa for the past 17 years (Data obtained from statutorally required commercial fishermen reports, Iowa Conservation Commission).

This species, the only sizable game-fish in Iowa streams, is a major component of the recreational fishery. Angler catches of fish in excess of 20 lbs (9.1 kg) are frequently reported from the Des Moines River. Angling for flathead catfish is becoming increasingly popular. Presently a sizable group of fishermen expend considerable time and effort catching a few large fish. Most such fishermen willingly accept the low productivity of flathead catfish angling for the capture of a few exceptionally large fish. Consequently, the fishery assumes more aesthetic value than economic importance.

A 20-mile (32 km) section of the Des Moines River, which lies in a broad alluvial valley, winding from bluff to bluff in a series of sharp bends, near Knoxville in Marion County was examined. Width of the river varied from 200 to 500 ft (60–152 m). The stream was characterized by short riffles and long, sluggish pools with numerous protective drifts of lodged, floating logs, fallen trees, and debris. Many large sand bars were exposed during low flow. According to Harlan and Speaker (1956: 113), flathead catfish prefer this type of habitat. Within two years this segment of the Des Moines River will be impounded by a flood control reservoir.

Intensive netting with baited hoop nets in the summer and autumn of 1966 produced a catch of 455 flathead catfish, of which 302 were used for age and growth determinations. This study presents information on the length–weight relationship, body–spine relationship, and growth in length and weight of these fish.

PROCEDURE

Pectoral spine samples were randomly obtained from fish collected throughout the entire netting period. Physical separation of the spine was accomplished by simultaneously twisting and depressing the spine toward the body of the fish at the articulating process. Most spines were removed without aid of pliers or forceps except for large fish when it was difficult to remove the spine without injury to the fish or breakage. Spines were

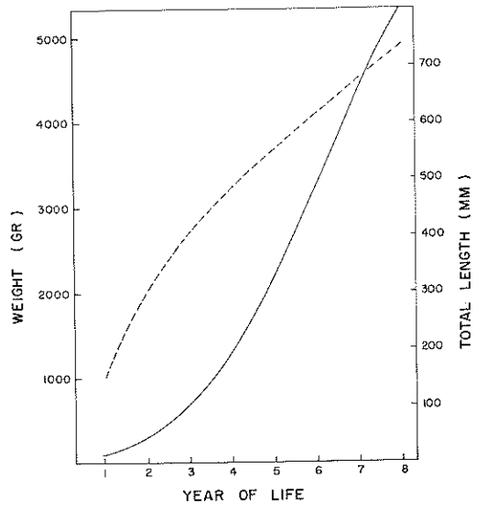

FIGURE 1.—Growth of flathead catfish in length and weight (solid line represents weight; broken line represents length).

Spine samples were aged and growth calculated identical with the method used for channel catfish, *Ictalurus punctatus*, by Sneed (1951). Large spines were difficult to cross-section properly because the thin dental separating saw blade of the sectioning device warped with friction heat, resulting in unevenly cut sections. This caused some distortion in microprojected images and resulted in inaccurate location of annuli on tab strips. These samples were omitted from the study.

VALIDITY OF ANNULI AS YEAR MARKS

The general appearance of spine sections was similar to the description given by Jenkins (1952). Magnified spine images possessed alternating broad opaque bands and narrow clear bands. Narrow bands were regarded as annuli caused by slower winter growth.

These marks were considered true annuli because: (1) there was a progressive increase in assigned age of fish with increased body length; (2) there was general agreement between modes in total length frequency distribution and modal lengths assigned to year

LENGTH–WEIGHT RELATIONSHIP

A length–weight relationship was determined from a randomly selected subsample of 175 fish divided into 25 mm length intervals. Determination of the length–weight equation was made by fitting a straight line to logarithmic transformed values of the two variables. The calculated equation $\log W = -5.5819 + 3.2597 \log L$, where L = total length in millimeters and W = weight in grams best describes this relationship. Differences between calculated and observed weights were not significant ($P > 0.05$). Large deviations occurred only in size groups of fewer than three fish.

Coefficients of condition, K, were computed for each size group by using the reciprocal of the average total length multiplied by the mean weight. Mean K for the total sample was 1.23 with a range of 1.03 to 1.37.

BODY-SPINE RELATIONSHIP

Establishment of a mathematical relationship between total length and spine radius was desired for back calculation of growth. Magnified spine images (×32) were measured in millimeters along a straight line from the estimated center of the lumen to the edge of the spine image in the largest lateral lobe.

