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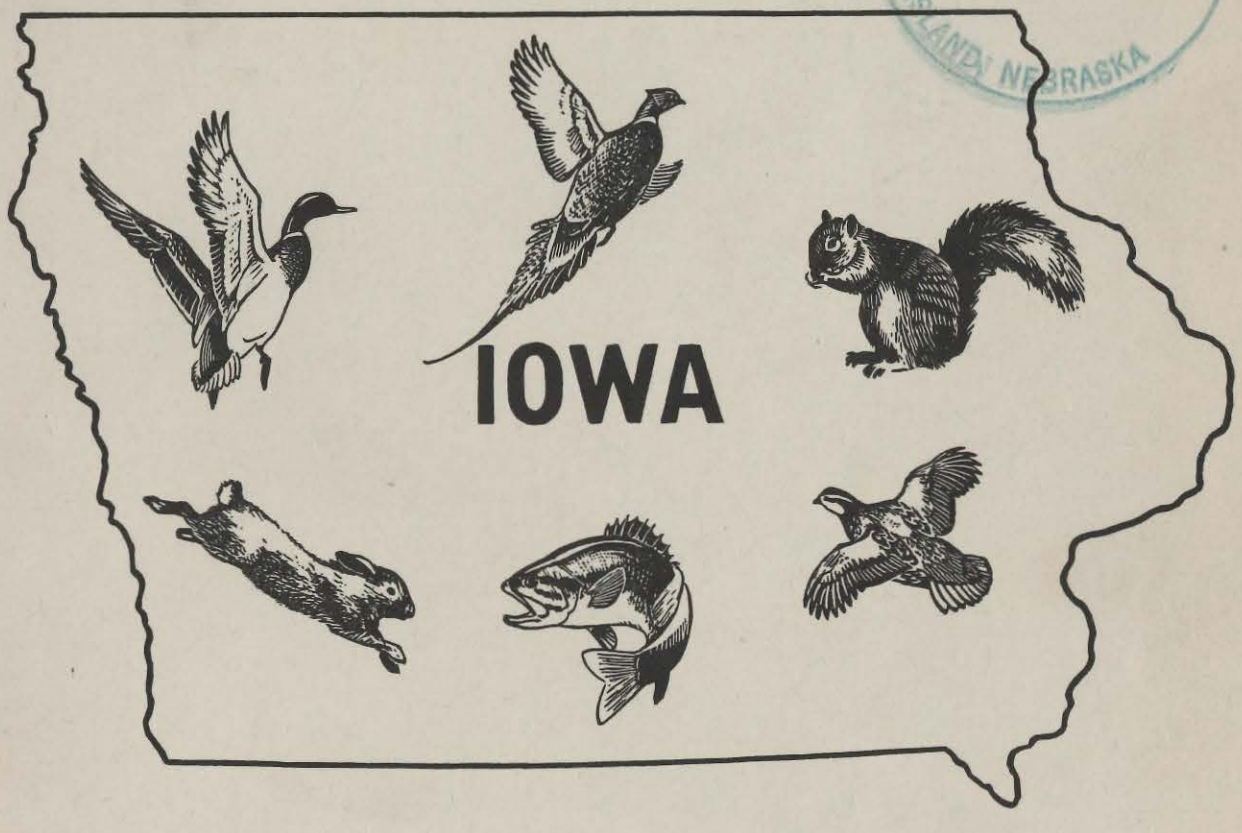
QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

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GROUND CENSUS
WOOD DUCK NESTING BOX DATA
LAKE ODESSA, IOWA
SPRING 1952
James G. Sieh
Game Biologist

Wood ducks (Aix sponsa)will probably never become an abundant waterfowl species because their nesting range and available nesting habitat are both limited. In Iowa the wood duck is important from two standpoints. First, it is an important part of the hunter's bag, especially along the Mississippi River. Secondly, it is an important nesting species in Iowa. Where ever we find habitat suitable to the requirements of this species in Iowa they will attempt to nest.

The establishment of the nine foot channel system by the Corps of Army Engineers along the Mississippi River has created additional problems for nesting wood ducks. It is not unreasonable to assume that the lock and channel system has created additional nesting habitat for the species, and subsequently increased wood duck production; but the entire story is not that simple. Let us examine the known facts in the light of past experience and make some future predictions.

Lake Odessa in Louisa County, near the town of Wappelo, Iowa, was a suitable location for an experimental wood duck nesting box study. Schreiner and Hendrickson (1951) stated that "Of the 5800 acres in the area, about 2500 are under water, 700 farmed and the remainder covered with lush marsh vegetation". Part of the land now under water was re-flooded during the advent of the nine foot lock and channel system on the Mississippi and previously had been semi-successful or unsuccessful drained agricultural land.

BRIEF RESUME OF WOOD DUCK PRODUCTION AIDED BY NESTING BOXES
LAKE ODESSA, IOWA, IN 1950
After Keith M. Schreiner and George O. Hendrickson
by J. G. Sieh

Twenty-six wood duck nesting boxes were installed in the Odessa area by April 1, 1950. The nesting box used was designed by the U. S. Fish and Wildlife Service. Fred Schwob, former Director of the Iowa State Conservation Commission, redesigned the removable lid or top to fasten with wedges instead of hooks and eyes. The nesting boxes were nailed on trees, both living and dead, completely surrounded by water. Sawdust or wood shavings were placed inside the boxes to provide nesting material.

The first nesting was started on April 14 and the last nest hatched on July 17. Eighteen boxes (69%) were used by wood ducks and (61%) brought off broods successfully. The successful nests contained 132 eggs, or (83%) of the total 158 eggs laid. Of the 18 clutches stated, seven (39%) were unsuccessful because of a windstorm and desertion.

Exact incubation periods of two nests were 29 and 30 days respectively. The incubation periods for nine other nests were estimated to be between 26 and 33 days. By dividing the number of days elapsing between the box checks into the additional number of eggs found, approximately an egg a day was established as the average rate of laying.

WOOD DUCK PRODUCTION AIDED BY NESTING BOXES LAKE ODESSA, IOWA, IN 1952

During the nesting season of 1952 Mr. Dan Nichols of the Iowa Conservation Commission and Mr. Fritz Pierce of the U. S. Fish and Wildlife Service continued the wood duck nesting study at Lake Odessa on a part time basis.

A predicted flood crest on the Mississippi caused Nichols and Pierce to "raise" 24 nesting boxes on April 11, 1952 up above the predicted crest. On that date 10 wood duck nesting boxes contained a total of 72 wood duck eggs and 28 additional hooded merganser (Lophodytes cucullatus) eggs. Box number 9 contained 10 merganser eggs; box number 16 contained 14 merganser eggs; and box number 27 contained a mixed clutch of 4 merganser and 14 wood duck eggs on April 11. All the nesting boxes were raised above the predicted flood crest by the simple expedient of removing each box from the tree trunk to which it was nailed, and re-nailing the box higher up on the tree trunk well above the predicted flood crest.

On April 29, 1952, the flood had inundated 8 of the 32 boxes, but no nests were lost. Eighteen of the 24 boxes raised above flood crest contained nests (one box held 3 young screechowls) of wood ducks and hooded mergansers. Not a single case of nest desertion was reported from the ordeal of nest "raising". Three of the wood duck clutches had hatched out and left their nesting boxes by April 29, 1952.

On May 27, 1952, Schwob and Sieh visited 25 nesting boxes and recorded the nesting box contents of each (Appendix, Table I.). Of the total number visited, 17 boxes contained eggs or showed evidence of nesting activity. Two additional boxes were known to have been active during the nesting season, and one box contained 3 young screechowls and the other box a clutch of 17 eggs (assumed to be wood ducks).

Only 6 boxes remained unused up until May 27, 1952. Two of these 6 boxes had been moved to new locations this spring, and a third box was not raised above the flood crest. Two boxes, numbers 14 and 15, were unused this season for no apparent reason. One of these, box number 14 was reportedly unused in previous years; and Mr. Schwob has suggested the location of the box is to blame. The location of this box is unique in that it is situated on a dead tree surrounded by five smaller living trees on a tiny island about 6 feet square in the center of an open water area. It was assumed

that emergent plant cover was too far away from the nesting box and therefore the site was undesirable. There was no explanation for box number 15 being unoccupied.

Discounting the box occupied by screechowls, two boxes moved to new locations during the nesting season, one box inundated by flood water, and one box poorly located; it leaves only one nesting box out of 25 boxes unoccupied. This represents a high percentage of occupancy for the 1952 nesting season.

Egg production per nesting box was likewise high. Thirteen boxes were known to have contained 208 wood duck eggs. This is an average of 16 eggs per nesting box. The 13 complete clutches contained from 9 to 29 eggs apiece. Schreiner and Hendrickson (1951) found 11 complete clutches which contained from 9 to 16 eggs, with a mean of 12 1.7, during the season of 1950 at Lake Odessa.

Schreiner and Hendrickson believed one nest contained the eggs of 2 hens. On May 12, 1950, the dump nest reported was empty, but on May 26 it contained 16 eggs. Thus 16 eggs were deposited in 14 days or less. Dump nesting has been reported by other writers, and is not uncommon among wood ducks.

Unfortunately, there is little evidence (based upon the supposition of one egg laid per hen per day) other than extra-large clutch size to indicate large scale dump nesting in 1952. On April 29, 1952, nesting box number 30 was empty, but contained 16 eggs on May 13, 1952. Thus 16 eggs were deposited in 14 days or less. Evidence was lacking to prove conclusively that the other extra-large clutches were the result of dump nesting, but it is the opinion of the writer at this time that these large clutches were the result of two or more hens laying in the same nesting box. It is probable that flood waters covered many incomplete clutches in natural tree cavities. Female wood ducks having eggs ready to lay and their own nesting cavities suddenly inundated by abnormal flood crests may have been forced to dump nesting in those few boxes raised above the flood crest. This would explain the presence of such extra-large clutches during the 1952 study. Flood crests were reached just following the check on April 29 and abnormally high water preceded these crests and receded slowly.

Nichols and Pierce reported that on June 10, 1952, that all the clutches had hatched with the exception of nesting box number 4. The latter contained one dead wood duck chick and 3 eggs with dead ducklings inside.. It appeared that something may have entered the nesting box during hatching causing abnormal mortality.

The success of the wood duck nesting boxes at Lake Odessa is extraordinary. Certainly their use on this one area should encourage others to build and install nesting boxes in similar areas.

Only two simple suggestions are offered concerning wood duck nesting box construction and installation. First, select a good design such as that recommended by Bellrose of the Illinois Natural History Survey; or Terrill and Shanks of the Missouri Conservation Commission.

It is mandatory that in areas subject to flooding the boxes be placed well above any possible flood crest. This will avoid unnecessary loss of eggs or young by flooding. It is recommended that the boxes be placed on substantial trees over water, and high enough above the anticipated high water stages (15-30 feet) to require a boat and ladder to visit Mrs. Wood Duck at home. The simple precaution of installing boxes well up above the highest probable flood crest (10-15 feet) will discourage most curious vandals and other predators. A good nesting box well located in Iowa will pay its way in wood ducks.

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Appendix, Table I
WOOD DUCK NESTING BOX DATA
LAKE ODESSA, IOWA

SPRING 1952

Nesting Box Number	Nesting Box Contents (May 27, 1952)	Previous Nesting Data *(Nichols and Pierce)	Total Egg Production
1.	Box not checked (probably destroyed by flood).		
2.	5 eggs counted; (3 new and 2 old).	On or before May 13, 1952 29 wood duck eggs counted.	29 counted
3.	3 eggs counted; probably 6 or more eggs covered by the incubating hen and not counted.	Hen wood duck on the nest May 13, 1952.	9-12 estimated
4.	17 eggs counted; probably 6 or more eggs covered by the incubating hen and not counted.	Wood duck hen on the nest May 13, 1952	23-26 estimated
5.	Not checked this date.	Contained 17 eggs.	17 counted
6.	Box not checked (probably destroyed by flood).		
7.	Not checked this date.	Contained 3 young screech owls on May 13, 1952.	0 counted
8.	0 eggs counted; unused this season and was moved from the big lake into lower end of "Heidelbaugh".	Apparently unused this season.	0 counted
9.	2 eggs counted; (1 new and 1 old) 1 dead wood duck (died just after hatching).	Contained 10 hooded merganser eggs on April 11, 1952 and on May 13 the merganser eggs were hatching.	10 counted
10.	Egg shells and down (apparently a successful hatch).	Contained 19 wood duck eggs on May 13, 1952.	19 counted
11.	0 eggs counted; unused this season and was moved from big lake this spring.	Apparently unused this season.	0 counted

Appendix, Table I Continued
WOOD DUCK NESTING BOX DATA

SPRING 1952

Nesting Box Numbers	Nesting Box Contents (May 27, 1952)	Previous Nesting Data *(Nichols and Pierce)	Total Egg Production
12.	Egg shells and down (apparently a successful hatch).	Contained 10 hooded merganser eggs on May 13, 1952	10
13.	9 eggs counted; the hen wood duck flew out as we approached.	Wood duck hen in the box on May 13, 1952.	9
14.	0 eggs counted; unused this season.	Apparently unused this season.	0
15.	0 eggs counted; unused this season.	Apparently unused this season.	0
16.	Egg shells and down (apparently a successful hatch).	Contained 14 hooded merganser eggs on April 11, 1952 and all but one hatched by May 13.	14
17.	This box number not located, Un-numbered box across the channel from box #18 had apparently not been used this season.	No record of a box by this number having been checked.	0
18.	4 eggs counted; no indication of a previous hatch.	Clutch had hatched prior to check on May 13, 1952.	4
19.	Egg shells and down (apparently a successful hatch).	Contained about 14 wood duck eggs on April 11, 1952 and all hatched.	14
20.	Egg shells and down (apparently a successful hatch).	Contained 11 eggs on April 11, 1952 and on April 29 all hatched out. On May 13, there were 5 new eggs.	16
21.	Female wood duck was on the nest and 9 eggs counted as she sat; hen left the nest and 18 eggs counted all total.	Previously no eggs found in this box.	18

Appendix, Table I Continued
WOOD DUCK NESTING BOX DATA

SPRING 1952

Nesting Box Numbers	Nesting Box Contents (May 27, 1952)	Previous Nesting Data *(Nichols and Pierce)	Total Egg Production
22.	Box not raised above flood crest and unused this season.		
23.	Box not checked (probably destroyed by flood).		
24.	Box not checked (probably destroyed by flood).		
25.	17 eggs counted; hen flew out of the box as the ladder was placed against tree.	Contained 7 eggs on April 11, 1952 and these were hatched on April 29. On May 13, 1952 there were 6 new eggs.	24
26.	Box not checked (probably destroyed by flood).		
27.	Egg shells and down (apparently a successful hatch).	Contained 14 wood ducks eggs and 4 hooded merganser eggs on April 11, 1952; on the 29th they were hatched and box was empty.	18
28.	Egg shells and down (apparently a successful hatch).	Contained 8 wood duck eggs on April 11, 1952; these eggs were hatched by April 29, 1952.	8
29.	Only a trace of egg shells and down remaining (apparently a successful hatch).	A merganser was on the nest on April 29, 1952; eggs were hatched by May 13, 1952.	10
30.	20 eggs counted; the wood duck hen was not present.	This box was empty on April 11 and 29, but contained 16 eggs on May 13, 1952	20

AGE OF IOWA QUAIL IN THE HUNTER'S BAG, 1951 AS INDICATED BY QUAIL WING SAMPLES

M. E. Stempel
Game Biologist

During each Iowa quail season Conservation Department personnel contact quail hunters, and collect one wing from each quail killed: Stage of wing feather growth, feather structure, and color, yield data used in determining the age of quail.

