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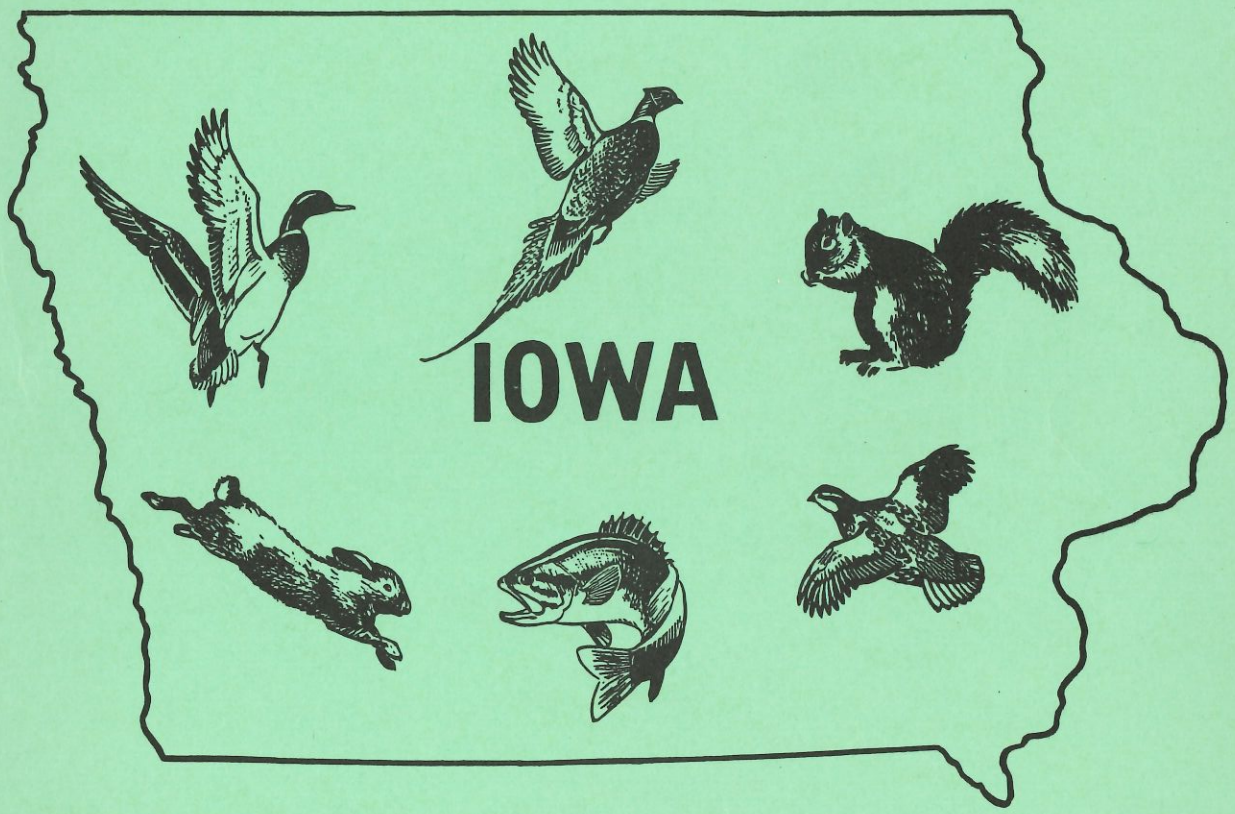
QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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ABSTRACTS OF QUARTERLY BIOLOGY REPORTS

ANALYSIS OF DATA OBTAINED FROM DEER CHECKING STATIONS - 1962

Eldie W. Mustard
Game Biologist

Biological data were obtained for 932 of the 5,703 deer killed in 1962. Data collected included sex, weight, age, antler measurement, and general condition. The general conclusion is that the Iowa deer herd was in good physical condition at the time of the 1962 deer season. The reproductive rate remained at a high level.

Statistical analyses of the various data indicate there were no true differences among the regions for the various factors tested. The Iowa deer population appears to be homogeneous at this time.

INSTALLATION OF MIRROR-TYPE DEER WARNING DEVICES

Eldie W. Mustard
Game Biologist

Mirror-type deer warning devices have been placed in two locations in Pottawattamie County. The device, invented in the Netherlands, works on the idea that a deer will "hold" if the light from oncoming vehicles is reflected into its eyes. Certain problems involved in the installation of the devices in Iowa are briefly discussed.

IOWA DEER POPULATION ESTIMATES - 1963

Eldie W. Mustard
Game Biologist

Conservation Officers reported a winter deer population of 19,565 in 1963. This is a 23 per cent increase over the estimated winter population of 1962, and is almost 50 per cent greater than the average for the preceeding 5 years. The fall, 1963, deer population is predicted to be about 33,260.

QUAIL HATCH DATES FROM 1962 WING SAMPLES

M. E. Stempel
Game Biologist

One thousand two hundred eighty-nine quail wings were collected from 24 counties in the Iowa quail range in 1962. Eighty-eight per cent of the birds were juveniles. The hatch began in May and peaked in early July with a smaller peak in late August. Examination of adult wings indicated that brooding extended over a longer period in 1962 than in 1961.

RUFFED GROUSE STUDIES, 1963 (PROGRESS REPORT)

Eugene D. Klonglan
Game Biologist

A project to determine the current status of the ruffed grouse in Iowa was initiated on a cooperative basis by the Biology and Game Sections in early 1961. The three main objectives of the study are (1) to determine the present density and range of ruffed grouse in Iowa, (2) to investigate the possibility of expanding the range of the species in the state, and (3) to evaluate the harvest potential of the species. Roadside drumming counts were again made on several routes in northeastern Iowa in the spring of 1963. The ruffed grouse population in the state has apparently remained rather stable during the past 3 years, with drums per stop averages of 1.4, 1.8, and 1.7 being recorded in 1961, 1962, and 1963, respectively. A brief attempt was made to trap grouse for release in Shimek State Forest in southeastern Iowa, with three males and four females being transplanted. A more extensive trapping program will be carried on during the coming fall and winter. The evaluation of the potential for hunting ruffed grouse in Iowa is continuing.

IOWA'S SPRING PHEASANT POPULATION - 1963

Eugene D. Klonglan
and
Richard C. Nomsen
Game Biologists

There were 146 crowing cock and roadside pheasant counts taken in the spring of 1963, compared to 114 in 1962. An average of 12.9 calls per stop was heard in 1963, which is 11 per cent greater than the 11.6 calls per stop heard in 1962. The 1963 spring hen index (obtained by multiplying calls per stop by winter sex ratio) was 38.7, an 8 per cent increase over the 36.0 of 1962. An average of 2.31 pheasants per mile (0.95 cocks and 1.36 hens) was sighted on the spring roadside counts, a 30 per cent increase over the 1.77 birds per mile (0.74 cocks and 1.02 hens) of 1962. In the opinion of the Conservation Officers, this spring's pheasant population was the same as in the preceding years in 64 counties, up in 22 counties, and down in 13 counties. Spring weather conditions were very favorable for an early start in nesting activity, which usually indicates an above normal hatch and an above average hunting season.

A REVIEW OF RECENT SQUIRREL STUDIES IN IOWA

Paul D. Kline
Game Biologist

Methods for conducting four statewide studies of squirrels are reviewed. These studies consist of: Hunter-cooperator reports, officer field contacts, collection of forelegs, and mast surveys. Hunting success based on hunter-cooperator reports has ranged from 0.60 to 1.21 squirrels killed per gun hour, with a 13-year average of 0.82. Hunting success for three recent seasons based on officer field contacts has averaged 0.59 squirrels killed per hour. The discrepancy between results of the two surveys probably arises because hunter-cooperators are better squirrel hunters than the average hunter contacted by officers.

Fox squirrels have comprised 87.1 per cent of the bag during recent years, and greys 12.9 per cent. Juveniles have comprised an average of 55.1 and 54.5 per cent of the kill respectively for fox and grey squirrels. Females make up 46.0 and 46.3 per cent for fox and greys. Average annual production has been 2.67 juveniles per adult female for fox squirrels and 2.99 for greys. Using indices of "1" for poor, "2" for moderate, and "3" for abundant, mast yield over the state has ranged from 1.31 in 1958 to 2.17 in 1962. A correlation between low mast production and poor production of juveniles followed by poor hunting success appears in the data. This correlation appears most pronounced in data from the heavily wooded areas of northeast Iowa.

A SUMMARY OF AN INTENSIVE CREEL CENSUS ON POOLS 11 and 18 OF THE MISSISSIPPI RIVER

Roger Schoumacher
Fisheries Biologist

From April through October, 1962, one full-time creel census clerk was employed on each of two navigation pools on the Mississippi River bordering Iowa - pools 11 and 18. This creel census was run on a statistically designed schedule in cooperation with the Upper Mississippi River Conservation Committee, and will be repeated every 5 years to determine trends and changes in the sport fishery.

The clerk interviewed 3,166 anglers in pool 11, and projected data indicate that 32,408 fishermen fished 168,523 hours and caught 191,059 fish at the rate of 1.13 fish per hour. Crappies, bluegills, sauger, sheepshead, and channel catfish were the most important species numerically in the catch in that order. In pool 18, 4,606 fishermen were interviewed, and projection of the data indicates that 28,509 fishermen fished 123,991 hours and caught 105,024 fish at the rate of 0.85 fish per hour. Channel catfish, bullheads, crappies, white bass, and sheepshead were the most important species in the creel.

WALLEYE POPULATION STUDIES, SPIRIT LAKE, 1962

Tom Moen
Fisheries Biologist

A brief review of the walleye population studies conducted in 1961 is presented in order to provide continuity to the present report.

Electro-fishing and gillnetting during the spawning run of 1962 provided additional samples of walleyes for observation of marked and unmarked fish. Data is presented that indicates a low vulnerability of large walleyes over 20 inches in length. An additional group of walleyes was marked in the spring of 1962 by fin-clipping to provide data for a population estimated at 48,380 walleyes, 11.6 inches long and longer as of May 12, 1962. An exploitation rate of 33 per cent of these walleyes is considered valid.

AN EVALUATION OF INTRODUCING THE WALLEYE INTO A SOUTHERN IOWA ARTIFICIAL LAKE

PART II: AGE AND GROWTH

Jim Mayhew
Fisheries Biologist

The age and growth of the walleye was studied in Green Valley Lake for further evaluation of the success of introducing this species in a southern Iowa artificial lake. Scale samples from 246 walleye were obtained from the impoundment by electro-fishing in the spring of 1962.

The body-scale relationship is best represented by the second degree polynomial $L = 72.6 + 0.901 R + 0.0042 R^2$. Mean standard length for the first seven years of life was 122, 219, 294, 352, 399, 444, and 463 millimeters respectively. The mean annual increments of growth were 122, 92, 75, 60, 54, 42, and 37 millimeters. The length weight relationship as expressed by the least squares was Log W = -4.8814 + 3.0354 Log L. Average "K" was 1.64.

DESOTO BEND FISHERY INVESTIGATION, 1963

Bill Welker
Fisheries Biologist

Biologists from the Iowa Conservation Commission, Nebraska Game, Forestation and Parks Commission, and the U. S. Fish and Wildlife Service conducted a fishery survey of the Federal DeSoto Bend Refuge in western Iowa. This lake is a 7 1/2 mile section of the Missouri River which was separated from the main channel in 1960 by impervious levees. Electrofishing, gill nets, trammel nets, trap nets, and seines were used for sampling. Shad, carp, carpsuckers, drum and buffalo were the most numerous rough fish and in that order of abundance. Reproducing populations of crappie, catfish, largemouth bass, and bluegill are present. There is evidence of reduced success of walleye and sauger since separation of the lake from the river. Bottom sampling was also conducted.

ANALYSIS OF DATA OBTAINED FROM DEER CHECKING STATIONS - 1962

Eldie W. Mustard
Game Biologist

INTRODUCTION

A sample of the deer killed during the 1962 deer season was taken to determine the physical condition and reproductive success of the Iowa Deer Herd. State Conservation Commission personnel, who had attended a brief training session covering the techniques used, were situated in many localities in the State. Data were taken from deer brought to permanent check stations, locker plants, and deer located in the field.

The cooperation of all personnel who worked on the various phases of this project is appreciated.

RESULTS

Various data were obtained from 932, or 16.3 per cent, of the 5,703 deer harvested in 1962. Comparison of the number of deer checked with the number killed in each region indicates a very good distribution in the sample, with percentages for the several regions ranging from 14.0 - 17.0 per cent (Table 1).

Portions of the data were subjected to statistical analyses to determine if mean differences among the regions were true differences or merely due to normal expected variations. Regions used were those given by Kline (1958) and are based on apparent ecological differences (Figure 1). Table 2 contains a complete listing of all deer checked by sex, age, region, and for the State.

Sex Ratios

The sex was determined for 928 of the 932 deer examined in 1962. A sex ratio of 103 males: 100 females was found for all deer. The sex ratio for fawns was 98:100, and a sex ratio of 106:100 was observed for adults 1.5 years and older. The sex ratio observed for all deer in 1962, 103:100, was the lowest in the 10 years these data have been taken (Table 3). Gun hunters in 1962 reported a sex ratio of 113:100, which was the lowest number of males:100 females ever reported by this group (Table 3). No special importance is placed upon the apparent changes in the sex ratios. A chi-square (goodness of fit) test indicated there were no significant differences among the regions in the sex ratios found in 1962 (Table 4).

Age Ratios

Age was determined for 925 of the 932 deer examined; however, six of these were reported as adults, with no specific age given (Table 2). The fawns:100 adults ratio of 71:100 observed in 1962 is in close agreement with similar ratios from past years, and is indicative that the reproductive rate remained at a high level. A fawn:100 adult females ratio of 146:100 was reported and, while slightly lower than the 160:100 in 1961, is still indicative of excellent reproduction. Chi-square analysis of the fawn:adult ratio revealed no significant differences among the regions in 1962 (Table 5).

TABLE I. Number of deer killed and number of deer checked for biological data, Iowa, 1962

Region	Number Counties	Number of Deer Harvested	Number of Deer Checked	Per cent of Harvested Deer checked
I	5	751	111	14.8%
II	37	1286	180	14.0
III	21	1692	238	14.1
IV	36	1974	335	17.0
Unknown	-	-	68	-
Totals	99	5703	932	16.3%

TABLE 2. Sex, age, and number of deer checked, Iowa, 1962

Age Class	Region I		II		III		IV		Unk.		Statewide		Sex Unk.	Total
	M	F	M	F	M	F	M	F	M	F	M	F		
Fawn	25	25	31	41	49	51	68	63	17	13	190	193	4	387
Adult (Age Unk.)	0	0	2	1	1	0	2	0	0	0	5	1	0	6
1.5 year	7	14	33	23	38	13	44	47	8	9	130	106	0	236
2.5	8	13	15	14	17	35	31	38	3	9	74	109	0	183
3.5	6	5	4	5	17	7	16	8	5	3	48	28	0	76
4.5	3	1	4	2	5	0	3	5	0	0	15	8	0	23
5.5	0	1	2	0	1	1	1	1	0	0	4	3	0	7
6.5	0	0	1	0	0	1	0	0	1	0	2	1	0	3
6.5 plus	1	2	0	0	0	0	0	1	0	0	1	3	0	4
Age Unk.	0	0	0	1	1	0	0	5	0	0	1	6	0	7
Total by Sex	50	61	92	87	129	108	165	168	34	34	470	458	0	928
Sex Unk. 1/	0		1		1		2		0				4	
Total	111		180		238		335		68				932	

1/ All were fawns.

