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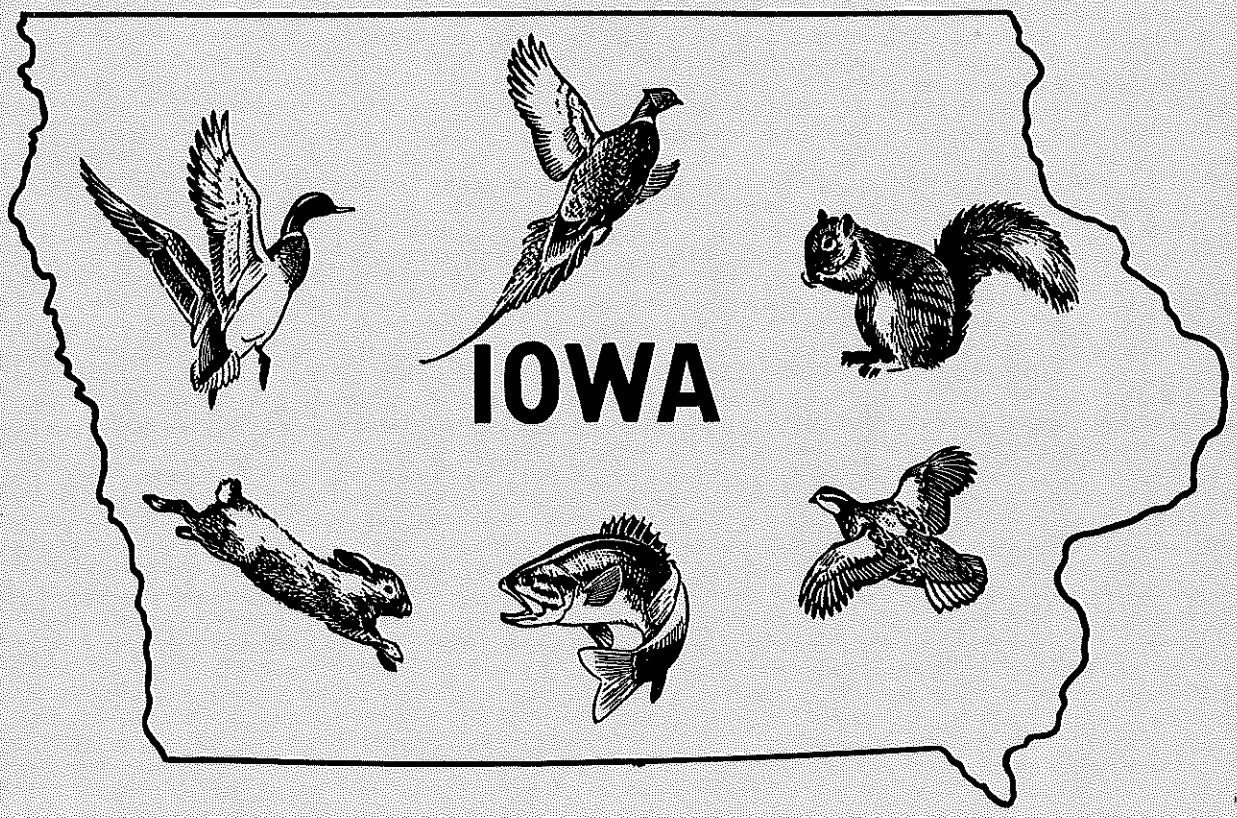

FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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THE ERADICATION OF A FISH POPULATION IN A SOUTHERN IOWA ARTIFICIAL LAKE

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Thayer Lake, a ten and one-half acre state-owned recreational lake in Union County was chemically treated to eradicate the fish population on June 16, 1958. The impoundment had been designated an experimental fish production lake in 1957, and the poor quality of fish inhabiting the area made the eradication project necessary.

Past history of the lake is not complete and much of it has been extracted from local individuals that have familarized themselves with the lake by living in the vicinity for many years. Construction was completed in approximately 1920 by the Chicago, Burlington, and Quincy Railroad Company. Principle use of the water was for commerical supply to the railroad. In 1947 the area was sold by the railroad to private enterprise for development and agricultural use. Early in 1957 the Conservation Commission acquired the lake and part of the watershed through a Federal Aid project.

The lake is considered a typical small southern Iowa artificial impoundment. It is located in a relatively long, narrow valley with approximately 1,200 acres of watershed of which more than one-half is under general agricultural practice. The original maximum depth was reported in excess of 20 feet, but siltation has reduced this to slightly over 12 feet at the present. Bottom contours are relatively steep at the lower reaches of the lake, and shallow at the upper end. Approximately one-half of the shoreline is covered with climax woodland. Physical and chemical studies indicate thermal and chemical stratification are not present during the summer months.

Preliminary surveys of the fish population were initiated in the spring of 1958. Electro-fishing, pound net, drag seine, otter trawl, and spot rotenone samples revealed 15 species of fish present. During the previous winter, physical, chemical and biological studies, including mapping and sounding, were completed.

Complete eradication projects of this nature are extremely valuable for studying fish populations. Although perhaps they are not as desirable or accurate as drainage projects, basic information on populations in artificial lakes can be studied extensively. Since Thayer Lake had been established as an experimental area, several additional studies were incorporated into the eradication project. Two of these were: (1) the efficiency of various types of sampling gear, and (2) the accuracy of mark and recovery population estimate methods. These studies will be reported on in the future.

Method of Treatment and Population Estimate

The lake was treated in three different segments with various concentrations of emulsified Pro-Noxfish (contained 5 per cent rotenone bearing active ingredients). A concentration of 0.6 parts per million was applied to the surface by

means of a airplane motor powered boom-spray boat and two portable power sprays. An additional concentration of 0.5 parts per million was applied to a layer six feet deep by underwater spraying apparatus described by Williams (1958). This application was used to insure even distribution of the chemical from the surface to the bottom of the lake. The application was calculated on an applied basis of 1.1 parts per million of the total volume of water. A remaining one acre of heavily vegetated water was treated at a rate of 2.0 parts per million.

The total number of fish killed by the chemical treatment was recorded by counting the individuals by species as they were picked up by personnel cruising the lake in boats. Eleven teams, of two men each, were involved in the recovery of fish on the first day. Approximately 25 per cent of the fish were recovered within 12 hours after the chemical was applied. The remainder of the fish were counted two days later when they floated to the surface and drifted to shore. Weight of specific populations was determined by using random scale samples and representative length frequencies to establish the percentage of age composition in each species and applying the mean weight of each age group to the total number within the group. A small amount of error was involved due to people picking up dead fish, especially largemouth bass, for table consumption and not reporting the number taken.