Aging of the wings is done by following procedures adopted by the following men: Petrides and Nestler constructed an aging chart by which age in days of young quail can be determine. Thompson and Kabat reported on the relationship between adult, and young quail wing moult. Stoddard pointed out a method of quickly identifying the young quail, and he published extensive tables on the sex ratio in quail.

Procedure and Method

Since the year 1946, quail wings have been collected during the quail hunting season in Southern Iowa. Until 1950 the wings were used to determine the young-old ratio of quail taken by hunters. In 1950 and 1951 some of the wings were dated, and from the data on these wings hatching periods were determined. Data from the adult wings determined stage of moult which was found to have a relationship to the hatching dates of the young.

Wings of young quail are identified by the pointed ends of the outer two primaries, and by the buff colored tips of the covert feathers. Adult covert feathers are uniform grey color to the tip, and the outer two primary flight feathers are rounded on the outer ends.

Young quail, will between the ages of three weeks and 20 weeks mount, and replace the inner eight primary flight feathers. The outer two primaries, or number nine, and ten primaries are fully grown in 65 days, and these two primaries are not moulted the first year. Growth of the new feathers progresses at a uniform rate. Measuring the length of a feather that is growing will give the age of the young quail in days. A young quail having primary number four of 34 mm in length is 52 days old. A number five primary 46 mm in length indicates an age of 62 days.

In adult quail the number nine, and ten (outer) primaries are replaced during moult, and in this study, the number of adult quail having completed re-growth of nine and ten are considered. Maximum growth of the number nine, and ten primaries in the adult indicates an early moult, and early moult follows an early hatching season.

Collection of wings has been carried on since 1943. In this paper only the figures since 1946 are used.

Table Showing % of Young Quail in the Hunter's Bag

1946	85.7% young
1947	82.7% "
1948	87.2% "
1949	88.2% "
1950	83.1% "
1951	85.6% "

YOUNG-OLD RATIO OF IOWA QUAIL, 1951

The age ratio of Iowa quail, 1951, as determined by wing samples collected during the 1951 quail season.

County	Young	Adult	Damaged	% young identifiable wings
Adair	20	2		90
Adams				
Allamakee				
Appanoose	17	5	1	77
Benton				
Blackhawk				
Buchanan				
Cedar				
Clarke	10		10	100
Clayton				
Clinton				
Dallas				
Davis	62	13		82
Decatur	164	21	1	88
Delaware				
Des Moines				
Dubuque				
Fayette				
Guthrie				
Henry	7	2		77
Iowa				
Jackson				
Jasper	17	5		77
Jefferson	51	13	1	79
Johnson	7	1		
Jones				
Keokuk	9	3	1	75
Lee	63	7	2	90
Linn				
Louisa				
Lucas	107	7		93
Madison	45	9		83
Mahaska				
Marion	9	1		90
Marshall				
Monroe				

YOUNG-OLD RATIO OF IOWA QUAIL, 1951 CONTINUED

County	Young	Adult	Damaged	% of Young Identifiable wings
Muscatine				
Page				
Polk	63	18	21	77
Poweshiek	15	3		83
Ringgold				
Scott	5			
Tama				
Taylor				
Union	30	5		85
Van Buren	55	10		84
Wapello	2			
Warren	43	2		95
Washington				
Wayne	152	30		83
Winneshiek				
Unknown	36	8		
Totals	990	166	38	85

% OF YOUNG IN THE HUNTER'S BAG OF QUAIL, 1948-1951
BY AGRICULTURAL DISTRICTS

District	Year	% Young
East Central	1948	89.6
South Central	"	87.0
South East	"	87.6
Border Counties	"	72.1
East Central	1949	83.6
South Central	"	89.7
South East	"	87.9
Border Counties	"	88.5
East Central	1950	92.8
South Central	"	81.2
South East	"	84.2
Border Counties	"	81.3
East Central	1951	86.6
South Central	"	87.8
South East	"	83.8
Border Counties	"	80.4

On a statewide basis from 1947 through 1951 a higher percentage of young in the hunter's bag has accompanied a poorer shooting season. When the percentage of young in the hunter's bag declined the hunting success went up. In 1947, a good hunting year, it required 1.4 hunter hours to bag one quail. In 1947 young quail represented 82.7% of the hunter take.

In 1949, a poorer year for hunting, it took the hunter 1.9 hours to bag one quail, and 88.2% of the take was young quail.

This could result either from failure of late nesting when small broods are common, or from high populations of breeding adult quail. In the latter case with other animals, the result is good populations with smaller percentages of young.

South Central Iowa in 1951, had good quail hunting, and a high percent (87.8%) of young quail. South East Iowa had poor hunting and 83.8% young birds. It is therefore possible that the availability of the birds may be as important as the number of quail that are in the territory. Heavy cover, generally good feeding conditions, and ground conditions may determine hunting success.

Age Classes in the Quail Hunter's Bag

Date of kill of quail taken was recorded for a large sample of wings from the following counties: Appanoose, Davis, Decatur, Jasper, Lucas, Poweshiek, Union, Wapello, Wayne. In 1950, which may be classed as a better hunting season over all the state, 37% of the young quail taken were less than 120 days of age. 14 % were 121 to 130 days of age, and 10% were 131 to 140 days of age, and 37% were 141 or more days of age.

In 1951, a poorer hunting season, 59% of the young quail were less than 120 days of age, 21% were 121 to 130 days of age, and 6% were 131 to 140 days of age, and 12% were 141 or more days of age.

The youngest bird taken was 45 days of age, 44% of the young hatched in 1951 between July 15, and August 15, while in 1950, the better year for hunting 44% of the young hatched a month earlier, and in 1950, there was a late upswing in the hatching period that did not occur in 1951.

There was a ratio of 112 cocks per 100 hens. This would be 53% males, or it indicates a good percentage of hens, as Stoddard reports that there may be from 51% to 58% of cocks in the quail population.

Over all the state in 1951, from November 1 to November 15, 81% of the quail taken were young quail. November 16 to 30 88% of the birds taken were young, and during the December 1 to December 15 period 83% of the hunter take of quail was young.

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IOWA RACCOON DATA--1951-52 SEASON

Glen C. Sanderson
Game Biologist

The raccoon project was initiated in the fall of 1949 with hunter cooperators and expanded in 1950 to include information from a fur dressing station. The results for the first two years have already been reported (Sanderson, 1950b and 1951a). The project was continued along the same lines as in the previous two years. However since the hunter cooperation has declined and the collection of data at the fur buying establishment of Mr. Louis Lamb of Bloomfield has been expanded, most of the information is now collected by the writer. The hunters who cooperated with the project during the first two years, plus new names furnished by hunters and conservation officers were used for the 1951 contacts. Approximately 203 hunters and Commission employees were contacted by letter which explained the purpose of the project and again outlined the information the hunters were asked to collect. A form for recording the information was sent with the letter and in addition each hunter received a one page mimeographed summary of the 1950-51 results. The hunters were asked to return their completed blanks soon after the close of the hunting season (Jan. 10, 1952).

As mentioned previously, the best source of information has come to be Mr. Louis Lamb's fur buying establishment at Bloomfield, Davis County, Iowa. The writer spent several days at his place during the hunting season examining dead raccoons as they were being pelted. Age and sex ratio information, body weights, penis bones, uteri, ovaries, skulls, tails, and other information were collected from these carcasses. Mr. Lamb cooperated whole-heartedly with the project and is to be commended for his interest and help.

In addition to the above, several hundred cased raccoon pelts were examined for sex-ratio and breeding information at Iowa fur houses.

RESULTS--Table 1 shows that only 16 of the 203 hunters contacted, or approximately 8 per cent, returned the forms. For the previous season approximately 28 per cent of the hunters contacted returned the forms (Sanderson, 1951a). The reporting hunters contributed 97 penis bones and other valuable information to the project. Thus, it is felt that this phase of the project should be continued, and expanded if possible, even though the percentage of returns is small.

A comparison of the results shown by Table 1 and the 1949-50 and 1950-51 results (Sanderson, 1950b and 1951a) reveals that the hunting success per hour, the number of times each reporting hunter hunted, and the distribution of the hunting pressure through the open season was about the same in all three years. However the percentage of the total harvest taken during the first 10 days of the season was smaller in 1951-52 than for the previous year. Doubtless this is a reflection of more severe weather conditions in 1950-51 which curtailed the harvest as the season progressed.

TABLE 1.--Data from the 1951-52 raccoon hunter's reports.

Total no. hunters reporting	16	
No. hunters who took no raccoons	3	
No. hunters who saved penis bones	11	(saved 97 bones)
Av. no. in hunting party	2.8	(123 parties totaled 347 hunters)
Av. no. hours hunted by each party	3.3	(123 parties hunted 409.5 hours)
Av. no. raccoons taken per hour per party	0.56	(238 raccoons taken in 409.5 hours)
Av. no. raccoons taken per hunting trip	1.9	(238 raccoons taken by 123 parties)
Per cent of catch that was females	45.4	(238 raccoons reported as to sex108F-130M)
Per cent of juvs in harvest (penis bone criterion)	66.8	(97 bones--67 junv. - 30 ads.
Per cent of hunters who reported more raccoons this year than last	37.5	(18.9% said fewer, 43.8% said same, 16 reported)
Av. no. times each hunter hunted	9.3	(16 hunters reported 149 trips
Per cent hunting trips made during 1st 10 days of season (Nov.10-Nov.19)	44.5	(61 trips of 137 total trips reported as to date)
Per cent hunting trips made during 1st half of season (Nov.10-Dec.9 incl)	97.8	(134 trips of 137 total trips reported as to date)
Per cent hunting trips made during last 10 days of season (Jan. 1-10 incl)	0.0	(0 trips of 137 total trips reported as to date)
Per cent of catch made during 1st 10 days of season (Nov. 10-19 incl)	48.3	(110 raccoons of 228 raccoons reported as to date)
Per cent of catch made during 1st half of season (Nov. 10-Dec. 9 incl)	96.5	(220 raccoons of 228 raccoons reported as to date)
Per cent of catch made during last 10 days of season (Jan. 1-10 incl)	0.0	(0 raccoons of 228 raccoons reported as to date)
Total number of hunters contacted by letter	204	
Per cent of hunters contacted who returned the form	7.8	(16 of 204 contacted)
Total number of raccoons reported by the 16 hunters	237	
Average number of raccoons caught by each hunter reporting	14.8	(237 raccoons by 16 hunters)
Av.no.raccoons taken per party per hr. during 1st 10 days of season (Nov. 10-19)	0.65	(113 raccoons in 173 party-hours)
Av. no. raccoons taken per party per hr. 1st half of season (Nov.10-Dec.9)	0.60	(221 raccoons in 336.5 party-hours)
Av. no. raccoons taken per party per hr. last 10 days of season (Jan.1-10)		none taken

Many raccoon hunters still want an earlier opening date for hunting raccoons with dogs to give them more time to enjoy their sport. The raccoon population certainly seems to be at a high enough level to justify an earlier opening date. Although several raccoons do not have fully prime pelts in Iowa until the middle of November or later, the low pelt value prevailing at the present time keeps this consideration from becoming too important. Certainly the lower value of pelts taken earlier than is possible under existing regulations would be partly or wholly compensated for by the increased sporting value which would come with an earlier opening date.

Age-Ratio--The age-ratio of the male segment of the harvest, as determined by 97 penis bones sent in by hunters and 627 bones collected by the writer at Bloomfield, Iowa, is 1.69 young per adult (Table 2). To state it another way, juveniles comprised 62.8 per cent of the male harvest. This compares with 63.9 and 65.1 per cent juveniles in the male harvest for the 1949-50 and 1950-51 seasons respectively (Sanderson, 1950b and 1951a). The 2.3 per cent decline in the percentage of juveniles in the harvest is perhaps too small to be significant especially when the sample sizes for the first two years are considered (255 bones in 1949-50; 192 bones in 1950-51). Data for another year should indicate if a downward trend in the percentage of juveniles in the harvest has begun. Perhaps the apparent decline in the percentage of juveniles in the harvest can be explained by the weather conditions more favorable to hunting during the late part of the 1951-52 season than

TABLE 2.--Age ratios[1] of Iowa male raccoons taken during the 1951-52 hunting season.

	From Hunters	From carcasses at Bloomfield, Iowa	Totals
Ads	30	239	269
Juvs	67 (69.1%)	388 (61.9%)	455
Totals	97	627	724

Juveniles per adult----------1.69
Per cent juveniles in harvest---------62.8

1 Age determined by the penis bone criterion.

during either of the two previous seasons. Sanderson (1949) reports that a greater percentage of young animals are taken early in the season in Missouri than are taken late, and when broken down the data in Table 3 tend to confirm this for Iowa. During the first third of the season 63.4 per cent of the males taken were juveniles, during the middle third 65.4 per cent were juveniles, but during the final third of the season only 40.3 per cent were juveniles.

Sex Ratio--A total of 2,453 raccoons were sexed during the past fall and winter--1,660 were examined by the writer at fur houses, 238 were reported by hunters, and 555 were examined by the writer at a dressing station (Table 4). Of these 1,386 were females and 1,067 were males or 77.0 males per 100 females. To state it another way, females comprised 56.5 per cent of the harvest in 1951-52 in Iowa. This compares to 52.5 per cent females for the 1949-50 season and 55.1 per cent for the 1950-51 season (Sanderson, 1950b and 1951a).