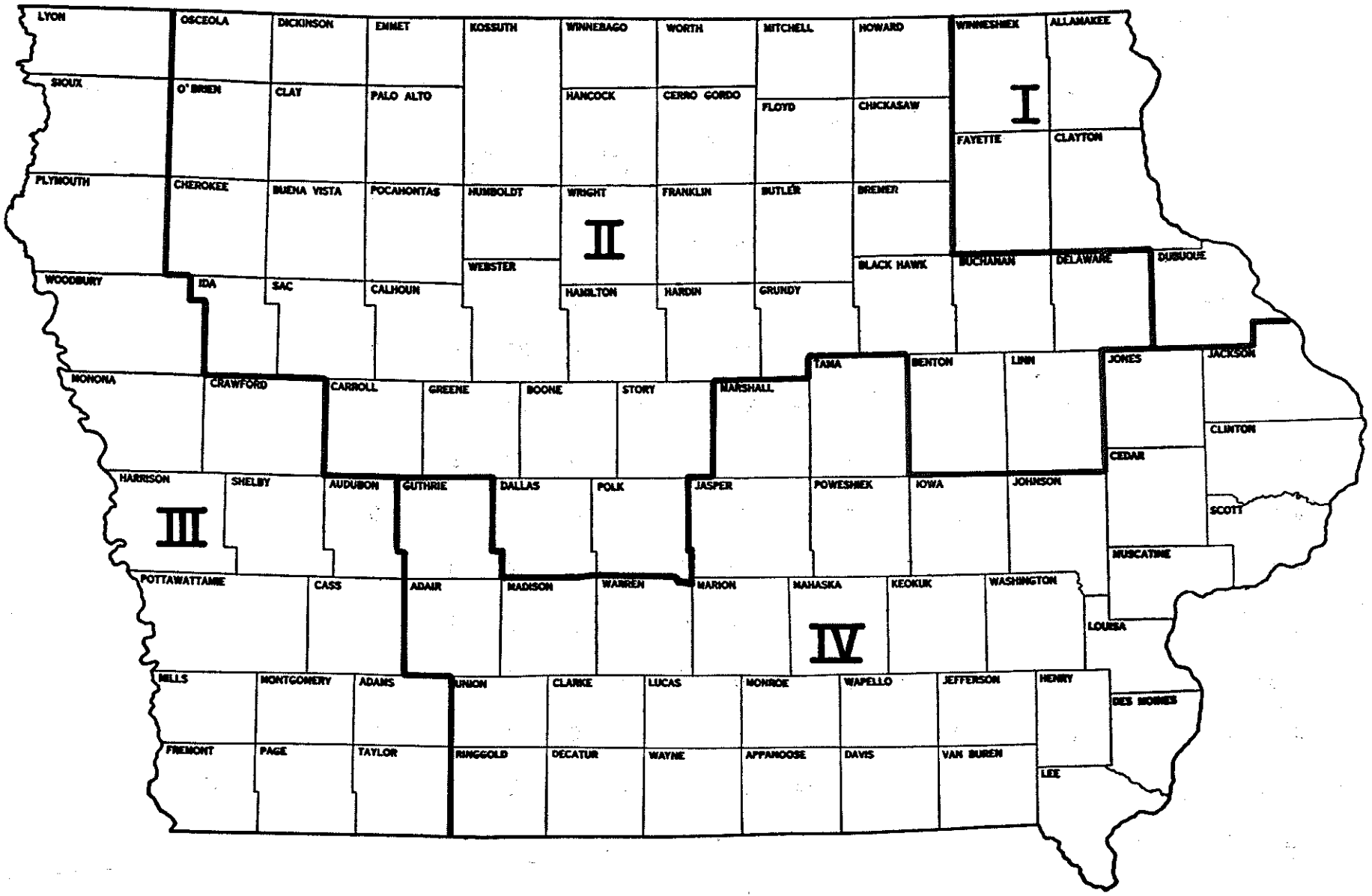

FIGURE I - PRIMARY DEER REGIONS OF IOWA

TABLE 3. Comparison of sex ratio data obtained from deer hunter report cards and deer check stations, Iowa, 1953-1962

Year	Source 1/		Difference
	Hunter Card Returns	Check Stations	
1953	115	116	1
1954	120	137	17
1955	133	110	23
1956	132	118	14
1957	120	113	7
1958 2/	177	112	65
1959 2/	280	132	148
1960 2/	195	126	69
1961	117	110	7
1962	113	103	10
Means	150	118	32

1/ Data presented as males:100 females.

2/ Years hunters were asked to save reproductive tracts from female deer.

TABLE 4. Chi-square analysis, sex ratio data, Iowa, 1962

Sex	Region I	II	III	IV	Totals
Male					
observed	50	92	129	165	436
expected	56.277	90.753	120.159	168.831	-
chi-square	0.700	0.017	0.650	0.087	p = .507
Female					
observed	61	87	108	168	424
expected	54.723	88.247	116.841	164.169	-
chi-square	0.720	0.018	0.669	0.089	p = .493
Chi-square	1.420 1/	0.035 1/	1.319 1/	0.176 1/	2.950 2/

1/ Individual chi-square: 1df, .05 = 3.841; .10 = 2.706

2/ Total chi-square: 3df, .05 = 7.815; .10 = 6.251

TABLE 5. Chi-square analysis, fawn:adult ratios, Iowa, 1962

Age	Region I	II	III	IV	Totals
Fawn					
observed	50	73	101	133	357
expected	46.287	74.643	98.829	137.610	-
chi-square	0.298	0.036	0.048	0.154	p = .417
Adult					
observed	61	106	136	197	500
expected	64.713	104.357	138.171	192.390	
chi-square	0.213	0.025	0.034	0.110	p = .583
Chi-square	0.511 1/	0.061 1/	0.082 1/	0.264 1/	0.918 2/

1/ Individual chi-square: 1df, .05 = 3.841; .10 = 2.706

2/ Total chi-square: 3df, .05 = 7.815; .10 = 6.251

The percentage of the deer in each age class and the cumulative percentage of deer in the sample are given in Table 6 for the years 1959-1962. It can readily be observed that the percentages of deer in each age class were very similar during the 4-year period in spite of tremendous differences in tht total harvest for the individual years. This I believe, is indicative that the Iowa deer herd is not being over-harvested. A chi-square test revealed no significant differences in the age ratios among regions in 1962 (Table 7).

Weights

Weights were taken from 183 deer during the 1962 season. Most of the deer weighed were hog-dressed. However, allowances were made where necessary for the heart, liver, and/or lungs, if they remained in the body cavity, in accordance with Park and Day (1942). Dressed weights were converted to liveweights by the formula 1.272 x dressed weight as given by Hornaday (1935).

Calculated liveweights for all male deer averaged 160 pounds, with an average for all females of 124 pounds (Table 8). The average weight for all deer, both sexes, in 1962 was 144 pounds compared with 130, 132, 140, 139, 136, 137, 143, and 141 for 1953-1961 respectively.

While the average weight for all deer is given for the reader's inspection, I do not believe it offers valid comparisons for deer weights among years because the various age classes and sexes are not represented in the same proportions in the sample for each year. For instance, 27 per cent of the deer checked in 1953 were fawns, while 42 per cent were fawns in 1962; obviously, weight data which simply lump all deer are not comparable and in reality reveal little.

Calculated liveweights for deer weighed in 1962 are given by age and sex in Table 8. Dressed weight data from 1.5-year old male deer were analyzed statistically to determine if apparent regional differences were true differences or due to normal variation. Reasons for using this age and sex group in the statistical analysis may be found in Mustard (1962). The statewide mean dressed weight for the 1.5-year old males was 124.0 pounds, with regional means ranging from 121.0-128.8 (Table 9). A statewide standard deviation of 13.0 pounds was determined, with regional standard deviations ranging from 2.9-15.8 pounds (Table 9). An analysis of variance test was made to determine if regional differences in mean weights were true differences; however, due to a totally inadequate sample of only one deer from Region 1, I was only able to establish that no significant differences occurred in the samples from three regions (Table 10).

Points Per Antler

Another of the general condition factors is the mean number of points per antler. Comparison of the mean number of points for all deer for 1962 of 3.83 with the means for 1960 and 1961, which were 3.88 and 3.71 respectively, indicate very little difference among the years. Comparison of the mean number of antler points for 1.5-year old males for the years 1960-1962 indicates more differences: means for these years were 3.28, 3.27, and 3.05 respectively. The number of points on the left antler of 1.5-year old deer in 1962 was statistically tested to determine if differences existed among the regions. The analysis of variance test revealed no significant differences among the regions (Table 11). Descriptive statistics and necessary sample sizes are given for the antler point data for 1.5-year old deer in Table 12. The mean number of antler points, by age, region, and state are found in Table 13.

TABLE 6. Comparison of age classes represented in deer samples during four Iowa deer seasons, check station data, 1959-1962

Age Class	Per cent of total sample				Cumulative Per cent			
	1959	1960	1961	1962	1959	1960	1961	1962
Fawn	38.3%	41.2%	43.1%	41.8%	38.3%	41.2%	43.1%	41.8%
1.5 yrs.	28.9	26.4	24.5	25.5	67.2	67.6	67.6	67.3
2.5	17.8	16.0	17.5	19.8	85.0	83.6	85.1	87.1
3.5	7.5	8.0	7.4	8.2	92.5	91.6	92.5	95.3
4.5	3.3	3.2	3.1	2.5	95.8	94.8	95.6	97.8
5.5	0.8	0.5	0.8	0.8	96.6	95.3	96.4	98.6
6.5	0.2	0.5	0.4	0.3	96.8	95.8	96.8	98.9
6.5 plus	0.4	0.2	0.7	0.4	97.2	96.0	97.5	99.3
Unknown adults	2.7	3.7	2.6	0.6	99.9	99.7	100.1	99.9

TABLE 7. Chi-square analysis, by age class and region, Iowa, 1962

Region		Age: Fawn	1.5	2.5	3.5	4.5	4.5 plus	Total No. of Deer	Chi-square Values
I	observed	50	21	21	11	4	4		
	expected	46.287	28.527	22.527	8.880	2.997	1.665	111	6.477 1/
	chi-squre	0.298	1.986	0.077	0.506	0.336	3.274		
II	observed	73	56	29	9	6	3		
	expected	74.643	45.232	35.376	14.080	4.752	2.640	176	5.989 1/
	chi-square	0.036	2.563	1.149	1.833	0.328	0.080		
III	observed	101	51	52	24	5.	3		
	expected	98.829	60.652	47.436	18.880	6.372	3.540	236	3.693 1/
	chi-square	0.048	1.441	0.439	1.388	0.295	0.082		
IV	observed	133	91	69	24	8	3		
	expected	137.610	84.296	65.928	26.240	8.856	4.920	328	1.853 1/
	chi-square	0.154	0.533	0.143	0.191	0.083	0.749		
Age Class Total		357	219	171	68	23	13	851	18.012 2/
Probability		0.417	0.257	0.201	0.080	0.027	0.015		

1/ Individual (regional) Chi-square: 5df, .05 = 11.70; .10 = 9.236

2/ Total (state) Chi-square: 15 df, .05 = 24.996; .10 = 22.307

TABLE 8. Calculated liveweights of deer checked, by age and sex, Iowa, 1962 (to nearest whole pound). 1/

Age Class	Males		Females	
	Number	Calculated Liveweight ($\bar{x}$)	Number	Calculated Liveweight ($\bar{x}$)
Fawns	34	98 lbs.	34	88 lbs.
1.5 yrs.	28	158	12	143
2.5	7	196	26	152
3.5	13	223	10	153
3.5 plus	9	237	-	-
All adults	67	191	48	150
All deer (by sex)	101	160	82	124
All deer		N = 183, $\bar{x}$ = 144 lbs.		

1/ Calculated liveweight equals 1.272 X hog-dressed weight (Hornaday, 1935).

TABLE 9. Descriptive statistics, dressed weights of 1.5 year old male deer, Iowa, 1962

Region	Number deer	Mean dressed weight	Standard Deviation	Standard Error	Confidence Intervals 2/	Necessary sample size .05 level	.10 level
I	1	110.0	-	-	-	-	-
II	3	126.0	2.9	1.68	126.0 ± 7.22	2	1
III	10	128.8	15.8	5.00	128.8 ± 11.30	30	5
IV	13	121.0	11.4	3.17	121.0 ± 6.91	16	3
State	28 1/	124.0	13.0	2.46	124.0 ± 5.04	18	3

1/ State total includes deer from unknown region (s)

2/ Confidence interval, .05 level $= \bar{x} \pm (t.05) \left(\frac{s}{\sqrt{n}}\right)$

TABLE 10. Analysis of variance, dressed weights of 1.5 year old male deer, 1962

Source	DF	SS	MS	F	Table F Value, .05, 2/25 df
Total	26-1=25	4,556.35			
Regions	3-1= 2	350.75	175.38	0.96	3.39
Residual	23	4,205.60	182.85		

TABLE 11. Analysis of variance, number points on left antler of 1.5 year old deer, 1962

Source	DF	SS	MS	F	Table F Value, 3/96 df .05	.10
Total	97-1=96	77.63				
Regions	4-1= 3	2.48	0.83	1.02	2.72	2.13
Residual	93	75.15	0.81			

TABLE 12. Descriptive statistics, number of points on left antler, 1.5-year old deer, Iowa, 1962

Region	Number left antlers	Mean no. points	Standard Deviation	Standard Error	Confidence Intervals 2/	Necessary sample size .05 level	.10 level
I	4	2.50	0.50	0.80	2.50 ± 0.80	193	19
II	28	3.21	0.90	0.35	3.21 ± 0.35	170	23
III	28	2.93	0.92	0.35	2.93 ± 0.35	178	31
IV	37	3.11	0.86	0.28	3.11 ± 0.28	151	21
State	101 1/	3.08	0.89	0.18	3.08 ± 0.18	154	22

1/ State total includes deer from unknown region (s)

2/ Confidence interval, .05 level $= \bar{x} \pm (t.05) \left(\frac{s}{\sqrt{n}}\right)$

TABLE 13. Mean number of antler points, by age, region, and state, Iowa, 1962

Age	Region I	II	III	IV	Unknown	Statewide
1.5 yrs.	2.40 (10) 1/	3.12 (56)	2.89 (57)	3.19 (74)	3.22 (9)	3.05 (206)
2.5	4.75 (16)	4.21 (24)	4.13 (31)	4.11 (44)	4.00 (2)	4.22 (117)
3.5	4.42 (12)	4.25 (8)	4.64 (28)	5.35 (17)	4.60 (10)	4.72 (75)
4.5	4.50 (2)	5.28 (7)	4.62 (8)	5.00 (6)	-	4.91 (23)
4.5 plus	9.00 (2)	5.17 (6)	7.00 (1)	5.00 (2)	-	6.00 (11)
Mean	4.28 (42)	3.74 (101)	3.74 (125)	3.83 (143)	3.95 (21)	3.83 (432)

1/ Number in parenthesis equals sample size.

TABLE 14. Mean beam diameter measurements, by age, region, and state, Iowa, 1962

Age	Region I	II	III	IV	Unknown	Statewide
1.5 yrs.	0.82 (9) 1/	0.84 (54)	0.88 (48)	0.86 (62)	0.86 (9)	0.85 (182)
2.5	1.30 (16)	1.18 (24)	1.22 (29)	1.15 (36)	-	1.20 (105)
3.5	1.29 (11)	1.24 (8)	1.40 (18)	1.50 (13)	1.48 (10)	1.39 (60)
4.5	1.51 (2)	1.36 (5)	1.46 (4)	1.21 (2)	-	1.39 (13)
4.5 plus	1.82 (1)	1.53 (6)	1.74 (2)	1.38 (2)	-	1.56 (11)
Mean	1.21 (39)	1.02 (97)	1.11 (101)	1.04 (115)	1.18 (19)	1.08 (371)

1/ Number in parenthesis equals sample size.

Beam Diameter

Beam diameter is another criterion of physical condition. Beam diameters for all deer averaged 1.08 in 1962 compared with 1.13 in 1961 and 1.12 in 1962. Means, by age, region, and for the state are given in Table 14.

Beam diameters from the left antler of 1.5-year old deer were analyzed statistically to determine if differences in the means for the regions were true differences. Results of an analysis of variance test indicated there were no significant differences among the regions in 1962 (Table 15).

Means, standard deviations, confidence intervals, and necessary sample sizes, on a regional and statewide basis, are given in Table 16.

CONCLUSIONS

The deer in Iowa appear to be in fine shape physically and, as in past years, reproduction was good in 1962.

There appears to be little necessity to analyze the data obtained through our deer checking operations by regions. Statistical analyses of 1962 check station data indicated there were no significant differences among the regions for the items subjected to analyses. If results of similar tests on data from one or two other years, perhaps including some grouping of the data for each of the several regions to secure an adequate regional sample, bears out the theory that the deer population is homogeneous, then much time can be saved in making the annual analysis.

It is my recommendation that permanent check stations be abandoned. They do have a certain value for public relations, but the only data obtained at these stations that cannot be secured in locker plants or in the field, are weight data. These data are are disappointingly sparse when divided by sex, age, and region. We have collected weight data for 10 years. This is only one of the condition factors on which information is taken, hence, its further collection is unnecessary.

I would also recommend that data be taken from one antler only. Measurement of both antlers only adds another source of variation in statistical tests and takes more time to analyze. It would be my suggestion that the left antler be used because it is the one I used in making the statistical analyses. If the left antler is missing or broken I assume it would be statistically proper to use the right antler.