Trial plots of spine radius (R) on total length (L) by 100 mm size groups indicated the body–spine relationship was curvilinear and best defined by the equation $\log (L - 9.0) = 0.4325 + 1.1115 \log R$. The calculated intercept (R = 0) was 9.11 mm and the correlation coefficient (r) was 0.986.

Total length at each annulus was computed by construction of a nomograph to accommodate the body–spine regression. Curvilinearity of exponential values in this device were identical with log-log transformation of length and spine radius. Calculated length was automatically shifted by adjusting the marked center of the spine image on the tagboard strip to the calculated intercept.

CALCULATED GROWTH IN LENGTH

TABLE 1.—*Calculated growth in total length (millimeters) for flathead catfish in the Des Moines River (equivalent total length in inches in parentheses)*

Age group	Number in sample	Year of life							
		1	2	3	4	5	6	7	8
I	208	165 (6.5)							
II	36	145 (5.6)	254 (10.0)						
III	22	117 (4.6)	287 (11.3)	381 (15.0)					
IV	8	142 (5.6)	244 (9.6)	429 (16.9)	480 (18.9)				
V	8	145 (5.7)	310 (12.2)	376 (14.8)	470 (18.5)	549 (21.6)			
VI	4	—[1]	244 (9.6)	376 (14.8)	475 (18.7)	561 (22.1)	607 (23.1)		
VII	13	—	277 (10.9)	399 (15.7)	462 (18.2)	549 (21.6)	599 (23.6)	671 (26.4)	
VIII	8	—	—[1]	396 (15.6)	457 (18.0)	541 (21.3)	594 (23.4)	676 (26.6)	714 (28.1)
Grand average lengths		142 (5.6)	269 (10.6)	393 (15.5)	469 (18.5)	550 (21.6)	600 (23.6)	674 (26.5)	714 (28.1)
Grand average increment		142 (5.6)	124 (4.9)	130 (5.1)	74 (2.9)	84 (3.3)	51 (2.0)	76 (3.0)	38 (1.5)
Sum of increments		142 (5.6)	266 (10.5)	396 (15.6)	470 (18.5)	554 (21.8)	605 (23.8)	681 (26.8)	721 (28.4)

[1] Annulus eroded into lumen of spine.

were also captured, but the small sample size and inaccuracy in sectioning spine samples made it inadvisable to use these fish. After fish reach age VI, there was marked deterioration of the bony structure around the lumen. At this age the first annulus was either missing or was only partially complete. Erosion loss of this annulus was first detected when calculated total length of age VI and VII was less than age V fish. After close re-examination of the spine samples by size groups from the smallest to the largest fish, it was apparent that at least one annulus had eroded into the lumen. The second annulus also deteriorated by age VIII. Erosion begins at approximately age IV and apparently continues throughout the life of the fish. Jenkins (1952) noticed this factor in his study of flathead catfish growth in Oklahoma and attempted to minimize the occurrence of annulus erosion by using dorsal spines in a second collection of fish.

Estimates of general growth in body length were computed by grand averages of calculated total length and successive summation of average growth increments (Table 1). Both methods showed only minor variation in length at each annulus. Growth was greatest during the first 3 years of life (Figure 1), with a systematic decrease in length increment with increased age. Age group VII attained a higher growth increment, but this was attributed to a small sample.

Comparison of growth of flathead catfish in the lower Des Moines River with fish from the upper Des Moines River in Iowa, Oklahoma, Kansas, and the Mississippi River bordering Iowa revealed total length at each year of life was between the extreme ranges. Muncy (1957) found growth of flathead catfish in the upper Des Moines River was about 25% less at each annulus than in the present study. Early life growth of Oklahoma and Kansas flathead catfish (ages I through III) determined by Jenkins (1952), McCoy (1953), and Minckley and Deacon (1959) agreed quite closely with this study, but in the later years of life growth was considerably faster in the former investigations. Schoumacher (1968) found growth rates of flathead catfish in the Mississippi bordering Iowa very rapid during the first four years of life, but after age VI calculated length was in close agreement with

TABLE 2.—*Calculated weight at each year of life for flathead catfish in the Des Moines River*

Year of life	Calculated weight		Increment of average	
	Grams	Pounds	Grams	Pounds
1	28	0.06	28	0.06
2	227	0.50	199	0.44
3	757	1.67	530	1.17
4	1,345	2.96	588	1.30
5	2,282	5.02	937	2.06
6	2,980	6.55	698	1.53
7	4,337	9.53	1,357	2.98
8	5,251	11.54	914	2.01

this study. Most variation in growth occurs in younger fish age groups.