TABLE 3.--Age and sex of raccoons bought at various times during the hunting season at Bloomfield, Iowa.

Date	AGE COMPOSITION Ads	Juvs		SEX COMPOSITION Males	Females	
Nov. 12, 1951	11	26		36	47	
Nov. 13-18, 1951	31	47		--	--	
Nov. 19, 1951	13	28		42	29	
Nov. 19-26, 1951	27	42		--	--	
Nov. 26, 1951	7	14		19	27	
Nov. 27-Dec. 2, 1951	30	49		--	--	
Totals for 1st third of season	119	206	(63.4%)	97	103	(51.5%)
Dec. 3, 1951	15	48		62	58	
Dec. 5, 1951	32	42		87	102	
Dec. 10, 1951	7	10		18	11	
Dec. 11-16, 1951	5	20		--	--	
Totals for 2nd third of season	83	157	(65.4%)	167	171	(50.6%)
Dec. 18-27, 1951	28	15		--	--	
Dec. 31, 1951	4	7		8	9	
Jan. 1-7, 1952	4	7		--	--	
Totals for last third of season	37	25	(40.3%)	8	9	(52.9%)
TOTALS	239	388	(61.9%)	272	283	(51.0%)

1 Males only.

TABLE 4.--Sex-ratio and breeding history information of the 1951-52 raccoon population obtained by the examination of cased pelts in fur houses, carcasses at one dressing station, and from reports submitted by hunters.

	FROM CASED PELTS	FROM HUNTERS	DRESSING STATION	TOTALS
MALES	665	130	272	1,067
FEMALES:	(995)[2] (59.9%)	108 (45.4%)	(283)[3](51.0%)	1,386
Parous	206 (20.7% of females)		76 (34.2% of females)	
Non-parous	789		146	
TOTALS	1,660	238	555	2,453

Computed from the above data:

No. of young of the year animals in cased pelt sample[4]----------1,042

5.1 young raccoons per parous female in the harvest.

Sex Ratio: 77.0 males per 100 females
or
56.5 per cent of the harvest was females

1. Examined at Bloomfield, Iowa.
2. Total of parous and non-parous females.
3. Total of parous and non-parous females plus other females examined.
4. Obtained by multiplying 1,660 by 62.8%(the % of yg in harvest)

Breeding History--Information indicates that adult males show some signs of sexual activity in Southern Iowa during November and December but that they probably do not become fully sexually active until January. Only a very few juvenile males show signs of becoming sexually mature during December in Southern Iowa.

There were 236 placental scars representing 67 litters observed in the uteri of 64 females examined at Bloomfield, Iowa, for an average of 3.5 placental scars per litter. The average for 103 placental scars observed during the 1950-51 season was 3.3 per litter (Sanderson, 1951a). The number of scars ranged from 2 to 8, but three females showed evidence of having given birth to two litters. Whether these additional scars represent a litter from a previous year or whether they represent a second litter in the same year is not known; however; it is suspected that the latter is the case. It is known that raccoons rear only a single litter each year although the writer believes that second litters sometimes result in the same year when the first litter is lost soon after birth.

Table 6 shows that there were 67 parous females among 205 females examined at Bloomfield. Thus 32.7 per cent of the females examined were parous compared to 47.6 per cent of 63 females examined at the same place during the 1950-51 season (Sanderson, 1951a).

Probably this difference may be explained, in part at least, by the fact that during 1950-51 no information was collected before November 27 and the bulk of the information was collected during December whereas during the 1951-52 season much information was collected earlier in November at a time when perhaps the non-parous juvenile females were taken in greater proportion than they were later in the season.

Havest and Population--Table 5 reveals an increase in the reported harvest from 56,075 pelts in 1950-51 to 67,211 in 1951-52, an increase of 19.9 per cent. This is an all time high for Iowa's raccoon harvest, at least the high since 1930-31 when records were first available (Sanderson, 1951b). The 1951-52 harvest is an increase of 5,331 pelts over the previous high reported for 1946-47 (Table 5). It is believed that much of this increase in the harvest was due to the more favorable weather conditions prevailing during the hunting season in 1951-52 than during either 1949-50 or 1950-51, rather than to a large increase in the population. However the percentage increase in the harvest is somewhat higher than had been anticipated on the basis of weather conditions alone and since the average pelt value declined $.51 from 1950-51 to 1951-52 (Table 5) the 1951-52 raccoon population level may have reached an all time high, for recent years at least.

TABLE 5--Raccoon harvest and average value received per pelt in Iowa in 1951-52 compared with the highest, lowest and average figures for the past 20 years and the 1950-51 figures--as reported by fur buyers.

Season	No. of pelts bought by dealers	av. value per pelt	Total value
1932-33	10,468	$2.60	$ 27,216.80
1943-44	38,303	7.25	277,696.75
1946-47	61,880	1.97	121,903.60
1949-50	58,527	1.95	114,127.65
1950-51	56,075	2.95	165,421.25
20-year totals*	560,404		1,782,130.95
20-year average*	28,025	3.18	89,106.55
1951-52	67,211 (19.9%+)	2.67	179,435.37

* Does not include 1950-51 or 1951-52.

This is in spite of the fact that only 37.5 per cent of the 16 reporting hunters thought there were more raccoons in 1951-52 than there were in 1950-51, while 18.8 per cent thought that there were fewer, and 43.7 per cent thought that there were about the same number (Table 1).

For four years the writer (Sanderson, 1949, 1950b, 1951a and this paper) has reported that the raccoon population appeared to be at or near a peak in numbers. The evidence still indicates that this statement is true although it may indicate that the population is still increasing slightly. Figures presented in Tables 2 and 4 show that the age and sex ratio of the population has remained essentially unchanged through 1949-50, 1950-51, and 1951-52. The slight decline in the age-ratio perhaps favors a slight decline in the population but at the same time the increasein the percentage of females in the harvest favors an increasing population. There was a slight increase in the average litter size from 1950-51 to 1951-52 which should also favor an increasing population.

There are no real indications of a decline in the raccoon population in the immediate future and there is at least the possibility if not the probability that the population will go even higher before it declines. Of course if something such as disease causes a "crash" decline in the population the indicators of productivity probably will not indicate it before it comes.

Body Weights--The exceptional body weights often reported for raccoons are usually weighed by the imagination rather than by scales. Table 6 shows the average weights for 242 male and 205 female raccoon. The adult males ranged from 22.0 pounds down

TABLE 6.--Average body weights of Iowa raccoons taken during the 1951-52 hunting season, grouped according to age, sex, and breeding history.[1]

MALES:			
81	adults	17.0	(12.2 to 22.0)
161	juveniles	11.3	(6.0 to 18.2)
242	males (both ages)	13.2	(6.0 to 22.0)
FEMALES:			
67	parous adults (32.7% of all females)	14.7	(8.5 to 18.7)
138	juveniles and non-parous adults	10.6	(5.3 to 16.5)
205	females (all females)	11.9	(5.3 to 18.7)

1 Raccoons weighed at Bloomfield, Iowa.

to 12.2 pounds in body weight while the juvenile males ranged from 18.2 pounds down to 6.0 pounds. The juvenile males averaged 11.3 pounds, the adult males 17.0 pounds, and all males 13.2 pounds in body weight. Parous females ranged from 18.7 down to 8.5 pounds in body weight. On the whole these average body weights are similar to the ones reported for the previous season although they do run slightly lower.

Penis Bones--The bony distal tip of the raccoon penis bone identifies it as a bone from an adult animal while a cartiliganous tip (or square tip if the cartilage has been lost in the cleaning process) identifies the bone as coming from an animal less than one year of age (Sanderson, 1950a). Length and weight of the penis bones will also place the bones in virtually the same two age classes, and although at present no further breakdown as to age is possible, if enough information is available it may be possible to place the adults in two or more age classes on the basis of length and/or weight of the penis bones. So that they will be available for future reference the lengths and weights of the penis bones collected during the 1951-52 hunting season in Iowa are recorded in a table with a more complete report covering this same material. They are not included in this report but may be found in the files of the Commission's Des Moines office.

SUMMARY

1. Results of the 1951-52 hunter reports reveal that the hunting success per hour, the number of times each reporting hunter hunted, and the distribution of the hunting pressure through the open season was about the same for the past three seasons.

2. The age-ratio, as determined from 724 penis bones, is 1.69 young per adult compared to 1.87 for the 1950-51 season, and 1.77 for the 1949-50 season.

3. The sex ratio of 2,453 raccoons, as reported by hunters, from checks in fur houses, and from carcass examinations, is 77.0 males per 100 females compared to 81.4 and 90.7 males per 100 females for the two previous seasons respectively.

4. There were 236 placental scars representing 67 litters in the uteri of 64 females examined at Bloomfield, Iowa for an average of 3.5 scars per litter. An average of 3.3 scars per litter was found during the 1950-51 season.

5. It is believed that Iowa's raccoon population is still near a peak in numbers, but that it is still increasing gradually. The 1951-52 harvest was at an all time high and was 19.9 per cent higher than the harvest for the previous season; however much of this increase was doubtless due to the favorable weather conditions during the 1951-52 hunting season.

6. Juvenile males averaged 11.3 pounds, adult males 17.0 pounds, juvenile females (and non-parous adults) 10.6 pounds, and parous females 14.7 pounds in body weight. A total of 447 raccoons of both sexes and all ages averaged 12.4 pounds in body weight. On the whole these average body weights are similar to the ones reported for the previous season although they do average slightly lower than those for the previous year.

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PHEASANT CROWING COCK COUNT -- SPRING 1952

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Conservation officers have completed the third Spring Crowing Cock Count. This report will include the results for this year and comparisons with results obtained in 1950 and 1951.

The period of maximum crowing was determined by check routes in Linn and Franklin counties. Counts reached a peak April 25 in Central and Southern Iowa - and May 1 in Northern Iowa. The period of maximum crowing began about a week earlier this year.

Weather conditions were more favorable before and during the count this spring. Temperatures were slightly above normal and precipitation was normal during the survey. The last two weeks in April were very warm and precipitation was below normal. Last year, temperatures were below normal and precipitation above normal for the period.

Conservation officers began their counts April 27 and completed them by May 20. In 1951, the survey was made during the period May 3 to May 29.

Officers were instructed to use the same two routes for each county, use the same stops, and travel the same direction on each route as they did during previous counts. Counts were not to be taken during periods of unfavorable weather or when the wind velocity exceeded 8 miles per hour.

From a total of 198 routes, there were 158 routes repeated by the same officers in 1951 and 1952. Records are kept of officers taking each count in order to make a more accurate comparison from year to year. Of these 158 routes, 99 showed a higher number of calls in 1952, 55 were lower and 4 remained the same table 1. However, this does not present a true picture of the total pheasant population. Sex ratios must be applied to the number of calls heard to get an index of the spring breeding population.

Winter counts indicated a fewer number of hens per cock than the two previous years. The observed sex ratio for 1952 was 2.7 hens per cock -- in 1951 it was 2.9.

Table 2 presents the results of these 158 routes before and after the sex ratio, given as hens per cock, is applied. This table lists the average number of calls heard per stop, sex ratio, and the product of those two figures. The latter figure would then represent an index number of the spring hen population. The surplus cocks do not add to the reproduction potential of the brood stock.

The average number of calls heard per stop increased 21% from 8.2 to 9.9 for the 158 routes. However, about half of this increase disappears when hens only are considered. The index number for hens only was 26.7 this year compared with 23.8 for 1951 - an increase of 12%. In 1950, this figure was 22.9. If the cocks were added to the hens in order to represent the total spring population, the increase would be 14%.

North Central Iowa again recorded the highest figure with North West Iowa second. North East and East Central Iowa showed a decrease this year. South West Iowa more than doubled their count taken in 1951. The sex ratio for the Southern three districts is estimated as 1.5 hens per cock. There were 7 Southern counties open to hunting for the first time last fall. Of the 13 routes checked, eleven decreased, on increased and one remained the same. The other 17 counties in Southern Iowa that have had previous open seasons, recorded more calls on 28 routes while six decreased.

Table 3 lists the results of all counts taken by officers during the 1952 Spring Count. They recorded 36,314 calls at 3,910 stops along the 198 routes checked. The following table lists the results for all counts taken during the three surveys.

Year	Average Number of Calls per Stop	Sex Ratio Hens per Cock	Sex Ratio x Calls per Stop
1950	7.9	2.9	22.9
1951	8.1	2.9	23.5
1952	9.3	2.7	25.1

A pheasant distribution map was constructed from the results of this survey. Intervals used were the same as last year.

Averaged less than 1 call per 2 minute stop
Averaged between 1-9 calls per 2 minute stop
Averaged between 10-19 calls per 2 minute stop
Averaged 20 or more calls per 2 minute stop

Table 1

Summary of 158 Routes Repeated by the Same Officers for Years 1951 and 1952

District	Total No. of Routes	No. of Routes That Had a Higher Count	No. of Routes That Had a Lower Count
1 North West	18	10	8
2 North Central*	20	11	8
3 North East*	19	13	5
4 West Central	22	14	8
5 Central	20	14	6
6 East Central	8	6	2
7 South West*	17	15	1
8 South Central	20	9	11
9 South East*	14	7	6
State	158	99	55

* Total includes one route that remained the same.

Table 2

Results of 158 Routes Repeated by the Same Officers for 1951 and 1952

District	1951 Av. No. of Calls per Stop	1951 Hens per Cock	1951 Av. Calls X Sex Ratio	1952 Av. No. of Calls per Stop	1952 Hens per Cock	1952 Av. Calls X Sex Ratio	Percent Change
1 NW	18.1	2.4	43.4	18.3	2.7	49.4	plus 13%
2 NC	18.3	3.1	56.7	21.5	3.0	64.5	plus 14%
3 NE	8.1	3.5	28.4	8.4	2.3	18.5	minus 35%
4 WC	9.0	2.2	19.8	11.4	2.0	22.8	plus 15%
5 C	5.2	2.8	14.6	7.7	2.9	22.3	plus 53%
6 EC	5.1	3.5	17.9	6.2	2.1	13.0	minus 27%
7 SW*	3.1	1.5	4.7	6.7	1.5	10.1	plus 115%
8 SC*	2.3	1.5	3.5	2.7	1.5	4.1	plus 17%
9 SE*	0.9	1.5	1.4	1.1	1.5	1.7	plus 21%
STATE	8.2	2.9	23.8	9.9	2.7	26.7	plus 12%

* The sex ratio for the Southern three districts is estimated at 1.5 hens per cock.