SUMMARY

1. Biological data were obtained for 932, or over 16 per cent, of the total deer harvest in 1962.

2. The overall sex ratio was 103:100, with the observed ratio for fawns 98:100 and for adults 106:100.

3. Age composition of the sample indicated the Iowa deer herd was not over-harvested in 1962.

TABLE 15. Analysis of variance, left antler beam diameters of 1.5-year old deer, Iowa, 1962

Source	DF	SS	MS	F	Table F Value, 3/85 df .05	Table F Value, 3/85 df .10
Total	86-1= 85	1.49				
Regions	4-1= 3	0.03	0.01	0.50	2.72	2.15
Residual	82	1.46	0.02			

TABLE 16. Descriptive statistics, left antler beam diameters of 1.5-year old deer, Iowa, 1962

Region	Number left antlers	Mean beam diameter	Standard Deviation	Standard Error	Confidence Intervals 2/	Necessary sample size .05 level	Necessary sample size .10 level
I	4	0.84	0.09	0.13	0.84 ± 0.13	35	5
II	27	0.84	0.16	0.06	0.84 ± 0.06	60	10
III	24	0.89	0.12	0.04	0.89 ± 0.04	30	5
IV	31	0.86	0.12	0.04	0.86 ± 0.04	33	6
State	90 1/	0.86	0.13	0.02	0.86 ± 0.02	37	6

1/ State total includes deer from unknown region (s)

2/ Confidence interval, .05 level $= \bar{x} \pm (t.05) \left(\frac{s}{\sqrt{n}}\right)$

4. The fawn:adult ratios indicated the usual high rate of reproduction.

5. The general conclusion is that the Iowa deer herd was in good physical condition at the time of the 1962 deer season.

6. Statistical analyses of the various data failed to disclose any areas of significant differences in the deer sampled among the four regions. Data on some factors were scanty, but it appears there is little need to break the deer data out by region because the population seems to be homogeneous.

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INSTALLATION OF MIRROR-TYPE DEER WARNING DEVICES

Eldie W. Mustard
Game Biologist

Deer-traffic accidents have been increasing at an alarming rate in Iowa, due to an increasing deer herd, increasing travel on highways, and new highway construction which intercepts deer travel lanes, this trend is expected to continue. Losses due to traffic have increased from 120 in 1951, when records on such occurrences were begun, to 726 in 1962 (Mustard, 1962). Each deer-traffic accident holds a great potential for personal injury, or even death, to the occupants of involved vehicles, and they are a cause of great financial loss due to damage to vehicles, as well as a major loss, or waste, suffered by the Iowa deer herd.

Various measures have been taken by other states to curb deer-traffic accidents, including deer-proof fences and signs which warn the motorist of deer crossings. To my knowledge no such venture has been too successful in preventing deer-traffic accidents.

A Dutchman, A. Van de Ree, devised a device (Grahame, 1961) which utilized mirrors that reflected the light from the headlights of oncoming traffic into the eyes of deer about to cross roads. This caused the deer to "freeze" momentarily while the auto passed by. Metal mirrors were set at 45-degree angles to the road on metal posts about 3.5 feet above the road. The devices were spaced about 33 feet apart on both sides of the area protected. Apparently the device worked successfully in Holland.

Analysis of the information received from the Conservation Officers on deer killed by means other than legal hunting in 1962 indicated that 77.3 per cent of the deer reported on were killed by traffic. Of the deer killed by traffic, 82.8 per cent were killed on hard-survaced roads, and 82.8 per cent of the traffic-killed deer were hit between the hours of 5:00 P.M. and 7:00 A.M. (Mustard, op. cit.).

With a pattern of deer-traffic accidents such as given above, it appeared as though the deer warning device which was developed by A. Van de Ree warranted a test in Iowa because most of the deer were involved with traffic on heavily travelled hard-surfaced roads at times when most motorists would have their headlights on. Permission was sought, and eventually received, from the Iowa State Highway Commission to install a series of the mirror-type deer warning devices on two locations in Pottawattamie County. The locations were: (1) U. S. Highway 6, east side of West Nishnabotna River and extending about 325 feet east of the bridge. Ten mirror-type warning devices were used on each side of road; (2) Iowa Highway 275 (South Omaha Road), east of the Missouri River and extending about 375 feet east of entrance to service station. The installation involved 11 devices on each side of the road.

The State Highway Commission directed that the devices be set 2 feet from the break of the shoulder and we abided by this as well as we could while still maintaining a degree of uniformity in lining up the metal fence-posts. Placement of the mirror-devices 2 feet from the break in the shoulder meant that they were actually four or more feet from the edge of the highway, which may prove to be too far.

The devices were set on 7-foot angle-type metal posts; use of the angle-type post enabled us to mount the mirrors quite accurately at the recommended 45-degree angle to the road. Army

surplus stainless steel mirrors, approximately 3.5 x 4.75 inches, were utilized.

One problem which we tried to overcome was the fact that the mirror on the right hand side, if mounted on the metal post in the normal manner, would actually reflect the headlights about 8 to 15 feet above the level of the road ditch because of the embankment. The mirror on the right side was placed on a wedge so the light would be reflected into the ditch instead of over it.

The devices are to be checked periodically by the local Conservation Officer who will notify the Unit Manager at the Missouri River Game Management Unit in the event some of the devices need to be maintained.

The final evaluation of the mirror-type deer warning device must be based on the general impressions and experience of the local Conservation Officer because we have not kept records on deer-traffic accident locations more specifically than the county level. Deer killed by traffic on the two study areas will be reported as to location, which will be some help in evaluating the devices.

The study is to run for a two-year period, unless vandalism is a frequent occurrence. If it is, the project will probably be terminated. Under our agreement with the Iowa State Highway Commission, copies of reports concerning the mirror-type deer warning device will be made available to the office of the Chief Engineer at Ames.

Two problems concerning the devices have already made themselves evident. It was raining lightly when we began to install the devices and we noticed that the fine mist thrown by the cars as they drove by, along with a certain amount of dirt, got on the mirrors. This would undoubtedly have an effect on the reflectability of the mirrors. The other problem is one we ran into when installing the devices on Iowa Highway 275. The devices were set up on a curve which was heavily banked. Because of the extremely heavy traffic, it was virtually impossible for us to place the mirrors 3.5 feet above the level on the road because we could not get on road to check height level, so we did the next best thing and put them 3.5 feet above the level of the shoulder. This, I believe, is too high in this location because the level of the headlights is much lower due to the banked curve. A double set of mirrors, to catch the highbeam and lowbeam may be needed here and may even help on other sites.

Our visual tests at night indicated that the mirrors on Highway 275 did not pick up the lights from oncoming traffic too well. Those on U. S. Highway 6, which is a straight road with high embankments, seemed to perform as expected. It may well be that curved mirrors could be used and that such mirrors would take care of the problem caused by the embankments and curves. It is suggested that this be tried in the future.

ACKNOWLEDGEMENTS

I wish to thank my good friend Harry Harrison, Fisheries Biologist, for his assistance and mechanical ability; Duane King, Conservation Officer, for his aid in locating installation sites; Gene Goecke, Unit Game Manager, for equipment and quarters; and Don Hackbarth and Larry Van Horn, Biologist Aides, for working overtime and in the rain without complaint.

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IOWA DEER POPULATION ESTIMATES - 1963

Eldie W. Mustard
Game Biologist

INTRODUCTION

Since 1947, Conservation Officers have been asked to make an estimate of the deer population in the county or counties comprising their territories, and to delineate on county maps, areas where deer are concentrated. This paper presents the results of the 1963 population estimates.

RESULTS

A winter deer population of 19,565 was estimated in 1963, which was the greatest number of deer ever reported since the origin of the winter estimate (Table 1). Estimates ranged from 5 for Grundy County to 1,385 for Pottawattamie County (Table 2). The reported 1962 deer population was 15,938, which is 3,627 fewer than the 1963 estimate of 19,565. Comparison of the population estimates for the two years indicates about a 23 per cent increase in the winter deer population during this period.

The average winter deer population for the preceeding 5 years was 13,108, with a range of 10,643 to 15,938. The 1963 estimate of 19,565 is 6,457 (49.2%) greater than the 5-year average.

Iowa deer have an annual average reproductive rate of about 70 fawns:100 adults (Mustard, 1962). Projection of the average reproductive rate on the current winter population estimate indicates a fall, 1963, deer population of about 33,260.

DISCUSSION

This brief report was prepared essentially for the benefit of my successor so that no void would occur in our deer population data. Because of this, I will limit my discussion to one point and will include other conclusions in the biological recommendations for the 1963 deer season, which will be submitted prior to my departure.

I feel, as I believe my predecessor Paul Kline felt, that the deer in the area comprising much of north-western and north-central Iowa are in need of some reduction in hunting pressure during the open deer seasons. This area is characterized as primarily cultivated agricultural land whose rivers have a narrow - usually very narror - fringe of wooded cover. Hunting deer in this type of cover is very easy and hunters have discovered that by driving the area they can increase their success.

We are not presently over-harvesting our deer, but, as is surely indicated by the 1963 deer population estimates, there will be more permits allowed for the 1963 shotgun season. More permits will mean greater hunting pressure on the deer in the area under discussion and I do not think they should be subjected to this if we are to maintain a huntable population.

Information furnished by the gun permit holders for the 1960-1962 3-day deer seasons

TABLE 1. Winter Deer Population Estimates, Iowa, 1947-1963

Year	Population Estimate
1947	1,650
1948	2,024
1949	No Estimate
1950	4,530
1951	6,553
1952	10,721
1953	12,982
1954	11,892
1955	10,674
1956	10,811
1957	10,284
1958	10,643
1959	11,705
1960	13,101
1961	14,155
1962	15,938
1963	19,565

TABLE 2. Comparison of 1962 and 1963 Iowa winter deer population estimates, and anticipated fall 1963 population estimates, by county and state

County	Winter Pop. Est. 1963	Winter Pop. Est. 1962	Numerical Change	Pct. Change	Fall 1963 Pop. Est.
1. Adair	189	139	50	36%	321
2. Adams	25	66	-41	-62	42
3. Allamakee	750	600	150	25	1275
4. Appanoose	84	96	-12	-12	143
5. Audubon	87	72	15	21	148
6. Benton	39	51	-12	-24	66
7. Black Hawk	139	135	4	3	236
8. Boone	106	117	-11	-9	180
9. Bremer	117	55	62	113	199
10. Buchanan	138	85	53	62	235
11. Buena Vista	51	41	10	24	87
12. Butler	220	180	40	22	374
13. Calhoun	30	25	5	20	51
14. Carroll	35	26	9	35	60
15. Cass	220	223	-3	-1	374
16. Cedar	77	155	-78	-50	131
17. Cerro Gordo	25	25	0	0	42
18. Cherokee	111	99	12	12	189
19. Chickasaw	120	55	65	118	204
20. Clarke	450	260	190	73	765
21. Clay	112	58	54	93	190
22. Clayton	1150	920	230	25	1955
23. Clinton	160	160	0	0	272
24. Crawford	375	200	175	88	638
25. Dallas	242	190	52	27	411
26. Davis	89	73	16	22	151
27. Decatur	590	340	250	74	1003
28. Delaware	283	155	128	82	481
29. Des Moines	410	171	239	140	697
30. Dickinson	75	65	10	15	128
31. Dubuque	200	175	25	14	340
32. Emmet	80	80	0	0	136
33. Fayette	80	70	10	14	136
34. Floyd	155	125	30	24	264
35. Franklin	135	90	45	50	230
36. Fremont	224	166	58	35	381
37. Greene	88	75	13	17	150
38. Grundy	5	0	5	-	8
39. Guthrie	527	495	32	6	896
40. Hamilton	111	95	16	17	189
41. Hancock	33	20	13	6	56

County	Winter Pop. Est. 1963	1962	Numerical Change	Pct. Change	Fall 1963 Pop. Est.
42. Hardin	115	85	30	35%	196
43. Harrison	260	320	-60	-19	442
44. Henry	153	80	73	91	260
45. Howard	165	160	5	3	280
46. Humboldt	80	55	25	45	136
47. Ida	57	36	21	58	97
48. Iowa	127	115	12	10	216
49. Jackson	595	570	25	4	1012
50. Jasper	106	70	36	51	180
51. Jefferson	192	80	112	140	326
52. Johnson	130	110	20	18	221
53. Jones	160	355	-195	-55	272
54. Keokuk	146	111	35	32	248
55. Kossuth	73	58	15	26	124
56. Lee	237	144	93	64	403
57. Linn	220	170	50	29	374
58. Louisa	85	70	15	21	144
59. Lucas	530	515	15	3	901
60. Lyon	155	145	10	7	264
61. Madison	300	240	60	25	510
62. Mahaska	139	92	47	51	236
63. Marion	129	140	-11	-8	219
64. Marshall	133	102	31	30	226
65. Mills	264	247	17	7	449
66. Mitchell	135	130	5	3	230
67. Monona	775	575	200	35	1318
68. Monroe	285	240	45	19	484
69. Montgomery	194	150	44	29	330
70. Muscatine	80	60	20	33	136
71. O'Brien	35	20	15	75	60
72. Osceola	21	32	-11	-34	38
73. Page	188	135	53	39	320
74. Palo Alto	44	43	1	2	75
75. Plymouth	315	158	157	99	536
76. Pocahontas	45	28	17	61	76
77. Polk	120	125	-5	-4	204
78. Pottawattamie	1385	1175	210	18	2354
79. Poweshiek	65	30	35	117	110
80. Ringgold	85	61	24	39	144
81. Sac	87	57	30	53	148
82. Scott	58	45	13	29	99
83. Shelby	215	270	-55	-20	366
84. Sioux	205	115	90	78	348
85. Story	72	47	25	53	122
86. Tama	63	79	-16	-20	107
87. Taylor	38	41	-3	-7	65
88. Union	85	72	13	18	144

County	Winter Pop. Est. 1963	Winter Pop. Est. 1962	Numerical Change	Pct. Change	Fall 1963 Pop. Est.
89. Van Buren	109	117	-8	-7%	185
90. Wapello	162	165	-3	-2	275
91. Warren	144	120	24	20	245
92. Washington	240	300	-60	-20	408
93. Wayne	120	105	15	14	204
94. Webster	160	100	60	60	272
95. Winnebago	60	50	10	20	102
96. Winneshiek	775	510	265	52	1318
97. Woodbury	370	365	5	1	629
98. Worth	70	61	9	15	119
99. Wright	72	59	13	22	122
STATE TOTALS	19,565	15,938	3,627	23%	33,260

indicates that about 28.6 per cent of the deer are killed on the third day (Mustard, 1963). In 1962, Conservation Officers found that 25.2 per cent of the deer hunters hunted the third day (letter, Bob Rollins, dtd. Jan. 23, 1963). Based on this information, which is the best we have, it would appear that about 25-30 per cent of the hunters are out the third day. A reduction in the hunting pressure could most expediently be accomplished on the area under consideration by reducing the deer season by one day. This area is large, encompassing 25 counties, and because of its large size and the fact that it is a continuous area, I believe a shortened season would accomplish the desired reduction in hunting pressure. I feel it would be unwise to recommend such an action for isolated counties which are essentially surrounded by counties with longer seasons. Such an action would probably only cause confusion.

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QUAIL HATCH DATES FROM 1962 WING SAMPLES

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Game Biologist

In 1962, as in former years, the writer made a study of wings from quail taken during the hunting season. These were collected from hunters by Officers, Game Section Personnel and Biologists in the quail range which lies mostly in southern Iowa. Many wings are from young quail which can be classified as to age in days, and for this group of young it is possible to back date and establish hatching periods. Others can be classed only as young or adults. Sight records of coveys are included to complete our understanding of quail production.

METHODS

Before the 1962 quail shooting season, each Officer in the 69 counties of the quail range received a letter requesting that he assist in collecting wings. I located additional hunter-cooperators in Appanoose, Davis, Jefferson, Monroe, Van Buren, and Wapello Counties. Each person was provided with wing collection envelopes. As soon as wings from a day's hunt were placed in the envelope, the date and county were noted on the container along with sex of birds. As soon as it was filled, each envelope was to be mailed to me in Ottumwa. Each week of the quail hunting season I gathered the wings from the hunter-cooperators in counties near Ottumwa.

The age of quail is determined by classifying the wing as outlined in the Quarterly Biology Reports, July 1959. First, each bird is put into one of three general categories: adults; young over 150 days old; young under 150 days old. This latter group can be classified as to days of age by referring to a chart based on primary flight feather development.

RESULTS

A total of 1,289 wings was collected from 24 counties with most of the total from 8 of the 20 counties which comprise the southern Iowa quail country. Of the collection, 450 wings were either damaged, spoiled, or not accompanied by sufficient information to be of any value in computing the hatch. Of the remainder, 736 (88 per cent) were from young quail.

Slightly more than one-half of the young were shot between November 3 and 15. Twenty-six per cent were taken between November 16 and 30 and only 20 per cent were bagged between December 1 and 14 (the end of the shooting season).

Most of the information on hatching is from wings of quail under 150 days old, but a limited amount of information is secured by examining wings of older juveniles. The latest possible hatch date can be learned; this would be the kill date minus 150 days. In 1962, 29 per cent of young over 150 days old and which were shot between November 3 and 15, hatched before June 18. This increased to 67 per cent in the December 1 to 14 period - the last 2 weeks of the season.

Quail may be shot during an open season in 69 counties. In 1962, practically all of the wings were from the following counties:

Adams	Greene	Monroe*
Appanoose*	Jasper	Poweshiek
Buchanan	Jefferson*	Ringgold
Clarke*	Lee	Taylor
Dallas	Lucas*	Van Buren*
Decatur	Madison*	Wapello
Davis*	Mahaska	Warren
Des Moines	Marion	Wayne

* These 8 counties contributed 546 wings, and reported some of the best quail shooting. A large contribution from the Ringgold County area could not be used since there was no information on place or date.

