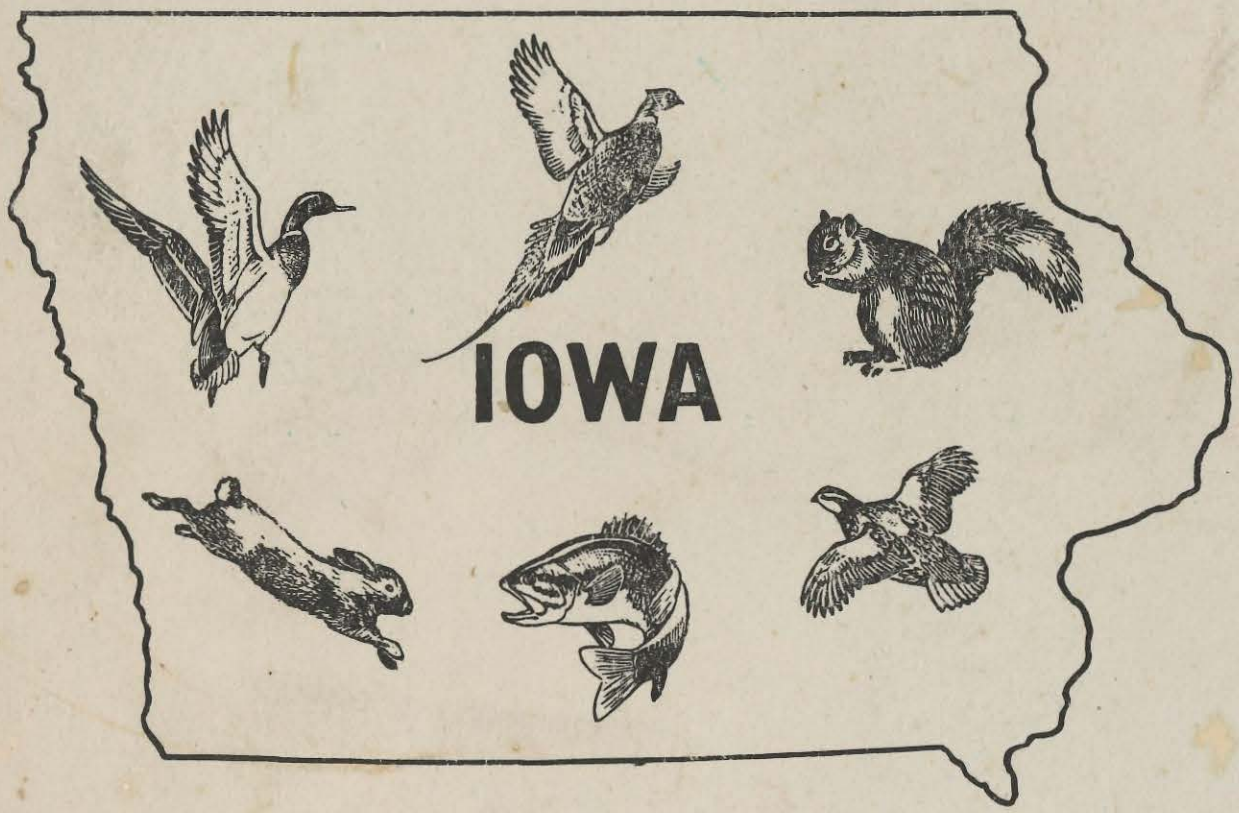
1955

QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

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CHANNEL CATFISH SURVEYS - NORTHEAST IOWA
1952 - 1955

R. E. Cleary*
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Special surveys on channel catfish populations in the rivers of northeast Iowa were begun in the spring of 1952. At that time baited hoop nets were used in conjunction with trap nets at the established river survey stations. In 1952 ten stations were netted for catfish. In 1954 this number was increased to fourteen.

In 1955, a year having one of the lowest average river stages on record, lack of water curtailed surveys and the coverage was cut to eleven stations. Surveys at Anamosa on the Wapsie River and at Monticello on the Maquoketa River were dropped. Both stations, being below dams, lacked the necessary water to cover a 20-inch hoop net. The survey above Littleton on the Wapsie was also dropped due to lack of adequate flowing water.

Table 1 gives the netting data for 1955. It is apparent that at Charles City, Tripoli, Manchester, and Rockford, the catch didn't justify the effort. At all these locations, the current in water over two feet deep was not sufficient to hold the hoop nets open. When this fault was remedied through the use of stakes and bridles, the current just wouldn't flow the cheese out of the nets. In addition to this lack of odor attraction, a most important factor in netting catfish, it was assumed that the fish were just not moving in the sluggish water.

Table 1 - Catfish Netting Totals - Northeast Iowa, 1955.

River	Netting Station	No.	Wt.	No. Net Hrs.	No./Hr.	Wt./Hr.	Av.Wt
Iowa	Belle Plaine	309	115.8	330	.94	.35	.38
Iowa	Le Grande	938	143.7	514	1.83	.28	.15
Iowa	Marshalltown	2345	159.4	525	4.47	.30	.07
Cedar	Vinton	1151	245.2	552	2.08	.44	.21
Cedar	Cedar Falls	319	88.9	570	.56	.16	.28
Cedar	Charles City	44	22.0	369	.12	.06	.50
Wapsie	Central City	769	99.2	564	1.36	.18	.13
Wapsie	Otterville	948	271.3	528	1.79	.52	.29
Wapsie	Tripoli	57	4.0	441	.13	.01	.07
Maquoketa	Manchester	12	6.8	381	.03	.02	.57
Shellrock	Rockford	46	15.2	388	.12	.04	.33
	Totals	6938	1171.5	5162	1.34	.23	.17

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As can be seen from Table 2, the 1952 catch data are not compatible with the succeeding years' data. This same phenomenon, the low number per hour basis, is also apparent in Harrison's (1954) first-year data in his bait net surveys of the Des Moines River catfish population. He attributes it to inexperience in fishing bait nets.

Table 2 - Four-year Summary of Bait Netting in Rivers of Northeast Iowa, 1952-1955

	1952	1953	1954	1955
Number Cat Taken	2198	9861	7057	6938
Weight of Cat Taken	889	2048	1662	1172
Number Hours Fished	4230	4854	6460	5162
Number / Net Hour	.54	2.03	1.09	1.34
Weight / Net Hour	.21	.42	.26	.23
Av. Wt. / Fish	.40	.21	.24	.17

It has been pointed out (Cleary, 1954) that strong year classes of catfish, entering the catch as yearling fish, result in a sharp drop in the average weight per fish in the catch, and that this phenomenon is usually accompanied by a noticeable increase in the fish-per-hour catch. The 1952 catch may have been adversely affected by inexperience or it may have been a true picture of an adult dominated population. The fish certainly were of a large average size (0.40 lb.). This condition may have been the result of poor reproduction during the two high-water years preceding the survey. If the 1952 data are not biased by inexperience in netting, then it is evident that 1952 and 1954 were seemingly years of high catfish reproudction. Witness the sharp drop in average weight per fish in the 1953 (-48 percent) and 1955 (-29 percent) catches.

The data for Table 3 have been selected from the various survey stations in eastern Iowa rivers. These stations had net catches of over 100 fish for each of the years mentioned. Only the Belle Plaine station on the Iowa River, which was surveyed in late May, did not follow the state-wide trend of heavy fingerling catches in 1953 and 1955. This station deviated only in 1955, indicating that management plans can be based on area-wide surveys without too much error due to lumping of the data.

Table 3 - Comparison Between Number Per Hour and Average Size of Catfish Taken at Some Survey Stations in Northeast Iowa, 1952-1955.

		1952		1953		1954		1955	
River	Station	No./Hr.	Av.Wt.	No./Hr.	Av.Wt.	No./Hr.	Av.Wt.	No./Hr.	Av.Wt.
Iowa	Belle Plaine	.80	.26	2.33	.08	1.57	.18	.94	.38
Cedar	Vinton	.30	.43	.90	.30	.85	.40	2.08	.21
Wapsie	Otterville	.66	.78	.91	.52	1.10	.55	1.79	.29
Wapsie	Central City	1.75	.19	14.84	.14	.90	.27	1.36	.13

During the 1955 surveys, a sample of each catch was measured and a portion of this sample was processed for future growth studies. A total of 2,583 catfish was measured. If the catch was less than 300 individuals, the entire catch was measured. If over 300, the first 300 fish removed from the nets were measured to the nearest one-half inch.

Table 4 indicates that 75 per cent of the catfish taken in bait nets in 1955 were less than 10 inches in total length. Therefore, if these netting results are indicative of the existing population, the discriminating angler must be satisfied with a fishable portion of only 11 per cent of the total population, for only 11 per cent of the catch (not including fish of the year) was over 12 inches in total length.

Table 4 - Total Length Frequency Groupings of a Sample of Channel Catfish Taken in Rivers of Northeast Iowa in 1955.

River	Number Measured	% less than 10 in.	% between 10 & 12 in.	% greater than 12 in.
Iowa	935	72%	18%	10%
Cedar	779	70%	15%	15%
Wapsipinicon	811	86%	7%	7%
Maquoketa	12	74%	13%	13%
Shellrock	46	20%	28%	52%
Grand Average		75%	14%	11%

Conclusions

1. Low water and lack of adequate current limited the 1955 bait net catch of catfish.

2. Average weight catch trends indicate that 1952 and 1954 were years of heavy natural reproduction.

3. There are indications that good or poor fingerling catches are manifest at all stations and on all rivers during a given year. Factors which affect catfish production are evidently wide in effective scope.

4. A series of length-frequency samples from all stations indicate that 75 per cent of all catfish taken in bait nets during 1955 were less than 10 inches in total length.

5. Of the bait net catch, only 11 per cent were 12 inches or over in total length.

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THE 1955 ARTIFICIAL LAKES CREEL CENSUS

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Fisheries Biologist

This year, as in the past few years, a creel census was conducted on several of the state-owned artificial lakes in southern Iowa. The method of making the creel census was essentially the same as other years. Briefly, the procedure was as follows: before the fishing season started the area fisheries manager[1] contacted the boat livermen on the various lakes and requested that data pertaining to number of people in fishing parties, number of hours fished, fish caught, and county in which the anglers lived be tallied on a special creel card. The census was designed primarily to check only fishermen using the rental boats. These data were sent to the fisheries biologist for tabulation and interpretation. The census was by no means compulsory for the boat liverymen, but done in concurrence with bait minnow inspection for which they received payment. In many cases the success of such a creel census is more dependent upon individual interests and initative of these people than the monetary rewards involved.

In all, eleven lakes were checked during the summer fishing season. Three of these lakes were excluded from this report because of insufficient fishermen contacts. Thus, it was felt that from eight lakes sufficent creel cards were returned to constitute a reasonably good creel census, and be of some value in the understanding of the harvest and potentials in the artificial lakes fishery. The lakes censused were Springbrook, Beed's, Ahquabi, Wapello, Red Haw Hill, Keomah, Darling, and Green Valley. Nine Eagles Lake was inadvertantly dropped after the 1954 creel census program; however, Beed's and Green Valley were added this year. One other artificial lake was censused through a federal aid project and the results are included in another report.

Due to additional encouragement to the boat livery operators to contact more fishermen, the number increased slightly from 1954. This was approximately 4,500 last year and slightly over 5,400 the past summer. Three of the lakes had decreases in sample size ranging from 240 per cent at Red Haw Hill to 10 per cent at Lake Wapello. Keomah and Ahquabi had good increases from last year in anglers contacted.