Table 3
Crowing Cock Count 1952

District	No. of calls heard	No. of stops	Av. No. of calls per stop	Sex Ratio	Total No. of Birds for count	Av. No. of Calls X Sex Ratio
1 NW	8990	480	18.7	2.7	33,263	50.5
2 NC	8795	440	20.0	3.0	35,180	60.0
3 NE	3273	422	7.7	2.3	10,801	17.7
4 WC	5048	480	10.5	2.0	15,144	21.0
5 C	3670	480	7.6	2.9	14,313	22.0
6 EC	2814	398	7.1	2.1	8,723	14.9
7 SW	2266	340	6.7	Est 1.5	5,665	10.1
8 SC	1141	440	2.6	Est 1.5	4,108	3.9
9 SE	317	430	0.7	" 1.5	793	1.1
State	36,314	3,910	9.3		127,990	25.1

AN ANNOTATED CHECK-LIST OF FISHES OF THE WAPSIPINICON RIVER DRAINAGE SYSTEM IN IOWA

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The Wapsipinicon rises in the southeast corner of Mower County, Minnesota, at an elevation of 1250 feet above mean sea level, and flows 255 miles in a southeasterly direction to enter the Mississippi River some five miles above Princeton, Iowa. In its course across northeast Iowa it falls approximately 685 feet, maintaining a rather gradual slope, the average seldon, if ever, exceeding 2.5 feet per mile. The major portion of the Wapsie basin lies within the area of the Iowan drift, and the topography for the major portion is a constructional type of the youthful stage. The Wapsie Valley is narrow (10 miles in width) and gives rise to no important major tributaries. Buffalo Creek, Little Wapsie, Otter and Plum Creeks are the largest of the tributaries. The flat, narrow valley of the main river probably contains more overflow areas and backwater ponds than any other river in the state. This feature, besides enhancing fishing prospects, attracts numerous waterfowl and gives the river the reputation of being the best duck-hunting inland river of the state.

The angling pressure is primarily for catfish, crappie, northern pike, and largemouth bass. Smallmouth are common in some reaches and the area adjacent to the Minnesota state line is annually stocked with trout. The 1951 Voluntary Creel Census reports show that it took 50 minutes to catch a trout, and the average warm-water game fish took slightly over an hour to catch.

Collections on the Wapsipinicon watershed have been made by Meek in 1889, 1890 and 1891 (Meek, 1892), by Salyer in 1932, Hubbs in 1933, and Bailey, 1939 to 1943 (the latter three collections listed only in unpublished field notes on file at the office of the State Conservation Commission and Iowa State College). A total of 65 collections from 55 stations in the watershed were made by the author from 1948 to 1951 inclusive. Most collections were made from flowing water. However, a few representative ponds were sampled. Since quite a few of these ponds were leased to fishing and hunting rights, most of them have been stocked with some typical river forms from time to time, and these fish escape to the river during high water, which accounts for the yellow perch in Buchanan County, the largemouth bass in Mitchell County (nearly in the trout waters), and the silver bass in Otter Creek, Fayette County. This may also account for the presence of redfin shiner, Notropis lutrensis, in a backwater lake in Bremer County, the present site of Sweet's Marsh Public Hunting Grounds. This species has never been in any of the flowing water collections and is definitely out of its known range, as it has never been taken recently in any flowing water north of Highway 30 nor west of the counties fringing the Mississippi River in Northeast Iowa.

Another rather remarkable collection was made in 1951 in an area where annual collections have been made since 1948. A series

of 15 gravel chubs, Hybopsis sp., were taken over a coarse gravel riffle on the Wapsie River in Buchanan County. This collection is remarkable in that heretofore only a single specimen of Hybopsis sp. has been taken in over 300 recent collections on the watersheds of Northeast Iowa, and these specimens were taken at the selfsame location Meek reported taking them in 1890.

The relative abundance listed for each species is purely the author's opinion. This is of necessity, since certain populations shift in abundance at certain times of the year or even day, and in an overall distribution work, individual sample abundance is of relatively no importance. The collections were made with drag seines of various sizes, trap nets, hoop nets, and angling observations. The identification of the species collected recently were made by the author, and questionable specimens were identified either by Dr. Reeve Bailey, Museum of Zoology, University of Michigan, or Dr. Raymond Johnson, U. S. Fish and Wildlife Service. Type specimens are in collections housed by the author, Iowa Conservation Commission, or the following museums: University of Michigan, Iowa State College, Coe College, Wartburg College, and Iowa State Teachers College.

The following is an annotated list of 73 species found in the watershed:

LEPISOSTEIDAE

Lepisosteus platostomus Rafinesque - Shortnose Gar.
Rare to occasional in lower reach.
Lepisosteus osseus oxyurus Rafinesque - Northern Longnose Gar.
Reported in backwaters and lower reaches by Meek. Not taken in recent collections.

AMIIDAE

Amia calva Linnaeus - Bowfin.
Rare in extreme lower reach.

SALMONIDAE

Salmo trutta Linnaeus. - Brown Trout.
Salmo gairdneri Richardson - Rainbow Trout.
Both stocked in the extreme upper reaches of main stream.

CLUPEIDAE

Dorosoma cepedianum (LeSueur) - Gizzard Shad.
Reported by Meek and Bailey as rare in bayous of lower reaches. Not taken in recent collections.

UMBRIDAE

Umbra limi (Kirtland) - Central Mudminnow.
Wapsie River in Mitchell County.

ESOCIDAE

Esox lucius Linnaeus - Northern Pike.
Occasional in lower reaches of main river. Common to rest of river except headwaters.

CATOSTOMIDAE

Ictiobus cyprinellus (Valenciennes) - Bigmouth Buffalo.
Common in middle and lower reaches. Confined primarily to slack water areas.
Carpiodes cyprinus (LeSueur) - Quillback.
Abundant over watershed.
Carpiodes c. carpio (Rafinesque)- Northern River Carpsucker.
Abundant over watershed.
Carpiodes velifer (Rafinesque) - Highfin Sucker.
Common to abundant in middle and lower reaches of main river.
Moxostoma erythrurum (Rafinesque) - Golden Redhorse.
Occasional to common in upper two-thirds of drainage. Rare to absent downstream.
Moxostoma anisurum (Rafinesque) - Silver Redhorse.
Occasional in upper two-thirds of drainage. Commonly found in tributaries.
Moxostoma aureolum (LeSueur) - Northern Redhorse.
Occasional to common in upper two-thirds of main river. Specimens weighing between 8 and 10 lbs. taken in Linn and Buchanan Counties.
Hypentelium nigricans (LeSueur) - Northern Hogsucker.
Occasional in upper reaches of main river and tributaries.
Catostomus c. commersoni (Lacepede) - Common White Sucker.
Occasional in upper reaches of main stream; rare to absent downstream; common in tributaries.

CYPRINIDAE

Cyprinus carpio Linnaeus - Carp.
Common to abundant in main river. Occasional in lower reaches of tributaries.
Notemigonus crysoleucas auratus (Rafinesque) - Western Golden Shiner
Rare to occasional over drainage. Common to abundant in some pools and lakes.
Semotilus a. atromaculatus (Mitchill) - Northern Creek Chub.
Rare in main river except trout waters where common. Common in tributaries of upper drainage.

Hybopsis biguttata (Kirtland) - Hornyhead Chub.
Occasional in upper drainage. Rare to absent below Linn County.

Hybopsis storeriana Kirtland - Silver Chub.
Found by Meek and Bailey as common to lower reach. Not taken in recent collections.
Hybopsis sp. - Gravel Chub.
Rare. Found only once in main river in Buchanan County.
Rhinichthys atratulus meleagris Agassiz - Western Blacknose Dace.
Rare. Taken only once in headwaters of a tributary.
Phenacobis mirabilis (Girard) - Plains Suckermouth Minnow.
Rare to occasional throughout drainage.
Notropis a. atherinoides Rafinesque - Common Emerald Shiner.
Occasional in lower reach of main river; absent elsewhere.
Notropis rubellus (Agassiz) - Rosyface Shiner.
Occasional in upper two-thirds of drainage. Common in some tributaries.
Notropis umbratilus (Girard) - Redfin Shiner.
Rare. Found only in upper reach of Otter Creek, Little Wapsie and extreme upper reach of main river.
Notropis cornutus frontalis (Agassiz) - Northern Common Shiner.
Common-abundant everywhere except in extreme lower reach of main river.
Notropis blennius (Girard). River Shiner.
Rare in lower reaches. Taken by Bailey but not in recent collections.
Notropis d. dorsalis Agassiz - Central Bigmouth Shiner.
Abundant over entire drainage, except occasional in extreme lower reach.
Notropis spilopterus (Cope) - Spotfin Shiner.
Common to abundant in middle reaches and tributaries. Rare to absent in headwaters and extreme lower reach.
Notropis l. lutrensis Baird & Girard - Plains Red Shiner.
Absent in all waters except occasional in pond in Bremer County.
Notropis d. deliciosus (Girard) - Eastern Sand Shiner.
Abundant in entire drainage except occasional in extreme lower reach.
Notropis v. volucellus (Cope) - Northern Mimic Shiner.
Very rare. One specimen taken by Salyer in Buffalo Creek constitutes only record for inland stream of the state.
Dionda nubila (Forbes) - Ozark Minnow.
Found by Meek to be common in a small feeder creek in Jones County. Not taken in recent collections.
Hybognathus hankinsoni Hubbs - Brassy Minnow.
Occasional over entire drainage.
Hybognathus n. nuchalis Agassiz - Western Silvery Minnow.
Rare. Found in lower reaches of main river and lower tributaries.
Pimephales perspicuus (Girard) - Bullhead Minnow.
Rare to occasional in lower portion of main river.
Pimephales notatus (Rafinesque) - Bluntnose Minnow.
Common to entire system except in extreme lower reach, where rare to absent.
Pimephales p. promelas Rafinesque - Northern Fathead Minnow.
Occasional to common over entire system.

Campostoma a. pullum (Agassiz) - Central Stoneroller.
Occasional in upper and middle reaches of main river and tributaries.
Campostoma anomalum oligolepis Hubbs & Green.
Very rare. Found in Buffalo Creek by Salyer. Not taken in recent collections.

AMEIURIDAE

Ictalurus l. lacustris (Walbaum) - Channel Catfish.
Rare to absent in upper system. Common to rest of river; occasional in lower reaches and tributaries.
Ameiurus m. melas (Rafinesque) - Northern Black Bullhead.
Occasional in middle and lower reaches of main river. Common to abundant in some overflow ponds.
Ameiurus natalis (LeSueur) - Yellow Bullhead.
Rare in middle and lower reaches of main river.
Pilodictis olivaris (Rafinesque) - Flathead Catfish.
Rare in middle reach and occasional in lower reach of main river.
Noturus flavus Rafinesque - Stone Cat.
Rare to occasional in middle and lower reaches of main river.

CYPRINODONTIDAE

Fundulus notatus (Rafinesque) - Blackstripe Topminnow.
Rare to occasional in middle reach of main river.

ATHERINIDAE

Labidesthes s. sicculus (Cope) - Northern Brook Silversides.
Found occasionally in lower reach by Meek. Not taken in recent collections.

SERRANIDAE

Morone chrysops (Rafinesque) - White Bass.
Rare. Stocked behind dam in Fayette County on Otter Creek.

CENTRACHIDAE

Micropterus d. dolmonicui Lacepede - Northern Smallmouth Bass.
Occasional except in lower reach where rare to absent. Common in some tributaries.
Micropterus salmoides (Lacepede) - Northern Largemouth Bass.
Confined primarily to slack waters behind dams.
Chaenobryttus coronarius (Bartram) - Warmouth.
Rare. Found only in Silver Lake, Clinton County.
Lepomis cyanellus Rafinesque - Green Sunfish.
Occasional in main river; rare to absent in tributaries.
Lepomis gibbosus (Linnaeus) - Pumpkinseed.
Rare. Taken only twice in survey, in middle reach of stream.

Lepomis m. macrochirus Rafinesque - Northern Bluegill.
Occasional. Found only in main river and confined primarily to slack water or overflow ponds.
Lepomis humilis (Girard) - Orangespotted Sunfish.
Common to middle and upper reaches of main river.
Ambloplites rupestris rupestris (Rafinesque) - Northern Rock Bass.
Rare. Taken only once in main river in Buchanan County.
Pomoxis annularis Rafinesque - White Crappie.
Common to abundant in middle reaches of main river.
Pomoxis nigromaculatus (LeSueur) - Black Crappie.
Occasional in middle reach of main river.

PERCIDAE

Stizostedion v. vitreum (Mitchill) - Walleye.
Rare. Found only in middle reaches of river.
Perca flavescens (Mitchill) - Yellow Perch.
Rare. Taken from two stocked lakes.
Hadropterus maculatus (Girard) - Blackside Darter.
Rare. Taken only in middle reaches of system. In recent collections taken in headwaters by Bailey.
Hadropterus phoxocephalus (Nelson) - Slenderhead Darter.
Very rare. Taken only once in main river in Buchanan County.
Hadropterus shumardi Girard - River Darter.
Very rare. Taken in extreme lower river by Bailey. Not taken in recent collections.
Ammocrypta clara Jordan & Meek. - Western Sand Darter.
Found by Meek to be rare in middle and lower reaches of main river. Not taken in recent collections.
Etheostoma n. nigrum Rafinesque - Central Johnny Darter.
Common to entire system except absent in extreme lower reach of main river.
Etheostoma zonale (Cope) - Banded Darter.
Rare. Taken on three occasions in middle reach of main river. Taken by Bailey in Little Wapsie River.
Etheostoma exile (Girard) - Iowa Darter.
Very rare. Taken only once in backwater pond in Buchanan Co.
Etheostoma caeruleum Storer - Rainbow Darter.
Rare. Taken by Meek and Salyer in tributaries and middle reaches. Not taken in recent collections.
Etheostoma flabellare lineolatum (Agassiz) - Striped Fantail Darter
Rare. Found on two occasions in middle reach of main river.

GASTEROSTEIDAE

Eucalia inconstans (Kirtland) - Brook Stickleback.
Very rare. Confined to headwaters of main river.