For the dated wings under 150 days old, back dating revealed that the hatch began about June 15 and continued through September 15. Hatching peaked in July, with a smaller peak in August.

If only the aging method was used on dated wings, there would be little information on the fully matured juveniles (over 150 days old). This group in 1961, made up 37 per cent and in 1962, 42 per cent. It was found advisable to use another means of estimating the hatch dates for these. This was accomplished by: (1) Reports of young broods seen during the summer by Conservation Officers; (2) reports from Biologists, farmers, and other interested individuals, concerning birds seen on roadsides and in fields. Age of these broods is based on a description which designated each as 1/4, 1/2, 3/4 or fully matured.

This information revealed that quail began to hatch in May. Hatching was fairly well distributed through summer. Combined data from ageable wings and from observations indicate that for all birds aged, the hatch began in May, peaked in early July and fell off somewhat thereafter. A lesser peak appeared in late August and production ceased about October 1.

Adult birds (over one year old) cannot be classified as to days of age, but after the brooding period they do moult. This moult includes the 10 primary flight feathers and except for the outer 2 feathers (which are shed by adults but not by young), the pattern of moult and regrowth follows that of the young. Thus the flight ability in parents is similar to that of the offspring. That is, associated quail, juveniles and adults, moult and regrow one feather at a time during about the same period. A record of stage of growth of primary feathers in adults indicates that in 1962 most adults were in the process of completing the moult of the outer primaries by the latter part of the shooting season, but none had fully completed this process. Since moult follows brooding, some possible late brooding is indicated for 1962. In 1961, 6 per cent of adults had 10 mature primary flight feathers which indicates early production.

SUMMARY

1. In 1962, Officers and Biologists collected 1,289 quail wings in 24 counties.

2. A study of 643 wings accompanied by information on place and date of kill revealed a July hatch peak and a lesser August peak.

3. Twenty-nine per cent of the older juveniles shot between November 3 and 15, hatched before June 18. This, along with data on broods seen during summer, indicated that hatching began in May.

4. Adult quail had not completed the primary wing feather moult by the end of the 1962 hunting season. In 1961 the moult was nearly completed. This indicates a later production period in 1962.

RUFFED GROUSE STUDIES, 1963 (PROGRESS REPORT)

Eugene D. Klonglan
Game Biologist

A cooperative project to learn more about the status of the ruffed grouse in Iowa was begun in 1961 by the Biology and Game Sections. Little detailed data are available on grouse for earlier years, only general information on the main occupied range of the species. Little was known about the exact range and present density of the population, and it may be true that this species could support a limited hunting season. There is also a possibility that the current range of the species in the state could be expanded by trapping grouse and transplanting them to suitable habitat.

The first step in the investigation is to determine the present density and range of the ruffed grouse in Iowa. Many people have been contacted and earlier records searched to learn as much as possible about the past history and, insofar as possible, the current status of the species in the state. The need for a census method that could be used to obtain comparative quantitative population data on an annual basis soon became apparent. As a result, the spring roadside drumming count technique was selected as most suited for our purposes, considering limitations of time and personnel (see April-June 1961 Quarterly Biology Reports).

A few exploratory drumming counts had been made in northeastern Iowa in 1956 and 1960, and more intensive surveys were initiated in 1961. Fifteen routes were run in six counties in 1961 (again see April-June 1961 Quarterly Biology Reports). Some of these were also primarily of an exploratory nature, and on these routes few or no grouse were heard. In 1962 the number of routes was decreased to ten in three counties (see October-December 1962 Quarterly Biology Reports). Nine were repeats from 1961 and one was new.

In 1963, 15 roadside drumming counts were made on ten different routes by the Biologist, Area Game Manager, local Conservation Officers, and ISU graduate student Dale Hein. One of these was of a strictly exploratory nature along the Turkey River in the Elkader vicinity in west central Clayton County, and no drums were heard there. One new route encompassing the lower Yellow River was added. Two of the ten routes used in 1962 were abandoned for purposes of annual comparison, these being the route north of Lansing in Allamakee County and the route in the Bluffton area along the Upper Iowa River in northwestern Winneshiek County. Too few suitable stops were available on the former and two few grouse were heard on the latter to show year to year changes. (It should be pointed out that in some instances where few grouse were heard on drumming routes it may only mean that the roads in the area did not come close enough to the best grouse habitat for drumming grouse to be heard, and not that there are no grouse in the area.) Some of the routes were run more than once to get an idea of the amount of variation that might be found with this particular technique. Thus, after 3 years of drumming counts in northeastern Iowa nine routes have been established for the purpose of maintaining annual comparisons of ruffed grouse population trends. The results of the 1963 counts on the nine chosen routes are presented in Table 1.

Seven of these nine routes have been run during all 3 years of the current study. A comparison of the results obtained on these routes indicates the grouse population has been relatively stable over this period (Table 2). The slightly lower 1961 mean of 1.4 drums per stop is somewhat clouded by the low count on the Village Creek route that year. This route was run

TABLE 1. Results of 1963 spring ruffed grouse drumming counts in northeast Iowa

County	Part	Route	Date Run	No. of Stops	Individual Birds Drumming	Total Drums Heard	Total Drums Heard Per Stop
Allamakee	SE	Yellow River State Forest	4/18	15	31	38	2.5
Allamakee	C	Village Creek	4/17	13	17	26	2.0
Allamakee	E	Harpers Ferry - Wexford	4/24	15	21	24	1.6
Allamakee	N	Upper Iowa River	4/27	15	16	26	1.7
Allamakee	SE	Lower Yellow River*	4/27	15	22	28	1.9
		TOTALS		73	107	142	1.9
Winneshiek	NE	Highlandville - North Bear	4/27	14	36	42	3.0
Winneshiek	SE	Frankville - Yellow River	4/26	15	8	9	0.6
		TOTALS		29	44	51	1.8
Clayton	NE	Sny Magill - Bierbaum	4/24	15	9	11	0.7
Clayton	NE	Bloody Run	4/24	13	11	13	1.0
		TOTALS		28	20	24	0.9
Statewide		Nine Routes Run		130	171	217	1.7

* New route in 1963; route N. of Lansing in Allamakee County and Bluffton route in NW Winneshiek County not run in 1963.

TABLE 2. Comparison of 1961-62-63 spring ruffed grouse drumming counts on seven routes run all three years

Route	No. of Stops	Total Drums Heard			Total Drums Per Stop		
		1961	1962	1963	1961	1962	1963
		Allamakee County					
Yellow River State Forest	15	36	52	38	2.4	3.5	2.5
Village Creek	13	6	30	26	0.5	2.3	2.0
Harpers Ferry - Wexford	15	26	30	24	1.7	2.0	1.6
Upper Iowa River	15	24	30	26	1.6	2.0	1.7
	58	92	142	114	1.6	2.4	2.0
		Winneshiek County					
Highlandville - North Bear	14	40	25	42	2.9	1.8	3.0
Frankville - Yellow River	15	6	3	9	0.4	0.2	0.6
	29	46	28	51	1.6	1.0	1.8
		Clayton County					
Sny Magill - Bierbaum	15	5	9	11	0.3	0.6	0.7
Statewide	102	143	179	176	1.4	1.8	1.7

by a different individual in 1961, one who did not participate in any of the other counts in the table, and differences in hearing ability may have been a factor. If the Village Creek data are deleted from Table 2, means of 1.5, 1.7, and 1.7 drums per stop for 1961, 1962, and 1963, respectively, are obtained--which certainly indicates no significant change in ruffed grouse population levels over this period. The drumming count technique was a new one to all observers in 1961, and this may also be reflected in the results obtained.

The second phase of this ruffed grouse study involves the possible re-establishment of the species in some of its former range in the state. There are at least two areas that appear to have considerable potential for maintaining a grouse population--Shimek State Forest in Lee and Van Buren Counties in southeastern Iowa and Stephens State Forest in Lucas and Monroe Counties in south central Iowa. A brief attempt was made by the Game Section in the fall of 1962 to trap and and transplant grouse to Shimek Forest. Seven birds, three males and four females, were successfully stocked as a result of this venture. One ten-stop drumming route was run around the release site in mid-April, but no drums were heard. An expanded trapping program is planned for this fall and winter, with the aim of stocking 50 grouse in Shimek State Forest. If trapping success permits, it is hoped to stock another 50 birds in Stephens State Forest.

The third aspect of the project is concerned with evaluating the harvest potential of ruffed grouse in northeastern Iowa. The drumming counts indicate a population density that compares favorably with many other states where hunting is allowed. Thus a limited hunting season to remove some of the annual surplus of birds should not harm the species. Several "flushing" counts in typical grouse range are planned for this fall to obtain an idea of what a hunter might expect. An attempt is also being made to determine the approximate number of square miles of occupied grouse habitat and to arrive at a rough estimate of the total grouse population in northeastern Iowa. This should give us some idea of how many grouse would be available for hunting each year.

SUMMARY

1. Ruffed grouse roadside drumming counts were again made on several routes in northeastern Iowa in the spring of 1963.

2. The ruffed grouse population in the state has apparently remained rather stable during the past 3 years.

3. A brief attempt was made to trap grouse for release in Shimek State Forest, with seven birds being stocked. Further trapping and transplanting will be done.

4. Evaluation of the hunting potential for grouse in Iowa is continuing.

IOWA'S SPRING PHEASANT POPULATION - 1963

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INTRODUCTION

The primary method for obtaining information on the spring pheasant population in Iowa is the crowing cock count. Such counts have been made by Conservation Officers since 1950. Previous to 1962, two 20-stop routes were run in each county. In 1962 this was changed to two 10-stop routes for each Officer, regardless of whether he is assigned one or two counties. New routes and stop locations were also designed in 1962 for all counties, many of the old routes having become unsatisfactory for various reasons (see April-June 1962 Quarterly Biology Reports, pp. 25-31, for discussion of revised system). In addition to the regular crowing count, a 10-mile roadside sight count was added on an experimental basis in 1962. Unit Game Managers and Game Biologists are also included in the new scheme.

The winter of 1962-63 was in general a favorable one for Iowa's pheasants, a marked contrast from the severe winter of 1961-1962. Though it was a rather cold winter, snowfall was comparatively light over the state. No severe statewide blizzards occurred, and pheasants experienced less winter mortality than is usually the case. Food was plentiful, and lack of adequate winter cover in much of the pheasant range was not as critical a factor as it is under severe winter conditions. Spring weather conditions were very favorable for an early start in nesting activity, which usually indicates an above normal hatch and an above average hunting season. This spring was the warmest since the excellent pheasant year of 1958. Also, it was not a wet spring (a wet spring usually being an adverse factor, particularly in combination with cool weather). Reports of broods being sighted were earlier than usual this spring, which again indicates an early hatch and a bumper crop of pheasants.

METHODS

The technique for conducting the spring crowing and roadside counts remained essentially the same as in 1962. The number of cock calls heard during a 2-minute period at each of 10 stops on a route was recorded. Counts were to be started 45 minutes before sunrise on relatively clear, calm mornings. As soon as the crowing count is completed, a 10-mile roadside sight count is made over the same route. The observer drives at a speed of 15-20 mph. and records the numbers of cocks and hens sighted. Special columns to record the numbers of cottontails, jackrabbits, bobwhite quail, and hungarian partridge were added to the forms this year, rather than a single column for "other species".

Each Officer making the counts was asked his general opinion as to the status of the pheasant population in this county this spring as compared to the years preceding. He was also asked whether the particular route he was running was in a part of the county with an above average, average, or below average pheasant population for that county ("average" referring to a long-term basis). A third question asked which part of each county had the best pheasant population and which had the poorest, again on a long-term basis.

For purposes of analysis, the state is divided into six major regions (Figure 1). These regions were set up to each contain more than 20 census routes, with the aim of obtaining at least 20 good counts each year from each region in order to have an adequate number to make valid year to year comparisons. Other items considered in delineating the divisions were similarity of soil types, pheasant populations, and agricultural practices, and recognizable geographical areas of the state (partially for publicity purposes).

RESULTS AND DISCUSSION

Crowing Cock Counts

The 1963 crowing cock census indicated there was no important change in this spring's pheasant population from that of 1962, with only a slight upward trend (Table 1). There was an apparent statewide increase of 11 per cent, but when the figures for the six different regions are examined it becomes obvious that the bulk of this increase could be attributed to the north central region. Four of the regions actually showed a slight decrease; however, in all four instances the change was so slight it was not significant. Southern Iowa continued to show a slight upward trend, but the fewest birds are recorded here.

TABLE 1. Results of 1963 spring crowing cock counts made by Conservation Officers, Unit Game Managers, and Game Biologists, and comparison with 1962 counts

Region of state	1963		1962		Change from 1962
	No. of counts	Mean calls per stop	No. of counts	Mean calls per stop	
Northwest	22	20.4	16	20.7	- 1%
North Central	22	29.0	16	21.9	+32%
Central	25	13.7	18	15.5	- 12%
Southwest	21	9.3	16	9.5	- 2%
East	24	5.7	21	6.0	- 5%
South	32	4.0	27	3.3	+21%
Statewide	146	12.9	114	11.6	+11%

It should be pointed out that in the 1963 vs. 1962 comparisons, crowing counts from Conservation Officers, Unit Game Managers, and Game Biologists were all included for both years. Thus the indicated 1962 mean of 11.6 calls per stop differs slightly from the 11.5 reported in Table 1 in the April-June 1962 Quarterly Biology Reports. In the 1962 vs. 1961 comparisons reported therein only Officer counts were used, inasmuch as the other two groups were not a part of the system in 1961.

Censusing conditions were more favorable in 1963. The spring of 1962 was characterized by unusually persistent winds throughout the period of peak pheasant crowing activity. As a result, many counts were taken under marginal wind conditions, whereas some routes were not run at all and others were delayed. In 1963 the average wind velocity reported on the counts taken was 4.1 mph., varying from 3.5 to 4.9 within the six regions (Table 2). The 1962 mean was 4.8 mph., varying from 4.2 to 5.8 within regions (Table 2). The mean wind velocity in 1961 was 3.9 mph. Average wind velocity was decreased in all but the southwestern region this year, with the greatest decrease in north central Iowa (the area with the most persistent winds in 1962). This may account in part for the apparent increase of 32 per cent in the crowing count in this region. If so, this would tend to substantiate the conclusion that there was no important change in this spring's crowing count over last year's.

The peak of crowing activity occurred earlier this year than in 1962, no doubt due to the earlier spring. As a result, instructions to take the counts were sent out sooner. With the generally favorable weather conditions that prevailed, it was possible to complete the counts earlier than in 1962. The average date of completion on a statewide basis was May 4 in 1963 compared to May 13 in 1962 (Table 2). This trend was evident in all regions. Counts in northern Iowa were taken about a week later than in southern Iowa.

Spring Hen Index

In order to make the crowing count information more meaningful, it is necessary to take into consideration the ratio of hens per cock found in the field. Sex ratios generally have not varied much in Iowa from year to year, so the crowing count alone usually gives a fairly accurate picture of population changes. However, in years following a poor harvest of cocks, which might result from unduly adverse conditions during the hunting season, it would be possible to obtain an erroneous picture. Hence, each year a statewide hen index is determined by multiplying the observed sex ratio from winter observations by the average number of calls per stop. The 1962 statewide spring hen index was 36.0 (11.6 calls per stop multiplied by the observed winter sex ratio of 3.1 hens per cock). In 1963 it was 38.7 (12.9 calls per stop multiplied by observed winter sex ratio of 3.0 hens per stop). This again points to only a slight increase - 8 per cent - in this spring's pheasant population.

Spring Roadside Counts

There were 3,369 pheasants sighted on the 146 10-mile roadside routes censused this spring, an average of 2.31 birds per mile (Table 3). This is about a 30 per cent increase over the 1.77 per mile sighted in 1962 (see Table 4, which is a tabulation of all 1962 data and not just the Officers' data as given in the April-June 1962 Quarterly Biology Reports). Both hens and cocks showed similar increases. However, this apparently significant increase must be tempered by the realization that the counts were completed on an earlier date, on the average, in 1963. As mentioned earlier, persistent winds in 1962 forced many of the counts to be delayed more than is usually the case. Hence in 1962 the spring vegetation had reached a more advanced stage for many of the counts and made it more difficult to see birds. Perhaps most significant here is the fact that the roadside counts indicate an upward trend, the same as do the crowing count and the spring hen index.