Several facts concerning the fishing pressure and its relationship to sample size seem worth mention. The number of hours spent by boat anglers indicates fishing pressure, and in this case it is the minimum. This minimum fishing pressure is wholly dependent upon the number of anglers contacted, the length of time the creel census was conducted, and the relative size of the lake. There seems little difference in the number of fishermen checked in any one time period, but a rather wide variation in the length of time the creel census operated. In general the census was started in April and continued until September. Springbrook, Wapello, and Keomah had the greatest number of fishermen checked, and the census continued into October. A comparison of size of sample, fishing pressure, and catch statistics in 1954 and 1955 are listed in Table 1.

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Table 1. A comparison of size of sample, fishing pressure, and catch statistics in 1954 and 1955 in several southern Iowa artificial lakes. 1954 data in parenthesis.

Lake	Area in Acres	Months Censused	No. of Men	No. of Hours	Total Fish	Hours Acre	Men Acre
Springbrook	27	6	866	3438	4465	127	32
		(6)	(1027)	(3718)	(5208)	(137)	(38)
Keomah	82	6	983	3217	4558	36	12
		(5)	(734)	(2667)	(3084)	(32)	(9)
Wapello	287	6	744	2996	2348	10	3
		(6)	(821)	(3359)	(3753)	(12)	(3)
Red Haw Hill	72	4	280	1198	1085	16	4
		(5)	(505)	(2093)	(2416)	(29)	(7)
Ahquabi	130	6	559	2037	3521	16	4
		(4)	(346)	(1345)	(2177)	(11)	(3)
Beed's	130	4	565	2050	2019	15	4
Green Valley	390	5	738	2797	1746	7	2
Darling	302	5	655	2891	4546	10	2

Angling Success

By and large, fishing the past season could be considered good in southern Iowa artificial lakes. However, by comparison it was not as good as in 1954. The catch rate varied from 0.62 fish per hour in Green Valley to 1.56 at Lake Darling. The eight lakes had an average catch rate of 1.06 fish per hours. This is considerably lower than last year when the mean catch per unit effort was 1.37 for seven lakes (Table 2). This decrease is apparently partially due to the boat livery men filling out cards for unsuccessful fishing parties as well as successful anglers since this was stressed when they received instructions. Many more cards from unsuccessful fishermen were received than ever before.

Table 2. A comparison of the fishing success in 1954 and 1955 in eight southern Iowa artificial lakes. The 1954 data in parenthesis.[1]

Lake	No. of Men	No. of Hours	Total Fish	Fish per Man	Fish per Hour
Springbrook	866	3438	4465	5.16	1.30
	(1027)	(3714)	(5208)	(5.0)	(1.40)
Keomah	983	3217	4558	4.63	1.41
	(734)	(2667)	(3084)	(4.2)	(1.15)
Wapello	744	2996	2348	3.15	0.79
	(821)	(3359)	(3753)	(4.5)	(1.11)
Red Haw Hill	280	1198	1085	3.57	0.91
	(505)	(2093)	(2416)	(4.7)	(1.15)
Ahquabi	559	2037	3521	5.41	1.43
	(346)	(1345)	(2177)	(6.3)	(1.61)
Beed's	565	2050	2019	3.57	0.98
Green Valley	738	2797	1748	2.37	0.62
Darling	655	2891	4546	6.94	1.56

[1]From Tom Moen, Biology Seminar Report, January 1955.

The fish per man per fishing trip ranged from 2.37 at Green Valley to 6.94 in Darling. The average fishermen took home about four fish (Table 2). Although there is no definite correlation between fishing success and size of lake there is a general trend for the smaller impoundments to have the highest anglers success.

One interesting fact concerning fishing pressure can be seen in the catch data from Green Valley. This is one of Iowa's newest artificial lakes (completed in 1952).* The lake was opened to public angling for the first time on May 30, 1955. During the first two days the 153 fishermen contacted caught 826 fish. This represents 47 per cent of the total fish caught during the remaining five months that the creel census was conducted.

If a mean weight of 0.3 pound is arbitrarily assigned to crappie, bluegill, and yellow perch; 0.5 pound to bullheads; 1.0 pound to largemouth bass, white bass, and walleye; and 2.0 pound to channel catfish and northern pike, some idea can be gained concerning the harvest of fish by boat anglers in the artificial lakes. In the eight lakes involved the production in pounds per acre varied from 2.4 at Green Valley to 60.0 pounds per acre in Springbrook. In each case this represents the minimum pound per acre harvested by boat anglers. The pounds per acre harvested in the individual lakes are presented in Table 3.

Table 3. A comparison of the minimum pounds of fish harvested per acre in eight southern Iowa artificial lakes during 1955.

Lake	Area in Acres	Total Fish All Kinds	Total lbs.[1] All Kinds	Pounds per Acre Harvested
Springbrook	27	4465	1619	60.0
Keomah	82	4558	1699	21.0
Wapello	287	2348	1033	3.6
Red Haw Hill	72	1085	421	5.9
Ahquabi	130	3521	1254	9.7
Beed's	130	2019	496	3.8
Green Valley	390	1746	1640	2.4
Darling	302	4546	2097	6.9

[1] Based on mean weight 0.3 pound crappie, bluegill, and perch; 0.5 pound bullhead; 1.0 pound largemouth bass, white bass, and walleye; and 2.0 pounds channel catfish and northern pike.

Species Composition

As usual crappies and bluegills were the most caught fish in the eight lakes. Crappies made up the largest percentage of the fish caught in four impoundments. Bluegills were caught more frequently in Ahquabi and Wapello. Green Valley and Darling were the only lakes in which bullheads were the most important species in the creel. In relation to total harvest largemouth bass ranged from one percent at Beed's Lake to 25 per cent at Green Valley. Yellow perch were relatively unimportant except in Lake Wapello where they made up 25 per cent of the fisherman's bag. A few white bass, northern pike, walleye, channel catfish, and carp were taken in various lakes but never

* The first brood stock and fingerling stocking was completed in the spring of 1953.

constituted more than one per cent of the harvest. The species composition of the anglers catch for each lake is listed in Table 4.

Table 4. The species composition of the 1955 anglers catch in eight southern Iowa artificial lakes, expressed as per cent of total catch.

Lake	Total Fish	Crappie	Bluegill	Lm. Bass	Bullhead	Ch. Cat.	Pch.	N.P.	Wall.	Wh. Bass
Springbrook	4465	50	45	4	3	-	T	T	T.	-
Keomah	4558	71	26	3	T	T	T	-	-	T
Wapello	2348	24	29	10	10	T	25	-	T	2
Red Haw Hill	1085	53	38	5	1	T	1	T	-	T
Ahquabi	3521	26	68	3	2	T	2	-	T	-
Beed's	2019	84	10	1	2	-	T	-	-	-
Green Valley	1746	1	18	25	55	T	-	-	T	-
Darling	4546	23	7	1	67	T	T	-	-	-

Summary

A creel census conducted on eight state-owned artificial lakes is reported on. These are Springbrook, Keomah, Wapello, Red Haw Hill, Ahquabi, Beed's, Green Valley, and Darling. Boat liverymen conducted the creel census on the various lakes at the request of the State Conservation Commission.

There is noted a slight increase in the number of fishermen contacted from last year. Three of the lakes had decreases in sample size, but two show substantial increases. Some facts concerning sample size and the relation to fishing pressure are discussed.

Fishing was considered good during the season, but not as good as in 1954. The catch rate varied from 0.62 fish per hour at Green Valley to 1.56 in Darling. The fish caught per man ranged from 2.37 at Green Valley to 6.94 in Darling.

A comparison of the minimum pounds of fish harvested per acre in the eight impoundments during the season is presented.

Crappie and bluegill were the most caught species in all but two lakes. Largemouth bass, bullheads, yellow perch, channel catfish, walleye, white bass, northern pike, and carp made up the remainder of the catch.

THE 1955 NORTHERN IOWA LAKES SURVEY

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The lakes survey, or perpetual inventory of fishes, has been conducted for the past fifteen years by the State Conservation Commission. As usual, in 1955, the survey was conducted on the major fishing lakes by test seining with 500 feet of one-quarter inch mesh web seine at several stations on each lake. Pond nets, gill nets and an electric shocker were used in some lakes to supplement the seine catch especially in problem areas or lakes that could not be adequately sampled with the seine. The principal purposes of the lake survey are to determine the magnitude of reproductive success of the various fishes in each lake and to compare these data with those of past years. Also, various management practices can be evaluated such as extensive rough fish control, stocking, chemical control of vegetation and drainage-rehabilitation projects. In addition, these data provide pertinent information from which recommendations for improvement of fishing can be made.

The following observations were recorded for each lake's survey, including comparisons with the past several years of inventory work.

Spirit Lake

In 1955 there was no significantly large reproduction in any species of fish in this lake. For example, the best success indicated by the test seining was in the yellow perch which yielded an average of 2,300 fingerlings (young of the year) per haul. By comparison, the 1954 survey produced an average of over 30,000 fingerlings per haul; and, this can be compared with the previous ten year average of about 10,000 per haul. Populations of adult perch, crappie, bluegill, largemouth bass and bullheads are about normal. Walleye adult and yearlings are abundant. In the rough fish species, sheepshead and buffalo have increased significantly; however, carp have apparently declined steadily since 1952 when an average of 14 adults were obtained per haul, to an average of six per haul in 1955. White bass again failed to reproduce successfully and the stocks of adults remains very low.

As is well known, the Commission has carried on a long-time research project in an attempt to evaluate the stocking of walleye fry. Present evidence strongly suggests that fry stocking may be necessary in most of the Iowa lakes in order to maintain adequate standing crops of this desirable species. Also it has been pointed out (Rose, 1954) that possible interspecific relationships may be operating at Spirit Lake that limits successful reproduction. The project, now in its eleventh year, has involved five years of no fry stocking, followed by six years of heavy fry stocking and is now patterned to coincide with Clear Lake's alternate year fry stocking. Annual survey data are used to evaluate the program according to the average numbers of walleye fingerlings, yearlings and adults obtained per haul with the 500 feet of one-quarter inch seine. The information obtained up to the present time is included in Table 1, and is identical with that from the previously cited paper (Rose, op. cit.) except that the 1955 data are added. It is apparent that the large number of fingerlings obtained in 1950 is related to the subsequent increase in yearlings taken in 1951 and the adults in 1952. Also the comparative grand averages indicate the influence of the

* State Biology Building, Okoboji, Iowa.

fry stocking in all three categories. Again in 1955 the no stocking immediately reverts to the low fingerling count and strongly suggests a cause and effect relationship.

Biologically, the lake appears to be in excellent condition with no major problems existing at the present time.

Table 1. Comparison of walleye catches per seine haul during years of no fry stocking and years of heavy fry stocking.

Year	No. fry per acre	Av. Number fingerlings	Av. Number yearlings	Av. Number adults	Number of hauls
1944	0	10.6	0.6	0.4	11
1945	0	0.1	2.2	0.6	11
1946	0	2.7	0.8	0.0	15
1947	0	13.1	2.6	2.6	14
1948	0	16.7	2.7	3.9	10
Grand Av.	0	8.6	1.8	1.5	
1949	3,000	42.6	2.5	3.0	10
1950	3,000	137.3	4.0	1.6	9
1951	1,800	38	59.3	1.82	11
1952	3,000	57.9	72.9	76.0	7
1953	3,000	51.0	2.4	6.4	10
1954	3,000	68.1	20.0	10.5	10
Grand Av.	2,800	62.5	26.8	16.5	
1955	0	3.3	15.4	14.7	10

West Okoboji

A total of fourteen hauls were made in this lake's survey, seven in the summer and a similar number again in the fall recheck. A tremendous hatch of bluegills and perch occurred here this year together with a good hatch of crappie. Walleye reproduction and/or stocking effect was practically nil this year. A total of fifteen fingerlings was obtained in the survey; however, as mentioned in previous seminar reports, this lake is very difficult to sample for walleyes and therefore too much significance cannot be placed on these results for this species. The usual large numbers of adult perch,

bluegills, crappies and average numbers of large-and smallmouth bass, northern pike, walleyes and pumpkinseed were obtained.