Fish Population

A total of 15 species of fish were recovered in the treatment of Thayer Lake. Largemouth Bass, bluegill, white crappie, black crappie, and yellow bass comprised the major species in the impoundment. Small indigenous populations of channel catfish, carp, yellow bullhead, black bullhead, quillback, golden shiner, yellow perch, warmouth, green sunfish, and tadpole madtom were also present.

In all, a total of 42,452 fish, weighing 5,964 pounds were recovered during the project (Table 1). The mean weight of fish per acre was estimated at 568 pounds. Most of the standing crop of fish was comprised of game and pan-fish species, with relatively few rough fish.

Table 1. The estimated fish population in Thayer Lake by number and weight.

Species	Total Number	Per Cent Composition	Total Weight	Per Cent Composition
Largemouth Bass	286	0.6	401	6.7
Bluegill	35,216	83.1	3,907	65.5
White Crappie	1,694	4.0	425	7.1
Black Crappie	138	0.3	24	(T)
Yellow Bass	4,482	10.6	990	16.6
Black Bullhead	120	0.3	45	0.8
Yellow Bullhead	213	0.4	56	1.0
Channel Catfish	4	(T)	18	(T)
Carp	3	(T)	42	0.7
Quillback	1	(T)	11	(T)
Golden Shiner	156	0.4	29	(T)
Yellow Perch	1	(T)	(T)	(T)
Warmouth	76	0.2	10	(T)
Green Sunfish	56	0.1	6	(T)
Madtom	6	(T)	(T)	(T)
GRAND TOTAL	42,456		5,964	

Largemouth Bass

A total of 286 largemouth bass, weighing 401 pounds were recovered during the operation. The number of bass was insignificant to the standing crop (less than one percent of the total number); however, by weight this species occupied 6.7 per cent of the population. Approximately 22 per cent of the bass population was made up of age groups I and II (Table 2). Age group IV was the most abundant comprising 30.0 per cent of the population. The mean total length was 5.0, 7.5, 10.0, 13.0, 15.5, 17.8, 20.8, and 21.5 inches for the first eight years of life (Table 3). The average weight of 177 randomly selected specimens was 1.4 pounds.

Table 2. Age composition of the major fish populations in Thayer Lake.

Species	No. in Sample	Per Cent in Age Group I	II	III	IV	V	VI	VII	VIII
Largemouth Bass	177	7.8	14.8	21.4	30.0	14.7	3.5	6.0	1.8
Bluegill	866	2.9	32.3	31.7	31.2	2.0	(T)		
White Crappie	228	10.4	15.9	50.8	14.1	5.2	3.6		
Black Crappie	67	3.0	41.8	47.8	6.0	1.4			
Yellow Bass	452	---	(T)	2.5	93.4	4.0			

Table 3. Average total length and weight at each year of life of five species of fish in Thayer Lake. Weight (in ounces) in parenthasis.

Species	No. in Sample	Age Group I	II	III	IV	V	VI	VII	VIII
Largemouth Bass	177	5.0 (2.0)*	7.5 (4.0)*	10.0 (10.0)*	13.0 (1.0)	15.5 (2.8)	17.7 (3.3)	20.0 (4.3)	21.5 (5.5)
Bluegill	866	2.0 (0.5)	3.7 (1.0)	5.0 (1.5)	5.7 (2.8)	6.9 (4.0)	7.5 (6.0)		
White Crappie	228	4.0 (0.8)	6.0 (2.0)	7.5 (3.0)	8.5 (4.0)	10.5 (10.0)	13.2 (21.0)		
Black Crappie	67	3.5 (1.0)	5.8 (2.0)	7.0 (3.5)	8.0 (4.5)	10.5 (8.0)			
Yellow Bass	452	- -	- -	6.7 (1.8)	8.7 (3.5)	9.5 (5.0)			

*Largemouth bass weighed in ounces--all other bass weighed in tenths of pounds.

Bluegill

Bluegill were by far the most abundant species of fish in the lake. Approximately 81 per cent of the total population by number, and 65 per cent by weight was represented by this species. Age groups II, III, and IV comprised 96 per cent of the bluegill population. Growth was exceptionally slow indicating crowded conditions within the population. Mean total length for the first six years of life was 2.0, 3.8, 5.0, 5.7, 6.9, and 7.5 inches respectively.

Crappie

The crappie population was composed of about 92 per cent white and eight per cent black crappie. Although these species were not present in abnormal numbers (1,832 total count), growth and physical condition was considered poor. A part of this is thought to be due to the large 1955 year class. This age group represented 51 per cent of the entire crappie population. The black crappie was more evenly distributed in year class development, and did not exhibit extremely poor growth or condition. Average total length for the first six years of life was

4.0, 6.0, 7.5, 8.5, 10.5, and 13.2 inches. Both species of crappie represented five per cent of the standing crop by number and seven per cent of the population by weight.

Yellow Bass

This species is usually not important to the fishery of southern Iowa artificial lakes. Many fisheries technicians consider the yellow bass undesirable for artificial impoundments because of its tendency toward poor growth and stunting in such environment. In Thayer Lake this species ranked second in abundance comprising 10.6 per cent of the population by number and 16.6 per cent by weight. The bulk of the population (93 per cent) was represented by four year old fish. Growth of this year class was exceptionally poor; whereas, growth of older fish was above normal.

Miscellaneous Species

Other species of fish present in the lake included black and yellow bullheads, channel catfish, carp, quillback, yellow perch, warmouth, green sunfish, and tadpole madtom. Yellow bullheads was the only species among this group that represented more than one per cent of the standing crop by weight. None of these fish represented in this group comprised more than one per cent of the population by number. Carp, which are usually found in abundance in artificial lakes where they exist, were insignificant. Only three specimens were recovered during the entire project. Origin of the fish in this group is thought to be from the stocking by helpful anglers, or were present in the stream bed and isolated after the dam was completed.

Summary

Thayer Lake was chemically treated with a sufficient quantity of rotenone to make a concentration of 1.1 parts per million. A total of 15 species of fish were recovered. Bluegills were the most abundant species of fish comprising 83 per cent of the total population. Yellow bass, white crappie, and largemouth bass ranked next in importance.

The total population was estimated at 42,452 fish with a combined total weight of 5,964 pounds. This is a mean of 568 pounds per acre. Specific populations were estimated by number through counting of individuals as they were picked up in dip nets, or when they floated to shore two days after the completion of spraying. Population weight was computed by using scale samples and length frequencies to establish age groups, and applying mean weights of each group to the total population within that year class.

Age group composition of major fish populations are discussed. Total length and weight distribution of largemouth bass, bluegill, yellow bass, white and black crappie are listed.