The statewide observed sex ratio on the 1963 spring roadside counts was 1 cock:1.4 hens, the same as in 1962 (Tables 3 and 4). It must be remembered that this ratio is strictly an index and not the true situation in the population. The more conspicuous coloring of the cocks and

TABLE 2. Comparison of dates on which spring pheasant counts were taken and mean wind velocity during counts, 1963 vs. 1962

Region	Mean date of counts		Mean wind (mph) during counts	
	1963	1962	1963	1962
Northwest	May 8	May 21	3.5	4.2
North Central	May 9	May 19	4.3	5.8
Central	May 1	May 11	4.2	4.8
Southwest	May 3	May 12	4.9	4.4
East	May 3	May 12	3.7	4.5
South	May 2	May 7	4.1	4.9
Statewide	May 4	May 13	4.1	4.8

TABLE 3. Results of 1963 spring roadside pheasant counts made by Conservation Officers, Unit Game Managers, and Game Biologists

Region of state	No. of miles	No. of cocks	No. of hens	Total no. of birds	Cocks per mile	Hens per mile	Total per mile	Sex ratio (M:F)
Northwest	220	336	446	782	1.53	2.03	3.55	1:1.3
North Central	220	422	708	1130	1.92	3.22	5.14	1:1.7
Central	250	224	288	512	0.90	1.15	2.05	1:1.3
Southwest	210	169	248	417	0.80	1.18	1.98	1:1.5
East	240	112	145	257	0.47	0.60	1.07	1:1.3
South	320	119	152	271	0.37	0.48	0.85	1:1.3
Statewide	1460	1382	1987	3369	0.95	1.36	2.31	1:1.4

TABLE 4. Results of 1962 spring roadside pheasant counts made by Conservation Officers, Unit Game Managers, and Game Biologists (for comparison with 1963 results shown in Table 3)

Region of state	No. of miles	No. of cocks	No. of hens	Total no. of birds	Cocks per mile	Hens per mile	Total per mile	Sex ratio (M:F)
Northwest	160	214	270	484	1.34	1.69	3.03	1:1.3
North Central	160	225	334	559	1.41	2.09	3.49	1:1.5
Central	180	152	303	455	0.84	1.68	2.53	1:2.0
Southwest	160	108	124	232	0.68	0.78	1.45	1:1.1
East	210	91	95	186	0.43	0.45	0.89	1:1.0
South	270	53	35	88	0.20	0.13	0.33	1:0.7
Statewide	1140	843	1161	2014	0.74	1.02	1.77	1:1.4

TABLE 5. Summary of Conservation Officers' opinions on status of 1963 spring pheasant population as compared to preceding years in each county

Region of state	No. of counties in region	Conservation Officers' opinion on spring population trend		
		Up	Same	Down
Northwest	16	4	12	0
North Central	13	1	7	5
Central	15	5	8	2
Southwest	16	4	10	2
East	18	2	12	4
South	21	6	15	0
Statewide	99	22	64	13

their bolder habits at this season plus the beginning of nesting by the hens means a disproportionate share of cocks is sighted. The sex ratio observed in winter gives a more accurate picture. The winter sex ratio in 1963 was 3.0 hens per cock; in 1962 it was 3.1 hens per cock - certainly not a significant difference. The spring counts following show the same relationship, inasmuch as both resulted in 1.4 hens per cock. The 1963 spring ratios did not exhibit as much variation between regions as did the 1962 ratios. This may indicate a more even distribution of the kill during the last hunting season, but without regional kill figures this must remain purely speculative. North central and southwest Iowa, two areas with good pheasant populations and considerable hunting pressure, showed the most divergent sex ratios.

Conservation Officers' Opinions

Each Officer was asked for his general opinion as to the status of the pheasant population in his county, or counties, this spring as compared to the preceding years. Replies were received for all 99 counties. In 64 counties the population was rated the same, in 22 it was believed to be up, and in 13 it was felt to be down (Table 5). This further substantiates the apparent slight increase in the 1963 spring pheasant population indicated by the crowing count, spring hen index, and roadside count.

SUMMARY

1. There were 146 crowing cock and roadside pheasant counts taken in the spring of 1963, compared to 114 in 1962.

2. An average of 12.9 calls per stop was heard in 1963, which is 11 per cent greater than the 11.6 calls per stop heard in 1962.

3. The 1963 spring hen index (obtained by multiplying calls per stop by winter sex ratio) was 38.7, and 8 per cent increase over the 36.0 of 1962.

4. An average of 2.31 pheasants per mile (0.95 cocks and 1.36 hens) was sighted on the spring roadside counts, a 30 per cent increase over the 1.77 birds per mile (0.74 cocks and 1.02 hens) of 1962.

5. In the opinions of the Conservation Officers, this spring's pheasant population was the same as in the preceding years in 64 counties, up in 22 counties, and down in 13 counties.

6. Spring weather conditions were very favorable for an early start in nesting activity, which usually indicates an above normal hatch and an above average hunting season to follow.

7. The general conclusion reached is that the 1963 Iowa spring pheasant population showed a slight, but not important, increase over 1962.

A REVIEW OF RECENT SQUIRREL STUDIES IN IOWA

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This report is intended as a review of squirrel research techniques practiced in Iowa during recent years. It is not intended as a final compilation of findings, although some results are presented. Most of the work has been directed at determining hunting success on a comparative basis from year to year, and correlating hunting success with annual juvenile production, mast production, and climatic conditions.

METHODS

Hunter-Cooperator Reports

Records of squirrel hunting success in Iowa have been accumulated each season since 1950 through the cooperation of hunters. Questionnaires are mailed before the start of the squirrel hunting season each fall to squirrel hunters distributed throughout Iowa. These hunters are selected as potential cooperators by Conservation Officers or have known records of past cooperation. They record the following information for each of their hunting trips: number and species of squirrels killed, crippled, and observed; sex of squirrels; size of hunting party; hours spent hunting; county hunted; use of dogs; and type of guns used. In addition, they are asked to venture their opinions regarding overall abundance of squirrels as compared to the previous seasons. Finally, each hunter is asked to save one front leg bone from each squirrel killed.

Officer Field Contacts

Beginning in 1960 Conservation Officers have recorded on special forms the objectives, party sizes, hours afield location, and success of hunters and fishermen contacted in the field. These records provide valuable data which is used to compute hunting success, expressed as squirrels killed per gun hour, in various portions of Iowa.

Foreleg Collections

Conservation Officers, Game Managers, and Biologists have collected one foreleg from each squirrel examined in hunters' bags starting in 1958. These collections, with the forelegs submitted by hunter-cooperators, are boiled in water until soft, then inspected for the presence of epiphyseal cartilage on the distal ends of the radius and ulna. Presence of cartilage or an epiphyseal line denotes juvenile squirrels. Ratios of juvenile versus adult squirrels are used as indicators of annual production each year. In addition, by multiplying per cent adults in the bag for one season by the per cent females reported by hunters for the previous season and dividing this into the per cent of juveniles we can obtain an index of juveniles produced per adult female per season.

Mast Surveys

Starting in 1958, all Foresters, Game Managers, and Biologists have recorded an annual estimate of mast production in the form of hickory nuts, walnuts, and acorns within the area with which they are familiar. Each observer records for the species he comes in contact with,

local production classed as "abundant", "moderate", or "poor". The reports are compiled by assigning values of 1 for poor, 2 for moderate, and 3 for abundant. An index of statewide production of one species is calculated by adding all values for that species and dividing by the number of observations of the same species. The statewide index of production for all nut-bearing trees is computed by adding all values for all species and dividing by the total observations of all individual species.

RESULTS

Hunting Success

Reports received from hunter-cooperators indicate hunting success has remained relatively stable during the past three seasons (1960 to 1962). Hunters reported 0.84 squirrels killed per gun hour in 1962 compared to 0.88 in 1961 and 0.85 in 1960 (Table 1). Only 0.69 squirrels were killed per gun hour in 1959. The average for 13 seasons since 1950 has been 0.82, with a high of 1.21 in 1951 and a low of 0.60 in 1963. The number of squirrels seen per hour of hunting has varied between 2.29 in 1951 and 1.47 in 1953, and appears to fluctuate directly with the kill per gun hour.

Field contact records by Conservation Officers show slightly better success was enjoyed by squirrel hunters in 1961 than in 1960 and 1962 (Table 2). Best hunting was reported from the Southern loess area in 1960 and from the Western loess in 1961 and 1962. The indices of success reported by Conservation Officers, as compared to those reported by hunter-cooperators, show the latter group consistently hunts with more success (Table 3).

Sex and Age Ratios

During the past 13 seasons hunter-cooperators have reported killing 11,153 fox and 1,652 grey squirrels. On a percentage basis the fox squirrels comprise 87.1 per cent of the total, which is considered representative of the total kill of squirrels in Iowa during average years. In computation of sex and age ratios the species are separated.

The per cent of juveniles in the bag has ranged from 59 in 1953 to 50.1 in 1959 for fox squirrels and from 78.3 in 1955 to 38.1 in 1952 for grey squirrels. The average for the two species is remarkably close, 55.1 for fox squirrels and 54.5 for grey (Table 4). The percentages expressed for fox squirrels are believed more consistently accurate than that for grey squirrels as the sample size for greys has in some years been quite small.

The per cent of females reported in the bag has ranged consistently near the 13-year averages of 46.0 and 46.3 for fox and greys respectively during most years (Table 4). There are at least three possibilities that might explain the consistently higher proportion of males in the bag. It may be possible that the sex ratio is really accurate and that the squirrel population has a preponderance of males. Secondly male squirrels may range more and be more active, thus exposing themselves to hunting more than the females. Finally, it is possible that squirrel hunters are more reluctant to report shooting females than males. The writer has no real hint as to the reason for this phenomena.

Annual squirrel production expressed as juveniles produced per adult female varied from 3.11 in 1953 to 2.09 in 1959 for fox squirrels, with a twelve year average of 2.67. In greys the average is somewhat higher (2.99) but varies much more because of the small sample used in making

TABLE 1. Statewide Success of Squirrel Hunters for 13 Recent Seasons Based on Hunter-Cooperator Reports

Year	Gun Hours Recorded	Squirrels Killed		Squirrels Killed/ Gun Hour	Squirrels Seen/ Gun Hour
		Fox	Grey		
1950	-------	1,393	185	0.75	1.56*
1951	-------	770	115	1.21	2.29
1952	-------	1,209	97	0.87	1.85
1953	-------	710	42	0.60	1.47
1954	-------	541	36	0.80	1.87
1955	-------	1,027	108	0.80	1.90
1956	1,590.6	1,009	125	0.71	2.27
1957	1,298.25	835	170	0.77	1.82
1958	1,499.5	1,093	194	0.86	1.93
1959	1,320.5	772	134	0.69	1.76
1960	1,027.5	705	170	0.85	2.01
1961	750.25	503	155	0.88	2.07
1962	837.0	586	121	0.84	1.95
Total Squirrels		11,153	1,652	----	----
Average	1,189.1	857.9	127.1	0.82	1.90

* Squirrels seen includes all those observed, whether or not killed or crippled.

TABLE 2. Squirrel Hunting Success Based on Conservation Officer Field Contact Records for 1960 Through 1962 Seasons

Area	Season	Gun Hours Recorded	Squirrels Bagged	Squirrels Killed/ Gun Hour
Western Loess	1960	191.5	103	0.54
	1961	232.75	195	0.84
	1962	142.	89	0.63
Northern Glaciated	1960	1,016.25	558	0.55
	1961	944	562	0.60
	1962	958.5	532	0.56
Southern Loess	1960	410.5	245	0.60
	1961	832.5	522	0.63
	1962	508.5	278	0.55
Northeast Driftless	1960	116.5	62	0.53
	1961	170.75	107	0.63
	1962	400.5	228	0.57
Statewide	1960	1,734.75	968	0.56
	1961	2,180	1,386	0.64
	1962	2,009.5	1,127	0.56
	All Seasons	5,924.25	3,481	0.59

TABLE 3. Comparison of Hunting Success from Conservation Officer Field Contact Records with Hunter-Cooperator Reports

Season	Squirrels Per Gun Hour	
	Officers Field Contact Records	Hunter-Cooperator Reports
1960	0.56	0.85
1961	0.64	0.88
1962	0.56	0.84
Average	0.59	0.86

TABLE 4. Sex and Age Ratios and Production of Squirrels in Iowa for 13 Recent Seasons

Year	Per Cent Juveniles		Per Cent Females		Juveniles Produced per Adult Female	
	Fox	Gray	Fox	Gray	Fox	Gray
1950	57.2	54.0	43.4	46.8	----	----
1951	52.5	50.9	45.7	47.6	2.55	2.21
1952	56.4	38.1	46.3	46.4	2.83	1.29
1953	59.0	59.4	46.7	37.0	3.11	3.15
1954	53.2	48.6	44.7	43.1	2.43	2.56
1955	55.9	78.3	44.7	48.5	2.84	8.37*
1956	56.1	65.7	47.5	48.7	2.86	3.95
1957	56.0	57.6	46.5	47.8	2.68	2.79
1958	51.6	52.6	48.1	49.3	2.29	2.33
1959	50.1	48.4	46.0	46.0	2.09	1.90
1960	58.6	58.8	46.4	49.1	3.08	3.10
1961	53.4	40.1	45.4	44.6	2.47	1.36
1962	56.35	55.75	46.0	47.0	2.84	2.82
Average	55.1	54.48	45.95	46.3	2.67	2.99

* Apparent fluctuations in grey squirrel data due in part to paucity of data some years.

computations during some years (Table 4).

Mast Yields

The statewide index of mast yield has varied from 1.31 in 1958 to 2.17 in 1962 (Table 5). It is difficult to compare yields for recent years except by the expression of these indices, but 1958 was known as a poor mast year. All of the major mast producing trees - walnut, shagbark hickory, white oak, burr oak, and black oak, with the possible exception of red oak - show variation in yield from year to year. It is noteworthy that in 1958, already described as a poor mast year, no species in the state achieved an average index of 2, which would indicate moderate production.

On the basis of the evidence presented in Table 6 we can surmise that a poor mast crop is detrimental to squirrel populations. After the poor crop of 1958 we had our lowest recorded production of juvenile fox squirrels. In addition, hunting in 1958 was the poorest of recent years.

DISCUSSION

Squirrel research in Iowa has been, at best, only superficial. We have records of hunting success dating back to 1950, but these records, until 1960, are based entirely on hunter-cooperator reports and may not portray the actual fluctuations in hunting success. I feel the very nature of the method of collecting data from hunter-cooperators may askew our hunting success figures on a falsely high plain. For the hunters who report year after year tend to be the hard-core, expert squirrel hunters, a relatively rare species in Iowa. These expert hunters average considerably better success than the average hunted, and because of their persistance and knowledge can be expected to bag squirrels irregardless of moderate population fluctuations. Only when squirrel abundance is drastically up or down will the kill per gun hour be affected for the best hunters.

With the advent of officer field contact records we will receive success data more representative of average squirrel hunters. The data already indicates this, as indices obtained from this source during the past three years have been considerably lower than those obtained from hunter-cooperator reports.

We cannot discontinue our hunter-cooperator contacts, however, until we are absolutely positive that the officer contacts give more representative data. Also, we are dependent on hunter-cooperators for sex ratios. This information could be obtained from Conservation Officers, but not without an inordinate amount of difficulty and confusion.

The mast survey, initiated in 1958, seems to fulfill the purpose for which it was intended. Although based on arbitrary estimates, these estimates are made on a local basis by qualified personnel familiar with local species. Since we consider practically all nut bearing trees native to Iowa it might be easy to assume that we attach the same importance to burr oak, a widely distributed and abundant native tree, as we do the blackjack oak, a relatively local tree of the southeast. Since each cooperator of the mast survey reports only on his local area, it follows we will receive many more reports of burr oak abundance than of blackjack oak. In obtaining the statewide index we add values for all observations and divide by the number of observations; therefore, the burr oak lends much more weight in determining the index than any of several less important species.

Mast, as used in these studies, is limited to nut-producing trees only, and does not include

TABLE 5. Comparisons of Mast Yields for Years 1958 Through 1962 as Reported by Foresters, Unit Game Managers, and Biologists

Species	Index of Production*				
	1958	1959	1960	1961	1962
Black Walnut	1.33	2.25	2.05	1.75	2.28
Butternut	1.00	1.86	1.75	1.25	2.29
Shagbark Hickory	1.08	2.29	1.86	2.06	2.17
Bitternut Hickory	1.40	2.08	1.86	1.71	2.00
White Oak	1.15	2.31	1.87	1.44	2.52
Burr Oak	1.23	2.35	2.11	1.86	1.96
Swamp White Oak	1.00	1.67	1.00	1.00	1.50
N. Red Oak	1.77	2.00	2.00	2.00	2.04
Black Oak	1.64	1.78	1.73	1.63	2.25
Pin Oak	1.25	2.25	2.50	1.89	2.09
Blackjack Oak	1.00	2.00	1.00	1.00	2.00
Shingle Oak	1.00	2.00	1.00	1.67	1.75
Chinquapin Oak	----	----	----	----	3.00
Average All Species	1.31	2.15	1.91	1.73	2.17

* The index of production is based on observations of individuals which are recorded as "abundant, moderate, or poor". Numerical values are assigned these observations as follows: Abundant - 3, moderate - 2, and poor - 1. Index of production for one species for any one year is derived by totaling the total numerical values and dividing by total observations of that species.