There was considerable complaint by the fine-fish anglers about the large numbers of bullheads that have developed in this lake. A special check was made during the fall with six pond nets. These caught a total of nearly 4,000 in 216 hours of fishing. When compared with past pond net catches this indicates a vast increase in population.

The possibility of removing the catch limits on bullheads or adding them to the rough fish list is suggested as a means of further control of this species in this lake.

East Okoboji

Reproduction of most fishes in this lake was very poor this year except for a fair hatch of bluegills. Bullheads and sheepshead have increased in alarming numbers. Populations of adult perch, crappie, walleye and bluegill are fairly good; and angling success was very good especially early in summer. The lowering of water levels plus high mid-summer temperatures caused some rather extensive fish losses in the upper, shallow portion during a prolonged period of calm. At freezeup, the lake was about two feet below crest level, the lowest since about 1939. This decline in volume has contributed to declines in dissolved oxygen this winter, necessitating the opening of most of the lake to promiscuous fishing (nets, spears etc.).

The dense beds of aquatic vegetation and heavy growths of bluegreen algae create a nuisance especially in the northern part of the lake. Control of these growths by chemicals in the portion above No. 9 highway would cost in the neighborhood of $4,000 for one year.

Clear Lake

This was a poor year for reproduction of fishes in Clear Lake. Declines were noted in young-of-the-year walleye, crappie, bluegill, yellow bass and largemouth bass. Populations of adult bullheads, bluegill and yellow bass are very good and the adult walleye, crappie and perch are about normal. Northern pike have declined to the lowest point in many years.

This was a non-stocking year for the walleye and again, as usual, few young-of-the-year were obtained. An average of 1.8 fingerlings were taken per haul this year (5 hauls); whereas none were found in the other no-stocking years of 1953 and 1951. In 1949 an average of ten were obtained. This is compared with 27, 23 and 20 per haul in the stocking years of 1950, 1952, and 1954. While these figures are not as striking as the variance at Spirit Lake, they follow the same pattern and indicate the importance of the hatchery. This project is being followed in very complete detail by the Research Unit at Iowa State College.

Angling was very good at Clear Lake this year, particularly for the bluegill, crappie and yellow bass. There are no serious problems existing at the present time.

Storm Lake

This lake is probably Iowa's No. 1 problem lake. Ever since the devel-

opment of the huge gizzard shad population, angling has been very poor and the efforts to control excessive forage (shad) by seining, and stocking of predators have not been successful. On the other hand, many comments have been received concerning the additional lake usage by swimmers since the reduction in bluegreen algae. No bloom existed throughout the entire summer and beaches were loaded with bathers and picnickers. Since all of the lakes having high shad populations are free from blooms, and whereas they too formerly were heavily infested we must assume that the shad are responsible for the decline in algae. Experimental feeding of shad in aquaria has indicated that some algae is consumed; however, not in sufficient quantities to control heavy growths. Further tests are planned.

There was good reproduction of white bass this year. Sub-adult populations of channel catfish, bullhead, perch and crappie are very high and adult walleyes are abundant. The 1954 year-class of gizzard shad is abundant and the reproduction this year was again very high.

Thus we are faced with a difficult decision. In order to produce good angling the shad must be brought under control to reduce forage; however, if the shad are eliminated the lake will doubtless bloom heavily curtailing angling during summer and reducing other recreational uses. If the lake blooms, a return to copper sulfate or other control chemicals will doubtless be necessary. Since it is our job to aid in promotion of angling it is suggested that either one of the two courses be followed that have been outlined verbally to the Section Superintendent.

Lost Island

Most significant findings in this year's survey were the presence of a tremendous crop of yearling bullheads. An average of 25,000 were taken per haul, and in addition, another large year-class was produced this year. A good natural hatch of walleyes was obtained (no fry stocked). Adult walleyes are fairly abundant. Bottom food are very scarce and indicate over-populations of bullheads and carp.

Silver Lake (Palo Alto Co.)

This lake was drained in 1953 for rehabilitation purposes. Stocking has been confined to walleye fry and a fair crop has developed therefrom. Bullheads and fathead minnows abound in the lake apparently having survived in watershed areas and the undrained portion. Heavy vegetation and filamentous algae have become a problem and with the low water levels this winter it is expected that most of the fishes will perish. Future stocking should include perch and northern pike with a minimum of walleye fishing to be expected since the lake is largely unsuited for this species.

NOTES ON OTHER LAKES

Silver Lake (Dickinson Co.)

Conditions at this lake this year were not favorable. A vast decline in the important crappie, perch and bullhead have occurred, although there was a fair reproduction in perch, walleye and bullhead. Carp have increased considerably. Heavy blooms of bluegreen algae limit angling and other recreation on the lake. Winter angling, usually fairly good for the crappie has been very poor and at the present time all angling has ceased due to inability to

catch fish and to keep bait alive in holding pails. Dissolved oxygen is declining rapidly. Some consideration should be given to algae control at this lake.

Center Lake

Reproduction was largely ineffectual in any of the species of fish in this lake in 1955. A good population of bullhead adults is present and recent crappie stocking has been effective since several adults and a few young were obtained. Adult carp abound in the lake and no improvement in angling or crops of fish can be expected until extensive control has been accomplished. No walleyes were obtained this year.

Blackhawk Lake (Sac Co.)

This lake is in about the same category as Storm, except that the "shaditis" infection has festered for a longer period of time. The surveys revealed some increases in adult walleye, white bass, bullhead, largemouth bass and channel catfish. Declines are noted in adult crappie, perch and shad. Young-of-the-year shad declined from an average of 17,000 per haul in 1954 to 8,000 in 1955. Angling has been extremely poor all year. Carp remain at a high level of abundance. Suggestions have been made to supplement present shad control measures.

Five Island Lake
(Palo Alto Co.)

Reproduction of fishes in this lake was again very poor. Ample supplies of small stunted perch exist together with an over-abundance of adult golden shiners. The lake is a difficult one to sample due to the tremendous growths of aquatic vegetation (submergents). Some measures were again carried on to control unsightly areas along parks and the highway. A five parts per million application of sodium arsenite was used (D-J project) and good results obtained. The area treated in 1954 was practically devoid of weeds indicating that control may be effective for several years.

Angling for northern pike, largemouth bass and walleyes was very good in the treatment area this year. This may have been partially due to the stimulation of fishes appetites by the sodium arsenite.

Ingham Lake (Emmet Co.)

Fish populations appear to be considerably improved here. Ample numbers of perch, walleye, crappie and bullheads are present and the number of forage minnows has declined considerably since 1954. Reproduction was poor in all of the game fishes this year. Carp are present but in such small quantity that they are not a problem at this time. Additional stocking of walleye, either as fry or fingerling is indicated to maintain a high predator population.

High Lake (Emmet Co.)

This lake is in an extremely poor condition biologically. Bullheads (15,000 per haul) in sub-adult and adult sizes as well as the walleyes were emaciated. Bottom fauna is scarce. Suggestions for improvements have been presented.

Manawa (Pottawattamie Co.)

Fish populations in this lake have improved but little from last year. Game fish reproduction was negligable. The adult crappie population is fair and sub-adult white bass, yellow bass and largemouth bass indicate a fair crop of adults in the future. Sheepshead, shad, buffalo and carp dominate. Due to upstream dams on the Missouri and consequent low stages of the river the lake is very low (approximately eight feet below crest). The diversion of Mosquito creek to the lake ($250,000 project) should maintain this lake at adequate levels. Deepest area of lake about 5.5 feet this winter.

Blue Lake (Monona Co.)

About the same conditions that prevail in Manawa are present here. Game fish are entirely dominated by a huge rough fish population. The lake is approximately five feet low at the present time.

Browns Lake (Woodbury Co.)

Aside from low water stage this lake is in very good condition. Stocks of crappie, bluegill, northern pike and largemouth bass are good and shad are not as abundant as formerly. Rough fish removal crews had removed 65,000 pounds of rough fish just prior to survey which should do this small lake (840 acres) a tremendous amount of good. At this time there is no problem except the maintainence of water levels.

North Twin Lake (Calhoun Co.)

Except for a tremendous increased gizzard shad population this lake is in very good condition. Good reproduction occurred in the yellow bass assuring a continuation of this desirable species. Good populations of adult bullhead, crappie, yellow bass, walleyes and northern pike are present.

Beeds Lake (Franklin Co.)

Aside from a lack of adequate forage this lake was at the time of the survey in very good condition. Reproduction of bluegills and crappies was either very poor or the tremendous crop of two-year-old crappies plus other game fishes had reduced these usual forage types to a very few. While most of the adult game fish were in good condition there was some evidence that additional forage was needed. Ample stocking of small fathead minnows has been done by the management section to care for this emergency.

Lower Pine (Hardin Co.)

This lake is much improved over last year. Reproduction of crappie and bluegills was good this year and adequate numbers of adults of these and largemouth bass are present. The lake is infested with carp and suckers. Growth rates of game fish are sub-normal.

Conclusion

In view of the ecological diversity of the natural lakes in Iowa, it is difficult to generalize on the findings of the survey. However, with few exceptions, 1955 might be classed as a comparatively poor year for game fish reproduction and a year in which crops of adult game fishes were high. This

may be a normal consequence of a drouth year, preceeded by several years of high water stages. In several lakes, large populations of predator fishes have developed from 1942-1954 (wet years) during which the connecting lakes and sloughs produced large crops of game and forage fish. In a dry year, such as 1955, spawning was confined to the lakes proper, providing easy prey for the increased populations of predatory types. This may have reduced the young-of-the-year game and forage fishes as indicated by the surveys this year and in some lakes has doubtless increased angling success.

Gizzard shad continue to be a major problem in several lakes and present indications point up the failure of current management practices, recommended by our section, to adequately cope with the situation. More drastic measures are mandatory if progress is to be made. Also, bullheads have become too abundant in several lakes, indicating the need of some further control in the near future.

A total of 32 lakes were surveyed by our five man crew in 1955, starting as usual in July and ending just before freeze up. Only 19 of these are reported here in order to save space and to outline present conditions in major areas. Complete data on each lake are filed on special forms in the Central Office and the State Biology Building at Okoboji.

Sampling techniques used in the survey are still a problem in Iowa as well as in our neighboring states; however, until more useful equipment is devised we will have to utilize to the best advantage the simple tools now employed.

RESULTS AND DISCUSSION OF THE ELECTRICAL SHOCKING METHOD OF CONDUCTING STREAM SURVEYS IN IOWA STREAMS, 1955

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Fisheries Biologist

The use of electricity in the management and study of fishes in this country and Europe dates back to the early 1920's or even possibly a little before. The first uses of electricity in fisheries work centered around fish screens, weirs, and deflection devices. In the early 1940's, the electric shocker method for making fish population studies came into being, and since that time the technique has been given considerable attention.

For the most part, the development of the electric-shocking method took place in the narrow, shallow, clear, cold water streams, and only in the past decade has the use of this valuable tool been expanded to include the turbid warm water rivers and lakes. The technique has been relatively slow to catch on in these last named habitats, largely because biologists were primarily interested in dealing with whole or, at least, large blocks of fish populations rather than with samples. In addition, the successful use of the shocker in warm waters seems to require the development of specialized equipment and procedure for every section of the country. On the other hand, the standard gear designed for trout streams meets with about equal success wherever trout streams exist.