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MONTHLY SUCCESS AND EFFORT ON NORTHEAST IOWA STREAMS FOR 1950 AND 1951

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One of the by-products of the voluntary creel census in Northeast Iowa, is the monthly success and effort data on the major game fish species. Since all reported fishing trips are dated, it enables one to follow the amount of effort and the resulting success on a monthly basis to determine the trends in game fish catchability.

Table 1 shows the 1951 monthly success and effort based on 4,939 hours of fishing and 4,391 fish of the five most sought after species of game fish.

In comparing the 1950 and 1951 fishing years, (table 2) a certain amount of information can be gathered as to just how important, either beneficially or detrimentally, are the physical factors of the environment in determining angling success.

Rather than go into explicit details on the climatic conditions of the two years, a feature not warranted by the scantness of the data, it may be said that 1951 was by far a wetter and colder year than 1950. Assuming, therefore, that angling conditions were much poorer in '51 than in '50 due to high, turbid water in the streams, and that the metabolic activities of the fish would be lower due to lower temperatures, a brief analysis of the data proves interesting.

Since the data are based on reports of different anglers, and these anglers vary in skill, the increase or decrease in fish per hour per month is not comparable, but the fact that there is an increase or decrease over the previous month's fishing is a trend which merits comparison.

Trout fishing for the two years shows little variation as to monthly success. In five out of six months there are corresponding rises or drops in success. September fishing in 1950 showed a lag in success, while in 1951, September was the peak month of the year. Trout are cold-water species and trout streams have small drainage areas. These features, coupled with the fact that replenishment of the population is periodically taken care of by stocking, seemingly establish the principle that climatic conditions do not play too important a role in the trout fishery here in Iowa. This apparently refutes the general conception that all or most of the trout are washed out of streams during extended periods of high water.

The catfish, which feeds by smell and/or taste as well as by sight, seemingly has its feeding habits unaltered by climatic conditions as the same months in two different years show corresponding highs or lows in success.

Members of the Centrarchid or sunfish family which feed by sight are definitely affected by adverse climatic conditions. The smallmouth showed corresponding trends in only one out of four comparable months, July being the month where a corresponding upward trend of success is noted.

The largemouth bass was seemingly more tolerable to changed conditions than the smallmouth, and in two out of four comparable months there were corresponding changes in fishing success.

The crappie had similar highs in April and May, a low in June, but instead of following a gradual upward trend in the remaining months as can be expected, the 1951 data show a high in July and a decline in August and September. The high success in July, usually an off month in crappie fishing, and with the rivers all in bank-full condition during the month, leads to a severe doubt as to whether crappie fishing success lends itself to comparison on these factors without a more equal angling effort or greater angling effort. (see table 2)

Table 1
1951 Tabulation of Monthly Angling Success by Species

Species	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Trout								
Number		920	360	397	249	302	151	51
Hours		824.75	238.5	281.2	165.7	182.5	96.05	30.55
Fish per hr.		1.11	1.50	1.41	1.50	1.65	1.57	1.66
Catfish								
Number	32	341	227	204	151	160	44	
Hours	59.25	551.5	422.5	271	355	256.5	119.25	
Fish per hr.	.54	.62	.54	.75	.43	.62	.37	
Smallmouth								
Number		21	56	93	55	77	18	
Hours		63	131.5	157.5	111.75	112.25	44.5	
Fish per hr.		.33	.42	.59	.49	.68	.40	
Largemouth								
Number		3	16	13	39	21	9	
Hours		4	43.5	24	42.5	27	10.5	
Fish per hr.		.75	.36	.54	.91	.77	.85	
Crappie								
Number	23	146	60	29	50	28	5	
Hours	8.75	82.5	29	42	24	25.5	5	
Fish per hr.	2.62	1.77	2.07	.69	2.08	1.09	1.00	

Table 2
1950 and 1951 Tabulation of Monthly Angling Success by Species

Species		April	May	June	July	Aug.	Sept.	Oct.	Nov.
Trout									
Number	'50		829	236	118	113	93	33	18
	'51		920	360	397	249	302	151	51
Hours	'50		741.75	164.5	106.25	72.75	73.25	40.0	16.5
	'51		824.75	238.5	281.2	165.7	182.5	96.05	30.55
Fish/hr.	'50		1.12	1.43	1.11	1.55	1.27	.83	1.09
	'51		1.11	1.50	1.41	1.50	1.65	1.57	1.66
Catfish									
Number	'50	66	211	150	274	116	91	54	7
	'51	32	341	227	204	151	160	44	
Hours	'50	122.75	215.5	333.75	372.5	185.25	148.5	100.5	22.0
	'51	59.25	551.5	422.5	271	355	256.5	119.25	
Fish/hr.	'50	.54	.98	.64	.73	.62	.61	.54	.32
	'51	.54	.62	.54	.75	.43	.62	.37	
Smallmouth									
Number	'50			81	110	130	92	15	5
	'51		21	56	93	55	77	18	
Hours	'50			163.75	175.5	185.25	148.25	20.5	7.5
	'51		63	131.5	157.5	111.75	112.25	44.5	
Fish/hr.	'50			.49	.63	.70	.62	.73	.67
	'51		.33	.42	.59	.49	.68	.40	
Largemouth									
Number	'50			53	67	48	46	26	
	'51		3	16	13	39	21	9	
Hours	'50			78.75	96.25	72.25	51.5	25.0	
	'51		4	43.5	24	42.5	27	10.5	
Fish/hr.	'50			.67	.70	.66	.89	1.04	
	'51		.75	.36	.54	.91	.77	.85	
Crappie									
Number	'50		73	58	20	3	19	25	
	'51	23	146	60	29	50	28	5	
Hours	'50		50.5	34	25	7	16.5	15.5	
	'51	8.75	82.5	29	42	24	25.5	5	
Fish/hr.	'50		1.45	1.71	.80	.43	1.15	1.61	
	'51	2.62	1.77	2.07	.69	2.08	1.09	1.00	

NOTES ON THE POSTMORTEM ACTIVITY OF FISH

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With the wide publicity given the fact that great numbers of fish die of old age, we are often questioned as to what happens to these fish. Do they all die at one time? Do they float? Why don't we see more evidence of this vast mortality? These questions and many more are asked by laymen and trained personnel alike. Relatively few attempts have been made to answer these questions. I do not mean to infer that I have the answers. The only purpose of the following discussion is to present the results of a number of experiments and general observations. Many of these experiments and observations are admittedly incomplete and often short on pertinent background and supporting data. This is partially explained by the fact that the greatest share of the time spent on this work has been incidental to the normal and routine work that has been assigned to me.

The material discussed here comes from more than 250 observations over the three year period of 1946-1948. Only a few notes have been recorded since 1948. For the most part these observations can be grouped into three catagories; 1. Experimental work with individual fish; 2. Counts of the numbers and species of dead fish on a 1,000 yard section of beach; 3. Miscellaneous notes made following fish poisoning, winter freeze-outs, and fish kills due to disease, etc.

Experimental work with individual fish consisted of trying to determine the pattern of events following the death of a fish, namely, when and if the fish floated and the period of time involved. The usual procedure was to allow the fish to suffocate in a small amount of water, than place the fish in a small pond and record the subsequent events. Occasionally fish were transferred from another body of water for closer observation. The experimental pond covered about one surface acre and had a maximum depth of seven feet. The experiments were conducted under a variety of water temperatures, including winter or ice covered conditions.

Observations were made on 67 individuals with the following 11 species represented by at least one specimen: shortnose gar, northern pike, carp, black bullheads, white bass, largemouth bass, black crappie, walleye, perch and sheepshead. All fish were adults. For the sake of brevity, the results of these experiments will be confined to general statements wherever possible.

All individuals used in these experiments followed the common pattern of sinking to the bottom when placed in the pond, then after a period of time rising to the surface and floating for another period of time. Another typical activity, but one that did not occur in all cases was floating just prior to death. Occasionally a fish would lay on the bottom with

their ventral surface up, showing faint signs of life such as gill action or fin movement. In either case the fish wound up on the bottom. There was no observed difference in species as to whether the fish floated or sank prior to death. Although the point was not checked, it is strongly suspected that sinking tended to coincide with the development of rigor mortis. As might be expected, the period of time spent on the bottom was apparently more dependent upon water temperatures than any other single factor. Again there seemed to be a greater variation between individuals than between species. This period at the bottom ran from 24 hours with water temperatures at 80° to a maximum of one month under the ice. With the changing water temperatures during open water conditions it is difficult to pin down the time a fish remained on the bottom. A single crappie, perch, white bass and carp each floated after 24 to 48 hours in shallow water having a temperature of 78° to 80°. At 52° to 64° two suckers, one bullhead, one carp and one white bass came to the surface after 3 to 4½ days on the bottom. One sheepshead went to the bottom and floated again within 24 hours with water at 64°. During the ice covered conditions the period of time on the bottom was even greater, with a range of 4 days to one month. There seemed to be some evidence that larger, heavier fish, even of the same species, tended to remain at the bottom longer than smaller fish. This was particularly evident in carp.

The tendency to remain floating was quite marked in most instances. This floating condition lasted from 24 hours to 3 months; both were extremes that occurred under abnormal conditions. Due to muskrat activity, one sucker floated for 24 hours. The other extreme concerned a white bass that floated for 3 months under a screened box that was anchored under the ice. The usual floating period during the time of open water ran between 3 days and 3 weeks. Although the data is skimpy, some species differentiation showed up in this portion of the experiments. White bass seemed to be the most persistent floaters with carp in second place. On two occasions white bass continued to float after an opening was made in the abdominal cavity. The abdominal cavity of a carp, perch and crappie were each punctured while in a floating condition. The carp remained in a floating conditions but the perch and crappie went to the bottom for a period of 48 hours then floated again. One white bass continued floating after a piece of flesh four inches square was cut from its side. This piece of flesh went to the bottom and then floated again about 2½ days later, (shallow water, 75°-80°) the fish continued to float for 20 days. Thus it appears that there are other factors besides bloating or gas in the abdominal cavity that causes at least some species of fish to float.

The last step of course is the final resting place and decomposition. One of several things can take place once the fish has reached a floating condition; they may float until decomposition

is sufficient to cause them to sink; they may float to shore through wind and waves action; or carrion feeding birds or mammals may eat them.

Those that find their final resting place on the bottom continue to decompose until there are no readily visible remains. Again temperature plays an important part. Again the data is skimpy. Only five fish were observed through the complete decomposition. A number of the observations were made by diving and the remainder were made on fish that had come to rest in about one foot of water. A sheepshead that had floated for nine days began to show signs of decomposition after a period of 6 days and only a few larger ribs and vertebrae could be found on the 11th day. This fish was lying in seven feet of water with a temperature range of 61° to 66°. The skeleton of a carp (6 lb) that had floated three days could just be distinguished after a period of 33 days. Water temperatures were slightly lower during this decomposition than those mentioned above. The skeleton of a walleye was barely distinguishable after 21 days (had floated eight days). This fish was also in seven feet of water and a temperature around 60°. In shallow water with water temperatures from 45° to 65° only a white spot marked the remains of a walleye after a period of 57 days. In shallow water a crappie disintegrated to a white spot in ten days with the water at 78°. During ice covered periods decomposition is extremely slow and is usually not completed until there is an increase in water temperatures following ice break-up.

The second catagory concerns the count of dead fish along a 1,000 yards of beach. The area selected for these counts is known as Crandall's Beach and is located on the north shore of Spirit Lake. This project was not original with the author. It was initiated late in 1941 and counts were made for August, September, and October of that year. Dr. Sigler continued the counts during 1942 and 1946 (Sigler 1947); the author carried the counting through 1947 and 1948.

The general procedure consisted of making a check of the beach at least once each week, recording the numbers and species of fish washed ashore and burying the week's accumulation. All sizes of fish were counted. All counts have been summarized by months and totaled for each year, (Table 1,2,3 and 4).

The conclusions to be drawn from these data are limited but some discussion is necessary. First of all the total dead fish counted for each year (478 in 1942 to 670 in 1948) seems like an extremely small number to be found on 1,000 yards (about 1/25 of total shoreline) of beach exposed to the prevailing winds. Whatever the reason for this small number there was a surprisingly small variation from year to year over the four year period. There might have been less variation if counts for May and June were included in 1942 total. The

species ratio on shore was not consistent with what was known about the populations as they occurred in the lake. This was particularly noticeable in such species as carp, white bass, walleyes and suckers, bullheads and perch. Perch and bullheads were either first or second in abundance each year with their combined numbers making up 78 to 94% of the total dead fish each year. Other than bullheads and perch only white bass, walleye, bluegill, and crappie were found each year, but their combined totals seldom exceeded 10% of the total in any one year. An additional nine species were recorded during the four year period. Most of them were found at least three years out of the four.

During the 1947 and 1948 total lengths of all fish and scale samples of a few were taken. Although neither the length distribution or the scales have been analyzed in any detail, it was quite evident that there was no preponderence of old or large fish, except for bluegills, nor were the larger numbers made up of young of the year fish. It seems logical to assume that young of the year fish were covered up by sand and/or picked up by other animals more readily than larger fish. Bullheads and perch the most abundant species were represented by all sizes from young of the year to old adults.

Examination of the fish, particularly the gill area, lead to the conclusion that some fish, especially smaller sizes, were washed ashore during the stage just prior to death. The gills of these fish retained a nearly normal red color. The gills of all experimental fish were a grey color after any period of time on the bottom.

The most important, unanswered question is "What per cent of the fish that die reach shore?" In a body of water the size of Spirit Lake the per cent is likely small but we seldom see any number of fish floating on the surface. If such a thing does occur, we know something out of the ordinary has happened.