TABLE 6. Production of Mast for Previous Season Compared to Annual Production Per Adult Female Fox Squirrel and Hunting Success

Year	Mast Index for Previous Year	Juveniles/Adult Fox Squirrel	Hunting Success*
1958	----	2.29	0.86
1959	1.31	2.09	0.69
1960	2.15	3.08	0.85
1961	1.91	2.47	0.88
1962	1.73	2.84	0.84
1963	2.17	----	----

* Hunting success based on hunter-cooperator reports.

the many seeds, fruits, and berries commonly eaten by squirrels. Evaluation of yield of these many species would be impossible without intensive and expensive survey work. The mast survey definitely seems to provide the service for which it was intended, and is practical and inexpensive.

In working with the data it has seemed impractical to use both agricultural areas, which divide the state into nine districts, and the six ecologic areas based on soils, etc., previously used. From some areas in Iowa there simply has not been enough data. Consequently, I have divided the state into four major areas. Some of the data in this paper have been presented in this manner (Figure 1). The use of four areas shows promise but cannot be evaluated properly in this paper.

The data does show positive correlations between mast yield and juvenile production and hunting success. So far it appears these correlations are most highly developed in the heavily wooded areas of northeast Iowa. This might be expected, as widespread planting of corn in Iowa, and the obvious intensive use of corn by squirrels as a stable food, should alleviate mast scarcity in the highly developed agricultural regions of Iowa.

These studies should be continued until all factors being studied are understood and evaluated.

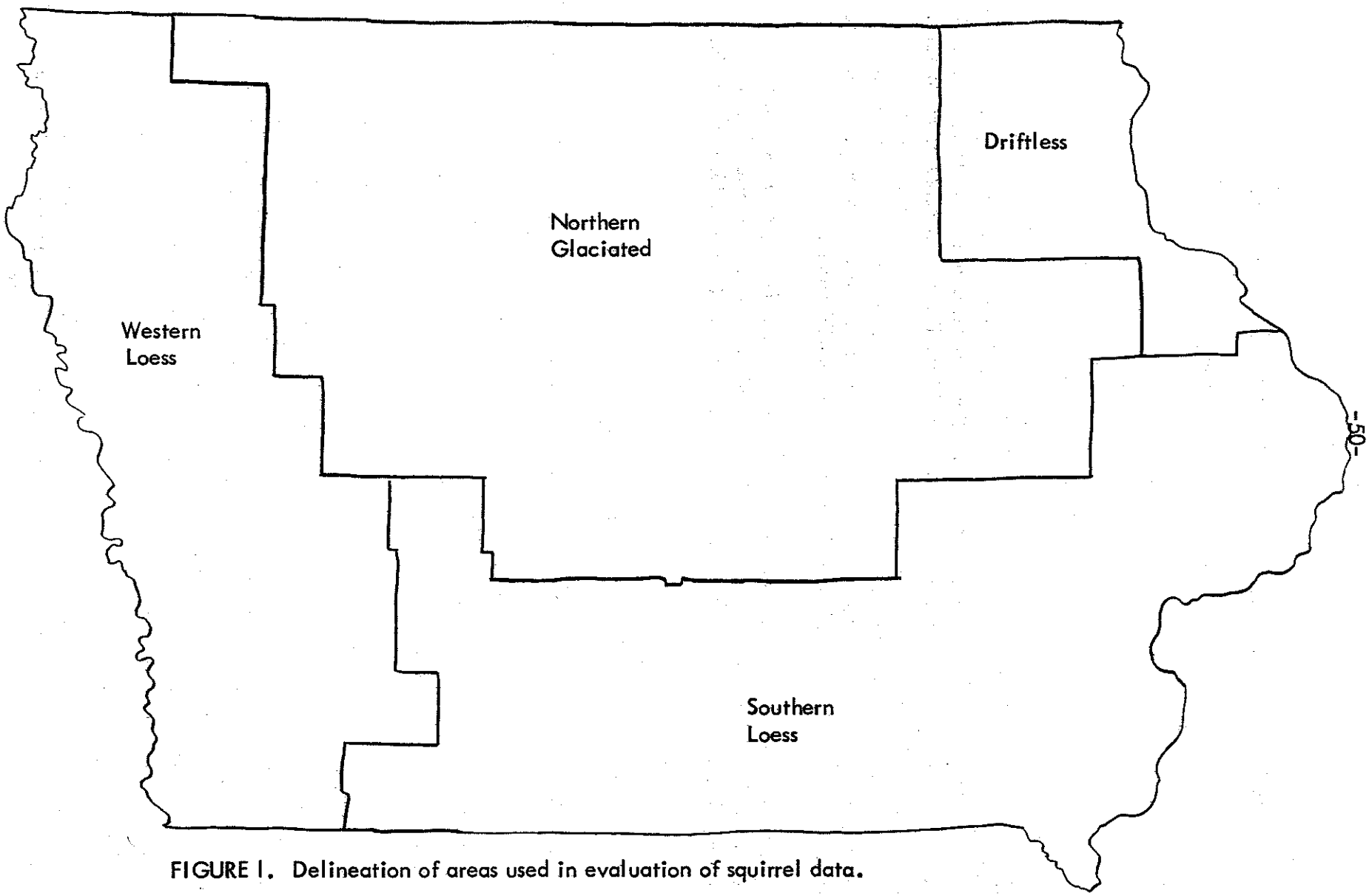

FIGURE 1. Delineation of areas used in evaluation of squirrel data.

A SUMMARY OF AN INTENSIVE CREEL CENSUS ON POOLS 11 AND 18 OF THE MISSISSIPPI RIVER

Roger Schoumacher
Fisheries Biologist

INTRODUCTION

From April 1 through October 31, 1962, an intensive creel census was conducted on pools 11 and 18 of the Mississippi River. This census was conducted by the Biology Section of the Iowa Conservation Commission in cooperation with the Upper Mississippi River Conservation Committee, an organization formed about 20 years ago and consisting of the states of Iowa, Illinois, Wisconsin, Minnesota, and Missouri, as well as various federal agencies, for the purpose of studying the fisheries and other recreational aspects of the upper Mississippi River. This creel census will be repeated every five years on the same two pools in order to determine trends and changes in the sport fishery. Similar studies were conducted on pools 4, 5, 7, 13, and 26 by the other UMRCC states.

Pool 11 is located in northeast Iowa between Guttenberg and Dubuque, Iowa. It is 32 miles long and contains 21,100 acres of water. Pool 18 is located in southeastern Iowa, from just north of New Boston, Illinois, to just above Burlington, Iowa. The pool is 26.6 miles long and has an area of 13,300 acres.

METHODS

The creel census was run on a statistically designed basis so that a very good estimate of the total fishing pressure and catch could be made at the end of the census period. Each of the pools was divided into four sections. The clerk covered the entire pool each work day according to a pre-determined schedule so as to census each pool section at all times of the day and on all days of the week. The clerks worked four consecutive days and then took off two days. Each was equipped with a 14-foot Naden boat and a 40-horsepower Johnson motor.

Upon entering a given section of a pool, the clerk would first make a count of the boat, bank, and barge fishermen and pleasure boats. This "instantaneous" count was to be made in not more than one hour. The remaining time was to be spent interviewing anglers. Information collected from the anglers included: no. of fishermen in party; no. of hours fished; whether the fishing trip was completed or still incomplete; the origin (home post office) of the anglers; the statuatory waters fished in; the location fished (boat, bank, or barge); the method fished (casting, trolling, or still-fishing); the bait used (natural, artificial, or prepared); the access used (public or private); the habitat type fished in (tailwater, navigation channel, slough, running slough or backwater); total number of fish caught by species; species of fish the angler was after, if any particular species; age of anglers; sex of anglers.

The interview and count data were expanded by dividing the fishing year into three seasons - spring (April and May), summer (June, July, and August), and fall (September and October). The average numbers of boat, bank, and barge fishermen and pleasure boats were calculated for each section at various hours of the day from the counts. These hourly averages were again averaged to give the average number of fishermen present at any given hour. This was multiplied by the number

hours in the fishing day and the number of fishing days in the fishing season to give the total fishing pressure in hours. The total fishing pressure in hours was multiplied by the catch per hour for each species for boat, bank, and barge fishermen to give the total catch. The number of fishermen was determined by dividing the total fishing pressure in hours by the length of the average completed fishing trip.

RESULTS

The census clerks interviewed a total of 3,166 fishermen in pool 11 and 4,606 fishermen in pool 18, and the projected data is based on these interviews plus the fishermen counts.

In pool 11, 32,408 fishermen fished 168,523 hours and caught 191,059 fish at the rate of 1.13 fish per hour. In pool 18, 28,509 fishermen fished 123,991 hours and caught 105,024 fish at the rate of 0.85 fish per hour. There were 24,003 pleasure boat hours in pool 11 and 53,241 on pool 18. No figures are available for the average number of people per pleasure boat, but if it is assumed that this number were three, the pleasure boating pressure on pool 11 would be nearly one half the fishing pressure, and on pool 18 the pleasure boating pressure would exceed the fishing pressure by about one third.

In pool 11, 64 per cent of the fishing pressure was by boat fishermen, 22 per cent by barge fishermen, and 14 per cent by bank fishermen. In pool 18, 56 per cent of the pressure was by boat fishermen and 44 per cent by bank fishermen. There is no fishing barge in pool 18.

Sixty-three per cent of the anglers in pool 11 were stillfishing, 35 per cent casting, and 2 per cent trolling. In pool 18, 90 per cent were stillfishing and 10 per cent casting. Ninety-four per cent of the fishermen in pool 11 used natural bait, 5 per cent artificial, and 1 per cent prepared. In pool 18, 81 per cent used natural, 6 per cent artificial, and 13 per cent prepared.

Forty-nine per cent of the fishermen in pool 11 were fishing in the tailwaters, 23 per cent in running sloughs, and 17 per cent in sloughs. The remaining 11 per cent were fishing in the navigation channel and backwaters. In pool 18, 62 per cent were fishing in running sloughs, and 19 per cent each in the navigation channel and tailwaters.

In pool 11, 85 per cent of the fishermen were fishing in the statuatory waters of Iowa and 15 per cent in Wisconsin waters. Eighty-seven per cent were Iowa residents, 9 per cent Wisconsin residents, and 4 per cent were from other states. In pool 18, 66 per cent of the fishermen were fishing in the statuatory waters of Iowa, and 34 per cent in Illinois waters. Forty-two per cent were Iowa residents and 58 per cent were from Illinois.

Seventeen per cent of the pool 11 anglers were fishing especially for walleye and sauger, 11 per cent for bluegill and crappie, and 69 per cent for "anything". A few individuals were after catfish, white bass, largemouth bass, and bullheads. In pool 18, 30 per cent were fishing for catfish, 5 per cent for bluegill and crappie, 4 per cent for bullheads, and 56 per cent for "anything". A few fished especially for other species.

Ninety per cent of the anglers in pool 11 used private access areas, whereas access was divided about equally between private and public in pool 18.

Eighty-five per cent of the anglers were male in pool 11; 76 per cent were male in pool 18.

In both pools nearly two thirds of the anglers were in the 35 to 64 year age class, with most of these 45 years of age or older. Only about 15 per cent of the anglers were 24 years of age or less. Eighty-nine per cent of the anglers traveled 75 miles or less to fish pool 11, with 43 per cent traveling 25 miles or less. Pool 18 anglers tended to come shorter distances, with 67 per cent coming 25 miles or less and 88 per cent coming 50 miles or less.

Crappies, bluegills, sauger, sheepshead, and channel catfish were the five numerically most important species in the creel in pool 11 in that order (Table 1). Channel cat, bullheads, crappie, white bass, and sheepshead were the "big five" in that order in pool 18.

TABLE I. Species Composition of the Sport Fishing Catch in Pools II and 18 of the Mississippi River

Species	Pool II Number	Pool II Rank	Pool 18 Number	Pool 18 Rank
Bluegill	53,950	2	8,836	6
Other Sunfish	423			
Drum	16,178	4	12,611	5
Sauger	17,877	3	2,410	7
Walleye	2,968	7	538	
Crappie	77,891	1	13,842	3
White Bass	6,919	5	13,444	4
Yellow Bass	15			
Carp	509		2,116	8
Northern Pike	419			
Channel Catfish	6,900	6	33,840	1
Flathead Catfish	466		925	10
Bullheads	2,086	9	15,274	2
Yellow Perch	1,399	10	11	
Largemouth Bass	2,617	8	1,137	9
Smallmouth Bass	403		40	
Hackleback Sturgeon	39			
TOTALS	191,059		105,024	

WALLEYE POPULATION STUDIES, SPIRIT LAKE, 1962

Tom Moen
Fisheries Biologist

A brief physical description of Spirit Lake and a review of prior population studies were presented in the Quarterly Biology Report for July, 1962. The present report covers the second consecutive year of walleye population studies in Spirit Lake. These population studies conducted during the summer of 1962 and winter of 1962-63 were concerned with the continuation of the work started in 1961, and the marking of an additional group of walleye by fin-clipping. A third phase was added in the fall of 1962 through the stocking of some 3,500 fin-clipped young walleyes from the nursery ponds. The contribution of this phase will not be assessed until the 1963-64 studies are under way or completed.

A brief review of the 1961 studies is presented in order to provide continuity to this report.

During April of 1961 a total of 1,503 walleyes from Spirit Lake were marked with numbered monel metal tags applied to the upper jaw. Electro-fishing gear and gill nets were used in the collection of these fish, all of which were twelve inches or longer in total length. An additional 116 large walleyes, 20 to 28 inches in total length were fin-clipped (left pelvic) in order to provide additional information on these large fish, most of which were too large to tag with a number 3 tag. A voluntary return of 405 tags by fishermen during the 1961-62 fishing season represented a minimum exploitation rate of 27 per cent. Evidence from the comprehensive creel census placed this exploitation rate at nearly 50 per cent. The creel census clerk observed that 5.4 per cent of all the walleyes in the creel were marked. The tag return for the winter fishery was slightly higher, averaging 7.9 per cent. Adjustments for recruitment may have biased the calculation somewhat but subsequent examination of walleyes during the spawning run in April of 1962 indicated that the ratio of tagged to untagged walleyes in the creel was only slightly less than what appeared to be the true ratio.

A shocker sample of 410 walleyes from the spawning run in April of 1962 recaptured 26 marked fish, or 6.3 per cent. A sample of 455 walleyes taken by management crews using gill nets (2 1/2 inch bar measure) produced 52 tagged fish, or 11 per cent. On the spawning run the gill nets are obviously selective toward larger fish and the shocker toward the smaller fish. Eighty per cent of the walleyes taken for marking in the spring of 1961 were captured by electro-fishing gear and 20 per cent by gill nets. The higher ratio of tagged fish in the gill net sample seems to indicate that a higher proportion of the larger fish were marked in the original tagging operation. Tag returns by fishermen failed to show any difference in the per cent of tags returned from smaller fish as opposed to larger fish in the size range of 12 to 23 inches, but there were no tags returned from 21 tagged walleyes that were 23 inches or more in length. This provides some evidence that the "lunkers" are less likely to be caught than the smaller fish. Additional information to support this contention was obtained from the 116 fin-clipped walleyes that were 20 to 28 inches in length. During the ten months of censusing in which the census clerk personally observed 2,310 walleyes, he failed to record a single fin-clipped walleye in this length group. Unfortunately there were no records kept concerning the size of unmarked walleyes in the creel. A close examination of 224 walleyes of this larger size that were gill netted and used for hatchery purposes disclosed twelve fish with the left pelvic fin missing (5.3 per cent). Although the evidence presented above points to a relatively low vulnerability of large walleyes, the data is not conclusive. This phase of the population will be given additional study in the tagging program planned for 1963.

1962 POPULATION ESTIMATES

In addition to recording the 1961 tag returns an additional group of walleyes was fin-clipped in an effort to make a second successive population estimate of adult walleyes in 1962. A total of 879 walleyes was marked by excising the right pelvic fin. These fish ranged from seven to 11.5 inches in total length and belonged to the 1960 year class. Another group of 1,071 walleyes was marked by removing the right pectoral fin. These fish ranged from 11.6 to 20 inches in total length with 60 per cent belonging to the 1959 year class. All collections were made with electro-fishing gear and the fish were marked and released near the point of capture.

The creel census clerk kept careful inventory of marked and unmarked walleyes that he observed in his daily work. He also maintained a length-frequency record of the walleyes in the creel. Scale samples from fish in the creel and scale samples and length-frequencies from special shocker collections provided additional data on growth and recruitment. The essential data concerning the population were compiled and calculated on a monthly basis (Table I).

The 1960 year class accounted for an increasingly higher per cent of the catch, composing three per cent in May, 30 per cent in July and about 50 per cent during the winter fishery. In spite of the number in the creel, only one marked fish of the 1960 year class was observed in the creel. Although providing insufficient data for a population estimate, this indicates a high population of walleyes of the 1960 year class. The same situation was evident during 1961 when 394 fish of the 1959 year class were fin-clipped. There were no marked fish from this group recovered during the 1961 fishing season although they made up 75 per cent of the catch during the winter fishing of 1961-62.