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FURTHER NOTES ON TOXAPHENE IN FISH POPULATION CONTROL

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Fisheries Biologist

Preliminary field and laboratory testing of toxaphene as a fish toxicant in Iowa waters have been very encouraging. These trials were recorded in Volume IX of the Quarterly Biology Reports. Briefly, the laboratory tests indicated that for cold, clear waters, concentrations in excess of 25 parts per billion of toxaphene would be required for complete fish eradication when such tolerant species as carp and bullheads were present. In waters that are highly turbid, concentrations in excess of 200 parts per billion (0.2 ppm) were required to kill these species, or ten times the concentration required for clear water. This suggests that silt in suspension has a direct detoxifying effect. Bottom fauna in a lake (Pleasant, Dickinson County) treated with 0.1 ppm toxaphene declined in volume from 2.1 ml. to 0.3 ml. per Eckman dredge sample. This decline may have been due to seasonal fluctuation at least in part.

Since these first field and laboratory trials, some additional tests have been made in both areas that may be of interest and also point out the need for more studies under controlled conditions to obtain reliable bio-assays.

Aquarium tests

Detailed tables are not deemed necessary in this report since the results can be summarized briefly. The aquaria used were large display tanks of 111 gallon capacity. Since no aeration was provided, only four small bullheads (6 inch) were used in each aquarium, partially fulfilling the requirements of standard procedure as suggested by Doudoroff, et al (1951), in limiting the weight of test animals to about 1 gram per liter of water. At the end of a seven day period all bullheads were dead in a 10 parts per billion concentration of toxaphene. However, in an identical unit, only a slight distress was noted. These were then rechecked in a ten-day test period and two bullheads remained alive, although obviously in distress. At 20 parts per billion only one remained alive. Therefore it would appear that the "ultimate median tolerance limit" (Doudoroff, loc. cit.) would be somewhat below the 10 parts per billion level for bullheads. Temperatures ranged around 68° F. during the ten-day test period. Again, this emphasizes the need for adequate bio-assay equipment for these and similar studies.

Detoxification (lakes)

In the previously mentioned report, it was noted that Pleasant Lake remained toxic to test fishes throughout the entire winter (lake treated 0.1 ppm toxaphene prior to freeze-up). Shortly after the ice went out, the lake very suddenly detoxified indicating that exposure to wind and increased turbidity on a shallow lake speed recovery. Walleye fry were used to test toxicity prior to stocking with nursery fry. Frequent subsequent test seining reveal a normal growth pattern and a high survival of these walleyes. Incidentally, no bullheads (or other species) survived the treatment and it is believed it is the first Iowa lake in which complete kill of fish was obtained by chemical means. Repeated otter trawl and seine hauls have failed to yield a single bullhead.

Another example in which rapid detoxification has occurred is at Silver Lake in Palo Alto County. This 600 acre lake was treated with sufficient toxaphene to make a 50 parts per billion concentration on May 27, 1958. Purpose of the treat-

ment was complete eradication of a vast over-population of small bullheads. The lake had previously been drawn down to its lowest possible level by means of a control structure at the outlet. Careful plans were developed prior to treatment to obtain proper dosage rates including contour mapping and volume computation for each zone ranging from one to four-foot contours. After treatment, some additional personal soundings were made and a vast variance in depths were obtained. Where there were supposedly four feet of water, less than two feet were present. Thus, of course, over-treatment occurred and instead of a 50 parts per billion, the concentration doubtless approached 100 parts. Great masses of small bullheads perished within a short time, and present indications are that a complete kill was achieved. When detoxified completely and the lake is filled, large-scale stocking of walleye fingerlings will be stocked on a test-production basis.

It is believed that detoxification has beennearly completed at this time (July 8). Test walleyes (10 inch) were caged in the lake on June 11 and were alive and healthy five days later. At that time a high wind drove their screened box container to the lee shore where soft mud killed the fish. Fingerling walleyes have been retained in the treated water at the laboratory for over two weeks.

Equally interesting and perhaps more important is the return of bottom fauna. Prior to treatment practically no bottom organisms were present, presumably due to the vast population of bullheads. On June 23, less than a month after treatment, Edkam dredge samples were literally squirming with chironomid larvae. The following table includes the analysis of three samples from various portions of the partially drained lake.

Table 1. Bottom fauna per square foot in Silver Lake, one month after treatment with Toxaphene.

Organism	Sample 1 (mud)	Sample 2 (mud)	Sample 3 (mud)
Tendipedidae	1,129	772	116
Caratopogonidae	24	20	12
Oligochaeta	Common	Common	Common (not counted)
Volume (ml)	9.6	4.8	0.8

Thus, from a lake devoid of potential fish-food organisms, a tremendous insect biota has developed in this very short period of time. Doubtless the extreme shallowness, high turbidity (secchi disk -6 inches) and as suggested by Hooper (personal communication) contributed toward a rapid build up of this valuable biota. Contrasted with these observations are those of Cushing and Olive (1956) which stated insect fauna repopulations required nine months in a Colorado reservoir following a 0.1 ppm treatment with toxaphene. Contributing to this variance in detoxification time doubtless centers in the greater depth of the Colorado reservoir (14 feet) and the lower turbidity (26.5 inches secchi disk). This suggests the possibility of artificially detoxifying a body of water by induced turbidity if the time factor is of importance to a project.

Conclusion

From these limited observations it is obvious that detoxification of toxaphene is rapid in shallow, highly turbid waters. Bottom fauna recovery is very rapid creating an immediate supply of forage for a restocking program. The possibility of inducing detoxification by artifically creating turbidity is suggested as a means toward speeding recovery in clear water areas.

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SUMMARY OF HATCHERY STUDIES, SPRING, 1958

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Fisheries Biologist

This annual report concerns certain phases of walleye and northern pike hatchery operations. Each year, routine data are collected during the hatching season and experimental studies are conducted. The following discussion presents the highlights of the work at the Spirit Lake, Clear Lake and Lansing hatcheries.

Spirit Lake Hatchery

Northern Pike: For the fourth consecutive year the northern pike run has been hindered by low water levels in lakes, and little or no runoff. Less than fifty northerns were collected from carp traps and taken to the hatchery for spawning. Nine quarts of eggs were obtained from these fish between April 8 and 14. These eggs averaged 60,000 per quart. They produced 240,000 fry for a 44 per cent hatch. About fifty per cent were stocked in nursery ponds and the fingerling removed at an early date. The remaining fifty per cent were stocked in suitable areas in the natural lakes.