This brings us to the third catagory labelled miscellaneous observations. The most spectacular evidence of fish mortalities takes place at the time of winter freeze-outs. Although circumstances vary during these freeze-outs the sequence of events at Center Lake in Dickinson County in 1947 seems to fit into this discussion quite well. Center Lake showed signs of serious oxygen depletion on February 10, 1947, readings of .5 ppm were made on the 6th of February. Following a heavy thaw the second week in March, a channel opened up along the east shore of the lake. This channel was approximately 300 feet long and 4 to 10 feet wide with the water depth in this area from 2 to 4 feet. On March 14 an undetermined number of bluegills were noted on the bottom beneath this channel. By the 16th of March this channel had enlarged to 15 to 40 feet in width and an estimated 300 yards in length. About one-half of this area could be checked by wading. The water was clear enough to distinguish

young bluegills on the bottom at a depth of 3½ feet. No count was made of the young bluegills. No young fish of any other species could be found in this area. Adult fish consisted of 350 bluegills and 15 largemouth bass. Of this number only three adult bluegills and a few young bluegills were found floating. It was noted that about 20% of the bluegills and all of the bass were about to float, just their nose touched bottom. On the 19th of March the channel was covered with about ½ inch of ice. Seven bluegills were floating at this time. On the 20th there were 150 bluegills under the ice. Sometime between nonn on the 20th and 10 A.M. on the 21st the channel opened again and the gulls and mergansers moved in. Only 13 bluegills were found on the bottom in the same area that was checked on the 16th. Thirty adults were found on shore or floating. There appeared to be no change in the number of young bluegills on the bottom. As far as could be determined only a small per cent had floated. They were usually found in fairly compact groups as though entire schools had perished at one time. By the 23rd of March the channel had opened considerably and large numbers of bluegills (counted over 200) and a few bass were drifting ashore. Only one adult bluegill was noted on the bottom in the area of the original count. This is the only case where the author has been able to make a close check on a freeze-out.

The foregoing discussion seems to leave little doubt about the activity or sequence of events following the death of a fish. But the exception that proves the rule always shows up. On December 8, 1947, a ten pound northern pike was killed in a gill net. He immediately went to the bottom (ten feet of water) when released from the net. As far as I know, that fish never came to the surface. A 3½ pound carp in the same place came to the surface in 28 days. The northern was observed over a period of nearly three months. After 33 days at the bottom in 70 feet of water one 3½ pound carp and one 10 pound carp had not floated. When raised to the surface the smaller fish floated and the larger one did not. These fish showed relatively little evidence of decomposition, some odor but fairly firm flesh. Unsafe ice prevented further observations.

Eschmeyer (1945) reporting on the Norris Lake fishing experiment was of the opinion that most fish in Norris Lake sink when they die and that there was no evidence that they floated again, except that they may float when in shallow water.

Not applicable to fresh water but an interesting side light occurred during 1947 and 1948, the years of the "Red Tide" when tons of ocean fish floated ashore. Surface fish were said to be little effected by the poison as evidenced by not showing up on shore but the local fishermen said mackeral did not float. To bear this out sponge divers claimed to have seen the ocean floor covered with mackeral.

What is more important and in direct contrast to the experimental data described in the foregoing part of this paper is the fact that some workers have reported that a large percentage of marked fish were not recovered after poisoning. In one farm pond Carlander & Lewis (1948) recovered only the following percentage of marked fish:

Bluegills -	38
White Crappie -	14
Largemouth Bass -	33
Black Bullhead -	80
Golden Shiner-	91

The pond was turbid but free of vegetation.

Fischtall (1947) recovered only 29.2% of the marked fish from a deep weedy lake.

Table 1

Number and percentage of each species of dead fish counted on a 1000-yard section of Crandal's Beach, sections 8 and 9, Spirit Lake, 1942.

	July	Aug.	Sept.	Oct.	1942	Percentage of 1942 total
Lepisosteus platostomus	1	1			2	.40
Megastomatobus cyprinella	1				1	.20
Cyprinus carpio		2			2	.40
Ameiurus m. melas	123	65	9	3	200	41.80
Esox lucius		1			1	.20
Lepibema chrysops	2	6		1	9	1.90
Perca flavescens	118	106	8	2	234	48.90
Stizostedion v. vitreum	1	2		1	4	.90
Lepomis m. macrochirus	3	5			8	1.70
Pomoxis nigro-maculatus		11			11	2.30
Aplodinotus arunniens	2	2	2		6	1.30
Total	251	201	19	7	478	

Table 2

Number and percentage of each species of dead fish counted on a 1000-yard section of Crandal's Beach, sections 8 and 9 Spirit Lake, in 1946.

	April	May	June	July	Aug.	Sept.	1946	Percentage of 1946 total
Lepisosteus platostomus				1			1	.2
Notemigonus crysoleucas			1				1	.20
Ameiurus m. melas	12	1	324	30	21	12	400	62.20
Lepibema chrysops	2			1	1		4	.60
Perca flavescens	4	8	36	68	84	5	205	31.90
Stizostedion v. vitreum	2		5	2		1	10	1.50
Micropterus d. dolomieu		1				1	2	.30
Huro salmoides			1	2			3	.50
Lepomis m. macrochirus			3	3		2	8	1.20
Pomoxis nigro-maculatus				2	2		4	.60
Aplodinotus grunniens				3	1	1	5	.80
Total	20	10	370	112	109	22	643	

Table 3

Number and percentage of each species of dead fish counted on a 1000-yard section of Crandal's Beach, sections 8 and 9 Spirit Lake, in 1947.

	May	June	July	Aug.	Sept.	Oct.	1947	% of 1947 total
Cyprinus carpio	1	3	2				6	1.0
Notemigonus c. auratus		2	3	2			7	1.1
Ameiurus m. melas	13	136	33	34	10	4	230	36.3
Esox lucius		1	2				3	.5
Morone chrysops	1			6	3	1	11	1.7
Perca flavescens	6	41	73	114	24	13	271	42.8
Stizostedion v. vitreum	2	1	1		2		6	1.0
Micropterus salmoides		3					3	.5
Lepomis machrochirus	1	3	15	7	1	1	28	4.4
Pomoxis spp.		1		52	8	1	62	9.9
Catostomus c. commersonnii				5			5	.8
Total	24	191	129	222	46	20	632	

Table 4

Number and percentage of each species of dead fish counted on a 1000-yard section of Crandal's Beach, sections 8 and 9, Spirit Lake, in 1948.

	May	June	July	Aug.	Sept.	Oct.	1948	Percentage of 1948 total
Lepisosteus platostomus			1	1			2	.3
Esox lucius		2	2				4	.6
Catostomus c. commersoni		1					1	.1
Cyprinus carpio	2	2		2	2	1	9	1.3
Notemigonus c. auratus						4	4	.6
Ameiurus melas melas	85	176	57	54	23	3	398	59.4
Morone chrysops	1	2			3		6	.9
Stizostedion v. vitreum	8	1			2		11	1.6
Perca flavescens	55	24	25	15	16	1	136	20.9
Micropterus dolomieui	1		1				2	.3
Micropterus salmoides			1				1	.1
Lepomis machrochirus	6	1	6	3	2		18	2.6
Ambloplites r. rupestris				1			1	.1
Pomoxis spp.	6	3	6	19	2	28	64	9.3
Aplodinotus grunniens	3	2		1	1	6	13	1.9
Total	167	214	99	96	51	43	670	

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CHANNEL CATFISH STUDIES IN THE UPPER DES MOINES RIVER

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At the January Seminar, I gave a report on the channel catfish population studies that have been persued in the upper reaches of the Des Moines River during the period 1946 through 1951. In that report, consideration was also given to the various types of sampling gear used and their respective effectiveness as it was related to the seasons of the year, changes in water temperature and fluctuations in stream flows. In addition a discussion of the information gained from the techniques of marking fish and catch per unit of effort was included.

In brief, the conclusions from the study indicated that population trends in channel catfish at least could best be attained by the technique of catch per net hour in baited hoop nets during the spring of the year or through the spawning season. Using the same approach, channel catfish populations for the upper Des Moines River have now been completed for the year 1952, and the purpose of this paper is to bring the study up to date.

Table I summarizes the data by counties through which the upper Des Moines River flows, and gives the number fish caught, the net hours fished and the number of fish caught per net hour. An inspection of the table shows the catch of fish per net hour to vary considerably and would indicate a spotty population of catfish. This has also been the case in former years, and as was postulated in my January report, reflects changes in trapping conditions rather than in populations.

To review briefly, our success in trapping catfish have always been irradic to say the least. Many times netting operations meeting with absolutely no success have suddenly "boomed" with an increase in water stage. In the case of early spring, nets work much better after the water temperature gets to approximately 60^{0}F., and during the spawning season a net will fill up with great rapidity subsequent to the entrance of a spawning fish. The only recourse to correcting large variations in netting success is that of longer netting periods. The logic of this argument has been witnessed in the case of the Humboldt County data. Because there are two forks, the main stem and an impoundment in the Des Moines River in that county, we have more sampling stations and fish a greater part of the year there. This presents a better chance of having the nets in during more kinds of fishing conditions and in turn has always averaged the over-all take by running the whole gamut of excellent to very low catches. This points up the fact that catfish populations on any area may be much better or poorer than hoop net catches indicate for any particular netting period.

Because of the physical impossibility of netting the whole upper Des Moines River at one time, it has been our feeling that the best approach to the problem is to net as much as possible in the time given and then to total up the year's catch and use those totals to follow the trends in the population. This tends to iron out the exceptionally high and low catches and gives a factor that is representative of all netting conditions that have occurred during the year.

To go again to Table I, the figure .15 catfish per net hour with some reservations to be pointed out below, seems quite indivative for the 1952 season. For instance, the Humboldt County figures where we had a 3,000 hour trapping interval is roughly the same. The Pocahontas County figures also approximate the yearly totals. These nets were in and fishing at a time when the Humboldt County sets were making average catches. In the case of Boone County where the counts are exceptionally high, the traps were in only a comparatively short time while excellent netting conditions ensued. In the instances of Emmet, Palo Alto and Kossuth counties, water levels were quite stable or falling slightly at the time the nets were set. Such circumstances have always result in poor success. Had water levels been rising the take figures for these areas should have been some better at least. Webster and Polk Counties, on the other hand, present a perplexing problem. These nets were in during a rapid rise in water levels, a condition which in the past has always made for better than average catches at least. This is the first failure of its kind experienced in seven years of netting and no explanation for the failure is in the offering at present.

Table II compares the yearly catch records of channel catfish from the upper Des Moines River, 1946 through 1952, and from that Table, the catch per net hour is pictured in graphic form in Figure I. A look at that data shows gradual increase from 1946 to 1949 followed by rather uniform trend downward through 1952. There are, however, extinuating circumstances that tend to alter the picture somewhat. As was pointed out in the January Seminar referred to above, the low catches for 1946 and 1947 are explained by inexperience of setting hoop nets which in all probability resulted in poorer catches for those years. A dry spring in 1950 with few river rises expain the drop in the population for that year.

The 1952 yearly catch was also down. Now there is some reason to believe that the catfish populations in the upper Des Moines have fallen off somewhat. Angling success, for instance, dropped noticeably during the 1951 fishing season. This being particularly so in Humboldt and Webster counties. In spite of that drop however, it is doubtful that the catfish population has fallen off to the extent indicated by the catch of .15 catfish per net hour. This low figure probably resulted more from the array of trapping conditions experienced in 1952

rather than so much from any large drop in populations. For one thing, in previous years our netting success has run as follows: In the early spring our catches are without exception very low until the waters warm to about 60°F. This is followed by a short period of high catches which gradually tapers off to almost nothing until the advent of the June floods at which time netting success always increases markedly. With the recession of the June floods our netting success also wains, and during the warm and static flows of summer the catches again fall to almost nothing.

In 1952, work on the Skunk River necessitated completion of our Des Moines River work early in the year. Consequently, we were unable to fish the June floods and missed the good catches of that period. This in turn has resulted in a low over-all catch for 1952. It is believed that had we fished the June period the yearly catch would have been somewhat better.

From certain angling and other empirical data, the truer picture of channel catfish populations in the upper Des Moines seems to have been rather static from 1946 through 1950 with a little drop in 1951 and 1952.

Comes now the question of just what meaning can be assigned to the factor resulting from the number of fish caught per net hour. Foremost of all, it can be pointed out that nothing is yet possible in the order of estimating the total size of the population nor will such be forthcoming in the foreseeable future. There are somethings, however, that can be said about the population from such data. First, there is good reason to believe that the figures show trends. In other work we have established the fact that hoop nets catch fish faster in areas of local abundance than elsewhere. From that fact it is not unreasonable to conclude that hoop nets will take catfish faster or slower as the size of the population ebbs and flows. As hinted at above, however, too much emphasis cannot be assigned the catch factor alone. The factor must be judged in the light of the conditions that persisted during the netting interval. Doing so, we conclude that the catfish population in the upper Des Moines River in 1952 are down but not to the extent indicated by the .15 factor.

A second thing that might indicate something about the size of the catfish population has to do with that of the number of fish caught. These figures represent only the fish from a very small area in comparison to the size of the river as a whole. In most instances, they are taken in traps set in less than one hundred places. Then considering that our marking experiments had shown that we never take more than a small per cent of the fish in any given area during a netting interval, and considering further that the river is literally a succession of good catfish spots or holes, the total population of catfish must run

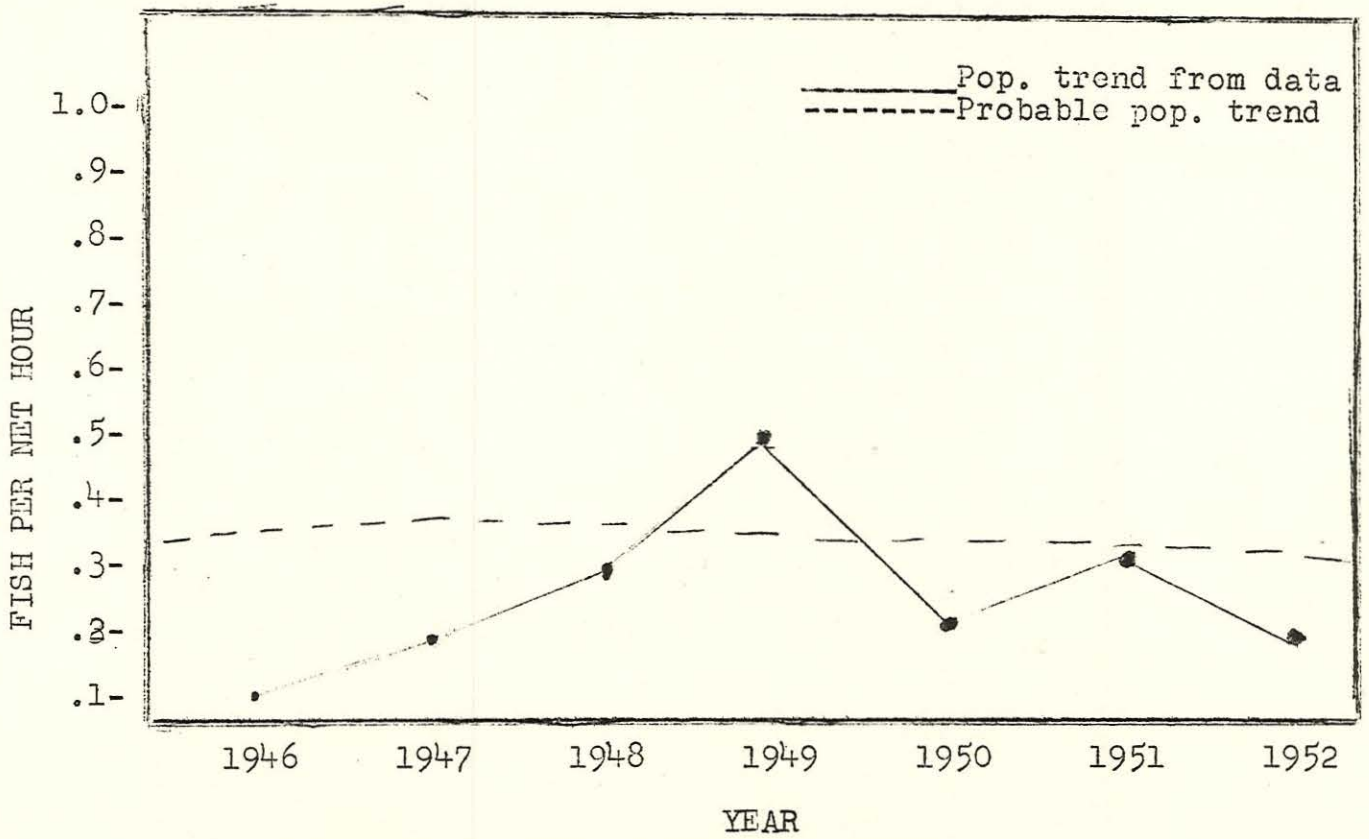
in the thousands per mile of stream. Of incidental interest it can be pointed out that of the fish caught about 25% are of sizes large enough to be creeled.