During the past three years, several types and makes of shocker, together with many devices for getting the electricity into the water, have been checked out in several of our warm water Iowa streams. Both direct and alternating current units have been studied.

The initial work with the direct current outfit demonstrated it to be of very limited value in the warm waters of this state. Its principle limitation involved the small size of the generated field and its inability to hold more than just a few fish around the poles. Alternating current plants, including 110 and 230-volt, 60 and 180 cycle, single and three phase, and 1,000 and 2,500 watt capacity have been used with varying degrees of success. The largest plant, that is, the 230-volt, 180 cycle, 2,500 watt, three phase device, without exception, always produced the most fish, and it is this unit that is employed in the stream surveys in western Iowa streams at this time.

The rigging for getting the electricity into the water involved considerable experimentation. Factors of efficiency, mobility, transportation and limited crew size all necessarily came in for considerable attention. The gear to evolve from this turned out to weigh a little less than 300 pounds which could be assembled or disassembled in twenty minutes with the heaviest segment (the shocking unit) weighing about 130 pounds. It can be operated efficiently with two men, and transported in a panel truck. As respects its efficiency, fish have been turned over and identified at a rate of from one to ten individuals per minute in rivers the size of the Des Moines River and from about one fish per minute down to one in every five minutes in the Missouri River. In these instances, this is the approximate average over an hour's shocking time. Species and seasonal-wise,

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the efficiency of the gear offers certain problems that will be discussed later in this paper. Regarding its mobility, the unit is mounted on a boat equipped with an outboard motor. This makes for good mobility except at time of low water when it became difficult to move from pool to pool across shallow riffles or submerged sand bars.

Assembled for use, the shocking equipment is described briefly as follows: A board 5/4"x2"x7', is clamped across the bow of the boat perpendicular to the vertical plane of the keel. Three forward projecting booms are hinged to the cross member. These are arranged with the one at the middle pointing directly forward and one on either end placed at an angle so that their projecting ends are about ten feet apart. The booms are constructed of 5/4"x2"x4' pieces of hardwood. The electrodes are four foot lengths of $\frac{1}{2}$" ground rod affixed to the booms by means of an eight inch length of furnace chain. The shocker unit is placed amidships and is connected to the electrodes by means of insulated wire.

In the operation of the unit, one man runs the outboard and directs the path of the boat, while the second man stands immediately behind the shocker and logs the fish that are turned up into view.

In our western Iowa streams, this gear is almost completely effective to a distance of five feet from the electrode, which means that all fish lying in a twenty foot swath or ten feet to either side of the path of the boat are stunned. In addition to this, fish lying in a five to ten foot swath adjacent to the stun path are variously effected; some are stunned, others run away from the field and escape, while still others run into the field and are knocked out. By all appearances, all species of fish are quite similarly effected, but to confuse things, some species (carp, quillback, carpsuckers, the redhorses and walleye) float better than do some others (principally catfish and bullhead). And, to add to this, all fish float better at moderate temperatures (50-70°F.) than they do in either cold or warm waters. Below 40°F. and above 80°F. very few fish are observed in the path of the shocker in the turbid waters with which we are dealing. To make allowances for these variations, several things are taken into account in an effort to get the best data. First, an attempt is made to shock as many fish as possible. This is accomplished by steering a zig-zag course through the pools so that the fish that are not stunned are driven to shelter or to the top or bottom of the pool or into narrow channels where they cannot escape the shocker field. In addition, it has been found that some fish which fall to the bottom when stunned, if allowed to partially recover, will come to the top on a second or third exposure to the shocker. For this reason, all pools and shelter areas are worked repeatedly.

As mentioned above, certain species float better after stunning than do others. As yet we know of no way to adjust for this from the standpoint of the composition of the total population. Since, however, our inventories have always been on a population trend basis, we encounter no problems with which we are not already blessed. The enignma simply resolves itself to one of treating each species separately and this coupled with growth studies and/or population trends in other populations of fish from ohe year to the next, should give a fair idea of the well-being of any specific population.

To correct for the difference seen in the numbers of fish between hot and cold water temperatures, our surveys are conducted in the spring and fall at which times the maximum number of fish are observed.

Above, in connection with the operation of the unit, it was mentioned that one of the operators logged the fish as they turned up. That is essentially the way the surveys are run. Only large fish, those beyond the fingerling stage, are counted. This excludes the multitudes of forage and young fish from the census. As the surveys progress, the shocked areas will be re-visited annually and the number and species of fish shocked on each return will be compared to those of the past. Significant changes in numbers will be interpreted to reflect trends in the population.

Since we are charged with tracking trends in stream fish populations, the data collected on the various study areas has to be framed into a function of measurement. Upon reviewing the data in several different ways, such as length of stream worked, number of pools and riffles shocked, length of shocking time, and others, it was found that the best expression was in function of time. Fish shocked per hour was the unit of measure decided upon.

During the spring and fall of 1955, shocker surveys were made on 31 stations in nine streams. The data collected from these areas are summarized in Table I. That table names the rivers surveyed, together with the number of stations visited on each stream and the number of hours shocked on each. In addition, the table lists by species the kind, the total number, and the number of each species shocked per hour.

In that the surveys were initiated in 1955, we have at present only the beginning point for following the population trends. Because of this, no discussion of the data is now possible from that point of view.

Nonetheless, there are a few things that the data reflects as regards the technique as a tool for studying stream fish populations in medium sized to large turbid water streams. Most of these point up the electrical method to be far superior to any of the techniques employed in the past.

Most important, the table shows that a large number of fish were observed by the method. Except by poisoning, there is probably no known way of consistantly observing as many fish in as wide a vicinity with as little effort as by the electrical method. Witness the fact that approximately 8,500 fish were seen in about 38 hours of actual shocking time. This, of course, does not include preparation and travel time to, from and between survey stations. Taking these things into account, it is possible to average about three stations a day. This is certainly not possible in the case of any other technique.

Additionally, the data also show the technique not be immuned of limitations. These limitations are quite common to all survey techniques but, even so, they are less pronounced in the electrical method.

Due to the fact that certain species float better after stunning than do others, or that they live in habitats more vulnerable to shocking, limit the method as a means of evaluating species compositions. For example, take the case of the Des Moines River from its forks to the city of Des Moines. Using only the shocking data, it would appear that the species composition by numbers would be as follows: Quillback, 39%; Carp, 23%; Catfish, 15%; Northern redhorse, 7%; Golden and Silver redhorse, 5%; Buffalo, 3%; Walleye, 3%; Flathead, 2%; Smallmouth, 2%; misc.sp., 1%. From past experience and other data the only thing out of line in this sequence is that the catfish

should rank first and quillback, third. This discrepancy is probably due mostly to the habitats of the fish. Quillback inhabit shallow water and are more easily seen after being stunned. Catfish, of course, tend to stay in deep water and because they often sink after shocking, are observed less frequently.

Summary

In 1955, the electrical shocking method of studying stream populations of fish was employed for the first time in this state. The data collected in connection with the study are presented in tabular form, and comments relative to the design of the gear and its efficiency in the turbid warm water streams of Iowa are included. Additionally, the method of using the shocker in the field and the way in which the data are handled are also given consideration.

TABLE 1. Stream Surveys By Electric Shocker 1955

Name of Stream Sampled	Missouri	Little Sioux	N. Raccoon	Des Moines Des Moines Cty E. Forks	West Fork Des Moines	East Fork Des Moines	Cedar River	Wapsipinicon	Humboldt Impoundment
No. Stations Sampled	5	5	2	13	2	1	3	1	2
No. Hours Shocked	9.5	6	1.66	11	2	1	4.25	.66	1.66
Species	Total Number fish shocked in stream Number fish shocked per hour								
Paddle fish	1 .1								
Gizzard Shad	39 4.2	21 3.5	1 .2						
Goldeye	33 3.3	2 .33							
Northern pike		6 1		1 .1				1 .5	1 .6
Blue sucker	34 3.3								
Buffalo	2 .2	23 3.8	21 12.6	67 6	21 10.5	1 1	33 7.8		4 2.2
Quillback and carpsuckers	43 4.5	172 28.7	285 172	951 86	190 180	60 60	351 83	36 55	126 - 76
Golden and silver redhorse			15 9	136 12.4	10 5	3 3	66 13	3 4.6	25 15
Northern redhorse		85 14.1	21 12.6	163 14.8	3 1.5	12 12	84 18	11 17	52 31
Hog sucker			2 .4	17 1.5	1 .5		2 .5		2 1.2
Common sucker			1 .2	7 .6	3 1.5	1 1	4 .1		
Carp	354 35	593 99	378 227	572 52	504 252	88 88	423 99	34 51	515 310
Channel Catfish	25 2.7	44 7.3	29 18	383 34.8	31 15.5	16 16	571 134	9 14	55 34
Bullhead	2 .2	4 .6			60 30	11 11	1 .2	2 3	
Flathead Catfish	43 4.5		2 .4	49 4.5					
Smallmouth bass				45 4	44 22		20 4.7	5 8	3 .2
Bluegill							8 2	6 10	
Crappie			1 .2	8 .7	3 1.5	1 1	8 2	5 8	1 .6
Walleye		21 3.5	39 23.5	67 6	37 18.5	4 1	18 4.2	10 15	13 8
Sauger	3 .3								
Sheepshead	23 2.4	4 .6	5 .3						

STRATIFICATION OF IOWA ARTIFICIAL LAKES

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Fisheries Biologist

The southern half of Iowa is well supplied with artificial impoundments in the form of water supply reservoirs, industrial pits, farm ponds and State owned artificial lakes. Individually these water areas are relatively small, but collectively they furnish several thousand acres of fishing water. One important aspect of the management of these waters has been concerned with education of the fisherman in the values of increased harvest of pan fish. An unknown share of the success of the harvest is related to the reaction of fish to the stratification of these artificial lakes and ponds. The fisherman must be informed of the nature of this phenomenon and how it may affect his fishing.

Little was known about the stratification of southern Iowa waters until Lewis (1949) pointed out that Red Haw and East Lake, in Lucas County, were stratified during the summer of 1948. During a special fisheries survey of the Des Moines City Reservoir in 1949, prior to opening the area to public fishing, Rose found that this body of water was stratified, but it wasn't until several years later that a definite program was initiated in an effort to find out which lakes were affected and to what extent. Determination of the extent of chemical and thermal stratification became an integral part of the southern Iowa lakes survey program in 1952. This resulted in only one set of data for each lake each season (usually midsummer) except for a few key lakes that were visited two to four times each season as time would permit.

This report is the result of an attempt to consolidate and summarize the data secured during the past four years. During this period thirty-six lakes have had one or more checks to determine whether or not the lake was stratified. Over 1,000 separate temperature readings were recorded and about 350 dissolved oxygen and hydrogen-ion determinations were made during 132 visits to these lakes.

Location and Description of Lakes

The thirty-six lakes included 17 State owned artificial lakes and 19 city reservoirs. All but three of these impoundments lie south of U. S. Highway number six and they are fairly well distributed east and west across the State. Most of the State owned lakes are located in narrow, steep-sided valleys, surrounded by wooded ridges and hills. The city reservoirs are located in about the same topographical situations but often lack the shelter from wind action afforded by timber.