Walleye: Gill-netting started on April 8th in East Okoboji, April 9th in Spirit Lake and on April 16th in West Okoboji Lake. There were 10 nights of gill-netting in East Okoboji Lake, 11 nights in Spirit Lake and four nights on West Okoboji Lake. The gill-netting crews collected 2,808 walleyes from the three lakes in 97 crew nights for an average of 28 fish per crew-night. The Biology Section electro-fishing crews supplied approximately 400 males for hatchery use.

A total of 517 quarts of eggs was taken from 1,657 females for an average of 0.31 quarts per female. These eggs averaged 146,000 per quart. A total of 399 quarts reached hatching stage, representing a 77 per cent hatch and 58 million fry. The first eggs were put up on April 12 and the last fry were stocked on May 7. Following a pre-arranged experimental stocking program for Spirit Lake, 15 million walleye fry were stocked by the biology crew.

Experimental work conducted at the Spirit Lake Station included plankton determinations and walleyes sperm storage. Plankton counts made at the time of fry stocking have been instituted as a rountine procedure on Spirit Lake and several nursery lakes in an effort to correlate survival with abundance of potential food. Progress has been slow and there have been no direct correlations noted during the limited time (two seasons) that this study has been in effect.

The second item in the experimental program concerns the shortage of walleye bucks in late spawning season. Walleye males make an early run during the spawning season, often comprising as much as 75 to 95 per cent of the catch during the first few nights of gill-netting. This ratio never reverses itself, and the number of males may become so few after midseason that the hatchery superintendent has too few bucks on hand for efficient fertilization of the eggs secured from the more abundant females. Often, extra effort is necessary to catch the needed males (it is difficult to hold males through entire season). Therefore, there is need for the storage of sperm during the time of abundance. Should storage of sperm become an actuality, the males could be eliminated from the holding tanks in the hatchery, theoretically doubling the hatchery holding capacity for females. Walleye sperm was stored at refrigerator temperatures in frog Ringer's solution made up according to Sneed and Clemmens (1956). The solu-

tion was then added to freshly taken eggs at 24 hour intervals but it was soon evident that fertilization was not taking place. Microscopic examination indicated that the sperm were alive but inactive. The addition of the solution to tap water as suggested by Sneed and Clemmens (op. cit.) failed to activate the sperm. This experimental work will be continued in more detail during the next spawning season.

Clear Lake Hatchery

Northern Pike: No northern pike were hatched at the Clear Lake hatchery in 1958. This is the second year that low water has prevented a normal spawning run of northern pike into the carp trap at the west end of the lake.

Walleye: The 1958 season was a "hatching" year for walleyes at the Clear Lake station in the alternate-year fry stocking program being conducted in cooperation with the Iowa State College Fisheries Research Unit. This season of hatching marked the eleventh year of the program.

The gill-netting crews fished 30 crew-nights, from April 7 to 14 inclusive, catching 2,744 walleyes for an average of 97 fish per crew per night. Only the gill-netting season of 1950 (98 fish per crew per night) exceeded this catch rate in the last twelve years of this type of netting for walleyes.

Water temperatures and gill-netting records seem to indicate that the optimum spawning temperature at Clear Lake was 48°F while at Spirit Lake the most females per crew were taken at a water temperature of 50°F (Table 1).

Table 1. Catch per crew of male and female walleyes at Spirit and Clear Lakes during the 1958 season.

Date	Spirit Lake			Clear Lake		
April	Water Temp.	Males	Females	Water Temp.	Males	Females
7				43	158	7
8				43	100	25
9	45	7	18	44	34	15
10	46	13	15	44	58	42
11	48	8	19	45	54	54
12	48	10	14	46	44	57
13	47	6	6	48	33	67
14	50	19	22	51	36	27
15	50	15	15			
16	54	4	21			
17	54	4	18			
18	56	6	17			
19	55	8	14			

The 1,154 females taken by the gill-netting crews produced 295 quarts of eggs for an average of 0.25 quart per female. Due to the shortage of males after midseason, some of the females were returned to the lake and therefore the average quarts per female may have been reduced. The first eggs were put up on April 9 and the last fry hatched on April 26. Eggs from the Clear Lake walleyes are larger than those checked from walleyes from any other area in the state, averaging 130,000 per quart. A total of 260 quarts of eggs were brought through to eyed stage for an 84 per cent hatch, producing 33,800,000 fry of which 25 million were

stocked in Clear Lake, and the remainder used for nursery ponds.

Lansing Station

Most of the work at the Lansing Station (on Mississippi River) consisted of experimental work concerning the injection of pituitary extract into female northern pike. A limited amount of routine checks on egg fertility, size and etc. were made but the final results are not included in this report.

Injection of carp pituitary extract into non-spawnable female northerns was initiated in 1956. Results during 1956 and 1957 were inconclusive, in fact, there was no evidence that such injections were beneficial at all. Encouraging results obtained this past season however, give hope for future success.

On the evening of April 11, female northerns that came into the hatchery on the 10th and 11th were divided into three groups of 18 fish each. Group one was kept in river water at 46°F without injection of pituitary material. Those in group two were placed in artesian well water at 56°F without injection of pituitary material, and the fish in group three were each given a pituitary injection (one pituitary gland in 5 cc of distilled water) and placed in well water. A fourth group of ten females that had not ripened were being held in well water in an attempt to determine if temperature alone would bring on any degree of egg maturity. These fish of group four had been in this water from four to ten days without any apparent success. They were given 5 cc of pituitary extract and replaced in the well water. Fifteen hours later, the fish in all groups were examined. Five females in group one appeared ripe enough to strip. There was one ripe fish in group two and one in group three, and none in group four.

Ten fish of group one were then given 5 cc of pituitary extract. Group two was continued as the control for well water and those (17) of group three were given another pituitary injection. Due to a shortage of pituitary glands, group four was dropped from injection program.

On April 13, twenty-one hours later, the fish were examined again. There was one ripe fish in group one, no ripe fish in group two, three or four. Discouraging as this appeared at the moment, the fish were held in their respective groups another 24 hours. At the end of this period, group one contained one ripe fish, group two and four contained none but group three produced eleven ripe females (65%). Another injection would likely have ripened the remaining six fish. The value of the warmer artesian water was not demonstrated conclusively and the benefits are doubtful.

The eggs taken from these females were handled in the regular manner with no differences noted in fertility when compared with eggs taken from non-injected females.