CHANNEL CATFISH TRAPPING RECORDS FOR THE UPPER DES MOINES RIVER SPRING OF 1952 BY COUNTIES

COUNTY	FISH CAUGHT	TOTAL NET HOURS	FISH PER NET HOUR
EMMET	22	664	.03
PALO ALTO	18	672	.02
POCAHONTAS	100	688	.14
HUNBOLDT	512	3136	.16
WEBSTER	11	876	.01
BOONE	581	1356	.42
POLK	000	192	.00
KOSSUTH	121	1448	.09
TOTALS	1365	9032	.15

CHANNEL CATFISH TRAPPING RECORDS FOR THE PERIOD 1946 THRU 1952 EXPRESSED AS TOTAL CATCH FOR THE UPPER DES MOINES RIVER WATERSHED

YEAR	FISH CAUGHT	TOTAL NET HOURS	FISH PER NET HOUR
1946	1037	8930	.11
1947	1472	7064	.21
1948	3554	11348	.31
1949	4164	8869	.47
1950	2465	8676	.28
1951	4035	11278	.35
1952	1365	9032	.15


Pop. trend from data
Probable pop. trend
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
FISH PER NET HOUR
1946
1947
1948
1949
1950
1951
1952
YEAR

CONTROL OF BLUE GREEN ALGAE AT NORTH TWIN LAKE

E. T. Rose
Fisheries Biologist

For the past several years North Twin Lake in Calhoun County, Iowa, has had periodic heavy blooms of blue green algae during the summer months. The blooms are objectionable primarily because of their unsightly appearance and offensive odors that are especially noticeable on hot quiet days. This lake is one of several in Iowa that maintains large growths of these primitive plants; however, this is the only lake where control measures have been attempted for many years. Since nearly all forms of recreation in and around these lakes are affected, particularly swimming and fishing, it is expected that an expanded program of algae control will develop in the future. Several of the species of blue-green algae are known to be extremely poisonous to livestock that drink the water, and we have record in recent years of extensive livestock losses on East Okoboji, Center and Storm Lakes. Usually the most virulent species concerned is Anabaena flosaquae.

Algal growths in North Twin Lake have been objectionable since the dredging of the lake and the changes in fish populations which have developed since that time. Previous to dredging, the lake was of course shallow, with a high population of bottom feeding fishes and a large stunted population of largemouth buffalo fish. These conditions were conducive to high turbidities which of course retarded development of any form of plant life. After dredging, and during the subsequent low water period a huge stand of cat-tails and other aquatic vegetation occurred in the shallow, undredged portions. During the winter of 1944-45, the decaying vegetation created such a heavy demand on the dissolved oxygen that the lake froze out. Many tons of fish perished including most of the carp and buffalo. The lake was subsequently heavily stocked with game fish and the lake has been much less turbid than previously. It is believed that this reduction in turbidity has promoted the development of the blooms during the recent years. In the summer of 1951 the growth of blue-greens was especially heavy. Swimming and other forms of recreation were reduced to a minimum most of the summer. This led the Twin Lake Restoration Association to decide upon treating the lake with copper sulfate during the summer of 1952 to control the algae. Final arrangements were made with the Conservation Commission to provide the technical assistance and the organization to supply the necessary copper sulfate.

Treatment

The exceptionally warm spring this year, especially during April and the latter part of May produced a rather heavy early bloom on the lake. Consequently plans were made to treat the lake on June 4, providing bloom conditions warranted treatment and weather conditions were suitable. A preliminary inspection

on this date revealed a heavy concentration of algae in the south half of the lake in the dredged portion and along the State Park swimming beach. Plankton samples were taken for qualitative and quantitative assay from the dredged portion at the south end of the lake and from the undredged area at the north end. These analyses are recorded in in Table 1. Counts of the plankton were made by modified standard procedure as follows: Two liter samples were obtained by Kemmerer Water Bottle from the surface and 10 foot depths at Station 1 and surface sample only at Station 2 (6 ' maximum depth here.) These samples were concentrated by emptying the sampler into a fine mesh plankton net and preserving the concentrate in 60 ml. vials. Ten sample counts were made from this on a calibrated slide and the counts averaged. Only the important components of the plankton were included. All colonies of the blue-greens, Microcystis, Coelosphaerium and Anabaena were counted as well as the major diatoms and Pediastrum. Zooplanton are lumped together for the sake of previty.

Table 1

Number of plankton organisms per liter before treatment, June 4,1952

	Station 1		Station 2	
	Surface	10 Foot	Surface	Remarks
Phytoplankton				
Microcystis	25,296	24,304	5,952	Heavy scum Sta. 1
Coelosphaerium	16,952	12,897	4,454	Water Temp. 72°F.
Anabaena	0	481	481	Secchi Disk 11"
Melosira	2,397	4,495	6,978	pH 8.0.
Stephanodiscus	5,693	7,424	7,998	Wind S.E. 12 mph.
Zooplankton				
Cyclops				
Diaptomus				
Anuraea				
	492	481	992	

A strong wind from the north on June 3, had concentrated most of the plankton into the south half of the lake. The southeast wind of June 4 had not redistributed the algae during treatment since the south and east portions of the lake are protected by heavy timber along shore.

In order to determine the correct amount of copper sulfate to be administered, the lake volume was previously determined. The lake was divided into two portions, the dredged and the undredged, and volumes calculated for each. These contained 497,022,438 gallons and 454,681,524 gallons respectively. In order to obtain a 0.5 parts per million treatment a total of 3,962 pounds of copper sulfate would have been required for these two areas (one part per million equals 8 1/3 pounds per million gallons of water).

Treatment of the lake was accomplished by towing a flat-boat equipped with out-rigged frames to which burlap bags were attached. Copper sulfate crystals were poured into these sacks during travel and dissolved at the rate of about 30 pounds every 5 minutes. The tow boat (Higgins inboard) was supplied by the association and piloted by Mr. Harry Burch, a member from Fort Dodge.

A total of 3,000 pounds of copper sulfate was dissolved in the lake by traveling continuous lengthwise and crossing lanes. The heaviest treatment was confined to the southern half of the lake where the algae was of greatest density. The southern half of the lake received 1800 pounds of copper sulfate or 0.45 ppm and the northern half received 1200 pounds or 0.33 ppm. Basing calculations on the entire volume of 952 million gallons, the treatment was 0.393 ppm. It had been planned originally to treat at the rate of 0.5 ppm; however, the Association had available only the 3,000 pounds, thus making the lighter treatment mandatory.

Results

The lake was examined 25 hours after treatment with Mr. E. B. Speaker, Superintendent of the Biology Section. At this time the algae were still largely confined to the south and east portions of the lake. The colonies of blue-green algae were obviously dead. A huge scum had accumulated along the State Park and south east shore regions and was changed from a bright green to a pale yellow color. Samples were taken in the same stations as on the day of the treatment, and counts were about the same as reported in Table 1; however, no live colonies were found. Cyclops, Diaptomus and other entomostracans were apparently not seriously affected by the treatment.

On June 9, 5 days after treatment, the lake was again checked. At this time the mass of dead algae had entirely disappeared, and the lake was entirely free of bloom. Samples were taken at the same stations and assayed as before (Table 2). The decline in counts of blue-greens is readily apparent. A characteristic tremendous increase in diatoms (non-bloom former) occurred. A slight increase in acidity occurred--pH 7.6. The Secchi disk reading indicated a considerable increase in water clarity as compared to the pre-treatment reading (11 inches to 36 inches).

No loss of fish was observed or reported. Several livery and cottage owners were contacted and all seemed very enthusiastic about the improvement in the lake.

A third check of the lake was made on June 16, 12 days after treatment, and samples obtained from the stations as before. At this time the lake was just as clear visibly as on June 9. Assays from these samples are listed in Table 3.

Table 2

Number of plankton organisms per liter 5 days after treatment

	Station 1		Station 2	
	Surface	10 Foot	Surface	Remarks
Phytoplankton:				
Microcystis	1488	2480	4460	No bloom on lake
Coelosphaerium	0	0	1488	Water slight brown
Anabaena	0	0	0	color. Secchi
Pediastrum	3472	9920	4960	disk--36 inches.
Melosira	992	4460	6944	pH 7.6.
Stephanodiscus	9920	26283	34720	
Zooplankton:	491	248	491	
Cyclops				
Diaptomus				
Anuraca				
Difflugia				

Table 3

Number of plankton organisms per liter, June 16

	Station 1		Station 2	
	Surface	10 foot	Surface	Remarks
Phytoplankton				
Microcystis	2,560	2,400	8,192	Lake free of
Coelosphaerium	1,024	800	3,072	bloom. Wind N.W.
Anabaena	512	400	1,024	Previous 4 days
Melosira	44,032	45,600	76,800	S.W. Wind.
Stephanodiscus	47,104	52,800	51,200	pH 8.2.
				Secchi Disk 24"
Zooplankton				
Cyclops, Bosmina	6,175	3,000	9,727	
Anuraea, Stentor				
Difflugia				

This would indicate that a slight increase from the June 9 counts; however, the great majority of the colonies of blue-greens were very small. A vast increase in diatoms occurred, which is a natural sequence. Also a considerable increase in zooplankton is evident.

The last examination of the lake was made on June 25. The lake was still free of any bloom, and the local people were very pleased with the results of the treatment. In view of the success of the project the Association is receiving funds from skeptical cottagers and anglers that had guardedly waited to see the effects of the first treatment. Sufficient funds are now available for two more treatments if they are deemed necessary.

It is likely that at least one more application will be necessary this summer since analysis indicates a plentiful supply of the algae present even though it is not apparent (Table 4.).

Table 4

Number of plankton organisms per liter in N. Twin Lake, 3 weeks after treatment, June 25, 1952

	Station 1		Station 2	
	Surface	10 Foot	Surface	Remarks
Phytoplankton:				
Microcystis	8,928	4,800	27,360	Bluegreens, small
Coelosphaerium	1,240	0	1,920	colonies, no bloom.
Anabaena	0	800	924	pH. 8.0.
				Secchi Disk 30 in.
Melosira	8,928	32,000	62,880	at Station 1, and
Stephanodiscus	63,023	206,000	58,520	12 inches, Station 2
Pediastrum	3,072	4,000	3,780	Wind South.
Zooplankton:				
Cyclops, Diaptomus, Bosmina, Anuraea, Difflufia	2,312	14,400	1,584	

A better conception of the magnitude of reduction in bloom forming species (Microcystis, Coelosphaerium, Anabaena) is possible by comparing these only as in Table 5. In this table, the average number of blue-greens per liter obtained from the two stations are compared for each days samples.

Table 5

Date	Period	Colonies of Algae per liter
June 4	Before treatment	30,275
June 9	5 days after treatment	3,305
June 16	12 " " "	6,661
June 25	21 " " "	13,724

This indicates that a 10 fold reduction occurred shortly after treatment and that three weeks later there was still much less algae per liter than before treatment. Also, the algae present were in much smaller colonies than before treatment, and no evidence of bloom could be found anywhere on the lake.

Effects on Angling

Creel census records indicate that the treatment may have stimulated fish feeding. Basic records from May 15 to July 1 are included in Table 6.

Table 6

Date	Total fish recorded	Average Fish per man	Average Fish per hour
5-15 to 24	1,280	2.76	1.30
5-24 to 6-3	6,313	7.77	3.38
6-4 to 13	12,364	11.71	4.42
6-14 to 23	6,122	8.21	3.17
6-24 to 7-1	1,863	3.42	1.39

Bottom Fauna

No evidence of significant damage to bottom organisms is indicated by Peterson dredge sampling. These samples averaged 0.4 ml. of larvae and nymphs per square foot. The principal components were Chironomid larvae. Last July (1951), the average of 4 samples was 9.7 ml. This shows some decline; however, no dead larvae were observed on the surface after treatment. When lakes are deliberately over-treated the dead chironomids soon appear on the surface. All of the insects obtained in the sampling after treatment were alive and in good condition. Table 7 contains the species, number and volume of insects obtained from four stations on the lake.