Individually they are rather small lakes, varying from 16 to a little less than 400 surface acres; over 50 per cent of the lakes fall in a group having an area between 70 and 130 acres. Maximum depths range from 7 to 55 feet. The average depth is approximately 22 feet. Seventy per cent of the lakes occur in a group 15 to 25 feet in depth. About the same averages in size and depth occur if the two groups of lakes are treated separately. The State owned lakes do not have the extreme variation in depth that is found in

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the city reservoirs.

Although there is considerable variation in the watershed ratios among these lakes, none have permanent streams as a source of water, but depend entirely on runoff to maintain water levels. Turbidity due to suspended soil particles, is often high following heavy runoff, but usually settles out in a short time. Turbidity due to plankton organisms is quite variable from lake to lake and if present it is likely to be persistent. Due to the use of copper sulfate the city reservoirs consistently have less turbidity due to plankton that the State owned lakes. Rooted aquatics, predominately Potamogeton spp., are usually abundant, forming dense bands of vegetation along shorelines and often completely taking over in the shallow portions of a lake.

Materials and Methods

A single station was selected for each lake, preferably the deepest part of the lake. In the early part of this work several stations were selected for each lake but the data agreed with the single station to the extent that it was felt that one set of data at the time of each visit would delineate the stratification for the entire lake.

Temperature data were secured with a system of three minimum-maximum thermometers attached to a plastic cord. The cord was marked at three foot intervals. The thermometers were attached at the one, two, and three foot marks respectively. Temperature in ^{o}F. was recorded for surface (4 inches below water level) and each three foot of depth to the bottom. A Whitney electrical resistance thermometer was available for a small amount of this work and where this instrument was used all readings were recorded in meters and ^{o}C. For purposes of this paper all temperatures will be expressed as ^{o}F. and all depths in feet.

Water samples were taken with a one liter Kemmer water bottle at depths corresponding to stratification as indicated by temperature gradients; this was usually 3 to 5 samples. Dissolved oxygen and hydrogen-ion concentrations were determined from each water sample. The amount of dissolved oxygen was determined by the Winkler method and expressed in parts per million. Hydrogen-ion concentration was determined by colorimetric method, using phenol red as an indicator with a pH range of 6.8 to 8.4.

During the summer of 1954, twenty-five lakes were sampled for alkalinity of the surface water. These were completed only oh surface water because of the possible relation to electric shocker efficiency. Both phenalphthalein and methyl orange alkalinity were ascertained from the water samples and recorded in parts per million.

Water transparency was measured with a Secchi disc, recording the depth at which the disc disappeared from view.

Recognition of Stratification

Stratification of lakes is commonly separated into thermal and chemical components. Thermal stratification was considered present if the temperature readings indicated that a thermocline exited (1.62^{o}F. drop in temperature per three foot drop in depth) even though a hypolimnion was not present. Apparently the relatively shallow depths prevented the formation of a hypolimnion

in most instances thus the thermocline extended to the bottom of the lake. Chemical stratification was considered present if the amount of dissolved oxygen approached minimum requirements for fish at any depth. The decision as to what constituted minimal oxygen level under the various conditions of stratification is admittedly difficult and any statements made hereafter are strictly the opinion of the investigator.

Results

Each of the 36 lakes examined in this study can be placed in one of three general groups: one, those that do not stratify; two, those that have a temporary and/or a very limited stratification; three, those that have a strong stratification each summer. It is rather difficult to draw a sharp line between any two of these groups; group two, for instance, contains several border line lakes that might fit in one of the other groups if a more detailed study was made.

Group one: This is strictly a minor group. Only four (11 per cent) of the lakes fall in this catagory. These lakes have three things in common. They are comparatively shallow, ranging from 7 to 13 feet in depth. Secondly they are exposed to wind action, allowing complete circulation of the entire body of water. All four lakes have had a history of high turbidity and no vegetation. Secchi disc readings seldom exceed twelve inches. Water temperatures in these lakes more or less follow the air temperatures.

Group two: Ten lakes (28 per cent) can be placed in this group having either a temporary stratification or a very limited layer of water unsuitable for fish life. Lakes that stratify once in 3 or 4 years and those that stratify 2 out of 3 years are also included in this group. These lakes are also rather shallow, averaging 18 feet in depth (range 14 to 23) and are exposed to considerable wind action. A prolonged warm period with comparatively little wind will allow these lakes to stratify to a limited extent. An epilimnion may be formed with thermocline temperatures present in a very small volume of water in the deepest area of the lake. Bottom temperatures in these lakes are rather high. Temperatures below 70°F. were rare and many times the deepest area of these lakes had water temperatures of 75°F. or higher, even though the lakes was considered stratified. In a number of instances the qualification for thermal stratification were met with the minimum temperature gradient.

Chemical stratification in these lakes was often very slight. Occasionally dissolved oxygen was depleted in the deeper area but more often there would be some reduction but sufficient oxygen in the thermocline to support fish.

Due to the relatively small volume of water involved and/or the temporary nature of the stratification, the fish populations and other organisms in these lakes are not seriously effected by these conditions.

Group three: Twenty-two of the 36 lakes (61 per cent) show evidence of consistent thermal and chemical stratification each year. As a group these lakes are deeper than either of the first two groups, averaging 24 feet in depth (range 13 to 55) but showing greater variation. Surrounding hills and wooded watersheds afford protection from wind action.

The stratification of these lakes is often characterized by early

formation of a thermocline and a considerable change in temperature between the lower limits of the epilimnion and the upper limits of the thermocline during midsummer. This difference in temperature reached a maximum in the Williamson pond on July 20, 1955 when a 15°F. decline in temperature was recorded as the thermometer was moved from 6 to 9 feet. A 7.4 degree drop was recorded for a one foot difference in depth at Nine Eagles lake on June 3, 1953. The average change in temperature from epilimnion to thermocline was six degrees. Total temperature decline within the thermocline often exceeded 20 degrees. Bottom temperatures were quite cool (usually 60-65 degrees), particularly in the deeper lakes where temperatures of 50°F. and lower were common. Total temperature decline from surface to bottom was greater than 35 degrees in several instances. It was also noted that where a hypolimnion was present the bottom temperatures did not increase to any extent during midsummer (Table 1).

Table 1. Surface and bottom temperatures of three lakes in group three taken at three intervals during 1953.

Lake	Date	Max. depth	Stratified	Surf. temp.	Bottom temp.
Geode	May 4	41	No	55.4	48.2
	June 4	41	Yes	75.2	49.6
	July 23	41	Yes	82.0	51.0
Keosauqa	May 4	27	Yes	55.7	47.3
	June 4	27	Yes	80.0	47.0
	July 30	27	Yes	87.0	51.0
Nine Eagles	May 5	33	No	54.6	49.0
	June 3	33	Yes	75.2	49.2
	Aug. 6	33	Yes	81.0	51.0

Table 1 also indicates that stratification may be evident as early as the first week in May but normally or in most lakes it is later than this.

Chemical stratification usually follows the thermal stratification quite closely. In the deeper lakes oxygen depletion was evident in the hypolimn-ion early in June and by the last of July or the first part of August the oxygen concentrations were approaching minimum amounts in the thermocline in most lakes of this group.

Hydrogen-ion concentrations seldom fell below 7.0, even in the hypolimn-ion, but any reduction in oxygen was usually accompanied by a reduction in hydrogen-ion concentration.

The depth of the epilimnion appears to be quite consistent among all the lakes that stratify each year, varying from 6 to 21 feet, depending more on topography and surface area than on the depth. The average epilimnion extended to a depth of 9 feet. The thickness of the midsummer epilimnion of an individual lake seldom varied more than 3 feet from one

year to the next.

The width of the thermocline varied from year to year in all lakes, especially in those lakes in which a hyplimnion was formed during some years. If we consider lakes of both group one and two we find that most of the thermoclines extended to the bottom of the lake.

Turbidity of the lakes in both groups varied a great deal. Secchi disc readings from 2½ inches to 14 feet were recorded, but transparency was usually two feet or more.

Alkalinity determinations were made on lakes in all three groups. Electric shocker work had indicated that there were less electrolytes in the southern Iowa impoundments than in the northern natural lakes. This was born out to some extent by the fact that the methyl orange alkalinity of twenty-five lakes averaged 109 parts per million (range 65 to 155), less than half of that found in the average natural lake. Only four lakes had phenolphthalein alkalinity. Eighteen parts per million was the highest reading.

The three groups contained the following lakes: Group one; Allerton Reservoir, West City Reservoir at Osceola, Lake McKinley and Summit Lake. Group two; Lake McBride, Loc Ayr (Mt Ayr city reservoir), Lake Darling, Corydon Reservoir, Fisher Lake (Bloomfield reservoir), Green Valley Lake, Rock Creek Lake, Lake of Three Fires, Crystal Lake (Chariton), and Humeston Reservoir. Group three; Fairfield Reservoir (#1), Nodaway Lake (Greenfield reservoir), Geode Lake, Lake Keomah, Lake Keosauqua, Lake Wapello, Des Moines City Reservoir, Lake Ahquabi, Afton Reservoir, Albia Reservoirs (both upper and lower), Cold Springs, Centerville reservoirs, East City reservoir at Osceola, Corning reservoir (old), Montezuma reservoir, Nine Eagles Lake, Williams Pond, Red Haw Lake, Springbrook Lake and Beeds Lake.

Summary

The determination of thermal and chemical stratification became a routine part of the southern Iowa lakes survey program in 1952. During the past four years 36 lakes have received one or more checks with over 1,000 separate temperature readings recorded and some 350 oxygen and pH determinations made during 132 visits.

The lakes ran from 16 to 400 acres in surface area and 7 to 55 feet in depth, averaging about 100 and 22 respectively.

These lakes were placed in three groups; those that do not stratify, those that have a temporary or very limited stratification, and those that have a strong stratification each year. Epilimnions extended from 5 to 21 feet, averaging about 9 feet. Thermoclines usually extended to the bottom except in the deeper lakes. Temperature declines within the thermocline varied from minimum to over 20 degrees. Transparency was usually over two feet except in group one where the turbidity was always high. Alkalinity of the surface waters of 25 lakes varied from 65 to 155 parts per million.

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THE 1955 PHEASANT SEASON

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Game Biologist

The 1955 pheasant season opened at noon, November 12 for 24 days in 70 counties and for 13 days in 22 southern Iowa counties. This was the first Saturday opening in accordance with the new commission policy which was established last year. Shooting hours were set from noon to four-thirty with a bag and possession limit of three cocks.

The information presented in this report was collected from 3,506 hunters by conservation officers and unit managers during the open season. The cards and procedure were the same as in previous surveys.

The results of this study indicate that the 1955 pheasant season was the best in recent years. The hunters contacted had bagged 3,791 cocks in 10,816 hours for an average of 2.9 hours per bird. The average time per rooster in 1954 was 3.4 hours. A total of 108 birds was checked per 100 hunters last fall which was a new high and 20 per cent higher than the 1954 figure. Previous to last season, the 1950 hunting success was best with 103 birds checked per 100 hunters and an average of 3.0 hours for each pheasant.

The lower crippling loss of the 1955 season was encouraging. Hunters lost less than 12 per cent of all birds shot down compared to 16 per cent lost during the previous season.

Hunting conditions varied a great deal during the 1955 season. Cover was generally light because of below normal precipitation last year. The final issue of the Iowa Weather and Crop Bulletin stated that more than 90 per cent of the corn was harvested by the end of October - about three weeks ahead of average. Consequently, the fields were quite bare and birds were consentrated for the opening guns. Weather conditions were ideal for the first part of the season but temperatures then dropped well below normal. The snow and cold winds forced the pheasants into heavy cover but also discouraged many hunters from leaving their cars.