Based on the above results, the S.T.O.P. for the hatchery superintendent working with northerns might read as follows:

1. Sort males and females as they come into the hatchery, as same time separate ripe females from green.

2. Inject all green females with carp pituitary extract.

3. Repeat injections at 24 hour intervals until three injections have been given.

4. Handle eggs as before.

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NOTES ON THE EFFECTIVENESS OF AN ELECTRO-FISHING DEVICE USED IN THE MISSISSIPPI RIVER SURVEYS IN IOWA

Robert Cleary
Fisheries Biologist

The first survey-type investigation of the fish populations in the Mississippi River under the auspices of the U. M. R. C. C.* was begun in 1944 in the Dubuque, Iowa, to Carruthersville, Missouri, reach of the river. This survey was continued in 1945 over the same general area using a combination of new and old stations. The main objective of these surveys was to test the effectiveness of various types of commerical fishing gear, and secure information as to relative abundance of certain commerical species and information as to the population structure of these species. A similar test-netting program was conducted in 1946 and again in 1948 in the Hastings, Minnesota - Dubuque, Iowa, reach of the river.

It was not until 1956 that another general survey of the river was made. At that time Minnesota made routine fisheries surveys in Pools 3, 4, 5a, and 6. Similar surveys were undertaken, cooperatively, but Illinois, Iowa and Wisconsin in Pools 8 through 19. These surveys differed from their predecessors in that the emphasis was placed on game-fish populations; the types of gear used being vastly reduced and standardized to allow for comparison between pools or areas in the river.

As in preceding surveys, special projects were undertaken, which furnished data to life history features of the various important game species; as well as efficiency appraisals of the survey techniques themselves.

In both the 1956 and 1957 Iowa surveys, the trap net was the primary piece of fish-taking gear used. This net was of a standard commerical design; 3 x 6 frame, six 30-inch hoops, and 50 feet of 3-foot-deep lead. The web in the lead and the frame was $1\frac{1}{2}$ inch bar measure; while the in crib it was reduced to 1 3/8 inch bar measure. This piece of gear was augmented by gill nets, trammel nets and seines, and an electric shocker (boom type) in 1956.

There was an increase in the use of electro-fishing gear in the 1957 surveys. A Homelite, 230-volt, 180-cycle, 2500-watt, 3 phase-AC generator was mounted in the bottom of an 18-foot river flat boat. The three electrodes constructed of $\frac{1}{2}$-inch copper rods, four feet long, hung into the water from individual 8-ft. booms, which were spread fan-shape from the bow of the boat. The boat lacked maneuverability because of its size; however, since some shocking traverses were 10 miles from the "home port", maneuverability had to be sacrificed for safety.

It has been our experience in making electro-fishing surveys, that stunned fish often rise to the surface well after the shocker boat. To this effect we employed a second or "follow-up" boat. In many of the traverses an attempt was made to determine the quantity and quality of this off-missed sample of stunned fish. Table 1 gives the catch comparison between the two craft. The primary reason of the "follow-up" boat was not to increase the party catch but to determine whether any species or group of species exhibited latent surfacing more often than others and if so to what magnitude. This was an important consideration in any future plans to use the shocker.

It was evident that while the two craft took comparatively the same species combination and numbers of fish, the smaller individuals took longer to surface or were unnoticed by the retriever on the "shocker" boat. A larger percentage

* Upper Mississippi River Conservation Committee

by weight of commercial fish was retrieved by the "follow-up" boat with other groupings remaining fairly constant in their inter-relationship in the catch. No evidence of specific latent surfacing could be determined from the data.

Table 1. Comparison between shocker and follow-up boat catches in the U. M. R. C. C. Exploratory Fishing Surveys, 1957.

	Shocker Boat				Follow-up Boat			
Category	No.	Wt.	Av. Wt. in lbs.	% of Catch by Wt.	No.	Wt.	Av. Wt. in lbs.	% of Catch by Wt.
Commercial Fish	170	322.3	1.89	55	175	258.3	1.47	70
Sport Fish	416	204.3	.49	35	365	101.2	.28	27
Predatory Fish	13	33.5	2.57	6	8	6.3	.80	2
Forage Fish	61	28.8	.47	4	8	2.8	.35	1

Several shocker traverses in different habitat types were used to compile these data. We can, therefore, assume that our sample was not biased by a single set of ecological conditions.

At Spring Lake, opposite Cassville, Wisconsin, the survey party made a simultaneous comparison between clear and turbid water shocking. An oval backwater, opening downstream on the channel, was bisected into two approximately equal portions by a ridge of land. The river, which was about two to three feet above normal at the time, had risen above the outside bank of this cove and flowed turbid water into the outer half; the inner portion was still clear to its bottom (4-6 feet). Each portion was subjected to a half hour shocking traverse over similar habitat.

Generally speaking, the species composition and abundance in the two areas was quite comparable, (Table 2). The major difference was in the average size of the fish taken. Larger commercial fish were taken in clear water, while the larger sport-fish were taken in the turbid water. It may be that the larger game fish could visually determine that the electro-fishing activity was the cause of disturbance and avoided the shocker boat in the clear water and not in the turbid.

The difference expressed by these data may also have been the result of either the turbid water affecting the efficiency of the shocker or actually affecting the abundance, size, and species composition of the fish.

It has been the opinion of many river biologists that the trapnet is the most effective and least selective of any webbed entrapment device. However, the mobility and compactness of the electric shocker makes it an ideal piece of survey equipment especially for inventory surveys.

As a portion of these investigations an attempt was made to compare the "fish-taking" efficiency of the shocker with that of the trap net. The 1956 survey at the same station demonstrated that the shocker was 40 times more effective on a per-hour catch basis ($15\frac{1}{2}$ shocker hours compared with 5791 trapnet hours); however, the shocker took an average of 20.2 species at each of five stations compared with 23.6 species taken by the trap net. The shocker was also less selective as to size; the trapnet retaining only those fish that were too large to pass through the 1 3/8 inch webbing in the crib.

Table 2. Comparison on between clean and turbid water shocking in same area, U. M. R. C. C. 1957 Exploratory Fishing Surveys.

Species	Clear (Clear to Bottom) No.	Wt. in lbs.	Av. Wt. in lbs.	Turbid (Sechii Disk Reading - 4.5 in.) No.	Wt. in lbs.	Av. Wt. in lbs.
Bigmouth Buffalo	5	27.0	5.4	3	9.2	3.1
Ictiobus Sp.	8	11.3	1.4	12	12.8	1.1
Carpiodes Sp.	3	11.3	3.8	3	5.1	1.7
Carp	1	4.4	4.4	-	-	-
Flathead Catfish	1	.8	.8	-	-	-
	18	54.8		18	27.1	
Yellow Bass	-	-	-	1	.1	.1
Largemouth Bass	3	2.2	.7	5	12.1	2.4
Bluegill	23	3.4	.15	7	1.1	.16
White Crappie	1	.1	.1	4	1.2	.3
Black Crappie	3	.8	.3	2	1.8	.9
	30	6.5		19	16.2	
Shortnose Gar	-	-	-	1	.1	.1
	0	0		1	.1	

Table 3 is based on data gathered in the 1956 survey in an area from Dubuque to Burlington, Iowa. The shocker took greater numbers of buffalo, carp, sheepshead (drum), and gizzard shad and considerably fewer crappies and white bass. While there was some deviation in the comparison by weights, the same general pattern was apparent in the important species in the catch.