CALCULATED GROWTH IN WEIGHT

Calculated growth in weight (Table 2) was determined by applying the sum of the average increment of total length in Table 1 to the length–weight relationship. Annual increments of calculated weight (Figure 1) increased rapidly from 28 gm in the first year of life to 1,357 gm in the seventh year. Irregularities of weight increments in older age groups (VI and over) were attributed to insufficient samples. In general, calculated weight became progressively greater with increased age.

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Successful Renovation of a Small Natural Iowa Lake

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Abstract. Center Lake, having a surface area of 264 acres, is located in northwestern Iowa. During 1958 management problems in the form of stunted bullheads and carp along with very poor fishing, indicated the lake should be renovated. During October, 1958 liquid toxaphene was applied at a rate of 0.05 ppm. Apparently, a complete kill resulted.

During 1962 an estimate of the bluegill population was made. Nearly 1,100,000 bluegills or about 500 pounds per acre, were present at that time. The 1962 black crappie population was estimated at 250,000 or about 140 pounds per acre.

Based on a comprehensive creel census conducted on the lake during 1963, 1964, 1965, and 1966 approximately 124,200 angler trips totaling nearly 311,500 hours were made to the lake during the 4-year period. During these trips an estimated 1,054,853 fish totaling 291,305 pounds were creeled. An average year produced an estimated angler harvest of 275 pounds per acre. The high harvest rate occurred during 1964 when an estimated 480 pounds per acre were creeled.

Center Lake, having a surface area of 264 acres, is located in northwestern Iowa. This eutrophic lake of glacial origin has a maximum depth of about 14 feet. During periods of normal water levels, the shoal area is steeply sloping to about the 5-foot contour and is composed mainly of scattered boulders and sand. The remainder of the lake is composed of mud and silt. Because the shoreline is largely wooded and undeveloped, the littoral zone contains excellent habitat for fish in the form of dead limbs and fallen trees. Two sloughs connecting with the lake during periods of normal water levels make excellent spawning habitat for most fish present in the lake.

Moen (1962) aptly stated the management problems in Center Lake when he said,

> Late in the summer of 1958 stunted bullheads (3 years old, averaging 3.7 inches in length) were present at a population of about 580 pounds per acre. Carp Carp were the next most abundant species, comprising 213 pounds per acre. Other species, including walleye, northern pike, largemouth bass, black crappies, bluegills, and common sucker, accounted for less than an estimated 5 pounds per acre.

Based on these observations and very poor fishing, the decision was made to eliminate the existing fish population. It was decided the lake would be restocked for maximum production of largemouth bass and bluegills.

[1] Fisheries Biologist, Iowa State Conservation Commission.

On October 1, 1958 the lake was treated with liquid toxaphene a rate of 0.05 ppm. Apparently, a complete kill resulted. The xicity of the lake remained high throughout the winter. By lay, 1959, minnows in a live-box lived for 2 weeks, thus it as assumed the lake had detoxified.

Restocking

Restocking of the lake began during June, 1959 with the addi-on of 60,000 largemouth bass advanced fry (Table 1).

able 1. Species, numbers and size of fish stocked into Center Lake, 1959-66.

ear	Date	Species	Number	Size
959	June	Largemouth bass	60,000	Advanced fry
	September	Largemouth bass	22,000	Fingerlings
960	March	Bluegill	9,000	Adults
	July	Yellow bullhead	200	Adults
	August	Yellow bullhead	10,000	Fingerlings
	August	Largemouth bass	35,000	Fingerlings
962	June	Largemouth bass	30,000	Advanced Fry
963	August	Northern pike	53	Adults
	September	Largemouth bass	8,300	Fingerlings
	October	Northern pike	45	Adults
	November	Northern pike	24	Adults
	November	Northern pike	32	Fingerlings
964	January	Northern pike	34	Adults
	April	Northern pike	259	Adults
	August	Yellow bullhead	6,000	Fingerlings
	September	Largemouth bass	10,000	Fingerlings
	October	Largemouth bass	4,000	Fingerlings
965	August	Northern-muskie hybrids	18	Fingerlings
	September	Largemouth bass	10,000	Fingerlings

During the last week of July, a severe oxygen depletion, precipi-ated by dying algae, was experienced. Following this summer-ill no dead leargemouth bass were noted. It was assumed that ven though the water had not been toxic to minnows it had been oxic to the small stocked bass. Fingerling bass were stocked in eptember, 1959. Trawling in October indicated good survival f this stocking. With the successful establishment of a predator opulation, 9,000 adult bluegills were stocked during March, 960. Crappies were inadvertently stocked along with the blue-ills in 1960. Yellow bullheads and northern pike have been tocked since.