Table 1 lists the hunting success by state agricultural districts for each week of the season and compares the state average and the percentage of contacts made for each period for the past two seasons.

Hunting success was much better the first week in 1955 than it was in 1954 due to the increased number of birds and lighter cover (Table 1). After opening week, the average time required to bag a bird remained about the same for each period indicating a good supply of roosters in the population. The trend of weekly hunting success figures was similar to the results of the 1950 season, which was also an excellent year.

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Table 1. Comparison of Weekly Hunting Success

DISTRICT	Hours Required To Bag One Pheasant 1955			
	1st Week	2nd Week	3rd Week	Last 3 days
1. Northwest	1.9 hrs.	3.4 hrs.	4.2 hrs.	3.5 hrs.
2. Northcentral	1.8	2.9	4.0	2.6
3. Northeast	2.3	2.5	2.7	3.1
4. Westcentral	2.5	5.6	2.8	5.6
5. Central	3.2	4.6	6.0	2.6
6. Eastcentral	3.6	8.1		
7. Southwest	2.2	10.6		
8. Southcentral	2.2	3.4		
9. Southeast	2.9	4.4		
State Average				
1955	2.3	3.8	3.9	3.7
1954	2.8	4.4	4.2	5.3
Percentage 1955	53%	22%	17%	8%
of Contacts 1954	48%	19%	19%	14%

Hunters in the northern one third of the state experienced the best success in 1955. Good shooting was also reported from areas in southern Iowa but increased hunting pressure raised the average time per bird bagged. The westcentral district was again about average while eastcentral Iowa produced the poorest shooting last fall. The time required to bag a bird in central Iowa was also above the state average (Table 2).

Table 2. Average Hunting Success by Districts 1952-1955

District	Hours per Bird Bagged			
	1952	1953	1954	1955
1. Northwest	2.7	3.3	3.4	2.5
2. Northcentral	3.3	2.4	2.8	2.4
3. Northeast	3.9	2.8	2.6	2.6
4. Westcentral	3.3	3.8	3.7	3.0
5. Central	4.1	5.5	7.5	3.7
6. Eastcentral	3.4	5.4	4.9	4.8
7. Southwest	2.3	2.4	2.4	3.2
8. Southcentral	3.9	3.4	3.3	2.4
9. Southeast	3.3	5.5	4.8	3.0
State Average	3.3	3.5	3.4	2.9

It appears that the Saturday opening had little effect upon sportsmen traveling to hunt last fall. Of all hunters checked, 48 per cent had traveled to a different county to hunt compared with 50 per cent the previous year and 47 per cent in 1953. The high percentage of non-local hunters in southwest Iowa decreased slightly in 1955, but was still high for the state. District 6 in eastcentral Iowa attracted very few residents from other counties, but non-local hunters increased in northeast Iowa again this year. Table 3 shows the amount of non-local hunting in each district as well as for the state during the past three years.

Table 3. Per Cent of Non-Local Hunters - By Districts

District	1953	1954	1955
1 Northwest	48%	48%	32%
2 Northcentral	47	54	48
3 Northeast	33	46	55
4 Westcentral	40	39	44
5 Central	54	59	60
6 Eastcentral	37	41	15
7 Southwest	60	67	63
8 Southcentral	54	55	48
9 Southeast	56	50	39
State Average	47	50	48

The percentage of out of state hunters remained at three per cent of the total checked, however, some officers stated that there was an increase. Nonresident hunters spent an average of 2.4 hours in the field for each bird. Most of them were checked during the first part of the season.

One-fourth of all parties interviewed used dogs in 1955. This figure has remained nearly constant the past few seasons. Hunters using dogs lost only six per cent of all birds shot down and averaged one cock every 2.3 hours. Those without the help of dogs had to work nearly an hour longer for each bird. A comparison of the hunting success and birds lost for groups using dogs and those without dogs is shown in Table 4. Parties with dogs averaged 31 per cent more birds bagged at the time of contact than those without dogs.

Table 5. Comparison of Hunter Success and Birds Lost - Parties With and Without Dogs.

	With Dogs			Without Dogs		
	1953	1954	1955	1953	1954	1955
Hours per bird bagged	2.8	2.9	2.3	3.9	3.8	3.1
Birds in bag for each bird lost	9.6	8.1	16.5	4.5	4.2	6.5
Per cent of birds shot down and lost	9%	11%	6%	18%	19%	13%

Table 6 lists the types of dogs most frequently used and information regarding each type. Pointers and labradors continued their excellent low records of birds lost.

Table 6. Hunting Data Collected From Parties Using The Following Types Of Dogs.

Type of Dog	Hours Hunted	Birds Bagged	Birds Shot Down and Lost	Percent of Birds Lost
Labrador	729	321	12	3.6%
Pointer	484	220	9	3.9
Setter	203	84	4	4.5
Chesapeake	63	33	2	5.7
Springer Spaniel	228	132	9	6.4

THE FALL COUNT OF QUAIL

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Each fall since 1936 a preseason count of quail has been made by officers in the primary range. Hunting regulations were based on this census. There were indications that reduced autumn populations withstood shooting as well as did high numbers, nevertheless it was advisable to know in advance when birds were scarce. The first efforts were made in early autumn with the assistance of trained dogs. The work was done during the cool of morning when suitable temperature and moisture conditions existed.

More recently the officers have had less time to give to this job. Therefore fewer counties were censused by this means, and the necessary data are obtained during other times of the year.

In late years the fall check has served two purposes. It determined the availability of quail for shooting, and it was an enumeration of the brood birds of the following summer.

Several problems have faced the checker. First, weather has always presented difficulties, and as far as possible this was overcome by doing the work only under suitable conditions. Furthermore, individuals varied in ability to pick good quail cover and in counting flushed quail.

Basis for the Count

Research proved that quail occurred in proportion to existing cover near grain producing lands. Stoddard (1936) gives the opinion that adverse weather conditions forced quail into limited areas where they could be located with only a small expenditure of effort. Hence officers had best luck locating birds in wet weather. Conversely, birds were difficult to find when it was dry. Thus the fall work reflected the probable hunting success when the censusing was done under the same conditions as were faced by the gunner.

A summary of results of counts made during other periods of the year usually indicated the size of a quail hatch before the fall census was made but the earlier efforts could have failed because of adversities. The earlier counts were preferred because they gave a set of figures on which to base seasons set in the summer.

Methods

Officers in quail territory received instructions in the early fall for making the count. In the same letter they also received forms for recording findings and a set of suggestions for selecting areas as well as for choosing the best time of day for doing the work.

The same kind of job was undertaken by the biologist. Some of this was done on areas near Ottumwa, and some in other parts of the State. The suggested unit for checking was one mile of brushy edge cover adjoining

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grain fields. In recent years the counts were made in a total of 41 counties. Most officers were assigned only one county.

When all reports were returned the data were classified as to origin and results were summarized.

Results

Statewide results: On 210 covey ranges, a total of 1,177 quail in 87 coveys was counted by officers in 1955. This amounted to 13.2 birds per covey. Fifty-five per cent of areas had quail on them. The men had seen 89 quail roosts. Officers learned that the farmers on whose land the work was done had seen 206 coveys. Officers concluded that on 15 units of range there were more quail than in 1954, on two there were less, and in 39 instances quail numbered the same as the year before.

In 1954, on 295 ranges, 2,176 birds were counted in 165 coveys, or there were 13.5 per covey. The men saw 301 roosts. Forty-one per cent of ranges had quail on them. Farmers stated that they had seen 301 bunches of birds. After contacting the rural dweller, the officers concluded that 38 ranges had more quail than last year, 5 had less, and 32 had the same number as the season before.

Table 1. Statewide Covey Range Censuses, 1954-1955

Year	No. of Counties	No. of Areas	No. of Quail	Per Cent of Ranges Occupied
1954	34	295	2,176**	56%
1955	23*	210	1,177***	41%

* All counties checked in 1954 are not included because the officers having the counties participated in other types of counts.

** Figure is high because some farmer estimates were included.

*** Reporting only the birds actually flushed on the first visit was partly responsible for this lower figure.

Results by Agricultural Districts: In the south central part of the state in 1955 there were 13.0 birds per covey range and this amounted to 0.8 covey per range. Officers were told by the farmers that there were 1.8 coveys per area. In 1954 officers saw 10.7 birds per range. This was 0.7 covey per range and the officers learned the farmers had observed 1.0 coveys per range.

In the southeast the officers flushed 5.6 birds per range in 1955 with 0.4 covey per unit. The men were told the farmers knew of 1.3 coveys per range. In 1954 there were 5.9 birds per range and 0.4 coveys per unit while farmers reported 1.1 coveys on each area.

East central Iowa officers saw 4.2 birds per range in 1955 or 0.3 covey per effort, and farmers thought that the covey density was 1.0 per area. In 1954 the officers put up 6.8 birds per effort, and these were contained in 0.7 covey per area while rural dwellers thought they had 1.1 coveys per range.

Border counties: The 1955 censuses in border, or low population counties revealed that there were 5.6 birds per unit worked, or 0.5 bunch per area while farmers told checkers that 0.8 covey lived on each range. In 1954 the men saw 7.8 birds on each place which amounted to 0.7 covey. Farmers stated they knew of 0.8 brood per area.

Individual counties: For the two year period, 1954 and 1955, there is one report from each of the following counties: Adair, Benton, Cass, Cedar, Dallas, Fremont, Grundy, Henry, Jackson, Keokuk, Page, Taylor, Linn and Winneshiek. Davis, Wayne, Monroe, Pottawattamie, Ringgold, and Wapello were censused by means of other controlled autumn counts and officers there were not asked for reports in 1955.

Clarke county had a high count but this was due to some extent to an intensive field effort. A high count in Louisa could be due to the tendency of often having some figures that are above average results.

New counties: In Monona and Harrison counties, opened in 1955 for the first time in recent years, six field counts were made by the biologist in company with the officers. In Harrison county, on three areas, a total of 40 quail were flushed in three coveys. Nohe were seen in Monona county.

Discussion

Interpretation of General Results: When making a final critical examination of data the following measures were used to determine reliability: First, the number of counties which were censused both years; second, the extent to which directions were followed; and third, effect of the weather and the extent to which birds moved into the vicinity of permanent winter cover. Data sorted on the above basis reveals that officers in 1955 found 155 coveys in 153 areas and 74 roosts were seen. Farmers reported an average population of 1.0 covey. This is an increase over 1954 when the men flushed 139 coveys in 152 areas where 59 roosts were found. Farmers had seen 0.9 covey per unit. The fall of 1955 was drier than 1954 and it was more difficult to find quail.

Where the biologist gave assistance or worked a spot alone quail were located in over 90 per cent of cases. This indicated a better than average population.

In all counties where abnormally high counts occurred in 1954 the officers were contacted and in 1955 there was a statewide tendency toward a leveling of results.

The Fall Count and the Game Program

As it functioned this year, the fall count did not require an excessive amount of time by participating officers. The count was timely since it sampled the quail population just prior to the open season. It gave figures that could be used in evaluating earlier counts, and thus determining their worth. In addition, we now have the first estimate on next year's brood quail.

Summary

1. The 1955 officer's fall count of quail is a continuation of the counts made since 1936.

2. This count is a basis for estimating birds available to the hunter, and the size of the brood stock for next summer.

3. A total of 210 covey ranges were checked, and of these there were comparable results on 153 areas. There was an upward trend in the number of quail seen.