Table 3. Comparison by numbers and weights of catch by trapnets and shocker at same station in U. M. R. C. C. surveys, 1956, expressed as percent of total catch.

Species	T. N. Catch % by Numbers	Shocker % by Numbers	T. N. Catch % by Wt.	Shocker % by Wt.
Carpiodes Sp.[1]	9	9	13	8
Ictiobus Sp.[2]	11	21	14	22
Carp	11	16	35	48
Freshwater Drum	5	20	3	8
Bowfin	1	1	4	4
Gizzard Shad	1	5	1	2
White Bass	5	3	4	1
Bluegill	9	10	2	1
Pomoxis Sp.[3]	45	10	20	3
Largemouth Bass	1	3	2	2
	98	98	98	99

1. C. volifer, C. cyprinus, and C. carpio.
2. I. cyprinella, I. bubalus, and I. niger.
3. P. nigromaculatus, and P. annularis.

The 1957 trapnet-shocker comparison (table 4) was made in an area from Stoddard, Wisconsin, to Sabula, Iowa (18 shocker hours compared with 5088 trapnet hours). In this area, the shocker took more buffalo, carp, gizzard shad, bulegill, and largemouth bass than did the trapnet. The latter two species were taken almost equally by the shocker and trapnet in the 1956 surveys. However, in comparing average weight, there was a sharp difference only in two species: the largemouth bass and the bluegill. The increased number of bluegills taken by the shocker actually weighed less than the smaller number taken in the nets. Evidently the shocker took both greater numbers and larger bass, and greater numbers and smaller bluegills than the trapnet. The reduced shocker catch of crappies and white bass was again evident.

Table 4. Comparison by numbers and weights of catch by trapnets and shocker at same station in U. M. R. C. C. surveys, 1957, expressed as percent of total catch.

Species	T. N. Catch % by Numbers	Shocker % by Numbers	T. N. Catch % by Wt.	Shocker % by Wt.
Carpiodes Sp. [1]	6	3	13	5
Ictiobus Sp. [2]	6	11	11	23
Carp	12	16	30	34
Freshwater Drum	2	3	3	3
Bowfin	1	1	3	4
Gizzard Shad	2	6	1	2
White Bass	4	1	3	1
Bluegill	17	31	7	5
Pomoxis Sp. [3]	49	8	27	4
Largemouth Bass	1	18	1	19
	100	98	99	100

1. C. velifer, C. cyprinus, and C. carpio.
2. I. cyprinella, I. bubalus, and I niger.
3. P. nigromaculatus, and P. annularis.

Summary

1. There was no evidence of latent surfacing of any particular species over another in a study of the catches made by the shocker boat and its accompanying "follow-up" craft. The larger-sized commerical species were, however, slower to come to the surface than any other category or size grouping.

2. In turbid water, the larger-sized game fish were more easily taken than in clear water. This case was reversed with the larger-sized commercial fish.

3. Further comparisons between trapnet and shocker catches were made in 1957 and the shocker was found to be less efficient in the taking of crappies and white bass, but more efficient in taking buffalo, carp, and gizzard shad. It also took greater numbers and larger bass and greater numbers and smaller bluegills than the trap net.

CONSERVATION OFFICERS WINTER COUNT OF QUAIL

Elden Stempel
Game Biologist

In some respects, each of the four seasons of the year is critical for quail. During spring the food is poor, brooding causes losses in summer; hunters take many birds in the fall, and in winter the cold, wet stormy weather is unfavorable.

Through field counts of quail after the winter has passed we get figures to be used in estimating surviving brood stock. Winter censuses are based on recent studies; Boehnke (1950) expressed the opinion that usually different quail occupy a given covey range each year because of losses. Errington (1941) stated that, "coverts occupied the most continually seem to show the greatest year to year constance of carrying capacity".

Baker (1940) ascertained that certain types of woody coverts adjacent to cornfields usually held quail coveys. Kozicky and Hendrickson (1952) wrote that snow depth, and duration of snow cover had a relationship to survival of quail.

Some type of winter census is therefore essential. An exceptionally rigorous winter having unusually deep snow, and violent storms will likely effect the population adversely - birds could be killed outright, or vitality could be lowered, thus reducing the breeding potential. This may be determined by first obtaining samples of the population in average winters. These data may then be compared with those collected in severe periods.

Method

The winter count of 1958 was made about March 1 after most danger of storms passed. To simplify the work, and make it more effective, it was suggested that birds be counted when there was snow cover. Thus some areas might be checked by finding quail tracks. Three covey ranges were searched in each county assigned.

Items recorded in 1956 were: county where count was made, snow condition, number of quail flushed, number tracked, time the count was made and amount of time spent. In 1957 and 1958, the number of roosts seen were also recorded.

Officers were asked to search areas identified by brushy cover-edge, adjacent to corn or beanfields. It was suggested that time in the field be held to a minimum to make results uniform. The field data were sent to the Des Moines office and later collected by the biologist.

Results: Statewide

Results of the winter counts for the years 1956 through 1958 are presented in the table below.

Table 1. Results of the Winter Count of Quail in Iowa

Year	No. Man Hrs.	No. Quail	No. Ranges	No. Quail Tracked	No. Roosts
1956	87	605	117	270	
1957	88	590	111	150	22
1958	84	433	99	333	46

Less ranges were reported occupied in 1958 than in 1957. Some of this is due to stressing one point. No count is to be repeated. Only one trip is to be made over an area.

The 1956 census indicated 6.9 quail found per man-hour in the field; in 1957 the figure was 6.7 and in 1958, it was 5.2 quail. It is my opinion that some of this is due to continued emphasis that care must be used in counting quail flushed, and that estimates are not to be entered in spaces provided for recording birds flushed. There was little difference in the number of quail found per area in morning and in the afternoon.

During the 1958 census, 10 men had good snow cover for making counts, nine had fair cover, while 14 had little or no snow. Snow cover does not seem to be utilized sufficiently to be of benefit to the census taker.

Quail by Agricultural District

Proper food, cover and terrain are necessary for the existance of quail: when they are present, finding quail is difficult, or easy, according to sunshine, wind, humidity and temperature.