Table 7

LAKE SURVEY

BOTTOM FAUNA

Date 6-25-52

STATION NUMBER:	North 1		Above Park 2		St. Park 3		South 4		5		6		7
ORGANISM:	NO.	VOL.	NO.	VOL.	NO.	VOL.	NO.	VOL.	NO.	VOL.	NO.	VOL.	NO.
DIPTERA													
CHIRONOMIDS													
CHIRONOMUS													
LARGE	4		4		6		15						
MEDIUM	1												
SMALL	2		10		19		3						
PUPAE			2				1						
TANYPUS													
CERATOPOGONIDS					1								
OTHER DIPTERA													
TRICHOPTERA													
EPHEMERIDA					1								
ODONATA													
NEUROPTERA													
OTHER INSECTA													
MOLLUSCA													
ANNELIDA													
TUBIFICIDS					3								
OTHERS													
MISCELLANEOUS													
TOTAL NUMBER, VOLUME	7	0.2	16	.3	30	.5	19	.6					
	6' Undredged		6'Undredged		10'Dredged		14'Dredged						

CONCLUSION

A moderately heavy bloom of blue-green algae was practically eliminated by a moderate dosage of copper sulfate (0.393 p.p.m.) applied to the lake by dragging bags of the chemical in the usual manner. This was the first State sponsored project ever attempted in Iowa to improve the recreational value of a lake by this means. The North Twin Lakes Restoration Association purchased the copper sulfate and cooperated in the treatment. Since it is customary that blooms return to the lakes after treatment, it is expected that at least one more application will be necessary this summer, especially if the present prolonged warm weather continues. No apparent ill effects could be determined on fish or fish-food organisms by the treatment.

LAKES CREEL CENSUS IN 1952

E. T. Rose
Fisheries Biologist

Another season of creel census work has just been completed on nine Iowa lakes. The mechanics of the census methods have been outlined several times, so details will not be reiterated here. Briefly, the census is conducted annually for 45 days from May 15 to July 1. A census clerk contacts cooperating boat lines, cottage camps, dock and shore fishermen every day for catch records. These are tabulated each 10 days for total catch of each species per day, number of anglers and hours fished. A final summary covering each lakes' total catch by species, grand total of all species and the total men and hours of fishing together with the average catch per man and hour is presented in the appendix of this report with comparisons of former years of census data. These records are becoming more and more valuable as the years go by in interpreting other data and in providing fundamental knowledge concerning harvests of fish, following population trends and other population phenomena.

Fishing this year was about average or a little below, for the 7 lakes for which comparative records are available. These lakes are: Spirit, East and West Okoboji, Clear, Storm, Lost Island and Blackhawk. Center Lake is not included here since it is solely a bullhead lake and only one livery's record is taken. No previous record is available for North Twin Lake in Calhoun County and its record is included in basic summary. In the following, a brief account of this season's angling record for each lake is accompanied by reference to its appendix table containing the annual summary of this year's record together with all of the preceding seasons of census work.

Spirit Lake

Crappies continued to decline in the catches this year, as did the walleye, largemouth bass, smallmouth bass, bullhead, white bass and bluegill. A significant increase in yellow perch and northern pike catches were recorded. The decline in the other species is not altogether alarming although some explanation is in order. Angling in Spirit and the Okobojis was decidedly curtailed due to a heavy influx of fathead minnows from the adjoining Loon and Pearl Lakes in Minnesota. Shortly after the ice left the lakes this spring, and prior to the census period, crappie fishing was excellent in the numerous inlet areas of Spirit and East Okoboji Lakes. In addition, many perch, bass and walleyes were unintentionly caught by the crappie fishermen. By May 15, practically no crappie were being taken by shore fishermen and the shoal areas of the lakes were literally infested with large schools of fathead minnows. Previous to this time it was discovered that the outlet of Loon Lake was loaded with millions of fathead minnows migrating out to Spirit Lake. This huge migration soon

spread throughout the entire chain of lakes. The species has not been abundant, at least in recent years, in Spirit or the Okoboji Lakes. Unquestionably, these minnows have flooded the lakes with forage and seriously reduced the catch of certain fishes this year. The decline in bullhead catch is partially attributed to the reimposed catch limit.

Much more commentary could be made concerning the census on the lake; however, space must be limited to more or less outline form (Table Appendix 1).

West Okoboji

Angling on West Okoboji this season was about average for the seven seasons of census. No significat decrease or increase in any species taken is evident. The huge influx of minnows from Loon Lake has doubtless affected to some degree the angling success on West Okoboji. The importance of this phenomenon may be determined to some extent by this summer's lake survey. Table Appendix 2 .

East Okoboji

Prior to the census period, crappie fishing was excellent in this lake particularly in the region above the No. 9 Highway. It is believed that the conditions which apparently limited angler success in Spirit also prevailed here. As soon as the vast horde of minnows appeared in the chain of lakes, predatory types of fish became increasingly difficult to catch. Bullhead fishing was very good and was the best ever recorded in the 8 years of census. Table Appendix 3.

Clear Lake

The highlight of the season at Clear Lake was the excellent yellow bass angling. This season about equalled the last previous high of 1948 for this species. A significant increase in the catch of perch occurred. Crappies continued to increase in the catch, with this the highest on record. A vast decrease in walleye harvest is not encouraging, and the high percentage of return on tagged fish (about 16% to date according to my information on the Iowa State College project) may indicate a declining abundance in this lake. Table Appendix 4.

Lost Island

This typical Iowa bullhead lake is again returning to its former fame. The season started poorly and ended with good catches reported from both shore and boat lines. The fish per man and hour were about twice that of the 1951 season's census, although it was still far below the high records of 1947 to 1950. An interesting sidelight should be mentioned here. Bottom sampling early in the census period showed large supplies of

Chironomid larvae at all stations except those on the east portion of the lake bottom. This was the only area of the lake that bullhead angling was good. This may further indicate the biological significance of bottom organisms in lake studies. Table Appendix 5.

Storm Lake

The first 20 days of the open season were very good at Storm Lake again this year. Most of the walleyes caught were taken during this period. White bass fishing held up well throughout the 45 day period, in fact more were reported than in any of the previous five seasons. Perch fishing improved as did channel catfish and bullhead. Crappies continued their decline as was predicted. Much of the typically good crappie environment of Storm Lake has disappeared due to ice action on the huge stand of sapling trees that formerly lined the shoal areas. These had developed during the low water period of the 1930's and were partially inundated by the return of crest elevations during the past 10 to 12 years. A considerable improvement in the environment and in angling might be achieved by the installation of submerged shelters of rock along strategic regions of the lake. Table Appendix 6.

Blackhawk

Six years of census on this important recreational area has just been completed. Fishing success was the poorest on record this year. A glance at the table shows a continual steady decline since 1947, in spite of our most concerted efforts to improve conditions. A tremendous amount of effort has been made to control shad by corrective stocking and seining, but to date it is difficult to point out any improvement. We, as well as the public, are impatient to have the angling improve here; however, it seems well to advise restraint in departing from the planned policy for the lake. In view of the considerable number of walleyes caught this year, it might be well to consider a closed season for a year or two since the population is just getting started by the recent stocking program. I cannot believe that our program for this lake can fail to produce good fishing again if it is vigorously pursued. Table Appendix 7.

North Twin

In view of the growing importance of this lake since the completion of dredging and fish improvement programs, a creel census was conducted this year to obtain information relative to benefits incurred. Also, since the lake was to be treated with copper sulfate to control blue-green algae, an evaluation of this as it affected angling was also desired.

In the 45 day census, a total of 84 crappies, 3,116 perch, 23 northern pike, 14 largemouth bass, 119 walleyes, 24,473 bullheads and 13 yellow bass were reported caught. The total of 27,842 fish were taken by 3,597 anglers contacted who fished a total of 8,893 hours, for an average of 7.74 fish per angler at the rate of 3.13 fish per hour. Detailed 10 day reports of the census were submitted to the central office for this as well as the other lakes. Angling was considered very good by all the local fishermen this year.

Summary

Basic summaries of the angling success on 8 lakes censused this year indicates that fishing is somewhat below normal.

APPENDIX 1

IOWA LAKES SURVEY
SPIRIT LAKE

SPECIES	1945	1946	1947	1948	1949	1950	1951	1952
CRAPPIE	109	3,390	2,823	13,533	16,063	13,298	6,933	1,730
PERCH	614	5,921	2,019	32,958	3,802	656	1,856	3,428
N. PIKE	308	3,607	825	2,936	655	178	56	492
WALLEYE	70	12,917	7,685	4,185	6,023	4,091	2,204	1,413
L.M.BASS		3,092	1,452	1,922	326	94	134	73
S.M.BASS		493	219	357	105	6	21	7
BULLHEAD		57,019	41,601	69,227	82,157	84,642	79,068	25,935
WHITE BASS	1,444	11,262	2,189	5,091	1,004	152	94	61
BLUEGILL		1,530	314	2,544	1,337	245	223	49
								3 Sheepshead
YEARLY TOTALS	2,545	99,121	59,217	132,754	112,372	103,316	90,589	35,191
NO. ANGLERS	1,115	20,937	9,951	22,171	15,614	8,896	9,553	6,990
NO. HOURS	4,157	66,354	43,570	101,382	66,339	41,939	45,210	34,773
FISH/MAN	2.28	4.73	5.95	5.98	7.19	11.62	9.47	5.03
FISH/HOUR	0.61	1.49	1.36	1.31	1.69	2.46	2.01	1.01

APPENDIX 2

IOWA LAKES CREEL CENSUS

WEST OKOBOJI

SPECIES	1946	1947	1948	1949	1950	1951	1952
CRAPPIE	5,310	2,661	3,682	2,405	1,421	1,889	1,279
PERCH	876	2,589	4,217	6,815	1,001	1,437	1,156
N. PIKE	924	646	1,160	658	657	439	740
WALLEYE	1,599	1,073	4,018	1,956	1,270	2,357	1,628
L.M. BASS	706	613	581	650	710	777	690
S.M. BASS	113	39	425	329	321	194	285
WHITE BASS	125	79	405	242	158	265	19
BULLHEAD	456	1,496	1,756	3,721	2,062	8,051	8,192
BLUEGILL	313	350	1,339	1,601	583	1,280	1,399
YEARLY TOTALS	10,422	9,546	17,583	18,583	9,187	16,689	15,418
NO. ANGLERS	3,292	2,417	5,860	5,975	3,540	3,987	4,010
NO. HOURS	9,878	8,942	21,485	21,192	11,145	16,416	15,815
FISH/MAN	3.19	3.95	3.00	3.07	2.60	4.19	3.60
FISH/HOUR	1.03	1.06	0.82	0.86	0.82	1.02	0.97

29 sheep-head 1C. Cat

APPENDIX 3

IOWA LAKES CREEL CENSUS

EAST OKOBOJI

SPECIES	1945	1946	1947	1948	1949	1950	1951	1952
CRAPPIE	6,904	22,899	9,704	4,660	2,637	3,562	660	395
PERCH	26	433	251	2,113	4,464	742	1,376	366
N. PIKE	93	247	126	294	117	55	40	95
WALLEYE	1,608	4,704	1,792	6,148	705	1,120	490	225
S.M.BASS		15	13	63	37	29	14	12
L.M.BASS	98	296	153	276	27	47	37	52
BULLHEAD		5,404	3,394	5,785	13,380	5,072	31,036	31,657
WHITE BASS	405	1,102	1,016	1,012	745	428	67	31
BLUEGILL		219	117	486	1,166	1,184	127	278
ROCK BASS							1	51
CHANNEL CAT						1		Sheeps-head
YEARLY TOTALS	9,134	35,354	16,566	21,737	23,287	12,240	33,848	33,162
NO. ANGLERS	2,759	9,119	4,725	6,125	3,789	2,812	3,232	4,005
NO. HOURS	9,080	31,346	18,566	25,947	15,566	11,143	15,195	20,824
FISH/MAN	3.31	3.88	3.51	3.55	6.14	4.35	10.47	8.28
FISH/HOUR	1.01	1.13	0.89	0.84	1.46	1.09	2.23	1.59

APPENDIX 4

IOWA LAKES CREEL CENSUS

CLEAR LAKE

SPECIES	1948	1949	1950	1951	1952
CRAPPIE	2,401	1,464	1,151	3,597	3,991
PERCH	3,541	250	39	47	892
N. PIKE	401	159	17	10	191
WALLEYE	2,299	2,004	468	7,908	1,860
YELLOW BASS	12,673	8,944	3,764	4,376	11,900
S.M. BASS	213	45	21	3	8
L.M. BASS	130	229	126	214	8
BULLHEAD	13,643	5,670	9,379	28,973	16,038
WHITE BASS	1,624	481	259	51	38
BLUEGILL	866	295	134	67	217 9channel cat
YEARLY TOTALS	37,800	19,531	15,359	45,247	35,152
NO. ANGLERS	10,214	6,253	4,169	8,003	7,184
NO. HOURS	30,463	17,523	13,722	32,176	31,462
FISH/ANGLER	3.69	3.12	3.68	5.65	4.89
FISH/HOUR	1.24	1.11	1.12	1.41	1.12

APPENDIX 5

IOWA LAKES CREEL CENSUS

LOST ISLAND

SPECIES	1946	1947	1948	1949	1950	1951	1952
CRAPPIE	0	0	5	2	250	3	9
PERCH	56	51	285	19	22	25	60
N. PIKE	23	50	131	479	366	121	305
WALLEYE	130	359	760	106	2,266	531	647
L.M. BASS	0	0	0	2	0	1	2
BULLHEAD	100,111	169,344	346,954	51,482	87,646	15,427	20,455
YEARLY TOTALS	100,320	169,804	348,135	52,089	90,554	16,108	21,478
NO. ANGLERS	3,378	7,495	25,017	10,842	12,753	8,821	6,730
FISH/MAN	29.69	22.61	13.42	4.81	7.02	1.83	3.20
FISH/HOUR	5.27	5.23	2.98	0.92	2.03	0.53	0.89

APPENDIX 7

IOWA LAKES CREEL CENSUS

BLACKHAWK LAKE

SPECIES	1947	1948	1949	1950	1951	1952
CRAPPIE	14,359	12,507	5,057	6,977	4,590	1,837
PERCH	1,924	2,014	406	21	344	95
CHANNEL CAT	14	333	201	63	131	113
CARP	2	2,477	491	499	255	182
WALLEYE	0	6	0	0	0	640
S.M.BASS	2	5	22	0	1	18
L.M.BASS	34	390	476	72	141	345
BULLHEAD	4,649	2,422	1,250	1,844	1,625	818
WHITE BASS	5	11	3	5	1	19
BLUEGILL	0	1,140	388	64	150	60
NO. PIKE	0	0	0	1	2	2Yellow 33Bass
YEARLY TOTALS	20,987	21,206	9,296	9,646	7,240	4,162
NO. ANGLERS	7,704	7,829	9,005	7,338	6,939	6,353
NO. HOURS	21,587	16,474	16,824	11,395	5,648	7,209
FISH/MAN	2.76	2.68	0.92	1.31	1.04	0.65
FISH/HOUR	0.97	1.37	0.49	0.85	1.30	0.57