4. The fall census does not require much of the officer's time and it is valuable as one of the counts of birds.

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WATERFOWL BAG CHECKS - 1955

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The State Conservation Commission requested conservation officers and other field personnel to make waterfowl bag checks and complete tally cards during the 1955 open season. This was the eighth consecutive year the program was undertaken to sample waterfowl harvested in Iowa. Commission personnel checked 6,776 waterfowl hunters in 62 counties who had hunted 22,523 hours (appendix tables 1 and 2). These nimrods harvested 6,931 ducks and 196 geese. These figures by no means indicated all the waterfowl killed in Iowa during the 1955 season; however, they provide a sample of the kill and the data obtained were comparable with similar data collected from 1948 through 1954.

Sixteen species of ducks, mergansers, and four species of geese were taken by wildfowlers. The Iowa hunter bagged one duck in 3.2 hours of hunting in 1955 which approximated other average duck-per-hour kill figures (table 1). This represented only fair duck hunting success oh a state-wide basis; however, goose hunting was much poorer requiring 115 hunting hours afield to average one goose in the bag. Unsuccessful hunters averaged 2.7 hours in the field when checked in 1955.

Table 1.---The average calculated hunting hours per waterfowl bagged in Iowa; and, the average number of hours afield for unsuccessful hunters when checked (1948-1955)

YEAR	1948	1949	1950	1951	1952	1953	1954	1955
Av. Hunt. Hours Per Duck Killed	2.3	3.2	4.1	1.9	3.2	3.2	3.6	3.2
Av. Hunt. Hours Per Goose Killed	67.6	25.4	41.1	52.0	183.7	27.1	81.7	114.8
Av. Hunt. Hours Per Unsuc'ful Hunter	2.2	2.8	3.3	2.1	2.4	2.8	2.8	2.7

Mallards totaled 53 percent of the ducks examined and this sample comprised 3,673 birds bagged in 1955. This species has averaged 50 percent of the total duck harvest in Iowa since 1948. It is obvious that mallards are the most important waterfowl to Iowa wildfowlers; and that the annual kill of this species largely determines a successful or an unsuccessful season.

Blue-winged teal increased to 14 percent (966 birds) of the kill sampled in 1955, a slight increase over 1954; however, blue-wings were far below the unprecedented 24 percent (2,031 birds) tallied in 1953. In 1948 the waterfowl season opened on October 29th, eight to twenty-one days later than the last seven consecutive openings, and the blue-winged teal harvest dropped an average of 14 percent.

On a percentage basis the green-winged teal harvest decreased somewhat in 1955, but remained within the limits of the samples recorded during the last seven years. Pintails accounted for 5 percent of the take, and lesser scaup 6.7 percent of the tally. These percentages approximated figures for previous years for green-wings, pintails, and lesser scaup.

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The season was reopened on the wood duck, and 217 or 3.1 percent of the aggregate checked were woodies. This kill figure is about average for this controversial species in Iowa, based upon harvest figures of the past seven years.

The remaining ten species of ducks and mergansers in aggregate totaled only 8.7 percent of the kill sampled in 1955. These same ten species contributed 11.8 percent in 1948; 12 percent in 1949; 10.6 percent in 1950; 11.8 percent in 1951; 8.7 percent in 1952; 6.4 percent in 1953 and 9.5 percent in 1954. None of these ten species of ducks and mergansers exceeded 3.2 percent of the aggregate during the eight years of study. There has been little change in the percentages in the samples; and the black duck, gadwall, baldpate, shoveller, redhead, ring-necked duck, canvas-back, golden-eye, buffle-head, ruddy duck and mergansers, have comprised but a small fraction of the annual waterfowl harvest.

Blue geese approximated 20 percent of the total goose sample in 1955. Snow geese contributed 27 percent, while Canada geese and their subspecies contributed 48 percent. Four white-fronted geese were reported in 1955, accounting for 2 percent of the harvest. A few white-fronts have been reported in five of the eight years on record.

This study has established the species composition of the total aggregate waterfowl bag taken in Iowa during each of the past eight open seasons, and the percentage of each species taken (appendix table 2). Conservation officers and other field personnel have contributed to the waterfowl program by completing and returning their waterfowl bag checks each year. All conservation personnel are again urged to contribute to this study as generously as possible.

Appendix Table 1

RECAPTULATION OF DUCK KILL BY COUNTY

	Allamakee	Blackhawk	Boone	Bremer	Buchanan	Buena Vista	Carroll	Cerro Gordo	Clarke	Clay	Clayton	Clinton	Dallas	Davis	Decatur	Des Moines
Total Number Hunters Checked:	19:	47:	38:	420:	165:	287:	33:	312:	30:	144:	74:	99:	26:	64:	40:	154:
Total Number of Hours Hunted:	132:	103:	186:	1717:	261:	701:	115:	1601:	76:	306:	214:	183:	63:	89:	105:	281:
None Taken:																
Number of Hunters	5:	24:	6:	242:	63:	158:	19:	152:	7:	22:	21:	22:	20:	26:	2:	43:
Hours Hunted	24:	42:	15:	840:	95:	340:	57:	520:	10:	41:	68:	32:	41:	32:	4:	78:
Mallard	10:	26:	22:	130:	56:	133:	24:	176:	4:	48:	13:	50:	5:	4:	35:	72:
Black Duck	:	:	:	:	:	3:	:	2:	:	:	1:	:	:	:	:	1:
Gadwall	:	1:	:	:	:	1:	:	9:	:	1:	:	1:	:	5:	3:	4:
Baldpate	1:	1:	2:	5:	3:	1:	1:	4:	:	12:	:	:	:	:	:	2:
Pintail	2:	4:	3:	7:	2:	3:	1:	14:	:	10:	1:	:	:	:	:	6:
G. W. Teal	6:	:	3:	8:	11:	23:	:	14:	5:	29:	10:	5:	2:	1:	9:	8:
B. W. Teal	:	7:	7:	3:	18:	19:	:	14:	12:	59:	11:	6:	3:	:	33:	6:
Shoveller	:	:	:	1:	1:	:	:	14:	:	4:	:	:	:	:	:	3:
Wood Duck	8:	2:	2:	10:	14:	:	:	8:	:	2:	22:	3:	:	:	:	10:
Redhead	:	:	:	3:	:	16:	:	34:	2:	7:	:	2:	:	2:	:	3:
Ring-necked	:	:	3:	1:	:	:	:	:	7:	:	:	:	:	3:	:	:
Canvas-back	:	:	:	1:	1:	:	:	:	:	:	:	11:	:	1:	:	5:
Lesser Scaup	:	:	5:	8:	21:	2:	:	:	7:	3:	1:	9:	:	35:	8:	18:
Golden-eye	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1:	:
Bufflehead	:	:	:	1:	:	:	:	:	:	1:	:	1:	:	:	:	:
Ruddy Duck	:	:	:	:	7:	:	:	:	1:	:	:	3:	:	:	:	4:
Merganser	:	:	:	:	:	:	:	:	:	:	:	:	:	2:	:	:
TOTAL DUCKS	27:	41:	47:	178:	134:	201:	26:	289:	38:	176:	59:	91:	10:	53:	89:	142:
Canada Geese	:	:	:	:	:	13:	:	3:	:	:	:	:	:	:	1:	3:
Blue Geese	:	:	:	:	:	16:	:	2:	:	:	:	:	:	:	:	3:
Snow Geese	:	:	:	:	:	14:	:	:	:	3:	:	5:	:	:	:	2:
White Fronted Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Other Geese	:	:	:	4:	:	:	:	:	:	:	:	:	:	:	:	:
TOTAL GEESE	:	:	:	4:	:	43:	:	5:	:	3:	:	5:	:	:	1:	8:
Coots	:	:	1:	4:	3:	:	:	:	:	6:	13:	5:	:	:	:	12:

RECAPTULATION OF DUCK KILL BY COUNTY

Appendix Table 1
(continued)

	Dickinson	Dubuque	Emmet	Fayette	Greene	Hamilton	Hancock	Hardin	Harrison	Howard	Humboldt	Iowa	Jasper	Jefferson	Johnson	Kossuth
Total Number Hunters Checked:	66:	41:	84:	15:	82:	208:	60:	23:	309:	4:	22:	7:	139:	2:	17:	97:
Total Number of Hours Hunted:	186:	76:	168:	22:	146:	497:	130:	59:	913:	16:	45:	23:	300:	3:	43:	152:
None Taken:																
Number of Hunters	:	6:	2:	4:	23:	63:	21:	7:	54:	:	:	2:	71:	1:	5:	31:
Hours Hunted	:	11:	3:	5:	37:	121:	32:	15:	246:	:	:	6:	155:	1:	15:	60:
Mallard	51:	30:	7:	33:	41:	38:	22:	10:	262:	3:	21:	2:	16:	:	18:	52:
Black Duck	:	1:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Gadwall	2:	:	:	:	1:	10:	:	:	2:	:	:	:	:	:	:	:
Baldpate	5:	1:	2:	:	1:	1:	3:	:	3:	:	:	:	8:	:	:	:
Pintail	11:	1:	:	:	5:	37:	4:	2:	27:	:	:	:	1:	:	2:	:
G. W. Teal	16:	7:	3:	:	8:	63:	26:	2:	8:	1:	:	:	11:	:	3:	12:
B. W. Teal	10:	9:	12:	1:	8:	10:	14:	:	119:	:	2:	:	10:	:	:	:
Shoveller	1:	:	101:	:	:	4:	:	:	6:	:	:	:	:	:	:	:
Wood Duck	1:	4:	4:	:	:	9:	1:	3:	4:	:	:	:	:	:	:	:
Redhead	4:	:	1:	:	1:	5:	1:	:	4:	:	:	:	1:	:	:	:
Ring-necked	2:	:	:	:	:	1:	:	:	:	:	:	:	2:	:	:	:
Canvas-back	1:	:	:	:	:	3:	:	:	:	:	:	:	1:	:	:	:
Lesser Scaup	1:	:	4:	1:	2:	10:	:	:	31:	:	2:	:	10:	4:	5:	:
Golden-eye	2:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Bufflehead	:	:	:	:	:	1:	:	:	:	:	:	:	:	:	:	:
Ruddy Duck	:	:	:	:	:	7:	:	:	:	:	:	:	:	:	:	:
Merganser	:	:	2:	:	:	:	:	:	:	:	:	:	:	:	:	:
TOTAL DUCKS	107:	53:	136:	35:	67:	199:	71:	17:	466:	4:	25:	2:	60:	4:	28:	64:
Canada Geese	:	:	:	:	:	4:	:	2:	14:	:	2:	:	:	:	:	5:
Blue Geese	:	:	:	:	:	1:	:	:	2:	:	:	:	:	:	:	:
Snow Geese	3:	1:	:	:	:	:	:	:	8:	:	:	:	:	:	:	:
White-Fronted Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Other Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
TOTAL GEESE	3:	1:	:	:	:	5:	:	2:	24:	:	2:	:	:	:	:	5:
Coots	:	22:	2:	:	:	14:	:	:	:	:	:	:	:	:	:	?:

RECAPTULATION OF DUCK KILL BY COUNTY

Appendix Table 1
(continued)