There are indications that populations of quail may fluctuate locally and the total picture may change little; on the other hand, some areas may remain comparatively stable, while others may vary considerably. Therefore records are kept on Agricultural Districts as well as on a statewide level. Table 2 represents the number found within several districts.

Table 2. Quail Populations by Agricultural Districts 1956, 1957, 1958.

Agricultural District	Average No. of Quail per Occupied Winter Range			Av. No. of Quail on all of the Ranges Checked		
	1956	1957	1958	1956	1957	1958
East Central	12.6	12.7	8.4	7.0	6.8	3.5
South Central	12.1	12.0	5.4	8.1	8.8	2.3
Southeast	15.0	10.6	11.1	6.5	5.8	4.9
Border Counties	8.2	9.0	15.0	3.5	4.0	8.3

Of the counties within the main quail range, those in the southeast are the only ones to show gain. In the outlying areas or border counties, a gain is indicated, but these areas are lightly hunted since they do not have extensive quail ranges. After further investigation, it is known that some of the losses indicated for the south-central, and the east-central are due to adhering more strictly to directions for making the counts.

The Count by Counties

Some unusual counts of quail occurred: when compared to 1957 records, these were, Clarke county a drop from 26 birds to 7, Iowa county 17 birds down to 5, Jackson 60 down to 0, Ringgold 12 to 0, Warren 60 down to 14, Wayne 33 down to 0.

In 1958 no quail were found in Adams, Chickasaw, Fayette, Jackson, Jasper, Ringgold, Story or Wayne. In 1957 none were seen in Adams, Buchanan, Chickasaw, Harrison, Jasper, Linn and Story.

Highest counts in 1958 were in Allamakee, 34; Blackhawk, 27; Cass, 22; Clayton, 24; Marshall, 38; Pottawattamie, 24; Story, 34; Woodbury, 30. In 1957,

highest were in Cass where 42 quail were seen, Clarke, 26; Davis, 34; Jackson, 60; Marshall, 27; Monroe, 31; Wayne, 33; Woodbury, 25.

Discussion

The winter count of quail is made to bring population records up-to-date. There is no opportunity to compare the merits of censuses made with or without snow as most winter counts are made without snow. Evident changes in population will be rechecked when the July whistling quail count is made.

Summary

1. A 1958 winter count was made by conservation officers in February and March.

2. Snow is seldom on the ground when counts are made.

3. There were fewer quail flushed in 1958 than in 1957.

4. An unknown amount of apparent change in numbers of quail was due to change in field procedure.

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PHEASANT CROWING COUNT AND HEN

INDEX SPRING - 1958

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Pheasant Biologist

The annual spring pheasant crowing count was taken by conservation officers during the last two weeks of April and the first half of May. The crowing count was included in our year-round program to determine trends in the spring breeding population and to note changes in local pheasant abundance.

This report presents the results of the 1958 census and compares them with the results of previous surveys. The routes used and procedure remained the same as for earlier counts.

Special routes were checked by biologists to determine the seasonal peak of crowing activity. This peak occurred during the middle of April which was about ten days earlier than in 1957. At this time, officers were promptly notified to begin routes in their counties.

Weather conditions prior to the survey were quite favorable, but soon changed as the count got underway. Temperatures ranged slightly above normal for the first two weeks of April and then increased to much above normal the third week, which stimulated crowing activity. For the rest of the census period, temperatures varied considerably with the many weather fronts that crossed the mid-west. Winds and frequent precipitation were troublesome in most areas of the state.

The statewide average for the spring crowing count was the highest ever recorded since the survey was started in 1950 (Table 1). Officers completed 158 routes and recorded 37,704 calls at 3,106 stops. They recorded an average of 12.1 calls per stop which was 53 per cent above the 1957 figure. Some averages for single routes were as high as sixty calls per stop, and a few individual stops ranged to the lower eighties. This considerable increase in crowing activity was not surprising - sight records since the close of the 1957 season have shown an extremely high population of roosters.

The spring hen index was determined by applying the observed sex ratio from winter counts to the results of the crowing count (Table 1). The statewide spring hen index of 27.8 was six per cent higher than the 1957 figure, and equal to the results obtained in 1956.

Therefore, Iowa's 1958 spring pheasant population was higher than normal, but nearly all of this increase was due to the excess of cocks carried over from the 1957 season.

Crowing activity increased in all districts of the state, but changes in hen index figures were less spectacular. The results of the 1958 spring population check are listed for each district in Table 2 and a comparison of previous counts is made in Table 3.

The pheasant population in northwest Iowa appeared to have recovered from the sharp decline recorded in 1957. Crowing intensity nearly doubled this year and the hen index increased 16 per cent.

Results from districts two and three in north central and northeast Iowa indicated substantial gains this year. Populations in both districts are far above the state average, with the exception of the Mississippi River counties in districts three.

Table 1. Statewide Results of the Crowing Count and the Hen Index 1950 - 1958

Year	Average Number of Calls per Stop	Sex Ratio	Spring Hen Index[1]
1950	7.9	2.9	22.9
1951	8.1	2.9	23.5
1952	9.3	2.7	25.1
1953	9.4	2.2	21.7
1954	8.5	2.8	23.8
1955	8.5	3.6	30.6
1956	8.4	3.3	27.7
1957	7.9	3.3	26.1
1958	12.1	2.3	27.8

1. Average calls x sex ratio

The population of birds remains low in the west central district following the severe drought in 1956. Cocks were numerous in the area but the hen index decreased slightly.

Spring hen index figures for districts five and six, central and east central Iowa, were similar to the statewide average this year. Fewer hens were reported for the central district when compared with 1957, while the figure remained the same in district six.

Counts in the southern three districts indicated more birds in 1958 with the highest concentrations in the southwest part of the state.