Population Sizes and Growth Rates

Bluegill. Seine hauls late in the 1960 summer, using 500 feet of ne-fourth-inch web indicated a large number of young bluegills. ince this is a special study lake, it was thought desirable to have more definite knowledge of this year-class size. During Septem-er, 1962, a simple Peterson-type estimate of the bluegill popula-ion was made. Bluegills were captured for marking with an otter

trawl. One week later the ratio of marked to unmarked fish captured through trawling operations indicated a population of 562,000 bluegills. Seining during this same period captured marked to unmarked buegills at a ratio indicating a population of 1,157,000 fish or about 500 pounds per acre. The population estimate obtained by seining was considered excessive, whereas trawling seemed to have produced a more realistic figure. Consequently, the size of this year class was estimated at between 500,000 and 600,000 (Moen op. cit.). Recent observations, however, indicate the population estimate obtained by seining was more nearly correct.

Growth rates for the 1960 year class of Center Lake bluegills were obtained by using the standard scale examination method (Table 2). These total lengths at each annulus are only slightly below those reported by Mayhew (1956) for bluegills in West Okoboji Lake.

Table 2. Mean total length in inches at each annulus for the 1960 year-class of bluegills in Center Lake as determined from examination of scale samples.

	Mean length at each annulus					
Sample Size	1	2	3	4	5	6
108	2.1	4.5	5.3	6.2	6.8	7.1

Test netting failed to indicate the presence of young bluegills until 1964. During 1964 an abundance of them was sighted near the weedy areas of the lake. One seine haul in an area considered as poor habitat for young bluegills captured nearly 5,500. Based on these observations, it was apparent they would present a management problem in the near future. Consequently, it was decided to try and selectively lower the population of these fish by applying light dosages of rotenone. Beginning early in September, 1964 and continuing for 9 days, 22.5 gallons of liquid rotenone was applied along the shoreline at a rate of 1 gallon per 1,000 shoreline feet, or a calculated application rate of about 0.05 ppm. Because of the many problem involved in making an accurate estimate of the number of young bluegills destroyed, the range of the estimated number killed was quite wide, between 500,000 and 1,000,000. During these applications fewer than 100 adult fish—including largemouth bass, northern pike, bluegills, and crappies—died. The effectiveness of this technique was apparent during 1965 when seining captured only fair numbers of yearling bluegills. Small hatches of bluegills have been observed during 1965 and 1966.

Black Crappie. During 1960, test netting demonstrated the presence of one young crappie for each 4 to 5 young bluegills. This ratio of about 20% was found in subsequent samplings done dur-

g 1961 and 1962 (Moen op. cit.). By assuming the bluegill pop-ation in 1962 to be approximately 1,100,000, then the crappie pulation should have been nearly 250,000, or about 140 pounds r acre.

The average total length of crappies was determined from ac-al measurements taken near the end of each growing season. e overall growth is about average for this species in other lakes the region (Table 3).

ble 3. Mean total length in inches for the 1960 and 1964 year-classes of black crappies from Center Lake as determined from actual meausurements taken near the end of each growing season.

Mean length at end of each growing season						
1960	1961	1962	1963	1964	1965	1966
3.4	6.4	7.3	8.2	8.4	9.3	9.4
				2.6	6.6	8.1

Seine hauls using 500 feet of one-fourth-inch web failed to cap-re significant numbers of young crappies until 1964. Since these ung crappies were inhabiting the deeper portion of the lake at e time chemical work was done on the young bluegills, they ere not measurably affected by the treatment. There has been od survival of this year class and they are now clearly the most undant year class of crappie in the lake. Their growth during e first 3 years approximated that of the 1960 year class. Repro-ction for this species during 1965 and 1966 has been limited.

Miscellaneous Species. The largemouth bass population is ex-llent with 3 year classes present, 1959, 1962 and 1964. Natural production of this species has been limited until 1966.

Several attempts to establish a yelow bullhead population in nter Lake have been unsuccessful.