	Lee	Linn	Louisa	Lucas	Madison	Marion	Marshall	Mills	Mitchell	Montgomery	Palo Alto	Plymouth	Pocahontas	Polk	Ringgold	Sac
Total Number Hunters Checked:	146:	75:	507:	454:	6:	60:	272:	247:	17:	22:	88:	41:	38:	286:	41:	178:
Total Number of Hours Hunted:	429:	248:	3432:	1226:	16:	172:	794:	961:	35:	74:	176:	108:	186:	449:	65:	385:
None Taken:																
Number of Hunters	35:	60:	99:	108:	4:	22:	112:	129:	5:	20:	6:	9:	6:	112	9:	94:
Hours Hunted	82:	191:	586:	253:	13:	59:	322:	511:	8:	70:	7:	20:	15:	146:	18:	181:
Mallard	49:	2:	765:	343:	:	42:	105:	87:	21:	2:	6:	54:	22:	103:	6:	64:
Black Duck	:	1:	2:	:	:	:	:	:	:	:	:	:	:	3:	:	:
Gadwall	9:	:	:	9:	:	:	:	4:	1:	:	6:	:	:	1:	:	3:
Baldpate	1:	:	8:	8:	:	:	1:	2:	:	:	1:	:	2:	2:	2:	2:
Pintail	2:	:	20:	36:	1:	:	21:	4:	2:	:	9:	:	3:	30:	3:	4:
G. W. Teal	22:	:	7:	15:	:	:	22:	:	:	:	101:	4:	3:	1:	3:	15:
B. W. Teal	30:	:	25:	105:	:	:	3:	37:	2:	:	79:	5:	7:	23:	:	12:
Shoveller	1:	2:	:	2:	:	:	:	:	:	:	4:	:	:	9:	:	:
Wood Duck	1:	3:	60:	17:	:	:	4:	:	2:	:	:	2:	2:	4:	:	:
Redhead	8:	:	:	17:	:	:	1:	:	:	:	:	:	:	7:	:	13:
Ring-necked	4:	:	3:	4:	:	:	:	:	:	:	:	:	3:	:	:	2:
Canvas-back	14:	:	:	7:	:	:	:	:	:	:	:	:	:	3:	:	10:
Lesser Scaup	41:	2:	3:	73:	:	18:	10:	1:	3:	:	:	:	5:	7:	1:	:
Golden-eye	4:	:	:	:	:	:	:	:	:	:	:	1:	:	:	:	:
Bufflehead	2:	:	:	1:	:	:	:	:	:	:	:	:	:	:	:	1:
Ruddy Duck	:	:	:	15:	:	:	:	:	:	:	4:	:	:	:	:	:
Merganser	1:	:	1:	1:	:	:	3:	:	:	:	:	2:	:	:	:	:
TOTAL DUCKS	189:	10:	894:	653:	1:	60:	170:	135:	31:	2:	210:	68:	47:	193:	15:	126:
Canada Geese	2:	:	1:	14:	:	1:	2:	11:	:	:	:	:	:	:	:	11:
Blue Geese	:	:	:	:	:	:	:	8:	:	:	:	:	:	1:	2:	:
Snow Geese	2:	:	:	6:	:	:	:	6:	:	:	:	:	:	:	:	:
White Fronted Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Other Geese	:	:	:	:	:	:	:	1:	:	:	:	:	:	:	:	:
TOTAL GEESE	4:	:	1:	20:	:	1:	2:	26:	:	:	:	:	:	1:	2:	11:
Coots	3:	:	:	:	:	:	:	:	:	:	6:	:	1:	:	1:	:

Appendix Table 1
(concluded)

RECAPTULATION OF DUCK KILL BY COUNTY

	Scott	Sioux	Story	Tama	Union	Van Buren	Wapello	Warren	Washington	Wayne	Winnebago	Woodbury	Worth	Wright
Total Number Hunters Ghecked:	123:	19:	8:	41:	42:	22:	53:	38:	10:	21:	198:	157:	87:	331:
Total Number of Hours Hunted:	242:	48:	27:	73:	75:	73:	82:	91:	16:	54:	648:	399:	237:	1787:
None Taken:														
Number of Hunters	31:	9:	2:	18:	6:	7:	15:	13:	7:	4:	47:	76:	42:	110:
Hours Hunted	61:	23:	5:	28:	16:	19:	25:	40:	12:	10:	118:	194:	79:	388:
Mallard	107:	12:	4:	45:	17:	32:	40:	25:	1:	19:	34:	23:	13:	213:
Black Duck	1:	:	:	:	:	:	:	:	:	2:	:	:	1:	1:
Gadwall	4:	:	:	:	1:	:	:	:	:	:	2:	6:	1:	2:
Baldpate	:	:	:	:	:	:	:	:	:	:	:	1:	:	:
Pintail	:	:	2:	:	1:	1:	:	:	:	1:	8:	3:	2:	27:
G. W. Teal	1:	1:	:	2:	:	:	:	:	1:	:	35:	11:	11:	98:
B. W. Teal	2:	5:	2:	:	6:	4:	:	1:	:	:	77:	20:	2:	23:
Shoveller	:	:	:	:	1:	:	:	:	:	:	:	:	2:	1:
Wood Duck	7:	:	:	:	:	:	:	:	:	:	1:	2:	2:	5:
Redhead	2:	:	:	:	11:	4:	:	:	:	1:	:	2:	1:	2:
Ring-necked	:	:	:	:	:	:	:	:	:	:	1:	5:	1:	:
Canvas-back	15:	:	:	:	:	1:	1:	:	:	:	:	1:	2:	:
Lesser Scaup	32:	:	:	:	11:	1:	1:	4:	:	8:	5:	3:	2:	34:
Golden-eye	1:	:	:	:	:	:	:	:	:	:	:	:	:	:
Pufflehead	2:	:	:	:	:	:	:	:	:	:	:	7:	1:	:
Ruddy Duck	:	:	:	:	:	:	:	:	:	:	5:	:	1:	:
Merganser	:	1:	:	:	:	:	:	:	:	1:	:	:	1:	:
TOTAL DUCKS	174:	19:	8:	47:	48:	43:	42:	30:	2:	32:	168:	84:	43:	406:
Canada Geese	5:	:	:	:	:	:	:	1:	:	:	:	:	:	:
Blue Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	1:
Snow Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	2:
White Fronted Geese	:	:	:	:	:	:	:	:	:	:	:	4:	:	:
Other Geese	:	:	:	:	:	:	:	:	:	:	:	:	:	:
TOTAL GEESE	5:	:	:	:	:	:	:	1:	:	:	:	4:	:	3:
Coots	:	:	:	:	:	:	:	:	:	:	2:	:	:	14:

COMBINED TOTALS AND PERCENTAGES

Appendix Table 2

	TOTAL RECORDED KILL BY SPECIES							
	1948	1949	1950	1951	1952	1953	1954	1955
Hunters Seen								
Bags Not Checked		43,413	2,807	6,800	2,163	4,222	3,266	3,678
Size of Hunting Party 1	700	523	572	1,198	969	993	899	830
(man) 2	822	951	979	1,907	1,367	1,464	1,556	1,264
(man) 3	417	494	434	800	551	1,644	631	577
(man) 4	215	274	192	362	232	266	312	228
five or more than 5	91	134	91	207	93	133	121	121
Total Number of Hunters	4,984	5,862	5,170	9,955	6,838	7,839	7,887	6,776
Total Hours Hunted	13,926	18,802	19,132	25,419	20,141	27,484	26,472	22,523
None Taken:								
Number of Hunters	1,463	2,021	1,921	2,368	2,557	2,474	2,848	2,333
Hours Hunted	3,171	5,563	6,340	5,029	6,184	7,000	8,012	6,431
Mallard	3,327	2,735	2,344	7,354	2,698	4,121	3,916	3,673
Black Duck	38	26	71	168	54	27	37	19
Gadwall	120	185	98	207	56	80	62	92
Baldpate	58	34	50	231	71	59	97	83
Pintail	546	643	291	1,252	634	477	382	345
G. W. Teal	766	670	399	885	697	523	860	656
B. W. Teal	174	691	637	1,502	810	2,031	736	966
Shoveller	175	192	91	244	110	118	94	62
Wood Duck	114	133	148	464	427	321	7	217
Redhead	102	79	62	264	71	60	76	157
Ring-necked	48	52	26	138	35	68	90	37
Canvas-back	47	94	43	229	77	72	104	74
Lesser Scaup	439	317	351	787	468	557	649	459
Golden-eye	21	7	9	36	8	8	13	10
Bufflehead	30	11	9	10	9	19	5	17
Ruddy Duck	61	24	19	70	45	34	58	49
Merganser	19	13	18	29	19	19	14	15
TOTAL DUCKS	6,085	5,906	4,666	13,870	6,289	8,594	7,200	6,931
Canada Geese	39	159	73	127	54	297	66	95
Blue Geese	84	380	181	214	21	309	115	39
Snow Geese	70	189	180	128	32	353	139	53
White Fronted Geese		9	7			6	3	4
Other Geese	13	3			2	48	1	5
TOTAL GEESE	206	740	441	469	109	1,013	324	196
Coots		127	63	344	185	42	282	229
Parties With Dogs		300	240	601	316	437	246	266
Unretrieved Ducks & Geese		37	45	187	69	62	46	58
Parties Without Dogs		2,075	2,028	3,873	2,896	3,064	3,273	2,754
Unretrieved Ducks & Geese		260	508	1,680	658	779	548	465
TOTAL PARTIES CHECKED		2,375	2,268	4,474	3,212	3,501	3,519	3,020

COMBINED TOTALS AND PERCENTAGES

Appendix Table 2
(continued)

Species	TOTAL RECORDED KILL BY PER CENT							
	1948	1949	1950	1951	1952	1953	1954	1955
Mallard	54.7%	46.3%	50.2%	53.0%	42.9%	47.9%	54.4%	53.0%
Black Duck	0.6	0.4	1.5	1.2	0.9	0.3	0.5	0.3
Gadwall	2.0	3.1	2.1	1.5	0.9	0.9	0.9	1.3
Baldpate	0.9	0.6	1.1	1.7	1.1	0.7	1.3	1.2
Pintail	8.9	10.9	6.2	9.0	10.1	5.5	5.3	5.0
G. W. Teal	12.6	11.4	8.6	6.4	11.1	6.1	11.9	9.5
B. W. Teal	2.9	11.7	13.7	10.8	12.9	23.6	10.2	14.0
Shoveller	2.9	3.2	1.9	1.8	1.8	1.3	1.3	0.9
Wood Duck	1.9	2.3	3.2	3.3	6.8	3.7	0.1	3.1
Redhead	1.7	1.3	1.3	1.9	1.1	0.7	1.1	2.2
Ring-necked	0.8	0.9	0.6	1.0	0.5	0.8	1.3	0.5
Canvas-back	0.8	1.6	0.9	1.6	1.2	0.8	1.4	1.1
Lesser Scaup	7.2	5.4	7.5	5.7	7.5	6.8	9.0	6.7
Golden-eye	0.3	0.1	0.2	0.3	0.1	0.1	0.2	0.1
Bufflehead	0.5	0.2	0.2	0.1	0.1	0.2	0.1	0.2
Ruddy Duck	1.0	0.4	0.4	0.5	0.7	0.4	0.8	0.7
Merganser	0.3	0.2	0.4	0.2	0.3	0.2	0.2	0.2
TOTAL DUCKS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Canada Geese	19.0%	21.5%	16.6%	27.2%	49.5%	29.3%	20.4%	48.5%
Blue Geese	41.5	51.3	41.7	45.6	19.3	30.5	35.5	19.9
Snow Geese	33.1	25.6	41.5	27.2	29.4	34.9	42.9	27.0
White Fronted Geese		1.2	0.2			0.6	0.9	2.0
Other Geese	6.4	0.4			1.8	4.7	0.3	2.6
TOTAL GEESE	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Banded Ducks Shot Previous Year	1	2	8	6	2	5		
Opening Dates	Oct.29	Oct.21	Oct.20	Oct.12	Oct.8	Oct.8	Oct.15	Oct.8
Closing Dates	Nov.27	Nov.29	Nov.23	Nov.25	Dec.1	Dec.1	Dec.8	Dec.16