Table 3. Comparison of Crowing Count Results and Spring Hen Index 1956 - 1958

Districts	Year	Av. Number of Calls Heard	Spring Hen Index
1. Northwest	1956	18.4	51.5
	1957	12.2	41.5
	1958	22.9	48.1
2. North Central	1956	21.6	71.3
	1957	21.9	54.8
	1958	32.2	64.4
3. Northeast	1956	10.0	38.0
	1957	13.1	53.7
	1958	24.3	58.3
4. West Central	1956	9.0	36.0
	1957	6.1	23.8
	1958	10.1	20.2
5. Central	1956	7.4	34.0
	1957	7.6	35.7
	1958	9.2	28.5
6. East Central	1956	3.3	12.5
	1957	6.9	25.5
	1958	8.2	25.4
7. Southwest	1956	2.1	6.3
	1957	2.6	8.1
	1958	3.5	10.9
8. South Central	1956	1.6	3.8
	1957	1.5	2.9
	1958	3.0	4.2
9. Southeast	1956	0.5	1.0
	1957	0.5	1.0
	1958	0.5	1.4

Table 2. District Results of the 1958 Crowing Count and Hen Index

District	Number of Calls Heard	Number of Stops	Average Number of Calls per Stop	Sex Ratio	Spring Hen Index
1. Northwest	4,674	204	22.9	2.1	48.1
2. North Central	13,840	430	32.2	2.0	64.4
3. Northeast	6,622	272	24.3	2.4	58.3
4. West Central	3,734	370	10.1	2.0	20.2
5. Central	4,336	470	9.2	3.1	28.5
6. East Central	1,978	240	8.2	3.1	25.4
7. Southwest	1,245	360	3.5	3.1	10.9
8. South Central	1,091	360	3.0	1.4	4.2
9. Southeast	184	400	0.5	2.7	1.4
STATE	37,704	3,106	12.1	2.3	27.8

A BRIEF RECORD OF MANAGED AQUATIC HABITAT AT RUSH LAKE, PALO ALTO COUNTY, IOWA AND THE RESPONSE OF THE MUSKRAT POPULATION

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Rush Lake in Palo Alto County, Iowa is a very shallow (2-4 feet) marsh-type lake with an unusually large watershed. Consequently, following heavy rains, the rooted emergent aquatic plants growing in Rush Lake are subjected to frequent changes in water level. During wet years the increased water levels have jeopardized the growths of cat-tail, bulrush, arrowhead and other common emergent species. To counteract the harmful effects of continuous high water upon the emergent aquatics, to eliminate undesirable fish and to initiate seedling growth of aquatic plants, control structures have been constructed at the outlet. Drainage and water level control have been used as the only practicable method to manage food and cover plants for wildlife on the area.

Mr. E. T. Rose, Fisheries Biologist, stated from memory that when visiting Rush Lake in 1936 with a Mr. Andy Ammon, a student from Ames, "the lake was a jungle of vegetation with evidence of a good muskrat population present". Mr. B. I. (Stub) Severson in his letter of April 11, 1958 indicated the lake contained no vegetation and produced few muskrats during the period of 1937 through 1940. The written field records of Mr. Tom Moen, Fisheries Biologist, stated that in December 1940 while visiting the lake for the purpose of taking oxygen samples, "There was only a blank expanse of ice and no vegetation". This corroborates Mr. Severson's preceeding statement.

In the spring of 1941 the lake was drained to provide suitable growing conditions to re-establish the emergent aquatic vegetation. According to Mr. Severson, the muskrat population and the vegetation both increased through 1945. There is a very slight discrepancy in that Mr. Elmer Wogen of Estherville, then Conservation Officer, indicated from memory that peak numbers of rats were present in 1942 and 1943 and they declined thereafter. Mr. Severson was in the army at this time and not present in Iowa. There was complete agreement that by 1946 the vegetation was declining, and by the end of 1949 the vegetation and the muskrat population had declined to a critical point. These conditions were corroborated by my own observations during the spring and summer of 1949. My mimeographed notes (Quarterly Seminar of January 10, 1950) indicated that, "The emergent vegetation has rapidly disappeared from Rush Lake in Palo Alto County and both the remaining emergent and submergent vegetation is poor". Likewise the muskrat population on the area was very low.

Referring to muskrat populations in the lakes region, including the counties of Dickinson, Emmet, Clay and Palo Alto, my mimeographed seminar report dated April 10, 1950, stated: "A post-trapping season survey in northwest Iowa indicates a sufficient seed stock of muskrats remaining for the 1950 breeding season. Low water levels in some areas contributed to greater trapping success and reduced populations this spring (1950) compared with last spring (1949). Muskrat house building this fall greatly exceeded the number of houses built last year, but the percentage of dead houses was greater this year (samples were checked on marshes by probing houses with a sharp steel rod). This is normal for a dry fall. Mink are not overly abundant, and populations are still low". From my seminar paper dated October 10, 1950, I mentioned, "The 1950 growing season in Iowa has been excellent for practically all emergent aquatic plant species. In several lakes where water levels were too high, emergent vegetation did not increase in density and amount," (Rush Lake was one of these). "In the majority of Iowa lakes and marshes, emergent vegetative growth has improved while obser-

vations would indicate that the reverse situation is true regarding submergent aquatic plants. For all practical purposes the submergent aquatic plant crop was satisfactory this year. During this early fall season most of the lakes and marshes have more water in them than was present last fall (1949) at the same date". My estimate of the fall population of muskrats in 1950 was stable, with no positive indication of a trend downward.

In my opinion the muskrat population in the lakes region from 1950 to 1952 would have been slightly upward. The year of 1951 was one of the wettest years on record, with practically all local marshes full to overflowing from spring to fall. This high water on some of the state-owned areas such as Rush Lake completely wiped out the remaining emergent vegetation, and the muskrat population continued downward until it virtually reached zero.

On May 29, 1952, ditching and drainage were initiated by the use of dynamite at Rush Lake. On July 16, approximately 3 weeks later, the exposed portions of the lake bottom were already covered with smartweed, seedling cat-tails, and arrowhead (see Quarterly Biology Seminar Vol. IV, No. 3, pp. 45-49, for details). On May 11, 1953 an excellent growth and dense cover crop of two-year old hard-stemmed and soft-stemmed bulrush, cat-tail, and river bulrush were flourishing. There was no muskrat population to speak of because the lake was still dry, and continued in this condition with the exception of a few sporadic downpours on the watershed. This temporary flooding soon was eliminated from the lake by drainage.

Muskrat populations began to build up at Rush Lake as soon as the new structure was completed and water could again be impounded. Mr. Severson's letter of April 11, 1958, indicated 1.09 muskrats were harvested per acre in 1953, increasing to 7.03 per acre in 1955, and to 15.2 per acre in 1957. The trend has been continuously upward to date with a population explosion this last fall estimated to be over 9,000 muskrats. Mr. Mark Campney of Ruthven, who is now responsible for management of the area, contends he has harvest records indicating some 9,000 to 12,000 rats or more were removed from the area. A tremendous muskrat population was present in 1957, and a slightly smaller population is anticipated in 1958 because of deteriorating marsh conditions.

Muskrat populations in the lakes counties do not parallel the picture at Rush Lake. The muskrat population peaked about 1944 in the lakes areas, decreased steadily with a slight but noticeable increase peaking about the fall and winter of 1952-53. Thereafter, the muskrat population has declined steadily during the drouth years from 1954-57. With the natural re-vegetation of the marsh areas during the last few dry years, we anticipate excellent muskrat populations as soon as sufficient water returns these areas for optimum muskrat reproduction.