In recent years black bullheads have become well established the lake even though there is no record of them having been cked. In the near future this species is not expected to cause nagement problems, such as those experienced prior to reno-tion.

Since renovation, no carp were captured from the lake until e spring of 1966 when one young and one adult were taken.

Angler Harvests and Utilization

Following chemical treatment Center Lake was out of produc-n, as far as the fisherman was concerned, for over 3 years. uring the latter part of 1962 the bluegills and crappies had at-ned a size acceptable to anglers. Since angler utilization of the e was expected to increase, it seemed desirable to have an es-nate of the total number of each species caught and of total ning pressure. Consequently, a comprehensive creel census, nilar to that described by Rose in 1956, was used. This census

was first used on this lake in 1963 and has been employed each year since. The census period during the first 3 years extended from May through October. The 1966 census period encompassed only the months of May through September. Fishing pressure during the remainder of the year is too light to justify a full-scale census.

As expected, bluegill was the most abundant species creeled, comprising 71% of the total estimated 4-year catch. Nearly all of these fish came from the 1960 year class. (Table 4).

Black crappie were second in creel abundance accounting for nearly 17% of the estimated harvest. Prior to 1966 nearly all of the crappie caught were from the 1960 year class. During 1966 the bulk of the catch was composed of 1964 year class fish. Fishing for other species in the lake was quite poor. The small number. of largemouth bass caught can probably be explained by the lack of angling for this species. Most of the bass recorded were caught accidentally by bluegill and crappie fishermen.

One of the most enlightening aspects of this project is the total amount of fish creeled when expressed in pounds per acre. During 1963, 1964, 1965, and 1966 anglers harvested approximately 170, 480, 260, and 190 pounds per acre. The 480 pounds per acre angler harvest for 1964 may seem unreal but from personal observation this figure should be reasonably close. It was not uncommon to see parties creel 200 bluegills during an afternoon of fishing. The most striking figure here is not only the high harvest for 1964 but rather the consistency with which high yields occurred. During an average year 275 pounds of fish per acre were creeled from this lake.

Angling pressure was quite heavy during these census periods, totaling nearly 124,200 angling trips, or an average of about 31,000 trips per year. Nearly 311,000 hours were spent fishing in this lake, approximately 77,800 hours per year. Average fishing pressure amounted to 117 angling trips totaling 295 hours per acre per year.

One of the best means of determining fishing success is by examining the number of fish creeled per fishing hour. Fishing success has been excellent during the census period in each of the 4 years with observed fish per hour rates of 4.6, 4.12, 2.58 and 2.19 annually.

Discussion

It is apparent the renovation of this lake has been highly successful as demonstrated by the many hours of high quality fishing during the last 4 years. The 3.53 average fish-per-hour rate for this period is substantially better than the 2.07 and 1.27 rates observed for two other lakes in this region during the same time.

Table 4. Comprehensive creel census data for Center Lake, 1963-66.

Species	1963*		1964*		1965*		1966**	
	Fish	Weight	Fish	Weight	Fish	Weight	Fish	Weight
Bluegill	167,824	29,100	309,542	71,444	173,918	44,372	101,042	33,612
Black crappie	51,652	10,360	135,550	49,232	51,208	20,690	25,500	10,868
Bullhead	2,530	2,428	2,628	3,126	9,016	3,452	9,927	4,549
Largemouth bass	1,758	2,504	798	1,734	448	860	622	1,074
Yellow perch	204	28	34	14	136	194	43	13
Northern pike	0	0	186	564	0	0	287	1,087
Total	233,968	45,420	448,738	126,114	234,726	68,568	137,421	51,203
Angler trips	22,766		45,406		30,290		25,804	
Angler hours	49,118		108,914		90,744		62,795	
Fish/man	10.27		9.87		7.74		5.33	
Fish/hour	4.68		4.12		2.58		2.19	

*Census period May through October

**Census period May through September

Prior to renovation there was no indication that fishing in this lake would improve in the near future. Thus, it is assumed, that without this project, angler utilization of this lake would have been insignificant during the past 4 years.

The bulk of the bluegills caught were from the 1960 year class. These fish were in good body condition but by some standards they were small. Even though these fish were small, they were readily caught and because of this they were highly desired by people participating in this form of recreation.

Acknowledgements

The author wishes to thank the many individuals involved in collecting data for this project and the men who spent considerable time editing this paper. Special thanks is extended to Mr. Tom Moen who initiated this project, supervised and set up procedures for collection of data prior to my appointment in northwestern Iowa.

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