The ratio of marked to unmarked remained quite consistent through the first 3 months of fishing, thus producing population estimates of about 52,000 fish 11.6 inches and longer at the start of the fishing season (Table I). Population estimates during the late summer months varied and were based on relatively small samples. Although the monthly estimates ranged from 11,781 to 53,550, the season estimate of 48,380 (8.5 per acre) appears to be valid. Based on the quantitative creel census catch estimate of 22,500 walleyes in the creel, we can calculate an exploitation rate of 33 per cent, about 17 per cent less than the exploitation rate calculated for adult walleyes during 1961. This lower exploitation rate was not unexpected. All phases of the study indicated that the 1959 year class was large and the creel census indicated that fishing pressure was about the same for both years, thus the calculated rate of exploitation and the population estimate are considered as providing fairly reliable data.

TABLE I. Monthly Summary of Data Concerning Number of Walleyes Checked by the Census Clerk, Number of Walleyes Under 11.6 Inches in Length Found on Stringers, Recruitment of Walleyes into the Marked Size Group, Number of Marked Fish Observed and Estimate of Population as of May 12, 1962

Month	Total Observed	Total Under 11" No.	%	Recruitment No.	%	Adjusted Sample	Marked No.	%	Population Estimate
May	460	14	3.04			446	9	2.02	53,074
June	539	48	9.77	50	9.26	441	9	2.04	52,468
July	137	8	1.46	32	23.33	97	2	2.06	51,994
August	16			5	31.25	11	1	9.99	11,781
September	68	13	18.85	20	29.41	35	1	2.86	37,485
October	83	34	40.8	26	31.32	23	1	4.35	24,633
November	2	2	100						
December	268	17	6.29	138	51.5	113	4	3.54	30,255
January	177	32	18.24	83	46.83	94	2	2.13	50,837
February	78	1	1.28	27	34.61	50			53,550
TOTAL	1828					1310	29	2.21	48,380

AN EVALUATION OF INTRODUCING THE WALLEYE INTO A SOUTHERN IOWA ARTIFICIAL LAKE

PART II: AGE AND GROWTH

Jim Mayhew
Fisheries Biologist

Growth of most species of fish has been reported on at various times from a multitude of locations and different types of waters. Basically, growth information is valuable to the fishery worker since it provides an index to habitat suitability and internal population stresses. This is particularly true of species that are introduced into waters in which they are not native. Those species that react sub-normally to certain environmental stresses are mostly unsuited to the habitat, and will not add measurably to the total population or angler harvest. Since the walleye is not native in the lakes and most of the streams in southern Iowa (Cleary, 1956) the age and growth of this species is evaluated to further determine the relative success of introducing the walleye in artificial lakes.

Scale samples from 246 walleye from Green Valley Lake were obtained by electro-fishing in the spring of 1962. Each individual specimen was measured for total and standard length, and weighed. The standard length used in the study was the distance in millimeters from the snout to the distal end of the caudal peduncle. Weight was recorded in grams. A "key" scale, one scale row below the intersection of the compressed pectoral fin and the lateral line, was removed from each fish. In the laboratory the scale sample was cleaned with a mild detergent and dry-mounted between microscope slides. Micro-projection of the scale image was used to assess the age of each individual, and the location of each annulus was marked on a tagboard strip.

Validity of the Annulus as a Year Mark

The validity of the scale method for aging walleye in Green Valley Lake was based on the following observations: (1) larger walleye had more annuli than smaller individuals, and (2) the persistent abundance of individual size groups corresponded inversely with a scarcity of other groups when the representative lengths of fish were tested on a length-frequency histogram. The abundance of one certain group of lengths also corresponded with the lengths of other fish in that particular age group indicating the annulus was a true year mark.

Body-Scale Relationship

The relationship between the standard body length of the fish and the anterior radius of the scale was determined to calculate growth rate. Data were divided into 25 millimeter standard length intervals and the mean body length and scale radius determined for each group. All ages and both sexes were combined for this study.

From the original sample of 246 fish, only 216 scale samples were usable because of regeneration or deformed scales. Only one key scale was removed from each fish, which accounts for the high loss of scale samples.

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

$$L = a + bR$$

where, L = standard length of the fish

R = scale radius

a and b = mathematical constants

A linear regression line having a slope of 1.9857 and a length intercept of 19.8 millimeters on the abssica best describes this relationship (Line A of Figure 1).

Visually, the linear regression line did not appear to fit the data closely. The body-scale measurements in Table I were recalculated to a curvilinear regression represented by the second degree polynomial:

$$L = a + bR + cR^2.$$

The body-scale relationship by the second degree polynomial is represented by the curvilinear regression (Line B of Figure 1):

$$L = 72.6 + 0.901\,R + 0.0042\,R^2.$$

To test the "goodness of fit" of both the linear and curvilinear regressions the sum of the squares of the standard deviation were calculated for both values of individual size groups. These resulting values were:

Curvilinear regression ------ $(L - L_n)^2 = 66.2$

Linear regression ---------- $(L - L_n)^2 = 333.8$

TABLE 1. Mean body and scale measurements for walleye in Green Valley Lake used in calculating the body-scale relationship by linear and curvilinear regression

Mean St. Length	Mean Sc. Radius	Mean L/Sc. Ratio	No. in Sample	Computed length	
				Linear*	Curvilinear**
117	43	2.72	13	104	117
132	48	2.75	7	112	124
244	124	1.97	3	264	249
264	132	2.00	8	292	277
287	140	2.05	41	297	295
312	157	1.98	43	330	318
338	165	2.04	35	348	338
361	175	2.06	21	368	358
396	180	2.20	23	378	396
414	190	2.17	13	399	399
434	208	2.08	4	434	442
488	226	2.18	4	465	448
508	231	2.18	1	478	503

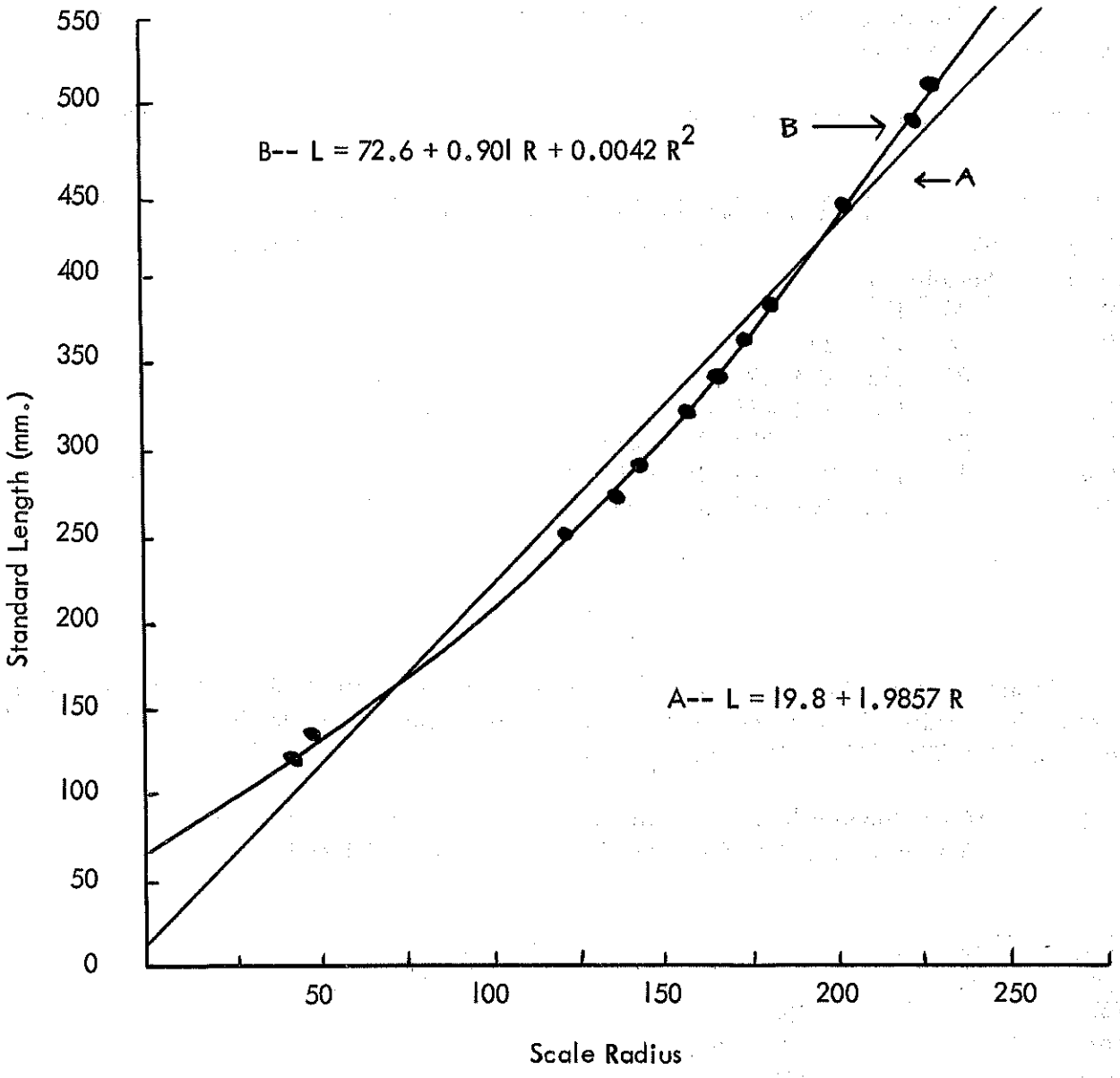

Figure 1. Body-scale relationship of Green Valley Lake walleye. Line A represents the linear regression, Line B represent the curvilinear regression. Dots represent the mean body-scale measurements.

* $L = 19.8 + 1.9857\ R$
** $L = 72.6 + 0.901\ R + 0.0042\ R^2$

This pronounced difference between the two values is significant at the 0.05 per cent level of confidence when submitted to the standard student's test. When the linear and curvilinear regressions are calculated to standard length there is a mean variance of 9.8 per cent in the total sample (Table 2). Accuracy of computing body length was greatly increased by using the curvilinear regression.

TABLE 2. Difference in standard length when calculated by linear and curvilinear regression

Year Class	No. in Sample	Length in mm. by curvilinear regression							Deviation in mm. of linear from curvilinear regression						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
1961	20	120							-13						
1960	6	128	243						-11	+17					
1959	86	123	224	298					-12	+16	+15				
1958	62	120	214	298	357				-13	+15	+15	+ 8			
1957	24	123	219	291	352	398			-12	+15	+16	+ 9	+4		
1956	14	128	208	287	340	408	450		- 9	+14	+10	+11	- 1	-12	
1955	6	118	196	251	324	383	426	463	-15	+12	- 3	+13	+4	- 5	-15

Growth Analysis

Standard length for each year of life was calculated on the basis of the curvilinear body-scale relationship. Mean standard length of walleye from the first to the seventh year of life was 122, 219, 294, 352, 399, 444, and 463 millimeters respectively (Table 3).

TABLE 3. Mean standard length and annual growth increment in millimeters at the end of each year of life for 219 walleye from Green Valley Lake.

Year Class	No. in Sample	Growth Year of Life						
		1	2	3	4	5	6	7
1961	20	120						
1960	6	128	243					
1959	63	123	224	298				
1958	70	120	219	298	357			
1957	37	123	219	291	352	398		
1956	19	128	208	287	340	408	450	
1955	6	118	196	251	324	383	426	463
Weighted Grand Mean		122	219	294	352	399	444	463
Corresponding Total Length		145	261	350	419	474	528	551

Increment

Year Class	No. in Sample	Year of Life 1	2	3	4	5	6	7
1961	20	120						
1960	6	128	115					
1959	63	123	101	74				
1958	70	120	99	79	59			
1957	37	123	96	72	61	46		
1956	19	128	80	79	53	68	42	
1955	6	118	78	65	73	59	43	37
Weighted Grand Mean Increment		122	92	75	60	54	42	37

As shown in Table 4 walleye growth varies considerably with the latitude location of lakes. Walleye growth in Green Valley Lake was quite similar to that reported by Cleary (1949) in Clear Lake, Iowa. Walleye growth reported by Rose (1949) in Spirit Lake, Iowa was significantly greater in all age groups. In comparison to lakes in Minnesota and Wisconsin the walleye in this study were larger in all age groups. Walleye growth in Lake Norris of the Tennessee Valley Authority was much more rapid than in other areas.

TABLE 4. The comparative mean standard length of walleye at each annulus between Green Valley Lake and other lakes. (Data taken from Carlander's Handbook of Freshwater Fishery Biology).

Lake and Location	Year of Life 1	2	3	4	5	6	7	8	9	10
Green Valley, Iowa	122	219	294	352	399	444	463			
Clear Lake, Iowa	124	230	308	364	409	454	499	557	573	588
Spirit Lake, Iowa	157	282	366	445	505	564	602	632	660	706
Lake of Woods, Minn.	142	204	255	296	330	358	388	419	456	494
Clear Lake, Wisc.	86	171	229	271	301	337				
Norris Lake, Tenn.	213	352	408	435	449	453	478	539		

Annual growth increment (Table 3) was found to be the greatest during the first year of life and decrease slowly as the fish became older. This is the identical pattern of growth indicated in most walleye studies. The mean annual growth increment of walleye in Green Valley Lake was 122, 92, 75, 60, 54, 42, and 37 millimeters for the first seven years of life (Figure 2).

Length-Weight Relationship

The length-weight relationship was determined for 226 walleyes. The total sample was divided into 25 millimeter size groups and the mean standard length and weight derived for each group. This mathematical relationship is best expressed by the least squares equation:

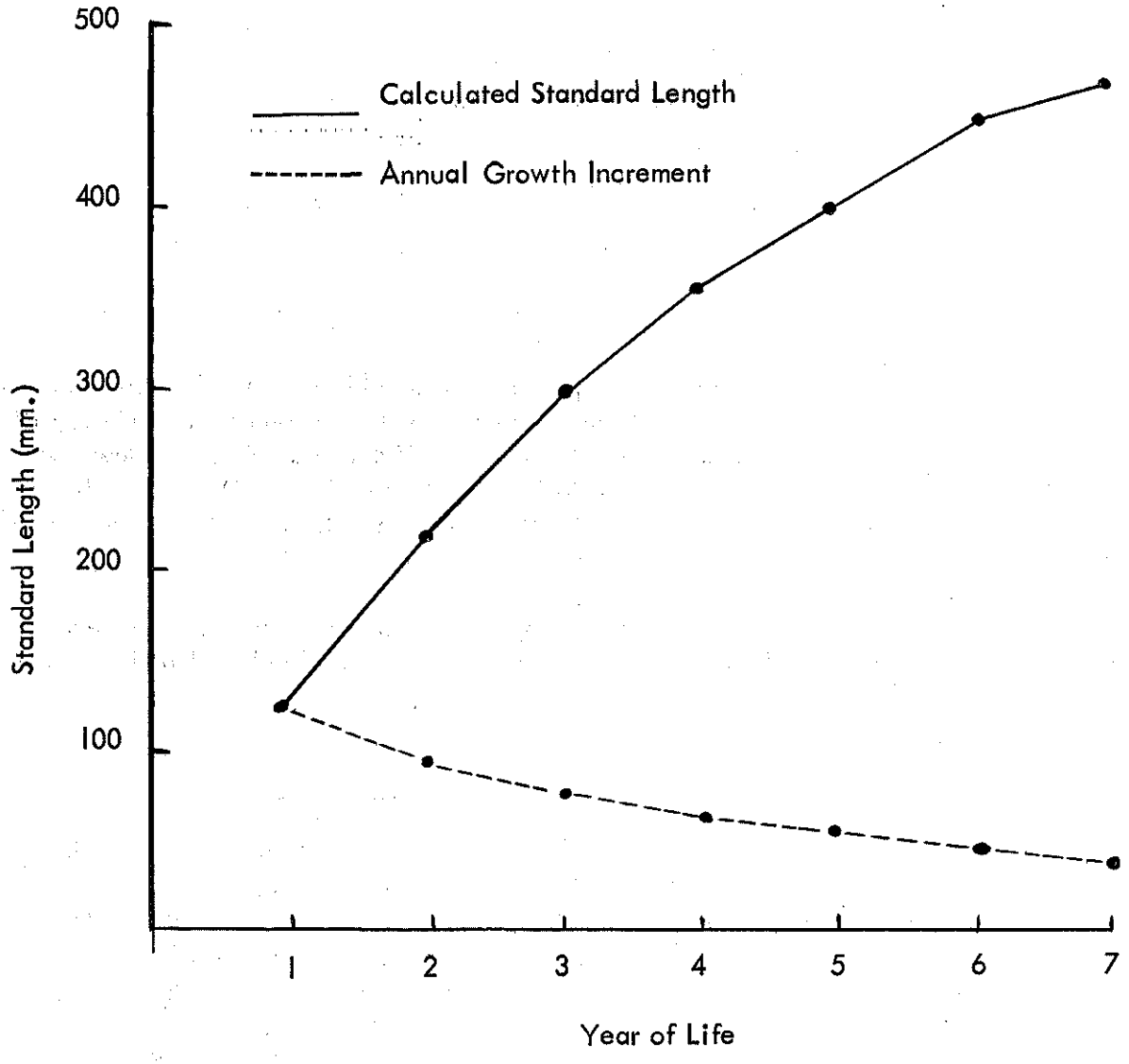

Figure 2. Mean calculated standard length and growth increments at each annulus for walleye in Green Valley Lake.

$$W = cL^n$$

or in logarithmic form:

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

where,

W = weight

L = length

c and n = mathematical constants.

A line having a slope of 3.0354 and an intercept on the length axis of -4.8814 best describes the length-weight relationship in this study (Figure 3). In graphical representation the divergence from the calculated parabola is limited in the smaller size groups, but increases in a ratio less than the cube of the length in the larger size groups. This is thought to be due to the limited sample of larger fish. Table 5 lists the observed and calculated weights of each size group in the study.

TABLE 5. The observed and empirical weights and condition factors of walleye in Green Valley Lake.

Mean St. Length	No. in Sample	Mean Weight		Deviation of C from O	Condition Factor
		Observed	Calculated		
117	13	24	24	0	1.74
130	8	30	30	0	1.63
244	3	227	237	+10	1.56
267	11	312	322	+10	1.65
287	40	394	391	- 3	1.57
315	44	492	518	+26	1.54
340	36	605	633	+28	1.56
363	22	729	753	+24	1.61
391	23	968	942	-26	1.66
414	15	1165	1137	-28	1.75
437	4	1436	1389	-47	1.75
467	2	1630	1602	-28	1.93
493	4	1826	1875	+49	1.59
511	1	1814	2098	+184*	1.40

* Beyond the scope of realiability on the length-weight relationship equation.

The condition or "K" factor is often used by fisheries workers to express the relative plumpness of fish. In this study the reciprol of the standard length was used to determine this factor for each size group. Mean "K" for the total sample was 1.64 with a range of 1.40 to 1.93. There was a slight tendency for the condition factor to increase as the fish became longer.

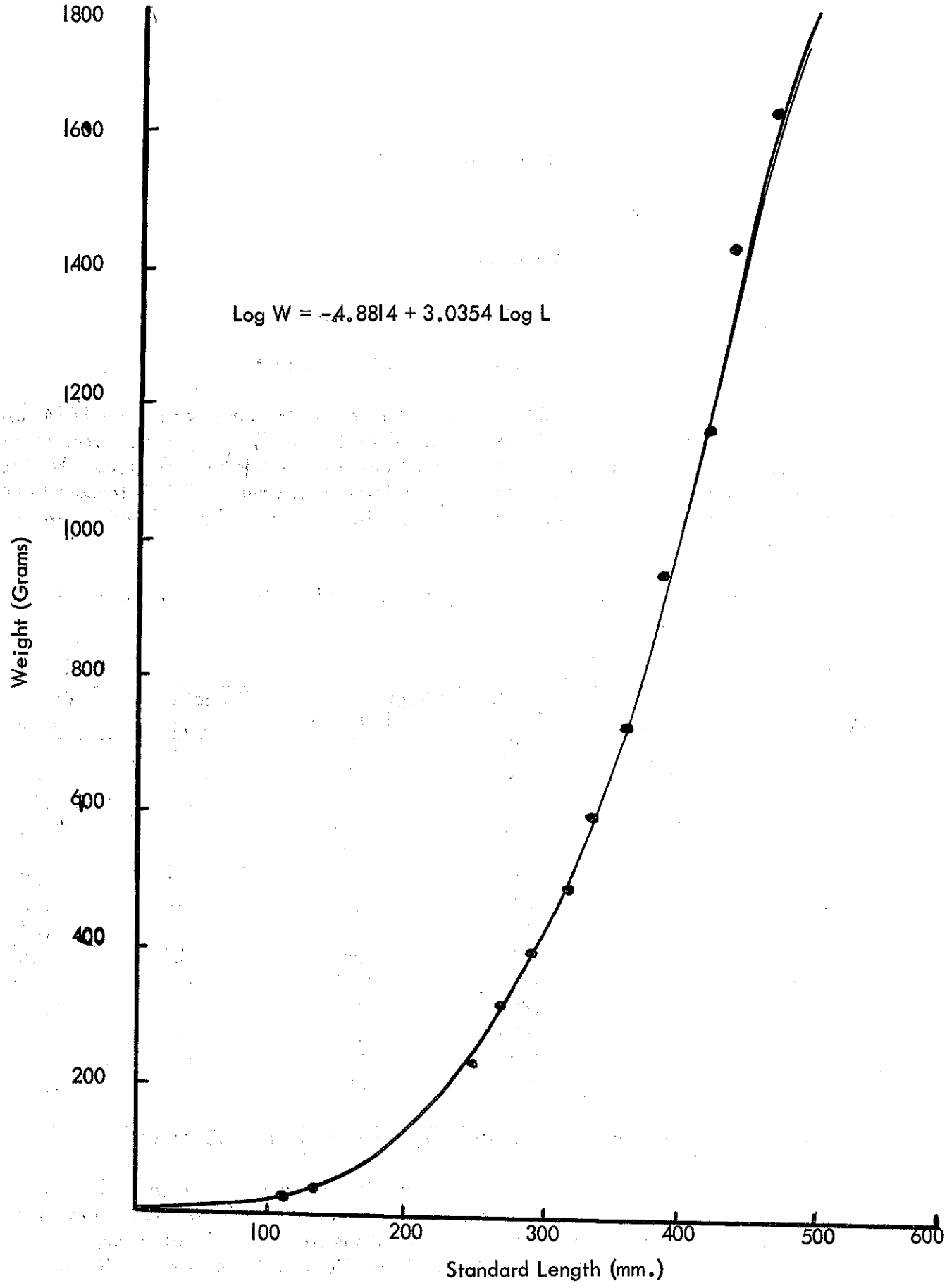

Figure 3. Length-weight relationship of 226 walleye in Green Valley Lake.

SUMMARY

1. The scale method was determined to be an accurate method of studying the age and growth of 246 walleyes from Green Valley Lake Pond.

2. The body-scale relationship is best described by the second degree polynomial - $L = 72.6 + 0.901 R + 0.0042 R^2$. This relationship of body length and scale radius was much more accurate than the first degree polynomial $L = 19.8 + 1.9857 R$.

3. Mean standard length for walleye from the first to seventh year of life was 122, 219, 294, 352, 399, 444, and 463 millimeters respectively.

4. Mean annual growth increments were 122, 92, 75, 60, 54, 42, and 37 millimeters for the first seven years of life.

5. The length-weight relationship is best described by the least squares equation - $\text{Log } W = -4.8814 + 3.0354 \text{ Log } L$.

6. Condition factors averaged 1.64, with a range of 1.40 to 1.93.

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DESOTO BEND FISHERY INVESTIGATION, 1963

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Fisheries Biologist

INTRODUCTION

Biologists from the Iowa Conservation Commission, Nebraska Game, Forestation and Parks Commission, and the U. S. Fish and Wildlife Service conducted a fishery survey in DeSoto Bend Lake between May 20 and 24, 1963. Although the lake is part of the Federal DeSoto Bend Refuge and managed primarily for waterfowl, the three agencies began cooperative work in 1962 to develop and manage the sport fishery. Some limited survey work has been done prior to 1962 by the Iowa Conservation Commission and the U. S. Fish and Wildlife Service.

DESCRIPTION OF THE AREA

The lake was formed in the fall of 1960 from a 7 1/2 mile bend in the main channel of the Missouri River by construction of impervious levees across the upper and lower ends of the bend. A water control structure was built in the upstream levee connecting the newly formed lake with the new Missouri River channel. The lake covers slightly more than 700 surface acres and the width varies between 700 feet and 1200 feet.

Since the lake was part of the original main channel of the Missouri River less than three years ago, the aquatic environment has had little time for major change. Some siltation occurred in the upstream area of the lake during construction of the levees. Depth survey work along the long center axis of the lake indicates the mean depth is between 10 and 15 feet. The maximum recorded depth (34 feet) was found by old river piling. One important change in the aquatic environment has been the reduction in turbidity. Secchi disk readings during the survey varied between 22 inches and 26 inches at nine locations on the lake. During the summer months, Secchi disk readings in the main channel of the Missouri River between Sioux City and Omaha do not exceed 8 inches.

The fish management of the lake has consisted of a three year stocking program of largemouth bass, walleye, channel catfish, white bass and northern pike begun in 1961 (Table 4). All of these fish are found in the Missouri River between Sioux City and Omaha.

METHODS

Fish were collected with electro-fishing gear, 150 ft. experimental gill nets, 250 ft. trammel nets, small frame trap nets, and a 100 ft. bag seine. The nets and traps were set in pre-located sampling areas and checked daily, then moved to new locations. Electro-fishing was conducted along one mile sections of shore during both day and night. The amount of use by type of gear fished is as follows:

gill nets - 264 hours

trammel nets - 44 hours

frame nets - 108 hours

100 ft. bag seine - 24 hauls

electro-fishing - 14 miles of shore

All fish collected by each type of gear were counted and a random sample of each species was weighted and measured. Scales or pectoral spines were also collected.

In addition to the fish collections, bottom samples were taken with a Peterson dredge at nine locations in the lake. All organisms found in each sample were counted and identified to family when possible. No volumetric determinations were made.

RESULTS

Rough Fish

Shad, carp and carpsuckers were the three most numerous in that order (Table 1). The majority of the shad were taken by electro-fishing and their total lengths ranged from 5.0 to 8.1 inches (Table 2). Only a few shad caught with gill nets were over nine inches. Shad ranging in length from approximately 7 to 9 inches appear to be the 1961 year class. Total lengths of carp and carpsuckers ranged from 3.0 to 28.2 inches and from 6.7 to 19.1 inches, respectively.

Drum, largemouth buffalo, smallmouth buffalo, goldeye and shortnose gar composed the remainder of the rough fish populations in the catch. Total lengths of drum ranged between 6.0 and 18.5 inches although the majority were between 6.0 and 10.0 inches. Over 90 per cent of the drum were caught with gill nets and electro-fishing gear. Most of the buffalo were taken with trammel nets and few were less than 18 inches long. Only 2 goldeye and 6 gar were collected during the survey (Table 1).

Game Fish

Crappie, bluegill, channel catfish and largemouth bass were the four most numerous game fish taken in the survey and in that order (Table 1). Both white and black crappie were caught but white crappie dominated in numbers by a ratio of about 10 to 1. Although crappie between 2.5 and 13.1 inches were taken, the majority were between 6.0 and 8.0 inches and from the 1961 year class. Total lengths of bluegills ranged between 2.5 and 7.0 inches but few were over 6 inches (Table 2). The majority of the channel catfish were between 10 and 20 inches long although total lengths ranged between 2.6 inches and 25.0 inches. Only five flathead catfish were taken in this survey. Total lengths of largemouth bass ranged between 3.6 and 18.3 inches (Table 2).

All of the 27 sauger collected in this survey were at least 13 inches long. The longest sauger was 21.5 inches. Total lengths of walleye ranged from 4.6 inches to 22.5 inches. Only 2 of the 47 white bass were over 9 inches long and the majority were between 5 and 7 inches. Ten yellow perch ranging in length from 4.5 to 7.2 inches were also collected.

Bottom Fauna

Chironomid larvae were the most abundant organisms at 5 of the 9 sampling locations (Table 3). They appear to show a preference for deep water areas. Oligochaets were the

TABLE 1. Total numbers of fish taken by different gear during five day survey, DeSoto Bend, 1963

Species	Gear*					Totals
	Electro-fishing	Gill Net	Trap Net	Trammel Net	Bag Seine	
Largemouth Bass	82		2		6	90
Crappie**	111	176	1187		63	1537
Bluegill	138		72		83	293
Sauger	10	17				27
Walleye	20	8			5	33
Channel Catfish	9	94	1	1	3	108
Flathead Catfish	2			3		5
Yellow Perch	1	5			4	10
White Bass	7	1	15		24	47
Shad	1539	501	19		97	2156
Carp	410	19		6	8	443
Other Cyprinids***					526	526
Carpsucker	54	66	3	2	7	132
Goldeye		2				2
Drum	31	18		1	4	54
Shortnose Gar		6				6
Largemouth Buffalo	5	5		31		41
Smallmouth Buffalo				6		6

* See text for total time each type of gear was fished

** Black and white crappie

*** Minnows

TABLE 2. Ranges in total length by inches of fish taken by different types of gear

Species	Gear*				
	Electro-fishing	Gill Nets	Trap Nets	Trammel Nets	Bag Seine
Largemouth Bass	4-18		5-14		4- 5
Bluegill	3- 7		3- 6		2- 6
Crappie**	4-13	4-10	4-11		3- 8
Sauger	13-19	14-22			
Walleye	5-21	15-22			5- 7
Channel Catfish	6-19	8-25	11	17	3- 9
Flathead Catfish	11-12			20-38	
Yellow Perch		5- 7			4- 5
White Bass	6- 9	10	5-11		5- 6
Shad	5- 8	6-15	7- 9		7- 9
Carp	3-21	14-24		18-28	14-17
Carpsucker	8-15	12-16	13-13	17-19	7-13
Goldeye		12-15			
Drum	6-14	6- 9		19	4- 5
Shortnose Gar		25-28			
Largemouth Buffalo	12-20	19-21		18-29	
Smallmouth Buffalo				19-20	

* See text for total time each type of gear was fished
** Both black and white crappie

TABLE 3. Numbers of bottom fauna collected at nine stations in DeSoto Bend Lake, May 23, 1963

Station	A	B	C	D	E	F	G	H	I
Water Depth	11' 2"	8' 3"	14' 9"	2' 2"	14' 1"	9' 6"	5' 10"	3' 7"	12' 5"
Oligochaeta	2	4	10	1	36	10	6	6	12
Diptera larva									
Chironomidae	3	19	23	6	35	17	3	1	30
Culicidae									1
Ceratopogonidae								1	
Ephemeroptera larva								1	
Odonata larva	1								
Hymenoptera adult								1	

TABLE 4. Total numbers of fish stocked in DeSoto Bend since formation of lake

Species	Number Stocked			Year Stocked
	Fry	Fingerlings	Sub-adults and Adults	
Largemouth Bass		20,000		1961
		160,000		1962
Walleye	2,000,000	43,800		1962
Channel Catfish		80,000		1962
White Bass			1,650	

most numerous at the 4 remaining locations. Other Diptera, a mayfly larva, a dragonfly larva, and an adult bee were also found in the bottom samples.

DISCUSSION

DeSoto Bend Lake has large populations of rough fish composed mainly of shad, carp, carpsuckers, and buffalo. Although this survey was too early in the year to adequately sample their 1963 year classes, all of them have reproduced during the remaining two years since formation of the lake in late 1960. Shad are the most numerous. Actual counts of over 1000 yearling and adult shad seen per hour have been made during past electro-fishing surveys. This fish is undoubtedly important as a forage species since its yearly production of young-of-the-year dominates the available forage population. The carp composed the highest per cent of the total weight of rough fish taken in this survey, but ranked second, numerically, to shad. Both the carp and shad had large 1962 year classes. The combined weights of the buffalo also formed a large per cent of the total weight of rough fish. Although only 47 buffalo were taken, most weighed over 4 pounds with the largest weighing 17.5 pounds. All of the rough fish appeared in good condition.

The goldeye is abundant and has good reproduction in the Missouri River. However, only two goldeye (both over 12 inches long) were taken in this survey. The new environment of the ox-bow lake apparently does not contribute to the success of this species. Other investigations of Missouri River ox-bow lakes also support this view. There does not appear to be a very large population of shortnose gar in DeSoto Bend since only six were collected.

White crappie are the most abundant game fish in the lake and compose most of the yearly catch by local fishermen. They have reproduced every year since the area was separated from the Missouri River even though a large rough fish population has been present. Their growth appears similar to that of white crappie in other, older Missouri River ox-bow lakes.

Channel catfish was the third most numerous game fish taken but ranks second in the creel of local fishermen.

There is some evidence of reduced success of both the walleye and sauger populations since formation of the lake. There were no sauger less than 13 inches long taken in this survey. This fish is very abundant in the Missouri River and has reproduced well in recent years. The large walleye stocking last year may have been responsible for the high per cent of one year old fish in this survey. However, there were few walleye from the 1961 year class, although there were several from the 1960, 1959, and 1958 year classes.

Largemouth bass, white bass, and bluegill have reproduced yearly since the lake was separated from the river. All three species, especially the largemouth bass, appeared to be in good condition.

Further survey work will be needed before the 1962 stocking program can be fully evaluated. It has been proposed that at least walleye be stocked yearly through 1964. There is some evidence that a walleye stocking program might be necessary in order to support their population. Undoubtedly, the large populations of rough fish, especially shad and carp will have to be controlled before game fish populations can reach their maximum potential. Further work on age and growth and life histories, especially shad, are needed before a sound management plan can be formulated for this relatively new ox-bow lake.